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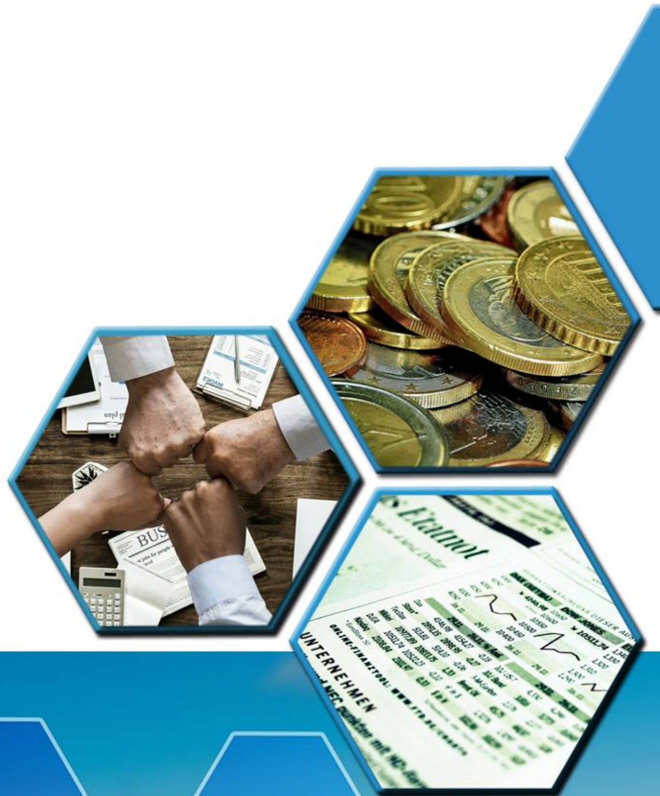

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Editioral Office Stanisław Staszic University of Applied Sciences in Piła
Podchorążych street 10
64-920 Piła, Poland
phone: (+48 67) 352 26 11
e-mail: cp@pwsz.pila.pl

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Poland's agricultural budget under the influence of the changed economic policy strategy after 2016

Andrzej Czyżewski
University of Zielona Góra, Poland
ORCID: 0000-0002-6233-6824, e-mail: a.czyzewski@ue.poznan.pl

Anna Matuszczak
Poznan University of Economics and Business, Poland
ORCID: 0000-0002-5045-5447, e-mail: anna.matuszczak@ue.poznan.pl

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Abstract: The main aim of the article was to indicate the changes that have taken place in the budget for agriculture in Poland. 2016 is an important year for this study, since it was then that the new strategy of national economic policy came into being. In it, is a transition from a pro-liberal option, which was controlled by money supply, to a pro-social one, which is controlled by budget expenditure. This change has been stimulated by spending restrictions in the national agricultural budget. The research focuses mainly on the last two years (2016-2017), but for comparison, historical data from 2010 and earlier is presented. In the article, the analysis of structure and dynamics for the examined term was applied. The most important conclusions are that the pro-social, nationwide initiatives of budgetary expenditure after 2016 have had a negative impact on the agricultural sector in terms of the expenditure allocated to it; the level of expenditure for the agricultural sector from the national budget is unstable and has been declining since 2016. This could be related to the need to finance a significant increase in spending on social purposes.

Keywords: agriculture, budget, economic strategy

JEL: H29, H55, H60

Introduction

The purpose of the work is to indicate the changes that took place in the agricultural budget of Poland after 2016 under the influence of the new strategy of the national economic policy. It has been assumed that economic policy is driven by the dominance of either money supply (monetary policy) or budget expenditure (fiscal policy). In both cases, actions can be expansionary or restrictive in nature. The article presents the possibilities and consequences of certain choices. When it comes to the agricultural budget of Poland after 2016, we are dealing with a transition from a pro-liberal option (control by money supply) to a pro-social one (control by budget expenditures), with simultaneous spending restrictions in the national agricultural budget. These reductions are not compensated by the increase in expenditures from the European Funds Budget. There have been signs of renationalisation of the agricultural budget, with an initial increase in national expenditure and a relative decrease in expenditure for the

European Funds Budget, but to different extents in 2017 and 2018. The reasons for this process are weakened by the fact that the country's overall public spending do not allow maintaining a stable level of expenditure from the national budget. Thus, pro-social nationwide initiatives of budgetary expenditure after 2016 have a negative impact on the agricultural sector in terms of expenditure allocated to it.

Theoretical premises for changes in economic policy

Economic policy consists of key policies through which the state influences the economy, by using specific tools and measures to achieve its objectives. It depends on the doctrinal environment (i.e. theory of economics), internal factors that characterise a given country and external factors (processes of integration, globalisation) [Gajda, Tarnawska 2009]. One of the models that describes the principles of conducting economic policy is the "pendulum" model which is a certain idealisation of these activities, but which finds its roots in theories of the economic cycle and the need to adjust economic policy in order to slow down or stimulate the economic situation. Therefore, the variability of economic policy options results from the existence of the business cycle and its impact assessed in various aspects (i.e. through countercyclical policy, trade policy instruments or the synchronicity of cycles in the analysed countries), hence the model is close to the concept of the political business cycle. In practice, it means the alternation of restrictive and expansionary policies. The distinction between these two is presented as the effects of changes in the interest rate and budget deficit [Czyżewski, Poczta, Wawrzyniak 2005]. In addition, the model assumes the need to change policies as a condition for sustainable development, both in macroeconomic and sectoral terms (i.e. in agriculture). The volatility of policies, coinciding with the "pendulum effect", consists in the necessity to slow down inflation at one time, and to stimulate economic growth at another. The lack of such a change may lead to negative consequences, which may be manifested by a slowdown in economic growth, a slowdown in structural changes, an increase in unemployment or inflation. The application of the pendulum principle stems from the need for economic policy to converge with the business cycle, mitigate its negative effects and, most importantly, maintain a decent level of economic growth [Basu and Taylor 1999]. At the same time, it shows the logic and consequences of the transition from a more expansionary to restrictive variant, both in the policy of the domination of monetary and fiscal elements [Czyżewski A. 2001].

Therefore, assuming that the dominant objective of economic policy, both monetary and fiscal, is to increase the average efficiency of the use of available production factors, it is necessary to indicate four possible variants of the conditions for agricultural production (Table

1). The first refers to the case of expansionary monetary policy and the characteristic decrease in real interest rates, which is favourable to the economy, but may result in inflationary processes – prices of both agricultural products and means of production will rise. In the absence of adjustments made by the government, this may cause price scissors to widen, due to higher prices and income elasticity of demand for non-agricultural products and faster possibilities of return on capital invested outside agriculture. This phenomenon will be accompanied initially by a tendency to depreciate the domestic currency exchange rate, as long as the favourable price effects of changes in terms of trade in agricultural products (an increase in exports) prevail over the volume effects. The situation will last until further monetary expansion threatens the stability of inflation processes. The exact opposite mechanisms would apply in the case of a restrictive monetary policy [Czyżewski A. 2001].

Table 1. Economic conditions for agricultural production under different monetary and fiscal policies

Specification	**Monetary policy**		**Fiscal policy**	
	Changes in money supply		**Changes in public expenditures**	
	expansionary	**restrictive**	**expansionary**	**restrictive**
Domestic agricultural prices	increase ↑	decrease ↓	increase ↑	decrease ↓
Prices for agricultural inputs	increase ↑	decrease ↓	increase ↑	decrease ↓
Price scissors	increase ↑ (widening)	decrease ↓ (narrowing)	increase ↑ (widening)	decrease ↓ (narrowing)
Terms of trade	increase ↑	decrease ↓	decrease ↓	increase ↑
Real interest rate	decrease ↓	increase ↑	increase ↑	decrease ↓
Exchange rate	decrease ↓	increase ↑	increase ↑	decrease ↓

Source: own study, based on (Cramer and Jensen 1992).

On the other hand, a different, non-alterative variant is the impact of fiscal policy, where in the case of expansion, government expenditure, including support for agricultural production and income, may result in an increase in budget deficit, which may result in an increase in agricultural income and prices, in the short term [EC 2018, EC 2010]. An expansionary fiscal policy may also manifest itself in support for loans for agriculture, an increase in demand for means of agricultural production and, consequently, an increase in total demand, including demand for agricultural products [EC 2017, Petryni 2017]. Under these macroeconomic conditions, this may trigger a price-scissor-widening mechanism (due to different price and yield elasticities of demand). This may involve inflation, and the need to raise interest rates, which will be conducive to the appreciation of the domestic currency. Export prices will fall relatively, the price effect of terms of trade will deteriorate. In the situation of a restrictive fiscal policy, the macroeconomic mechanism will reverse. A key issue in economic policy favourable to the growth of agricultural incomes (especially directly, as in the case of fiscal expansion) is the question of their nominal and real growth. There is no simple answer to this question, while much depends on how the government's expenditures are addressed and whether their allocation will result in an increase in production and reduction of unit costs, rather than in an increase in labour productivity that is proportional to the incurred expenditures. If so, there will be conditions for the structural transformations induced in this way within the supported sector, and the increase in income will be real in nature [Czyżewski A. 2001].

Analyses of the "pendulum principle" in the literature exist in various countries (Germany, France, the Benelux countries, Italy, Russia or Poland) over a relatively long period [Czyżewski, Poczta and Wawrzyniak 2005; Czyżewski and Kułyk 2013]. On the basis of these observations, we can assume that since 2016 Poland has been dealing with a strategic change of economic option from pro-liberal to pro-social.

Methodology

Firstly, level and share of expenditures on the agricultural sector in the total budget and GDP are analysed in the article, including expenditures on the Agricultural Social Insurance Fund (ASIF) and resources from the European Funds Budget. Secondly, we focus more closely on the relations between agriculture support from national and EU funds. Finally, the social issues related to the agricultural sector, from the point of view of expenditures on ASIF, are pointed out. The research focuses mainly on the last two years, but for comparison, historical data from 2010 and earlier is presented (even as far back as 1997). All empirical analyses are based on project of budget laws for the relevant years – part devoted to agriculture, agricultural markets, rural areas and ASIF, as well as the budgets of the regions and EU funds. The analysis of dynamics and structure was applied.

Results

Public expenditures on the agricultural sector in Poland after 2016. Dynamics and basic relations

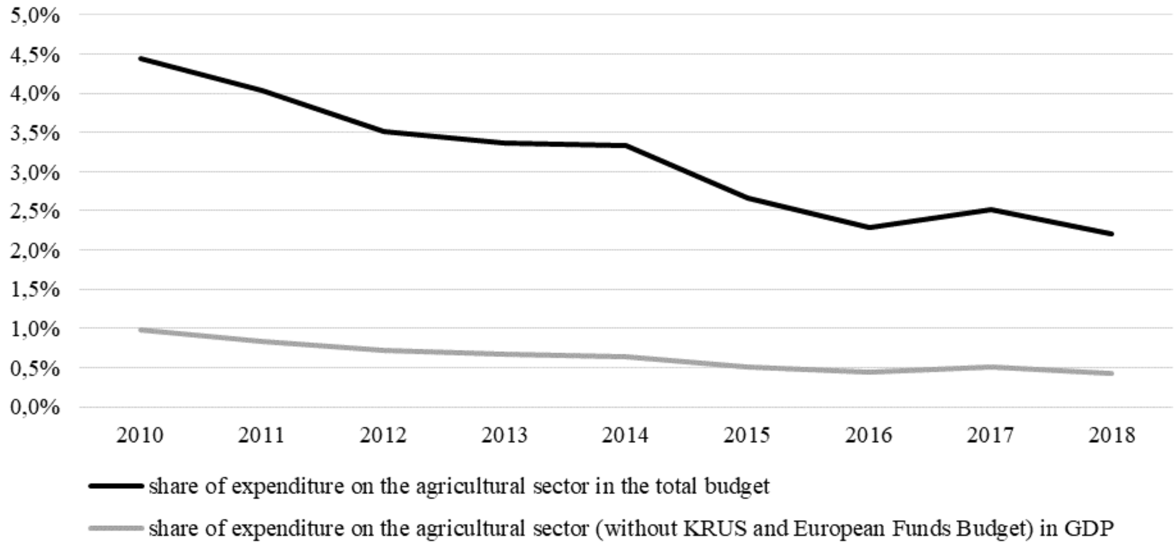
Overall, spending on agriculture, rural development and agricultural markets together with ASIF and the European Funds Budget has fallen by 2.32% over the past two years (after 2016), when Poland's general economic policy changed, with a real increase in total budget expenditure of nearly 1% in 2018 and a planned GDP growth of nearly 4%. This is a significant decrease in the position of the state agricultural budget in the hierarchy of budget expenditure in the national economy. It should be added that in 2018 this expenditure accounts for 12.37% of the state budget expenditure, and in 2017 it accounted for 12.58%, which is 0.21 p.p. more. In 2016, it was 14.59% higher than in 2018. It is also worth noting that in 2018 the share of the state's agricultural budget (including ASIF and European Funds Budget) in GDP will be 2.37%, compared to 2.47% in 2017 and 2.89% in 2016. In this case, the decrease in the share over the last two years is 0.52 p.p. This is caused, among others, by a reduction in expenditures in the national agricultural budget for agriculture, rural development and agricultural markets (in 2018 by PLN 892.6 million), as well as in the ASIF budget (less by PLN 880.96 million). It should therefore be emphasised that the successive reduction of the share of the Polish agricultural budget in the general state budget, as well as in Poland's GDP in 2018, is taking place despite a real increase in the European Funds Budget by 3.03% (nominally by ca. PLN 1.28 billion). Had it not been for this increase, the depreciation of the state agricultural budget in 2018 would have been much higher. It is also worrying that the decreasing share of spending on the agricultural sector in Poland (together with ASIF) is not an exception, and that this phenomenon has been continuing since at least 2010. In particular, in 2018, expenditure on all parts of the national agricultural budget, with the exception of expenditure on agriculture and hunting, is falling in real terms. The decline affects, among others, expenditure on rural development, agricultural markets, regional budgets, special provisions, expenditure planned in other parts of the agriculture budget and ASIF, where the amounts after taking into account the provisioned inflation rate (2.3%) are in real terms lower than in 2018. The budgetary situation in 2018 is improving, as has been pointed out above, only through increasing expenditure from the European Funds Budget, as well as appropriations for loans from the Bank Gospodarstwa Krajowego (BGK), which are also EU funds.

Total expenditure from the national budget for agriculture, rural development and agricultural markets, together with regional budgets, special provisions and expenditure planned in other parts of the budget, will amount to PLN 8.79 billion and will be 11.51% lower in real terms than in 2017 (in 2016 it was lower in real terms by 8.6% than in 2015). This represents 2.21% of state budget expenditure in 2018 without ASIF and European Funds Budget (2.52% in 2017, 2.28% in 2016, 2015 in 2.66%, 2014 in 3.33%,2013 in 3.36%, 2012 in 3.52%,2011 in 4.04%, and 2010 in 4.45%, details in Fig. 1) [Czyżewski, Matuszczak 2015b]. Thus, in 2018, this share decreased by 0.31 p.p. compared to 2017 and the decline over the last eight years was 2.2 p.p. This means a share almost two times lower than in the previous year.

Including budget expenditure on ASIF, the total amount of expenditure has increased to PLN 26.73 billion. This is in real terms 5.49% less than in 2017, and the successive decrease in this amount from 1 to 5% has been maintained annually since 2010. If one considers expenditure on ASIF, the share of the agricultural budget in national budget expenditure amounts to 6.73%, which is 0.45 p.p. less than in 2017. It is worth remembering that this year it was 0.05 p.p. lower than in 2016. In 2016, it was 0.54 p.p. lower, and 0.66 p.p. lower in 2015. The situation in this respect is, therefore, deteriorating again in 2018 in relative terms, in comparison with both 2017 and 2016. It should also be stressed that the ratio of total expenditure in the national agricultural budget for 2018 will be achieved with a real reduction of planned expenditure for ASIF by -2.24% compared to 2017.

When it comes to the share of total expenditure on the sector in GDP (excluding ASIF and European Funds Budget), it will amount to 0.43% in 2018, compared to 0.50% in 2017, 0.44% in 2016, 0.51% in 2015, 0.64% in 2014, 0.67% in 2013, 0.72% in 2012, 0.84% in 2011 and 0.98% in 2010 (see Fig. 1.). Thus, the share of GDP will be the lowest in eight years and equivalent to that of 2010. Including expenditure on ASIF, it will be 1.3% in 2018 compared to 1.42% in 2017, 1.43% in 2016, 1.49% in 2015, 1.69% in 2014, 1.67% in 2013, 1.7% in 2012, 2.0% in 2011 and 2.1% in 2010. Here, too, it will be the lowest in eight years, 38% lower than in 2010.The above comparisons demonstrate that the national agricultural budget as share of GDP has been gradually decreasing for eight years, which proves that the agricultural sector is not benefiting proportionately from the effects of GDP growth in Poland [Czyżewski, Matuszczak 2013]. If it were not for the financial support (also decreasing) from the European Funds Budget, the sectoral disproportions in the distribution of funds from national income would clearly increase. Part of this can be attributed to the adjustment to current conditions triggered by the need for financial constraints, due to the current social expenditure of the state, but the scale of the reduction is nevertheless too large and disproportionate, especially given the successive increase in GDP in recent years (more than 4% in 2017).

Fig. 1. Share of expenditure on the agricultural sector in total budget expenditure and GDP



Source: own study, based on The Draft Budget for years 2010-2017 and Explanation for the Budgets for years 2010-2018 (http://www.mf.gov.pl).

A closer look at the situation of the Polish agricultural budget in 2018 is illustrated by the high asymmetry in the dynamics of expenditure. Only 6 elements of the budget show an increase in real expenditure, and as much as 25 a decrease, but only 9 of them fall within the area of the assumed inflation (2.3%), while 16 are much higher, while in 12 cases the annual decreases in planned expenditure are usually within the range of 24% to 6%. The increase in planned expenditure in 2018 concerns only four items, in particular research and development and food quality control. It can be understood that in the situation of such a pro-social budget, there is a quite natural willingness to introduce financial restrictions in many areas, however, it must be recognised that the scale of the reduction in financial expenditure on the agricultural sector in the last two years is too large and disproportionate, especially when one considers the aforementioned successive increase in the level of GDP in the last two years. A real improvement in the living conditions of the rural population in the context of the pro-social state policy after 2016 should be permanent, and the social achievements of programmes, such as 500+, should not be accompanied by a reduction of expenditures in this budget.

The interdependence of the national agricultural budget and the European Funds Budget

The analysis of the share of expenditures on the agricultural sector in the national budget shows that integration with the EU was crucial for the changes in the trends in the perception of its financing by decision-makers. Until 2003, opinions on budget acts [Czyżewski 1997-

2016] were rather pessimistic. Symptoms existed leading many to think that the irrational restrictive approach after 1997 had placed agriculture in the face of a growing crisis. In fact, since the beginning of the economic transformation in Poland, it has been difficult to see that agriculture was a priority in government policy [Czyżewski, Matuszczak 2014a]. The share of expenditures on the agricultural sector in budget expenditures showed stagnating tendencies, with dangerous drops, as in 2002, to a level below 2%. Poland's membership in the EU is reflected in public expenditure on co-financing and pre-financing, planned in the European Funds Budget [Czyżewski, Matuszczak 2014b]. As part of the expenditure from this budget, the draft budget for 2018 assumes total spending of nearly PLN 21.5 billion, which is 4.03% higher in real terms than in 2017, when the Agricultural European Funds Budget forecasted spending equal to PLN 20.2 billion. The general spending planned in Poland's agricultural budget will amount to PLN 48.74 billion, which means that in 2018 they will be lower in real terms (including the inflation rate) by 1.63% than in 2017, when they were as much as 11.24% lower than in 2016, when it amounted to PLN 53.76 billion. Thus, the share of expenditure from the European Funds Budget in 2018 will be 45.16%, compared to 42.97% in 2017 and 50.44% in 2016. In 2018, as in 2017, there can be no question of multiplying the National Agricultural Budget or the European Funds Budget, which took place in 2016, when the EU funds exceeded the national funds allocated to the agricultural sector.

The above should be accompanied by the statement that spending one zloty from the national agricultural budget in 2018 for expenditure in parts of the budget from I to VI[1] is accompanied by PLN 7.53 recorded in the European Funds Budget, together with a loan from the BGK (also EU funds, in total PLN 22 billion). According to this estimate, in 2017 it was PLN 6.19 (PLN 1.34 less), in 2016 PLN 5.91, in 2015 PLN 8.69, and in 2014 PLN 6.81. It can therefore be assumed that in the last five years (2014-2018) the Budget of European Funds supported basic expenditure on agriculture, rural development and agricultural markets, recorded as above in the National Agricultural Budget, on average as 7:1, which emphasises Polish benefits from EU accession. It is worth noting, however, that the EU funds constituting the income of the European Funds Budget will be received there after prior payment of a contribution to the EU budget for 2018 and pre-financing of certain CAP objectives by BGK. It should be noted that the 2018 entitlements (payable in 2018) were definitively

[1] This means expenditure on Agriculture, Rural Development, Agricultural Markets, Regional Budgets, Target Reserves and expenditure planned in other parts of the budget and concerning co-financing and pre-financing of objectives of the Common Agricultural Policy (CAP) and Rural Development Programme as well as technical assistance, including payments under direct support, operational programmes implemented by the paying agency and PROW for 2014-2020.

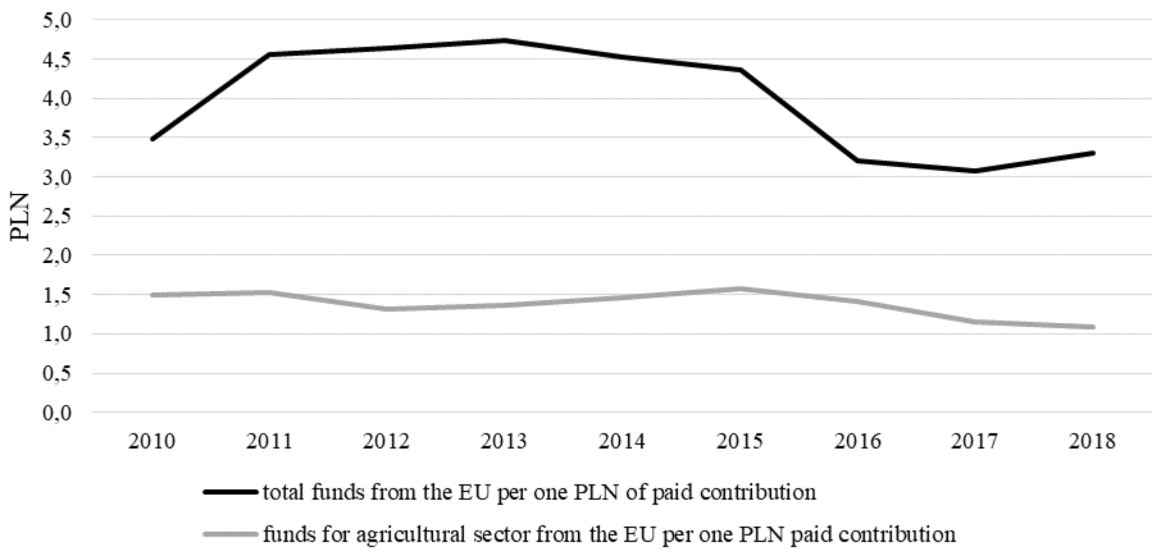
established on the basis of the PLN/EUR exchange rate adopted by the European Commission on 31 December 2017. In the draft budget for 2018, the contribution is estimated at PLN 19.64 billion[2], with an estimated exchange rate of PLN/EUR 4.25 and PLN/USD 3.99[3]. In the light of these estimates, the membership fee of Poland in 2018 will be nominally higher by about PLN 1.48 billion than in 2017, and considering the planned inflation rate in 2018 around 2.3%, in real terms by 5.84% higher than in 2017[4].

If we take into account the refinanced funds from the EU allocated for expenditure in the Budget of European Funds in 2018, i.e. for Agriculture, Rural Development, Agricultural Markets, Target Reserves to the amount of PLN 21.5 billion, they constitute 33.07% of the funds transferred to Poland by the EU. In 2017 it was 36.12%, in 2016 43.27%, in 2015 36%, in 2014 32.54%, in 2013 28.78%, in 2012 28.4%. With loans from BGK (also EU funds), this amount is higher and equates to PLN 22.01 billion in 2018 (PLN 20.8 billion in 2017 and PLN 27.12 billion in 2016), it is 33.86% of the total EU funds transferred to Poland. The total amount of EU funds received by Poland in 2018 will amount to PLN 64.75 billion[5] and will be higher by PLN 8.86 billion than in 2017[6]. The above shows that CAP is gradually losing its dominant position among EU programmes implemented in Poland, mainly for programmes implemented with the participation of Structural Funds and the Cohesion Fund.

However, the benefits of the Polish agricultural sector persists also in 2018, although they are decreasing. It can be estimated that for each PLN of Poland's contribution to the EU's general budget in 2018, PLN 3.30 is transferred back to Poland (in 2017 it was PLN 3.08, PLN 3.20 in 2016, PLN 4.36 in 2015, PLN 4.52 in 2014, PLN 4.73 in 2013, PLN 4.64 in 2012, PLN 4.56 in 2011, PLN 3.48 in 2010), of which PLN 1.09 (33.07%) will be allocated to the objectives and tasks of the agricultural budget in Poland. In previous years, the respective figures were: PLN 1.15 in 2017, PLN 1.41 in 2016, PLN 1.57 in 2015, PLN 1.47 in 2014, PLN 1.36 in 2013, PLN 1.32 in 2012, PLN 1.53 in 2011, PLN 1.50 in 2010, and the arithmetic mean for the period 2010-2018 amounts to PLN 1.38.

[2] Explanation for the Draft Budget for 2018, p. 167.
[3] Explanation for the Draft Budget for 2018, p. 10.
[4] The possible appreciation of the PLN exchange rate will automatically increase this fee in the EU currency, while depreciation will decrease it. CAP funds denominated in the Euro will be increased or decreased, accordingly with exchange rate differences.
[5] Without the funds transferred by EFTA States, i.e. PLN 14.572 million under the Norwegian Financial Mechanism, the European Economic Area Financial Mechanism and other PLN 251.199 million.
[6] In 2016 it was PLN 61.6 billion, and in 2015 it was PLN 79.37 billion.

Fig. 2. EU transfers to Poland, including agricultural funds, per one PLN of paid contribution (in PLN)



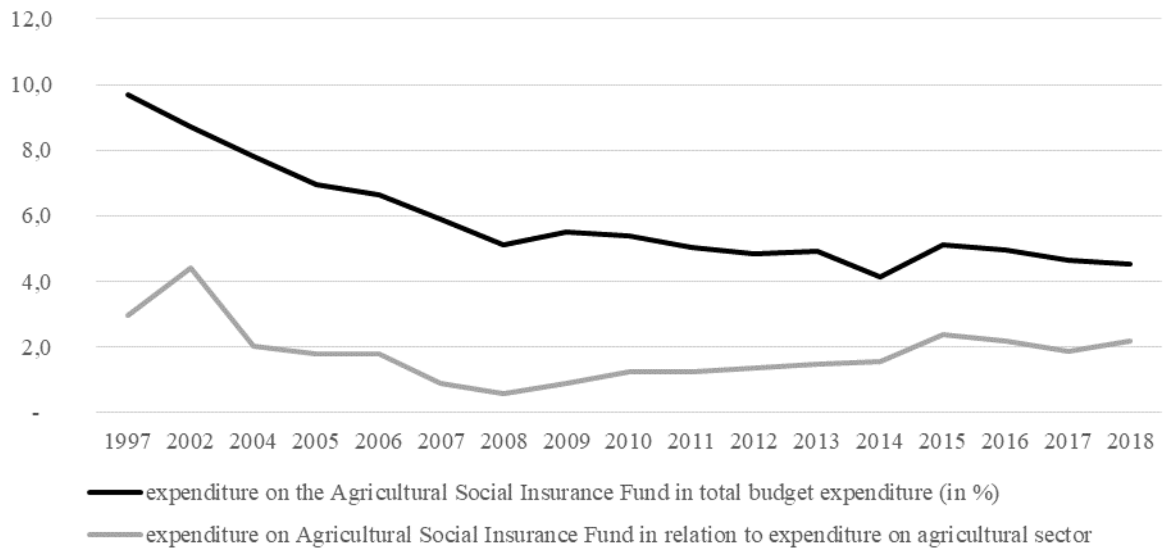
Source: own study, based on The Draft Budget for years 2010-2017 and Explanation for the Budgets for years 2010-2018 (http://www.mf.gov.pl).

Two conclusions can be drawn from the above. Firstly, agriculture and rural areas in Poland in 2018will also be net beneficiaries of the process of Poland's integration with EU structures, but to a significantly lesser extent than in previous years. Moreover, the decrease in the level of benefits from PLN 1.41 in 2016 to PLN 1.09 in 2018, per one zloty of contributions to the EU budget, that is by ca. PLN 0.32, and ca. 30%, should be considered as large, the largest in the last 9 years. Secondly, the benefits of the agricultural sector in Poland coming from the EU are decreasing, because a long-term trend is observed in the decreasing total amount of financial resources granted by the EU to Poland, although 2018 as compared to 2017 does not confirm this. It should also be noted that the relative share of European Funds in the Agricultural Budget of Poland in 2018 amounted to 45.16% (including loans from BGK) and was 2.19% higher than in 2017. Thus, in this case the situation with the decreasing share of the Agricultural Budget of European Funds in the total amount of EU funds transferred by the EU to Poland in 2018 did not repeat.

The problem of the Agricultural Social Insurance Fund (ASIF)

A special place in the structure of expenditure in the national agricultural budgets is occupied by the Agricultural Social Insurance Fund (ASIF) – firstly, it is nominally the largest expenditure, and secondly, it is subject to significant changes [Czyżewski, Matuszczak 2015a]. The amount of budget resources spent on ASIF (socially determined expenditures) will reach the level of PLN 17.94 billion in 2018. It will be 2.24% lower in real terms than in 2017 (taking into account the inflation rate). At the same time, it is equal to 204%, so more than double the expenditure planned for agriculture, rural development and agricultural markets in the national agricultural budget in 2018. It is worth noting that in 2017 this indicator was 185%, in 2016 217%, in 2015 189%, in 2014 152%, in 2013 140%, in 2012 134%, in 2011 122%, and in 2010 120% (Fig. 3). It should be noted that this relation in 2018 is 19 p.p. higher than in 2017, which means that there has been a return to the growing trend of spending on ASIF in a context of very moderate spending on agriculture, rural development and agricultural markets. It is worth noting here that the average expenditure on ASIF in relation to national budget expenditure on the agricultural sector in the period 2010-2018 (9 years) is 162%, so in 2018 this indicator is 40% higher. This leads to the conclusion that the overall cuts in the national agricultural budget have not affected planned spending on ASIF, which can again be considered as complementary to other parts of spending. The legislator could also conclude that this was justified in the context of the significant increase in expenditure from the European Funds Budget in 2018.

Fig. 3. Expenditure on the Agricultural Social Insurance Fund in total budget expenditure (in %) and in relation to expenditure on the agricultural sector



Source: own study, based on The Draft Budget for years 2010-2017 and Explanation for the Budgets for years 2010-2018 (http://www.mf.gov.pl).

The share of expenditure on ASIF in total budget expenditure in 2018 was about 4.52%. In 2017 it was 4.66%, in 2016 4.95%, in 2015 5.12%, in 20144.14%, and in the previous years it amounted to, respectively: 4.93% (2013), 4.82% (2012), 5.04% (2011), 5.37% (2010), 5.52% (2009), 5.09% (2008), 5.9% (2007), 6.63% (2006), 6.93% (2005), 7.8% (2004), 8.7% (2003), 9.06% (2000), and in 1998 it was 10.16%. This means that over the last 21 years it has decreased 2.2 times, and after 2009 this share amounted to 4.29% annually on average (Fig. 3).

The data presented also proves that the role of ASIF in the Polish Agricultural Budget is decreasing relatively in the long run. In the pre-accession period (in the years 1998-2003), this share decreased by 1.46 p.p. In the next 15 years of Poland's presence in the EU (2004-2018), it fell by a further 3.28 p.p. Thus, it may be assumed that the stimulation of the economic functions of the Polish agricultural budget has been going on throughout this period. In the years 2010-2016 the volume of expenditure on ASIF relatively increased, while the last two years (2017-2018) brought a real reduction in expenditure of 3-2%. It can therefore be assumed that the level of spending on ASIF has come close to the critical threshold of socially determined spending. On the other hand, during the period discussed here (21 years) it is clear how the socialisation of ASIF expenditure has been limited by the aforementioned, more than twofold (2.2 times) decrease in the share of total state budget expenditure.

The above arguments contradict the thesis about the need to abolish ASIF. In recent years, the rules for granting benefits on this account have been tightened up and further development in this matter is doubtful. Sustainable support, both in the economic sphere of the agricultural sector and in the social sphere of agricultural holdings, is rational in the current economic situation of Poland and in line with the principle that the economy should postulate solutions that are both economically efficient and socially adequate.

Finally, it is worth noting that the subsidy from the state budget to ASIF accounts for 93.72% of total revenues of ASIF without reimbursement of costs of payments of treatment benefits and other transfers (91.68% in 2017) and 86.54% with reimbursement of such benefits (84.67% in 2017). In the latter case, the total costs of the Pension Fund will amount to PLN 20.73 billion in 2018. These indicators show the increasing role of this fund in ASIF provisioning in 2018.

Summary, recommendations

To sum up the above, we can say that:

– total spending on agriculture, rural development and agricultural markets together with ASIF and the European Funds Budget has been declining since the beginning of the change in Poland's economic policy in 2016. In 2018, they amounted to PLN 48.74 billion, 12.37% of the total budget, of which PLN 8.79 billion (2.21% of the total budget) will be allocated to the agricultural sector[1] (excluding ASIF and European Funds Budget), PLN 17.94 billion to ASIF (4.52% of the total budget) and PLN 22.01 billion will be allocated to the European Funds Budget. Thus, it should be stated that on the basis of the above comparisons, the national agricultural budget has been gradually decreasing for 8 years in relation to total budget expenditure and GDP, thus not taking advantage of the effects of GDP growth in Poland. It should be stressed that the key issue in this case is financial support (also decreasing) from the European Funds Budget, which to a certain extent eliminates sectoral disproportions in the distribution of funds from national income;

- the national agricultural budget is gradually decreasing in relation to GDP in Poland. This means that the agricultural sector does not benefit proportionally from the effects of GDP growth (in 2018 about 4%). In the light of the above analysis, it can be concluded that in 2018 this budget is highly economical, which also applies to the budgets of regions and special purpose reserves. This is probably related to needs finance a significant increase in spending on social purposes, also for the rural population, mostly in the form of the flagship programme 500+;
- what is surprising and worrying in the national agricultural budget of Poland for 2018 is the significant decrease in expenditure on installation works in agriculture, land reclamation and biological progress in plant and animal production. Unfortunately, this does not go hand in hand with a significant increase in expenditure on research and development, including innovative activities. The causal link between these two groups of expenditure is clear and should be reflected in current agricultural budget expenditure in 2018, which is unfortunately lacking;
- agriculture and rural areas in Poland will also be net beneficiaries of the process of Poland’s integration with EU structures in 2018, however to a significantly decreasing extent compared to previous years. In 2016-2018, during the period of strategic change of Poland’s economic policy from pro-liberal to pro-social, the decline in EU support for the agricultural sector in Poland was clearly visible. In 2016, in terms of 1 PLN, the contributions to the budget amounted to PLN 1.41 of EU benefits, while in 2018 they will amount to PLN 1.09, by about PLN 0.32 (30% less). This decrease should be considered as relatively large, the biggest over the last 9 years (2010-2018). The benefits of the agricultural sector in Poland are also decreasing, due

[1] This means: agriculture, rural development and agricultural markets, together with region budgets and specific reserves, as well as expenditure planned in other parts of the budget.

to the long-term trend of decreasing the total amount of funds granted by the EU to Poland, although 2018 does not confirm this in comparison with 2017;

- when it comes to the budgetary expenditure on ASIF, its share in the total budget expenditure of the state has been gradually declining over a period of twenty years. In 2018 it amounted to 4.52%, in 2017 to 4.66%, while in 1998 it amounted to 10.16%. It decreased by more than a half, with the annual average decrease between 2010 and 2018 being over 5%, and the deviation from this average being within 3%. However, ASIF spending in 2018 will be 2.24% lower in real terms (due to the inflation rate) than in 2017. There are indications that the level of budget expenditure on ASIF is stabilising at a nominal level close to PLN 18 billion per year, while the potential to limit spending by tightening up the rules for granting benefits are relatively small, and the need to maintain existing services is obvious, both in terms of level and scale.

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The role of the Rural Development Programme (RDP) in creating growth in the agricultural sector. The case of countries from East-Central Europe[1]

Bazyli Czyżewski
Poznań University of Economics and Business
ORCID: 0000-0002-6324-2723, e-mail: bazylicz@interia.pl
Sebastian Stępień
Poznań University of Economics and Business
ORCID: 0000-0001-9475-8418, e-mail: sebastian.stepien@ue.poznan.pl
Silvia Maican
"1 Decembrie 1918" University in Alba Iulia
ORCID: 0000-0002-1762-9636, e-mail: smihalache@uab.ro

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Abstract: The evolution of the agricultural sector requires a permanent combination of activities related to raising the competitiveness of farms, improving the quality of life of the rural population and maintaining natural resources. Such tasks in EU countries are performed by rural development programmes (RDP), created under the second pillar of the Common Agricultural Policy. The aim of the paper is to define the role of RDPs in driving the transformation of the agricultural sector in selected countries of East-Central Europe – the Czech Republic, Hungary, Poland and Romania – for the years 2007-2013. The authors attempt to find certain interrelationships between the premises of rural development programmes and the funds directed their way, and changes in the agricultural sector for each of the economies. The work uses critical analysis of subject literature, meta-analysis, deductive and inductive reasoning, as well as a comparative analysis using elements of time series analysis (analysis of dynamics and structure changes). The main conclusion is that: 1. the second pillar of CAP was undoubtedly an important element of support for rural areas in the countries of East-Central Europe; 2. the accumulated effects of the support led to a considerable improvement in the income situation of agricultural producers; 3. investment expenditures led to structural changes at farm level. In relation to the above, the key issue is to keep a relatively high level of funding for the second pillar of CAP for EU-12 countries after 2020.

Keywords: rural development, agriculture, structural changes, investment, support

JEL: Q10, Q12, Q15, Q18

Introduction

The Czech Republic, Hungary, and Poland joined the structures of the European Union in May 2004, followed by Romania in 2007. EU funds, including those related to the Common Agricultural Policy (CAP) started flowing to these countries. New support mechanisms,

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combined into two CAP pillars, began to influence these countries' agribusiness and the environment. The first pillar primarily included direct payments (partly also market intervention), the second one concerned instruments connected with broadly defined rural areas. The money received largely complemented the income of farms, increasing the level of consumption and expenditure for the purposes of current production. Rural development programmes (RDP) detailed tasks of a typically investment-oriented nature, which were supposed to change the agricultural production structure and make it more competitive in the integrated market. EU resources were also used to finance other activities, including subsidies for less favoured areas (LFA), agri-environmental programmes, non-agricultural business activity development or the improvement of rural infrastructure.

The aim of the paper is to define the role of the rural development programme in driving the transformation of the agricultural sector in selected countries of East-Central Europe. It presents the basic information concerning RDP and then relates it to the changes taking place in agriculture. The spatial scope of the research includes the Czech Republic, Hungary, Poland, and Romania. These countries underwent a political transformation in the 1990s which determined the development of the sector over the next two decades. The Czech Republic, Hungary, and Poland joined the European Union and were included in the mechanisms of the EU's agricultural policy at the same time, while Romania joined just under three years later. Thus, it was possible to carry out a comparative analysis of the functioning of the agriculture of the above-mentioned economies in the context of CAP.

Methodology

The research is theoretical and cognitive in nature and contains an analytical part. The authors use critical analysis of the subject literature, meta-analysis, deductive and inductive reasoning, as well as a comparative analysis using elements of time series analysis (analysis of dynamics and structure changes). Due to objective obstacles in carrying out a quantitative analysis, the assessment is qualitative in nature, with elements of inductive reasoning. Firstly, the CAP second pillar includes activities oriented directly at carrying out investments on farms, but there are also some which may indirectly impact the level of such expenses (e.g. subsidies for less favoured areas (LFA) or agri-environmental payments). Hence, it is impossible to determine the precise amount of money which was allocated for specific purposes. Secondly, the quantitative measurement of the influence of the funds of the second pillar of CAP on the amount of investment expenses, production asset growth and other variables determining the changes in farm production structures for a period of time is difficult, due to the fact that the redistribution of subsidies occurred in different years for individual activities, in accordance with the RDP schedule, whereas expenditure for investment and production purposes was made on an ongoing basis, in order to ensure business continuity. However, the authors try to find certain interrelationships between the premises of rural development programmes and the funds directed their way, and the changes in the agricultural sector for each of the economies.

The paper uses Eurostat and FADN[2] database data for representative farms. The time scale begins with 2005, two years before the 2007-2013 budgetary period, and ends with the last year of this financial outlook (in the case of the FADN database, the data was supplemented with the years 2014-2015). In this way, it can be seen how the rural development programme for 2007-2013 influenced the changes in the agricultural sector relative to the years directly preceding that period.

A review of rural development programmes for 2007-2013 for the Czech Republic, Hungary, Poland, and Romania

The rural development strategies for 2007-2013 adopted by the countries under study resulted from a review of the strong and weak points of the agricultural and food sectors and the environment, followed by establishing the necessary directions of change. At the same time, the primary objectives of the RDP had to take into consideration the structure of activities, specified at the level of the European Union, divided into four axes. These included increasing the competitiveness of agribusiness, programmes for the protection of the natural environment, improving the quality of life in rural areas and activity diversification, and the LEADER axis[3] (complemented by so-called technical assistance[4]). The countries' emphasis on individual activities varied, which was reflected in a different expense structure within the second pillar (cf. Table 1).

In the case of Hungary, Poland, and Romania, the key position in the budget belonged to the activities of axis I, and one of the main elements was funds for the modernisation of farms. In Hungary, as many as 62% of axis I funds were allocated for that purpose, and the subsequent activities involved much less money: the highest allocation was related

[2] FADN (*Farm Accountancy Data Network*) is a European system of collecting accountancy data from farms. The field of observation of the European FADN system includes commercial farms which produce about 90% of the value of Standard Output within a given region or country. The minimum economic size of a farm participating in the system is determined at country level (e.g. in Poland, it is SO EUR 4,000). The representativeness of the sample involved in the study is determined based on three criteria: location, economic size, and type of farming. Because the FADN system excludes the smallest farms from analysis, study results may be related to those included in the system.

[3] Through the LEADER axis, support is directed to local activity groups, whose task is to implement local development strategies. Thus, the activities within this axis are grass-roots activities in nature and serve the accomplishment of the objectives for axes I, II, and III.

[4] The aim of the Technical assistance is to finance the preparation, management, monitoring, evaluation, information and control activities of programme assistance.

to infrastructure support for the development of agriculture and increasing added value in the agricultural sector (9% and 8% of the budget for axis I respectively) [Ministry of Agriculture of Hungary 2007].

In Poland, another important activity within the framework of axis I was structural pensions, which were supposed to facilitate the handing over of farms owned by older people to younger farmers. In total, more than 60% of the Polish RDP funds were allotted for these two activities – modernisation and pensions (31% and 30% respectively). The following activities occupied the subsequent positions: increasing the added value of agricultural and forestry production (11% of the RDP budget) and facilitating young farmers' start in life (10%) (Ministry of Agriculture and Rural Development of Poland 2015). Moreover, the *ex post* assessment of Programme execution shows that the manner of allocating the available funds was very effective – by the end of December 2015, 100% of the axis I budget had been used (by comparison, in Romania, this index oscillated around 85%).

Table 1. The budget of the rural development programme 2007-2013 (in million EUR) and the share of the individual axes in the RDP budget for the selected EU countries

Axis of RDP for 2007-2013	**Czech Republic**		**Hungary**		**Poland**		**Romania**	
	Sum	**Share**	**Sum**	**Share**	**Sum**	**Share**	**Sum**	**Share**
Axis I: Competitiveness of agriculture and forestry	840	23.2%	2 366	45.9%	7 188	41.7%	3 967	42.5%
Axis II: Improvement of natural evnironment	1 945	53.8%	1 627	31.5%	5 546	32.2%	2 293	24.5%
Axis III: Quality of life in rural ares	635	17.6%	691	13.4%	3430	19.9%	2473	26.5%
Axis IV: LEADER	175	4.8%	272	5.3%	788	4.6%	235	2.5%
Technical assistance	18	0.5%	203	3.9%	267	1.6%	376	4.0%
Totally	3 615	100%	5 159	100%	17 218	100%	9 344	100%
The share of EU funds	78%	-	74%	-	77%		81%	-

Source: European Commission 2007a; European Commission 2007b; European Commission 2007c; European Commission 2008.

In Romania, apart from farm modernisation (32% of the RDP budget), the share of the activity involving increasing the added value of agricultural and forestry production (37%) was also high. There was, however, no task similar to the Polish structural pensions, in spite of the high percentage of people employed in agriculture (32% at the beginning of the programme period 2007-2013) (Ministry of Agriculture and Rural Development of Romania 2017). In Hungary, expenditure for farmers' early retirement pensions was planned, yet with the amount of 1% of the entire axis budget, it is difficult to expect clear effects. Despite a large number of small entities in the structure of farms in all three countries, a small portion of the funds was allocated for the support of semi-subsistence farms – in Romania, it was 7.5% of the axis I budget, in Poland 6.3% (additionally, these expenses regarded the obligations from 2004-2006), while in Hungary – less than 1% (Ministry of Agriculture and Rural Development of Poland 2015; European Commission 2008; Ministry of Agriculture of Hungary 2007). The above-mentioned data shows that within the RDP, the priority for the countries in question was to support the farms in developing competitiveness, whereas help for smaller producers was temporary in nature, as in the long term, their number was to be limited.

In the Czech Republic, the expenditure structure within the second pillar was different, as more than half the budget was allotted for axis II, related to the improvement of the natural environment. Such a division of funds may have resulted from the fact that, in comparison with the three previously described countries, Czech agriculture is more similar to the agriculture of Western European countries. This means that farms are on average much larger than in Poland, Romania or Hungary, the scale of production is higher, and they achieve better labour and land productivity indices. On the other hand, the Czech Republic is a largely mountainous country, it has many valuable natural areas. This is why the objectives related to the natural environment dominated those concerning increasing the competitiveness of the agricultural sector [European Commission 2013, pp. 302-303; Dudzińska i Kocur-Bera 2014, pp. 49-64]. Thus, the Czech Republic is closer to the group of countries such as Finland, Sweden, the UK or Ireland (in Ireland and the UK as much as 80% of the entire RDP budget is allocated for pro-environmental objectives). It can also be concluded that countries with more fragmented agrarian structures allocate relatively more money to activities related to improving the competitiveness of the food sector (apart from Hungary, Poland, and Romania, this also applies to Spain, Portugal, Greece, and Italy).

Within the budget of axis II of the Czech RDP, agri-environmental payments (56%) and subsidies for less-favoured areas (41%), with mountainous areas constituting more than half, made up the highest share. Although by definition, they were environmental subsidies, in fact, they influenced the increase in farm income, and so indirectly also of investment. They may therefore be treated as complementary to the first pillar's programmes, increasing the competitiveness of the agricultural sector. As to the first pillar, it included three core activities: farm modernisation (42% of axis I budget), land consolidation and forest infrastructure (22%), and increasing the added value of agricultural products and provision of technical equipment (13%).

Apart from the RDP budgetary structure, the absolute amount of money allocated for these tasks is important. On account of the total agricultural area and the number of farms, the largest amount of funds went to Poland. However, we can obtain a more clear-cut picture of the scale of support by expressing the total amount per farm and hectare of AA. From this perspective, the highest level of budget on average per farm was clearly present in the Czech Republic. Hungary and Poland had similar values, while in Romania, it was nearly four times lower than in these two countries (cf. table 2). In turn, in relation to agricultural area, the amount for the Czech Republic, Hungary, and Poland was similar, while Romania was some way behind. With reference to axis I, the order changes in the case of the amount of support per hectare of AA. Here, Hungary came first, followed by Poland. The amount for Romania was nearly twice as low, whereas for the Czech Republic it was more than twice as low. Certainly, these numbers do not reflect the actual average allocation of RDP funds per producer and unit of area, but they show the potential that the programme generates for creating changes in the agricultural sector. The higher the budget, the larger the number of its beneficiaries, the larger the average rate of payments, and the larger the agricultural area covered by the activity.

Table 2. Total RDP budget and budget of Axis I for 2007-2013 on average per farm and hectare of AA (in EUR) in the selected EU countries

Specification	Czech Republic	Hungary	Poland	Romania
RDP budget per farm	122 529	9 134	9 697	2 455
RDP budget per hectare of AA	1 034	1 140	1 165	699
Budget of Axis I per farm	28 471	4 189	4 048	2 455
Budget of Axis I per hectare of AA	240	523	486	297

Source: Eurostat 2018a and data for table 1.

Structural changes in the agriculture of the selected countries

Integration with the European Union posed a challenge, and at the same time provided an opportunity for more dynamic development of the agricultural sector of the countries of East-Central Europe. The challenges included joining the European Single Market and the need to compete with Western European countries, and adjusting national legislation to EU legislation in terms of quality, environmental and health standards, whereas when it comes to new opportunities, the most important one was undoubtedly the possibility to take advantage of EU funds, primarily including the Common Agricultural Policy. The latter particularly impacts on the transformation processes in the agricultural sector, because it is the only economic policy of community character based on uniform EU regulations and financed from the EU budget [Sadowski, Baer-Nawrocka and Poczta 2013, p. 7]. It can be assumed that the support itself creates favourable conditions for concentration processes in agriculture (both of land and production itself). Moreover, through the funding of investment activities, it leads to the improvement of farming indices. On the other hand, in certain conditions, some CAP instruments may consolidate existing agricultural structures. This may be the case for subsidies for small farms, for which they constitute a relatively easy to obtain and important element of their income. Another example may be the modernisation programmes with an established upper limit of support, which might lead to the artificial division of farms in order to obtain funds [Czubak and Sadowski 2011, pp. 138-155]. Still, structural changes in the agriculture of the discussed countries are a fact, evidenced by the data provided below.

One of the manifestations of the concentration processes taking place in the agricultural sector is the decrease in the number of farms combined with the increase in their average size. In 2005-2013, in relative terms, the highest decline in the number of farms was recorded in Poland (–42%), and the lowest in Romania (–15%), although when it comes to the largest total number of farms in absolute terms, the decrease in their number in Romania came to more than 600,000, i.e. more than in Hungary and the Czech Republic (in Poland, the number dropped by over 1 million). With the decrease in the number of farms and minimal changes in the total agricultural area[5], the farms' average surface area increased in all the analysed countries, and in the case of the Czech Republic and Hungary, there was an increase of ca. 60%, while in Poland it was even as high as 70%. The process was the slowest in Romania, where the average surface area increased by 10% (cf. Table 3). It should be noted, however, that compared to the remaining three economies, Romania joined the EU three years later, hence the adjustments in the agricultural market were delayed.

Table 3. Total number of farms and average agricultural land in hectares

	Number of farms				
	2005	**2007**	**2010**	**2013**	**Change 2013/2005**
Czech Republic	42 250	39 400	22 860	26 250	-37.9%
Hungary	714 790	626 320	576 810	491 330	-31.3%
Poland	2 476 470	2 390 960	1 506 620	1 429 010	-42.3%
Romania	4 256 150	3 931 350	3 859 040	3 629 660	-14.7%

[5] In the Czech Republic and Poland, total agricultural area decreased by 2%, while in Romania it fell by 6%. The main reason for this decrease was changes in the use of agricultural land for other purposes (recreational, residential), mainly in peri-urban areas. Hungary was an exception, with agricultural area having increased by 9% due to the increase in the surface area of meadows and pastures.

	Average area of agricultural land (in hectares)				
	2005	**2007**	**2010**	**2013**	**Change 2013/2005**
Czech Republic	84.2	89.3	152.4	133.0	58.0%
Hungary	6.0	6.8	8.1	9.5	58.8%
Poland	6.0	6.5	9.6	10.1	69.2%
Romania	3.3	3.5	3.4	3.6	10.1%

Source: Eurostat 2018a.

What attracts attention is the much higher average agricultural area in the Czech Republic. This means that the transformation of the agricultural sector in this country was different in nature. The Czech authorities (just like in Slovakia) concluded that private ownership titles to land in their country were only suspended in the period from 1948-1989, which formed the legal basis for their restitution. Then, market-oriented production cooperatives and former state agricultural farms were transformed into commercial companies and partnerships, leasing agricultural land from their owners at the time. As a result, several-hundred- or even several-thousand-hectare farms operate over the vast majority of land, although their share in the total number of farms is relatively low. In turn, in Poland, Romania, and Hungary, as a result of the political transformations, most of the large state-owned farm enterprises collapsed or were closed down, and the direction of reforms created favourable conditions for the establishment of small farms. In the extreme case of Romania, in the early 1990s, 4.2 million farms with an average size of 2.4 ha were created as a result of the restoration of the right to land [Zadura 2009, p. 248-255]. Such activities have resulted in a diverse area structure of farms in the countries under study to this day (cf. Table 4). For instance, in 2013, more than ¼ of all the farms in the Czech Republic belonged to the "above 50 ha" area group and operated over ca. 90% of the total agricultural area. In the same period, in Romania, farms with an area above 50 ha constituted only 0.6%, although they owned more than 50% of the land.

Table 4. Area structure and share of agricultural area in the individual area groups of farms in the selected EU countries

	Area structure of farms					
	2005			2007		
	<10 ha	10-50 ha	>50 ha	<10 ha	10-50 ha	>50 ha
Czech Republic	64.1%	20.7%	15.2%	61.8%	21.5%	16.7%
Hungary	93.8%	4.6%	1.6%	93.3%	4.7%	1.9%
Poland	85.6%	13.5%	0.8%	84.8%	14.2%	1.0%
Romania	97.7%	1.9%	0.3%	97.4%	2.2%	0.4%
	2010			2013		
	<10 ha	10-50 ha	>50 ha	<10 ha	10-50 ha	>50 ha
Czech Republic	33.7%	36.4%	29.9%	37.4%	35.6%	27.0%
Hungary	91.6%	6.0%	2.4%	89.8%	7.3%	2.9%
Poland	77.4%	20.8%	1.8%	76.0%	21.8%	2.2%
Romania	97.9%	1.6%	0.5%	97.6%	1.9%	0.6%
	Share of agricultural area					
	2005			2007		
Czech Republic	1.9%	5.6%	92.6%	1.7%	5.6%	92.7%
Hungary	13.0%	15.9%	71.0%	10.7%	14.5%	74.7%
Poland	35.4%	41.0%	23.5%	35.5%	40.2%	24.3%
Romania	50.5%	9.5%	40.0%	49.8%	10.2%	40.0%
	2010			2013		
Czech Republic	1.0%	5.6%	93.4%	1.2%	6.1%	92.7%
Hungary	9.9%	15.8%	74.3%	9.2%	16.5%	74.3%
Poland	30.4%	40.1%	29.5%	28.2%	41.0%	30.8%
Romania	38.8%	8.4%	52.8%	38.5%	9.4%	52.1%

Source: Eurostat 2018 (a).

At the same time, in Poland, Romania, and Hungary a slow decrease in the share of the smallest farms up to 10 ha of AL can be observed, along with an increase in the share of those from the “above 50%” group. In the Czech Republic, this process took place from 2005-2010, but already three years later, the share of small entities increased at the expense of the decrease of the large ones' share (moreover, over 2010-2013 the total number of farms increased). This situation – different to that in the other countries – is a result of the relatively fast growth in the number of small farms oriented at direct sales or production for their own needs (which is reflected in the twofold increase of the share of farms with more than 50% of production retained for their own needs, cf. Fig. 1). Interest in this type of activity results from the growing consumer demand for traditional, higher quality, less processed food. With each year, the network of farmer-consumer links is developing, as part of the so-called community-supported agriculture [Havlová and Hnutí 2018]. Certified organic farms, the number of which is successively growing, have a large share in this type of relationship [De Potter and Matějková 2015].

The average size of farms in terms of their area translates into their economic strength, which can be expressed in Standard Output (SO) units. Standard Output is a mean value of the production of specific plant- or animal-related activity over 5 years per hectare or per animal in 1 year, in the average conditions for the given region [Bocian, Cholewa and Tarasiuk 2014, p. 8]. The data concerning this parameter indicates a clear relationship between the farms' area structure and the place of production. In the Czech Republic, in 2013, more than 80% of SO was produced by farms above 50 ha in size, whereas in Poland they created 25%, and 31% in Romania. On the other hand, farms with an area below 10 ha produced only 12% of SO in the Czech Republic and as much as 60% in Romania (cf. Table 5). It can also be observed that from 2005-2013 the share of Standard Output created in the group of the smallest farms was decreasing, while it increased in the group of the large ones, with the reservation that for the Czech Republic this applied to the 2005-2010 period.

Table 5. Standard Output (SO) structure in the individual area groups of farms in the selected EU countries

	2005			**2007**		
	<10 ha	**10-50 ha**	**>50 ha**	**<10 ha**	**10-50 ha**	**>50 ha**
Czech Republic	13.3%	5.5%	81.2%	13.1%	6.0%	80.8%
Hungary	37.5%	13.3%	49.2%	35.1%	13.4%	51.6%
Poland	38.4%	42.8%	18.7%	37.4%	42.2%	20.3%
Romania	73.4%	8.1%	18.5%	71.3%	9.2%	19.5%

	2010			2013		
	<10 ha	**10-50 ha**	**>50 ha**	**<10 ha**	**10-50 ha**	**>50 ha**
Czech Republic	10.9%	5.1%	84.0%	12.1%	5.4%	82.5%
Hungary	33.4%	13.8%	52.9%	26.1%	15.2%	58.7%
Poland	33.4%	42.0%	24.5%	31.3%	43.4%	25.3%
Romania	64.8%	8.1%	27.2%	60.2%	9.3%	30.6%

Source: Eurostat 2018 (a).

In terms of the use of agricultural land, only slight changes occurred over the years under study. In 2013, arable land took up the largest part of the agricultural area – from 63% in Romania, up to 82% in Hungary, and compared with the 2005-2007 period, their share decreased on average by 1-2%. The primary crop plants included cereals, with a share of 57% of arable land in the Czech Republic, rising to 70% in Poland. The average 2-3% decrease in this plant species' share in the crop structure was compensated by an increase in the production of maize and rapeseed. Acreage growth also concerned permanent grassland (meadows and pastures) and, except for Poland, forested areas. In animal production, decreasing interest in this type of activity can be observed. This is manifested both in the reduction of livestock (in LSUs[6]) and – to an even greater extent – in the number of farms keeping animals (cf. Table 6). As a result, in spite of lower number of animals, the concentration of cattle and pig breeding, expressed as an average number of livestock heads per farm, increased in all the countries under study, although compared to leading Western European countries it is still low [Stępień 2015] (it is also worth noting that among the analysed countries, the Czech Republic stands out positively).

[6] LSU – Livestock Unit, it is a reference unit which facilitates the aggregation of livestock from various species and age as per convention, via the use of specific coefficients established initially on the basis of the nutritional or feed requirement of each type of animal (see website: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Livestock_unit_(LSU)).

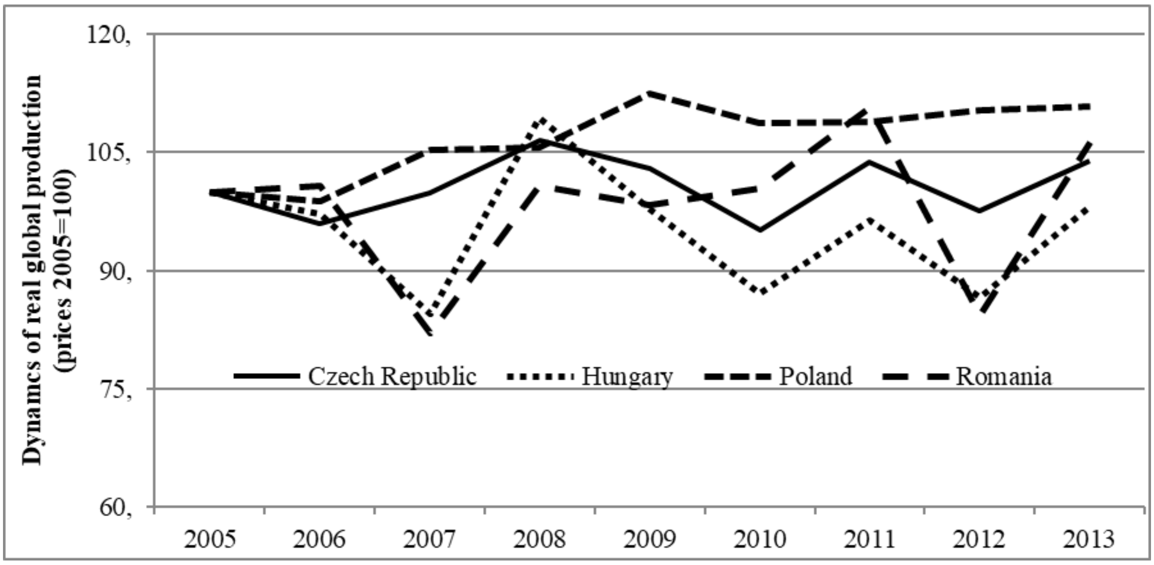
Table 6. Basic characteristics of animal production in the selected EU countries

	2005	2007	2010	2013	2013/2005
	Number of farms with livestock (pcs.)				
Czech Republic	31 540	28 480	15 920	18 840	-40%
Hungary	501 910	439 910	381 650	312 430	-38%
Poland	1 547 480	1 539 380	918 870	797 750	-48%
Romania	3 453 010	3 333 490	2 836 640	2 727 720	-21%
	Number of animals in livestock unit (LSU) (pcs.)				
Czech Republic	2 074 380	2 052 810	1 722 460	1 728 360	-17%
Hungary	2 502 090	2 409 330	2 483 790	2 259 080	-10%
Poland	10 564 750	11 117 920	10 377 220	9 164 570	-13%
Romania	6 602 750	6 041 720	5 444 180	4 975 310	-25%
	Number of cattle per farm (pcs.)				
Czech Republic	93	102	132	119	27%
Hungary	28	36	37	42	48%
Poland	7	8	11	14	98%
Romania	2	3	3	3	36%
	Number of pigs per farm (pcs.)				
Czech Republic	207	252	477	312	51%
Hungary	12	14	18	21	75%
Poland	25	28	39	41	61%
Romania	3	3	3	3	17%

Source: Eurostat 2018 (b).

Structural transformations in the agricultural sector determine the achieved production results by changing effects and outlays and the mutual relationship between the two. One of the basic measures used for the assessment of the economic situation in agriculture is output value. It is a derivative of the size of plant and animal production created, and raw material prices for a given period. Taking this perspective into consideration, from 2005-2013, an increase was recorded in all the countries under study: 44% for the Czech Republic, 31% for Hungary, 58% for Poland, and 35% for Romania. In turn in order to demonstrate real changes in the production volume, constant prices from 2005 were used. This way, the results were adjusted by the influence of prices, which made it possible to obtain a more clear-cut picture of the functioning of the sector. As we can see in Figure 1, a relatively high increase (over 10%) in real agricultural production occurred only in Poland, whereas in the remaining countries cyclical fluctuations, typical of the sector, were recorded, with no evident growth trend. However, it has to be taken into consideration that within the same period, the number of farms and their employees decreased considerably, which clearly improved labour productivity.

Fig. 1. Agricultural production dynamics for 2005-2013 for values expressed in the national currency in constant prices from 2005 in the selected EU countries.



Source: Eurostat 2018 (c).

Table 7 presents selected economic indices for farms. The size of standard output (SO) per farm increased in all the analysed countries, with the highest increase (as much as 135%) recorded in Poland, followed by the Czech Republic, Hungary, and Romania. In turn, the relation of standard output to the annual work unit (AWU)[1] improved most clearly in Romania, followed by the Czech Republic, Poland, and Hungary. In these three countries – the Czech Republic, Hungary, and Poland – the improvement of the productivity index was higher when the farm criterion was used, whereas in Romania the index increased more when AWU was used. This results from the fact that in Romania the decrease in employment (expressed in AWU) was higher in the 2005-2013 period than the decrease in the number of farms, while in the other countries the situation was the reverse. This is confirmed by another index –

[1] The annual work unit (AWU) corresponds to the work performed by one person who is occupied on a farm on a full-time basis. Full-time means the minimum hours required by the relevant national provisions governing contracts of employment. If the national provisions do not indicate the number of hours, then 1 800 hours are taken to be the minimum annual working hours: equivalent to 225 working days of eight hours each.

employment in AWU per farm. While in the Czech Republic, Poland, and Hungary this index increased in the period under study, in Romania it decreased. The last of the indices discussed is the level of labour force used (AWU) per 100 ha of AA. In this case, improvement occurred in all the countries, to the greatest extent in Romania and the Czech Republic.

Table 7. Selected economic indices of farms in the EU countries under study

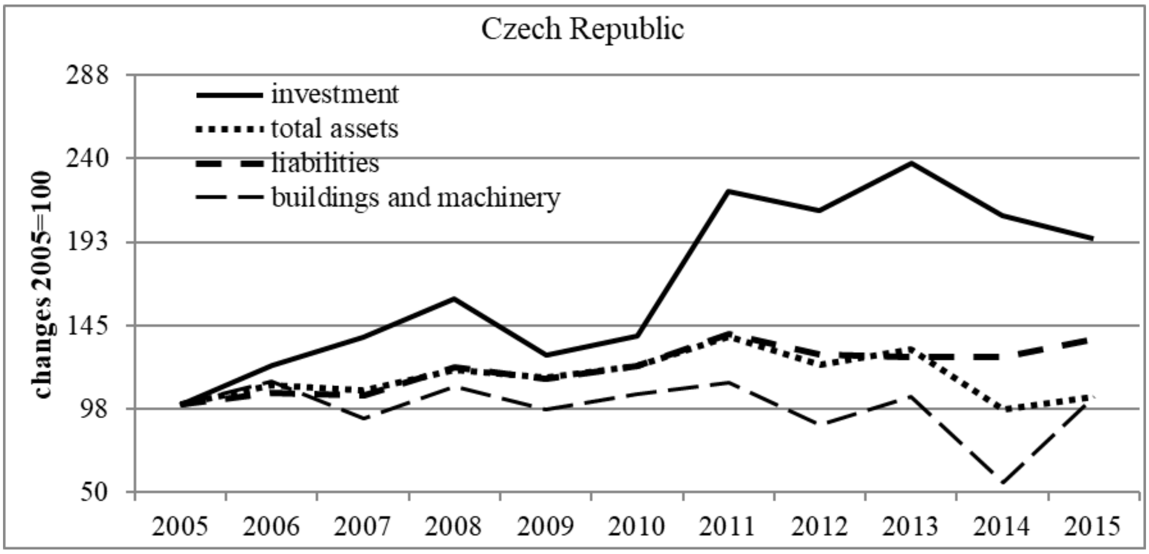
	Standard Output SO in thous. euro per farm					Standard Output SO in thous. euro per Annual Work Unit AWU				
	2005	**2007**	**2010**	**2013**	**2013/ 2005**	**2005**	**2007**	**2010**	**2013**	**2013/ 2005**
Czech Republic	86.5	91.2	168.5	169.4	96%	24.0	26.2	35.7	42.3	76%
Hungary	6.9	7.4	9.1	11.4	65%	10.6	11.5	12.4	12.9	21%
Poland	6.5	7.1	12.6	15.3	135%	7.1	7.5	10.0	11.4	61%
Romania	2.5	2.6	2.6	3.3	34%	4.0	4.6	6.1	7.7	91%
	Annual Work Units AWU per farm					**Annual Work Units AWU per 100 ha of agricultural area AA**				
	2005	**2007**	**2010**	**2013**	**2013/ 2005**	**2005**	**2007**	**2010**	**2013**	**2013/ 2005**
Czech Republic	3.6	3.5	4.7	4.0	11%	4.3	3.9	3.1	3.0	-30%
Hungary	0.6	0.6	0.7	0.9	36%	10.8	9.5	9.0	9.3	-14%
Poland	0.9	0.9	1.3	1.3	46%	15.4	14.6	13.1	13.3	-14%
Romania	0.6	0.6	0.4	0.4	-30%	18.7	16.0	12.1	11.9	-36%

Source: Eurostat 2018 (a).

Investment and farm asset dynamics

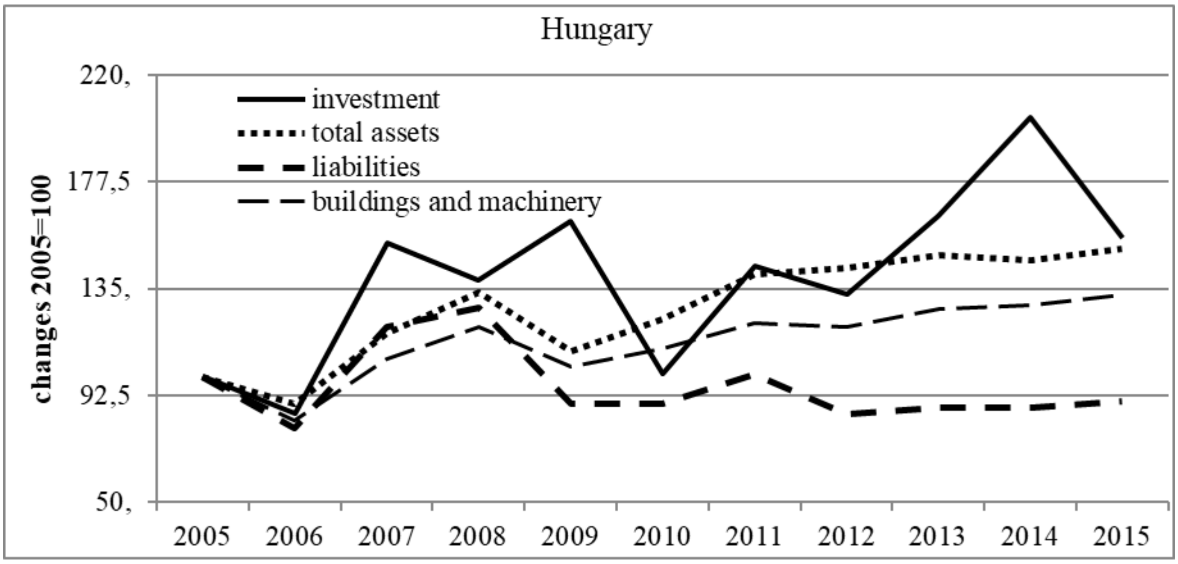
As the primary aim of the paper is to demonstrate the investment-oriented role of the second pillar of CAP in the transformations in the agricultural sector, it is important to specify the changes in investments and farm assets. Due to the lack of such information in the Eurostat database, this part of the work uses farm accountancy data provided by FADN (for 2005-2015, in Romania for 2007-2015). Based on the analysis of source data, it may be concluded that in the Czech Republic, Hungary, and Poland the level of investment expenses of an average representative farm in 2013, compared to 2005, was higher by 137%, 64%, and 40% respectively (cf. Fig. 2, 3 and 4).

Fig. 2. Gross investment, asset value and total liabilities dynamics in the Czech Republic in 2005-2015



Source: FADN 2018.

Fig. 3. Gross investment, asset value and total liabilities dynamics in Hungary in 2005-2015



Source: FADN 2018.

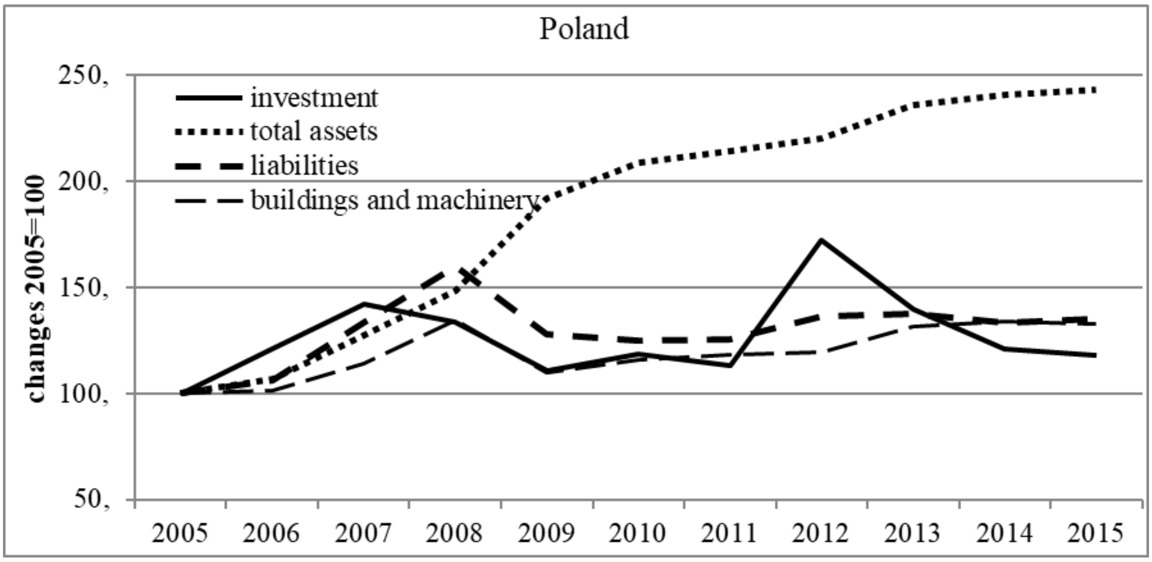
Over the following years, however, investments were characterised by clear fluctuations, reaching as high as several dozen percent (e.g. in the Czech Republic investment growth in 2010-2011 was as high as 60%). Thus, a statistically significant growth trend cannot be demonstrated, but we can talk about a general increase in investment expenses in these countries. The diverse scales of investment in the consecutive periods resulted from the schedule of activities adopted in the rural development programmes (the pool of funds for investment purposes was different in individual years). In turn, in Romania, in spite of including Common Agricultural Policy funds in the economy, the level of investment in all of the 2008-

2013 period (apart from 2009), relative to 2007, was lower (cf. Fig. 5).Thus, the accomplishment of the investment-oriented objectives of the second pillar of CAP was the least evident in this case. This may be a result of the lowest investment subsidies, compared with the other countries, obtained on average per farm. For 2007-2013, on average they amounted to EUR 15, whereas in the Czech Republic it was nearly EUR 4,200, in Hungary EUR 850, and in Poland EUR 234. Even if we take into consideration the remaining support for rural areas, such as payments for less-favoured areas and agri-environmental payments (which could also indirectly be allocated for investment purposes), the disparities remain very high. This disproportion once again reveals the diverse area structure of farms. The predominance of small farms in Romania was the decisive factor in making the average help for a single entity much lower than, for example, in the case of the Czech Republic[2].

The growing scale of investment expenses should in practice translate into higher asset values. If we look at the countries under study, the most evident increase in this respect occurred in Poland. Moreover, the assets grew each subsequent year (on average by 9%) and, as a result, in 2013 they were higher by 136% compared to 2005. Closer analysis allows us to understand this process better. It turns out that the main growth factor for the total value of farm assets in Poland was the increase in the value of land, resulting from higher prices. The value of buildings, machines and equipment alone increased by 31%, and the directions of changes were not always the same (cf. Fig. 4). In the remaining countries, the directions of changes in total asset values resulted above all from the direction of changes in the value of buildings, machines, and equipment, although the value of land also increased the total increase in asset value (cf. Fig. 2, 3, 5). And so in the case of Hungary, total asset growth came to 48% (including buildings, machines, and equipment 27%), and in the case of the Czech Republic 32% (and 4% respectively). The low increase in the value of the “buildings, machines, and equipment” group in the Czech Republic is a result of the large scale of farm building rental in this country, whereas FADN data only includes assets constituting the property of the farm. In Romania, between 2008 and 2013, the total value of assets, as well as buildings, machines, and equipment decreased only slightly. In this case, the small level of gross investment expenses made it impossible to expand the production potential.

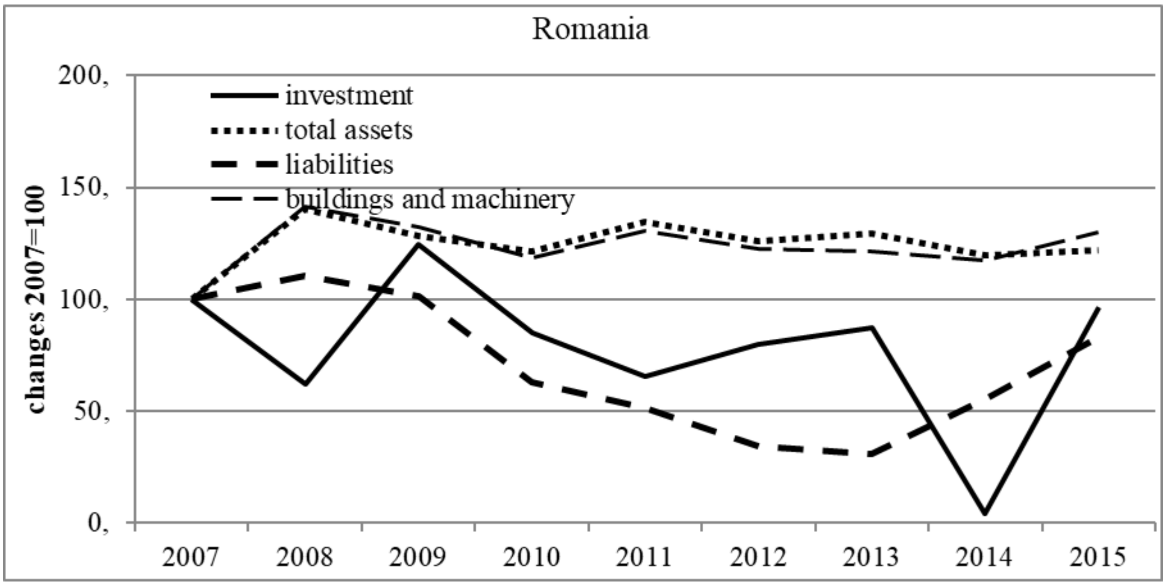
[2] Total annual average support for a FADN farm under rural development programme 2007-2013 was EUR 22 591 in the Czech Republic, EUR 3 509 in Hungary, EUR 1 342 in Poland and only EUR 126 in Romania.

Fig. 4. Gross investment, asset value and total liabilities dynamics in Poland for 2005-2015



Source: FADN 2018.

Fig. 5. Gross investment, asset value and total liabilities dynamics in Romania for 2007-2015



Source: FADN 2018.

Analysis of the data concerning assets also makes it possible to conclude that, in comparison with the dynamics of investment expenses, the changes in their value were more stable (the annual fluctuation amplitude usually amounted to anything from several to around a dozen percent). This means that with a high increase or decrease in investment expenses, the value of assets does not change rapidly. In order to execute agricultural production it is essential to guarantee the appropriate potential, regardless of whether we make an investment in a given year or limit them. Moreover, a surge of investment in fixed assets (e.g. farm buildings) increases the assets not only in the given fiscal year, but also in the subsequent years. Figures2-

5 also show the change in the level of farms' liabilities, because the execution of investments, also within the programmes of the CAP second pillar, often involves the need to obtain external funding. And so, in the case of the Czech Republic and Poland, the value of liabilities in 2013 was higher than in 2005 (by 27% and 37% respectively), which means that in these two countries investment expenses were financed to a relatively large extent from external capital. In Hungary, after initial growth, the level of obligations towards the end of the period was lower by 12%, which may mean a higher share of financing with the farms' own funds. In Romania, from 2007-2013, the decrease came to as much as 70%, but in this case it may result from a lower scale of investment [cf. P. Avramia 2013, pp. 721-729].

Finally, a couple of remarks on the years 2014-2015. This was a transition period – the beginning of the 2014-2020 budget period, and so also the beginning of the implementation of new rural development programmes. In the context of investment expenses, the data indicates a decrease in the Czech Republic and in Poland in 2014 and 2015, and in Romania in 2014 (in the Czech Republic and Romania combined with a decrease in asset value in 2014). This may signify exhaustion of funds for investment towards the end of the previous budget outlook for 2007-2013 and/or delays in terms of objective preparation and implementation of investment activities for the current outlook. If we take a closer look at the numbers included in Table 8, a large decrease in investment subsidies can actually be observed in the Czech Republic in 2013-2014 and in Romania in 2012-2013. In Poland, the average amount of support for farm investments remained at a similar level after 2010, but in 2015 a considerable decrease in the total support within the second pillar of CAP was recorded (and as mentioned before, the remaining funds may indirectly influence the amount of investment expenses). Hungary was the only country in which increased funding for 2014 was planned (both for investment and generally for the second pillar), although a year later. The amount of subsidies dropped.

Table 8. Investment subsidies and total support within the CAP second pillar (in EUR) on average per one FADN farm in the selected EU countries

	Czech Republic		**Hungary**		**Poland**		**Romania**	
Years	**Investment subsidies**	**Pillar II total**	**Investment subsidies**	**Pillar II total**	**Investment subsidies**	**Pillar II total**	**Investment subsidies**	**Pillar II total**
2004	641	8318	498	531	0	34	-	-
2005	1173	11573	665	1920	18	451	-	-
2006	1263	16898	268	1420	43	1261	-	-

2007	1829	16581	690	2492	157	1176	30	30
2008	2202	22897	913	3295	240	1602	24	37
2009	3845	22747	1504	3552	182	1281	26	46
2010	4398	22959	809	3662	255	1451	6	58
2011	8598	28973	725	4356	254	1346	12	199
2012	5536	23670	463	3459	269	1216	2	191
2013	2979	20312	843	3746	279	1321	5	318
2014	2782	18455	1662	4568	294	1263	131	188
2015	5957	20844	994	2159	272	705	77	104

Source: FADN 2018.

Conclusions and recommendations

The second pillar of the Common Agricultural Policy for 2007-2013 was undoubtedly an important element of support for rural areas in the countries of East-Central Europe. Its significance resulted from the need to improve agriculture's agrarian structure, increase the competitiveness of agricultural producers, transform the employment structure, needs in the area of infrastructure development, and finally, the accomplish tasks related to the protection of the natural environment [Czyżewski and Stępień 2017, pp. 37-54]. The accumulated effects of the support led to a considerable improvement of the income situation of agricultural producers and to structural changes at farm level [Wilkin 2016, pp. 120-124]. The creation of rural development programmes triggered the multiplier effect of investment expenses. Axis I activities, such as "farm modernisation" or "increase in added value", increased the scale of investment and led to the growth of fixed assets in the Czech Republic, Hungary, and Poland. Thanks to that, business activity results in improved standard output per farm and increased AWU. An increase in real output was also recorded in Poland. It was only in Romania, on account of the decidedly lowest level of subsidies among all the studied countries, that the investments and fixed assets decreased within the analysed period, and standard output per farm increased to the lowest extent. On the other hand, the higher level of investment in Poland and the Czech Republic resulted in an increase in these countries' liabilities, which may have consequences for their financial liquidity in subsequent periods.

Agrarian structure improved in all of the countries under study – the number of farms decreased, thanks to which an increase in their average surface area was recorded and the share of entities sised above 50 ha of AL increased, while the share of entities below 10 ha of AL decreased. The largest decrease in the number of farms, in absolute and relative terms, occurred in Poland, and the structural pension programme, as an element of RDP axis I, may have contributed to that. The process was the slowest in Romania, where no such programme was launched and where support in the form of area subsidies ossified small farm agriculture. Maintaining a large number of small farms made it possible to limit unit labour inputs (AWU), thanks to which the productivity indices of this production factor improved. In the remaining three countries, the increase in the average farm surface area and the growth of production scale required a higher use of labour force (AWU). Another common characteristic of the four economies was the decreased interest in animal breeding. Farmers preferred plant production, partly supported by supplementary payments in the CAP first pillar, and its second pillar did not include any special programmes for the animal sector. Still, due to the limitation of the number of producers, herd concentrations increased, although the distance between Hungary, Poland, and Romania and the EU's leading livestock producers in this respect remains large.

Taking into account previous experience, the key issue is to keep a relatively high level of funding for the second pillar of CAP for EU-12 countries after 2020. This will allow them to continue along the path of structural transformations and strengthen the competitiveness of the agricultural sector in this region. As the growth of production potential will primarily concern large households, by investment programmes, it is important to guarantee appropriate support programmes for small farms, as well as activities related to supporting entrepreneurship in rural areas and for the labour market (subsidies for non-agricultural activities, professional activation), support for the education system and increasing access to information technologies.

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Development of renewable energy market in the EU with particular regard to solar energy

Piotr Bórawski
University of Warmia and Mazury in Olsztyn, Poland
ORCID: 0000-0002-6616-7140, e-mail: pboraw@uwm.edu.pl
Tetiana Yashchenko
National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute"
ORCID: 0000-0001-9380-2237, e-mail: tanyayash123@gmail.com
Andrii Sviderskyi
National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute"
ORCID: 0000-0003-4901-7252, e-mail: Andruha-star4ik@yandex.ru
James W. Dunn
Pennsylvania State University
ORCID: 0000-0002-6643-8617, e-mail: jwd6@psu.edu

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Abstract: Solar energy is the fastest growing energy sector in the world, with growth rates of 40-50% per year. Solar energy creates the possibility of industrial use of new technologies, materials and structures of solar cells, modules and power plants. The aim of this paper is to present renewable energy sources and their use in the EU in the years 2004-2015. This paper analyzes the use of photovoltaic (PV) technology in Europe, discusses what this technology is, and the rate of its development. Also, a list of advanced countries that are actively using solar energy is given. The biggest part in renewable energy is occupied by biofuels and renewable waste. Our analysis confirmed the highest increase in the share of electricity from renewable sources in gross electricity consumption in the years 2004-2015 in Estonia (2,416.7%), Belgium (805.9%) and the United Kingdom (540%). The conducted analysis showed that Malta (1181.1%), the United Kingdom (685.8%) and Luxembourg (283.3%) achieved the highest increases in the share of renewable energy sources in heating and cooling in the years 2004-2015. In the same period Portugal (2.8%), Latvia (21.9%) and Croatia (31.3%) achieved the lowest increases in the share of renewable energy sources in heating and cooling. This paper finds a reduction in excise taxes stimulates the demand for "green" energy. European countries have achieved very impressive results in the development of solar energy. The results are of great interest to investors, politicians and others interested in the development of PV power plants.

Keywords: solar energy, photovoltaics, concentrated solar power, alternative energy, capacity, solar market

JEL: D40, N54, N74

Introduction

The theory of sustainable development has been heavily researched and is rapidly developing and becoming ever more popular in the last decade. All of the developed countries of the world have expressed their desire to follow a direction towards sustainable development.

One of the concepts of this theory for non-renewable natural resources is the maximum slowdown in the rate of depletion of their reserves with the prospect of replacing them in the future with other unlimited resources. For example, partial replacement of oil, gas or coal with alternative sources of energy – solar, wind, etc. [Sustainable Development… 2011, p. 11].

Renewable energy is the fastest growing energy sector in the world. It includes: biofuels and renewable wastes, hydropower, wind, solar, and geothermal energy.

Viewed by the main energy source, energy production has many industries, such as nuclear, coal, hydropower, gas and alternative, which are based on the use of non-traditional renewable energy sources. Alternative energy includes: wind energy, solar, geothermal, biomass, etc. If we compare all these sectors based on environmental, economic, and safety criteria, we can conclude that solar energy is the most promising [Udell, 1980, p. 88].

The solar energy industry develops methods and resources for using solar emissions or solar radiation to produce electrical, thermal and other types of energy. Scientists have estimated that utilising even a small percentage of the available solar energy will be enough to satisfy the needs of transport and industry now and in the future.

Today, solar energy produces 4% of the electricity in the EU. In Italy, Greece and Germany, the solar share exceeds 7%. In a pessimistic scenario of development, solar energy will provide 10% of European electricity by 2030. It is also obvious that it is extremely important that mechanisms of state regulation are correctly structured. They allow the formation of a market, creation of the appropriate production capacity, and ensure a long-term reduction in the price of solar electricity.

However, this industry has a significant disadvantage. The sun's rays that fall on the earth's surface do not have a specific concentration point, which is why it needs to be captured and converted into an energy form that could be used more readily. There is also a problem with the availability of solar energy at night and on dark days. But these problems can be solved. Now the main thing is to make the cost competitive [Ionov, 2006, p. 82].

The aim of this paper is to present renewable energy sources and their use in the EU in the years 2004-2015. To achieve this goal, the authors of the paper analysed changes in renewable energy, in particular biofuels and renewable wastes, hydropower, wind, solar and geothermal energy. Particular attention has been focused on solar energy. Within the main objective, two specific objectives were pursued: 1) to analyse the changes in share of electricity from renewable sources in gross electricity consumption, in heating and cooling, and in transport; 2) to find out whether a reduction in excise taxes stimulates demand for "green" energy. The authors of the paper used descriptive, tabular and graphic methods to analyse the results.

Renewable Energy Market Evolution in Europe

At the present stage of development, there is a strong interest of countries in energy security and environmental protection. In the world, there are more than 20 countries which have a share of renewable energy sources in their total energy usage that exceeds 20%. These include Iceland, Norway, Scotland, Denmark, Germany, and others. According to the energy strategy adopted in the EU, by 2020 the EU countries must achieve a 20% reduction in greenhouse gas emissions, an increase to 20% in the share of renewable energy and a 20% improvement in energy efficiency. By 2050, Germany plans to achieve a 60% share of renewable energy in the country's total energy balance and 80% in electricity generation.

Renewable energy is an effective way of addressing the energy crisis. In terms of installed capacity among European countries in 2015, wind power is in the lead. Taking the average annual growth rate of wind power plants (WPP) – 15%, and solar photovoltaic power stations (PV) – 31%, by 2020 the installed capacity will be: WPP – 845 GW, PV – 867 GW.

Renewable energy is a way to get new energy that can replace or supplement energy needs. The share of renewables in gross inland energy consumption is diverse in Europe. The highest share of renewables in gross inland energy consumption in 2015 was in Sweden (42.2%), Finland (31.6%) and Latvia (35.1%). The lowest share of renewables in gross inland energy consumption in 2015 was found in Malta (2.6%), the Netherlands (4.7%) and Luxembourg (4.9%).

The biggest share of renewable energy is occupied by biofuels and renewable waste. Analysis of the information in table 1 suggests that the biggest share of biofuels and renewable waste can be seen in Latvia (31.2%), Finland (26.7%) and Sweden (24.8%). The smallest share from biofuels and renewable waste was observed in 2015 in Malta (1.0%), Cyprus (2.1%) and Ireland (3.0%).

Table 1. Share of renewables in Gross Inland energy consumption 2015 (%)

Country	Renewable energy	Biofuels and renewable wastes	Hydropower	Wind	Solar	Geothermal
EU-28	13.0	8.4	1.8	1.6	0.8	0.4
Belgium	6.7	5.2	0.1	0.9	0.5	0.0
Bulgaria	10.8	6.5	2.6	0.7	0.8	0.2

Country	Renewable energy	Biofuels and renewable wastes	Hydropower	Wind	Solar	Geothermal
Czech Republic	10.1	9.1	0.4	0.1	0.5	0.0
Denmark	28.4	20.5	0.0	7.2	0.5	0.0
Germany	12.2	8.2	0.5	2.2	1.3	0.1
Estonia	14.5	13.5	0.0	1.0	0.0	0.0
Ireland	7.6	3.0	0.5	4.0	0.1	0.0
Greece	11.3	5.4	2.1	1.6	2.2	0.0
Spain	13.7	5.6	2.0	3.5	2.6	0.0
France	8.6	5.7	1.9	0.7	0.3	0.1
Croatia	23.0	15.5	6.4	0.8	0.2	0.1
Italy	16.8	8.6	2.5	0.8	1.4	3.5
Cyprus	5.5	2.1	0.0	0.8	3.5	0.1
Latvia	35.1	31.2	3.7	0.3	0.0	0.0
Lithuania	20.5	19.0	0.4	1.0	0.1	0.0
Luxembourg	4.9	4.2	0.2	0.2	0.3	0.0
Hungary	12.0	11.1	0.1	0.2	0.1	0.4
Malta	2.6	1.0	0.0	0.0	1.6	0.0
Netherlands	4.7	3.6	0.0	0.8	0.2	0.1
Austria	29.0	17.3	9.6	1.3	0.8	0.1
Poland	9.4	8.2	0.2	1.0	0.1	0.0
Portugal	21.5	12.6	3.2	4.3	0.6	0.8
Romania	18.4	11.5	4.4	1.9	0.5	0.1
Slovenia	16.1	9.9	5.0	0.0	0.5	0.7
Slovakia	9.6	7.2	2.0	0.0	0.3	0.0
Finland	31.6	26.7	4.3	0,6	0.0	0.0
Sweden	42.2	24.8	14.2	3.1	0.0	0.0
United Kingdom	7.7	5.3	0.3	1,8	0.4	0.0

Source: own elaboration on the basis of renewable energy statistics.

The authors of the paper analysed the changes in share of electricity from renewable sources in gross electricity consumption. It is worth mentioning that Cyprus and Malta had no share of electricity from renewable sources in gross electricity consumption in 2004, but by 2015 these countries reached the levels respectively of 8.4% and 4.2%. The highest increase in share of electricity from renewable sources in gross electricity consumption in the years 2004-2015 was in Estonia (2416.7%), Belgium (805.9%) and the United Kingdom (540%). The lowest increase in share of electricity from renewable sources in gross electricity consumption in the years 2004-2015 was observed in Slovenia (11.6%), Austria (13.8%) and Latvia (14.1%).

The highest increase in share of renewable energy sources in heating and cooling in 2004-2015 was observed in Malta (1,181.1%), the United Kingdom (685.8%) and Luxembourg (283.3%). The lowest increase in share of renewable energy sources in heating and cooling was observed in 2004-2015 in Portugal (2.8%), Latvia (21.9%) and Croatia (31.3%).

Finally, we analysed the share of renewable energy sources in transport. Malta, Cyprus and Ireland did not use renewable energy sources in transport. The biggest increase in share of renewable energy sources in transport in 2004-2015 was found in Luxembourg (6,400%), Finland (2,100%) and Denmark (1,575%). The lowest increase of share of renewable energy sources was found 2004-2015 in Spain (70%), Latvia (85.7%) and Estonia (100%).

Table 2. Changes in renewable energy in 2004-2015 (%)

Country	Share of electricity from renewable sources in gross electricity consumption			Share of renewable energy sources in heating and cooling			Share of renewable energy sources in transport		
	2004	2015	change	2004	2015	change	2004	2015	change
EU-28	14.3	28.8	97.2	10.2	18.6	82.4	1.4	6.7	378.6
Belgium	1.7	15.4	805.9	2.9	7.6	162.1	0.5	3.8	660.0
Bulgaria	9.1	19.1	109.9	14.1	28.6	102.8	0.9	6.5	622.2
Czech Republic	3.6	14.1	291.7	9.9	19.8	100.0	1.5	6.5	333.3
Denmark	23.8	51.3	115.5	20.6	39.5	91.7	0.4	6.7	1575.0
Germany	9.4	30.7	226.6	6.3	12.9	104.8	2.2	6.8	1600.0
Estonia	0.6	15.1	2416.7	33.2	49.6	49.4	0.2	0.4	100.0
Ireland	6.0	25.2	320.0	2.9	6.4	120.7	0.0	6.5	650.0
Greece	7.8	22.1	183.3	12.8	25.9	100.8	0.1	1.4	1300.0

Country	Share of electricity from renewable sources in gross electricity consumption			Share of renewable energy sources in heating and cooling			Share of renewable energy sources in transport		
	2004	2015	change	2004	2015	change	2004	2015	change
Spain	19.0	36.9	94.2	9.5	16.8	76.8	1.0	1.7	70.0
France	13.8	18.8	36.2	12.3	19.8	61.0	1.5	8.5	466.7
Croatia	35.5	45.4	27.9	29.4	38.6	31.3	1.0	3.5	250.0
Italy	16.1	33.5	108.1	5.7	19.2	236.8	1.2	6.4	433.3
Cyprus	0.0	8.4	-	9.3	22.5	141.9	0.0	2.5	250.0
Latvia	46.0	52.2	14.1	42.5	51.8	21.9	2.1	3.9	85.7
Lithuania	3.6	15.5	330.6	30.4	46.1	51.6	0.4	4.6	1050.0
Luxembourg	2.8	6.2	121.4	1.8	6.9	283.3	0.1	6.5	6400.0
Hungary	2.2	7.3	231.8	6.5	21.3	227.7	0.9	6.2	588.9
Malta	0.0	4.2	-	1.1	14.1	1181.8	0.0	4.7	470.0
Netherlands	4.4	11.1	152.3	2.2	5.5	150.0	0.5	5.3	960.0
Austria	61.8	70.3	13.8	20.1	32.0	59.2	4.5	11.4	153.3
Poland	2.2	13.4	509.1	10.2	14.3	40.2	1.4	6.4	357.1
Portugal	27.5	52.6	91.3	32.5	33.4	2.8	0.4	7.4	1750.0
Romania	25.0	43.2	72.8	17.6	25.9	47.2	1.5	5.5	266.7
Slovenia	29.3	32.7	11.6	18.4	34.1	85.3	0.9	2.2	144.4
Slovakia	15.4	22.7	47.7	5.1	10.8	111.8	1.4	8.5	507.1
Finland	26.7	32.5	21.7	39.5	52.8	33.7	1.0	22.0	2100.0
Sweden	51.2	65.8	28.5	46.7	68.6	46.9	5.3	24.0	352.8
United Kingdom	3.5	22.4	540.0	0.7	5.5	685.8	0.3	4.4	1366.7

Source: own elaboration on the basis of renewable energy statistics.

Solar PV technology

Currently, there are two popular ways of converting solar energy: photovoltaics (PV) and concentrated solar power. But photovoltaic technology has much wider use in the field, for several reasons.

Solar photovoltaic power is the most common source of electricity in the world by number of installations [Gielen et al., 2016, p. 19]. As a result of the decline in the cost of

PV panels and rising efficiency in solar cells [Honrubia-Escibano et al., 2015, p. 467], solar PV accounted for 20% of all new power generation capacity in 2015 [Gielen et al., 2016, p. 25].

Of course, PV generation is at a maximum in the daytime. One of the promising areas for the development of PV is the creation of self-contained photovoltaic installations with a capacity of 2 to 3 kW with an area of 20-30 m^2, located on the roofs and facades of private houses, and generating approximately 3,000 kWh per year.

Now, the most important task of PV is to achieve costs where photovoltaic electricity is equal in value, or even cheaper, than energy obtained through a conventional electrically conductive network from power plants [Teregulov, Abdrashitov, 2017, p. 21].

Photovoltaic cells are made of semiconductor materials. When sunlight enters the cells, it knocks electrons out from their atoms. The electrons generate electricity when they pass through the cell.

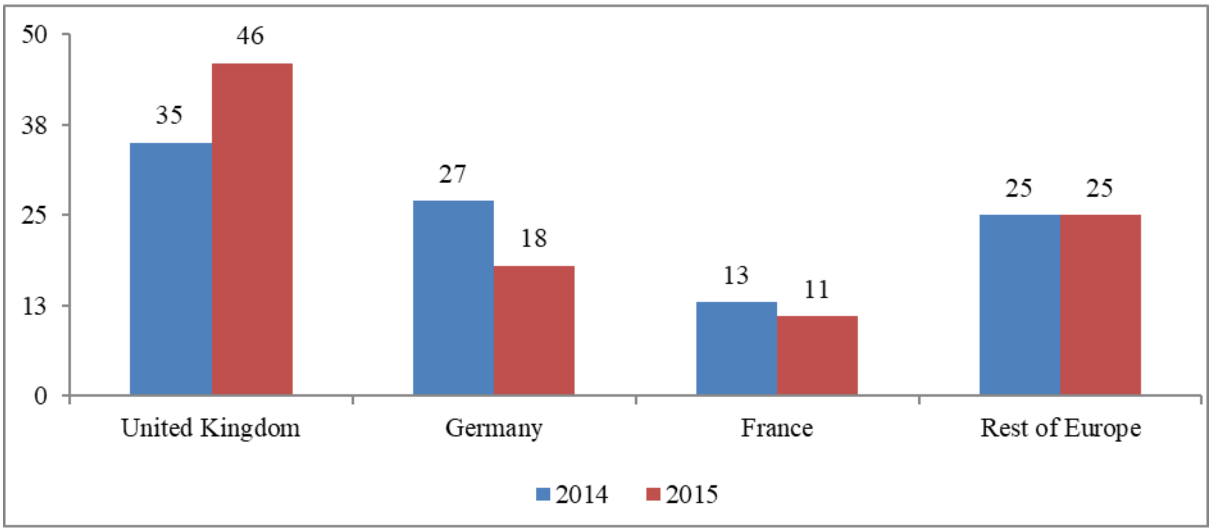
The structure of the material has two energy bands, separated by a forbidden zone, known as an energy or band gap: the valence band and the conduction band. The valence band of a semiconductor material, for example silicon, is filled with electrons, and its conducting band is empty. On the contrary, the conduction band in a conductor material is partly filled. A certain amount of energy must be reached before the electron is transferred from the valence band to the conduction band, which is equal to the band gap energy and depends on the type of material. Consequently, based on the material used, PV technology is subdivided into crystalline, thin film, compound semiconductor and nanotechnology [Horubia-Escribano, et al., 2017, p. 470].

The most solarised continent is Europe. In Europe, an average of about 4% of electricity demand comes from solar power, and, in the most advanced solar markets, is around 8%. No other region can boast such high solar shares [Solar Market Report & Membership Directory, 2016, p. 11].

In 2015 the European solar market saw significant growth. Demand grew by 15% compared to the previous year. In Europe, the base for the demand for solar power consists mainly of three countries – UK, Germany and France. Their markets produce 75% of the solar energy, which equals 6 GW, in 2014 it was also 75%, but 5.3 GW (figure1) [Solar Market Report & Membership Directory, 2016, p. 17].

Italy was previously a European leader. It installed about 300 MW, that’s almost 100 MW less than in 2014. In 2008, Spain was the world market leader. But the Spanish Government is blocking the emergence of the self-consumption market with a solar tax and high penalties for non-declared prosumers [Solar Market Report & Membership Directory, 2016, p. 25].

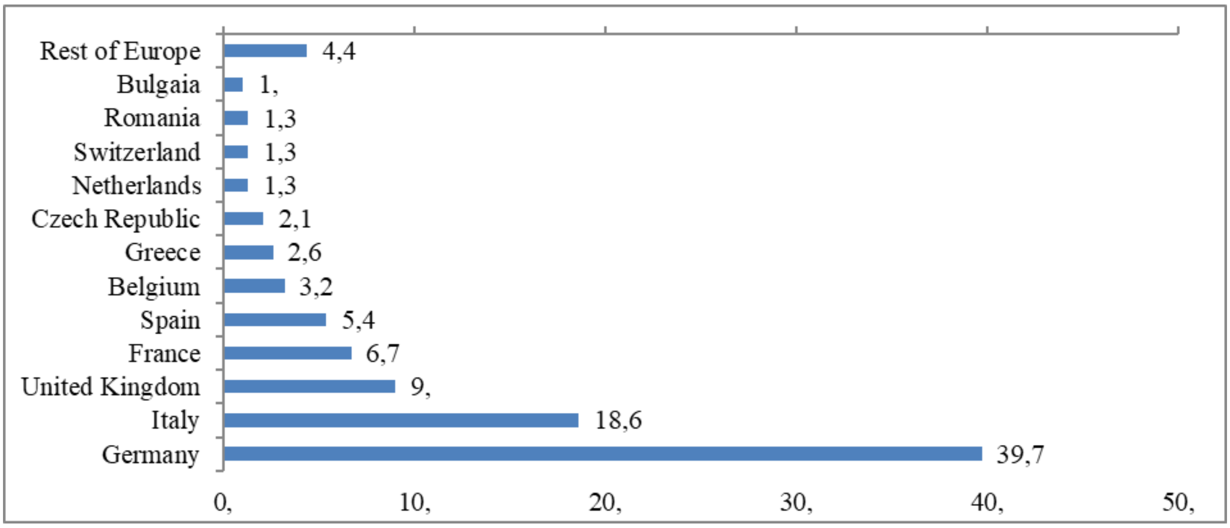
Fig. 1. Capacity additions and shares of main 3 European solar markets in 2014 and 2015 (%/MW)



Source: Solar Market Report & Membership Directory, 2016.

Twelve countries in Europe have installed solar power capacities exceeding 1 GW (figure 2). The total European on-grid capacity is 92 GW. Germany's PV capacity remains the largest in Europe, at about 40 GW. Italy's capacity is half that at almost 19 GW.

Fig. 2. European countries with total solar PV capacities larger than 1 GW



Source: Solar Market Report & Membership Directory, 2016.

But in the UK, the amount of solar power installed in 2016 decreased by about half compared with the previous year, when there was record growth. The fall occurred when the government severely cut incentives for householders to fit solar panels and closed subsidies for large-scale "solar farms" [Worldwide solar power growth leaps by 50% thanks to US and China, 2017, p. 16].

For today, there are several different policy schemes for divided solar generation in Europe. The Netherlands is using net-metering for residential buildings. For example, in Germany and Austria self-consumption schemes are applied to residential and commercial solar systems. Other countries have introduced net-billing schemes, such as Italy and Portugal, but still have limited success [Solar Market Report &Membership Directory, 2016, p. 22].

Tax stimulating for alternative energy in Europe

Global investment trends indicate a possible change in the structure of the entire global energy system in the coming decades towards the use of renewable energy sources. The study of the experience of the leading countries in the development of alternative energy makes it possible to identify and adapt the most effective mechanisms when developing investment programmes of federal and regional importance for improving energy efficiency. In various tax systems of European countries, incentive measures for investments in alternative energy take special forms and sizes, but are aimed at achieving the same effect – to make high-risk and long-term investments in energy objects more profitable.

According to experts from the US's Oak Ridge National Laboratory, a ten-year, federal, industrial tax credit of 1.5 cents per kWh can reduce the average life cycle cost of solar energy by about 25%. Some European countries are currently using this type of tax incentive. In some European countries a property tax reduction is used to stimulate the development of solar energy. This that can eliminate up to 100% of the tax on property, land and fixed assets used to produce solar energy [Clement et al., 2005]. Therefore, reducing property tax can help create a tax parity between alternative energy and traditional technologies. Investment tax incentives are also often applied to small, client-oriented or service companies that are not producers, but consumers of energy and energy-saving technologies. It should be noted that some European countries abolished the practice of granting production tax credits because it requires constant monitoring of the production activities of companies and leads to high administrative costs.

Reductions in excise duties allow consumers to avoid up to 100% of the sales tax when buying energy from renewable sources, equipment or fuel. Thus, the reduction of excise taxes stimulates the demand for "green" energy. Some European countries impose a tax on sales of conventional electricity, but do not tax the sale of energy produced from alternative sources. Others reduce excise duties on the sale of equipment for the production of alternative energy. A rarer case is the return of a portion of the excise duty. The consumer can file an application for the return of all or part of the tax paid at the time of equipment purchase. Tax benefits for consumers of energy-efficient technologies used in Europe are shown in Table 1.

Table 3. Measures of tax incentives for the development of alternative consumer-oriented energy technologies used in some European countries

Country	**Austria**	**Greece**	**Spain**	**Portugal**	**France**	**Czech Republic**
Sector	Residential	Residential, commercial	Residential, commercial	Residential	Residential	Residential, commercial
Type of tax incentive	Tax cuts	Credit	Credit	Credit	Credit	Tax cuts
Rate, %	Up to 25	Up to 75	10	Up to 30	15	Up to 100
Technologies that are subject to the stimulus	Solar energy, biomass energy	Solar energy	Solar energy, biomass energy	All	All	All

Source: Tax incentives for alternative energy in Europe, 2012.

As a result of the integrated use of tax incentives for alternative energy, as well as a number of other measures of state support (guaranteed tariffs for the supply of energy to the grid), European countries have achieved very impressive results in the development of solar energy [Ratner, 2011, p. 43].

Despite the fact that tax incentive measures for alternative energy have produced very significant results in a number of countries, other states prefer to use other incentive measures. Thus, in Germany, the main instruments of state support for alternative energy are guaranteed tariffs for the supply of electricity from alternative sources to the grid. Depending on the location and some technical conditions, the governmental programme Reneschabel Energy Sources Act guarantees a 20-year sponsorship tariff from 9.20 to 5.02 euro cents per kWh for generators installed earlier than 01.01.2010 [Ayodele et al., 2016, p. 15]. Based on the legislative level, guarantees to provide a bonus tariff for 20 years and mandatory connection to the grid allow investors of offshore projects to reduce risks and plan their activities for years to come.

Investing in renewable sources of energy

In 2014, the share of electricity received from renewable energy sources was 22.6%, which is 3.5% higher than in 2013 [Renewables, 2015, p. 136]. Such a steep rise was created thanks to world trends and government benefits for its production. Today, the largest corporations and financial institutions, in addition to profitability, should also pay attention to environmental sustainability, as the world community is increasingly worried about the state of the planet. Such technologies include photovoltaic, i.e. CSP panels. In monetary terms, this is almost $ 150 billion, with a total investment of $ 270 billion alone in 2014 [Renewables, 2015, p. 136]. The leader in the production of electricity today is Germany (photovoltaic and CSP). There is a “green tariff”, which allows any business to produce electricity, where the state is legally obliged to buy each kilowatt of energy produced. The availability of additional tender programmes and a system of pure measurement allows you to attract foreign capital. In Europe, the leaders in the production of electricity from renewable energy sources are Germany, Italy and Spain. To a greater extent, they are financed by such financial institutions as the European Investment Bank (EIB). These investments are innovative due to their novelty and pursued goals, namely: promoting environmental sustainability, the efficiency of production of electrical technologies, and promoting competitiveness with producers of “traditional” electricity. The EIB offers more than 15 subsidy options, including loans, partnerships, investments, various funds, initiatives, and research support. There are several programmes to be highlighted, namely:

- GEEREF (Global Energy Efficiency and Renewable Energy Fund) – this fund is investing in projects that introduce alternative energy sources to developing countries.
- JEREMIE (Joint European Resources for Micro to Medium Enterprises) is a fund dedicated to financing renewable energy projects in Europe for small and medium-sised businesses. During the existence of the fund, 1.2 billion euros were placed in 10 countries to provide guarantees, financial instruments, as well as borrowed funds. At the time of the last report, the EIB provided loans of more than 3,2 billion euros for alternative energy, most of which were directed to photovoltaic and CSP panels [Novikov, 2016, p. 315].

Conclusions

The paper has analysed changes in renewable energy, particular biofuels and renewable wastes, hydropower, wind, solar and geothermal in 2015. Then, renewable energy sources and their use in the EU in 2004-2015 were presented. Latvia (31.2%), Finland (26.7%) and Sweden (24.8%) are the countries with the biggest share of biofuels and renewable waste in 2015. The smallest share of biofuels and renewable waste in the EU in 2015 was observed in Malta (1.0%), Cyprus (2.1%) and Ireland (3.0%).

The analysis conducted showed that the highest increase of share of electricity from renewable sources in gross electricity consumption in the years 2004-2015 was in Estonia (2,416.7%), Belgium (805.9%) and the United Kingdom (540%). Slovenia (11.6%), Austria (13.8%) and Latvia (14.1%) were the countries with the lowest increase in share of electricity from renewable sources in gross electricity consumption in the years 2004-2015.

Solar energy is the most promising alternative energy based on environmental, economic and safety criteria. The main problem of solar energy is the cost of saving solar energy generated in the daytime, storing it for evening peak consumption. Battery systems, which have a service life of three to six years, are several times more expensive than the solar cells themselves. The cost of solar generation, which is “unregulated”, is not comparable to the cost of generating electricity in conventional power plants that can freely generate it at any time, if necessary. Currently, the use of solar energy and expensive solar battery systems is economically justified only for those regions and facilities where there is no other possibility of connecting to the electricity grid.

Some European countries impose a tax on sales of conventional electricity, but do not tax the sale of energy produced from alternative sources, and some of them are reducing excise duties on the sale of equipment for the production of alternative energy. For this reason, the reduction of excise taxes stimulates the demand for “green” energy.

However, we should not forget the following important factors that encourage the consideration of solar energy:

1. The cost of fossil fuels is steadily increasing as their reserves decrease.
2. Reasonable state policy makes the use of solar power plants more profitable.
3. Progress does not stand still. The efficiency of solar power plants is increasing, new technologies are being developed in the generation and accumulation of electricity.

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Eco-efficiency versus eco-effectiveness in the sustainable development of agriculture: a comparative analysis in EU regions[1]

Bazyli Czyżewski
Stanislaw Staszic University of Applied Sciences in Pila, Poland
ORCID: 0000-0002-6324-2723, e-mail: bazylicz@interia.pl
Anna Matuszczak
Poznan University of Economics and Business, Poland
ORCID: 0000-0002-5045-5447, e-mail: anna.matuszczak@ue.poznan.pl
Camelia Burja
“1 Decembrie 1918” University of Alba Iulia, Romania
ORCID: 0000-0003-3807-3005, e-mail: cameliaburja@yahoo.com
Andreea Muntean
“1 Decembrie 1918” University of Alba Iulia, Romania
ORCID:0000-0002-9008-9509, e-mail: bologandreea@gmail.com

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Abstract: The main goal of the article was to present the environmental sustainable value (ESV) generated by farms in EU regions. We can consider two points of view on this issue, either an eco-efficiency or eco-effectiveness approach. The fundamental problem, namely the environmental sustainability of farms is different depending on the criterion we apply. When we assume the eco-efficiency criterion and use total output as an effect indicator, producers maximise it by adopted input (polluting capital), but when it comes to the eco-effectiveness criterion, there is a different priority – not production, but the lowest possible strain on the natural environment (environmental subsidies). 125 European regions (excluding the Canaries, Cyprus, Malta and Luxembourg – outliers) were analysed in 2015, as the last available year in FADN. Estimating Environmental Sustainable Value with frontier benchmarking was carried out.

Keywords: eco-efficiency, eco-effectiveness, sustainable development, agriculture, EU regions

JEL: Q01, Q56, J43, O13

Introduction

Discussions on the sustainable development of agriculture, the methods and measurement indicators, evaluation and indicative values, etc. are nothing new [Zegar 2012, Kates et al 2005]. In the literature, the issue is most often analysed in its economic, social and environmental aspects. While the first two are not difficult to measure and evaluate (mostly from the perspective of income, employment, education), some dilemmas arise in the context of environmental sustainability. One of the major dilemmas, if not the most important,

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is whether to generate the highest production effect on a farm, taking into consideration the means used (e.g. fertilisers, plant protection products) and gases emitted (e.g. greenhouse gases) during production, or to adopt a consensus consisting in the fact that the products used in agricultural production are unfavourable for the natural environment, but simultaneously that such actions are somehow rationalised through agri-environmental activities, and therefore the creation of environmental public goods. Unfortunately, there is no universally accepted research methodology and, interestingly, the eco-efficiency approach is dominant in the literature.

Eco-efficiency versus eco-effectiveness – literature review

The term “eco-efficiency” appeared in the 1990s as a practical tool to measure sustainability. It was introduced by the World Business Council for Sustainable Development [WBCSD, 2000] to identify a management philosophy aimed at encouraging businesses to search for environmental improvements that yield parallel economic benefits. In other words, companies are asked to be more environmentally responsible and more profitable. The OECD [1998] refers to eco-efficiency as the efficiency with which ecological resources are used to meet human needs, which can be measured as the ratio of an output divided by an input, where the output is expressed by the value of products and services produced by a firm, sector or economy as a whole, and the input is the sum of environmental pressures generated by the firm, the sector or the economy. Therefore, an output increase, for a given level of inputs, or an input decrease, for a given level of outputs, leads to an improvement in eco-efficiency. However, a change in eco-efficiency does not necessarily reflect a corresponding change in terms of overall sustainability, since what this ratio measures is only the relative level of environmental pressure in relation to the volume of economic activity, while sustainability is more related to absolute levels of environmental pressure [Bonfiglio et al. 2017].

Thus, the above approach is somewhat contradictory to the idea of environmental sustainability, which should take into consideration the actual environmental effect (*eco-effectiveness*) in farms. In addition, the common agricultural policy is evolving and, next to its original assumptions related to the assurance of quantitative and qualitative food safety, support for agricultural incomes etc., sets goals related to respect for the environment or the creation of public goods, in particular environmental ones. Therefore, it is interesting to what degree the support for agriculture, from various CAP programmes, national and regional policies, affects the increase in eco-efficiency of farms, and to what extent it affects their eco-effectiveness. At this point a certain conflict between eco-effectiveness and eco-efficiency might be expected, as the programmes supporting agriculture surely include such that have a strong impact on eco-efficiency issues, but also such wherein eco-effectiveness will be dominant. This conflict impedes the sustainable development of agriculture. The results of the planned research, then, will contribute significantly to the discussion regarding the future of the EU's common agricultural policy after 2020, but also the national and regional agricultural and environmental policies in the context of its evolution. It is not certain to what extent the hitherto funding of agriculture facilitates the implementation of goals regarding its sustainable development, and to what extent it consolidates an industrial model of production where issues of efficiency will be of key importance.

Methodology for measuring eco-efficiency and eco-effectiveness

Estimating Environmental Sustainable Value with frontier benchmarking (ESV, authors' original methodology) was carried out using two approaches: 1) eco-efficiency as a trade-off of productivity versus environment, and 2) eco-effectiveness as an ecological approach to environmental public goods versus polluting capital.

Environmental Sustainable Value (ESV) is a value-oriented method, developed as a means of measuring agricultural eco-efficiency at microeconomic level (e.g an agricultural farm). This enables a synthetic assessment of a farm's contribution to farming sustainability, taking into account the efficiency resulting from using economic, social and environmental resources in comparison to the opportunity cost [Figge and Hahn 2005, Illge et al., 2008, Van Passel et al., 2007].

The calculation formula for determining the ESV of farms in the regions needs to indicate a benchmark farm. The author's proposal is to calculate benchmark indicators *yb*, *rb* using a frontier approach, according to the DEA method. In the literature, the use of DEA techniques to measure eco-efficiency in different sectors, as well as for the assessment of the environmental performance of farms and the agricultural sector, is widely known [Gadanakis et al., 2015]. Conversely, there are only a few studies which estimate eco-efficiency at farm level using the DEA approach [Picazo-Tadeo et al. 2011; Gómez-Limón et al., 2012; Picazo-Tadeo et al., 2012; Berre et al. 2015; Gadanakis et al. 2015; Pérez Urdiales et al., 2016]. DEA is a linear-programming (LP) methodology that, starting from data on inputs and outputs of a sample of decision-making units (DMUs), allows the construction of a piece-wise linear surface over the data points. This frontier surface is constructed through the solution of a sequence of LP problems, one for each DMU. The distance between the observed data point and the frontier measures the relative inefficiency or ineffectiveness of each DMU. Within the DEA approach, several models have been developed since the pioneer work of Charnes et al. [1978]. First of all, DEA can be either input- or output-oriented. In the first case, the DEA method defines a frontier by searching for the maximum possible reduction in input usage, with output held constant. While, in the second case, the DEA method seeks the maximum proportional increase in output production, with input levels held fixed. Moreover, in relation to returns to scale, two approaches can be adopted: either constant or variable. The latter encompasses both increasing and decreasing returns to scale.

The calculation formula advocated also in the studies of Burja C. & Burja V. (2016), Illge et al., (2008) was used to determine the environmental sustainable value ESV of the farms in regions:

$$ESV_i = \frac{1}{m}\sum_{j=1}^{m} r_{ij}\left(\frac{y_{ij}}{r_{ij}} - \frac{yb_{ij}}{rb_{ij}}\right)$$

ESV_i is the sustainable value afferent to a farm from region *i*; r_{ij} and rb_{ij} represent the resource value (polluting capital as input indicator) of type *j* and region *I* of the analysed farm, i.e. of the farm considered as reference system; y_{ij} and yb_{ij} are the return of resources (effects indicators) of the analysed and benchmark farm; *i*= 1..n is the region and *j*=1...m is the type of analysed resource.

The advantage associated with the use of DEA in measuring eco-efficiency or eco-effectiveness for ESV indicator is the identification of a set of optimal weights for inputs (r) determined at farm level which maximise the eco-efficiency or eco-effectiveness score relative to the other farms in the sample. The optimising formula used to identify benchmark units is orientated as follows, for eco-efficiency:

$$\max_{r} OUT = \frac{\sum_{k=1}^{n} y_{ij}}{\sum_{j=1}^{m} r_{ij}}$$

and for eco-effectiveness (due to constant resources of public goods):

$$\min_{y} INP = \frac{\sum_{k=1}^{n} y_{ij}}{\sum_{j=1}^{m} r_{ij}}$$

where *OUT* means output indicator, INP input indicator, y_{ij} indicates, as above, output *j* of a farm *i*, r_{ij} the value of polluting capital as input indicator, and *k*=1...*n* is the type of analysed output.

In the first approach (eco-efficiency as a trade-off: productivity versus environment) we use the following variables: the input indicator will be polluting capitals (crop protection, fertilisers, energy, non-wood area, stocking density) and as an effect indicator – total output, total output crops and total output livestocks (three separate models). In the second ecological approach (environmental public goods versus polluting capital) we will use the subsequent variables: the input indicator will be polluting capitals (as above) and as the effect indicator – environmental subsidies. 125 European regions (excluding the Canaries, Cyprus, Malta and Luxembourg – outliers) were analysed in 2015, as the last available year in FADN, because we are treating this as a pilot study, focusing first of all on the methodology.

Results

Based on the analyses carried out, two rankings of EU regions were made, classifying them according to the eco-efficiency and eco-effectiveness of the agricultural activity conducted there. It was observed that the most intensive European agriculture (Dutch, Danish, German, French) enjoys the highest degree of environmental sustainability according to the eco-efficiency approach, where the effect is the total output value. A high position in this ranking means that agricultural producers from these regions achieve relatively the best ratio of the above-mentioned total output to the polluting capital input used. To put it differently, the productivity of the polluting capital (fertilisers, plant protection products, energy, etc.) is relatively the highest in the case of farms from this group of EU regions (cf. Table 1, 3). At the bottom of the ranking, there is the agriculture of certain German regions, Slovakia, Czech Republic, Estonia, Scotland, and individual Romanian or Bulgarian regions, which are the least efficient in terms of eco-productivity. Table 1 also shows ESV, expressed in euros, brought in by farms from individual EU regions – for instance, the best (Dutch) farms make as much as ca. EUR 173,000 of environmental sustainable value considered from the point of view of eco-efficiency. On the other hand, in the case of farms which are the weakest according to this criterion (e.g. Comunidad Valenciana), the value remains at a relatively high, negative level (ca. EUR -248,000). It can therefore be assumed that the value reflects the level of inefficiency in the use of the polluting capital input relative to the total output achieved. At the same time, the amount can determine the value of environmental public goods which these farms should deliver in order to compensate for the negative effects of their activity.

Table 3, illustrating the average values of the analysed variables for the best and worst ten EU regions according to this ranking, indicates that the average value of animal output in both groups is comparable, however, regions with the highest environmental sustainable value (ESV) are characterised by a relatively high index of stock density (twice as high as in the regions with the lowest ESV). This is a curious phenomenon, which may prove that greater intensification of production does not necessarily go hand in hand with higher profitability. We are touching upon the issue of the technological treadmill here, the essence of which is a phenomenon consisting in agricultural income not growing proportionally to increases in agricultural productivity. In order to increase agricultural productivity, farmers have to keep investing in new technologies and increase the scale of production. This is more an affliction of the agriculture of highly developed countries, where subsidies are largely used to support production [Czyżewski, Staniszewski 2016]. Crop production is half as large in the regions with the lowest ESV. This results in a higher use of plant protection products and fertilisers, disproportionately to the production value, as the value of their use is about three times higher than in the case of farms from the regions with the highest ESV. The situation is similar in terms of the energy intensity of production – in the case of the latter, it is twice as low. There are four times fewer non-wooded areas here as well.

Yet the highest environmental sustainability according to the idea of eco-effectiveness, where the result is the amount of environmental subsidies obtained, can be observed in the case of agriculture which can be considered as extensive. It can be found in the Finnish, Swedish, and Austrian regions. On the opposite side, we find farms from regions which clearly show less respect for the environment, farming relatively more intensively, i.e. German, French, and Slovak farms (cf. Table 2). An analysis of the average amounts of the variables under study on ten farms with the highest and lowest ESV indicates that in the former, the sum of environmental subsidies obtained is slightly higher. However, farms with a positive, relatively high ESV according to the eco-effectiveness criterion are characterised by clearly lower use of fertilisers (eight times lower), plant protection products (more than twenty times lower), and energy (four times lower). Stock density seems not to be of much significance, yet it should be noted that in the case of these farms, there are five times fewer non-wooded areas.

It can be said that the philosophy of the operation of farms achieving a high ESV level according to the eco-effectiveness criterion lies in the lowest possible strain on the natural environment, which clearly does not go hand in hand with the highest production results, and which can be observed in the group of farms with the highest ESV according to the eco-efficiency criterion. Thus, we should ask ourselves the question of what level of environmental sustainability we are striving for within the framework of CAP principles. From which farms should we expect an increased supply of public environmental goods?

Table 1. Top and bottom ten environmentally sustainable regions of the EU according to eco-efficiency (benchmark – the best unit, DEA) (125 EU regions, 2015, in €)

Top ten		Bottom ten	
Region	**ESV**	**Region**	**ESV**
The Netherlands (NED)*	172937,5	Saarland (DEU)	-28357,7
Denmark (DEN)	91343,5	Estonia (EST)	-33807,5
Provence-Alpes-CĂ'te d'Azur (FRA)	79004,8	Severozapaden (BGR)	-36472,3
Bretagne (FRA)	77347,2	Centre (ROU)	-40995,6
Vlaanderen (BEL)	75854,8	Sachsen-Anhalt (DEU)	-47630,7
Champagne-Ardenne (FRA)	56123,9	Czech Republic (CZE)	-87518,2
Pays de la Loire (FRA)	52674,9	Mecklenburg-Vorpommern (DEU)	-88651,4
Aquitaine (FRA)	47821,1	Scotland (UKI)	-97614,7
Lombardia (ITA)	47336,4	Slovakia (SVK)	-193744,0
Languedoc-Roussillon (FRA)	42297,3	ComunidadValenciana (ESP)**	-248037,0

*best region, ** worst region

Source: own calculation based on FADN.

Table 2. Top and bottom ten environmentally sustainable regions of the EU according to eco-effectiveness (benchmark – the best unit, DEA) (125 EU regions, 2015, in €)

Top ten		Bottom ten	
Region	**ESV**	**Region**	**ESV**
Pohjois-Suomi (FIN)*	6221,5	Centre (FRA)	-15814,8
Aosta (ITA)	4100,2	Haute-Normandie (FRA)	-16262,4
Etela-Suomi (FIN)	3808,4	ĂŽle-de-France (FRA)	-18241,9
Pohjanmaa (FIN)	2959,1	Sachsen (DEU)	-18470,0
Sisa-Suomi (FIN)	2809,8	Thueringen (DEU)	-18755,2
Lan inorra (SVE)	1739,6	Picardie (FRA)	-18779,4
Skogs-ochmellanbygdslan (SVE)	1694,7	Sachsen-Anhalt (DEU)	-27081,6
Austria (OST)	1522,2	Slovakia (SVK)	-28116,1
Cantabria (ESP)	1245,1	Mecklenburg-Vorpommern (DEU)	-42516,3
Alentejo e do Algarve (POR)	202,7	ComunidadValenciana (ESP)**	-76782,4

*best region, ** worst region

Source: own calculation based on FADN.

Table 3. Average values of the analysed variables in agriculture of the ten best and worst regions of the EU (benchmark – the best unit, DEA)

Variable	Eco-efficiency		Eco-effectiveness	
	Top 10	Last 10	Top 10	Last 10
Total crop output €	136193,8	206087,4	-	-
Total animal output €	115403,7	113793,2	-	-
Environmental subsidies €	-	-	8509.2	7011,1
Fertilisers €	9740,0	32734,3	5191,5	43809,2
Crop protection €	8614,8	23907,1	1686,5	34811,6
Energy €	12783,1	30304,9	9864,0	40786,5
Non-wooded areas ha	61,0	257,4	62,4	305,7
Stock density LU/ha	1,84	0,93	1,1	1,2
Environmental Sustainable Value €	74274,2	-89856,3	3040,7	-21916,3

Source: own calculation based on FADN.

Conclusions

The aim of the article was to present the environmental sustainable value generated by farms in EU regions. The approach to this issue differed, depending on whether it was based on eco-efficiency or eco-effectiveness. The study results indicate a fundamental problem, namely, the environmental sustainability of farms is different depending on the criterion we apply. If we assume the eco-efficiency criterion, it is the highest where the adopted input (polluting capital) produces relatively the highest effect in the form of the total output. When it comes to the eco-effectiveness criterion, however, there is a different priority – not production, but the lowest possible strain on the natural environment, which results from the fact that the highest ESV is achieved in regions where the ratio of environmental subsidies (output) to the polluting capital (input) is the best. This results from a certain rationalisation of agricultural producers' behaviours – on the one hand, they use much less of the above-mentioned input, yet at the same time, they obtain slightly more environmental subsidies. As observed above, this does not go hand in hand with the highest production results, which also indicates a certain contradiction in achieving environmental and economic sustainability. This recognition is important for policy makers on the future of CAP after 2020, and it is important to review the objectives of CAP in the context of understanding environmental sustainability and to consider which pathway – eco-effectiveness or eco-efficiency –

is appropriate for providing society with environmental public goods. This recognition is important for EU policy makers in the light of the future of CAP after 2020: the objectives of CAP should be reviewed in the light of an understanding of environmental sustainability and which pathway – eco-effectiveness or eco-efficiency – is appropriate for the delivery of environmental public goods to society.

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Determinants of income of agricultural holdings in EU countries

Andrzej Czyżewski
University of Zielona Góra, Poland
ORCID: 0000-0002-6233-6824, e-mail: a.czyzewski@ue.poznan.pl
Aleksander Grzelak
Poznan University of Economics and Business, Poland
ORCID: 0000-0002-4290-4740, e-mail:agrzelak@interia.pl
Łukasz Kryszak
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-8660-9236, e-mail:lukasz.kryszak@ue.poznan.pl

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Abstract: The main aim of the study is to recognise the determinants affecting agricultural income in the EU countries. The time scope in the analysis refers to the period 2004-2013. The spatial range of the research concerns agricultural holdings from EU countries (25). The evaluation has been made using the aggregated results within the agricultural accounting system of the EU's FADN (Farm Accountancy Data Network). Comparative studied phenomena and panel regression models were used. Among the most important factors for the formation of the agricultural income, are the scale of production, subsidies under the common agricultural policy and the indicators reflecting the importance of the business outlook and price fluctuations.

Keywords: income of agricultural holdings, the common agricultural policy, subsidies

JEL: Q12, Q18

Introduction

Incomes of agricultural holdings are among the most important economic categories in agriculture because they reflect the development potential of this sector. However, it is known that the agricultural sector in the EU is developing in highly diverse circumstances. This concerns climatic and environmental factors, as well as the differences stemming from the quantity and relations between production factors (labour, land, capital). Secondly, agriculture in EU countries is one of the sectors covered by a high level of support, which in practice is carried out by the instruments of the Common Agricultural Policy (CAP). Thanks to the mechanism of agricultural policy, it was possible in some highly-developed countries to solve the problem of agricultural vs. non-agricultural income parity, and incomes in this first sector were sometimes even higher [Czyżewski and Kułyk, 2010]. However, in a number of the so-called new EU member states, agricultural incomes are still significantly lower in comparison to earnings from different sources [Baer-Nawrocka, 2013].

It can be stated that agriculture is increasingly dependent on external factors, that the head of a farm has no influence over. This results in the increasing integration of the world's food markets [Rembeza and Seremak-Bulge, 2009], and in the case of EU countries, in the increasing importance of a strong institutional factor (CAP). Moreover, in recent years we had to deal with the biggest EU enlargement (in 2004), when accession led to 10 new member states, and also with unprecedented fluctuations in agricultural prices and the global economic crisis that started in 2008. On the other hand, there is a need to search for the paths of agricultural income growths on the micro level. Therefore, the question may appear of the importance of factors influencing agricultural income in EU countries. Hence, the main aim of the study is to recognise the determinants affecting agricultural income in EU countries using different perspectives.

There are many studies concerning agricultural income in the literature. The Polish studies are dominated by research related to dynamics, level, creation and division and income diversification [Zegar, 2006; Woś, 2000; Czyżewski, 1986; Floriańczyk, 2003] or to links between incomes and CAP [Idczak 2001]. In the case of foreign studies, research related to the impact of direct payments on income are widely represented [Severini and Tantari, 2013, Agrosynergie, 2011]. These are recommended for their stabilising and liquid function. Interesting research, from the perspective of this issue, was included in the paper of Beckman and Schimmelpfening (2015). It indicates that in agricultural holdings in the USA, incomes are determined by variables such as GDP, technological changes, exchange rates, prices of products sold and purchased by farmers, interest rates, and prices of agricultural land. At the same time, the last three have a negative impact. The issue of determinants of agricultural holdings income is important in the context of the anticipated changes in CAP in the EU after 2020, further liberalisation of trade in agri-food in the WTO, as well as the impact of various factors.

Methodology of the research

The evaluation of the determinants of incomes of agricultural holdings in EU countries has been made using the aggregated results within the agricultural accounting system of the EU's FADN (Farm Accountancy Data Network). In the field of observation of this system there are market farms which, in a given region or country, produce at least 90% of the standard value of production. The timescale in the analysis refers to the period 2004-2013, which results from the availability of data. The spatial range of the research concerns agricultural holdings from EU countries (25), and so those countries that have belonged to this group since at least 2004. The study sample was divided according to the so-called "old" EU countries (15) and "new" EU members (10). On the one hand, in the EU15 the common agricultural policy mechanisms have been working for longer. On the other hand, the resource relations and the productivity of production factors in both groups of countries vary considerably. This results in serious differences in the environment for the economic development of the sector.

To begin with, we start with a comparative study of the phenomena. Than we run a panel analysis in two steps. First we model agricultural income (net value added per hectare in FADN as a dependent variable[1]) in nominal terms. As explanatory variables, we consider total output (as a proxy for the intensification of production), total workforce in AWU[2] (use of labour factor), total subsidies (institutional factor), gross investments from the previous period and Economic Sentiment Indicator[3] as a proxy for the business outlook factor. In the second step, we recalculate the models in real terms. To do this, we used the following procedure:

1. We deflated the raw data from FADN using the appropriate index of prices for each country and period taken from the Economics Accounts for Agriculture, Eurostat. For total output, we used the *agricultural output* price index, for intermediate consumption we used the *intermediate consumption* price index. For current subsidies and balance of current subsidies and taxes we used the *intermediate consumption* price index. We assume here that current payments within CAP (mostly decoupled) are spent on the means of production. For depreciation and subsidies on investments, we used the *fixed capital consumption* price index as gross fixed capital formation price indexes were not available for the whole group of countries.
2. We computed the variables we need again. Net value added is calculated as: total output – total intermediate consumption + balance of current subsidies and taxes – depreciation. Total subsidies are the sum of current subsidies and subsidies on investments.
3. Data in FADN is expressed in Euros using different exchange rates for each year for countries with currencies other than the Euro. We recalculate all the data using a fixed exchange rate from 2004. The exception is Slovakia, which joined the Euro zone in 2009, so we use the exchange rate for this year.

[1] As we include in the model the total resources of the labour factor, as well as total output, it is better to use net value added than net income, which is remuneration, to the production factor that was owed to the family of a farmer. It represents the income for a farmer and his family.

[2] AWU (Annual Work Unit) – "corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis. Full-time means the minimum hours required by the relevant national provisions governing contracts of employment" [Eurostat, Glossary, accessed 30.04.2017].

[3] The Economic Sentiment Indicator (ESI) "is a composite indicator made up of five sectoral confidence indicators with different weights: Industrial confidence indicator, Services confidence indicator, Consumer confidence indicator, Construction confidence indicator Retail trade confidence indicator. Confidence indicators are arithmetic means of seasonally adjusted balances of answers to a selection of questions closely related to the reference variable they are supposed to track (e.g. industrial production for the industrial confidence indicator)" [Eurostat, Product Dataset, accessed 30.04.2017].

When the panel model is taken into consideration, it is possible to use a simple pooled OLS model (this means that differences between countries are not significant), a model with fixed effects (FE) or random effects (RE). The equation for the fixed model takes the form (1)

(1) $y_{it}= \beta_0+ xit\beta' +\varepsilon_{it}$

The equation for the fixed model takes the form (2)

(2) $y_{it}= x_{it}\beta' +\alpha_i+\varepsilon_{it}$

where: b- the vector of structural parameters expressing the effect of the explanatory variable x_{it}, α_i – individual time-fixed effect, ε_{it}– net random error.

In turn, in the randomeffect model, we assume that the individual effect α_i is a random variable and we do not estimate its value [Kufel, 2007]. The equation is therefore as follows:

(3) $y_{it}= \gamma+x_{it}\beta' +v_i$

Where v_i is the sum for the individual random parameter (α_i) and ε_{it}). In our modelling, we choose logarithmic form, as it was the most appropriate.

In the case of rejection of the hypothesis of applicability of the OLS model (based on the Breusch-Pagan test), we computed panel models with fixed (FE) and random (RE) effects. The evaluation of which of these models (FE or RE) was more appropriate was made based on the Hausman test [Hausman and Taylor, 1981]. In each case, the multicollinearity of the variables was evaluated based on Variance Inflation Factors (VIFs). Variables not exceeding VIF=10 were retained in the model [Chatterjee and Hadi 2006].

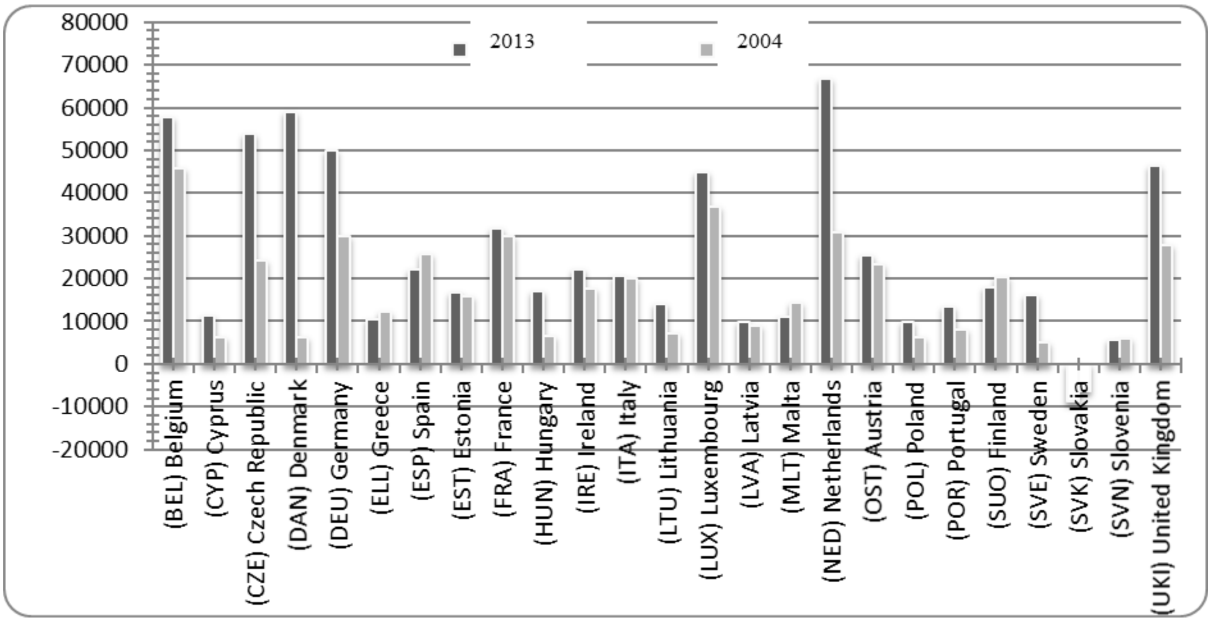
Findings

According to the accounting system of the Farm Accountancy Data Network, agricultural incomes per farm have increased between the years 2004 and 2013 in nominal terms[4]. Only in four countries has a decline been noted, while in the remaining 21, incomes have increased (fig.1). The average increase amounted to 79%. This resulted mainly from an increase in the scale of production and prices of agricultural products (fig. 2). Agricultural incomes are very unstable. The research indicates [Hill and Bradley 2015] that in the years 2012-2014 circa 55% of large and 38% of small farms experienced income change exceeding 30% of the average income from past three years. The incomes of agricultural holdings from the new member states were growing, but in comparison to farms from the “old” member states, they remained at a lower level. This was related to the lower scale of production (the farms are

[4] Reference to thesetwoyears result from the limits of observation for the timescale of the studies. Moreover, in theseyears, we were dealing with a favourable business outlook in agriculture.

usually smaller, both in terms of economic size and utilised agricultural area), technical devices and the level of subsidies.

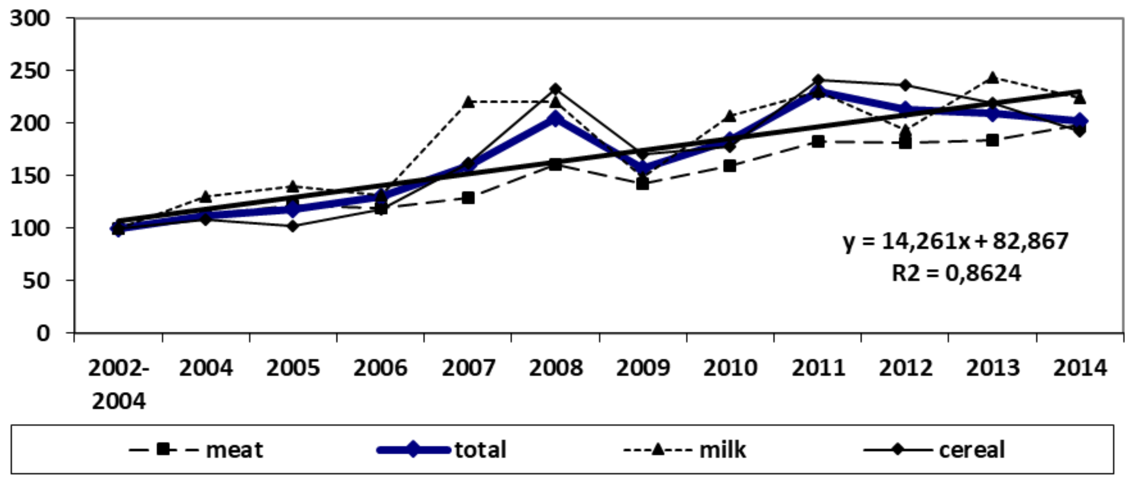
Fig. 1. Level of income (in EURO) in EU countries (25) in 2004 and 2013



Source: own calculations based on FADN database.

It is widely known that economic effects in agriculture depend on weather conditions. Combined with low elasticity of agricultural production, this leads to the greater volatility of prices than production. Thus, the sector's reactions to changes in economic conditions take place mainly via the volatility of prices of agricultural products, and this is one of the main determinants of incomes [Grzelak, 2016]. In the years 2004-2012, we were dealing with high volatility in agricultural commodity prices on food markets in the world (fig. 2). Simultaneously, cyclically repeated fluctuations around the trend line were observed. In total, during this period, we could observe an upward trend when it comes to agricultural commodity prices, especially for cereals (wheat). Up till 2008, prices of agricultural products increased. Then, when the economic crisis started in 2009, there was a rapid decline. In the period of 2009-2011, a significant growth could be observed, but in the following three years there was another decline in agricultural prices. This situation determined the general economic conditions in agriculture. Such significant fluctuations in agricultural product prices resulted from, among others, crop failures, market speculation, growing demand for food, as well as demand for plant products used for non-food purposes.

Fig. 2. The FAO index of agricultural commodity prices in the years 2004-2014



Source: based on the FAO data for the relevant years.

Price fluctuations have become one of the major risks in the agricultural sector. Risk management is now among the most important challenges facing the agricultural sector [Jerzak 2008]. It has been stated that prices of agricultural products react strongly to changes in the global business outlook, and on the other hand, the processes of change in these prices affect agricultural income[5]. This is especially true in the case of the price of wheat and oilseeds. The prices of these products react more flexibly to changes in the supply-demand relationship, which means that they can quickly make up for declines [Kavallari et al. 2011].

It is true that prices are among the most important factors shaping income levels [Czyżewski and Majchrzak 2015]. Additionally, prices influence the process of outflow of economic surplus from agriculture. However, from the microeconomic perspective, the farmer appears on the market as a price-taker. Prices are therefore an exogenous variable in farm management. A simple question arises: what are the paths of agricultural income growth under these conditions? The main aim of CAP is to maintain a fair standard of living for farmers, so the subsidies within CAP should increase incomes. It is not clear, however, what the impact of increasing output, investments and the labour factor has on income changes. To answer these questions, we constructed the models for agricultural income per hectare in nominal terms (table 1) as well as in real terms (table 2) in order to capture the effect of price and exchange rate changes (see details in methodology section).

[5] The correlation coefficient between the price index of agricultural commodities FAO and income of agricultural holdings of the EU (25) amounted to 0.74.

The results of the panel models of agricultural income in nominal terms (logarithmic models) are presented in table 1. Beck-Katz standard errors were used to deal with both autocorrelation and heteroscedasticity where possible.

Table 1. The determinants of agricultural income (net value added per hectare, nominal terms) in EU countries (2004-2013)

Variable	**EU14[a] (Fixed effect) N=126**	**EU9[b] (Fixed effect) N= 77**
Constant	-1.99** (0.79)	-4.701** (1.44)
Total workforce in AWU/ha	0.497*** (0.10)	-
Total output/ha	0.976*** (0.06)	0.589** (0.17)
Total subsidies/ha	0.246** (0.08)	0.382*** (0.10)
Lag gross investment/ha	-0.115*** (0.03)	0.080 (0.06)
Economic sentiment indicator (ESI)	0.461*** (0.07)	0.873*** (0.19)
Explanatory power	Within R2=0.73 LSDV R^2=0.98	Within R2=0.51 LSDV R2=0.98
Dornik-Hansen test for normality *(p value)*	0.03	0.64
Hausman test *(p value)*	0.05[c]	0.003

***, **, * denotes 99%, 95%, 90% statistical significance, respectively.
Standard deviation values in parenthesis.
a for Ireland there was no data for economic sentiment indicator
b without Slovakia (outlier)
c Hausman's test results do not give unambiguous results. We choose the fixed effect in order to compare with the EU9 model.

Source: Own calculations based on FADN database.

The impact of the labour factor on agricultural income (both nominal and real terms) turned out to be statistically insignificant in the EU9 countries. This can be explained by the phenomenon of hidden unemployment in rural areas. Labour resources in agriculture in these countries are too large compared to needs. This results in the fact that the increasing the use of this factor does not translate into higher incomes. In the EU15 countries, increasing use of labour resulted in higher incomes, but the marginal effect is not very strong, and (when it comes to real terms) declines from 0.497 to 0.205.

Interesting conclusions are related to the influence of total output on incomes. Regressor values indicate that the marginal effect of increasing output (or land productivity, as we use production value per unit of land) is relatively strong and statistically significant, both in nominal and real terms. This is in line with the results of other studies which pointed to a strong link between income growth and production [Baer-Nawrocka 2013, Szuba and Poczta 2013]. However, it should be noticed that in nominal terms the impact of output on incomes is substantially higher in EU15 countries, whereas in real terms this situation changes.

Table 2. Determinants of agricultural income (net value added per hectare, real terms) in EU countries (2004-2013)

Variable	**EU15 (Random effect) N=133**	**EU9[b] (Fixed effect) N=77**
Constant	-0.518 (0.57)	-3.145* (1.30)
Total workforce in AWU/ha	0.205*** (0.048)	-
Total output/ha	0.837*** (0.051)	1.25*** (0.17)
Total subsidies/ha	0.218*** (0.054)	0.16* (0.08)
Lag gross investment/ha	-0.112*** (0.02)	-0.08* (0.04)
Explanatory power	R^2=0.76	Within R^2=0.47 LSDV R^2=0.98
Variance[a]	*Between* = 0.011 *Within*= 0.007	-
Mean theta[a]	0.75	-
Dornik-Hansen test for normality *(p value)*	0.76	0.19
Hausman test *(p value)*	0.079	0.009

***, **, * denotes 99%, 95%, 90% statistical significance, respectively.
Standard deviation values in parenthesis.
a only for random effect model
b without Slovakia (outlier)

Source: Own calculations based on FADN database.

In the EU15 countries the marginal effect of output is only slightly smaller, whereas in the EU9 it is substantially higher. This means that price mechanisms on agricultural markets in the EU9 are less favourable from the farmers' point of view. Farmers in these countries, if they want to increase their income, must increase real productivity. Farmers in the EU9 cannot expect income growth only through favourable price relationships to the extent that farmers in the EU15 can. On the other hand, the efforts to increase real productivity in the new member states bring relatively large benefits in the form of increasing real income. In other words, intensification strategy is relatively more effective in these countries [Czyżewski and Kryszak 2016].

Agricultural incomes in the EU9 are also less resistant to economic fluctuations. In nominal terms, the general economic situation (measured by ESI) was the most important factor that shaping incomes in the EU9. This may indicate that the agricultural sector in so-called new EU member states is highly unstable and is particularly sensitive to cyclical changes. As we noted before, agricultural prices are pro-cyclical. The level of horizontal and vertical integration in agriculture in the EU9 countries is low, and farmers do not have enough bargaining power, which makes this sector more dependent on the economic climate.

It is not surprising that in both groups of countries a significant impact of payments on incomes can be noticed. In real terms, its impact is slightly smaller, and the differences between EU15 and EU9 countries are not substantial (tab. 2). The interesting thing is that the investment from the previous period has a negative sign, and in EU9 countries (nominal term) it was even insignificant. As the impact was negative, so investment spending did not translate into the expected higher incomes. Perhaps the positive effects of investment will be seen in later years.

Conclusions

The income situation of agricultural holdings in the EU (25) is highly varied, and depends primarily on natural factors, changes in the scale of production, the level of support and economic environment factors, including the prices of agricultural products. The existing, expanded system of support, while stabilising income levels, doesn't eliminate significant variability. In the case of holdings from some EU countries, eg. Denmark, Ireland, Sweden, Finland or the Czech Republic, the level of subsidies was higher than incomes in most of the analysed years. Among factors that are important for the formation of the agricultural income can be listed the scale of production, subsidies under CAP and the general situation in the macroeconomic environment that affects agricultural prices. The role of gross investments and labour factor was smaller, and in some specifications even statistically insignificant. In the case of the first of those, it may be due to the relatively high capital-intensity of production and the associated costs of depreciation that consume a significant proportion of the investment. On the other hand, the minor importance of the employment factor can be identified, taking into consideration the diversification of economic activity in rural areas, which allows for the optimisation of use of this resource, depending on economic conditions. Increase in production remains the most important factor in income creation, however, this was especially noticeable in the so-called "new" EU member states. This indicates that intensification strategy may be still appropriate in these countries. In addition, when analyzing the differences between the nominal and real income approach, one can conclude that EU farms (15) benefit more (in an income sense) from the effects of rising agricultural prices. This can result from more advanced vertical and horizontal integration processes, as well as higher levels of support of CAP instruments. On the other hand, farms in the new member states are more sensitive to business outlook fluctuations. Systems of support will be still needed, but their main goals and mechanisms should be reconsidered somewhat in order to help farmers with risk management. As differentiations in the conditions for agricultural production are often demonstrated on a regional scale, research at this level can be a fruitful line for further research.

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The amount of household waste disposed of in Poland, compared with other European Union countries

Anna Turczak
The West Pomeranian Business School in Szczecin, Poland
ORCID: 0000-0003-2965-4254, e-mail: anna.turczak@wp.pl

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Abstract: The purpose of this article is to answer the question how individual European Union countries differ from Poland with regard to the amount of household waste disposed of per capita. Two factors affecting the variable have been analysed in the paper: 1) the amount of household refuse generated per inhabitant and 2) the part of waste destined for disposal in the total quantity collected from households. Those two explanatory variables are directly proportional to the response variable. Thus, the smaller the mean volume of waste produced by one person and the lower the disposal rate, the smaller the quantity of waste disposed of per capita in a given country. Causal analysis enables us to answer the question of how the two factors affect the variable considered, namely, the direction and strength of their influence. The logarithmic method was applied to carry out the causal analysis. Data for 2010, 2012, and 2014 have been used for calculations.

Keywords: household waste, disposal, the European Union, Poland

JEL: C65, Q53, Q56

Introduction

The 'economics of waste' is a field of environmental economics which is of growing interest in theoretical analyses dealing with the design of optimal policy packages. The increasing scarcity of natural resources and the consequent changes in policy – focused first on reducing waste production, and then on decreasing the proportion of refuse destined for disposal to refuse destined for recovery – have also generated a need for empirical analyses providing evidence on the effectiveness of taxation and incentives, the relevance of specific regional features and the impact of a comprehensive set of socio-economic drivers [D'Amato et al., 2013]. Such sustainability drivers – in a gross simplification – are as follows [Kramer, 2012, p. 18]:

– **Consumer demand for sustainable products and services:** People today are making purchases not only as consumers, but also as responsible world citizens. By rejecting the indiscriminate consumption patterns of the past and becoming more selective in their choices, they are signalling a shift in consumer attitudes and behaviours that may significantly affect business profitability and growth.

- **Stakeholder influence:** Globalisation and technology give customers and citizens a powerful voice. Businesses and public sector organisations need to extend their reach to a new breed of stakeholders that includes non-government organisations, media, academics and the community at large.
- **Resource depletion:** Economic growth in developing markets, combined with high consumption in Western economies, has depleted natural resources.
- **Employee engagement:** Employees' commitment and enthusiasm for sustainability are shaping the way of working and living. As the sustainability mandate expands, organisations committed to social and environmental problems are likely to attract the top talent.
- **Capital market scrutiny:** Investors now look at sustainability performance when evaluating a company's potential for future returns.
- **Regulatory requirements:** Government and industry regulations are forcing companies in nearly every industry to take sustainability seriously.

Many studies have been conducted around the world to investigate and measure the effect of different factors on citizens' behaviour regarding waste production [Kinnaman, 2006]. For instance, social awareness [Evison and Read, 2001], intrinsic motivation [Halvorsen, 2004], social norms [Viscusi et al., 2011] and peer pressure [Shaw, 2008] can all have an impact on the effectiveness of a waste management system.

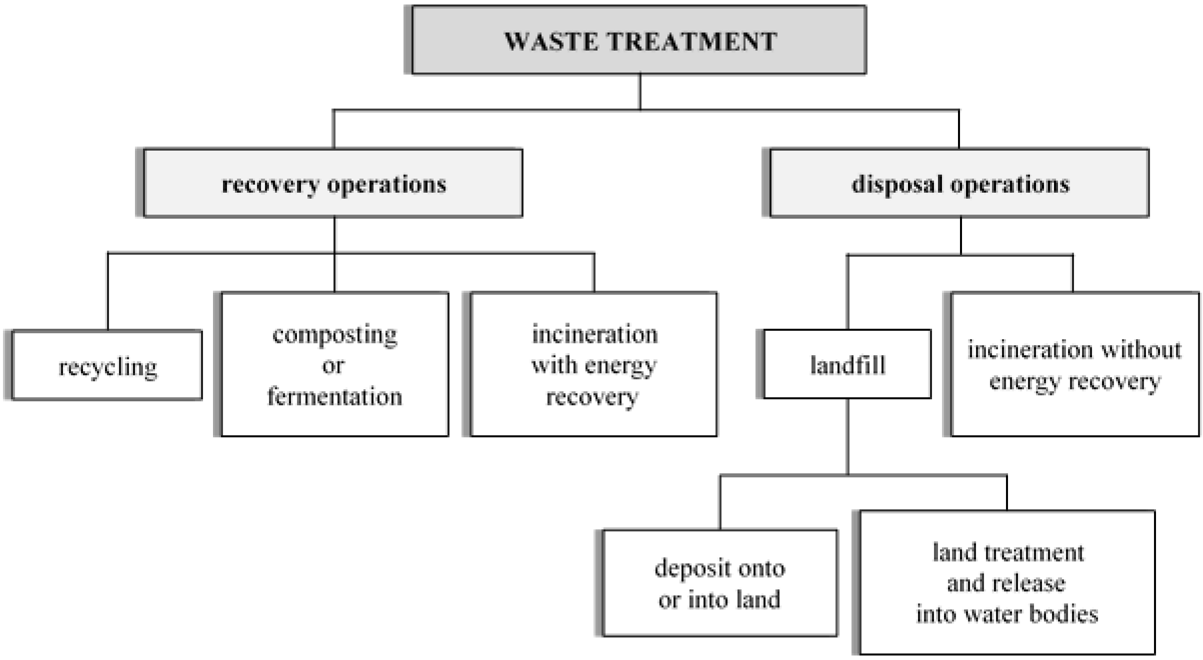
Among the variables for demographic factors, there is a consensus that population density and degree of urbanisation are positively correlated to solid waste generation [Gellynck and Verhelst, 2007; Mazzanti et al., 2008; Mazzanti and Zoboli, 2009; Mazzanti et al., 2009]. Karousakis [2006] notes that, though urbanisation is associated with higher levels of refuse generation, it has a negative impact on the amount of refuse sent to disposal.

In considering the impact of socio-economic variables, some authors focus on the relationship between education and household waste production. Intuition would suggest that better educated people would be more likely to sort their waste and have a higher awareness of environmental and health issues. Indeed, Podolsky and Spiegel [1998] and Fullerton and Kinnaman [1999] estimate that higher education levels tend to reduce, respectively, the total amount of refuse produced and the amounts of non-separated refuse. Furthermore, Johnstone and Labonne [2004] find evidence that the number of children in the population has a negative and significant effect on waste generation.

Two strategies for managing solid waste are prevention and treatment. Waste prevention is the most desirable form of control because it poses the fewest risks to human health and the environment. Prevention includes reduction of refuse generated. For example, manufacturers can use less packaging or use recycled materials in their products and packaging. Consumers can throw away less food, paper, shopping bags, and other items [Resnik, 2012, p. 150].

Generally speaking, the waste produced can be recovered or disposed of (see Fig. 1).

Fig. 1. Waste treatment



Source: own elaboration.

However, it should be strongly emphasised that solid waste disposal can have a number of different, adverse impacts on human health and the environment. Some of the health impacts include exposure to infectious diseases from landfills and medical waste; exposure to disease vectors, such as rats, flies, and mosquitoes; contamination of drinking water; gas discharge from landfills; air pollution from incineration; food and water contamination from chemicals that enter the environment; and exposure to radiation from radioactive waste. Depending on the nature of the waste product and the level of exposure, solid waste disposal can increase the risk of infectious diseases, such as cholera; parasites, such as malaria; various types of cancer; kidney disease; poisoning from heavy metals, such as lead, mercury, and cadmium; respiratory ailments; cardiovascular problems; and severe burns, trauma, or death from the ignition of gases emitted from landfills. Environmental impacts include the destruction of habitats when land is cleared to make room for waste disposal, and loss or extinction of species due to water contamination from landfills or hazardous waste sites [Rodenbeck et al., 2010].

Interestingly, Fullerton and Kinnaman [1995a, 1995b] describe the possibilities for substitution between waste disposal and recycling as part of household refuse management.

They develop models where households maximise utility subject to a budget constraint, which incorporates a unit price for refuse collection. These models underpin a series of solid waste disposal and recycling demand equations which are very helpful in understanding the behaviour of households [Abrate and Ferraris, 2013, p. 45].

There is no doubt that to manage something in the right way entails first getting to know it in depth. Moreover, it is necessary to quantify it and to identify the factors affecting it. Waste learning is an important element of waste management.

The 'waste revolution' in Poland

Since 1 May 2004, Poland has been a member of the European Union. This fact has forced the adjustment of Polish legislation to EU requirements. A number of legal regulations aligned with international standards have been introduced in this country. The term 'waste revolution' is commonly used in Poland to describe institutional changes resulting from the adjustment of domestic law to the European Union requirements.

In Poland, up to 2013, households directly contracted service providers for waste collection services. Due to insufficient policy enforcement by the local authorities, however, many households failed to do so, which resulted in illegal waste dumps or improper utilisation of refuse in households (for example waste burning). In this way, some households were able to avoid the cost of waste management.

The firms collecting municipal refuse received money directly from their customers, i.e. owners of real properties, in exchange for their services, and no money went to municipalities. This created situations where different companies collected waste from households on the same street, making the system inefficient.

Waste collectors did not have an incentive to invest in infrastructure, and the cheapest way of managing the waste was to send it to landfill. In addition, as many landfills lacked sufficient weighing equipment, service providers in some cases under-reported the amounts collected, in order to reduce landfill fees [EEA, 2016, p. 14].

It should be mentioned that the first time reform was attempted in Poland was in 2005, on the occasion of amending the law about municipal waste management, but legislative work was conducted in an atmosphere of a sharp dispute about the system's key assumptions [Radecki, 2012]. There were two main interest groups. One, represented by the Polish Waste Management Chamber, incorporating private enterprises engaged in waste transport, which favoured leaving the solutions in force that assumed competition among firms, with no major interference on the part of public authorities and no responsibility for reducing the waste mass stored. The other group, represented by the National Waste Management Chamber associating communal companies involved in waste transport and management, which favoured municipalities taking over all duties and full responsibility in this field. Ultimately, the Parliament took the side of the first lobby, thus postponing the introduction of unavoidable systemic changes [Kołsut, 2016, pp. 97-98].

Vital reforms in this sector were constantly being put off, despite the fact that the situation from year to year was becoming more and more dramatic. The impulse generating visible changes in the system was only provided by EU legal norms, and in practice by sanctions threatening Poland for the lack of specified, measurable effects in waste management.

The time for the necessary institutional changes came in 2011 and 2012. In the course of legislative work, the two interest groups clashed again, but this time the solution was different. It was decided that, given the very long delay in attaining correct values of municipal waste management indicators, radical systemic changes were required. Municipalities started to be responsible for municipal waste management. They also became responsible for achieving proper levels of recycling and reducing refuse intended for storage. Financial penalties were to be applied to municipalities not implementing national regulations or for a lack of compliance with municipal waste targets.

Since the introduction of new system, formal municipal waste management has covered 100% of generated municipal waste. Property owners are required to pay a fee which is defined by the municipality. The municipal council determines this fee by way of a resolution that is an act of local law [Rakoczy, 2014, p. 62]. Municipalities may base those fees either on the number of people per household, the area of the house or water consumption. This means that in Poland, no pay-as-you-throw systems are currently in place for municipal waste collected from households.

The final amount of fee is also affected by a declaration made by the householder regarding waste segregation. If a property owner declares that they have separated out recyclable materials then they pay considerably lower fees. Only those who declare that they do not want waste collected selectively pay full price. It is rare that people do so.

The problem is that some householders declare that they segregate their waste while in reality they do not. Monitoring the system, in order to crack down on such abuses represents quite a challenging task.

In general, however, it should be said that the first experiences of the ‘waste revolution’ are positive and indicate that the new system is going to help the country to meet the policy targets for municipal waste. There are still some challenges to be met, such as the need for additional refuse processing capacity and support for municipalities in carrying out their new responsibilities in an efficient manner. Furthermore, in many municipalities the fees set in the first place were insufficient to cover the full costs of waste management and there will probably be a need to increase the fees in the near future. Other issues of concern include the varying service levels among municipalities with respect to collection frequency and practices, and know-how in public procurement processes [EEA, 2016, p. 15]. But further analysis of these problems goes beyond the scope of this article.

Methodology

The purpose of this paper is to answer the question of how other European Union countries differ from Poland in terms of the amount of household waste disposed of per capita. Two factors affecting the variable, namely the household waste collected per capita and the disposal rate (which is the proportion of the refuse destined for disposal to the total refuse generated by households), shall be analysed in this article. The logarithmic method will be used to assess the influence of the deviations of the said factors on the deviation of the volume of household waste disposed of in relation to the number of inhabitants. The values obtained for Poland will be adopted as the basis for all comparisons.

The objective of the causal analysis is to determine how various factors affect a given variable, i.e. the direction and degree of their impact [Szczecińska, 2007]. Therefore, causal analysis can answer the question of whether a particular factor causes an increase or a decrease of the studied variable, and enables us to assess how big the impact of this factor is [Turczak, 2016, p. 69].

The following notation has been adopted for the purpose of this article:

D – the quantity of household refuse designated for disposal,

T – the total amount of household waste collected (i.e., sent to recovery+ sent to disposal),

P – the size of the population,

$\frac{D}{P}$ – the quantity of household refused signated for disposal in relation to the population size,

$\frac{T}{P}$ – the total amount of household waste collected in relation to the population size,

$\frac{D}{T}$ – the disposal rate.

The examined variable $\frac{D}{P}$ can be presented as a product of factors $\frac{T}{P}$ and $\frac{D}{T}$. The value of the variable $\frac{D}{P}$ for Poland will be the basis of reference and shall be marked by $\frac{D_0}{P_0}$. In turn, the value of this variable calculated for other European Union countries will be denoted as $\frac{D_i}{P_i}$ (i = 1, …, 27). Since $\frac{D_i}{P_i} = \frac{T_i}{P_i} \cdot \frac{D_i}{T_i}$ and $\frac{D_0}{P_0} = \frac{T_0}{P_0} \cdot \frac{D_0}{T_0}$, when dividing $\frac{D_i}{P_i}$ by $\frac{D_0}{P_0}$, the result is:

(1)

$$\frac{\frac{D_i}{P_i}}{\frac{D_0}{P_0}} = \frac{\frac{T_i}{P_i} \cdot \frac{D_i}{T_i}}{\frac{T_0}{P_0} \cdot \frac{D_0}{T_0}},$$

where:

D_i, T_i, P_i – the values of variables *D*, *T*, and *P* referring to the *i*-th EU country,

D_0, T_0, P_0 – the values of variables *D*, *T*, and *P* referring to Poland.

The same can be shown in a different way, namely:

(2)

$$\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right) = \left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right) \cdot \left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right).$$

Taking the common logarithms of both sides of the equation (2), the following expression can be obtained:

(3) $$\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right) = \log\left[\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right) \cdot \left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right)\right].$$

Then, using the logarithm property stipulating that the logarithm of a product of some numbers is equal to the sum of the logarithms of these numbers [Turczak, 2017, p. 83], the equation presented below can be derived:

(4) $$\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right) = \log\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right) + \log\left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right).$$

The next step is to divide both sides of equation (4) by the term $\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)$. This results in the expression:

(5)

$$1 = \frac{\log\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)} + \frac{\log\left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)},$$

where:

$\frac{\log\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)}$ – the impact of the deviation of $\frac{T}{P}$ on the deviation of $\frac{D}{P}$,

$\frac{\log\left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)}$ – the impact of the deviation of $\frac{D}{T}$ on the deviation of $\frac{D}{P}$.

The final step is to multiply both sides of the equation (5) by the value of deviation calculated for the variable $\frac{D}{P}$. Finally:

(6)

$$\frac{D_i}{P_i} - \frac{D_0}{P_0} = \left(\frac{D_i}{P_i} - \frac{D_0}{P_0}\right) \frac{\log\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)} + \left(\frac{D_i}{P_i} - \frac{D_0}{P_0}\right) \frac{\log\left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)},$$

where:

$\frac{D_i}{P_i} - \frac{D_0}{P_0}$ – the total deviation of $\frac{D}{P}$,

$\left(\frac{D_i}{P_i} - \frac{D_0}{P_0}\right) \frac{\log\left(\frac{T_i}{P_i} \div \frac{T_0}{P_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)}$ – the deviation of $\frac{D}{P}$ caused by the deviation of $\frac{T}{P}$,

$\left(\frac{D_i}{P_i} - \frac{D_0}{P_0}\right) \frac{\log\left(\frac{D_i}{T_i} \div \frac{D_0}{T_0}\right)}{\log\left(\frac{D_i}{P_i} \div \frac{D_0}{P_0}\right)}$ – the deviation of $\frac{D}{P}$ caused by the deviation of $\frac{D}{T}$.

Analysis of the amount of household waste designated for disposal per capita

The first task is the evaluation of the quantity of household refuse disposed of per inhabitant in the analysed countries against the value regarding Poland. Table 1 contains the relevant data.

Table 1. The amount of household solid waste disposed of (in kg per person per year)

Country	2010	Country	2012	Country	2014
Sweden	2	Austria	2	Austria	2
Denmark	21	Sweden	3	Sweden	2
Belgium	38	Netherlands	8	Netherlands	5
Germany	102	Denmark	16	Denmark	7
Netherlands	139	Belgium	55	Estonia	23
Austria	144	Germany	87	Luxembourg	51
Cyprus	177	Estonia	96	Germany	55
Poland	**197**	Italy	148	Belgium	74
Estonia	199	Cyprus	150	Ireland	76
France	217	Slovenia	151	Italy	90
Finland	225	Finland	164	Slovenia	100
Slovakia	237	Romania	170	Finland	115
Ireland	242	Spain	188	Cyprus	136
Romania	245	**Poland**	**189**	**Poland**	**153**
Spain	248	Ireland	193	Romania	159
Hungary	267	France	218	Spain	168
Slovenia	271	Slovakia	221	Lithuania	180
Latvia	278	Czech Republic	243	France	196
Croatia	283	United Kingdom	247	Hungary	197
United Kingdom	286	Hungary	255	Slovakia	211
Luxembourg	288	Latvia	259	United Kingdom	219
Czech Republic	289	Portugal	262	Czech Republic	223
Italy	305	Lithuania	265	Latvia	258
Lithuania	344	Luxembourg	271	Croatia	300
Portugal	381	Croatia	315	Bulgaria	307

Country	2010	Country	2012	Country	2014
Bulgaria	411	Malta	366	Portugal	321
Greece	429	Greece	393	Greece	378
Malta	506	Bulgaria	421	Malta	379

Source: own computation based on Eurostat database (date of access: 22.12.2017).

In 2010, in Poland 8,079,690 tons of solid household waste were collected (in 2012 – 9,577,550 tons; in 2014 – 10,330,409 tons), of which 7,471,163 tons (in 2012 – 7,209,023 tons; in 2014 – 5,834,850 tons) were disposed of by landfilling or by thermal processing without energy recovery. In fact, most of the waste disposed of was landfilled: 7,368,687 tons in 2010, 7,158,276 tons in 2012 and 5,436,900 tons in 2014.

In descending ranking, referring to the quantity of household waste disposed of per capita, Poland moved down six places to fourteenth position in 2012 and remained fourteenth in 2014.

Analysis of the amount of household waste generated per capita

The next task carried out is the assessment of the scale of household refuse production per inhabitant in each of the discussed countries in relation to the value of the same measure computed for Poland. All the data needed have been presented in Table 2.

Table 2. The amount of household waste generated (in kg per person per year)

Country	2010	Country	2012	Country	2014
Austria	146	Estonia	104	Slovenia	101
Belgium	170	Austria	135	Ireland	110
Estonia	208	Slovenia	153	Austria	136
Cyprus	208	Belgium	192	Cyprus	146
Poland	**212**	Cyprus	192	Lithuania	182
Ireland	242	Romania	203	Romania	182
Sweden	252	Germany	208	Estonia	196
Germany	256	Spain	220	Spain	197
Slovakia	268	Ireland	223	Finland	200
Slovenia	273	Sweden	244	Germany	209
Latvia	279	**Poland**	**252**	Sweden	226

Country	2010
Romania	279
Croatia	284
Spain	287
Luxembourg	304
Hungary	310
Finland	311
France	328
United Kingdom	331
Czech Republic	336
Netherlands	338
Lithuania	344
Italy	373
Bulgaria	411
Greece	429
Denmark	463
Malta	506
Portugal	550

Country	2012
Slovakia	252
Latvia	259
Lithuania	265
United Kingdom	267
Italy	285
Hungary	298
Czech Republic	302
Luxembourg	312
Croatia	317
France	335
Netherlands	350
Malta	366
Finland	371
Greece	393
Bulgaria	421
Portugal	434
Denmark	452

Country	2014
United Kingdom	235
Slovakia	246
Italy	255
Hungary	256
Latvia	260
Poland	**272**
Luxembourg	279
Czech Republic	284
Croatia	305
Belgium	306
Netherlands	314
Bulgaria	322
France	331
Portugal	359
Greece	378
Malta	379
Denmark	447

Source: own computation based on Eurostat database (date of access: 22.12.2017).

The waste generation rate in Poland has been increasing very rapidly. In 2010, the indicator was among the lowest in the European Union, but in the following years this changed. In descending order by quantity of household waste produced per capita, Poland ranked fifth in 2010, eleventh in 2012 and seventeenth in 2014.

In 2010, first position belonged to Austria, in 2012 – to Estonia, and in 2014 – to Slovenia. In turn, the highest household waste generation rate was recorded: in 2010 – in Portugal, in 2012 and 2014 – in Denmark.

Analysis of the disposal rate

The third task is the comparison of the volume of waste disposed of in proportion to the amount of household waste generated in the studied countries. The necessary data have been given in Table 3.

Table 3. The disposal rate (in %)

Country	2010	Country	2012	Country	2014
Sweden	0.8	Sweden	1.2	Sweden	0.9
Denmark	4.5	Austria	1.5	Austria	1.5
Belgium	22.4	Netherlands	2.3	Denmark	1.6
Germany	39.8	Denmark	3.5	Netherlands	1.6
Netherlands	41.1	Belgium	28.6	Estonia	11.7
France	66.2	Germany	41.8	Luxembourg	18.3
Portugal	69.3	Finland	44.2	Belgium	24.2
Finland	72.3	Italy	51.9	Germany	26.3
Italy	81.8	Portugal	60.4	Italy	35.3
Cyprus	85.1	France	65.1	**Poland**	**56.3**
Czech Republic	86.0	**Poland**	**75.0**	Finland	57.5
Hungary	86.1	Cyprus	78.1	France	59.2
United Kingdom	86.4	Czech Republic	80.5	Ireland	69.1
Spain	86.4	Romania	83.7	Hungary	77.0
Romania	87.8	Spain	85.5	Czech Republic	78.5
Slovakia	88.4	Hungary	85.6	Spain	85.3
Poland	**92.9**	Ireland	86.5	Slovakia	85.8
Luxembourg	94.7	Luxembourg	86.9	Romania	87.4
Estonia	95.7	Slovakia	87.7	Portugal	89.4
Austria	98.6	Estonia	92.3	Cyprus	93.2
Slovenia	99.3	United Kingdom	92.5	United Kingdom	93.2
Latvia	99.6	Slovenia	98.7	Bulgaria	95.3
Croatia	99.6	Croatia	99.4	Croatia	98.4
Bulgaria	100.0	Bulgaria	100.0	Lithuania	98.9
Ireland	100.0	Greece	100.0	Slovenia	99.0
Greece	100.0	Latvia	100.0	Latvia	99.2
Lithuania	100.0	Lithuania	100.0	Greece	100.0
Malta	100.0	Malta	100.0	Malta	100.0

Source: own computation based on Eurostat database (date of access: 22.12.2017).

In 2012-2014, the top place, in descending order, concerning disposal rates, was taken by the same country – Sweden. Second position belonged to Denmark (in 2010) and Austria (in 2012 and 2014). Poland moved up six places to eleventh position in 2012 and, in 2014, climbed one place to tenth position.

It is worth emphasising that in 2010 in Sweden only 0.8% (in 2012 – 1.2%, in 2014 – 0.9%) of the total household refuse was disposed of, and the remaining 99.2% (in 2012 – 98.8%, in 2014 – 99.1%) was recovered. In contrast, in the case of Greece and Malta, as much as 100% of total household solid waste was disposed of throughout those years.

Landfilling was the predominant method used for the disposal of household solid waste in Poland. According to Eurostat data, in 2010, approximately 91.2% of waste collected was disposed of in landfill, 1.3% was incinerated without energy recovery, and 7.5% was recovered (i.e. recycled, composted or incinerated at waste-to-energy plants). In 2012, those shares were as follows: 74.8%, 0.5%, 24.7%, respectively (in 2014: 52.6%, 3.9%, and 43.5%). Fortunately, the disposal rate in Poland is evidently on the decrease and, consequently, the recovery rate is on the increase.

Empirical results obtained from the causal analysis

It was established in this article that the value of the response variable – the amount of household refuse disposed of per capita – might be calculated by multiplication of 1) the volume of household refuse collected per inhabitant and 2) the quotient of the amount of waste destined for disposal and the amount of waste generated. The said relationship is as follows:

(7) $$\frac{D}{P} = \frac{T}{P} \cdot \frac{D}{T}.$$

The (2) ratio equality was derived from this relationship.

In the last part of this research the remaining stages of the logarithmic method will be performed. The results obtained for 2010, 2012, and 2014 are shown in Table 4.

Table 4. The importance that can be assigned to the causes of the occurring deviations of the response variable

Country	I / II	2010	2012	2014
Austria	I II	**0.731** = 0.689 · 1.061 (**−53**) = (−63) + (+10)	**0.011** = 0.536 · 0.020 (**−187**) = (−26) + (−161)	**0.013** = 0.500 · 0.026 (**−151**) = (−24) + (−127)
Sweden	I II	**0.010** = 1.189 · 0.009 (**−195**) = (+7) + (−202)	**0.016** = 0.968 · 0.016 (**−186**) = (−1) + (−185)	**0.013** = 0.831 · 0.016 (**−151**) = (−6) + (−145)
Netherlands	I II	**0.706** = 1.594 · 0.443 (**−58**) = (+78) + (−136)	**0.042** = 1.389 · 0.030 (**−181**) = (+19) + (−200)	**0.033** = 1.154 · 0.028 (**−148**) = (+6) + (−154)

Country	I / II	2010	2012	2014
Denmark	I II	**0.107** = 2.184 · 0.049 (**−176**) = (+61) + (−237)	**0.085** = 1.794 · 0.047 (**−173**) = (+41) + (−214)	**0.046** = 1.643 · 0.028 (**−146**) = (+24) + (−170)
Estonia	I II	1.010 = 0.981 · 1.030 (+2) = (−4) + (+6)	**0.508** = 0.413 · 1.231 (**−93**) = (−122) + (+29)	**0.150** = 0.721 · 0.209 (**−130**) = (−22) + (−108)
Luxembourg	I II	1.462 = 1.434 · 1.020 (+91) = (+86) + (+5)	1.434 = 1.238 · 1.158 (+82) = (+49) + (+33)	**0.333** = 1.026 · 0.325 (**−102**) = (+2) + (−104)
Germany	I II	**0.518** = 1.208 · 0.429 (**−95**) = (+27) + (−122)	**0.460** = 0.825 · 0.558 (**−102**) = (−25) + (−77)	**0.359** = 0.768 · 0.468 (**−98**) = (−25) + (−73)
Belgium	I II	**0.193** = 0.802 · 0.241 (**−159**) = (−21) + (−138)	**0.291** = 0.762 · 0.382 (**−134**) = (−30) + (−104)	**0.484** = 1.125 · 0.430 (**−79**) = (+13) + (−92)
Ireland	I II	1.228 = 1.142 · 1.076 (+45) = (+29) + (+16)	1.021 = 0.885 · 1.154 (+4) = (−23) + (+27)	**0.497** = 0.404 · 1.228 (**−77**) = (−100) + (+23)
Italy	I II	1.548 = 1.759 · 0.880 (+108) = (+140) + (−32)	**0.783** = 1.131 · 0.692 (**−41**) = (+21) + (−62)	**0.588** = 0.938 · 0.627 (**−63**) = (−8) + (−55)
Slovenia	I II	1.376 = 1.288 · 1.068 (+74) = (+59) + (+15)	**0.799** = 0.607 · 1.316 (**−38**) = (−84) + (+46)	**0.654** = 0.371 · 1.760 (**−53**) = (−123) + (+70)
Finland	I II	1.142 = 1.467 · 0.779 (+28) = (+81) + (−53)	**0.868** = 1.472 · 0.589 (**−25**) = (+68) + (−93)	**0.752** = 0.735 · 1.022 (**−38**) = (−41) + (+3)
Cyprus	I II	**0.898** = 0.981 · 0.916 (**−20**) = (−4) + (−16)	**0.794** = 0.762 · 1.042 (**−39**) = (−46) + (+7)	**0.889** = 0.537 · 1.656 (**−17**) = (−90) + (+73)
Romania	I II	1.244 = 1.316 · 0.945 (+48) = (+60) + (−12)	**0.899** = 0.806 · 1.117 (**−19**) = (−39) + (+20)	1.039 = 0.669 · 1.553 (+6) = (−63) + (+69)
Spain	I II	1.259 = 1.354 · 0.930 (+51) = (+67) + (−16)	**0.995** = 0.873 · 1.139 (**−1**) = (−26) + (+25)	1.098 = 0.724 · 1.516 (+15) = (−52) + (+67)
Lithuania	I II	1.746 = 1.623 · 1.076 (+147) = (+128) + (+19)	1.402 = 1.052 · 1.333 (+76) = (+11) + (+65)	1.176 = 0.669 · 1.758 (+27) = (−67) + (+94)
France	I II	1.102 = 1.547 · 0.712 (+20) = (+90) + (−70)	1.153 = 1.329 · 0.868 (+29) = (+58) + (−29)	1.281 = 1.217 · 1.053 (+43) = (+34) + (+9)
Hungary	I II	1.355 = 1.462 · 0.927 (+70) = (+87) + (−17)	1.349 = 1.183 · 1.141 (+66) = (+37) + (+29)	1.288 = 0.941 · 1.368 (+44) = (−11) + (+55)
Slovakia	I II	1.203 = 1.264 · 0.952 (+40) = (+51) + (−11)	1.169 = 1.000 · 1.169 (+32) = (0) + (+32)	1.379 = 0.904 · 1.525 (+58) = (−18) + (+76)
United Kingdom	I II	1.452 = 1.561 · 0.930 (+89) = (+106) + (−17)	1.307 = 1.060 · 1.233 (+58) = (+13) + (+45)	1.431 = 0.864 · 1.657 (+66) = (−27) + (+93)
Czech Republic	I II	1.467 = 1.585 · 0.926 (+92) = (+111) + (−19)	1.286 = 1.198 · 1.073 (+54) = (+39) + (+15)	1.458 = 1.044 · 1.396 (+70) = (+8) + (+62)
Latvia	I II	1.411 = 1.316 · 1.072 (+81) = (+65) + (+16)	1.370 = 1.028 · 1.333 (+70) = (+6) + (+64)	1.686 = 0.956 · 1.764 (+105) = (−9) + (+114)
Croatia	I II	1.437 = 1.340 · 1.072 (+86) = (+69) + (+17)	1.667 = 1.258 · 1.325 (+126) = (+57) + (+69)	1.961 = 1.121 · 1.749 (+147) = (+25) + (+122)
Bulgaria	I II	2.086 = 1.939 · 1.076 (+214) = (+193) + (+21)	2.228 = 1.671 · 1.333 (+232) = (+149) + (+83)	2.007 = 1.184 · 1.695 (+154) = (+37) + (+117)

Country	I / II	2010	2012	2014
Portugal	I II	1.934 = 2.594 · 0.745 (+184) = (+266) + (−82)	1.386 = 1.722 · 0.805 (+73) = (+122) + (−49)	2.098 = 1.320 · 1.590 (+168) = (+63) + (+105)
Greece	I II	2.178 = 2.024 · 1.076 (+232) = (+210) + (+22)	2.079 = 1.560 · 1.333 (+204) = (+124) + (+80)	2.471 = 1.390 · 1.778 (+225) = (+82) + (+143)
Malta	I II	2.569 = 2.387 · 1.076 (+309) = (+285) + (+24)	1.937 = 1.452 · 1.333 (+177) = (+100) + (+77)	2.477 = 1.393 · 1.778 (+226) = (+83) + (+143)

I – the ratio equality
II – the equation of impact effects (results in kg per person per year)

Source: own computation based on Tables 1-3.

As an example, the values obtained in 2014 for Austria shall be interpreted. The amount of household waste disposed of per capita in Austria was 2 kg and in Poland – 153 kg. Thus, in Austria it was 151 kg less (i.e. 98.7% less) than in Poland. Had the same amount of household refuse per capita been generated in Austria as in Poland, the quantity of household waste disposed of in Austria would have been 127 kg/person smaller than in the case of Poland, solely due to the lower disposal rate. Had the refuse sent to disposal in proportion to the total household refuse generated in Austria been at the Polish level, the volume of household waste disposed of in Austria would have been 24 kg/person less than in Poland, which would have been a result solely of the lower level of household solid waste production.

Conclusions

In this article, the amount of household waste generated per capita and the disposal rate have been adopted as the factors affecting the amount of household waste disposed of per capita. Causal analysis allowed us to answer the question how these factors influence the deviations in the response variable in the examined countries compared to the quantity for Poland. Calculations were performed for each EU Member State separately. The research was conducted based on data from 2010, 2012, and 2014.

The amount of household solid waste disposed of in Poland was 197 kg/person in 2010, 189 kg/person in 2012, and 153 kg/person in 2014. The amount of household refuse collected accounted for 212 kg/person in 2010, 252 kg/person in 2012, and 272 kg/person in 2014. Poland designated 92.9% of household waste for disposal in 2010, 75.0% in 2012, and 56.3% in 2014.

It has to be admitted that Poland is situated higher and higher (i.e. better and better) in the descending ranking related to disposal rate, but fares far worse in ranking by the amount of household waste generated per capita. Consequently, the location of Poland in the ranking by amount of household refuse disposed of per capita is quite poor, and the dynamics of ongoing changes in this area – in the light of this study – does not seem to be satisfactory.

When analysing the state of municipal solid waste management in Poland, it is clear that separation at source, composting of biodegradable waste, incineration with energy recovery and recycling have not yet been implemented entirely effectively. For efficient waste management in Poland, the following challenges seem to be crucial:

- Establishing an effective waste collection system;
- Reinforcing waste reuse;
- Increasing the number of facilities for municipal waste recovery;
- Reducing the amount of refuse directed into landfills.

There is also a need to increase composting of biodegradable waste. Organic waste separation, composting and then using the compost as an organic fertiliser is a sustainable way of managing biodegradable waste. In addition, to achieve higher levels of packaging recycling, it is advisable to increase the number and treatment capacity of packaging waste recycling plants.

There is no doubt that more emphasis ought to be placed on the permanent improvement and increased efficiency of the existing system. Selective waste collection at the location of waste generation should be the fundamental strategy for solid waste management in Poland. But – above all – it is extremely important to strengthen the reduction process of the generation rate.

The waste hierarchy prioritises waste prevention, followed by preparing for reuse, recycling, other recovery methods and finally disposal as the least desirable option. In the European Union, waste-related Directives, such as 2008/98/CE, now call for waste reduction as the most preferred way of tackling this problem, while in the past attention was mainly focused on targets concerning recovery rates [Alwaeli, 2015, p. 181]. Unfortunately, these EU principles, most appropriately supporting sustainable development, are not reflected in the current state of Polish solid waste management.

After the entire study carried out in this paper, it has become clear that the Polish municipal refuse management system is not yet as advanced as in many old EU countries. Poland still maintains very high rates of landfilling. Other treatment methods, such as recycling, composting, and incineration with energy recovery are also used, but on a negligible scale.

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The role of state schools of higher vocational education in the sustainable development process

Artur Zimny
State University of Applied Sciences in Konin, Poland
ORCID:0000-0002-8025-550X, e-mail: artur.zimny@konin.edu.pl

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Abstract: The indications of creating at the end of the 1990s and in the first decade of the 21st century public higher vocational schools were undoubtedly included in the idea of sustainable development. Thereby, the hypothesis that the functioning of higher schools fosters the current process of sustainable development is justified. The hypothesis was verified by means of inductive and deductive reasoning. The effects of analyses and considerations indicate the significant role of state schools of higher vocational education in the sustainable development process. Increasing educational opportunities for young people from smaller towns, the growth of gross enrolment ratio in regions where state higher vocational schools were formed, indirect economic stimulation in these regions and supplying them with financial means from the national budget in the form of grants for higher schools and financial assistance for students, boosting revitalisation processes in urban areas and the positive effects of cooperation of these schools with numerous entities in the socio-economic environment seem to demonstrate that their functioning supports the development of subregional centres, and in this way, contributes to sustainable development at the regional scale.

Keywords: state universities of applied sciences, sustainable development strategies, subregional centres

JEL: I25, Q01

Introduction

The results of numerous studies and analyses indicate a significant influence of higher education on creating human capital. M. Ratajczak claims that the changes taking place in human capital derive, to a great extent, from the education system, including higher education, and, at the same time, he adds that, considering the processes taking place in contemporary world, the role of human capital as a development factor will grow [Ratajczak 2013, p. 22-33]. In the knowledge society and knowledge based economy, higher education, as a significant link in the social system as well as economic sector, takes on particular importance [Ratajczak 2010, p. 3-9]. It can be seen, for example, in the communication from the European Commission "The Role of Universities in the Europe of Knowledge", whose aim was to initiate a debate on the issue of the role of European universities in society and knowledge based economy [European Commission 2003].

As long as, in the light of the aforementioned remarks, it can be stated with full responsibility that higher education plays an important role in the socio-economic development process, there arises a question about the role of education at a higher level in the sustainable development process. The question becomes much more important in the context of migration of people observed in Poland, and particularly of people of early working age, from smaller municipal centres and from rural areas to larger agglomerations. The ongoing process which, in the author's opinion, could be termed "metropolisation of development", calls into question the contribution of tertiary education in creating sustainable development. The functioning of large academic universities located in the biggest metropolitan areas, allows sustainable development at a national level, but, at the same time, it contributes to the aforementioned metropolisation and, in this way, it contradicts the need for sustainable development regionally. The sustainable development process, in terms of regions, should then be fostered by the functioning of state schools of higher vocational education, that is higher schools located in subregional centres.

The aim of the paper is to attempt to illustrate the role of public higher vocational schools (state schools of higher vocational education) in the sustainable development process. From the paper's point of view, it is significant that, at the end of the 1990s and in the first decade of the 21st century, the most important reasons for forming over 30 state schools of higher vocational education, that is higher schools having their seats in mid-size towns, located in different parts of Poland, was, on the one hand, the need to increase the low gross enrolment ratio at higher education level, which impeded the development process of regions, and on the other hand, the need for equality of educational opportunities, by bringing studies closer to less wealthy secondary school graduates, especially youths from small towns [Winnicki 2008, p. 29-34]. These reasons were, undoubtedly, part of the idea of sustainable development, which justifies the hypothesis that functioning of state schools of higher vocational education fosters the current process of sustainable development. The hypothesis was verified by means of inductive and deductive reasoning, using the results of the analysis of local sustainable development strategies, development strategies of higher schools, and the knowledge and experience gained by the author during almost 20 years of functioning in one of the state schools of higher vocational education.

Tertiary education in European and Polish sustainable development strategies

Among the currently existing European and Polish development strategies, two documents deserve particular attention, namely, "Strategy Europe 2020" and "Responsible Development Strategy to 2020". These strategies attach great importance to the issue of sustainable development and, at the same time, attribute a vital role to tertiary education in creating development processes. Further, the paper presents notations included in the aforementioned strategies which directly refer to higher education. It must be stressed here that the focus was on these excerpts of strategy documents which were dedicated to development targets (the programme part of the strategy), with text contained in the diagnostic part of the strategy being left out. The intention of the author was, then, not to present long and complex descriptions of issues connected with higher education included in sustainable development strategies, but raising the subject of the importance ascribed to education in creating development processes.

The second decade of the 21st century is marked in the European Union by the implementation of the three priorities contained in “Strategy Europe 2020” defined as a strategy for smart, sustainable and inclusive growth. The strategy puts forward five headline and measurable targets, and presents seven flagship initiatives enabling progress under each of the priorities. The issues related to higher education were directly reflected within the first priority of the discussed strategy, that is, intelligent development – economic development based on knowledge and innovation, and, relating to the target, in the field of education, in the light of which at least 40% of the people from young generation should gain a tertiary education[1]. To implement the priority and achieve the target there are, with regard to higher education, two flagship initiatives, namely, “The Innovation Union” whose aim is to use research, development and innovative activity to solve different problems, and “Youth on the Move” which is oriented towards the improvement and enhancement of the attractiveness of European higher education internationally, and raising the quality of all levels of education and training in the UE. In the first project, it was stressed that the European Commission will, among other things, promote knowledge partnerships and strengthen links between education, business, research and education, and promote entrepreneurship by supporting young innovative companies. Then, the second project signalled the engagement of the European Commission in, among other things, integrating and improving the activities of European programmes in relation to mobility, research and inter-university cooperation, and including them in national programmes and resources, and in stepping up the modernisation agenda of higher education (curricula, governance and financing) by benchmarking university performance and educational outcomes in a global context[2].

[1] Specifically, it is about increasing the share of the population aged 30-34 having completed tertiary education to at least 40% by 2020.

[2] At the same time, in “Strategy Europe 2020” it was stressed, in terms of the two discussed projects, that all member states must: reform national and regional systems of conducting research and development activity so that it fosters excellence and smart specialisation, reinforce cooperation between universities, research and business, implement joint programming and enhance cross-border cooperation in areas with EU value added and adjust national funding procedures so as to ensure the diffusion of technology across EU territory; to ensure

The core development strategy of the country for the coming years, defining the basic conditions, objectives and trends of development in social, economic, regional and spatial terms, is the "Responsible Development Strategy to 2020" (SOR)[3]. The strategy puts forward three specific objectives, and, within them 12 main areas of activity concentration (from 2 to 5 depending on the objective), completed with intervention directions (58 directions altogether). Furthermore, the document identifies six areas influencing the achievement of strategy targets, under which 28 intervention directions were proposed. Higher education directly fits into the specific objective concerning sustainable economic growth based increasingly on knowledge, data and organisational excellence, and in the field devoted to human and social capital. The authors of this strategy turn attention to the fact that in order to enhance human and social capital in the national system of innovation, programme and system activities are planned, targeted at all stages of the shaping of innovators, that is schools of different levels, universities and other scientific and research units and enterprises. Moreover, within SOR, there is mention of the need to better gear education and learning towards a system effectively cooperating with the environment (economic, social, cultural) and to base it on more autonomous and less bureaucratic universities, to support staff management and development, and internationalise and open Polish higher schools to innovation. Excerpts from SOR concerning higher education are presented in table 1.

Table 1. Formulations referring to higher education contained in "Responsible Development Strategy to 2020"

Areas, objectives, directions and activity directly referring to tertiary education
Specific objective 1. Sustainable economic growth based increasingly on knowledge, data and organisational excellence – Area: development of innovative companies • Intervention direction 1. Enhancing human and social capital in the national innovation system ▪ Promoting enterprise culture at universities, enhancing research potential at universities and their stronger involvement in the system of creating innovation ▪ Introducing changes in the education system oriented towards shaping attitudes and features fostering innovation

a sufficient supply of science, maths and engineering graduates and to focus school curricula on creativity, innovation and entrepreneurship; to ensure sufficient investment in education and training systems at all levels (pre-school to tertiary); to improve educational outcomes addressing each segment (pre-school, primary, secondary, vocational and tertiary) within an integrated approach, encompassing key competencies and aiming at reducing early school leaving; to enhance openness and relevance of education systems by building national qualification frameworks and better gearing learning outcomes towards labour market needs (European Commission 2010).

[3]The strategy is the updated version of the "National Development Strategy 2020". The adoption of it meant rejecting "Long-term National Development Strategy 2030. The Third Wave of Modernity".

Areas, objectives, directions and activity directly referring to tertiary education
The area influencing the achievement of strategy objectives: Human and social capital – Intervention direction 1. Better gearing of education and learning outcomes towards labour market needs • The development of higher education directed at a system effectively collaborating with the environment (economic, social, cultural) based on more autonomous and less bureaucratised universities • Tailoring tertiary education to the needs of the modern economy • Supporting management and development of academic staff • Internationalisation and opening of Polish higher schools to innovation

Source: Own elaboration based on (Ministry of Development 2017).

State schools of higher vocational education in local sustainable development strategies

Among currently existing local development strategies, or more precisely, the strategy documents of districts and cities where state higher vocational schools operate, four development strategies for districts (of Gorzów, Jarosław, Koszalin, Tarnów) and six development strategies for cities (Gorzów Wielkopolski, Łomża, Płock, Sanok, Suwałki, Wałbrzych) have been analysed. These strategies, unlike most local strategy documents, are not reduced to issues of socio-economic development, but they also pay attention to the issue of sustainable development, as can be seen in the titles of these documents. This paper further presents the results of the verification of whether the diagnostic and programme parts of the aforementioned documents contain reference to state schools of higher vocational education, and if they do, to what extent.

Based on the review of the contents of the four strategies for sustainable development of districts, it can be stated that two of them, namely, in "Sustainable Development Strategy of the Gorzów District to 2020" and "Sustainable Development Strategy of the Tarnów District for 2011-2020", the fact of the existence in their region of state higher vocational schools was completely ignored. Then, in "Sustainable Development Strategy of the Jarosław District for 2014-2020" there was just a mention that a state higher vocational school operates in the region. Only in the diagnostic part of "Sustainable Development Strategy of the Koszalin Functional Area"[4] was more attention given to state school of higher vocational education. Unfortunately, in none of the analysed strategic documents were issues relating to the discussed higher schools contained in the programme part (table 2).

[4] Koszalin Functional Area covers the territory of Koszalin district and the city of Koszalin.

Table 2. The extent of coverage of contents directly referring to state schools of higher vocational education in sustainable development strategies of districts*

Title of strategy document	Diagnostic part of the strategy	Programme part of the strategy
Sustainable Development Strategy for Gorzów District to 2020		
Sustainable Development Strategy for Jarosław District 2014-2020	+	
Sustainable Development Strategy for the Koszalin Functional Area	++	
Sustainable Development Strategy for Tarnów District 2011-2020		

* the symbols used in the table stand for: three pluses (+++) large coverage of the discussed issues; two pluses (++) average coverage of the discussed issues; one plus (+) minimal coverage of the discussed issues (just a mention that there is a state higher vocational school in the region); an empty field means no coverage of the discussed issues.

Source: Own elaboration based on sustainable development strategy of districts where state schools of higher vocational education operate.

Based on the review of the contents of the six sustainable development strategies for cities, it can be stated that most of them take into consideration the issues related to the functioning of state schools of higher vocational education, relatively assessing, to the medium or large extent. Only in the "Sustainable Development Strategy of the City of Wałbrzych to 2020" there was just a mention of the functioning of state schools of higher vocational education. Most attention to the discussed higher schools was paid by the following cities: Suwałki, Gorzów Wielkopolski and Łomża. Also quite significant is the extent of coverage of the issue directly referring to state schools of higher vocational education in the strategies for Płock and Sanok (table 3).

Table 3. The extent of coverage of the contents directly referring to state schools of higher vocational education in sustainable development strategies for cities*

Title of strategy document	Diagnostic part of the strategy	Programme part of the strategy
Sustainable Development Strategy for the City of Gorzów Wielkopolski 2010-2020	++	++
Sustainable Development Strategy for the City of Łomża to 2020	+	++
Sustainable Development Strategy for the City of Płock to 2022	++	
Sustainable Development Strategy for the City Sanok 2013-2024	++	
Sustainable Development Strategy for the City of Suwałki to 2020	+++	+++
Sustainable Development Strategy for Wałbrzych to 2020	+	

* the symbols used in the table stand for: three pluses (+++) large coverage of the discussed issues; two pluses (++) medium coverage of the discussed issues; one plus (+) minimal coverage of the discussed issues (just a mention that there is a state school of higher vocational education in the area of the city); an empty field means no coverage of the discussed issues.

Source: Own elaboration based on sustainable development strategies of the cities where state schools of higher vocational education operate.

One of the strategic objectives in “Sustainable Development Strategy for the City of Suwałki to 2020” was the development of PWSZ in Suwałki, including creating new degree courses and education to master level. In the document, it was signalled that besides educational activity, the school also focuses on research – the Cross-border Technology Transfer Centre is located there – in the implementation phase, aiming to create greater cooperation opportunities for science and business, while in the further plans for school development there is the establishment of the Cross-border Renewable Energy Centre. In the strategy, it was also stressed that Suwałki may play an important role in terms of education through the development of PWSZ’s activity in Suwałki and the Science and Technology Park Poland-East with a technology incubator. Based on the school, there are plans to create an Emergency Medical Centre – in collaboration with the Emergency and Medical Procedures Laboratory and Medical Air Rescue. In the programme part of the “Sustainable Development Strategy for the City of Gorzów Wielkopolski for 2010-2020” it was considered justified to support the efforts of PWSZ in Gorzów Wielkopolski to establish a Gorzowska Academy, through, among others, funding the necessary technical and scientific infrastructure, while the programme part of the “Sustainable Development Strategy for the City of Łomża to 2020” predicts support provided by the city for the development of higher schools, with the particular inclusion of PWSIP in Łomża, undertaking, together with the school and other institutions, joint action for the start-up in Łomża of a leading research centre for food processing, and developing the higher school's infrastructure, namely a campus, sports hall and a laboratory for modern food processing. In the "Sustainable Development Strategy for the City of Sanok for 2013-2024" it was stressed that the main task of PWSZ in Sanok is not only supporting regional development, through educating highly qualified employees, but also influencing the cultural and economic policy of the Karpacki Euroregion. In turn, in the "Sustainable Development Strategy for the City of Płock to 2022" there was presented detailed information on the PWSZ in Płock, namely on the number of students of particular degree courses, academic staff and its teaching facilities.

Summing up the review of the contents of local sustainable development strategies, it can be concluded that if in the district strategic documents the fact of the existence of state schools of higher vocational education in their region was left unstated, or only mentioned briefly (while listing all the functioning universities) then, in the city strategic documents the fact that state schools of higher vocational education are located in their region was mentioned and, what is more, was considered an asset of the city and its opportunities for development, and sometimes even providing support to state schools of higher vocational education was elevated to the status of a strategy objective.

The question of sustainable development in the strategies for state schools of higher vocational education

Development strategies for state schools of higher vocational education are highly diversified in terms of the form and scope of information presented. Despite the differences, the structure of most of the documents is similar. They include the mission, vision and development objectives (on one, or several levels). Many of them also include a diagnosis of the current state, usually concluded with a SWOT analysis. The further part of the paper presents the results of the verification of whether the strategies for the analysed schools, or more precisely the mission and vision contents, mention the sustainable development process.

The effects of this verification allow us to reach the conclusion that formulations referring to this development were included only in three among over 30 strategy documents. The manner of their formulation was quite varied – a very brief formulation was included in the "Development Strategy for the PWSZ in Głogów for 2014-2018", and a relatively long one in the "Development Strategy for S. Pigoń PWSZ in Krosno for 2015-2020". However, the missions and visions emphasised the issue of serving the city and regional development through conducting teaching and science, and research activity, and linked sustainable development to shaping democratic, civic and patriotic attitudes among students, graduates and employees. A detailed listing of the formulations is presented in table 4.

Table 4. Formulations referring to sustainable development contained in development strategies for state schools of higher vocational education

State School of Higher Vocational Education (PWSZ)	Formulations contents in terms of mission and/or vision referring to sustainable development
PWSZ in Głogów	Taking action fostering sustainable development in conditions of social and ethical responsibility.
PWSZ in Krosno	Shaping and developing responsible democratic, civic and patriotic attitudes among students, graduates and employees and in the environment for the sustainable development of the city, region, Poland and Europe, and in this way contributing to regional development.
PWSZ in Oświęcim	Taking action and projects in the field of science, teaching, education for sustainable development, shaping a knowledge based society and civic attitudes among the students, graduates, and employees of PWSZ, the inhabitants of the city and the region.

Source: Own elaboration based on development strategies for state schools of higher vocational education.

Functioning of state schools of higher vocational education and the sustainable development process

Attempting to verify the hypothesis according to which the functioning of state schools of higher vocational education fosters the process of sustainable development, there must be emphasised several issues which, in the author's opinion, are of particular importance. Firstly, creating state schools of higher vocational education greatly decreased the degree of spatial concentration of higher education, reducing in this way inequalities in access to higher schools in Poland, providing the same education opportunities for young people. As expected, greater spatial accessibility of tertiary education institutions positively affected the gross enrolment ratio in the regions where state schools of higher vocational education were formed. Secondly, the functioning of state schools of higher vocational education indirectly influences the economy of the cities and districts where the schools are located. Being established in mid-size towns, which previously did not have tertiary education institutions, the schools generated new employment, frequently becoming an important employer locally. Employment involved the necessity of student services and the need to maintain infrastructure facilities [Misztal 2000, p. 18-21]. In turn, residence and living of students in these cities generated growth in consumer demand in local rental markets, transport services, food services and entertainment, sports and recreation [Augustyniak 2015, p. 193-201], although it must be assumed that the growth was relatively small, as most students are either residents of the cities where these higher schools are located, or residents of the surrounding towns. Thirdly, creating state schools of higher vocational education boosted the process of revitalisation of urban areas, particularly in the neighbourhoods where the schools are located. These were frequently former military buildings or former office buildings which were shut down as a result of administrative reforms. Fourthly, state schools of higher vocational education receive subsidies from the national budget on an annual basis for tasks connected with educating students of full-time studies and maintenance of universities (the so-called “basic grant”). Their amount is very diverse (it depends on many factors – in compliance with the current algorithm of subsidies distribution), but on average, in recent years the amount accounted for several million zloty annually. Furthermore, state schools of higher vocational education receive funds from the national budget for financial assistance for students, where the average funding for one school in recent years amounted to several million zloty on an annual basis. If, with reference to the “basic grant” it is hardly possible to estimate what part is spent locally, then, in the case of funds for financial assistance for students, it can be assumed, taking into consideration the place of residence of its beneficiaries, that the largest part of them is spent locally. Fifthly, state schools of higher vocational education collaborate with numerous entities in the socio-economic environment, to the greatest extent with public institutions and city authorities. The collaboration with these entities, determined by the limited spatial extent of influence of state schools of higher vocational education and the type of degree courses conducted by them, contributes – in the opinion of university authorities, local government authorities and employers – to building partnerships and mutual trust, shaping positive behaviours and attitudes towards cooperation, and it also influences the sense of community in the regional/local environment. In the students’ opinion, state schools of higher vocational education also create a friendly atmosphere for studying and student life, but, over and above this, they contribute to creating the skills of cooperation, openness and flexibility among students. In the opinion of local government authorities (not to mention university authorities), these schools engage in initiatives raising the competitiveness and attractiveness of the cities, districts and regions where they operate.

The issues presented above indicate the significant role of state schools of higher vocational education in the sustainable development process. The increase in educational opportunities for young people from smaller towns, the growth in gross enrolment ratio in the regions where state schools of higher vocational education were created, indirect economic stimulation in these regions and enhancing them with financial means from the national budget in the form of grants for the universities and financial assistance for students, boosting the process of revitalisation of urban areas, as well as the positive effects of collaboration between the higher schools and numerous entities in the socio-economic environment, seem to show that the functioning of state schools of higher vocational education fosters the sustainable development process. The schools support the development of subregional centres, and in this way they contribute to sustainable development regionally. In the author's opinion, this fact allows the positive verification of the hypothesis stated in this paper.

Conclusion

The considerations on the role of state schools of higher vocational education in the process of sustainable development incline the author to formulate several general conclusions and points. Firstly, the adaptation of state schools of higher vocational education to a dynamically changing reality entails the necessity of emphasising its present place among the participants in the sustainable development process, and, at the same time, to continue searching for its place in this process. Secondly, acting through state schools of higher vocational education for the benefit of regional and local communities requires redefining their functions, which, undoubtedly should be different from the objectives and tasks of the scientifically strongest academic universities located in the largest conurbations. Thirdly, the building of long-term relationships with different entities by state schools of higher vocational education, based on mutual trust, should make these schools become, in a sense, "factories" of social capital for the cities, districts and subregions where they are located. Fourthly, enhancing the role of state schools of higher vocational education in creating the process of sustainable development at the regional and local level should be correlated with their evolution towards smart organisations. And finally, fifthly, implementing the changes in the functioning of state schools of higher vocational education should be well thought out and consistent – both at the level of the whole sector of state schools of higher vocational education and at the level of particular schools constituting this sector.

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The economic efficiency of agriculture and its contribution to regional economies in Poland

Dariusz Kusz
Technical University of Rzeszow, Poland
ORCID: 0000-0002-5643-5404, dkusz@prz.edu.pl
Ryszard Kata
University of Rzeszow, Poland
ORCID: 0000-0001-6085-3935, rdkata@ur.edu.pl

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Abstract: The study assesses the variation in terms of the share of agriculture in the economy of individual regions in Poland and assesses its economic effectiveness in comparison to the entire regional economy. The economic efficiency of agriculture is assessed using the indicators of labour productivity and fixed assets productivity. The research uses the public statistics panel data from 2002-2015. It was found that the level of employment in agriculture, and labour productivity in agriculture, against the background of the economy of regions is highly diversified. Large differences in labour productivity in the sector are an obstacle for the convergence of regional agriculture. A positive relationship was observed between the state of development of the economy of individual regions, and the effectiveness and potential of agriculture. A higher level of regional economic development makes it possible to effectively eliminate structural defects in agriculture, especially related to excess labour force. As a result of the research, a beneficial feedback loop was shown between the development of a region's economy and the economic efficiency of agriculture, expressed, among others, by labour productivity and the productivity of fixed assets.

Keywords: agriculture, national economy, technical labour equipment, economic efficiency

JEL: E01, R11, Q1

Introduction

The role of agriculture in the national economy is undergoing significant transformations. While the impact of agriculture on the basic macroeconomic indicators is becoming weaker in relative terms, its links to the national economy are growing stronger, taking on a new significance in the context of public-goods supply by agriculture [Van Huylenbroeck et al. 2007, p.7, Wilkin 2010, pp. 9-10; Czyżewski, Kułyk 2011, pp. 16-25; Kisiel and Babuchowska 2013, p. 62].

The global economy is changing as a result of the transitions from the industrial stage to the post-industrial stage, to the information stage, causing structural transformations in the economy. This process, coupled with globalisation and integration, causes transformations in the spatial structures and industry structures of national economies, as well as redefines the significance of individual sectors for the economic development of spatial systems at different levels (local, regional, national and international) [Rachwał et al. 2009, p. 31]. These transformations affect the entire economy, including agriculture. Integration with the EU was one of the impetuses behind the changes in Polish agriculture, as it compelled the sector to adapt its production mix to the requirements of the common market. However, there are significant regional variations in the scale and rate of these adaptive processes in Poland, including in agricultural modernisation and restructuring [Pietrzykowski and Wicki 2011, p. 8].

Polish agriculture distinguishes itself through its regional diversity in terms of production capacity and economic efficiency. Underlying the changes that Polish agriculture has been undergoing in recent years are many factors, both exogenous and endogenous. These include Poland's membership of the EU, the adoption of Common Agricultural Policy (CAP) mechanisms, legal considerations (concerning, in particular, animal welfare and environmental protection), global considerations for the competitiveness of the agri-food sector on international markets (including, in particular, the outcomes of WTO negotiations, the situation on the global market for raw materials and agricultural products, including non-food materials, the situation on the financial, energy and fuel markets, etc.), geopolitical changes affecting international trade in agri-food products, changes in the prices of agricultural products and input-price relationships, as well as advancements in production technology [Chavas 2011, pp. 384-385; Czudec et al. 2017, p. 52]. While it is difficult to identify the impact of these individual factors on agricultural transformations and developments, the positive role of CAP instruments is admittedly significant [Andreosso-O'Callaghan 2003, pp. 89-127].

Agriculture is integral to the economies of individual Polish regions. Its significance for regional economies should be assessed not so much on its gross GDP contribution, as on its role in realising the potential of the labour factor, and using land resources to serve the purpose of not only production but also of public-goods supply [Wilkin 2010; Czudec 2009; Czudec and Kata 2013].

Whatever the strategy for regional development, in order to meet the objective of bridging development gaps, it is essential to effect structural changes leading to better use of resources in each region and more dynamic endogenous development [Capello 2009]. Agricultural and rural resources represent an important part of regional resources in Poland. It is impossible to bring about dynamic and sustainable regional development unless these resources are efficiently used and unless agriculture is well-aligned with the regional economic structure [Czudec et al. 2017, p. 52-104].

Study aim and methodology

The aim of this study is to determine the regional variations in the significance of agriculture for the economies of individual regions in Poland. This significance is defined as the contribution of agriculture to selected regional economic factors (employment, capital expenditures, Gross Value Added, fixed-asset value) and the economic efficiency of agriculture relative to the economy of a region at large. To this end, a comparative analysis was employed, using the following measures: labour efficiency (Gross Value Added per employee), fixed-asset productivity (Gross Value Added/gross fixed asset value), technical labour equipment (the gross value of fixed assets per employee) and investment outlays per employee. The analysis covered two three-year periods – 2002-2004 (the years directly preceding Poland's accession to the EU) and 2013-2015. The aim was to determine how these measures changed over time, and to investigate whether there was convergence or divergence in the agricultural contribution to regional economies, and in its economic efficiency in these periods. The economic efficiency of agriculture was assessed with the measure of labour productivity (calculated as the ratio of gross value added to the number of persons employed in agriculture) and the productivity of fixed assets (calculated as the ratio of gross value added to the gross value of fixed assets).

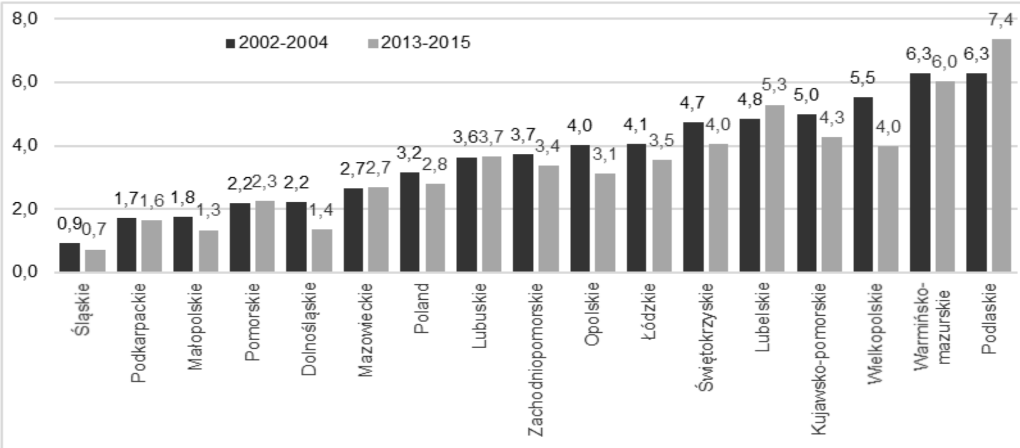
The Central Statistical Office (Statistics Poland) data from 2002-2015 was used as empirical material. CPI-based fixed prices from 2015 were used to make sure that the values in monetary terms are comparable. A hierarchical cluster analysis using Ward's method was applied to group individual regions according to the significance of agriculture for their economies. Using this method, it is possible to identify clusters of objects similar in terms of selected statistics, so that there is as little variation as possible within each cluster, and as much variation as possible between individual clusters [Hydzik and Sobolewski 2009, pp. 142-151]. Variance analysis was employed to estimate the distance between individual units [Stanisz 2007, p. 122]. Prior to the analysis, the attributes were standardised.

Results

In Poland, agriculture is a significant sector of the national economy. This significance is reflected in its contribution to the Gross Value Added of Polish economy. In the years 2002-2004, this contribution averaged 3.2 percent, and between 2013 and 2015 it shrank to 2.8 percent (Figure 1). This shows that agriculture is losing its significance as an income-generating sector of the national economy, as a result of the higher rates at which other sectors of the economy are growing. Ultimately, this proves that the economy is evolving towards a modern structure [Andreosso-O'Callaghan 2003, pp. 26-30; Mrówczyńska-Kamińska 2008,

p. 97]. There is substantial regional variation in the contribution of agriculture to Gross Value Added (Figure 1). In both periods under study (2002-2004, 2013-2015), this contribution was found to be lower than the national average in five regions – Śląskie, Podkarpackie, Małopolskie, Dolnośląskie and Mazowieckie (Figure 1). In most regions, agricultural contribution to Gross Value Added was lower in 2013-2015 than in 2002-2004 (except for the Podlaskie, Lubelskie, Lubuskie and Pomorskie regions).

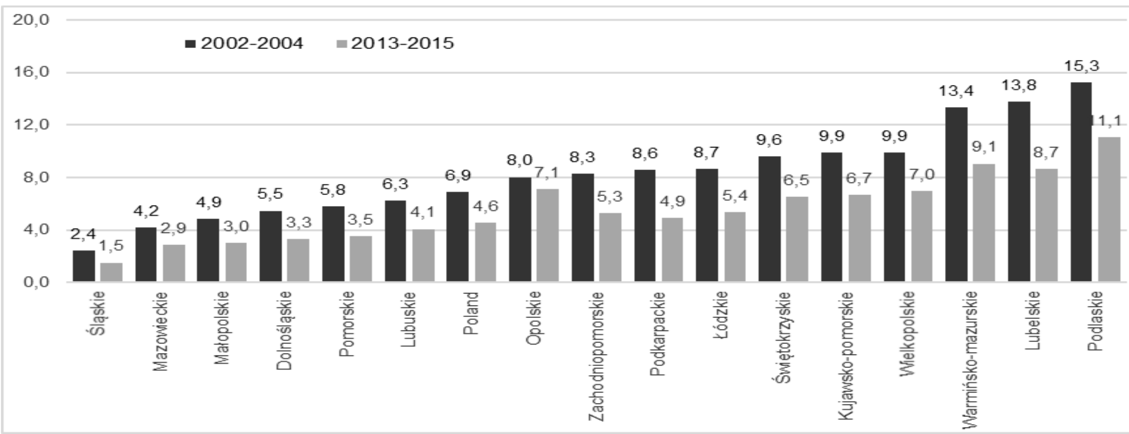
Fig. 1. Share of agriculture in Gross Value Added of individual Polish regions and of total economy of Poland [%]



Source: own calculations based on Central Statistical Office (CSO) data.

Another important indicator of the role of agriculture in the national economy is agricultural contribution to gross fixed-asset value, which was 6.9 percent in 2002-2004 and decreased to 4.6 percent in 2013-2015 (Figure 2). In regions where agriculture was a larger contributor to Gross Value Added of these regional economies, the agricultural sector also had higher fixed-asset values. It is also important to note that agricultural contribution to the value of all fixed assets in the economy was found to have decreased in all Polish regions (Figure 2).

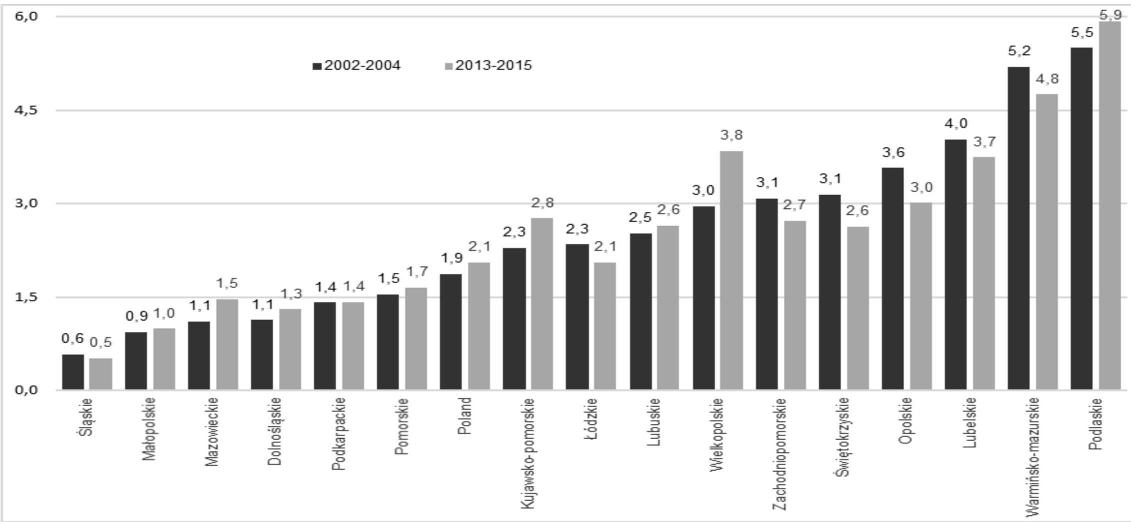
Fig. 2. The share of agriculture in gross fixed-assets value in the economy [%]



Source: own calculations based on Central Statistical Office (CSO) data.

Technical labour equipment is a function of capital expenditures. The share of agricultural investment expenditures in the investment outlays of the national economy was slightly lower in 2013-2015 than in 2002-2004 (Figure 3). More specifically, this figure increased in seven regions, in one region it remained unchanged, and in eight regions the figure decreased (Figure 3). The increase in the share of agriculture in the total investments of regional economies occurred in those regions where the scale of investment in agriculture, in the post-accession period, was the highest. A general observation can be made that the hierarchy of regions in relation to both this measure and the preceding measure is largely the same. This shows a relationship between the contribution of agriculture to Gross Value Added and its fixed asset and investment outlays levels.

Fig. 3. The share of agriculture in investment outlays in the economy [%]

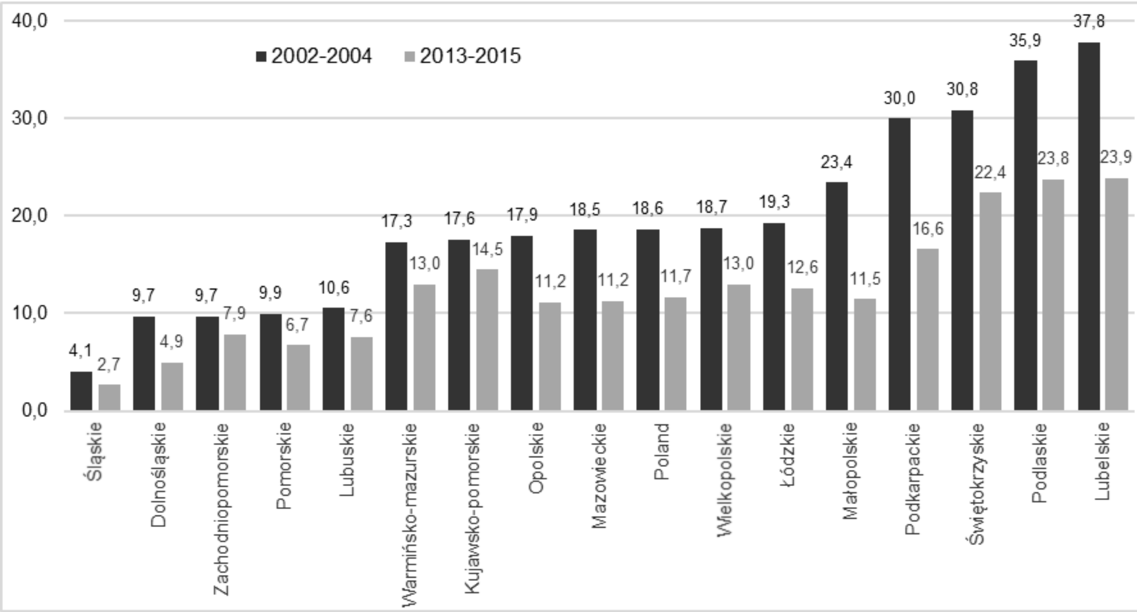


Source: own calculations based on Central Statistical Office (CSO) data.

Agricultural development mainly involves structural changes, concentration of production and the redistribution of surplus labour to non-agricultural sectors. A comparison between the 2013-2015 and 2002-2004 periods shows that the agricultural contribution to overall employment decreased from 18.6 percent to 11.7 percent (Figure 4). This rate dropped in all regions, including the most in regions with relatively high agricultural employment rates in 2002-2004. Notably, there is substantial regional variation in the agricultural contribution to employment. Śląskie region, where the level of industrialisation is the highest in Poland, had the lowest agricultural employment rate (4.1 percent in 2002-2004 and 2.7 percent in 2013-2015). In both periods under study, this indicator came below the national average in nine regions (Figure 4). For the Małopolskie region, the agricultural contribution to employment fell below the national average, whereas in the Wielkopolskie and Łódzkie regions this figure slightly exceeded the national average, which equals 11.7% (Figure

4). The agricultural contribution to employment was markedly higher in the Podkarpackie (in 2013-2015 the difference was 4.9 p.p. in relation to the national average), Świętokrzyskie (difference of 10.7 p.p.), Podlaskie (difference of 12.1 p.p.) and Lubelskie (difference of 12.2 p.p.) regions, i.e. regions with high agricultural land fragmentation and relatively low levels of economic development [Poczta and Bartkowiak 2012, p. 99; Czudec et al. 2017]. It is important to add, however, that in the periods under study, agricultural employment rates in these regions dropped the most (from 13.9 p.p. in Podkarpacie to 8.4 p.p. in Świętokrzyskie) (Figure 4).

Fig. 4. Share of agriculture in employment in the economy



Source: own calculations based on Central Statistical Office (CSO) data.

Despite this downward trend, the agricultural sector continues to be a major employer (11.6 percent), as opposed to many EU countries, where it accounts for 1-2 percent of the overall employment [Góral and Rembisz 2017, p. 120]. Reduction in agricultural employment, while maintaining at least the current level of agricultural production, is essential if the sector is to become more efficient. The modernisation, structural changes and concentration, and scaling up of production of agricultural holdings "push" labour out of agriculture. However, in order for labour resources to continue depleting, a second mechanism must be at work in which other sectors of the economy "pull" labour out of agriculture [Kusz and Misiak 2017, p. 147]. In order for this to happen, the economy must be developing at a high rate.

Technical labour equipment (capital-labour ratio) characterises the quantity of fixed assets per unit of labour (a full-time employee). A low capital-labour ratio has an adverse effect on labour efficiency [Gołaś and Kozera 2008, p. 73]. Furthermore, because of the relatively high rate at which labour costs grow compared to other factors of production, employing labour-saving technologies becomes a necessity [Mundlak 1988, p. 172; Runowski and Ziętara 2011, p. 30]. Compared to other sectors of the national economy in Poland, agriculture is characterised by a much lower capital-labour ratio, which is one of the reasons its labour efficiency is lower than in other sectors. This unfavourable disproportion was observed in both 2002-2004 and 2013-2015. Technical labour equipment increased between the periods under study in both agriculture and the national economy at large, with agriculture experiencing a slightly higher increase (Table 1). This means that the rate of modernisation and investment in agriculture is higher than in the economy at large. Nonetheless, the disproportion between agriculture and other sectors is still significant. In addition, agriculture exhibits significant regional variations in the capital-labour ratio. These disproportions are higher than in the economy at large (Table 1). Nevertheless, in the period under study (2002-2005), the difference between the regions with the highest and lowest technical labour equipment in agriculture had shrunk from a 5.6 times to a 3.8 times. This might indicate an ongoing, albeit slow, regional convergence of agriculture in terms oftechnical labour equipment.

Table 1. Technical labour equipment (thousands PLN) investment expenditures per worker (thousands PLN) in agriculture and national economy in Poland

Region	**Agriculture**			**Region**	**National economy**		
	2002-2004	**2013-2015**	**2002-2004=1**		**2002-2004**	**2013-2015**	**2002-2004=1**
	thousands PLN				**thousands PLN**		
A/ Technical labour equipment							
Zachodniopomorskie	151.3	165.4	1.09	Mazowieckie	243.1	261.8	1.08
Dolnośląskie	101.3	159.3	1.57	Pomorskie	173.1	196.7	1.14
Opolskie	87.5	133.9	1.53	Śląskie	170.1	213.7	1.26
Warmińsko-mazurskie	112.8	123.2	1.09	Opolskie	193.5	210.1	1.09
Śląskie	102.7	122.8	1.19	Dolnośląskie	179.1	236.4	1.32
Lubuskie	82.2	120.2	1.46	Warmińsko-mazurskie	146.3	176.4	1.21
Wielkopolskie	77.3	118,9	1.54	Wielkopolskie	146.0	221.8	1.52
Pomorskie	102.2	103.1	1.01	Zachodniopomorskie	175.0	246.1	1.41
Podlaskie	58.6	84.5	1.44	Podlaskie	138.1	181.2	1.31
Kujawsko-pomorskie	69.7	83.8	1.19	Lubuskie	138.5	219.7	1.59
Łódzkie	53.2	68.6	1.28	Małopolskie	128.8	185.4	1.44
Mazowieckie	55.7	67.1	1.22	Świętokrzyskie	129.5	147.9	1.14
Podkarpackie	34.4	53.1	1.56	Łódzkie	118.7	159.9	1.35

Lubelskie	39.7	51.6	1.30	Podkarpackie	120.0	180.4	1.50
Małopolskie	26.7	49.4	1.84	Lubelskie	109.1	141.7	1.30
Świętokrzyskie	40.4	43.1	1.07	Kujawsko-pomorskie	123.5	180.6	1.46
Poland	**59.0**	**80.0**	**1.36**	**Poland**	**158.37**	**204.84**	**1.29**
B/ Investment expenditures per worker							
Zachodniopomorskie	3.23	6.49	2.01	Mazowieckie	18.08	20.48	1.13
Dolnośląskie	1.60	5.23	3.27	Lubuskie	9.32	12.99	1.39
Wielkopolskie	1.86	4.88	2.62	Pomorskie	11.61	16.26	1.40
Warmińsko-mazurskie	2.46	4.70	1.91	Dolnośląskie	13.63	19.81	1.45
Lubuskie	2.22	4.55	2.05	Wielkopolskie	12.01	16.59	1.38
Opolskie	1.69	4.38	2.59	Zachodniopomorskie	10.10	18.80	1.86
Pomorskie	1.81	4.00	2.21	Śląskie	11.31	15.52	1.37
Podlaskie	1.13	3.39	3.00	Opolskie	8.50	16.59	1.95
Śląskie	1.60	3.03	1.89	Małopolskie	9.46	14.65	1.55
Mazowieckie	1.09	2.67	2.45	Warmińsko-mazurskie	8.20	12.90	1.57
Kujawsko-pomorskie	1.01	2.63	2.60	Podkarpackie	7.79	14.39	1.85
Łódzkie	0.93	2.17	2.33	Kujawsko-pomorskie	7.72	14.25	1.85
Lubelskie	0.57	1.62	2.84	Świętokrzyskie	7.51	9.08	1.21
Małopolskie	0.38	1.27	3.34	Podlaskie	7.47	13.62	1.82
Podkarpackie	0.37	1.24	3.35	Lubelskie	5.30	10.24	1.93
Świętokrzyskie	0.77	1.06	1.38	Łódzkie	7.7	13.34	1.73
Poland	**1.08**	**2.77**	**2.56**	**Poland**	**10.72**	**15.76**	**1.47**

Source: own calculations based on CSO data.

An increase in the capital-labour ratio is a result of an increase in capital expenditures per employee. For agriculture, this parameter is much lower than for the national economy (Table 1). Between 2002 and 2004 the value of investment outlays per employee differed by 10 times, whereas over 2013-2015 the difference had shrunk to 5.7 times. The differences between the national economy and agriculture in regional breakdown are, however, much larger. The largest disproportions in this respect between 2002 and 2004 were recorded for the Małopolska and Podkarpacie regions (a difference of 24.9 times and 21.1 times). Conversely, the smallest differences in investment expenditures per employee were observed in the Zachodniopomorskie and Warmińsko-Mazurskie regions (by a factor somewhat greater than 3). Between 2013 and 2015 the largest and smallest differences in capital expenditures per employee were recorded for the same regions, although the disproportions were smaller (from 2.7 times to 11.6 times). These disproportions had shrunk, to varying degrees, in all regions.

As technical labour equipment improves, so should labour efficiency, defined as the relationship between outputs per unit of labour. This study took Gross Value Added as the measure of output, as it is available in public statistics as an income category. Labour efficiency in both agriculture and the national economy was higher in 2013-2015 than in 2002-2004, but agriculture experienced a higher rate of growth in labour efficiency (Table 2). This is a positive development for the development of this sector. What remains problematic is that agricultural labour efficiency varies considerably between regions – much more considerably than in the case of the regional economy at large. For regional economies, the increase in labour efficiency ranged from 36 percent to 51 percent, while agricultural labour efficiency increased by a mere 3 percent (Dolny Śląsk) or as much as 88 percent (Podlasie).

The lowest agricultural labour efficiency was recorded in the Podkarpacie region, while Zachodniopomorskie region had the highest agricultural efficiency. These are data for both periods under study – in 2002-2004 the difference in labour efficiency between the most and least efficient regions was 9.5 times, and in 2013-2015 it decreased to a factor of slightly over 8 times. The substantial agricultural labour-efficiency differences between regions continue to exist, and the rate at which they are decreasing is too slow. A faster increase in labour efficiency would be particularly desirable in regions with fragmented agriculture. It is also important to note that the labour efficiency of Polish agriculture is considerably below the EU average, thus making it less competitive internationally [Poczta et al. 2009, p. 48].

Table 2. Gross value added per working person (thousands PLN) in agriculture and national economy in Poland

Region	**Agriculture**			**Region**	**National economy**		
	2002-2004	**2013-2015**	**2002-2004=1**		**2002-2004**	**2013-2015**	**2002-2004=1**
	thousands PLN				**thousands PLN**		
Zachodniopomorskie	31.79	39.43	1.24	Mazowieckie	95.92	144.50	1.51
Lubuskie	27.00	36.36	1.35	Śląskie	84.17	116.12	1.38
Warmińsko-mazurskie	25.81	35.33	1.37	Dolnośląskie	83.35	124.89	1.50
Pomorskie	18.70	30.62	1.64	Wielkopolskie	74.69	106.73	1.43
Mazowieckie	16.43	29.82	1.81	Kujawsko-pomorskie	71.69	98.52	1.37
Wielkopolskie	24.04	28.71	1.19	Pomorskie	82.20	113.72	1.38
Kujawsko-pomorskie	20.11	26.88	1.34	Zachodniopomorskie	80.43	110.56	1.37
Opolskie	17.42	22.46	1.29	Opolskie	74.03	104.35	1.41
Podlaskie	11.29	21.26	1.88	Łódzkie	67.52	99.71	1.48
Dolnośląskie	20.04	20.68	1.03	Lubuskie	78.09	104.70	1.34

Region	Agriculture			Region	National economy		
	2002-2004	2013-2015	2002-2004=1		2002-2004	2013-2015	2002-2004=1
	thousands PLN				thousands PLN		
Łódzkie	12.91	18.72	1.45	Warmińsko-mazurskie	70.97	96.62	1.36
Śląskie	12.81	15.65	1.22	Małopolskie	68.00	95.95	1.41
Lubelskie	7.06	12.03	1.70	Świętokrzyskie	59.41	82.00	1.38
Świętokrzyskie	8.50	10.73	1.26	Podlaskie	59.73	86.14	1.44
Małopolskie	5.38	6.89	1.28	Podkarpackie	57.45	81.26	1.41
Podkarpackie	3.32	4.88	1.47	Lubelskie	55.16	78.44	1.42
Poland	**13.54**	**19.56**	**1.44**	**Poland**	**76.22**	**109,54**	**1.44**

Source: own calculations based on CSO data.

In 2002-2015 both the national economy and agriculture experienced an increase in fixed-asset productivity expressed as the relationship between Gross Value Added and the gross fixed-asset value (Table 3). This increase was larger for agriculture than for the national economy at large, but the ratio was still substantially lower for agriculture than for the national economy in 2002-2004, as well as in 2013-2015. However, this gap had been bridged considerably in many regions, or eliminated altogether, as in the case of Mazowieckie region. This means that fixed-asset productivity in agriculture can be substantially improved to a level that is close to that of the national economy.

Table 3. Gross value added in relation to the gross value of fixed assets (%) in agriculture and national economy in Poland

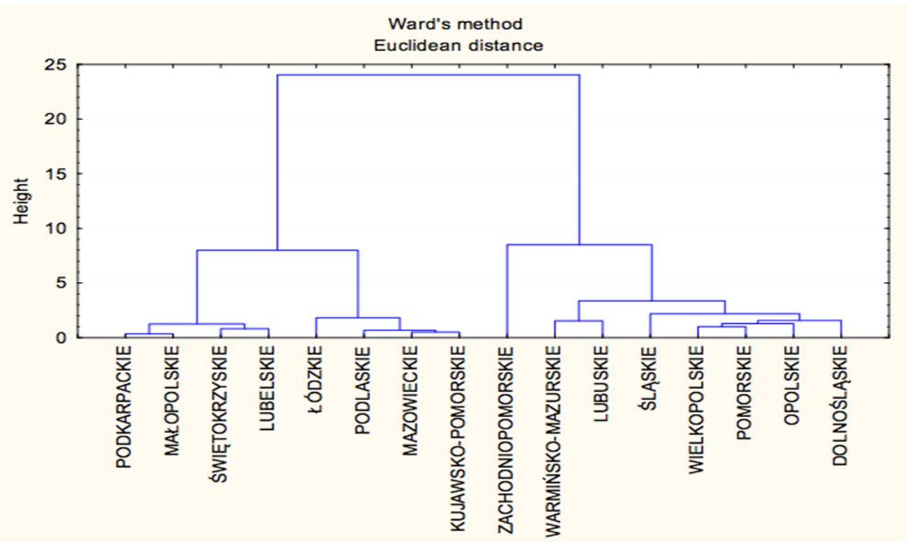
Region	Agriculture			Region	National economy		
	2002-2004	2013-2015	2002-2004=1		2002-2004	2013-2015	2002-2004=1
Podkarpackie	8.91	13.94	1.56	Opolskie	35.42	41.49	1.17
Lubelskie	14.50	25.81	1.78	Podlaskie	39.19	40.23	1.03
Podlaskie	16.33	26.70	1.64	Lubelskie	41.09	42.27	1.03
Małopolskie	17.33	21.66	1.25	Warmińsko-mazurskie	41.98	43.03	1.03
Pomorskie	17.54	30.65	1.75	Zachodniopomorskie	42.22	40.90	0.97
Opolskie	17.86	18.23	1.02	Świętokrzyskie	42.39	42.88	1.01
Dolnośląskie	18.73	20.42	1.09	Mazowieckie	42.90	49.81	1.16
Zachodniopomorskie	19.08	25.94	1.36	Podkarpackie	44.35	41.87	0.94
Śląskie	19.38	22.95	1.18	Lubuskie	45.51	37.78	0.83

Region	**Agriculture**			**Region**	**National economy**		
	2002-2004	**2013-2015**	**2002-2004=1**		**2002-2004**	**2013-2015**	**2002-2004=1**
Warmińsko-mazurskie	19.87	28.60	1.44	Dolnośląskie	46.41	49.73	1.07
Świętokrzyskie	21.07	26.58	1.26	Pomorskie	46.91	47.67	1.02
Łódzkie	22.70	30.51	1.34	Małopolskie	47.49	49.35	1.04
Kujawsko-pomorskie	25.27	30.00	1.19	Łódzkie	47.93	46.36	0.97
Lubuskie	26.75	33.83	1.26	Wielkopolskie	49.40	50.09	1.01
Mazowieckie	27.02	46.01	1.70	Kujawsko-pomorskie	49.49	47.04	0.95
Wielkopolskie	27.88	28.50	1.02	Śląskie	50.34	48.24	0.96
Poland	**20.83**	**28.66**	**1.38**	**Poland**	**45.41**	**46.93**	**1.03**

Source: own calculations based on CSO data.

Based on the variables related to the economic efficiency of agriculture (Tables 1, 2 and 3), as discussed above, the regions were grouped into three more-or-less uniform sets (clusters) using Ward's cluster analysis method [Stec et al. 2005, p. 141].The dendrogram in Figure 5 illustrates the results of this grouping. The first cluster included Podkarpackie, Świętokrzyskie, Małopolskie and Lubelskie regions, i.e. regions with the lowest economic efficiency of agriculture and the poorest productivity, attributable to the fragmentation of agricultural land. The second cluster comprised Mazowieckie, Podlaskie, Łódzkie and Kujawsko-Pomorskie regions and the third cluster included Zachodniopomorskie, Warmińsko-Mazurskie, Pomorskie, Wielkopolskie, Lubuskie, Śląskie, Opolskie and Dolnośląskie regions.

Fig. 5. Groups of regions in the aspect of economic efficiency of agriculture and the share of agriculture in the economy



Source: own calculations based on CSO data.

Agriculture in cluster-1 regions exhibited a relatively high contribution to employment, much lower labour-capital ratios and low capital expenditures per employee (Table 4). In the remaining two clusters, economic efficiencies were much higher, with cluster-3 regions standing out above other Polish regions in terms of higher capital-labour ratios, high capital expenditures per employee, a lower agricultural contribution to employment and high labour efficiencies. Cluster-2 regions had the strongest agricultural sectors in terms of their contribution to regional economies and the highest fixed-asset productivity (Table 4).

Table 4. Average annual values of selected features of agriculture and a region's economy in separated clusters of regions

Variables	Cluster 1	Cluster 2	Cluster 3
A/ Agriculture			
Share of agriculture in gross value added	3.27	4.63	3.26
The share of agriculture in the gross value of fixed assets	7.42	8.00	6.22
Share of agriculture in investments	2.20	2.82	2.41
Share of agriculture in employment	24.7	18.33	9.94
Technical labour equipment in agriculture [thousands PLN]	39.81	68.32	114.70
Investment expenditures per one employee [thousands PLN]	0.82	1.92	3.12
Labour efficiency in agriculture [thousands PLN]	7.79	20.24	25.60
Productivity of fixed assets [%]	20.42	29.73	24.22
B/ Region's economy			
Technical labour equipment in agriculture [thousands PLN]	135.56	169.92	181.68
Investment expenditures per one employee [thousands PLN]	12.11	15.42	15.98
Labour efficiency in agriculture [thousands PLN]	72.89	90.96	94.93
Productivity of fixed assets [%]	46.21	47.64	47.10

Source: own calculations based on CSO data.

An analysis of the individual characteristics of agriculture in the respective regions showed that a lower agricultural contribution to employment is coupled with a higher capital-labour ratio and higher capital expenditures per employee, leading to increased labour efficiencies. The study results also show that there is a link between the economic development of a region and agricultural development (Table 4). It is evident that in regions experiencing higher rates of economic development, the economic efficiency of agriculture is higher as well.

Table 5. R – Spearman correlation coefficients between variables characterising agriculture and the economy of each region

Variables	Region's economy			
	Technical labour equipment	**Investment expenditures per employee**	**Labour efficiency**	**Productivity of fixed assets**
Technical labour equipment in agriculture	0.5482*	0.4220*	0.4915*	-0.0471
Investment expenditures per employee in agriculture	0.5095*	0.4766*	0.4864*	-0.1342
Labour productivity in agriculture	0.4998*	0.4588*	0.5304*	-0.0037
Productivity of fixed assets in agriculture	0.3673*	0.4956*	0.5782*	0.3305*
Share of agriculture in gross value added	-0.3334*	-0.3243*	-0.3986*	-0.3779*
The share of agriculture in the gross value of fixed assets	-0.5539*	-0.5937*	-0.6882*	-0.4518*
Share of agriculture in investments	-0.2169*	-0.3882*	-0.3806*	-0.5528*
Share of agriculture in employment	-0.6069*	-0.6557*	-0.7458*	-0.3908*

* significant for $p<0,05$

Source: own calculations.

A statistical analysis of the correlations between the investigated characteristics of agriculture and regional economies shows that there is a positive correlation between most variables describing the condition of regional economies and the variables describing the economic efficiency of agriculture. This includes technical labour equipment in agriculture, investment expenditures per employee, labour efficiency and fixed-asset productivity (Table 5). It is also important to note the negative correlations between the efficiency of regional economies and the agricultural contribution to regional economies. With regional economies developing, agricultural contribution to Gross Value Added, fixed-asset value, investment outlays and employment in these economies decreases. These findings corroborate the correlations described in the literature [Mrówczyńska-Kamińska 2008; Poczta and Bartkowiak 2012; Czudec et al. 2017].

Summary

1. Between 2002 and 2015 agriculture became less significant for regional economies, in that it contributed less to Gross Value Added and the fixed-asset value. This proves that the rate of structural changes was higher for the economy at large than for agriculture. Similarly, agriculture has been contributing less to employment, although the sector continues to be

a major employer. This is attributable to the unfavourable socio-economic structure of Polish agriculture, including in particular the high fragmentation of farms in many Polish regions.

2. The study found that labour efficiency in agriculture varied considerably between regions, much more than in respect of regional economies at large. National economic policies should prioritise increasing agricultural labour efficiency in Poland, since agriculture's weakness in this respect impedes regional income convergence.
3. Also, the study found a positive correlation between the state of economic development of individual regions and the economic efficiency and productivity of agriculture. Higher levels of regional economic development allow regions to fast-track changes in the relationship between agricultural factors of production, leading to increased labour efficiency and fixed-asset productivity. In addition, this helps to mitigate the structural barriers in agriculture more effectively, but above all it facilitates the reduction of redundant labour.

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Changes in the use of production services in agriculture in the context of meeting the targets for sustainable agricultural development

Małgorzata Kołodziejczak
Poznan University of Life Sciences, Poland
ORCID: 0000-0001-5615-5560, e-mail: malgorzata.kolodziejczak@up.poznan.pl
Walenty Poczta
Poznan University of Life Sciences, Poland
ORCID: 0000-0002-7592-7412, e-mail: poczta@up.poznan.pl

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Abstract: The essence of sustainable agriculture is to orchestrate production, social and environmental objectives. The pursuit of sustainable agricultural development requires the use of optimum manufacturing processes, which should be cost-effective and environmentally-friendly. To do so, it is useful, if not necessary, to supplement a farm's production potential. The use of production services is an alternative to investing in technical farming equipment or to purchasing some productive inputs. It is therefore worth considering how, and to what extent, production services in agriculture may support the pursuit of sustainable manufacturing processes. The aim of this paper is to present the changes in the use of selected production services in agriculture against the background of the concept of sustainable agriculture. Also, this paper attempts to answer the question of the role of services in pursuit of sustainability in the agriculture sector. The following was considered: the relationships between production services and the implementability of the sustainable agriculture model; and the level of (and changes to) the use of these services in EU countries demonstrating different levels of economic development, different natural conditions and different agricultural production patterns. The analysis was based on a deductive method and correlation analysis. The study was based on relevant literature and statistical data. The average use of production services is greater in the agriculture of EU-15 than in EU-10 countries. This suggests a relationship between economic development levels (including agricultural ones) and the use of production services. In EU-15 countries, there is evident correlation between the use of services and fixed capital formation. In the EU-10, that correlation is weaker for agricultural services, but tends to be stronger for veterinary services. The use of production services may support the pursuit of sustainable agricultural development, provided that farm managers take sustainability into consideration in their decisions.

Keywords: production services, sustainable development, sustainable agriculture

JEL: Q16, Q19

Introduction

In the broad context of economic transformation affecting national and international economies, the sustainable development paradigm becomes particularly important for agriculture. According to Pawlak [2008, p. 13] the essence of sustainable agriculture *is to orchestrate production, social and environmental objectives*. From that perspective, it is of key importance to ensure the implementation of optimum manufacturing processes which should be cost-effective and environmentally-friendly[1]. To do so, it is useful, if not necessary, to supplement a farm's production potential. The use of production services is an alternative to investing in technical farming equipment or to purchasing some productive inputs. It is therefore worth considering how, and to what extent, production services in agriculture may support the pursuit of sustainable manufacturing processes. To answer that question, the following was considered: the relationships between production services and the implementability of the sustainable agriculture model; and the level of (and changes to) the use of these services in EU countries demonstrating different levels of economic development, different natural conditions and different agricultural production patterns. This is an important issue, because in the domestic and foreign literature on services there are almost exclusively theoretical and empirical analyses of a general nature, not referring to such a specific sector of the national economy as agriculture.

Methods and materials of the study

The aim of this paper is to present the changes in the use of production services in plant and animal production against the background of the sustainable agriculture concept. Also, this paper attempts to answer the question on the role of services in the pursuit of sustainability in the agriculture sector. For this reason, the article consists of two parts: the first one is a theoretical discussion, and the other one covers empirical analysis.

The empirical part of this paper presents quantitative characteristics of production services used in agriculture in specific member countries of the European Union. Two groups of services used in plant and animal production were selected for this study: agricultural services (for third parties) and veterinary expenses, as defined in EU legislation (*Regulation (EC)* No. 138/2004):

- agricultural services constitute the hire of machines and equipment with the

[1] Based on the *Our Common Future* report, Zegar (eds., 2013, p. 9) states that: *the requirement for implementing the idea of sustainable development is a certain level of economic development which, in the case of most countries around the world, also means economic growth. This is necessary in order to improve the quality of living and economic well-being which, in turn, raise awareness and increase public pressure on environmental issues. However, as a critical element of the sustainable development concept, economic growth cannot go beyond the potential of the global ecosystem (biosphere). To this end, having in mind demographic trends, three lines of action need to be pursued simultaneously. The first and the most important one is to intensify the creation and use of innovations, especially including technologies for more efficient use of available natural resources. The second one means measures taken to rationalise per capita consumption as regards both consumption levels in wealthy societies and the level of total capital: human capital and natural capital (assuming the two kinds of capital are substitutable by each other to a virtually unlimited extent). According to the requirements of the strong sustainability concept, each of the two kinds of capital (economic and natural) must be preserved separately (as they are not fully interchangeable). Also, critical natural capital (ecosystems and natural assets necessary in order to sustain the vitality and the patterns of consumption) must be preserved. The third line of action is represented by measures taken to reduce losses and wastage throughout the product's lifecycle.*

corresponding labour (*services for third parties — e.g. the renting and repair of agricultural machinery, irrigation projects, agricultural advisory services, product storage, maintenance of farm buildings, commercial services relating to agricultural products, transport of agricultural products, etc. These services are recorded as secondary activities, only if they are performed for a third party. When performed for own account, they are ancillary activities, which are not recorded in the accounts*). Due to the availability of data in the EUROSTAT database, only agricultural services related to plant production (which constitute the hire of machines and equipment with the corresponding labour) are included in the empirical part of the article;

– *veterinary expenses – medicines which are invoiced separately from the veterinary surgeon's fee should be recorded here (medicines administered directly by the veterinary surgeon are recorded with his fee and veterinary costs).*

The analysis was based on a deductive method and correlation analysis[2]. The study was based on data delivered by EUROSTAT, the Statistical Office of the European Union, and on relevant literature. The territory covered by this study are European Union countries. The period covered is 2000-2016. The starting point of the analysis was chosen to take into account the situation before the enlargement of the EU, while the last available data from EUROSTAT resources is related to 2016.

Theoretical background and discussion

The essence of production services used in agriculture

The definition of production services came later than the services themselves. The relevant terms were formalised because of the need to describe the reality for the purposes of farming activities and academic research. Another reason was the need to retrieve information for planning purposes. Several positive[3] definitions exist of production services in agriculture. Rogoziński [2000, p. 60] defined production services as *cooperation activities in the production process (...) which consist in increasing the use value of goods manufactured by undertakings, or in facilitating a production process*[4]. In the case of production services in agriculture, an operator external to the farm considered must be involved in the production process. Note also that the criterion of participation in production processes does not necessarily mean the physical involvement of the service concerned. The service only needs to contribute

[2] These are commonly known methods, so they do not require detailed description.
[3] Positive definitions identify services based on their characteristics which refer to addressing the needs of humans or production processes, usually by performing an act. A negative definition is based on negation; it specifies what a service is not, and states that if the negative conditions are not met, the act in question is a service.
[4] See: Ilnicki (2009, p. 40).

to the final result (i.e. the product). Therefore, production services in agriculture include agricultural services related to soil cultivation, veterinary services, maintenance of machinery and equipment used in production, financial services (if related to production) and consultancy services (if affecting production outcomes). Obviously, the above is a non-exhaustive list.

Sustainable development and sustainable agriculture

In the 1970s and 1980s, the progressing industrialisation of agricultural production disrupted the natural harmony between agriculture and the natural environment. The industrial agricultural model was dominated by economic aspects which inevitably led to an increase in the efficiency and intensity of agricultural production. This, in turn, resulted in soil degradation, increased environmental pollution and degradation of ecosystem biodiversity. The development of sustainable agriculture was a concept built to address the threats entailed by those adverse events [Kalinowski 2013, p. 113]. It was a part (and essentially a further detailing) of a broader definition of sustainable development with respect to social, economic and environmental aspects [Zegar 2007, p. 297]. B. Czyżewski [2012, p. 168] states that the essence of sustainable development is a Pareto-efficient progress. This means that monetised productivity needs to be aligned with the progressive implementation of environmental and social objectives. However, in this case, the necessary condition is to restructure the basket of *utility sold by producers* in order to take better account of environmental and social aspects. The improved quality of food and non-agricultural services (e.g. leisure or supply of renewable energy) may become new values which partially offset or supplement the drop in farming incomes caused by the need to incur environmental protection costs[5].

The objectives sought by agriculture are related not only to food production (the productive function) but also to new functions of agriculture and to rural development (non-productive functions) laying the grounds for multifunctional sustainable development, i.e. a process that takes economic, social and environmental criteria into account [Zegar 2005, p. 8, Wilkin 2010, p. 11-15, Kowalczyk and Sobiecki 2011, p. 35]. As the sustainable development paradigm is now widely adopted, that fact is becoming increasingly recognised. The concepts of the sustainability and multifunctionality of rural areas lie at the core of the CAP [Kulawik 2015, s. 48]. This is why financing is provided under the CAP for measures related to agricultural services delivery[6]. Another factor that drives the use of services is farm

[5] In this case, preventive measures taken by the government (which consist in imposing specific requirements and promoting the awareness of sustainable development) must be accompanied by a grass-roots process redefining the needs of consumers (B. Czyżewski 2012, p. 169).
[6] In 2007-2013, as a part of axis 3 on the "quality of life in rural areas and diversification of the rural economy,"

modernisation and increased technical potential, which largely results from aid disbursed under the CAP. Generally, although some forms of financing (e.g. area payments) are criticised, each of them contributes to increasing the amount of funds available to the farmers. This is why raising the awareness of farmers is just as important as the payments themselves, so that their decisions regarding allocation of funds are consistent with the sustainable agriculture concept and the European agricultural model[7].

How do production services in agriculture support the evolution towards sustainable agriculture?

Agricultural production is the result of three factors of production: labour, land and capital, which may be substituted[8] for each other within certain limits. Components of a specific factor of production may also be substituted for each other, as illustrated by the example of services used instead of the farmers' own agricultural equipment. Generally, a farm may attain a specific production result using various combinations of factors of production and of their components; the combination is determined by the prices of inputs concerned, resulting from the abundance of relevant factors of production and their components. A situation defined by large resources of labour and a deficiency of capital will be conducive to increased use of the abundantly available factor of production (labour). In this case, capital expenditure (including purchase of services) will be smaller, often limited to measures increasing the productivity of land. Because the agricultural goods output must continue to grow, the reduction

two measures were implemented to support the creation and development of non-agricultural activities (including services for farms): measure 3.1.1 "Diversification into non-agricultural activities" and measure 3.1.2 "Formation and development of micro-enterprises". In the 2014-2020 Financial Perspective, measure 8.2.6 (M06) "Development of farms and economic activity" includes measure 8.2.6.3.5 "Development of entrepreneurship – development of agricultural services" with a sub-measure "Support for investments in the creation and development of non-agricultural activities" which enables applying for funds to support investments in activities consisting in the delivery of agricultural services. Support will be allocated to operations which contribute the most to improving the availability of state-of-the-art agricultural services offered to small farms, and to implementing the EU's horizontal priorities. Therefore, preferential procedures were put in place for operations which contribute to implementing the European Union's priorities:

- innovativeness, by launching new services or changing the technology of services offered with the use of new machinery and equipment that has so far not been used by the service provider concerned;
- combating climate change, by delivering the services with the use of technologies, machines, devices and equipment which reduce the environmental impact; the organisation of service delivery needs to be based on low-carbon solutions that improve resource, energy and water efficiencies.

Aid shall be granted to operators who did not access support under either of the following measures: "Diversification into non-agricultural activities" or "Formation and development of micro-enterprises" covered by the 2007-2013 RDP. The investments shall be implemented in districts with highly fragmented structure of agricultural land (*Rural Development Program 2014-2020* 2014, p. 145-146).

[7] As pointed out by many authors, including A. Czyżewski (2013a, p. 835), an alternative path for agricultural development is not appropriate to reach the economic, social and environmental objectives in the long run.

[8] In addition to the above factors of production, entrepreneurship or human capital are cited in some sources (e.g. Marks-Bielska and Babuchowska 2015, p. 9).

of the farms' labour resources and the increase in costs thereof result in the growing importance of capital expenditure, especially if it enables an increase in labour productivity, e.g. by providing the employees with agricultural machinery and equipment. In turn, the increased availability of fixed assets drives increased demand for production services related to the creation, use and employment of such assets for production purposes (e.g. repair and maintenance services)[9]. At the same time, if capital expenditure is partially allocated to services rather than to the farm's own assets, it may reduce the production costs (and make them more flexible because of the reduction in fixed costs related to the purchase, ownership and use of own machinery and equipment). This is in line with the objective of seeking economies of scale in production processes and improving the economic outcomes of farming[10].

The pursuit of sustainable agricultural production, as an essential part of the broader process of developing a sustainable agriculture, requires the optimisation of production processes as regards both economic efficiency and compliance with social and environmental objectives. Production services may considerably contribute to that optimisation.

Since the very beginning, agricultural manufacturing processes have been a driver of technical progress, have contributed to a general increase of awareness among agricultural producers, and have played a major role in regulating farming incomes, thus improving the living and working conditions of the rural population[11]. The income-generating function of services is important for the stimulation of consumption and agricultural development, both of which depend not only on the levels of internal accumulation of capital and labour productivity in agriculture, but also on total national income. The resources of state-of-the-art productive inputs and manufacturing techniques delivered to farms through production services have led, and continue to lead, to the rationalisation of the mix of productive inputs and production growth drivers and, as a consequence, to an increase in business income and in the accumulation fund which is mostly allocated to investments stimulating the growth of farms' production potential. If appropriate technological regimes are adhered to, the above resources may also contribute to improving the quality of food production and to reducing the adverse environmental impacts of production processes. By offering jobs to members of farming families, the developing service sector becomes an alternative source of income. Also, as it takes over a part of the underutilised farming labour force, it determines the productivity growth

[9] This reflects the complementarity of inputs which also becomes apparent in a situation where the growing consumption of fertilisers and plant protection products (aimed at improving land productivity) boosts the demand for related work (whether performed internally or contracted).
[10] Cf. Cieśla, Kowalska-Grudzień and Kruczek-Patko (1987, p. 92-93).
[11] When used creatively, knowledge resources do not only contribute to social and economic development but are also a way to enhance competitiveness (Firlej and Żmija 2014, p. 9).

of other farm employees. With their income-generating function, production services do not just promote an increase in farms' economic strength and an improvement of the farming population's living conditions. They also drive the farmers' interest in joint projects and accelerate the horizontal integration of agriculture, enabling collective price negotiations and the shared use of technical productive inputs. Furthermore, they stimulate the release of excessive labour from the agricultural sector. The resulting benefits include reduced unit production costs and increased personal incomes. The technical and organisational progress allows the farms to upgrade their existing production facilities, eliminates hard work in harmful conditions and makes working more comfortable. By changing the nature of work and enhancing the attractiveness of the farming profession, it streamlines the structure of agricultural employment by age and education[12]. Also, it contributes to reducing the environmental impact of production processes.

Therefore, it will be more difficult to meet the sustainable agriculture requirements if the farms fail to tap into the potential and knowledge of service providers. First of all, in the long run, it is neither reasonable nor economically viable to continue using the resources of agricultural machines mostly composed of obsolete, end-of-life equipment. This is especially true if the service delivered with the use of newer, more powerful equipment is not only cheaper but also drives better production, environmental and social outcomes. Secondly, while improving the quality of a farm's own machinery (e.g. by purchasing newer, more powerful tractors and agricultural machines) and of other fixed assets (e.g. livestock buildings and related equipment) is a way to reduce the use of direct production services, it requires assistance from providers of other services (for instance, when it comes to servicing technically sophisticated machinery and equipment). Thirdly, the need to comply with technological production regimes makes it necessary to seek assistance from specialised service providers (e.g. veterinary or maintenance services). Fourthly, because of the service providers' knowledge and potential, services (including consultancy) often drive innovations which translate into environmental, economic and technological benefits.

Changing the mindset[13] is the first step required in shifting from industrial

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[12] Cf. Wojciechowska (1979, p. 32-33).

[13] Legiędź (2012, p. 41) states that (…) *the markets are imperfect, trade information is incomplete, transaction costs are considerable, and market players are guided by their subjective mindsets formed by historical developments and existing ideologies. Therefore, just as it often happens in real life, the selected development path may remain ineffective in the longer term. The operators may shift to another path only if they change their perceptions as a result of a slow evolution of formal and informal principles.* The above is consistent with Hayek's opinion (1948, p. 90) on the role of non-economic drivers of human behaviour affecting allocation decisions. Cf. Siebenhüner (2000, p. 15-25), Kiełczewski (2016, p. 269-276). The evolution of the abovementioned formal and informal principles is manifested not only at institutional and economic level but also (if not primarily) by a shift

to sustainable[14] agricultural processes. After that, adequate legal regulations must be adopted and an implementation framework must be established. The next step is to take measures which have not yet been applied, or to promote wide adoption of measures taken so far by only a few farms. To do so, sources of funding must be found to finance the changes. Then, measures need to be taken to comply with the requirements of the sustainable agriculture concept. At macro level, this requires political and systemic actions, whereas the key aspect for farms is their adaptability to the new operational concept and their technical capacities. This is where services become helpful, if not essential (because of farms' limited potential). It can therefore be concluded that services provide help for any kind of agricultural production and are an integral, often essential part of sustainable agriculture[15].

The results of empirical research and discussion

The use of services grows in line with economic development; this pattern is definitely true in the long term (at least several decades) [Kołodziejczak 2016, p. 192]. However, over a shorter time scale, it may be subject to fluctuations. Therefore, data collected over a period of several or ten to twenty years does not warrant the conclusion that a causative link exists between the two aspects. However, specific countries and country groups may be compared to each other in an attempt to find a pattern. Such groups may be created by aggregating the "old" and "new" EU countries, i.e. by extracting the UE-15 and UE-10 aggregates from the EU-25. Figure 1 shows the evolution of average values of agricultural services and veterinary expenses over the 2000-2016 period in the groups considered, per hectare of agricultural land and per AWU[16] (or per EUR 1,000 worth of agricultural goods output in Figure 2). First of all, note that the values presented in Figure 1 are considerably lower for EU-10 countries[17].

Despite the relatively short period, a growth in the value of services is also noticeable,

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in human attitudes. This is related to the market players' evolution from *homo oeconomicus* to *homo sustinens*, as described by Kraciuk (2015, p. 211-219).

[14] For a broader description, see A. Czyżewski (2013b, p. 1-24).

[15] A. Czyżewski (2013a, p. 834) states that *the shift from industrial to sustainable agriculture is inevitable in the long term. Today, it becomes necessary to set up ethical and social barriers that restrict the development of industrial agriculture. As the sustainable development paradigm becomes widely adopted and as the supply becomes constrained, it will be easier to overcome the barriers to demand for food. Obviously, the demand will remain rigid and restricted, and its income elasticity will remain low. Nevertheless, the agricultural adaptation mechanism will put a stronger focus on the allocation of productive inputs in line with the requirements of environmental welfare (...). However, there may be various forms of sustainable agriculture because its productive function will be combined with the following aspects: multifunctionality of family-owned farms; organic production processes; promoting a living countryside; improving the quality of food; or symbiosis with the natural environment.*

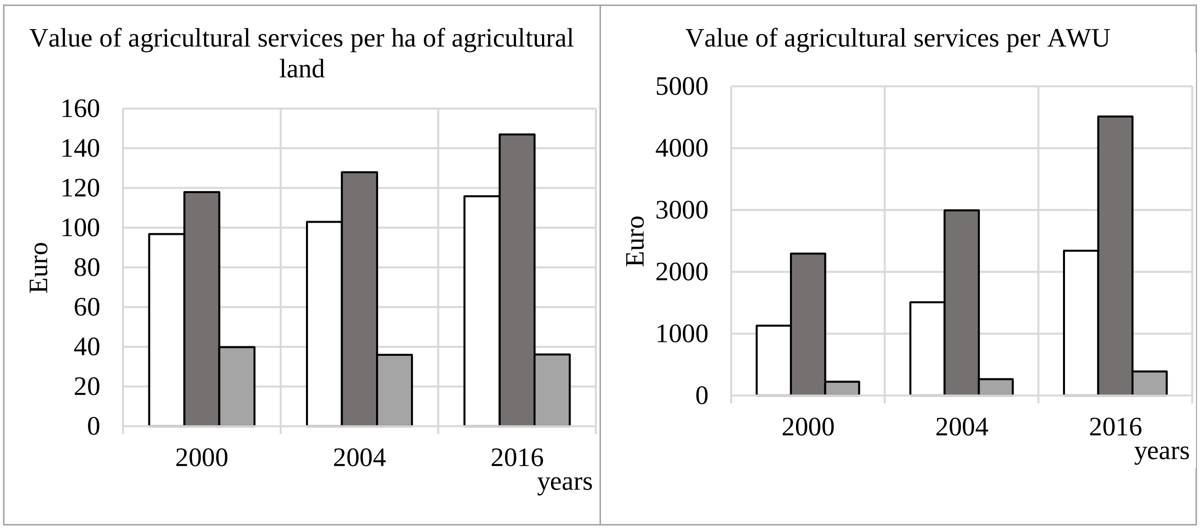
[16] AWU (Annual Work Unit) means the total amount of own and hired labour, i.e. 2,120 hours of work within a year (265 working days, 8 hours each).

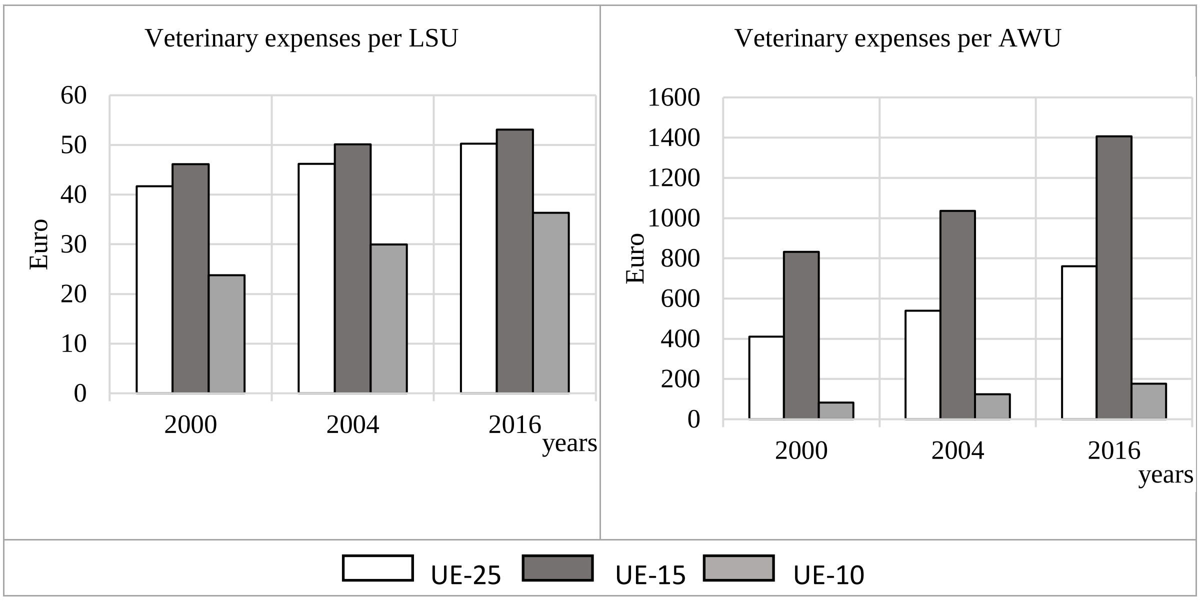
[17] Note that official statistics fail to provide a complete picture of how agricultural services are used, especially in EU-10 countries. They take account neither of free neighbourly help nor of paid services delivered by farmers to the local community (which are not registered and not recorded as non-agricultural activities).

except for agricultural services per hectare of agricultural land in EU-10. In EU-15 countries, the growth of agricultural services value per hectare of agricultural land and per AWU accelerated in 2004, when the new Central and Eastern European countries joined the European Union.

Over the study period, EU-10 countries experienced a decline in average values of agricultural services per hectare of agricultural land. However, this was accompanied by a growth in the value of agricultural services per AWU. With a relatively stable (or slightly declining) amount of land resources, the key reason for the above finding is the rationalisation of employment in the agricultural sectors of these countries. In EU-10 countries, the pace of change remained stable throughout the study period. In 2004, only EU-15 countries recorded a considerable acceleration of growth of veterinary expenses (and only if calculated per AWU). Both EU-15 and EU-10 experienced a consistent increase in veterinary expenses per LSU and per AWU.

Fig. 1. Evolution of the value of agricultural and veterinary services per hectare of agricultural land/per LSU and per AWU in 2000-2016. Average levels for UE-25, UE-15 and UE-10 (EUR, 2016 constant prices)

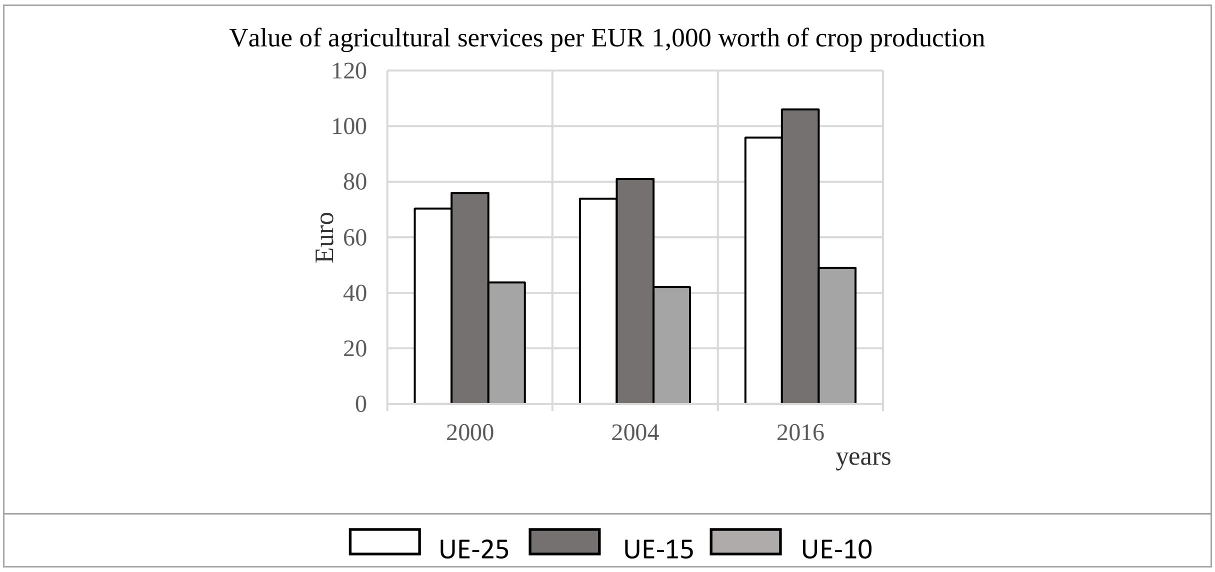


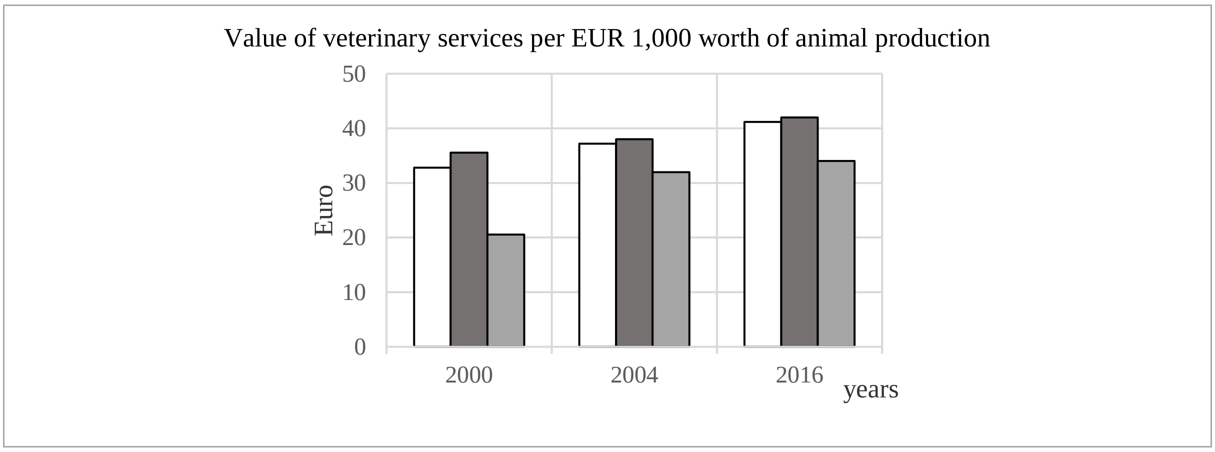


Source: own study based on *Eurostat database* (2013), *Eurostat database* (2016), *Eurostat database* (2017).

Another issue covered by this study was the service intensity rate of agricultural production, expressed as the value of services needed to generate EUR 1,000 worth of agricultural goods output (Figure 2). In the EU-15, that rate grew throughout the study period both for agricultural and veterinary services; the growth accelerated in 2004 (consistently with the value of services per hectare of agricultural land).

Fig. 2. Evolution of the value of agricultural and veterinary services in 2000-2016. Average levels for EU-25, EU-15 and EU-10 (EUR, 2016 constant prices)





Source: own study based on *Eurostat database* (2017).

In the EU-10, the agricultural services intensity rate decreased until 2004. Only after these countries joined the EU did the value of agricultural services per EUR 1,000 worth of agricultural goods output start to grow. However, this was not the case for veterinary services. EU-10 countries needed to align their animal production technology and organisation with the EU's sanitary and quality standards already in the pre-accession period. This is why, in that group, the value of veterinary services grew throughout the study period. Crop production was not under such heavy pressure. Therefore, the farms increased their investments in the upgrading of animal production facilities while crop production was based, to the largest extent possible, on existing resources of machinery (much worn out in most cases[1]) and labour. Note also that in EU-10, labour inputs were and, despite a clear improvement, often continue to be several times higher than in EU-15[2]. Most authors find the increase in the share of services in total production inputs to be a positive aspect which reflects the modernisation of agriculture and economic development [Kołodziejczak 2016, p. 192-193]. The question must, however, also be raised as to whether such an increase is always beneficial. Services are supposed to improve farming efficiency. But in order for this to happen, the increase in their value must be technically and economically justified, and cannot be regarded as an aim in itself. It seems obvious that this is not always the case. There may be various reasons for the increase in value and share of services in total production inputs (e.g. increase in prices, increase in interest rates, additional charges provided for in regulations to be put in place, wear and tear on farm machinery).

However, it may be unreservedly regarded as a positive development only if the value of services grows as a consequence of the farms' reasonable decisions guided by greater

[1] Using the example of Poland, Kukuła (2014, p. 74) states that *in the Polish agriculture sector, the availability of agricultural machinery and equipment* (...) varies from one region to another. This is due to many factors, including historical events. The above is highly likely to be true for other countries under consideration.
[2] See M. Kołodziejczak (2015, p. 464-467), W. Kołodziejczak (2016, p. 133-134).

economic, technological and environmental efficiency of the service compared to the following two alternative scenarios: scenario one consists in using the farm's own labour or contract work, or investing in the purchase and subsequent maintenance of machinery and equipment (which is often too powerful for the farm, and therefore cannot be fully used). Scenario two involves costly repairs of older machinery and equipment (which is often not powerful enough, and requires large amounts of labour to achieve the required output).

The data in Table 1 shows that the use of services varies extremely from one EU country to another, and that the results obtained for specific countries considerably differ from the average values recorded in EU-15 and EU-10 aggregates. Table 1 presents the value of agricultural services (at 2016 constant prices) per hectare of agricultural land, per AWU and per EUR 1,000 worth of crop production in the agriculture of EU countries in 2000 and 2016. In the EU-15 group, the Netherlands and Italy are the two countries reporting the highest value of services per hectare of agricultural land. The highest value of services per AWU was also recorded in the Netherlands, followed by Denmark, France, Sweden, Italy, UK and Germany. Ireland led the ranking for the value of agricultural services per EUR 1,000 worth of crop production, followed by the Netherlands, Denmark, Italy, Sweden, UK and Estonia. The levels of agricultural services per hectare of agricultural land and per AWU recorded in EU-10 countries were several times lower. However, when calculated per EUR 1,000 worth of crop production, the differences are less noticeable. This is because the levels of crop production recorded in the EU-10 are much lower than in the EU-15. Therefore, the use of agricultural services may be found to depend on two basic factors. The first one is the agricultural development level and the intensity and structure of crop production. The second one is the availability of the farms' own machinery and the amount of labour engaged in production. Having one's own machinery does not necessarily translate into a high capital value, especially in EU-10 countries. These can be obsolete machines which, although fully depreciated a long time ago, remain operational; despite their low efficiency, they enable avoiding the purchase of services if enough labour is available to do the field work. On the other hand, these can also be state-of-the-art machines purchased by farmers with funds provided under EU programmes, if they decided to invest in their own equipment rather than rely on services. Therefore, the use of agricultural services is primarily determined by needs which, in turn, are defined by the amount of labour resources, the structure of crop production and the farms' choice between paying for services and investing in their own machinery.

Table 2 presents the value of veterinary services per LSU, per AWU and per EUR 1,000 worth of animal production in the agriculture of EU countries in 2000 and 2016, expressed in

EUR at 2016 constant prices. In the group of EU-15 countries, the highest value of veterinary services per LSU was recorded in Italy, which, however, was outperformed by Bulgaria, a member of the EU-10 group. That index does not vary as much from country to country as does the level of agricultural services per hectare of agricultural land. The lowest values were recorded in Poland and Portugal (in 2000, also in Lithuania and Estonia). However, the values reported by both of these countries in 2016 were several times higher, reaching a level comparable to that of the UK and Hungary, respectively. Despite relatively small differences in the value of veterinary services per LSU, the level of veterinary services per AWU varied strongly from one country to another over the study period. This was caused by differences in labour inputs used in agricultural production across the countries. Note however that the above parameter has little informative value as it does not include data on labour intensity in animal production (instead, the calculation takes account of labour intensity for the entire agricultural production). Therefore, the differences revealed by this analysis mainly result from the amount of labour inputs. As an inevitable consequence of that approach, the value of veterinary services per AWU is low in EU-10 and in EU-15 countries demonstrating relatively high levels of agricultural employment; conversely, it is high or very high in countries with low levels of agricultural employment, such as Belgium, Denmark, France, the Netherlands, Luxembourg, UK, Germany or Ireland. This is why the service intensity rate, expressed as the value of veterinary services per EUR 1,000 worth of animal production, seems to be a more reliable indicator. That ranking is clearly led by Bulgaria, followed by Romania, Czech Republic, France, Belgium, Slovakia, Ireland and Slovenia. In turn, the lowest values were recorded in Portugal, Poland, Sweden and Finland. Note however that the service intensity rate for veterinary services depends not only on production intensity and sophistication but also (at least to the same extent) on the structure of animal output and on veterinary service charges which vary from one country to another.

Table 1. Value of agricultural services per hectare of agricultural land, per AWU and per EUR 1,000 worth of crop production in the agriculture of EU countries in 2000 and 2016 (EUR, at 2016 constant prices)

Countries	**Agricultural services per ha of agricultural land**		**Agricultural services per AWU**		**Service intensity rate**	
	2000	**2016[a]**	**2000**	**2016[b]**	**2000**	**2016**
Austria	62.1	102.3	1,255.7	2,588.5	75.8	95.4
Belgium	31.2	35.7	581.5	898.7	10.7	12.9
Bulgaria	111.2	48.3	419.0	753.6	138.3	84.0

Countries	Agricultural services per ha of agricultural land		Agricultural services per AWU		Service intensity rate	
	2000	2016[a]	2000	2016[b]	2000	2016
Czech Republic	8.2	35.5	178.2	1,227.2	17.5	42.0
Denmark	180.8	226.7	6,333.6	11,358.8	96.1	165.0
Estonia	12.4	44.8	152.4	1,988.4	43.5	134.5
Finland	36.0	60.8	719.7	2,589.4	45.7	100.7
France	122.2	158.5	3,310.2	6,866.1	79.8	113.0
Greece	159.8	56.5	977.9	665.3	49.0	40.3
Spain	23.8	20.6	564.1	726.0	20.2	16.7
Netherlands	858.3	1345.9	7,929.6	18,874.6	138.6	184.8
Ireland	74.0	72.9	2,155.9	2,250.7	193.8	204.3
Lithuania	8.9	17.1	118.1	343.3	25.8	30.0
Luxembourg	86.0	24.0	2,550.1	929.0	86.2	18.3
Latvia	8.3	24.3	79.6	558.4	30.5	64.7
Germany	95.1	146.4	2,382.2	5,237.7	60.7	95.3
Poland	30.5	34.4	176.5	265.6	49.3	47.0
Portugal	30.6	42.3	235.1	516.3	26.1	38.8
Romania	31.8	15.3	121.6	138.0	20.0	19.9
Slovakia	36.5	64.1	551.3	2,486.8	130.4	89.4
Slovenia	48.2	36.4	225.6	222.7	34.1	26.6
Sweden	48.6	126.1	1,865.2	6,875.5	51.2	146.9
Hungary	105.5	90.7	710.6	1,055.3	101.3	84.2
UK	102.4	77.7	4,717.2	5,176.9	111.6	134.8
Italy	302.3	404.4	2,855.3	7,027.1	113.1	167.0

[a] amount of agricultural land as at 2013

[b] amount of AWU as at 2013

Source: own study based on *Eurostat database* (2013), *Eurostat database* (2016), Eurostat *database* (2017).

Table 2. Value of veterinary services per LSU, per AWU and per EUR 1,000 worth of animal production in the agriculture of EU countries in 2000 and 2016 (EUR, at 2016 constant prices)

Countries	**Veterinary services per LSU**		**Veterinary services per AWU**		**Service intensity rate**	
	2000	**2016[a]**	**2000**	**2016[b]**	**2000**	**2016**
Austria	35.7	51.6	570.4	1,168.6	31.5	39.5
Belgium	57.5	66.2	3,350.5	4,561.4	47.3	55.4
Bulgaria[c]	110.6	119.5	233.6	410.3	69.5	123.7
Czech Republic	29.2	66.1	400.2	1,130.9	38.8	67.9
Denmark	42.9	49.0	2,479.3	3,877.0	24.9	37.9
Estonia	12.4	42.0	62.4	603.7	14.1	37.3
Finland	43.8	35.7	479.4	771.1	19.4	17.7
France	56.9	67.6	1,321.7	2,307.6	47.6	59.3
Greece	44.0	33.7	190.7	175.0	28.6	27.0
Spain	42.5	42.6	579.0	935.6	37.8	37.8
Netherlands	38.4	54.7	1,285.8	2,740.0	25.9	34.9
Ireland	31.5	48.2	1,331.2	1,777.8	36.3	54.0
Lithuania	3.7	23.7	23.0	139.3	6.5	23.7
Luxembourg	57.3	49.5	2,296.8	2,420.1	43.0	39.7
Latvia	41.4	31.2	123.9	185.4	41.4	33.2
Germany	40.1	49.4	1,132.6	1,946.0	31.5	38.0
Poland	7.8	10.9	34.7	53.7	10.0	8.9
Portugal	8.3	13.0	42.2	88.4	7.2	10.0
Romania	47.1	56.5	93.6	193.7	25.7	74.4
Slovakia	36.7	66.5	253.6	874.4	35.9	54.5
Slovenia	54.4	57.2	320.6	351.2	44.6	52.8
Sweden	19.1	20.0	471.5	616.1	11.6	12.8
Hungary	31.9	26.3	146.0	148.3	23.9	22.0
UK	41.0	42.0	1,891.7	2,172.9	32.3	36.8
Italy	75.4	79.0	543.4	1,064.2	44.1	49.5

[a] amount of LSU as at 2013, [b] amount of AWU as at 2013, [c] as at 2000, data on veterinary services as at 2002.
Source: own study based on *Eurostat database* (2013), *Eurostat database* (2016), Eurostat *database* (2017).

Table 3 shows the correlation between the use of production services in agriculture and the variables referring to agricultural development in groups of European Union countries in 2000-2016. Even a cursory analysis of the results indicates the difficulty of finding any universal relationships. The correlations presented separately in Table 3 for EU-25, EU-15 and EU-10 suggest above all the prevailing role of the situation in the EU-15, which affects the direction of relationships in the EU-25, the aggregate of all countries. In EU-15 countries, there is evident correlation between the use of services and fixed capital formation. A similar direction of relationships is observed in EU-10 countries. However, in that group, the positive correlation is weaker for agricultural services but tends to be stronger for veterinary services. This could result from the impact of aid schemes which help farmers invest in new, more powerful machinery and equipment. While the availability of their own machinery makes farmers less likely to use agricultural services, it does not affect the use of veterinary services, because of the veterinarians' required knowledge and competencies.

Table 3. Correlation between the use of production services in agriculture and the variables referring to agricultural development in groups of European Union countries in 2000-2016[a]

		ASO	VE	TIC	AGO	CO	ANO	GV	EI	GFCFP	GFCFA	GFCFM	GFCFE	GFCFT	GFCFB
EU-25	ASO		+++	+++	+++	+++	+++	+++	++	++	++	+++	+++	+	+++
	VE	+++		+++	+++	+++	+++	+++	++	++	++	+++	+++	++	+++
EU-15	ASO		++	+++	+++	+++	+++	+++	++	++	++	+++	+++	+	+++
	VE	++		+++	+++	+++	+++	+++	++	+	+	+++	+++	+	++
EU-10	ASO		+	++	++	++	++	++	+	+	+	+	-	+	+
	VE	+		+++	+++	+++	+++	+++	++	+++	++	+++	++	+++	++

[a] Panel correlation analysis of time series spanning from 2000 to 2016, $p<0.05$. The values of variables compared are expressed in constant prices per hectare of agricultural land. The values of correlation coefficients are marked as follows: "+" below 0.3 (weak correlation); "++" 0.3-0.7 (moderate correlation); "+++" 0.7-1.0 (strong correlation). Negative correlation is marked as follows in the corresponding intervals: "-", "-- " and "---".

Abbreviations used in table headers have the following meanings: (ASO) agricultural services output, (VE) veterinary expenses, (TIC) total intermediate consumption, (AGO) agricultural goods output, (CO) crop output, (ANO) animal output, (GV) gross value added, (EI) entrepreneurial income, (GFCFP) gross fixed capital formation in plantations, (GFCFA) gross fixed capital formation in animals, (GFCFM) gross fixed capital formation in materials, (GFCFE) gross fixed capital formation in machines and other equipment, (GFCFT) gross fixed capital formation in transport equipment, (GFCFB) gross fixed capital formation in buildings.

Source: own study based on *Eurostat database* (2017).

Thus, by contributing to the scaling up, or modernisation of production processes, fixed capital formation will rather increase the willingness to use veterinary services. It can be therefore assumed that the development of the farms' own potential may be accompanied by an increase in service expenditure in the case of crop production in highly developed countries with high inputs per hectare of agricultural land; or may substitute service expenditure in the agricultural sectors of converging economies which supplement or upgrade their own resources of fixed assets (crop production machinery, equipment and infrastructure). Because of the specific nature of animal production and veterinary services, the positive correlation between fixed capital formation and veterinary expenses is stronger in the agriculture of less developed countries (which supplement or upgrade their own resources of fixed assets) than in than the agriculture of highly developed countries.

Summary

1. Production services support the rationalisation of production processes. Tapping into the service providers' potential and knowledge is a way to reduce the costs of building and maintaining farms' own potential, to improve production performance and to enhance product quality. Services also drive progress and promote access to knowledge on manufacturing organisation and technologies.
2. The differences in the use of production services observed across the EU allow the conclusion that EU-15 countries report higher average levels than EU-10 countries. This suggests a relationship between economic (including agricultural) development levels and the use of production services. However, the analysis of particular countries shows that the specific nature of local agriculture is at least equally important. The use of agricultural services may be found to depend on two basic factors. The first one is the agricultural development level and the intensity and structure of crop production. The second one is the availability of the farms' own machinery and the amount of labour engaged in production. As regards livestock production, the key determinant is the amount of labour inputs.
3. In EU-15 countries, there is evident correlation between the use of services and fixed capital formation. A similar direction of relationships is observed in EU-10 countries. However, in that group, the positive correlation is weaker for agricultural services but tends to be stronger for veterinary services. It can be assumed that the development of the farms' own potential may be accompanied by an increase in service expenditure in the case of crop production in highly developed countries with high inputs per hectare of agricultural land; or may substitute service expenditure in the agricultural sectors of converging economies which supplement or upgrade their own resources of fixed assets (crop production machinery, equipment and infrastructure). Because of the specific nature of animal production and veterinary services, the positive correlation between fixed capital formation

and veterinary expenses is stronger in the agriculture of less developed countries (which supplement or upgrade their own resources of fixed assets) than in than the agriculture of highly developed countries.

4. The use of production services may support the evolution towards sustainable agriculture as regards the following aspects: reduced environmental impact; improved food safety; preserving the environment and the cultural and environmental characteristics of rural areas. However, in order for this to happen, the principles of sustainable development need to be taken into account, in addition to immediate economic benefits, in the decisions made by farm managers. The use of services itself is not decisive for the degree of agricultural sustainability, because services are only a tool which may be used or misused.

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The fallacy of composition on the example of incomes in European agriculture[1]

Łukasz Kryszak
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-8660-9236, e-mail:lukasz.kryszak@ue.poznan.pl
Jakub Staniszewski
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-8074-0911, e-mail: jakub.staniszewski@ue.poznan.pl

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Abstract: Determinants of agricultural income are often analysed both on sectoral and farm level. The results of this research are frequently contradictory. They may indicate the existence of the fallacy of composition. In the case of agriculture, it occurs when actions undertaken by the farmers to maximise their incomes bring opposite results to incomes analysed on a sectoral level. The aim of the paper is to examine in a systematic way whether this problem is real for agriculture in the European Union. Based on a literature review, a set of agricultural income determinants was established, as well as measure of that income. We constructed panel regression models based on a FADN (microeconomic) and EAA (sectoral) data. The results obtained indicate different sets of determinants of income on the farm and sector level. From the perspective of the individual farm, the intensification strategy proved to be effective despite higher dynamics of input prices than agricultural output prices, while in the sector as a whole, intensification growth has insignificant impact on income levels. In the case of specialisation, from the point of view of the whole sector, moderate specialisation may be optimal; in micro terms, either a high or low level of specialisation is more beneficial. Modernisation was a determinant of income in both sectoral and farm perspective. Overall our results indicate that the fallacy of composition exists also in the context of agricultural income.

Keywords: fallacy of composition, agricultural income, FADN, panel data

JEL: Q10 i Q12

Introduction

The fallacy of composition is a phenomenon consisting in the erroneous transfer of dependences true on one level of analysis (e.g. microeconomic) to another level (e.g. macro, global) [Grzelak 2015, p. 578]. The fallacy arises due to a failure to understand “the fact that the way the parts relate, interact, or affect each other often changes the character of the whole” [Damer 2009, p. 140]. Classic two examples of this phenomenon are the “tragedy of the commons” and “the paradox of thrift”. The former was popularised by Hardin (1968) and refers to a situation in which agricultural producers seek to maximise their income by using common pasture and increasing the intensity of its use, and thus increasing the herd and grazing time.

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This action is rational for a single producer. However, if such behaviour becomes a rule for all producers, it would lead to a tragedy for all of them, due to overgrazing and depletion of their pasture. The latter example refers to an idea known for centuries, but reintroduced by Keynes (1936). He argued that an increase in autonomous saving leads to a decrease in aggregate demand and thus a decrease in gross output, which will in turn lower total savings. In this context, a decision to increase savings, which is rational from the point of view of a single consumer, may be harmful to the economy, if undertaken by all citizens.

In this article we analyse a specific case of the fallacy of composition in agricultural sector analyses. Although earlier studies [Grzelak 2015]; [Czyżewski and Stępień 2010] identify numerous manifestations of this problem on the theoretical ground, there is a noticeable lack of studies attempting to empirically verify these observations. This research gap is partially covered by this study, which aims to identify differences in the set of determinants of agricultural income analysed at farm and agricultural sector levels. To achieve this research goal, panel regression models based on corresponding variables from alternative databases were constructed. If the set of significantly statistical determinants differ between the two research perspectives, this means that there are grounds for identifying the fallacy of composition. This would mean that actions taken by farmers to maximise income at farm level do not lead to the same results at sector level.

The first two parts are for review purposes. They present previous approaches to the analysis of the fallacy of composition in economics, in particular agricultural economics, as well as conclusions from the previous studies of determinants of agricultural incomes. The next part has a methodological nature. It contains a description of the data and quantitative methods used in the research. The following part contains the results of the research together with a discussion, whereas the last part concludes.

The fallacy of composition and its agricultural context

Research concerning the fallacy of composition has not been common in recent years. It can be attributed to the fact that in neoclassical theory, dominant in the mainstream of economics, such fallacy is not supposed to arise, at least not to any considerable degree. The "invisible hand" is supposed to coordinate self-interested agents and ensure the good standing of the whole group. Therefore, self-interest is sufficient to satisfy group-interest [Al-Suwailem 2014]. This constitutes very serious grounds for criticism of the neoclassical approach, coming from the Keynesian and post-Keynesian school of economic thought [Cingolani 2016, Keen 2011]. Authors representing this perspective argue that macroeconomic general equilibrium models, constructed within the neoclassical paradigm, are flawed because they simply extrapolate microeconomic relations valid for a single company or consumer to the scale of a sector or the whole economy. This procedure is justified only under a series of assumptions, which are considered counterfactual in the Keynesian and post-Keynesian perspectives.

This criticism has become even stronger since the last financial crisis, which neoclassical economics failed to predict, and was even considered the cause of the crisis by some experts [Al-Suwailem 2014]. That may be the reason why a deal of interest in the fallacy of composition is concentrated in the financial sector, especially in the context of risk assessment in the banking sector. Banking regulations derived from the models used nowadays focus solely on individual bank risk, without regard to the problem of the fallacy of composition; namely, even if individual banks function well, the banking system can fail. To avoid this, it is proposed to widen the scope of assessment to measures taking into account systemic risk as well [Sum 2016]; [Shin 2015]; [Markose 2013].

Another common area where the fallacy of composition occurs is international relations and trade. Arnim, Tavani and Carvalho (2014) found that it may emerge in the case of redistribution. Home can benefit from redistribution towards labour in Home, in terms of its own level of output and employment, while Foreign can benefit in the same way from redistribution towards labour in Foreign. Both, however, might pursue policies of relative wage suppression, in order to prevent the other country from reaping most of the benefits of demand expansion. As a consequence, global economic performance would be weaker than otherwise. Similarly, we can recognise the fallacy of composition in the growth strategies of developing countries, which are trying to simultaneously export similar types of manufactured goods to the same industrialised country markets. Greater exports may contribute to further development of any single country, but in the case of competition between them, the overall effect is negative. The occurrence of this mechanism was empirically tested by Blecker and Razmi (2009). These issues in the context of Sub-Saharian Africa were tested by Kaplinsky and Morris (2008). Similar doubts in the context of foreign-direct-investment-led growth strategy were raised by Kozul-Wright and Rowthorn (1998). A wide literature review of the fallacy of composition analysis in the context of international trade was provided by Mayer (2002).

The fallacy of composition was also identified in the context of many other research areas, including the ones presented below. Holcombe (2017) considers the fallacy of composition one of the explanations of malinvestment. He states that the interpretation of price signals from the market which is proper for a single investor, may be not right for a whole economy. A research approach similar to ours was presented by Chun, Kim and Morck (2016), but in the context of company productivity growth and stock returns. They constructed two regression models for the USA, explaining this relation on a company- and aggregate-level. Their results show that company-level stock returns are generally positively associated with a company's own productivity growth, but generally negatively associated with aggregate productivity growth. The fallacy of composition has been also empirically identified in the music industry, where the correlation between file sharing and album sales was evaluated using OLS and panel fixed-effects regression. The finding that file sharing is not harmful to individual artists was not consistent with the well-documented fact that file sharing is harmful to the music industry as a whole [Hammond 2014]. In the context of economics of consumption, da Graça and Masson (2013) identify an "ignorance is bliss" effect which refers to the quality of consumer information. For any individual, providing information can be beneficial, as they would be more likely to make the right purchase decision. Providing better information to all individuals, though, would alter the demand structure and the equilibrium price may rise endogenously. Through this mechanism, truthful information can reduce consumer surpluses.

Finally, the fallacy of composition is also present in the context of agriculture. Grzelak (2015) lists the following premises of this issue in agricultural sector:

- the costs of environmental degradation resulting from excessive fertiliser use, livestock density, and monocultures are not included in the (micro) economic calculation conducted by a single farm. However, the burden of those costs is carried by society, so an economic balance estimated on the micro and macro levels will differ greatly. This aspect is a part of a larger issue concerning the problem of externalities and public goods in agriculture;
- from the macro perspective, the existence of some small farms might be highly unfavourable. By staying out of the market, they create serious costs since the resources they use (land and labour) are not used in an efficient way. Furthermore, those production factors are characterised by low mobility and "equilibrium in poverty", in which this kind of farm remains, which may be optimal from their individual, micro perspective;
- in the specific conditions of economic transformation from a planned to market economy, the ability of the farm sector to absorb the negative social effects of this process may lead to an interpretation opposite to the one stated above. At the micro level, farms may be perceived as inefficient, because of excess employment, but in the macroeconomic perspective their assessment can be positive, due to their ability to create jobs and limit state social expenditure;

- in the context of global market liberalisation, which is believed to have a positive impact on social welfare (on the macro scale), some negative impacts can appear on the micro level of farms. An open market, which usually brings lower prices of food products, is definitely not beneficial for local food producers.

Some features of the fallacy of composition can be found in the concept of the market treadmill. In the original theory by Cochrane, farmers, in spite of their constant adoption of new technologies, lose any profits which might result from this adoption. “Early adopters” make profits for a short while, because of their lower unit production costs. As more farmers adopt the technology, however, production goes up, prices go down, and profits are no longer possible even with the lower production costs. Average farmers are nonetheless forced by lower product prices to adopt the technology and lower their production costs if they are to survive at all.

The “laggard” farmers who do not adopt new technologies are lost in the price squeeze and leave room for their more successful neighbours to expand [Levins and Cochrane 1996]; [Czyżewski 2017]. We can also see the fallacy of composition in this mechanism. Technological improvement which is profitable for single farms, in the macroeconomic scale of the whole sector brings no change or even worsens the situation of farmers, who now have to invest just to survive.

Another facet of the fallacy of composition can be identified in the analysis of the Common Agricultural Policy and its social impact [Czyżewski, Stępień 2010]. We can distinguish four main types of this fallacy:

- income vs. public-goods-provisioning function of direct payments – direct payments are perceived by farmers (on microeconomic level) mostly as additional income, while society (on macroeconomic level) consider them as a payment for public goods provisioning;
- income vs. public-goods-provisioning function of rural development funds – from the farmers’ point of view the most favourable situation is spending the whole CAP budget on direct support, while it is in the interest of society to maximise rural development funds, which are more directly connected with public goods provisioning;
- social and environmental role of modulation vs. interests of the largest farms – modulation, which means limiting support for the largest farms, is driven purely by macroeconomic goals of increasing general efficiency of support, while the microeconomic perspective of large farms is to keep financing on the same level;
- social vs. farm perspective on market intervention – measures of market intervention under CAP cause food prices in the EU to be higher than the world average, which

is unfavourable from the societal point of view, while it creates higher profits for the farmers.

Therefore, to our best knowledge, the fallacy of composition has not so far been analysed empirically in the context of agriculture, although problem was described in theory. Our research aims to fill this research gap. In our research strategy we will compare determinants of agricultural income identified on farm and sectoral level. Similar research tasks have been undertaken, but not simultaneously. There is some farm level analysis of income determinants, but they simply identify the determinants, without comparing results on different levels. On the sectoral level, labour profitability is more often analysed as a part of total factor productivity [Giannakis and Bruggeman 2014]; [Bojnec et al. 2014]. That's why, to find a set of income determinants, we follow the microeconomic perspective.

Determinants of agricultural income – literature review

Studies on agricultural income are hampered by the fact that the set of potential variables influencing them is very broad. Some of these variables are indirect and others direct, resulting from the income statement itself. Therefore, research on income determinants requires a specific research perspective[2]. The approaches listed below are not entirely separable, but identifying their characteristics contributes to a better understanding of the complexity of agricultural income issues.

The first possible view on income studies in agriculture is the macroeconomic perspective [Czyżewski B. 2017]; [Boehlje et al. 2012]; [Baek and Koo 2009]; [Baek and Koo 2010]. In this type of research, econometric models are constructed where independent variables include such factors as: price gap (the relation between prices of products sold by farmers and the prices of means of production), exchange rates, interest rates (as a result of monetary policy), GDP level or other indicators of the economic situation.

Price relations are a key variable from the perspective of macroeconomics and the importance of their relationship with agricultural income has been confirmed in many other empirical studies [Czyżewski and Majchrzak 2015]; [Beckmann and Schimmelpfennig 2015]; [Liefert and William 2005]. The impact of exchange rates and interest rates on agricultural income levels is not entirely clear and depends, among others, on the research perspective adopted, e.g. a long vs. short research period [Beckmann and Schimmelpfennig 2015]; [Ivanova

[2] There is a rich body of literature on the relationship between agricultural income and natural conditions (cf. Reidsma 2009); (Deryugina and Hsiang 2104); (Burke and Emerick 2016) and issues related to culture and education (cf. Panda 2015). In this paper, we are confined to economic problems and agricultural policy. Other factors are not the focus of analysis.

et al. 2003]; [Orden1986]; [Czyżewski B. 2017]. For example, an increase in the exchange rate results in a decrease in exports. The decline in the level of agricultural products sold abroad translates into a fall in domestic prices, which over time makes exports more attractive again. The increase in exports contributes to an improving income situation of farmers. Moreover, the effect of an increase in relative foreign prices linked to the appreciation of the domestic currency is not stable, as foreign countries gradually become accustomed to the new price levels.

The link between agricultural income and the general economic situation is also unclear. Some researchers [Gradzewicz et al. 2010]; [Da-Rocha Restuccia 2006] describe agriculture as an anti-cyclical sector. Basic economic variables characterising a given sector (such as the level of production and employment) are subject to greater fluctuations in agriculture than in other branches of the economy, and at the same time are negatively correlated with values for the economy as a whole.

The second line of research on agricultural income could be described as a technical approach. The starting point for this type of research is that an increase in agricultural income requires an improvement in productivity levels, whereas prices determine the profitability of production only in the short term. If we assume that output prices do not rise, the increase in input prices must be compensated by productivity improvements [Rembisz 2010]. Productivity (in the sense of TFP) is of a residual nature, i.e. it results from the difference between the production growth rate and the weighted factor growth rates of factor inputs [Bezat-Jastrzębowska and Rembisz 2015]. In the agriculture of developed countries, there is a decrease in the use of the labour factor in relation to the capital factor.[3] An increase in agricultural income (in particular income per unit of work) therefore requires an increase in the productivity of this factor. This can be expressed as the product of the productivity of the land and land to labour ratio ($Y/L \times L/W$) or the product of the productivity of capital and capital to labour ratio ($Y/K \times K/W$) [Sielska et al. 2015]. Empirical research has identified the improvement of capital to labour ratio as a key determinant of this factor's productivity growth [Gołaś 2010].

The third possible research perspective on agricultural income is referred to as an endogenous (microeconomic) approach, which is particularly applicable to the case of individual farms. In this context, in accordance with the principles of perfect competition, it is assumed that a farmer alone is not able to shape prices on the market, hence price relationships are treated as given data and are not analysed separately. In addition, it is accepted

[3] In some European countries, the process has been halted or even reversed in recent years as a result of a shift towards sustainable agriculture, which is characterised, among other things, by higher labour intensity and a relatively lower level of capital utilisation.

that changes in resource ratios and factor productivity are slow and are not entirely influenced by a farmer in either the short or medium term. They are partly conditioned by historical and natural factors. For example, the reduction of employment in agriculture at unchanged production levels (resulting in the improvement of labour productivity) is a process observed at the macro level, but in the short term it is difficult to carry out at the micro level and depends on the availability of jobs outside agriculture [Rembisz 2013]. In this research perspective, the emphasis is placed on the practices of a single entity which may result in an increase in agricultural income in a certain macroeconomic, institutional, natural and cultural environment.

Firstly, a farmer can choose the type of production. He or she is partially limited by climatic conditions, however, observations made in the long term should translate into more rational actions, i.e. taking up such types of production which are characterised by a higher degree of profitability. Profitability observation must be of a long-term nature, otherwise the phenomenon known as the cobweb theory may occur [Kaldor 1934]. This is based on the fact that farmers in a given year undertake such production types which turned out to be particularly profitable in the previous period. If many farmers follow this pattern, prices will fall and profitability will decrease. In this paper, we do not analyse the profitability of specific production directions, but rather test the hypothesis that a moderately high level of specialisation is a determinant of an increase in agricultural income [Ziętara 2014].

Investment decisions are also made at farm level. However, it should be mentioned that they are not completely autonomous, as they may also be conditioned by the current economic situation, or the availability of investment support under agricultural policy. Investments exceeding depreciation rates result in extended reproduction [Grzelak 2014] and contribute to the increase of farm assets and thus to an increase in the capital to labour ratio. At the same time, they constitute a potentially endogenous variable, as they may, on the one hand, be a determinant of income and, on the other hand, an effect of income.

On the basis of available production techniques, as well as the farmer's own knowledge and abilities, he or she makes a decision on production methods, including in particular fixed and circulating capital expenditure. Mechanisation, consisting of an increased use of machinery and intensification, understood as an increase in the use of fertilisers, plant protection products etc. should result in higher yields, which, assuming price stability, translates into higher income. On the other hand, increased investment also means higher costs, which, to a certain extent, limits the effectiveness of the intensification strategy.

From the microeconomic perspective, it is assumed that it is not possible to increase revenues (production) and reduce costs at the same time. It is possible to minimise costs at a given level of production or to maximise revenues at a given level of costs. Competitive farms focus mainly on increasing production, while in terms of costs it is only possible to manage their structure. This mainly concerns the reduction of overhead costs in favour of specific costs, as well as the relationship between their own costs and external factors of production. On the one hand, the use of so-called foreign production factors is connected with the need to pay a margin to the owner of this factor, on the other hand, a farmer who rents some of his equipment does not have to bear the cost of its acquisition and maintenance.

Another aspect of a farm's functioning at the microeconomic level is the management of the financial and asset structure of the farm. The development of agricultural activity is usually linked to the need for commitments. On the one hand, funds obtained from external sources for development purposes may in the long run improve the farm income situation, and on the other hand, in the short term, interest rates are a burden. Relationships between individual assets, such as current vs fixed assets or the extent to which assets are covered by equity [Kulawik, Płonka 2014] may also play an important role. The excessive value of fixed assets may overburden the holding with fixed costs. However, due to the lack of data at sector level, we do not include financial factors in our analysis.

The common element to be analysed from all 3 income perspectives are subsidies within the agricultural policy (our focus here is on the EU's common agricultural policy). From the macroeconomic perspective, subsidies may be treated as an additional control variable which creates conditions for the development of income in the agricultural sector. Similarly to other variables, subsidies are external in the sense that decisions on the allocation of funds for agricultural support and the level of subsidies are made in the course of political decisions. Farmers only have an indirect influence on them, through voting in elections and lobbying. In the technical approach, subsidies can potentially have two roles. First of all, they may influence the pace of changes in resource relations. For example, investment subsidies may stimulate the pace of improvement of capital labour ratio, whereas direct payments may reduce the rate of concentration, as the existence of this system limits the willingness of the owners of smaller farms to sell land to bigger entities. Theoretically, the agricultural payments system may also constitute a substitute for pro-efficiency-oriented changes. An increase in agricultural income can be achieved by increasing the level of payments without an effort to improve productivity. From an endogenous point of view, it should be assumed that a single holding has no impact on the level of payments available in the country concerned. However, it is possible to manage the payment structure and to apply for subsidies which are dependent on the fulfilment of specific criteria. For example, the owner of a farm maximising income should analyse whether it is economically justified to apply for agri-environment payments. To this end, he or she should carry out an account of the benefits (additional subsidies) and losses (additional costs, output reduction) associated with entering the scheme.

Data and methods

The data sources for this empirical analysis were two open-access databases: FADN (Farm Accountancy Data Network) and Eurostat (Economic Accounts for Agriculture – EAA) plus FAO Stat for agricultural utilised agricultural area data. Both databases provide information on, among others, agricultural income, but there are significant differences between them. The most important difference concerns their scope. The EAA covers the entire agricultural sector of a country or a region. On the other hand, the data in the FADN database refer to an average representative farm in a given country. However, representativeness does not apply to the entire population of the holding, but only to 'commercial' units. The objective of FADN is to cover 90% of a country's standard agricultural production. Due to the varied agrarian structure and uneven distribution of production among farms, FADN's field of observation covers from 16% of farms in Slovakia to 78% in Belgium. Unlike the EAA, the FADN database offers many more variables determining the economic and financial situation of farms. Its drawbacks include a longer delay in publishing data, as well as the impossibility to retrieve data in national currencies and at fixed or real prices, which is possible with the use of the EAA. In both databases agricultural income is understood by several different indicators (see *Manual... 2000* and *Standard Results Indicators* for the details of income calculation). The most basic income categories, similar to the so-called disposable income, is entrepreneurial income in the EAA database and net income in the FADN database. In this study we use these income categories increased by the compensation of employees. In this way, we achieve a total compensation of labour factor.

The timescale of this research covers the 2005-2015 period, while the spatial scope covers 23 EU countries (all EU countries apart from Romania, Bulgaria, Croatia, Malta and Cyprus). Table 1 gives an accurate description of the explained and explanatory variables used, while Table 2 contains descriptive statistics. A number of potential variables were initially selected to characterise the areas of activity of a holding. Ultimately, the models included those variables with the best statistical and factual values. In order to maintain comparability over time, raw data from the FADN database were deflated with the appropriate deflators from Eurostat (nominal prices indices) and converted at a fixed exchange rate (2004 or, for countries which joined the euro zone during the reference period, the rate of one year's entry into the euro zone). This eliminates income changes linked to price volatility and exchange rate fluctuations[4].

Tab. 1. Specification of variables used

Variable	*Economic Accounts for Agriculture*	*Farm Accountancy Data Network*
Agr_Inc (1)	Entrepreneurial income + compensation of employees in real prices in mln of euro	Farm net income + wages paid in real prices (GDP implicit deflator is used) in euro
Intens_level (1)	Energy and lubricants + fertilisers and soil improvements + plant protection products in constant prices per ha of total agricultural area in thousands of euro	Fertilisers + Crop protection + Energy in constant prices per ha of total utilised agricultural area in thousands of euro
Intens_level (2)	Total intermediate consumption in constant prices per ha of total agricultural area in thousands of euro	Total intermediate consumption in constant prices per ha of total utilised agricultural area in thousands of euro
Intens_level (3)	Fixed capital consumption in constant prices per ha of total agricultural area in thousands of euro	Depreciation in constant prices per ha of total agricultural utilised area in thousands of euro
Intens_level (4) (%)	The share of intensification (1) in total intermediate consumption	The share of intensification (1) in total intermediate consumption
Reprod_ratio	The ratio of gross fixed capital formation to fixed capital consumption	The ratio of gross investements to depreciation
Special_ratio	The share of main type of production in total output of agricultural 'industry' (values of production were in constant prices)	The share of main type of production in total output (values of production were in constant prices)
Concentr_ratio	The ratio of total agricultural area to total labour input (AWU)	The ratio of total utilised agricultural area to total labour input (AWU)
Subsid_ha	Subsidies on production in real prices per ha of total agricultural area in thousands of euro	Balance of subsidies and taxes (current and on investments) in real prices per ha of total utilised agricultural area in thousands of euro
Subsid_rate (1) (%)	The share of subsidies on production (real prices) in output of agricultural industry (constant prices)	The share of balance of subsidies and taxes (current and on investments) in real prices in total ouput (constant prices)
Subsid_rate (2) (%)	The share of subsidies on production (real prices) in Agr_Inc (1) (real prices)	The share of balance of subsidies and taxes (current and on investments) in real prices in Agr_Inc (1)(real prices)
Price_gap	The ratio of nominal price index of output of agricultural 'industry' and nominal price index of total intermediate consumption	The ratio of nominal price index of output of agricultural 'industry' and nominal price index of total intermediate consumption

Source: Own elaboration based on Eurostat and FADN.

The starting point for empirical analysis of the occurrence of the fallacy of composition on the example of agricultural income is the endogenous perspective. We analysed the

[4] It is worth noting that the values in real prices differ from values in constant prices by the adopted deflator. Fixed prices may be used for material variables (e.g. agricultural output). In the case of variables of a purely monetary nature (e.g. subsidies) this is not possible, so these figures are deflated using either a GDP deflator or inflation rates.

relationship between farm income and the independent variables which are its potential determinants (levels of intensification, concentration, specialisation and investment in terms of reproduction rates) at the level of a single average farm in the light of FADN data (see data and methods for details). The level of subsidisation and the price gap was a control variable. We did not include all the possible independent variables based on the literature review but only those which have potential equivalents in the EAA database. In the next step, we analysed the same interdependencies on the basis of data for the whole sector using data from the Economic Accounts for Agriculture. We looked for an answer as to whether potential strategies of increasing farm income at the level of an individual farm are appropriate for the whole sector as well. Another possible hypothesis could be that some of these strategies, such as intensification, at sectoral level, could reveal not only environmental limitations but also economic ones.

We ran panel models with fixed effects on FADN and Eurostat data separately. The dependent variable was agricultural income in real prices. From a farmer's point of view, the aim is to make the highest disposable income possible, the final value of which depends on changes in prices of production and means of production. This can be used as a reason in favour of using real income, i.e. nominal income adjusted for GDP deflator (or inflation rate).

Ultimately, the model of interdependence takes the following form:

$$lnAgr\_Inc_{it} = \beta_0 + \beta_1 Intens\_level(2)_{it} + \beta_2 Reprod\_ratio_{it} + \beta_3 Special\_Ratio^2{}_{it} + \rho X_{it} + \alpha_i + \varepsilon_{it}$$

where:

- $lnAgr\_Inc_{it}$ denotes the logarithm of the level of agricultural income of a country or single farm;
- X_{it} is a set of control variables (logarithm of the level of land concentration, subsidies rate (2) and price gap);
- α_i is the country fixed effect;

All the models were estimated using Panel Corrected Standard Errors [Beck and Katz 1995], as the problem of cross-sectional dependence and heteroscedasticity were identified. At the same time, the resistance of some models was also tested using equations on first differences to control for autocorrelation of residues[5]. The model with fixed effects was selected on the basis of merit criteria (agricultural income is also influenced by country-specific factors such as climate), but it was also confirmed by the Hausman test.

[5] We do not present these specifications for clarity and brevity reasons.

Results and discussion

In table 1 is a descriptive statistics for the variables used (data on agricultural income are provided per working unit in order to maintain greater comparability). The agricultural income per unit of labour (AWU) in the whole panel surveyed was higher in the FADN sample (15,600 euro/AWU vs. 13,800 euro/AWU), due to the fact that the FADN field of observation does not include the smallest farms with generally low income. The level of volatility of quoted income in both databases can be described as comparable. As regards the level of intensification measured in terms of per hectare expenditure, it is very similar in both databases, although slightly higher in the EAA database. In the case of this database, there is also a larger variation in the level of intensification, which is evidenced by higher values of standard deviation from average values. The average reproduction rate in both databases was higher than 1, which means that the level of investment exceeded the depreciation value and extended reproduction was observed. The degree of specialisation of production, understood as the share of the main direction of production in total output, was higher in the case of FADN farms and amounted to 31.2% as compared to 28.6%. Larger farms are most likely to be characterised by a higher degree of specialisation. The farms included in the FADN observations also had a larger area on average: almost 32 ha, compared to 25.7 ha of all farms. The average share of subsidies in production and income is significantly higher for FADN farms, which may be due to the increased use of additional payments (e.g. investment) by FADN farms. The price gap ratio by nature is volatile, but on average it was negative for agricultural producers over the period, considered on the scale of 23 countries.

Table 2. Descriptive statistics of the variables used (*in thousand of euro*)

Variable:	***Economic Accounts for Agriculture***				***Farm Accountacy Data Network***			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Agr_Inc (1)/AWU	13,800	8,990	-11,930	37,620	15,620	9,512	-9,756	48,402
Intens_level (1)	0.256	0.215	1.234	0.071	0.247	0.173	1.046	0.084
Intens_level (2)	1.294	1.412	7.512	0.251	1.185	1.153	6.636	0.270
Intens_level (3)	0.330	0.324	1.767	0.034	0.296	0.246	1.311	0.047
Intens_level (4) (%)	23.5	7.4	42.8	10.5	24.3	6.7	44.1	9.4
Reprod_ratio	1.253	0.595	0.382	4.688	1.282	0.613	-0.482	3.659
Special_ratio	28.6	6.7	14.3	48.1	31.2	11.9	14.0	66.0
Concentr_ratio	25.66	13.56	5.46	61.54	31.89	18.03	5.50	78.33
Subsid_ha	0.273	0.159	0.011	0.763	0.354	0.182	0.092	0.902

Variable:	*Economic Accounts for Agriculture*				*Farm Accountancy Data Network*			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Subsid_rate (1) (%)	16.4	8.9	1.7	44.3	23.6	12.4	1.9	70.8
Subsid_rate (2) (%)	52.4	29.4	7.2	160.5	77.2	59.4	9.2	701.0
Price_gap	0.948	0.105	0.676	1.253				

Source: Own elaboration based on Eurostat and FADN.

Initially, interdependencies were estimated using FADN data (Table 3). In the first step (specification 1) three variables which can stimulate the level of agricultural income in the light of the endogenous perspective were introduced into the model. Both the intensification as an input of intermediate consumption in constant prices per hectare of utilised agricultural land and the reproductive rate had a positive impact on agricultural income at farm level which is in line with expectations and other studies. Poczta, Średzińska and Mrówczyńska-Kamińska (2009) demonstrate that an increase in current capital expenditures was a statistically significant and positive determinant of agricultural income in all types of farms they studied. The previous results indicated that agricultural income is a significant determinant of investment processes on a farm [Czekaj 2011]; [Kusz, Gędek, Ruda 2013]. The present results show that there may also be an inverse relationship – a high reproductive rate translates into a high income.

The values of the ‘specialisation rate’ variable were squared, assuming that agricultural income initially increases with an increase in specialisation, while if a certain level is exceeded, income may decrease as a result of increased risk [Ziętara 2014]. The impact of this variable proved to be significant only if standard errors were not taken into account, or in the models with control variables. What is more, it turned out that from the micro perspective a more rational strategy is either a very high level of specialisation or a balance between different types of production.

The concentration ratio variable was included in the next step (2). According to the theory, in the conditions of inelastic demand for food, concentration, understood as an increase in the land to labour ratio, is one of the keys to increasing productivity and, therefore, the compensation of labour factor. However, the statistically significant impact of this variable on agricultural income cannot be confirmed in a model with robust errors. Then the robustness of the identified relationships was tested by including in the models subsidies rate (3), price gap (5) and both of these variables (4). The introduction of these variables (particularly price gap) improved the R-squared significantly, which indicates an important role of these variables in income formation. This is in line with the statement that a faster increase in prices of products sold by farmers than in input prices should lead to a linear increase in agricultural income [Liefert and William 2005], or Czyżewski and Majchrzak's research (2015) in which they pointed out that a price gap is a key determinant of income in a function in which they also included productivity and subsidies. Most importantly, however, despite the effect of agricultural subsidisation and price volatility, two of the identified agricultural income growth strategies remain relevant, and the related marginal effects can be assessed as similar to the specification (1). Thus, it can be concluded that the impact of intensification and reproductive rates on agricultural income is statistically significant and the relationship is robust. As the level of concentration increased, agricultural income increased, while in the case of specialisation, agricultural income initially increased with its growth, but then decreased. At the same time, the impact of concentration and specialisation should be interpreted with caution, as it was not statistically significant in specifications which did not take account of the control variables (at least by using corrected standard errors).

Table 3. The impact of selected determinants on agricultural income – single farm

Variable:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Const	9.34*** (0.16)	8.54*** (0.74)	8.62*** (0.79)	6.44*** (0.73)	6.34*** (0.74)
Intens_level (2)	0.00044*** (0.00009)	0.00042*** (0.00009)	0.00041 (0.00009)	0.00032*** (0.00009)	0.00033*** (0.00009)
Reprod_ratio	0.120*** (0.034)	0.136*** (0.038)	0.137*** (0.038)	0.147*** (0.033)	0.145*** (0.034)
Sq_Special_ rate	1.33 (0.85)	1.245 (0.869)	1.194 (0.811)	1.349* (0.759)	1.417* (0.801)
ln_Concentr_ratio		0.246 (0.221)	0.240 (0.222)	0.649*** (0.189)	0.653*** (0.192)
Subsid_rate(1)	No	No	Yes	Yes	No
Price_gap	No	No	No	Yes	Yes
Within R^2	0.13	0.14	0.15	0.23	0.22
LSDV R^2	0.94	0.94	0.94	0.94	0.94
Akaike criterion	-47,3	-49.4	-47.9	-70.2	-71.1
Observations	250	250	250	250	250

Note: standard errors in parenthesis. *, **, and *** denote 10%, 5%, and 1% significance levels, respectively.

Source: Own calculations based on Eurostat and FADN.

The second part estimates agricultural income models for the whole sector on the basis of Eurostat data (Table 4). The equivalents of variables contained in the FADN database were used (see Table 1). As the first step, a model was estimated which assessed the impact of three potential farm income stimulants at a farm level, to check whether these variables also shape income in terms of the whole agricultural sector. The only statistically significant variable proved to be the reproduction rate, but its marginal impact on agricultural income was lower than in the case of a single farm model. It suggests that modernisation embodied in the form of investments exceeding the consumption of fixed assets creates conditions for an increase in agricultural income not only at a farm level, but also at the level of the whole sector. However, this strategy is especially important from the single entity's point of view. At the same time, the effect of intensification proved to be statistically insignificant, and the whole model exhibits worse statistical properties. The inclusion of the level of concentration (2) and subsidy rates (3) in the variable model does not alter the previous conclusions. Still, intensification has no significant impact on income, and the reproductive rate is characterised by a relatively high resistance.

Table 4. The impact of selected determinants on agricultural income – agricultural sector

Variable:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Const	7.45*** (0.15)	7.36*** (0.40)	7.48*** (0.50)	5.65*** (0.40)	5.51*** (0.39)
Intens_level (2)	0.067 (0.082)	0.065 (0.081)	0.067 (0.077)	-0.06 (0.069)	-0.053 (0.068)
Reprod_ratio	0.090** (0.034)	0.093*** (0.037)	0.088** (0.038)	0.066** (0.04)	0.082*** (0.028)
Sq_Special_ rate	-1.32 (1.53)	-1.23 (1.37)	-1.087 (1.35)	-2.32* (1.215)	-2.58** (1.163)
ln_Concentr_ratio		0.023 (0.105)	-0.035 (0.140)	0.22*** (0.096)	0.350*** (0.091)
Subsid_rate(1)	No	No	Yes	Yes	No
Price_gap	No	No	No	Yes	Yes
Within R^2	0.04	0.04	0.04	0.27	0.24
LSDV R^2	0.98	0.99	0.98	0.99	0.99
Akaike criterion	-144.3	-142.3	-141.6	-70.2	-200.0
Observations	251	251	251	250	251

Note: standard errors in parenthesis. *, **, and *** denote 10%, 5%, and 1% significance levels, respectively.

Source: Own calculations based on Eurostat and FADN.

Specifications 4 and 5 also introduced price gap into the analysis, which is an important determinant of agricultural income, especially from a sector-wide perspective. The inclusion of this variable clearly improved the informative properties of the model (especially specification 5) and the variable itself proved to be statistically significant. Combining the lack of statistical significance of intensification with the significant role of price scissors, it can be assumed that King's effect still exists in European agriculture. In practice, the price mechanism usually depreciates farmers, which is related to relatively inelastic demand for agricultural products. Increasing production as a result of intensification usually leads to a greater fall in prices. The fall in prices is not matched by a corresponding increase in demand, with negative consequences for agricultural incomes [Tweeten and Zulauf 2008].

On the basis of specification 5, a significant impact of reproductive rates on income levels can be confirmed. There is also a strong and positive influence of concentration and a significant influence of specialisation. Regarding the latter, in contrast to the models for the individual FADN farm, the relationship is here different, that is to say a higher income level results from a moderate level of specialisation. Such results are in line with Ziętara (2014) and Purdy et al. (1997) who claim that, compared to diversification, specialisation is at the same time a strategy with a higher level of risk. Once more, given the lack of relevance of this variable in some other specifications, its interpretation should be treated with caution.

It is also worth noting that in all the specifications LSDV R-squared is much higher than *within*, which indicates a very significant impact of individual, country specific and time-invariant conditions on the level of agricultural income.

Conclusions

In this paper, we examine the occurrence of the phenomenon of the fallacy of composition on the example of incomes in European agriculture. We develop panel regression models for the whole sector and for a single representative farm. We use an inductive approach in this context. This is because we are introducing into the models further potential determinants of agricultural income from an endogenous perspective, in order to assess whether the impact of these variables is the same also in the case of the whole sector.

On the basis of the analyses presented in the article, it can be stated that the fallacy of composition in European agriculture manifests itself primarily through different practices at microeconomic and sectoral agricultural income levels. First of all, this concerns intensification expressed in the level of intermediate inputs. From the perspective of an individual farm, an intensification strategy proved to be effective, despite a higher dynamics of input prices than agricultural output prices.

In the sector as a whole, intensification growth has insignificant impact on income. The role of potential growth channels for agricultural income, such as concentration, manifested by an increase in the land to labour ratio, or specialisation, understood as a limitation of production diversification in favour of concentration on the dominant direction, is not entirely clear. Our models do not indicate a positive impact of concentration (both at farm and sector level). In the case of specialisation, the issue is more complex. From the sectoral point of view, moderate specialisation may be optimal; whereas in the micro perspective, either a high or low level of specialisation is more beneficial. Our research has also shown that when it comes to modernisation, understood in terms of investments in relation to the consumption of assets, there is no contradiction between the objectives of an individual farm and the whole sector. However, it is relatively more important for the single farm. Price relations also remain an important determinant of agricultural income, especially at sectoral level. However, individual farmers do not have a direct influence on the development of these relationships, so they have to look for ways to increase their incomes in an unstable environment.

Our results show that agricultural policy mechanisms that support investment and modernisation processes should be supported and developed in agriculture. It is also important to support dualism, based on the existence of small, multidirectional farms and large specialised farms, as a moderate level of specialisation is optimal from the perspective of the entire sector. The existence of a direct payment system makes it possible to increase the intermediate consumption level, which is beneficial from the point of view of the farm. On the other hand, one should remember that an excessive increase in inputs may have adverse effects on the environment. Furthermore, the high level of dependence of income on price mechanism is an incentive to develop risk mitigation policies, as well as support for vertical and horizontal integration. Providing an appropriate methodology and empirical verification of the occurrence of the fallacy of composition in agriculture, which would take into account not only income, but also the issues of public goods and externalities, may be a fruitful line for future research.

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The silver economy in regional development in light of the concept of human-centred-development

Grażyna Krzyminiewska
Uniwersytet Ekonomiczny w Poznaniu
ORCID: 0000-0002-1573-3771, e-mail: grazyna.krzyminiewska@ue.poznan.pl

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Abstract: The objective of the article is to indicate the possibilities and ways of utilising the silver economy in regional development. The presented thesis draws attention to the basis for the development of the senior economy resulting from the ageing of the population in many countries, including Poland and the Wielkopolskie Region. The basic assumption made here, is that the silver economy is also based on the important idea of social development – the concept of human-centred development, in which a humanistic, subjective approach is introduced to development strategies. The article points to the possibilities of the silver economy, and the broad benefits that can be obtained by entrepreneurs, recipients-beneficiaries, as well as society as a whole. The contents contained in the article fall within the category of economic and social analysis, utilise the achievements of sociological and economic studies, and were based both on existing sources and the results of original research. The method of descriptive analysis was used in the presentation of these issues.

Keywords: population ageing, silver economy, social development

JEL: R11, Z13

Introduction

In recent decades, we have been consistently dealing with analyses pointing to the intensifying process of ageing of societies, especially in the case of countries with a higher level of economic development. The numerous pessimistic analyses indicating the threat to economic and social development resulting from this fact, are counterbalanced by the belief that this process can be treated as a challenge for development. This allows us to change the way of thinking about older people in the context of social burden, and to notice the developmental opportunities associated with them. We are dealing with extensive academic research and the phenomenon of application of these studies to the socio-economic practice, which is manifested in the adopted paradigm of the so-called *silver economy*, or the *senior economy*.

The new paradigm of development does not focus exclusively on the silver economy as a new economic sector, but develops the thinking about the older generation, which we are obliged to respect and to provide with a dignified life. These two points of view are mutually integrated, and the objective of the article is to indicate:

1. The rate of ageing of Poland's population.

2. The recognition – derived from comparisons of different development concepts – that development should be based on the axiological assumptions of social development in accordance with the principle of *human-centred development*.
3. The determination of the paths of development of the silver economy in regional development.

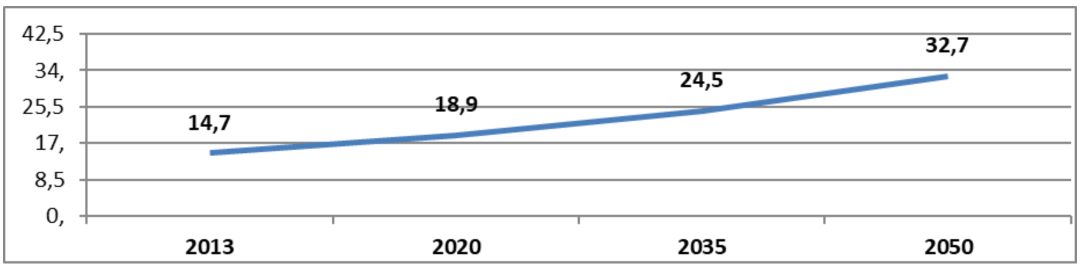
The method of descriptive analysis was used in the presentation of these issues. The research results fall within the category of economic and social analysis, utilise the achievements of sociological and economic studies, and were based on both existing sources and the results of original research.

Population ageing

The problem of the ageing of the population, which affects many societies, also including Polish society, is becoming increasingly important for regional development. In Poland, the processes of demographic change are taking place on an unprecedented scale, which creates a challenge that has to be met by the creators of regional development.

According to the forecasts of the Polish Central Statistical Office, in 2050 the share of people aged 65 and above in the total population in Poland will amount to 30.2%, and people aged 80 and above will account for 10.4% of the total population (in 2013 – 3.9%) (Fig. 1). Additionally, the Central Statistical Office predicts that the rate of natural population growth will be negative throughout the entire period considered, and that the population will decrease to 35.7 million people. By 2020, the total population will fall by 1 million people, and in the subsequent decade it will further decrease by 1.5 million people. At the same time – on average, with each year the number of people aged 65 and above will increase by 175 400. These changes will not be regular over time, and the most intense increases will fall on the period up to 2022, when the number of older people will increase by 200 000 annually [CSO 2014].

Fig. 1. Participation of population aged 65 and over in total Polish population (in %) in the years 2013, 2020, 2035, 2050



Source: Central Statistical Office 2014.

In the light of the above conclusions, a crucial issue is that of building regional development strategies in which direct activities aimed at seniors will play a significant role. These activities constitute a response to the changing standards concerning the quality and standard of living of people, associated with changes in the paradigms of development, where development is not exclusively identified with economic growth, and GDP is not its main determinant. The change in thinking about development is based on the concept of social development – the concept of human-centred development.

Development of the concept of human-centred development

The concept of social development was formed as a result of long-standing debates held at the turn of the 1980s and 1990s. This discourse was carried out under the auspices of the United Nations, and consequently brought a fairly consistent understanding of the concept of development. The basic assumption was based on the conviction that it was necessary to change the previously dominating model of development, which identified economic growth with social progress. The determination of human development involved a process of expansion of the scope of people's choices, understood as the shaping of people's abilities, as well as the creation of appropriate conditions for the full utilisation of these abilities. The goal of social development is to provide people with the ability to make independent choices in relation to all spheres of their life, so that they can be increasingly responsible for their well-being and social security. As Księżopolski put it, "the idea of human development refers indirectly and directly to those threads of social thought, in which development and social progress are identified mainly with the process of improving the quality of human life, and in which economic growth is seen as a a means to an end, and not an end in itself" [Księżopolski 1995, p.28]. The objective is to move away from the narrow economic criteria of progress measured by the size of the national income per capita, and to restore the importance of the qualitative and social indicators of progress. In the thinking concerning development, significant importance was attributed to the idea that developmental processes and the design of those processes should involve the participation of the people who these processes are supposed to serve.

The breakthrough in the thinking about development was associated with the conviction that the human being is always central to development. The concept based on human-centred development results from the adoption of an idea expressed in the belief that the real wealth of a nation is its people. "Human development is a process of enlarging people's choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living. Additional choices include political freedom, guaranteed human rights and self-respect" [HDR 1990, p. 10].

This idea is still confronted with different concepts, which put emphasis on other aspects of development, often omitting the subjective nature of the people affected by the development. Fukuda-Parr [2003] carried out a comparison of the three concepts which translate into the development strategies undertaken on the global scale. These are the theory of fulfilment of basic needs (basic needs approach), the theory of social development and the neoliberal approach to development (Tab. 1.).

Table 1. Three approaches to development

	Social development	**Neoliberalism**	**Basic Needs Approach**
Philosophical foundations			
normative assumptions	expressed directly	expressed indirectly	Not fully specified
Concept of well-being	Capabilities and functioning	Utility of a human being	Fulfilment of basic needs
Evaluation aspect			
Key criterion for the evaluation of progress	Human capabilities, equality in terms of achievements, impartiality and fairness of institutions	Economic prosperity, economic growth, effectiveness	Reduction of poverty in terms of income and access to basic social services
Preferred measurement tools	Human achievements outcomes, measures of deprivation and distribution	Activity and economic conditions, average and aggregate measures	Access to material means, measures of deprivation
Subjectivity aspect			
To what actions does it mobilize	Individual actions and collective actions	Individual actions	Associated with political will and the electorate (the political base)
Development strategy			
Main operational objectives	Expanding human choices (in the social, political and economic spheres)	Economic growth	Expansion of basic social services
Division of the benefits and the costs of development	Emphasis on equality and human rights of all individuals	Takes into account poverty	Takes into account poverty
Importance of human rights and freedoms	Human rights and freedoms are the ultimate objective with an intrinsic value. Search for their instrumental significance for social and economic progress	No clear link. Search for links between political and civil freedoms and economic growth	No clear link

Source: Fukuda-Parr, [2003, p. 311]; quoted after: Szarfenberg, [2010, p. 3].

The above comparison clearly shows, that the concept of social development based on human-centred development, captures development in a holistic way, primarily providing the broadest possible extent of subjectivity to the individuals and the communities.

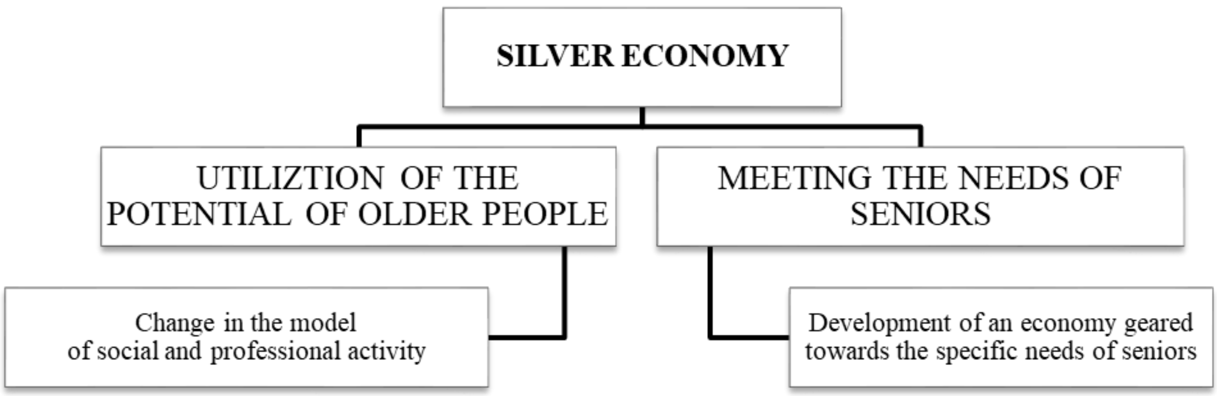
In this context, especially in the light of the process of population ageing, it is important to implement the assumptions of this concept, and to do everything that will enable the oldest generation, in a dignified manner, to remain active members of society, who are respected and surrounded by adequate protection.

The silver economy as a factor in regional development

The concept of the silver economy perfectly falls in line with the concept of social development. According to the definition, it consists in targeting supply in accordance with the changing needs of various groups of older people, so that they become a source of economic activation [Golinowska, 2014, pp. 31-32]. The essence of a development strategy defined in such a way is not only taking into account the needs of an ageing population, but also improving the quality of life of the remaining members of the population.

The essence of development of the silver economy is undertaking activities going in two directions (Figure 2). Firstly, this means striving to activate seniors, both in the professional sphere, in order to keep them in the labour market, as well as in the social sphere, thereby counteracting their social exclusion. Secondly – the development of the economy, which utilises the existence of the specific needs of seniors in the sphere of production, consumption and services, and responds to this demand.

Fig. 2. Paths of development of the silver economy



Source: own compilation.

The silver economy is an area whose essence is the implementation of specific activities thanks to broad cooperation between the seniors themselves, who know their own environment and their own needs very well, institutions of local government, the third sector, state institutions, as well as business. The senior economy includes many fields, such as medical care and health resort care, housing, the labour market and training for careers, and innovative economic initiatives. Thanks to the aforementioned cooperation, many activities can be implemented in a public-private partnership.

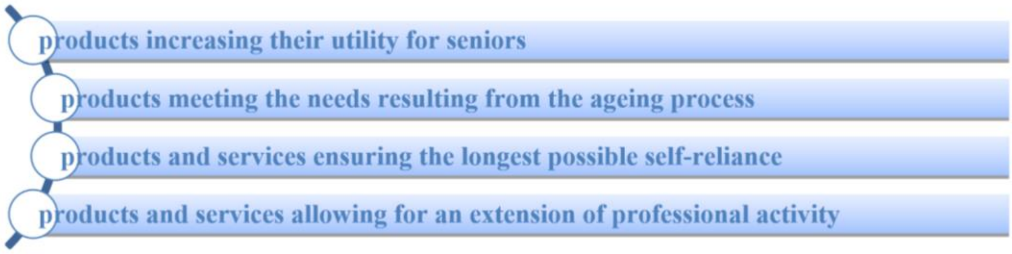
The essence of utilising the potential of older people is the lifelong learning and adequate policies supporting the activity of older people, which allow for an extension of the period of professional activity, and the promotion of continued social inclusion in spite of ageing. While describing the first of these areas on the basis of the official documents of the European Union, it can be indicated that the activity of older people and intergenerational solidarity require:

- strengthening social cohesion, inclusion and participation across a person's lifetime by ensuring opportunities and access to services and to political, social, recreational and cultural activities; volunteering, which helps to maintain social networks and reduce isolation; gaining new competences which contribute to personal fulfilment and wellbeing;
- promoting participation in the labour market, through actions;
- for the involvement of younger and older people in training and life-long learning activities, which facilitate the intergenerational transmission of knowledge; as well as through actions for the reconciliation of work and private life;
- recognition of the values of all age groups and their contribution to society, thus promoting positive perceptions and attitudes towards all age groups; engaging them in decision-making (policy formulation and implementation), paying special attention to their opinions and concerns and giving them a voice in research processes that may affect them;
- promoting research and innovation to improve the lives of older people, including accessible environments for all, promoting participation in society for longer, and independent living, including promotion of e-inclusion and e-health, as well as other technological and ICT innovations, thereby fostering the silver economy;
- health promotion, disease prevention and early diagnosis throughout the lifecycle, as well as rehabilitation, leading to active and healthy ageing and independent living, while taking into account the different needs of women and men regarding respective services and future research;
- adjusting social security systems in such a way that they are able to provide sustainable and adequate pensions which will contribute to the reduction of the number of elderly

people, especially women, who live below the poverty threshold and allow the elderly to live in dignity [Council of the European Union, 2012].

In turn, the silver economy could provide an opportunity to increase the competitiveness of the economy through the production of goods and services targeted at older people, and could be a source of economic activation and innovation. The important thing is to move away from thinking about the ageing of societies as a social burden, towards utilising this phenomenon for economic development.

Fig. 3. Main areas of activity of the silver economy



Source: own compilation.

The areas of economic activity (Figure 3) show the high level of diversity of the silver economy, which allows entrepreneurs from many industries to find a place in the market.

After conducting interviews with experts in various fields, M. Zsarnoczky [2018, p. 2] analysed their opinions in relation to the possibilities for the development of the silver economy. It turns out, that the possibilities for its development are very broad, as shown in Figure 4.

Fig. 4. Economic segments of the silver economy

MEDIA	FASHION	GERONTOLOG Y, HEALTH SERVICES	HOME SERVICES	REAL ESTATE, SMART HOMES
EDUCATIONA L SYSTEM	TOURISM, MEDICAL TOURISM	NURSING HOME, ASSISTED LIVING	FITNESS	FINANCE, INSURANCE
COSMETICS	MOBILITY	CULTURE, RECREATION	IT, INNOVATIVE TECHNOLOGY	HOME DELIVERY
ROBOTICS	ARCHITECHT URE	DESIGN	PUBLIC TRANSPORT	LOCAL MARKETS (e.g. FOOD)

Source: Zsarnoczky [2018, p. 2].

The development of individual areas of economic activity could become extremely effective economically, and could also become a significant part of Polish exports, also due to the fact, that by 2020 the purchasing power of the world's population of people aged 60 and above will reach USD 15 trillion [Urbaniak 2016, p. 280]. In Poland, this group of people (who are seen as the so-called winners of systemic transformation), will also become a significant bloc of consumers, due to the material resources held(movables and immovable property).

It is also pointed out, however, that the increased – social and economic – efficiency of the silver economy also depends on far-reaching cooperation between manufacturers and service providers. That is why it is believed that, for example, the creation of clusters of services devoted to seniors increases the economic rationality of the activities undertaken, adequately responding to the needs of an ageing society and creating new opportunities for entrepreneurship.

According to the definition presented by Porter, the term cluster is used to describe a geographical concept of related companies and individuals, specialised suppliers, service providers and enterprises associated in branches and affiliated institutions, which not only compete but also cooperate. [...] Kotela expanded Porter's definition by adding the aspect of interdependence, whereby clusters are groups of companies and institutions that are located in a given area and are mutually related in the scope of the production and supply of goods [quoted after: Rudnicka and Surdej, 2013, p. 12].

The clusters of senior services play a significant role in regional development, because cooperation takes place at the level of various institutions, and the goal is to utilise the purchasing potential of older people and to meet their consumption, living and health needs. As stated by Rudnicka and Surdej [op. cit.], the model of a cluster of senior services assumes the existence of a platform for an organised and comprehensive system of management of care services and accompanying services, in the area of the senior economy. This system includes entities such as: the media, universities and research centres, the organisers and participants of volunteer work, public offices, financial entities and manufacturers. Senior clusters constitute a network of mutual connections, thanks to which it is possible to effectively resolve social problems and to generate profits. Table 2 presents examples of clusters of senior services created in 2016. It is clearly visible that various entities are involved in their activities.

Table 2. Examples of clusters of senior services created in 2016

Regional Senior Clusters	
Kujawsko-Pomorskie Region Senior Cluster	Agreement concluded on 27 June 2016 by the Founding Members: Budlex S.A., Bydgoska Szkoła Wyższa, Lecznice CITOMED sp. z o.o.; Fundacja Kapitałowa dla Programu „Samorządowa Polska"; JS Solutions sp. z o.o. Herbarium Hotel & SPA; Klaster Turystyki Medycznej i Uzdrowiskowej sp. z o.o.; Neuca S.A., NZOZ Centrum Kultury, Higieny i Zdrowia Psychicznego NZOZ Remedis sp. z o.o.; Przedsiębiorstwo wielobranżowe Lech sp. z o.o.; Toruńskie Zakłady Materiałów Opatrunkowych S.A.
Podkarpackie Region Senior Cluster	Agreement concluded on 9 November 2016 in Rzeszów by the Founding Members: Fundacja Kapitałowa dla Programu „Samorządowa Polska", Gmina Zarszyn, Instytut Ekonomii Społecznej w Rzeszowie, Jasielskie Stowarzyszenie Uniwersytetu Trzeciego Wieku w Jaśle; NZOZ Centrum domowej Opieki Pielęgniarskiej „Libra", NZOZ Rudek Gabinety Rehabilitacji Medyczne Andrzej Rudek, ORTO-RES sp. z o.o., Sanatorium Uzdrowiskowe Bajka, Sanatorium Uzdrowiskowe „PIAST"; Społeczne Towarzystwo Oświatowe Samodzielne Koło Terenowe nr 213 w Jaśle; „Uzdrowisko Iwonicz" S.A.
Wielkopolskie Region Senior Cluster	Agreement concluded on 15 November 2016 in Poznań by the Founding Members: Elf sp. z o.o. spółka komandytowa, Fundacja AKME, Fundacja Pomocy Seniorom i Rodzinie AMA, Gnieźnieński Uniwersytet Trzeciego Wieku, „MAT" Henryk Matecki, Okręgowa Izba Pielęgniarek i Położnych w Poznaniu, Prowincja Zgromadzenia Najświętszego Jezusa Sacré Coeur, Stowarzyszenie „Senior XXI" Gminny Uniwersytet Trzeciego Wieku w Gołuchowie, Stowarzyszenie Uniwersytet Trzeciego Wieku w Lesznie, Uniwersytet Trzeciego Wieku w Pile, Wyższa Szkoła Uni-Terra w Poznaniu,VERBUM – Akademia Szkoleń sp. z o.o., Zakład Zielarski „Kawon-Hurt" Nowak sp. j.
Mazowieckie Region Senior Cluster	Agreement concluded on 23 November 2016 in Warsaw by the Founding Members: Burmistrz Miasta Piastowa, Caritas Diecezji Warszawskiej, Cech Rzemiosł Różnych i Przedsiębiorczości w Otwocku, Dom Kultury „Świt", Bródnowski Uniwersytet Trzeciego Wieku, Dom Pomocy Społecznej w Górze Kalwarii, Izba Gospodarcza Medycyna Polska, Narodowy Komitet Seniora, Doradca Prezesa Zarządu Związku Rzemiosła Polskiego.
Dolnośląskie Region Senior Cluster	Agreement concluded on 8 December 2016 in Wrocław by the Founding Members: Angel Care – Centrum Seniora, Dom Seniora Magdalenka w Dusznikach-Zdroju, Dom Seniora „Piastów Gród", Fundacja Kapitałowa dla Programu „Samorządowa Polska", Niepubliczna Wyższa Szkoła Medyczna we Wrocławiu, Step by Step sp. z o.o., Uczelnia Jana Wyżykowskiego, Xi4G sp. z o.o.

Source: [Newsletter of Regional Senior Clusters 2016].

Summary

The issues presented above very clearly indicate that the silver economy can play a significant role in regional development. On the one hand, we are dealing with a group of conscious consumers with significant human, social, cultural and financial capital, and the failure to utilise this capital properly would constitute a huge developmental loss. On the other hand – as a society we are, in this way, implementing the adopted value system of social solidarity, so important for maintaining intergenerational continuity, which determines social cohesion thanks to a humanistic vision of the human being.

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Spatial differentiation of seasonal unemployment in the USA

Grzegorz Przekota
Technical University of Koszalin
ORCID: 0000-0002-9173-2658, e-mail: grzegorzprzekota@wp.pl
Jerzy Rembeza
Technical University of Koszalin
ORCID: 0000-0001-8764-5538, e-mail: jerzy.rembeza@tu.koszalin.pl

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Abstract: The paper presents an analysis of spatial differentiation of seasonal unemployment in the USA. Harmonic analysis was used in the research. An attempt was made to present regional differences in the seasonality of unemployment as an effect of different amplitude and frequency. In this study, seasonality analysis was carried out on the example of the United States, one country, but with a varied climate structure. Limiting research to one economy allows a better understanding of the importance of non-economic factors. And as it turns out, these are crucial in the scale and distribution of seasonal fluctuations. Differences among states arise from a different share of waves of an annual and semiannual frequency, and from a date of maximal unemployment in a wave of an annual frequency. Northern states are characterised by the prevalence of a wave, of annual frequency, with its maximum in the winter period. In the southern states, the unemployment maximum is a wave of annual frequency occurring in the summer period, in which the further south, the bigger the share of this wave in total seasonal variability. In the majority of states between the northern and southern ones, seasonality of unemployment has the character of a cycle of semiannual frequency with seasonal maximum in both winter and summer periods. The value of seasonal fluctuations is clearly related to the distribution of seasonal fluctuations. Smaller seasonal fluctuations characterise those states where the maximum for the annual harmonic occurs in the summer period. The superposition of waves of different frequency results in specific seasonal fluctuations in unemployment in particular states.

Keywords: unemployment, seasonality, spatial differentiation

JEL: J64

Introduction

Seasonality is a phenomenon describing the functioning of entire economies and the majority of particular markets. In most countries, labour markets are subject to seasonal fluctuations. This is indicated by the number of people who are in work or are unemployed, and the number of vacancies – a number that changes over the year. Seasonality also concerns changes in markets with regard to time, but can describe market differences in space as well. Due to diverse climatic, economic and institutional conditions, particular domestic and regional labour markets may differ by a value of seasonal fluctuations [Krane, Wascher, 1999, 523-553; Rembeza, Przekota, 2014, 391-399]. The distribution of fluctuations within a year can be unequal. Seasonality is defined as a fairly regular change in a given value which is ongoing within a year. This definition does not state that seasonal fluctuations are described by one cycle in a year, or more. Therefore, such situations where some labour markets are characterised by one seasonal cycle, instead of two, are possible. Particular markets may differ also in terms of seasonal maxima and minima of particular values, e.g. number of people unemployed. Seasonal fluctuations may also show medium- and long-term changes over time, so seasonality may constitute a non-stationary variable [Canova, Hansen, 1995, 237-252]. Therefore, seasonality analysis cannot be brought to a simple determination of a value of seasonal fluctuations, while the specificity of the functioning of labour markets in a short period should consider various aspects of seasonality.

The literature on macroeconomics mainly concerns a discussion on the significance of seasonal fluctuations for the efficiency of an economy. This discussion is multithreaded, concerns interpretations and determinants of seasonal fluctuations. Similarities and differences between the causative factors of seasonal and cyclical fluctuations are discussed. There are two approaches to this problem. The first approach treats seasonal fluctuations as the "pollution" of economic time series [Sims, 1974]. They are caused by different factors affecting cyclical fluctuations and economic growth. The conclusion is that the analysis of seasonal changes adds nothing to understanding the changes in the economy that go beyond the annual horizon. Therefore, the right procedure is to remove seasonal ingredients from the time series. Such an approach may be justified when an assessment of changes in the economic situation is carried out, e.g. comparing one quarter to the previous quarter. In this case, seasonal fluctuations may interfere with the assessment of the dynamics. The second approach to the problem of seasonal fluctuations indicates the occurrence of similarities between seasonal and cyclical fluctuations. It is justified that the mechanisms shaping both types of fluctuations are partly shared, so the model describing economic fluctuations should take into account both cyclical and seasonal fluctuations [Beaulieu, 1992]. According to this position, the removal of seasonal fluctuations from economic time series is not necessary, and their analysis allows a better understanding of the shaping of changes in the economy which are also of a cyclical nature.

An important problem of seasonal fluctuations is their impact on the economic optimum and the economic policy of a state. In this context, it should be noted that if seasonal fluctuations associated with short-term fluctuations in demand and supply are treated as a manifestation of striving for the optimum, then economic policy should not be aimed at levelling out seasonal fluctuations. Some economists recognise that every kind of cyclical and seasonal fluctuation negatively affects the level of social well-being. They postulate such a setting of the economic policy of a state whose aim is to eliminate all kinds of fluctuations. This position was initiated by Kuznets' research.

An important part of research into the significance of seasonal fluctuations in the economy is their relationship with the labour market [Olivei, Tenreyro, 2007; Popp, 2011]. Olivei and Tenreyro stated that seasonal fluctuations in the labour market are a source of seasonal fluctuations in product, which largely depends on monetary policy [Olivei, Tenreyro 2007]. According to the conducted research, entrepreneurs react differently to monetary shocks at the end of the year and at the beginning of the year. A monetary shock at the end of the year is the cause of wage changes, while a monetary shock at the beginning of the year becomes a reason for changes in production. In this model, it is noted that wage rigidity depends on the period during the calendar year. At the end of the year, wages are more flexible and stiffen after the beginning of the year. In turn, the model proposed by Poppa leads to the conclusion that relatively small fluctuations in the stiffening of the economy in real expression may not only generate significant seasonal cycles, but also have an impact on cyclical fluctuations [Popp 2011].

Seasonality in the labour market has been the subject of numerous empirical studies. Their results show significant differences between individual national labour markets in the size and distribution of seasonal fluctuations [Engle, Hylleberg 1996]. Seasonality in the labour market changes, even over a single decade the volume of seasonal fluctuations may change. The impact on seasonal fluctuations is mainly caused by changes of a structural nature, and in this context one can speak about the significance of the economic policy of the state for seasonal fluctuations [Krane, Wascher 1999].

This paper presents an analysis of seasonal fluctuations of the number of people unemployed in particular states in the USA. The subject of interest was not only the size of the fluctuations, but also the number of seasonal cycles and their distribution within a year. We attempted to determine whether potential differences among states are subject to spatial regularity and whether there is any noticeable relation between the distribution of the fluctuations and their value. The analyses presented in the paper use the method of harmonic analysis. Thus, while referring to the assumptions of this method, seasonal fluctuations were treated as an effect of the superposition of waves of various frequency and amplitude. The paper uses the 1976-2014 data for the monthly number of people unemployed in particular states, published by the U.S. Bureau of Labor Statistics.

Method of analysis

Modelling of natural phenomena consists in the identification of components of the observed time series, i.e. a systematic component (trend), periodical component (long-term – cyclical development or short-term – seasonality), and a random component (noise). As observation of the unemployment-related data shows, it is possible to identify all these components, and in the case of the periodical component – both cyclical and seasonal changes. Harmonic analysis is a tool that enables us to describe such a time series in a clear way [Kammler, 2000]. A basic advantage of this tool is the detection of cyclical and seasonal changes, as well as the lack of special assumptions concerning its applicability. Its disadvantage is constituted by the fact that in a theoretical model a regular periodicity is assumed, which is often disturbed in natural phenomena.

The harmonic analysis is applied to study the phenomenon of periodicity in a time series [Box, Jenkins, Reinsel, 1994]. A time series is distributed into a sum of harmonics, i.e. the sinusoidal and cosinusoidal functions of a given period [Wei, 2005; Thornley, France, 2007]:

$$(1) \quad y_t = \alpha_0 + \sum_{i=1}^{n/2} [\alpha_i sin(\omega it) + \beta_i cos(\omega it)]$$

where:

i – number of the harmonic,

$\omega = \frac{2\pi}{n}$ – frequency related to the period n,

α_0, α_i, β_i – parameters.

The first harmonic (i=1) has a period equal to the length of an entire series, so with its help the cyclicity (periodicity) of length n can be tested; the second harmonic (i=2) has a period equal to a half of this series, so it enables us to test the cyclicity (periodicity) of length n/2; the third harmonic (i=3) – one third of the series length, enables us to test the cyclicity (periodicity) of length n/3; etc. The last harmonic of a number i=n/2 has a period equal to 2/n and enables us to test the cyclicity (periodicity) of length equal to 2. In general, it is about mapping n values of a time series per values of sinusoidal functions onto the section [0; 2π].

Assessments of the parameters of the above model are determined using the least squares method. They may be established from the following formulas:

$$(2) \quad a_0 = \frac{1}{n} \sum_{t=1}^{n} y_t \, ;$$

(3) $$a_i = \frac{2}{n}\sum_{t=1}^{n} y_t sin(\omega it)\, , fori = 1, \dots , \frac{n}{2} - 1;$$

(4) $$b_i = \frac{2}{n}\sum_{t=1}^{n} y_t cos(\omega it), fori = 1, \dots , \frac{n}{2} - 1.$$

Harmonic analysis concerns the study of a phenomenon formed around an average level represented by the parameter a_0. In the event of a trend's occurrence, it should be previously blocked, so the following model should be applied:

(5) $$y_t = f(t) + \sum_{i=1}^{n/2}[\alpha_i sin(\omega it) + \beta_i cos(\omega it)]$$

where: $f(t)$ – trend function.

In the paper the trend was eliminated with use of the Hodrick-Prescott filter [Hodrick, Prescott, Postwar, 1997, 1-16].

An individual cyclical component may be presented with the use of the following formula [Fichtenholz, 1969]:

(6) $$a_i sin(\omega it) + b_i cos(\omega it) = A_i sin(\omega it + \varphi_i)$$

which enables us to define the amplitude A_i and the phase shift φ_i for every harmonic component:

(7) $$A_i = \sqrt{a_i^2 + b_i^2},$$

and their phase shift:

(8) $$t_i = \frac{arctg\left(\frac{a_i}{b_i}\right)}{\frac{2\pi}{n} i}.$$

The phase shift enables us to locate on the timeline the points in which the phenomenon has extreme values, while the amplitude value allows for the definition of values of this extremum.

The harmonics are not correlated with each other, so each of them explains a different part of variance of the variable *Y*. The share of particular harmonics in the explanation of variance of the variable *Y* of a tested variable is determined from the following formula:

(9) $$\frac{a_i^2 + b_i^2}{2s^2}, fori = 1, \dots , \frac{n}{2} - 1;$$

where: s^2 – assessment of variance of the tested variable *Y*.

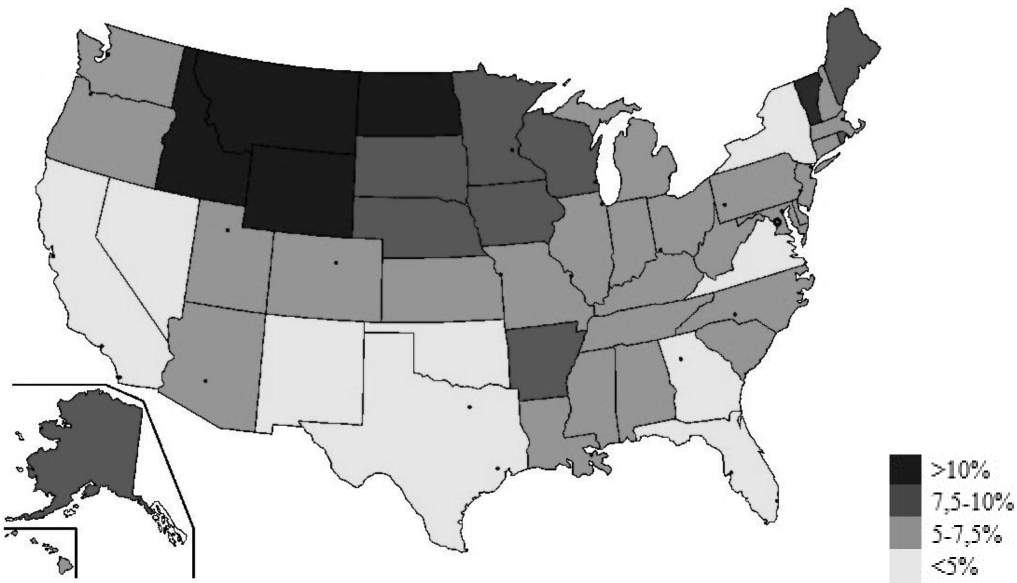
Subsequent stages of data analysis included:

1. Distinguishing the seasonal component from the data concerning the number of people unemployed. This made using the TRAMO/SEATS procedure.
2. For the seasonal component, two harmonics were distinguished: annual and semiannual. The length of the tested time series comes to 468, i.e. 39 years (1976-2014), 12 months each. Therefore, the annual harmonic has number 39 and semiannual – 78.
3. For the distinguished harmonics amplitudes, phase shifts and share of each harmonic in variance of the seasonal component were defined.

Spatial differentiation of the seasonality of unemployment

The first part of the paper describes the differences among states in the seasonality of unemployment illustrated with selected examples. Figure 1 presents the division of states by a year average value of seasonal fluctuations. The presented data show significant regional differentiation of the seasonality of unemployment in the United States.

Fig. 1. Average value of seasonal fluctuations

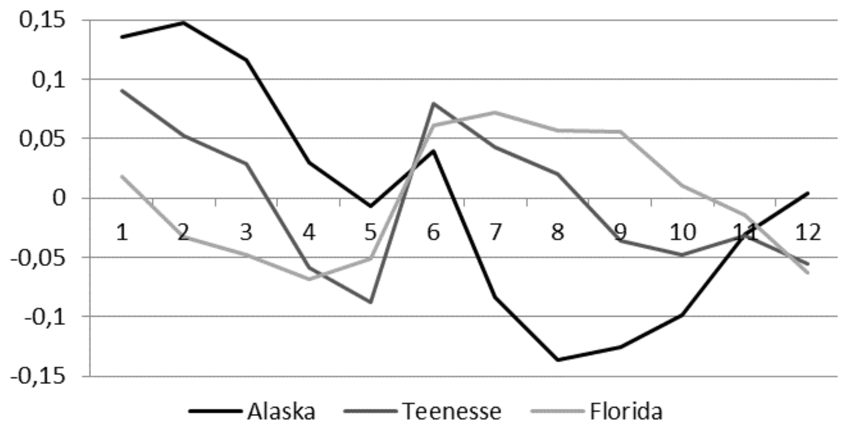


Source: own calculations.

Regional differentiation of the seasonality of unemployment among US states is similarly high among particular states of the European Union. In extreme cases, differences among states were more than three times. In general, it may be said that the seasonality of unemployment decreases together with movement towards the southern states. This suggests an explicit relation between climatic conditions and the value of seasonal fluctuations. The northwestern states show the largest fluctuations, especially North Dakota (13.5%) and Idaho (11.9%). The states with the lowest seasonality have smaller spatial concentration. This mainly concerns the southern states, including California (4.0%), Nevada (4.5%) and Texas (4.6%). However, neighbouring states with very different seasonality can also be indicated, e.g. Vermont (10.4%) and New York (4.4%).

The second indication of the differentiation of the seasonality of unemployment is its various distribution within a year. This phenomenon is also explained by the regional differentiation of climatic and economic factors [Guillemette, L'Italien, Grey, 2000]. Figure 2 presents average deviations of the number of people unemployed in particular months based on the example of three states.

Fig. 2. Seasonal fluctuations in the number of people unemployed



Source: own calculations.

The presented data indicate two aspects of regional differences that may be subject to more detailed analysis. Firstly, the dates of seasonal maxima and minima of unemployment can fall in different months. Alaska and Florida, in the presented example, are extreme oppositions. In the first state, the unemployment maximum is in February, while its minimum is August. In the second state, the maximum occurs in July and minimum in December. Therefore, we observe here an inversion of the course of seasonal fluctuations in unemployment in Florida against Alaska. In both states, one annual cycle of seasonal fluctuations can be observed. However, in Tennessee the situation is different, as two dates of seasonal increases and decreases in unemployment occur. Increases occurred in winter and summer months, while decreases in spring and fall months. Thus, a question may be asked whether the change in the distribution of seasonal fluctuations demonstrates spatial regularity, and how the inversion of a cycle of seasonal fluctuations as illustrated by Alaska and Florida can be described. As these states are located at opposite extremes, it may be assumed that between them are states with an intermediate distribution of seasonal fluctuations. The data presented in Fig. 1 indicate, though, that this transformation in the distribution of seasonal fluctuations does not consist in a simple suppression of an annual wave with a winter peak and its inversion into a wave with a summer peak. Then, the smallest seasonal fluctuations should characterise states located between those positioned in the extreme north and south of the country. Whereas in fact, the smallest seasonal fluctuations in unemployment concern the southern states.

Seasonality of unemployment – results of the harmonic analysis

The data presented in the previous section indicate the large regional differentiation of seasonal fluctuations in the USA. This section presents the results of the harmonic analysis of changes in unemployment in particular states. Harmonic analysis can be used to study the phenomenon of cyclicity in time series. It consists in the treatment of a time series as a sum of harmonics constituting the sinusoidal and cosinusoidal functions of a given period. A basic advantage of this tool is the detection of cyclical and seasonal changes, as well as the lack of special assumptions concerning the capacity of its application. A disadvantage of it is constituted by the fact that in a theoretical model a regular periodicity is assumed, which is often disturbed in practice.

The analysis presented in this section applied a model in which data on the number of people unemployed were cleaned of a trend. Data for 39 years were used, which means 234 harmonics in total. The subject of interest constituted two harmonics related to seasonal fluctuations: the harmonic of an annual period and harmonic of a semiannual period.

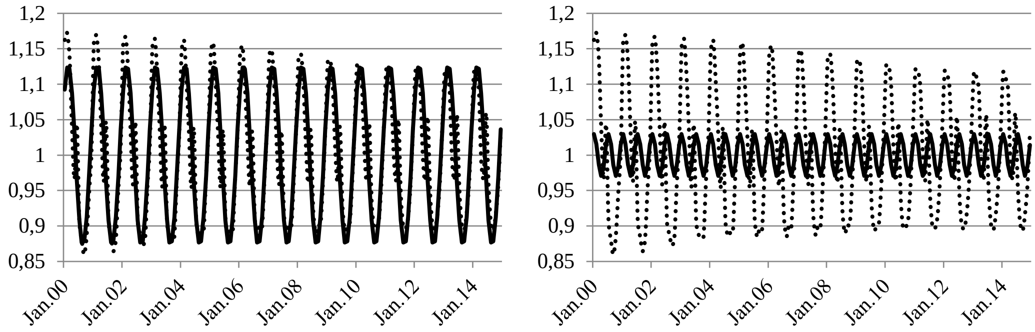
Figure 3 presents the way these harmonics are formed against total seasonal fluctuations illustrated with the example of two states: Alaska and Tennessee. The presented results show that seasonal fluctuations in Alaska are better described by the harmonic with an annual period, while in Tennessee – the harmonic with a semiannual period. This means that seasonal fluctuations in Alaska are dominated by one annual cycle, and in Tennessee – by two semiannual cycles.

Fig. 3. Seasonal fluctuations in the number of people unemployed (dotted line) and particular harmonics (unbroken line) for Alaska and Tennessee (example of behaviour)

Alaska

annual harmonic

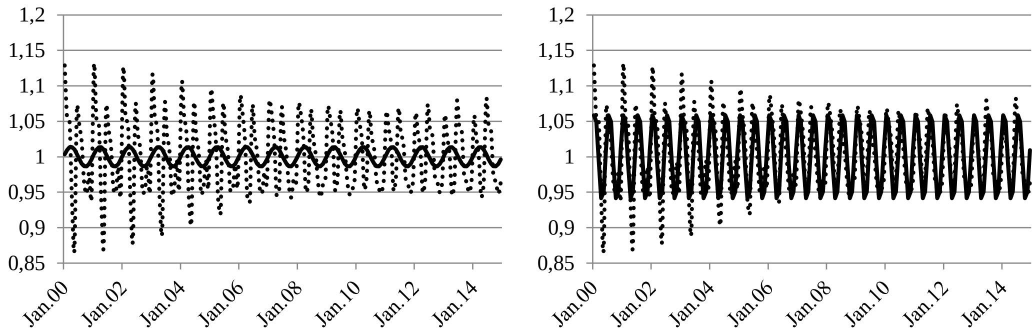
semiannual harmonic



Tennessee

annual harmonic

semiannual harmonic



Source: own calculations.

Table 1 presents detailed characteristics of the analysed harmonics in particular states. The summarised data concern the following values:

- amplitude describing values of extremes on a percentage basis (A);
- phase shift that enables to locate on a timeline the points (months) in which the number of people unemployed has maximal values (t_{max}). In the table 1 means January and 12 – December;
- share of harmonic in total variability of a seasonal component of the number of people unemployed (w).

While interpreting the results, attention should be paid to the fact that harmonics are not correlated with each other, so each of them explains a different part of variability of seasonal unemployment.

Tab. 1. Selected characteristics of the annual and semiannual harmonics in particular states

State	Average deviation	Annual harmonic			Semiannual harmonic			
		A	t_{max}	w	A	$t_{max (I)}$	$t_{max (II)}$	w
USA	0,0484	0,0296	3,3	15,6%	0,0564	1,4	7,4	56,9%
Alabama	0,0620	0,0298	7,8	8,4%	0,0774	1,4	7,4	56,6%
Alaska	0,0839	0,1269	2,4	83,3%	0,0296	1,0	7,0	4,5%
Arizona	0,0546	0,0531	7,9	37,0%	0,0524	1,6	7,6	35,9%
Arkansas	0,0765	0,0715	3,5	32,6%	0,0930	1,2	7,2	55,4%
California	0,0399	0,0215	2,8	11,0%	0,0495	1,5	7,5	58,3%
Colorado	0,0590	0,0524	2,7	29,9%	0,0539	1,4	7,4	31,6%
Connecticut	0,0626	0,0507	4,4	24,0%	0,0719	1,3	7,3	48,2%
Delaware	0,0718	0,0410	4,0	12,6%	0,0899	1,7	7,7	60,6%
District Columbia	0,0441	0,0278	7,0	12,0%	0,0546	1,1	7,1	46,3%
Florida	0,0465	0,0547	8,1	53,4%	0,0344	1,4	7,4	21,1%
Georgia	0,0449	0,0328	6,9	17,6%	0,0526	1,3	7,3	45,2%
Hawaii	0,0573	0,0745	7,1	48,9%	0,0228	0,8	6,8	4,6%
Idaho	0,1185	0,1697	2,1	72,6%	0,0846	1,8	7,8	18,0%
Illinois	0,0509	0,0406	3,4	25,2%	0,0579	1,3	7,3	51,1%
Indiana	0,0522	0,0635	2,7	48,3%	0,0521	1,5	7,5	32,5%
Iowa	0,0966	0,1345	2,0	66,1%	0,0742	1,6	7,6	20,1%
Kansas	0,0574	0,0229	4,9	5,7%	0,0643	1,4	7,4	45,1%
Kentucky	0,0625	0,0655	3,0	40,5%	0,0636	1,3	7,3	38,2%
Luisiana	0,0744	0,0596	7,4	22,5%	0,0810	0,9	6,9	41,6%
Maine	0,0909	0,1417	2,3	81,9%	0,0377	1,6	7,6	5,8%
Maryland	0,0462	0,0176	3,1	5,4%	0,0517	1,3	7,3	46,6%
Massachusetts	0,0627	0,0444	3,3	18,8%	0,0766	1,6	7,6	55,8%
Michigan	0,0682	0,0521	3,7	23,3%	0,0746	1,3	7,3	47,8%
Minnesota	0,0944	0,1103	2,6	50,1%	0,0819	1,6	7,6	27,6%
Missisipi	0,0594	0,0502	6,1	20,2%	0,0682	0,9	6,9	37,4%
Missouri	0,0652	0,0508	3,6	23,0%	0,0789	1,4	7,4	55,6%
Monatana	0,1001	0,1508	2,1	75,1%	0,0566	1,4	7,4	10,6%
Nebraska	0,0870	0,0739	3,2	28,5%	0,0913	1,2	7,2	43,4%
Nevada	0,0449	0,0247	2,2	9,0%	0,0581	1,3	7,3	50,0%
New Hampshire	0,0651	0,0760	2,7	43,8%	0,0690	1,7	7,7	36,1%
New Jersey	0,0549	0,0398	3,8	21,3%	0,0620	1,4	7,4	51,6%
New Mexico	0,0492	0,0470	6,0	26,5%	0,0529	1,0	7,0	33,7%
New York	0,0439	0,0372	2,2	26,0%	0,0524	1,6	7,6	51,5%
North Carolina	0,0526	0,0329	3,4	13,5%	0,0618	1,1	7,1	47,7%

State	Average deviation	Annual harmonic			Semiannual harmonic			
		A	t_{max}	w	A	$t_{max\ (I)}$	$t_{max\ (II)}$	w
North Dakota	0,1351	0,1745	3,0	61,0%	0,1086	1,3	7,3	23,6%
Ohio	0,0561	0,0506	2,5	29,7%	0,0615	1,5	7,5	43,9%
Oklahoma	0,0494	0,0325	2,2	14,1%	0,0496	1,1	7,1	32,9%
Oregon	0,0675	0,0894	2,6	58,9%	0,0588	1,7	7,7	25,4%
Pennsylvania	0,0602	0,0479	3,2	25,3%	0,0611	1,5	7,5	41,2%
Puerto Rico	0,0284	0,0252	6,9	26,5%	0,0236	1,8	7,8	23,2%
Rhode Island	0,0801	0,0789	2,1	31,2%	0,0878	1,7	7,7	38,6%
South Carolina	0,0509	0,0145	8,0	3,0%	0,0612	1,3	7,3	53,5%
South Dakota	0,0870	0,1236	2,5	64,1%	0,0700	1,5	7,5	20,6%
Tennesee	0,0526	0,0139	3,6	2,7%	0,0629	1,4	7,4	56,4%
Texas	0,0461	0,0296	6,3	14,1%	0,0547	1,2	7,2	47,9%
Utah	0,0651	0,0385	4,1	14,1%	0,0696	1,6	7,6	46,1%
Vermont	0,1037	0,1456	2,5	71,3%	0,0476	1,8	7,8	7,6%
Virginia	0,0474	0,0221	4,0	8,0%	0,0599	1,4	7,4	58,4%
Washington	0,0646	0,0932	2,1	63,8%	0,0559	1,4	7,4	22,9%
West Virginia	0,0675	0,0867	2,9	54,1%	0,0554	1,5	7,5	22,1%
Wisconsin	0,0953	0,1242	3,2	62,1%	0,0735	1,7	7,7	21,8%
Wyoming	0,1054	0,1643	2,1	81,5%	0,0479	1,3	7,3	6,9%

Source: own calculations.

The results obtained indicate large differences among particular states in reference to all analysed values, including the share of particular harmonics in the seasonal variability of the number of people unemployed and months when a given harmonic has maximal values. In some states an annual harmonic prevails in the seasonal variability, while in the other states – a semiannual one. The first group mainly includes the more northerly (e.g. Alaska, Idaho, Iowa, Montana) and southerly states (e.g. Florida, Hawaii). It means that in these states there is a clear single cycle of seasonal fluctuations in unemployment. The second group includes the states decidedly dominated by a semiannual harmonic. They mainly include the central states of the USA (Alabama, Arkansas, California, Missouri, Nevada, South Carolina, and Tennessee). In this group, two semiannual cycles are clearly visible. However, in a great number of states both annual and semiannual harmonics had a significant share in the formation of seasonal variability. In the case of these states, seasonal changes in unemployment are, thus, the superposition of two waves and have a less regular course, depending, say, on the prevalence of the annual or semiannual harmonic.

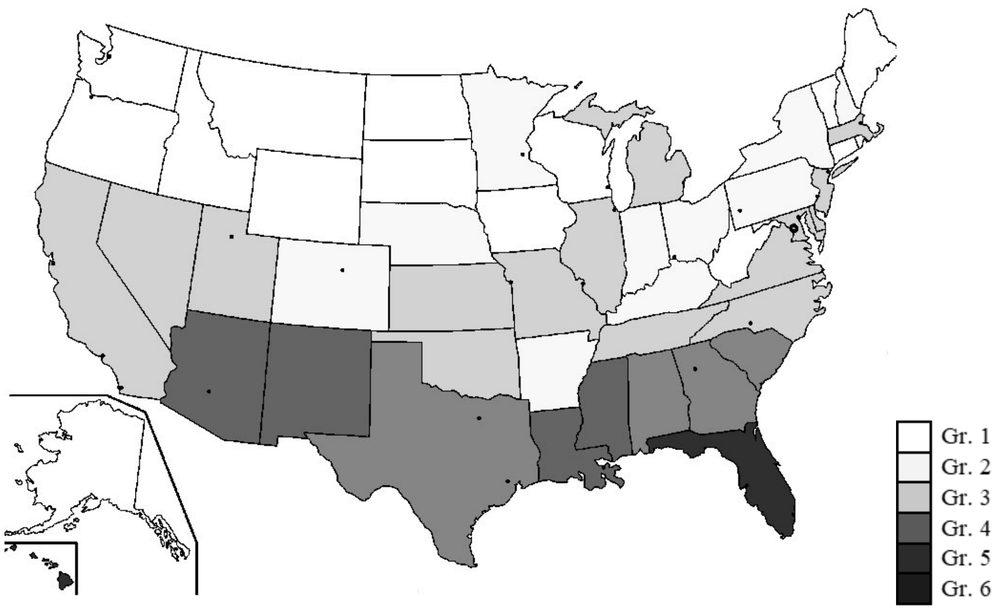
The second characteristic of the harmonic analysis was constituted by the phase shift, determining the months when a given harmonic had its maximal values. The results obtained indicate that in the event of a semiannual harmonic the differences among states were insignificant. It peaked in January and July. An annual harmonic created large differences among the states concerned. In some states, mainly the northern ones, the maximum occurred in the winter months (usually February or March), whereas in the southern ones, the maxima occurred in summer months (usually July).

To sum up, it may be said that particular states differ with regard to two criteria: the share of particular harmonics in the seasonal variability of the number of people unemployed, and the month when the number of people unemployed attains its maximum in the annual harmonic. Taking into account those two criteria, the following division of states into six groups was proposed:

– group 1: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), the annual harmonic prevails (share of the annual harmonic at least twice the size of the semiannual one);
– group 2: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), share of the annual harmonic does not differ significantly from the share of the semiannual harmonic (share of the annual one not larger than twice the size, and not smaller than half of the share of the semiannual one);
– group 3: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), the semiannual harmonic prevails (share of the semiannual one at least twice the size of the annual one);
– group 4: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), the semiannual harmonic prevails (share of the semiannual one at least twice the size of the annual one);
– group 5: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), share of the annual harmonic does not differ significantly from the share of the semiannual harmonic (share of the annual one not larger than twice the size, and not smaller than half of the share of the semiannual one);
– group 6: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), the annual harmonic prevails (share of the annual one at least twice the size of the semiannual one).

Figure 4 presents the results of the division of states into particular groups. Their parallel arrangement is clearly noticeable. The northern states belong mostly to group 1, so they are characterised by the prevalence of the annual harmonic, attaining a maximum in the winter months. A common feature of the southern states is the maximum of the annual harmonic in the summer months. Among them, Florida and Hawaii are described by the prevalence of an annual harmonic just like the northern states. States between these regions are characterised by the more complicated course of seasonal fluctuations. Some states are dominated by a semiannual harmonic, with two peaks of unemployment within a year (group 3), in some the seasonal fluctuations in unemployment are described by the superposition of annual and semiannual harmonics.

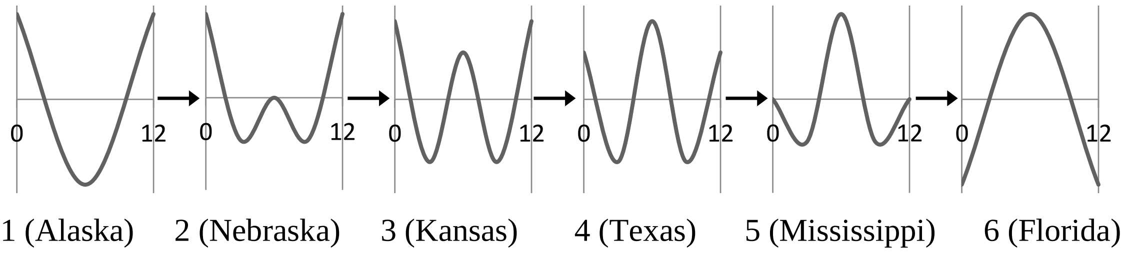
Fig. 4. Division of states with regard to the character of seasonal fluctuations



Source: own calculations.

Referring to the harmonic analysis results, the inversion of seasonal fluctuations in unemployment observed among the extreme northern (e.g. Alaska, Idaho, Wyoming) and southern states (Florida, Hawaii) may be described as an effect of the inversion of the annual harmonic, and the change in the share of annual and semiannual harmonics in the variability of seasonal unemployment. Figure 5 presents the model transformation from one extreme distribution to the other one. To put it simply, it was assumed that an amplitude of fluctuations with the annual harmonic of a winter and summer peak was the same. In fact these amplitudes can be different. When going from north to south, in the beginning the share of the annual harmonic with a winter maximum decreases and the share of the semiannual harmonic increases (2 and 3). Another stage of transformation is constituted by the dwindling of the annual harmonic for the benefit of the semiannual one (4). The next stage is a decreased share of the semiannual harmonic and an increased share of the annual harmonic with maximum in a summer period (5 and 6). The presented model of transformation from one wave to another may explain why the seasonal fluctuations in regions located between the two extremes are not the smallest.

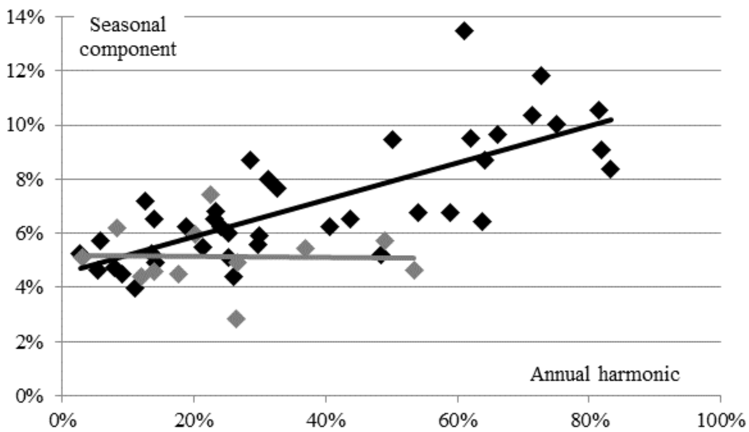
Fig. 5. Model of shift from an annual unemployment cycle with winter maximum to an annual cycle with summer maximum (in brackets, states with a set of seasonality features similar to the model)



Source: own calculations.

According to the statistical data, the largest seasonal fluctuations in unemployment concern the northern states, while the smallest ones – the southern. The harmonic analysis indicates significant differences among these states. This suggests a relation between the features of the characteristics obtained in the harmonic analysis and the value of the seasonal fluctuations in unemployment.

Fig. 6. Seasonal fluctuations in unemployment and share of annual harmonic in seasonal variability (black points – harmonic with winter maximum, grey points – harmonic with summer maximum)



Source: own calculations.

Figure 6 presents the dependence between the size of these fluctuations in particular states and the annual harmonic share in total seasonal variability, dividing states into two groups according to the date of unemployment maximum in the annual harmonic (maximum in winter or summer period). The data indicate that seasonality of unemployment in states where the annual harmonic peaks in the summer period are low, regardless of the harmonic's share in seasonal variability. In states where the annual harmonic attains a maximum in winter, the seasonal variability of unemployment increases with the increasing share of this harmonic in total seasonal variability.

Conclusions

This paper presents regional differences in the seasonality of unemployment as an effect of superposition of differing amplitude and frequency. Superposition of waves of a different frequency results in specific seasonal fluctuations in unemployment in particular states. Differences among states arise from the different share of waves of annual and semiannual frequency, and from the date of maximal unemployment in a wave of an annual frequency. Northern states are characterised by the prevalence of a wave of annual frequency with a maximum in winter. In southern states, the unemployment maximum in a wave with annual frequency occurs in the summer period, while the further south, the bigger the share of this wave in total seasonal variability. In the majority of states between the northern and southern ones, seasonality of unemployment has the character of a cycle of semiannual frequency with a seasonal maximum in the winter and summer periods.

The value of seasonal fluctuations is clearly related to the distribution of seasonal fluctuations. Smaller seasonal fluctuations are demonstrated by states where the maximum for the annual harmonic occurs in summer. In the case of the states where the maximum of the annual harmonic occurs in winter, the seasonal fluctuations in unemployment are the smaller, the smaller the share of this harmonic in total seasonal variability, and the larger the share of semiannual harmonic is.

This paper presents seasonal fluctuations in unemployment, limiting the presentation of results to two harmonics. In most states, they explained the vast majority of seasonal variability. In some states a significant part of the seasonal variability was not explained by those harmonics, though. It may be caused by the less regular course of seasonal fluctuations and/or changes in the seasonal distribution of seasonal fluctuations that might have had a character of a long-term trend or fluctuations in the area of cyclical development. Those aspects of changes in the seasonality of unemployment were not analysed in this paper.

Seasonality in the labour market is to a large extent a phenomenon specific to a given country. On the example of the United States, one can notice how climate conditions mean that the size and distribution of seasonal fluctuations over time may be spatially different. It is difficult to assume in advance that only seasonality is determined by non-economic factors, such as climatic conditions. Different economies may react differently to such, often similar climate conditions. Assuming that sensitivity to short-term disturbances indicates the lower efficiency of the economy, it can be hypothesised that weaker, less-efficient economies will be characterised by an average higher seasonality of production. However, the seasonality scale does not affect the growth dynamics.

In many empirical studies, seasonal variations occurring in different countries are compared. However, the differences between countries have in themselves uneconomical and structural factors. The important role of the structural factor is often indicated. Meanwhile, in this study, seasonality analysis was carried out on the example of the United States, one country, but with a varied climate structure. Limiting research to one economy allows a better understanding of the importance of the non-economic factor. And as it turns out, it is crucial in the scale and distribution of seasonal fluctuations.

Macroeconomic policy, which should serve to stabilise employment not only within the economic cycle, but also in the seasonal cycle, should take into account flows between the groups of the employed, the unemployed and economically inactive. Other reasons may be indications of short-term transition to and from the group of inactive people, than to and from the group of the unemployed. Attention should also paid to the relationship between the seasonality of employment and the seasonality of production. Studies carried out in this respect indicate that this relationship varies depending on the sector of the economy. Structural changes in the economy may contribute to limiting seasonal fluctuations and to better use of labour resources, and thus to more sustainable economic development.

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Assessment of the level of economic and social development of regions using the Hellwig taxonomic development measure

Marian Podstawka
Siedlce University of Natural Sciences and Humanities, Poland
ORCID: 0000-0002-3834-0743, e-mail: marian.podstawka@uph.edu.pl
Bartłomiej Suchodolski
Siedlce University of Natural Sciences and Humanities, Poland
ORCID: 0000-0002-6033-4825, e-mail: bartlomiej.suchodolski@uph.edu.pl

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Abstract: The paper presents the problem of regional development and its characterising determinants. The voivodeships constitute the highest level of Polish self-government administration. One of their responsibilities is to support regional development on their territory. Regional development includes quantitative and qualitative changes in the social and economic aspects of operation of voivodeships. Development is an ambiguous notion and it can be perceived through multiple social and economic determinants. It can be expressed both by research of macroeconomic variables, as well as the ongoing social and qualitative changes regarding the citizens' standard of living. The purpose of this article is the assessment of socio-economic development differentiation of Polish voivodeships between 2011 and 2016. The assessment was carried out using Hellwig taxonomic development measure. The level of development for each voivodeship was described with 23 variables. Among them the following can be mentioned: rate of natural increase per 1000 people, percentage of people in working age, total length of expressways and motorways per 1000 km2, percentage of people using the water supply network, number of beds in general hospitals per 10 thousand people, number of people per one library facility, number of registered passenger cars per 1000 residents, net enrolment rate on secondary school level, number of children in kindergarten facilities per 1000 children between 3 and 5 years of age, degree of use of bed places, share of protected areas in the voivodeship area, percentage of voivodeship councillors with higher education, migration rate per 1000 residents, rate of registered unemployment, the average monthly gross salary, GDP per capita, voivodeship own revenue per capita, share of PIT tax revenue in the total own revenue of the voivodeship, share of CIT tax revenue in the total own revenue of the voivodeship, gross worth of fixed assets per capita, capital expenditure per capita, number of entities entered into the REGON registered per 10 thousand residents. A model of development was created, i.e. a hypothetical voivodeship with the best observed values of variables and the distance of every voivodeship to the model voivodeship was calculated. The research proposed a hypothesis assuming the existence of a differentiation in regional development in Poland. The average distances of voivodeships from the model for the years in question were found to be on a low, relatively stable level. At the same time the particular voivodeships also maintained their distance from the model and their rank on a comparable level. It was a proof of an existence of a relatively stable developmental differentiation for the voivodeships in question. The voivodeship characterised by the highest level of development in all the years in question was the Masovian voivodeship, while the voivodeships characterised with the lowest level of development were Lublin voivodeship and Warmian-Masurian voivodeship.

Keywords: regional development, regions, Hellwig development measure, Poland

JEL: O11, R11, R58

Introduction

Due to the position of voivodeships in the administrative structure of the country, their main purpose is endorsement of the broadly-understood civilisation regional development. The regional development on the voivodeship level comprises both quantitative and qualitative changes in the social and economic aspects of operation of these self-government units. The development can be perceived through numerous social and economic determinants and expressed both by research of macroeconomic variables as well as the social and qualitative changes related to the quality standard of living. The development is a continuous phenomenon. The pace of development, though, is varied in different parts of the country. It leads to an increasingly visible developmental polarisation on the regional level.

The purpose of the following article is to assess the differentiation of development for Polish voivodeships. The research conducted aimed at verifying the hypothesis assuming an existence of diversification of regional development in Poland. The research covers the years from 2011 to 2016. The proposed hypothesis was verified with Hellwig taxonomic development measure based on the data of the Local Data Bank of the Central Statistical Office.

Voivodeship as the regional level of local self-government

“Local self-government is a union of the local community distinguished within the structure of the state, created based on the provisions of law, created for autonomous realisation of public administration, provided with material measures allowing for realisation of the entrusted responsibilities [Ochendowski; 1997; p. 22]”. Self-government is a decentralised form of public administration, i.e. public administration realised by entities other that the state power, based on relative autonomy [Jaskiernia; 2011; p. 22-23]. The distinguished self-government division units are supposed to be “little homelands” for their residents.

As a result of the law on introduction of a general three-tier territorial division of the state on January 1st 1999 a three-level self-government administration structure was implemented. The units of three-tier territorial division of the state are as follows: municipalities, counties and voivodeships. The regional level of Polish public administration comprises of voivodeships. According to the implemented self-government reform, 16 voivodeships were created: Lower Silesian, Kuyavian-Pomeranian, Lublin, Lubusz, Łódź, Lesser Poland, Masovian, Opole, Subcarpathian, Podlaskie, Pomeranian, Silesian, Świętokrzyskie, Warmia-Masurian, Greater Poland, West Pomeranian. Since the voivodeships are just the regional level, their actions are aimed directly at particular citizens only in limited scope. Their basic purpose is to act for the broadly-understood civilisation development. The voivodeships must be characterised by a scale sufficient to concentrate resources in specific guidelines. Creation of metropolitan urban centres, which guarantee a proper economic, institutional and intellectual potential, is a decisive factor for the possibility of existence of regional self-government units. The 49 voivodeships, which existed up till 1999 and comprised too small areas to have the proper academic background, were not suitable for such model of voivodeship [Gorzelak, Jałowiecki, Stec; 2001; p. 52].

According to the act on voivodeship government, the citizens build a regional self-governing community by the force of law [The act on voivodeship government; 1998; art. 1]. The scope of responsibilities of the voivodeship self-government comprises realisation of public duties characteristic for voivodeship, not reserved by law for state administration organs [The act on voivodeship government; 1998; art. 2]. The scope of activity of the voivodeship self-government must not infringe the autonomy of counties and municipalities [The act on voivodeship government; 1998; art. 4].

The voivodeship self-government defines the development strategy for the voivodeship, taking into consideration particularly the following goals [The act on voivodeship government; 1998; art. 11]:

- care for Polish values and shaping the national, civil and cultural identity of the citizens, as well as care and development of local identity;
- stimulating economic activity;
- raising the level of competitiveness and innovations of the voivodeship economy;
- protection of the cultural and natural environment by taking into consideration the needs of future generations;
- shaping and maintaining spatial order.

One of the duties of the voivodeship self-government is realisation of voivodeship policy, which comprises [The act on voivodeship government, 1998, art. 11]:

- creating conditions for economic development, including stimulation of the labour market;
- maintaining and developing the social and technical infrastructure on the voivodeship level;
- acquiring and joining public and private funds for the purposes of realisation of tasks in the field of public utility;
- supporting and leading the activities for raising the level of education among the citizens;
- rational use of natural resources and shaping the natural environment according to the sustainable development rule;

- supporting the science and cooperation between science and economy, endorsing technological advancements and innovations;
- stimulating the cultural growth and caring for the cultural heritage and its rational utility;
- promotion of advantages and developmental opportunities of the voivodeship;
- supporting and leading actions for social interaction and taking counter-measures against social exclusion.

Regional development and its determinants

The discussion on the development issue can be started by specifying the difference between local development and regional development. After the introduction of three-stage administrative division of the state, the local development is considered the development process, taking place on the area of municipalities, cities and counties. The development on the level of every self-government voivodeship is considered regional development [Szewczuk, Kogut-Jaworska, Zioło; 2011; p. 14]. „Development" is a basic notion. In science, practice, politics and common life it is generally defined and ambiguous. The notion is not only an undefined, ambiguous notion, but also a primal one [Piontek, Piontek; 2016; p. 14]. The notion of regional development is usually associated with desirable, positive quantitative, qualitative and structural transformations of the given area. It is a process of guided transformations, through which a transformation from simpler to more complex and perfect forms or states occurs [Nowa encyklopedia powszechna; 1997; p. 616]. Development creates an opportunity for progress in multiple fields of life: economic, social, cultural and political, allows for creating new values.

Regional development is a multi-dimensional notion, the complexity of which is a direct result of a multitude of its shaping factors. The level of development can be perceived though a wide range of characteristics of a voivodeship, e.g. economic situation of the voivodeship as a territorial self-government unit, economic situation and quality of life of its residents and level of infrastructure development in the voivodeship. All these characteristics can be divided into two groups of determinants – economy-related determinants and society-related determinants.

The level of regional development using the Hellwig measure

As it was pointed out in the introduction, the purpose of the paper is to assess the development differentiation of Polish voivodeships. This assessment was conducted with taxonomic development measure calculated with Hellwig method. The research was conducted in the following stages [Pomianek, Chrzanowska, Bórawski; 2013; p. 444]:

1. Choice of a set of variables and defining them;
2. Creation of a taxonomic development measure with Hellwig method;
3. Setting a ranking of voivodeships and dividing them into classes.

The concept of a taxonomic development measure was proposed by Z. Hellwig in 1968. Its use allows for arranging separated objects, e.g. territorial units, and dividing them into groups. The taxonomic values of the development measure are a resultant of the level of variables regarding various aspects of the researched phenomenon [Pietrzak; 2014; p. 182]. The purpose of calculating a taxonomic development measure is to arrange the objects according to the level of multi-characteristic phenomena. The Hellwig development measure allows for conducting a synthesis of information from a sequence of variables and attributing one aggregate measure to the analysed phenomenon [Krakowiak-Bal; 2005; p. 72].

Using the Hellwig taxonomic development measure allowed for arranging the set of voivodeships Pi (where: i = 1, 2, ..., n; n=16), where each of them was described with a set of 23 diagnostic characteristics, which include stimulants and destimulants.

The first stage of the research was the choice of variables to construct the measure. The variables must be measurable, available and complete. As it was mentioned in the introduction, the necessary data were collected from Local Data Bank of the Central Statistical Office. While choosing the variables, the authors made effort for the variables to broadly describe the socio-economic development of Polish voivodeships. The economic development of the voivodeships, as well as the quality of life perceived by its citizens, were important. The variables chosen for the research to construct the Hellwig taxonomic measure had to be measurable, available and complete. These requirements made it impossible to analyse the variables, the data for which was not gathered at the Local Data Bank of the Central Statistical Office for the voivodeship level and could not be obtained in any other way. Initially, 23 variables characterising the socio-economic development of voivodeships were chosen for the set of variables:

1. Rate of natural increase per 1000 people (in persons) – stimulant;
2. Percentage of people in working age (in %) – stimulant;
3. Total length of expressways and motorways per 1000 km2 (in km) – stimulant;
4. Percentage of people using the water supply network (% of total population) – stimulant;
5. Percentage of people using the sewer system (% of total population) – stimulant;
6. Number of beds in general hospitals per 10 thousand people – stimulant;
7. Number of people per one library facility – stimulant;
8. Number of registered passenger cars per 1000 residents - stimulant;

9. Net enrolment rate on the secondary school level (in %) – stimulant;
10. Number of children in kindergarten facilities per 1000 children between 3 and 5 years of age (in persons) – stimulant;
11. Degree of use of bed places (in %) – stimulant;
12. Participation of protected areas in the voivodeship area (in %) – stimulant;
13. Percentage of voivodeship councillors with higher education (in %) – stimulant;
14. Migration rate per 1000 residents (in persons) – stimulant;
15. Rate of registered unemployment (in %) – destimulant;
16. The average monthly gross salary (economic entities with less than 9 working persons were excluded (in PLN) – stimulant;
17. GDP per capita (in PLN) – stimulant;
18. Voivodeship own revenue per capita (in PLN) – stimulant;
19. Participation of PIT tax revenue in the total own revenue of the voivodeship (in %) – stimulant;
20. Participation of CIT tax revenue in the total own revenue of the voivodeship (w %) – stimulant;
21. Gross worth of fixed assets per capita (in thousands of PLN) – stimulant;
22. Capital expenditure per capita (in PLN) – stimulant;
23. Number of entities entered into the REGON registered per 10 thousand residents – stimulant.

After choosing the potential variables, the quasi-constants were eliminated. It was done by using the characteristics variability rate. For every jth variable the variability rate was calculated.

(1) $$V_j = \frac{S_j}{\overline{x_j}}$$,(j = 1, 2, …, m; m=23)

where:

V_j – variability rate for the jth variable;

S_j – standard deviation for the jth variable, calculated from the formula:

(2) $$S_j = \sqrt{n^{-1}\sum_{i=1}^{n}\left(x_{ij} - \overline{x_j}\right)^2}$$,(i = 1, 2, …, n; j = 1, 2, …, m)

where:

x_{ij} – the value of jth variable for the ith object;

n – number of tested objects

$\overline{x_j}$ – arithmetic mean of the jth variable, calculated from the formula:

(3) $$\overline{x_j} = n^{-1} \sum_{i=1}^{n} x_{ij} \quad ,(i = 1, 2, \ldots, n;\ j = 1, 2, \ldots, m)$$

The variables, for which the variability rate (Vj) was lower than the chosen critical value, were eliminated from the set. The critical value for the variability rate was chosen to be on the level of 0.05. Due to a low variability of a group of variables, three variables were dismissed: percentage of people in working age, net enrolment rate on the secondary school level, percentage of voivodeship councillors with higher education. As a result, a set of 20 variables was obtained – they are presented in Table 1.

Table 1. Variables chosen for the research

Symbol	Variable
X_1	Rate of natural increase per 1000 people (in persons)
X_2	Total length of expressways and motorways per 1000 km2 (in km)
X_3	Percentage of people using the water supply network
X_4	Percentage of people using the sewer system (% of total population)
X_5	Number of beds in general hospitals per 10 thousand people
X_6	Number of people per one library facility
X_7	Number of registered passenger cars per 1000 residents
X_8	Number of children in kindergarten facilities per 1000 children between 3 and 5 years of age (in persons)
X_9	Degree of use of bed places (in %)
X_{10}	Participation of protected areas in the voivodeship area (in %)
X_{11}	Migration rate per 1000 residents (in persons)
X_{12}	Rate of registered unemployment (in %)
X_{13}	The average monthly gross salary (economic entities with less than 9 working persons were excluded (in PLN)
X_{14}	GDP per capita (in PLN)
X_{15}	Voivodeship own revenue per capita (in PLN)

Symbol	Variable
X_{16}	Participation of PIT tax revenue in the total own revenue of the voivodeship (in %)
X_{17}	Participation of CIT tax revenue in the total own revenue of the voivodeship (w %)
X_{18}	Gross worth of fixed assets per capita (in thousands of PLN)
X_{19}	Capital expenditure per capita (in PLN)
X_{20}	Number of entities entered into the REGON registered per 10 thousand residents

Source: own elaboration.

The set of variables describing the voivodeships in question was arranged in an observation matrix X:

(4) $$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1p} \\ x_{21} & x_{22} & \dots & x_{2p} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{np} \end{bmatrix}$$,(i = 1, 2,..., n; j = 1, 2,..., p; p=20)

where:

x_{ij} – values of the jth characteristic for an ith object.

The diagnostic variables accepted for the research were characterised by varying, and thus incomparable, measures – they were expressed i.a. in persons, kilometres, percentages or PLN. To standardise them, they were normalised by standardisation according to the formula:

(5) $$z_{ij} = \frac{x_{ij} - \overline{x_j}}{S_j}$$,(i = 1, 2, …, n; j = 1, 2,..., p)

where:

z_{ij}– standardised value of x_{ij};

$\overline{x_j}$ – arithmetic mean of the jth variable;

S_j – standard deviation of the jth variable.

As a result of the standardisation, a Z matrix of standardised characteristic values was obtained.

(6) $$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1p} \\ z_{21} & z_{22} & \cdots & z_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ z_{n1} & z_{n2} & \cdots & z_{np} \end{bmatrix}$$,$(i = 1, 2,..., n; j = 1, 2,..., p)$

where:

z_{ij} – standardised value of x_{ij}.

Based on the matrix Z, a model of development, i.e. an abstract voivodeship P0 with standardised coordinates z01, z02, …, z0j, where z0j = max{zij}, when Zj is a stimulant and z0j = min{zij}, when Zj is a destimulant, was created. From all the variables chosen for the research, only the registered unemployment rate was considered a destimulant. The model can be perceived as a vector, the coordinates of which are the best values of subsequent standardised diagnostic characteristics. The model is an artificially, idealistically construed object, characterised by optimal properties expressed in correspondingly specified functions of the values of particular diagnostic characteristics. The model was a hypothetical voivodeship with the best observed values of the variables. The situation of real units in question was subsequently compared to the construed model. As a result it was found that all the voivodeships are distant from the model [Młodak; 2006; p. 121].

Subsequently, the distance to the model (di) for all the voivodeships was calculated from the formula:

(7) $$d_i = 1 - \frac{D_{i0}}{D_0}$$,$(i = 1, 2, \ldots, n)$

where:

d_i – taxonomic development measure for the ith object;

D_{i0} – the distance of the ith object to the object P_0, calculated from the formula:

(8) $$D_{i0} = \sqrt{\sum_{j=1}^{p} \left(z_{ij} - z_{0j}\right)^2}$$,$(i = 1, 2,..., n; j = 1, 2, \ldots, p)$

where:

z_{ij} – normalised value of the jth variable for the ith object;

z_{0j} – the model standardised value of the jth variable;

D_0 – guaranteeing the value of d_i to belong to a range between 0 and 1, calculated from the formula:

(9) $$D_0 = \overline{D_0} + 2S_0$$

where:

$\overline{D_0}$ – mean value of the norm;

S_0 – standard deviation from the norm.

The average mean value and the standard deviation were calculated from the formulas below:

(10) $$\overline{D_0} = n^{-1} \sum_{i=1}^{n} D_{i0}$$

(11) $$S_0 = \sqrt{n^{-1} \sum_{i=1}^{n} \left(D_{i0} - \overline{D_0}\right)^2}$$

Thus the synthetic determinants for every voivodeship were specified. The value Hellwig taxonomic development di was comprised within the range [0,1] – the closer the values of particular characteristics were to the model, the higher was the development level, and the more distant were the values the lower was the development level.

The next stage was the division of voivodeships into classes based on their level of socio-economic development. The classification was performed with the arithmetic mean distance from the model (¯(d_i)). All the voivodeships were divided into two groups:

- group I – underdeveloped voivodeships for which the value of di measure was lower than the arithmetic mean distance from the model;
- group II – well-developed voivodeships, for which the value of di measure was greater than the arithmetic mean distance from the model.

Average distance of voivodeships from the construed model for the years 2011-2016 is presented in Table 2.

Table 2. Mean arithmetic distance of regions from the model of development for the years 2011-2016 ($\overline{d_i}$)

Year	2011	2012	2013	2014	2015	2016
Mean arithmetic distance to the model	0.271	0.262	0.278	0.272	0.283	0.280

Source: own elaboration.

The mean levels of distance from the model were maintained relatively low and, at the same time. relatively stable, fluctuating between 0.267 to 0.283. It is a proof of a very significant distance of the voivodeships in question from the construed development model and maintained stagnation in development level differentiation on the regional level in Poland.

Table 3. Regions with the best values of the tested characteristics in the years 2011-2016

Char.	2011	2012	2013	2014	2015	2016
1	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian
2	Silesian	Silesian	Silesian	Silesian	Silesian	Silesian
3	Opole	Opole	Opole	Opole	Opole	Opole
4	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian
5	Silesian	Silesian	Silesian	Silesian	Silesian	Silesian
6	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian	Pomeranian
7	Greater Poland	Greater Poland	Greater Poland	Greater Poland	Greater Poland	Greater Poland
8	Opole	Opole	Opole	Opole	Opole	Masovian
9	Western-Pomeranian	Western-Pomeranian	Western-Pomeranian	Western-Pomeranian	Western-Pomeranian	Western-Pomeranian
10	Świętokrzyskie	Świętokrzyskie	Świętokrzyskie	Świętokrzyskie	Świętokrzyskie	Świętokrzyskie
11	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
12	Greater Poland	Greater Poland	Greater Poland	Greater Poland	Greater Poland	Greater Poland
13	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
14	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
15	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
16	Podlaskie	Podlaskie	Świętokrzyskie	Podlaskie	Podlaskie	Warmian-Masurian
17	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
18	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
19	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian
20	Masovian	Masovian	Masovian	Masovian	Masovian	Masovian

Source: own elaboration.

Table 3 present the voivodeships characterised by the highest values of particular characteristics in the years 2011-2016. As it is clear from the above, neither of the voivodeships dominated in all categories. Within the specified characteristics in the next years, the leaders generally remained unchanged. Only in the eighth characteristic (children in kindergarten facilities per 1 thousand children between 3 and 5 years of age) and characteristic 16 (participation of PIT tax revenue in total own revenue of the voivodeship) the leaders were changed in subsequent years. It must be noticed that the voivodeship, which took lead with regards to most of the characteristics, was the Masovian voivodeship.Table 4. Hellwig taxonomic development measures for the years 2011-2016 (the underdeveloped regions are marked in red, the well-developed regions in black).

Table 1. Hellwig taxonomic development measures for the years 2011-2016 (the underdeveloped voivodeships are marked in red, the well-developed voivodeships in black)

Voivodship	2011	Voivodship	2012	Voivodship	2013	Voivodship	2014	Voivodship	2015	Voivodship	2016
Lublin	0,091	Lublin	0,084	Warmian-Masurian	0,075	Warmian-Masurian	0,080	Lublin	0,086	Lublin	0,075
Warmian-Masurian	0,103	Warmian-Masurian	0,100	Lublin	0,099	Lublin	0,103	Warmian-Masurian	0,106	Warmian-Masurian	0,118
Subcarpathian	0,114	Subcarpathian	0,116	Świętokrzyskie	0,141	Świętokrzyskie	0,128	Subcarpathian	0,121	Świętokrzyskie	0,125
Podlaskie	0,147	Podlaskie	0,135	Subcarpathian	0,147	Subcarpathian	0,130	Świętokrzyskie	0,138	Subcarpathian	0,128
Świętokrzyskie	0,170	Świętokrzyskie	0,153	Podlaskie	0,157	Podlaskie	0,161	Podlaskie	0,146	Podlaskie	0,145
Opole	0,232	Kuyavian-Pomeranian	0,210	Kuyavian-Pomeranian	0,236	Kuyavian-Pomeranian	0,234	Kuyavian-Pomeranian	0,258	Kuyavian-Pomeranian	0,225
Kuyavian-Pomeranian	0,233	Opole	0,236	Opole	0,258	Lubusz	0,256	Opole	0,272	Western-Pomeranian	0,271
Lubusz	0,256	Lubusz	0,257	Lubusz	0,272	Opole	0,259	Lubusz	0,275	Opole	0,277
Western-Pomeranian	0,266	Western-Pomeranian	0,264	Western-Pomeranian	0,274	Western-Pomeranian	0,261	Western-Pomeranian	0,281	Lubusz	0,288
Łódź	0,272	Łódź	0,286	Łódź	0,299	Lesser Poland	0,297	Łódź	0,309	Łódź	0,295
Lesser Poland	0,281	Lesser Poland	0,294	Lesser Poland	0,311	Łódź	0,298	Lesser Poland	0,320	Lesser Poland	0,333
Pomeranian	0,369	Pomeranian	0,337	Greater Poland	0,358	Greater Poland	0,375	Silesian	0,397	Pomeranian	0,385
Greater Poland	0,373	Greater Poland	0,371	Pomeranian	0,390	Pomeranian	0,376	Pomeranian	0,398	Greater Poland	0,388
Lower-Silesian	0,403	Lower-Silesian	0,372	Lower-Silesian	0,405	Lower-Silesian	0,397	Greater Poland	0,406	Silesian	0,411
Silesian	0,447	Silesian	0,418	Silesian	0,426	Silesian	0,419	Lower-Silesian	0,418	Lower-Silesian	0,440
Masovian	0,574	Masovian	0,566	Masovian	0,603	Masovian	0,585	Masovian	0,603	Masovian	0,579

Source: own elaboration.

Table 4 presents the distances of particular voivodeships from the model. The Masovian voivodeship was the closest to the model for all the years. The Silesian, Lower-Silesian and Greater Poland voivodeships took places in the top 3 in subsequent years. The voivodeships farthest from the ideal were the Lublin and Warmian-Masurian voivodeship. It should be noted that the degree of distance of particular voivodeships and their average distance from the development model in subsequent years were maintained on an almost identical level. Thus it must be stated that the level of development disproportion on the voivodeship level did not change in subsequent years. Very large differences of the development degree on the voivodeship level between the voivodeships from the top and from the bottom of the list pose a particular concern. The distance of the best-developed voivodeship was over eight times closer to the model than the least-developed voivodeship. Also, a very significant division into well-developed Poland “A” and underdeveloped Poland “B”, where the border between them runs along the Vistula river. Most of the well-developed voivodeships were situated West of Vistula, and most of the underdeveloped were East of this River. As a result of an analysis of the data gathered in the Table 4 it can be stated that the hypothesis assuming an existence of differentiation of the level of development on the voivodeship level was confirmed.

Summary

Regional development is connected with desirable, positive quantitative, qualitative and structural transformations of the area of a given region. Based on the research conducted, the hypothesis assuming the existence of a differentiation in the level of development for the regions can be considered as confirmed. To verify the hypothesis, the Hellwig taxonomic development measure was used. The level of development for all the regions was described through 20 variables, based on which a synthetic development measure was calculated for all of them. A development model, i.e. a hypothetical region with the best values of the variables, was created. The distance of every region to the model region was measured. The average distances of regions from the model for the years 2011-2016 were found to be on a low, relatively stable level. At the same time the particular regions also maintained their distance from the model and their rank on a comparable level. This was proof of the existence of a relatively stable developmental differentiation for the regions in question during the analysed years. The best-developed region over all the years in question was the Mazowieckie region, while the regions characterised by the lowest level of development were the Lubelskie and Warmińsko-Mazurskie regions.

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Non-model methods in the study of regional development – the impact of the aggregation formula on the obtained research results

Rafał Czyżycki
University of Szczecin
ORCID: 0000-0003-4828-1887, e-mail: rafal.czyzycki@wzieu.pl

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Abstract: The study of the level of socio-economic development is one of the most frequently undertaken scientific considerations in the field of research into regions. Since the very concept of "socio-economic development" is currently not clearly defined and, hence, it is not possible to measure it directly, various attempts are being made to measure it indirectly using methods of multidimensional comparative analysis. The main goal of the article is to assess the impact of the chosen method for obtaining a synthetic measure of development, which is part of the non-model methods of aggregation of diagnostic variables, on the final result of orderingregions in terms of socio-economic development. Meanwhile, the considerations are accompanied by the following research hypothesis: *one of the factors significantly affecting the final result of ordering the regions in terms of socio-economic development is the choice of method used to obtain a synthetic measure of development*. As a result of the research, this hypothesis was confirmed, and proposals aimed at increasing the objectivity of this type of research were also indicated.

Keywords: regional development, non-model methods, synthetic development measure

JEL: C38, O18, R11

Introduction

Issues related to regional development, treated as the development of states, regions, districts, municipalities or otherwise defined relatively homogeneous areas, varying from areas adjacent in terms of specific natural or acquired features [Potoczna, 2006, pp. 86-92], are the subject of many scientific considerations. The analysis of information obtained on the basis of the *Publish or Perish* programme shows that only from the beginning of 2010 to the end of 2017, 120 scientific papers were published whose titles included the term "regional development", 108 papers with "development of regions" in the title and 114 works which used the term "socio-economic development" in their titles. These works, however, have a very diverse cognitive nature, resulting, inter alia, from the fact that the character, dynamics, direction or structure of processes related to regional development are conditioned by a number of factors[1] that influence the phenomena occurring in a region to a different extent [Korenik, 2004, pp 107-113]. The regional development process itself has a multidimensional, extremely heterogeneous character, which means that not only the method of its measurement remains ambiguous [Klóska, 2012, p. 127], but also the grasp of it and description are extremely difficult and lead, as a consequence, to the adoption of various simplifying assumptions [Kosiedowski et al., 2001, p 28]. As a result, research work in the field of regional development focuses in practice either on qualitative methods, or on quantitative methods. Qualitative methods form the basis for describing economic events or determining causal relationships between events and factors affecting these events. In contrast, quantitative methods, using a rich set of mathematical and statistical methods and techniques, enable the quantification of development measures, the measurement of structures and their transformations, as well as the inventory of resources and criteria for their allocation. Quantitative methods also enable the construction of formalised econometric models, including spatial cross-sections (national, regional, micro-regional and zonal) [Kozubek, 1999, pp. 63-71].

The main goal of the article is to assess the impact of the chosen method of obtaining a synthetic measure of development, which is part of the non-model methods of aggregation of diagnostic variables, on the final result of ordering the regions in terms of socio-economic development. It will make it possible to verify the following research hypothesis adopted in the work: *one of the factors significantly affecting the final result of ordering the regions in terms of socio-economic development is the choice of method used to obtain a synthetic measure of development.*

Research methodology

Socio-economic development is a term in the field of multidimensional statistics, directly immeasurable, however describable by a number of diagnostic variables, essentially related to this concept. The ordering of the examined objects from "best" to "worst" is based on the value describing particular objects, obtained from the function aggregating the information contained in the adopted diagnostic variables. The ordering of such a set of objects requires meeting the following assumptions [Walesiak, 1996, p. 125]:

– the set of objects is a non-empty and finite set;

[1] At the subsequent stages of socio-economic development, competition issues also come to the fore, to which particular attention should be devoted, and whose implementation has an impact on the development of the economy. (More in: on Drab-Kurowska, 2013, pp. 501-511).

- there is a primary, synthetic criterion of ordering the elements of this set, which is not subject to direct measurement (e.g. the level of development of the studied region in comparison with other regions);
- a finite set of variables is given, essentially related to the synthetic ordering criterion;
- variables used to describe objects are presented at least on an ordinal scale, meet the demand for uniform preference and are brought to comparability through normalisation;
- the relation that organises the elements of set A is the relation of the majority concerning the numerical values of the synthetic measure of development.

The final research results are determined mainly by the final list of diagnostic variables[2], as well as the selection of the aggregation formula. Due to the existence of many formulas of normalisation of variables, methods of determining weights, or methods of averaging normalised values, a number of different aggregate measures have been described in the scientific literature (used in practice, among others, in the preparation of various types of rankings). However, it should be noted that different aggregation formulas may give different final results, even with respect to the general criterion represented by the same list of diagnostic variables [Czyżycki, 2012, pp. 15-22]. However, the final list of variables included in the study is of key importance, so it should be discussed among experts and recognised as the best representative of the analysed issue. A broad review of literature in this respect was made by R. Klóska [2015, pp. 99-108] who, on the basis of in-depth research, offered 18 indicators, with the help of which it is possible to study regional development in three dimensions:

- from a social perspective: number of infant deaths per 1,000 live births (X_1), at-risk-of-poverty rate ($X_{2\ -\%}$), number of students of tertiary education institutions per 10 000 inhabitants (X_3), registered unemployment rate ($X_{4\ -\%}$), number of road fatalities per 100 000 inhabitants (X_5) and total water consumption for the needs of the national economy and population (hm^3) per 10 000 inhabitants (X_6);
- from an economic perspective: GDP (current prices) per capita (X_7), share of economy entities' financial outlays in the total outlays on research and development activities (X_8 –%), number of newly registered national economy entities in the private sector per 10 000 inhabitants (X_9), number of employees per 1000 inhabitants (X_{10}) and total investments (current prices) per capita in PLN (X_{11});

[2] The set of diagnostic variables substantially related to socio-economic development can be very extensive, taking into account, for example, changes occurring and related to the development of the Internet. M. Czaplewski presents the topic of the impact on the economy of information and communication technologies, including the Internet (Czaplewski, 2011, pp. 20-26).

- from an environmental perspective: percentage of the population using sewage treatment plants (X_{12} -%), forest cover (X_{13} –%), recycling of packaging waste (X_{14} –%), share of devastated and degraded lands requiring reclamation in the total area (X_{15} -%), share of waste (excluding municipal waste) recovered in the amount of waste generated during a year (X_{16} –%), share of the electricity generation from renewable energy sources in the total electricity generation (X_{17} –%) and electricity consumption per 1 million PLN GDP (X_{18} – GWh).

After selecting diagnostic variables, substantially related to the primary criterion according to which the objects (regions) will be ordered, the structure of the synthetic development measure boils down to the following stages:

- unification of the nature of variables subject to aggregation by means of the postulate of uniform preferences of variables, removal of titles from the values of variables, and unification of orders of magnitude in order to bring them to comparability [for more details see: Perkal, 1953, pp. 209-219, Hellwig, 1968, pp. 307-326; Bartosiewicz, 1976, pp. 307-326; Strahl, 1978, pp. 5-7, pp. 205-215; Walesiak, 2014, pp. 363-372];
- weighing standardised diagnostic features, i.e. assigning to individual variables weights defining their significance for the general criterion in comparison with other features;
- selecting an aggregation formula and, based on it, designating the synthetic development measure. There are two types of synthetic variable determination procedures in the literature: model and non-model [Grabiński, 1984, p. 38]. Model methods of aggregation of variables are based on determining distances of individual objects from a certain, defined model object, whereas non-model methods rely on the operation of averaging the values of normalised variables.

In order to bring the proposed diagnostic variables to comparability, the method of zero unitarisation will be used, which in the case of boosters (variables X_2, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, X_{14}, X_{16} and X_{17}) consists in applying a formula in the form [Kukuła, 2000, p. 226]:

(1) $$z_{ij} = \frac{x_{ij} - \min_i\{x_{ij}\}}{\max_i\{x_{ij}\} - \min_i\{x_{ij}\}}$$

whereas in the case of inhibitors (X_1, X_3, X_4, X_5, X_6, X_{15}, X_{18}) it is based on the formula:

2) $$z_{ij} = \frac{\max_i\{x_{ij}\} - x_{ij}}{\max_i\{x_{ij}\} - \min_i\{x_{ij}\}}$$

The normalised variables obtained on the basis of the above formulas are characterised by the adoption of values between <0,1>, where, from the point of view of the general criterion, higher values of normalised variables obtained indicate a higher level of socio-economic development of a given region. Finally, the measure of the development of a given region will be the aggregated value of all normalised diagnostic variables adopted in the study, i.e. the method of standardised sums will be applied, defined as:

(3) $$p_i = \sum_{j=1}^{m} w_j \cdot z_{ij}$$

where: w_j is the weight determining the impact of a given j variable on the adopted general criterion. The determination of individual weights takes place either on the basis of expert opinions, or through the use of specific statistical tools. In the literature on the subject, however, it is recommended that, in the absence of unambiguous indications as to the different meanings and roles of particular features, it is to be silently assumed that all selected diagnostic variables are of the same weight [Kukuła, 2000, p. 64]. This assumption will also be adopted in the article.

Due to the properties of normalised variables, the $p_i$value obtained is normalised in the range <0, m>, where m is the number of diagnostic variables. Using the method of standardised sums in research, a postulate to normalise the final results in the interval <0.1> often appears. An example of such a procedure can be found, among others in J. Dziechciarz [2003, pp. 290-291] and amounts to determining a standard measure of development according to the formula:

(4) $$m_i = \frac{p_i - p_{\_0}}{p_0 - p_{\_0}}$$

where:

(5) $$p_0 = \sum_{j=1}^{m} w_j \cdot z_{0j}$$

(6) $$p_{\_0} = \sum_{j=1}^{m} w_j \cdot z_{\_0j}$$

(7) $$z_{0j} = \max_i z_{ij}$$

(8) $$z_{\_0j} = \min_i z_{ij}$$

The determined m_i measure, irrespective of the previously used method for normalising diagnostic variables, will always take values from the expected interval <0.1>, whereas in the case of the zero unitarisation method proposed in the article, a faster way to obtain a development measure is to calculate the average value of standardised variables, i.e. to determine the value:

(9) $$u_i^1 = \frac{1}{m}\sum_{j=1}^{m} w_j \cdot z_{ij}$$

Among non-model methods, the alternative approaches in the study of the socio-economic development of regions are either the use of an absolute measure of development, defined as [Żmurkow-Poteralska, 2015, p. 187]:

(10) $$u_i^2 = \sum_{j=1}^{m} w_j \cdot z_{ij}^*$$

where: the variable $z_{ij}^*$is a variable normalised according to the formula:

(11) $$z_{ij}^* = \frac{x_{ij}}{S_j}$$

where: S_j is the standard deviation of the j-th diagnostic variable, or the use of the rank method, which consists in assigning each diagnostic variable an appropriate rank depending on the value of this variable in a given object. In a situation where in two or more objects a given variable assumes the same value, these objects are assigned the same rank, being the arithmetic mean of the subsequent ranks. The measure of development is the arithmetic mean of the ranks assigned to a given object for each diagnostic variable:

(12) $$u_i^3 = \frac{1}{m}\sum_{j=1}^{m} l_{ij}$$

In order to assess the degree of compliance of the received rankings, appropriate correlation coefficients can be used. From the statistical point of view, the values in the selected ranking are the values of the measurable characteristic on the ordinal scale, and this means that statistical measures used to study the interdependence of places in particular rankings, which are often used in this type of research are, among others, Spearman's rank correlation coefficient or the tau-Kendall coefficient (τ). However, because the Spearman coefficient is a derivative of Pearson's linear correlation coefficient and inherits its properties (sensitivity to outliers or lack of normality of distribution of variables) [Kuszewski and Sielska, 2010, p. 156], it is postulated that, instead of the Spearman coefficient, only the tau-Kendall coefficient be used while examining the degree of rankings compliance [Stanisz, 2006, p. 337]. This coefficient takes values from the interval <-1, 1>, where the value 1 indicates full compliance, value 0 indicates the lack of compliance of orderings, while the value -1 indicates their total contradiction. In order to verify the hypothesis about the compliance of the obtained rankings, the test of significance of the tau-Kendall coefficient is used, for which the test statistic defined as:

$$Z_\tau = \frac{\tau}{\sqrt{\frac{2(2n+5)}{9n(n-1)}}} \qquad (13)$$

for n> 10 has an asymptotically normal distribution [Abdi, 2007] (in the case of the study of the socio-economic development of regions in Poland n = 16).

Findings

Using the statistic portal strateg.stat.gov.pl, information on shaping the eighteen diagnostic variables proposed in the article was collected for all regions in Poland. At the same time, it was assumed that socio-economic development would be analysed at the end of 2016 and, in the case of thirteen variables, their values in individual regions, adopted for research, come from that year, while in the case of Gross Domestic Product per capita (X_7), the share of expenditure on R & D. More on the role of R & D: [Budziewicz-Guźlecka, 2014, pp. 9-17] financed from the enterprise sector, in R & D expenditure in total (X_8) and electricity consumption per 1 million GDP – their values from 2015 were taken into account; in the case of recycling of packaging waste (X_{14}) – from 2014, whereas in relation to the share of waste (excluding municipal waste) subjected to recycling in the amount of waste generated during the year (X_{16}), the value taken into consideration was from 2013. For the above five variables, the indicated years were the last for which, at the time of the research, the Central Statistical Office provided information on the value of these variables in individual regions.

Analysing the obtained results characterising the level of socio-economic development of individual regions in Poland in the adopted research period, attention should be paid to the very high correlation between the positions of individual regions resulting from the use of the method of average values of standardised variables (u1) and the rank method (u3) and completely different results obtained when using the absolute development measure (u2) (see table1). In the case of rankings received on the basis of u1 and u3, the maximum difference in the positions occupied concerned the Łódzkie region, for which the rank method indicates the sixth position in terms of socio-economic development in 2016, while the method of average values of normalised variables places this region on the ninth position. The change of two positions in the received rankings can be noticed in the case of the Western Pomeranian and Lublin voivodships, while in the case of nine regions, the positions in the ranking are the same regardless of the method of obtaining the value of the synthetic development measure.

However, the results obtained on the basis of the method of the absolute measure of development suggest a completely different ordering of regions in 2016 in terms of the general criterion adopted. No region occupies the position indicated by the previously discussed methods, what is more, in Masovian voivodship the difference in positions occupied in the rankings amounts to 13 places, and in the case of Warmian-Masurian, Podlasie and Silesian voivodships, differences in rankings ranged from ten to twelve places.

Table 1. The values of the synthetic development measure obtained by the means of the average values of standardised variables method (u11), the absolute measure of development (u2) and the rank method (u3) together with the information on the position of individual regions in the ranking due to the level of socio-economic development in 2016 year

	u_1	**position in the ranking**	**u_2**	**position in the ranking**	**u_3**	**position in the ranking**
Lower Silesia	0,4994	7	68,5628	9	144,5	7
Kuyavian-Pomeranin	0,4667	10	62,1353	13	159	10
Lublin	0,3829	12	65,9051	11	192,5	14
Lubusz	0,3895	11	68,7060	8	164,5	11
Łodz	0,4808	9	79,0625	3	144,5	6
Lesser Poland	0,6383	3	88,4474	1	98,5	2
Masovian	0,7796	1	61,5923	14	89,5	1
Opole	0,3566	13	70,2926	6	189	13
Subcarpathian	0,4885	8	62,9894	12	155	9
Podlasie	0,3483	14	79,4964	2	184	12
Pomeranian	0,6517	2	72,9056	5	102,5	3
Silesian	0,5178	5	59,0087	15	134	5
Świętokrzyskie	0,2902	15	58,1770	16	203	15
Warmian-Masurian	0,2793	16	77,5973	4	222	16
Greater Poland	0,6205	4	69,9172	7	113,5	4
Western Pomeranian	0,5044	6	66,1597	10	152	8

Source: own calculations and elaboration.

The large convergence of rankings obtained on the basis of the method of average values of standardised variables and the rank method, as well as the different results obtained in the case of the absolute development measure method, is also indicated by the analysis of the value of the tau-Kendall coefficient (see table 2). On this basis, one can clearly indicate a fairly strong, positive and, most importantly, statistically significant convergence of ordering of the regions examined in terms of the general criterion adopted in the case of applying u1 and u2 measures for this purpose, and the lack of such convergence in the case of the u3 measure.

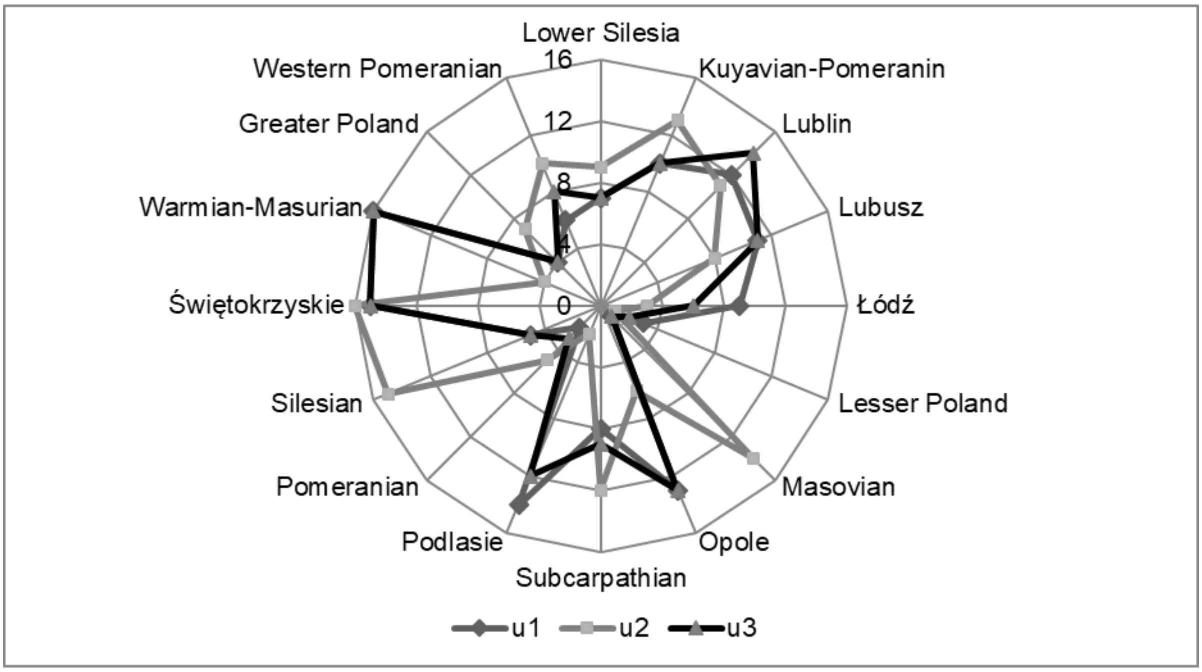
Table 2. Values of the tau-Kendall coefficient examining the compliance of the rankings obtained on the basis of the u1, u2 and u3 measures (values over the main diagonal) together with the ***p-value*** for the test examining the statistical significance of the obtained tau-Kendall coefficient (under the main diagonal)

	u_1	u_2	u_3
u_1	x	0,8667	-0,0500
u_2	2,84E-06	x	0,0833
u_3	0,7871	0,6525	x

Source: own calculations and elaboration.

Also, a graphical comparison of the ordering results of individual regions in 2016, obtained on the basis of the three non-model methods indicated in the article, shows the previously discussed relationships between the obtained results (see Figure 1).

Fig. 1. Positions of Polish regions due to the level of socio-economic development in 2016



Source: own study based on table1.

Summary

On the basis of the conducted studies, it seems justified to draw the following conclusions:

1. Due to the demonstrated dependence between the results of ordering the regions from the adopted method of obtaining a synthetic measure of development, in this type of research, not only the final results of the research should be presented, but also the research methodology should be presented in a fairly detailed way. This will allow, on the one hand, for repeating the conducted analyses and possibly verifying their correctness, and on the other hand, which seems more important, explaining possible differences in the rankings of objects obtained by different researchers, even if they include the same diagnostic variables;
2. In the case of the study of the socio-economic development of regions, the factor "objectifying" the final results may be basing them on the results obtained from several different methods of multidimensional comparative analysis (taking into account the same set of diagnostic variables each time). The final ordering of objects could be based either on the average values of the ranking position of the studied regions from all methods included in the study, or on average values of only those rankings that would be statistically convergent with each other (in this case, such convergence could be determined on the basis of the analysis of the significance of the Kendall-tau coefficient). Considering the latter approach, the convergent approaches in the study presented in the article were approaches based on the method of average values of standardised variables and the rank method. By averaging the results obtained with these methods, one could point out that the best in terms of socio-economic development in 2016 was the Masovian voivodship (in both approaches it took first place), then *ex aequo* Pomeranian and Lesser Poland voivodships (depending on the approach, they occupied second or third place in the rankings), Greater Poland voivodship (which took the fourth position twice) and the Silesian voivodship (fifth position twice).

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Shocks in capital markets – phase breakdowns in the wavelet analysis

Milda Burzała
Stanislaw Staszic University of Applied Sciences in Pila, Poland
ORCID ID: 0000-0001-5087-9680, e-mail: mburzala@pwsz.pila.pl

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Abstract: In the wavelet analysis, the basis for the inference on lead/lag times of response of return rates is the phase difference between the components of two time series connected with significant coherence coefficients. In theory, the occurrence of breakdowns in the phase shift signifies interference in the interdependence. The preliminary research results presented in this article aim to address the question whether those breakdowns can be used to identify moments of the occurrence of shocks in financial markets, resulting from the behaviour of return rates in the partner market under examination. The results presented in the article reveal the significance of most square rates of return in the period preceding the occurrence of a phase break in the model for variance and the lack of significance of return rates of those moments to the concurrent change in the expected value. This article presents a methodological approach to identification of shocks.

Keywords: wavelet analysis, capital markets, shocks (jumps) in financial markets

JEL: C14, C58, F36, G01, G15

Introduction

In the literature, for many years authors have been discussing the transmission of impulses in financial markets. To a large extent, the discussion is triggered by the ambiguity of the classification of the impulses, their identification, and the variety of the research methods applied. The studies most often use tests of correlation coefficients [Lee, Kim 1993], [Calvo, Reinhart 1996], [Forbes, Rigobon 2002], ARCH and GARCH models [Edwards, Susmel 2001], [Billio, Caporin 2010], DCC-GARCH models [Cappiello, Engle and Sheppard 2006], [Frank, Gonzalez-Hermossilloand Hesse 2008], [Wang, Moore 2012], structural VAR [Favero, Giavazzi 2002] and cointegration analysis [Longin, Solnik 1995], probit and logit models [Eichengreenet al. 1996], [Kaminsky, Reinhart 2000], [Falcetti, Tudela 2006], regime-switching models [Gallo, Otranto2008], factor models [Corsetti et al. 2005], [Dungeyet al. 2005, 2007] and a copula approach [Rodriguez 2007]. A shortcoming of time series models is that it is impossible to separate simultaneous and lagged responses, and short- and long-term ones – the reason is that at any given time the results of various responses are being actualised. For this reason, research on the transmission of impulses is more and more often conducted the frequency domain by means of spectral/co-spectral analysis and wavelet analysis [Fan and Wang 2007], [Bodart, Candelon 2009], [Orlov 2009]; [Rua, Nunes 2009], [Nikkinen et al. 2011], [Gallegati 2012], [Graham et al. 2011], [Kiviaho et al. 2014], [Madaleno, Pinho 2012], [Ranta 2013], [Ftiti et al. 2014], [Barunik and Vacha 2015]. These authors focus their attention on the analysis of coherence coefficients, or coefficients of short-term correlations. In this research, the author's focus is on the analysis of phase difference and time lags in the reciprocal responses of markets. The main reason for taking such a course of research is the possibility to depart from making the comparison of correlations in periods of relative calmness and crises in financial markets, where the results of the comparison depend largely on the adopted time periods [Burzała 2015].

This article complements the author's previous works on the transmission of crisis, contagion and the interconnections governing capital markets [Burzała 2014, 2016]. The results obtained by means of the cospectral analysis and wavelet analysis allow an unambiguous classification of markets' responses into simultaneous responses (resulting from comovements), the effects of contagion (significant lagged responses over a short period of time – up to two weeks), and the transmission of a financial crisis (significant lagged responses over a medium period of time – up to two months). When analysing significant time lags/time leads in markets' responses, it was found that phase breakdowns occur quite often. Hence the question: what do those breakdowns signal, and are they relevant to the behaviour of rates of return? The aim of this article is to identify the shocks in the mutual dependencies of capital markets on the basis of phase breakdowns occurring in wavelet analysis, and their verification using time series models. Section 1 presents a brief overview of the research on jumps (shocks) in financial markets, and explains how the research relates to the fractal market hypothesis. Section 2 presents the methodology. The statistical data used and the results obtained from the wavelet analysis are discussed in Section 3. Finally, Section 4 presents the results of and conclusions on the verification of shocks (phase breakdowns) conducted by means of a modification of a method proposed by Baur [2003]. At the very end, the article offers a summary and reference list.

The fractal market hypothesis and the jumps in financial markets

Under the fractal market hypothesis, investor behaviour is influenced by the information obtained from the market and the time horizon length of their investments. A piece of information which triggers a drop in the rate of return on a stable market prompts selling over a short period of time and buying over a long period of time. A change in the behaviour of long-term investors can be sparked by a piece of information of strategic importance [Weron,

Weron 2009]. The situation in which long-term investors begin to behave like short-term ones poses a threat to maintaining market balance (everyone wants to sell, no one wants to buy). Stability and assets liquidity is guaranteed by investors' buying and selling over different time horizons. The fractal market hypothesis explains the behaviour of investors not only in times of a balanced market but also during a time of panic in the capital market. An example of losing the fractal structure of the market is the financial crisis of 2007-2009. However, determining the breakthrough point is a hard task, as the statistical drop in prices can stem from not merely one incident but a cumulation of moods and a number of incidents over a short period of time. Some authors argue that the breakthrough moment was the day on which BNP Paribas declared problems in pricing toxic assets, some others claim that it was the bankruptcy of Lehman Brothers. The biggest drop (jump – shock) in the DJIA Index was reported after the US Congress turned down a bailout plan drawn up by Paulson.

The significant jumps of prices observed (so-called shocks) in capital markets may result from breakthrough points and cause contagion effects. Sometimes, however, they are an effect of short-term, random market turmoil. Barndorff-Nielsen and Shephard [2004] put forward statistical models to measure the stochastic features of jumps. Lee and Mykland [2007] designed a non-parametric test which is used to tell a real shock from a false one. A lot of research is into the analysis of the causes, and consequences of the observed jumps. Patton and Sheppard [2015], based on an analysis of high frequency data concerning the S&P 100 Index, infer that negative jumps increase the oscillation of return rates, while positive ones decrease it. Wright and Zhou [2009] argue that the jumps average helps predict bond risk premiums. Tauchen and Zhou [2011] claim that the jumps made in financial markets can be used to predict credit spreads. Zhou and Zhu [2012] examine the possibility to use jumps in assets pricing and predicting the oscillations in Chinese shares and bonds markets.

Many authors use daily data to test the response of markets to macroeconomic news stories, for instance Lahaye, Laurent and Neely [2011], Dungey, McKenzie and Smith [2009]. Most studies deal with fully developed capital markets.

Research on emerging markets is conducted by such authors as Haw et al. [2000] and Altiok-Yilmaz and Selcuk [2010]. Those authors argue that share prices are sensitive to pay statements, and that financial reports impact price oscillations. Research results by Będowska-Sójka [2016] show that jumps happen when the market is incapable of absorbing new and large orders (so-called liquidity shocks).

Wavelet analysis allows considering the rates of return of assets on different scales corresponding to actions over different time horizons. It also allows us to examine non-stationary processes. Finding a positive answer to the question posed in this article may foster further research on the classification of the shocks detected and the consequences they bring.

Phase difference in wavelet analysis

One-dimensional wavelet analysis decomposes process x_n into orthogonal components through the translation and dilatation of the mother wavelet ψ. For the purposes of this research, Morlet wavelet was used a mother wavelet, defined as:

$$\psi_0(t) = \frac{1}{\pi^{1/4}} e^{i\omega_0 t} e^{-t^2/2}, \tag{1}$$

where ω_0 is the centre frequency of the wavelet. When $\omega_0 = 6$, the scale in the wavelet analysis is almost equal to the period in the Fourier analysis, which makes it much easier to draw inferences [Grinsted et al. 2004]. All of the properties of the process under examination can be retained applying Discrete Wavelet Transform (DWT):

$$\psi_{j,k} = \frac{1}{\sqrt{s_0^j}} \psi\left(\frac{t - k\tau_0 s_o^j}{s_0^j}\right) . \tag{2}$$

In Equation 2, j, k stands for discrete, complete transform coefficients. When $s_0 = 2$, $\tau_0 = 1$, we obtain so-called dyadic sampling, and calculations are made octave by octave[1]. Dyadicity is expressed by a constant scale 2^j and shift $k \cdot 2^j$. A wave family is obtained by scaling and shifting the mother wavelet $\psi_{j,k}(t) = 2^{j/2}\psi(2^j t - k)$.

In the wavelet analysis of two time series x_niy_n, the measure of lead/lagged responses is phase difference:

$$\varphi_{x,y}(u,s) = \tan^{-1}\left(\frac{\Im[S(s^{-1}W_{x,y}(u,s))]}{\Re[S(s^{-1}W_{x,y}(u,s))]}\right). \tag{3}$$

During research, we usually consider those mean phases which are associated with high squared wavelet coherence. A phase shift within (0; π/2) or (-π; -π/2) signals that process x_n precedes process y_n. If the phase shift is within (π/2; π) or (-π/2; 0), it must be inferred that process y_n precedes process x_n. Basically, when two time series are correlated in a stable way, phase difference ought to be constant. Hence, a sudden change in phase shift signifies interference in interdependence, especially if connected with a change of the preceding series. Then, it can be inferred that the behaviour of one of the series changed so much that it caused a shock in market interconnections. In this research, the author considered only those phase

[1] The estimation used a smoothing operator as defined by Torrence and Webster (cf. Grinsted et al., 2004).

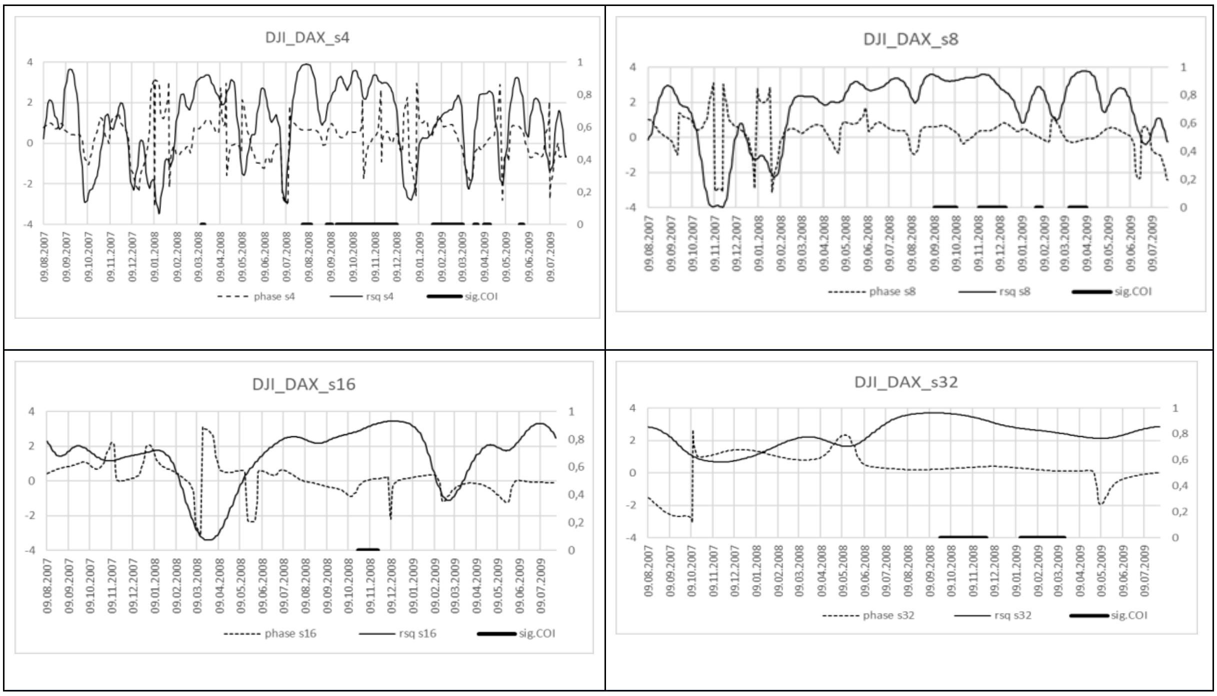
breakdowns which concerned with phase break+/- 2**s* with a change preceding the market (*s* is the circular standard deviation).

An analysis of phase breakdowns in the interconnections between the US and German markets

In this research, the author used data from the US market (the DJIAindex) and the German market (the DAXindex) during the period of the financial crisis 9 August 2007 – 31 July 2009. Due to the different times of market quotations (resulting from different geographical time zones), the series of logarithmic rates of return were smoothed with a two-period moving average [Dungey et al. 2007]. It was assumed that the time series obtained in this way were comparable.

Figure 1 presents phase differences and squared wavelet coherence in the interconnections of the two markets on four selected scales. It is worth noting that phase breakdowns are mostly connected with a rise in squared wavelet coherence, which implies increased comovements resulting from such jumps.

Fig. 1. Squared wavelet coherence and phase difference (s = 4, 8, 16, 32)

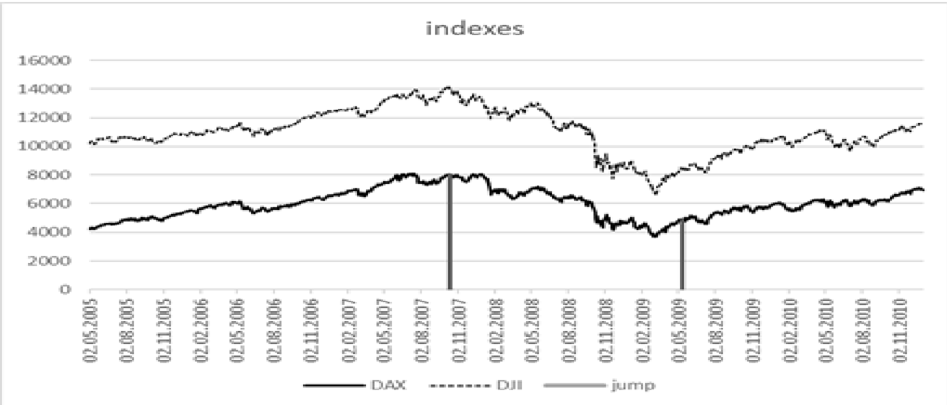


Source: own calculations and elaboration.

Most jumps (phase breakdowns on different scales) occurred before 15 September 2008, which might confirm the nervous reactions and growing anxiety that led to the outbreak of the financial crisis. More interestingly, no phase breakdowns were reported around 15 September, which in turn implies that both markets followed a “harmonious fall”.

The highest vulnerability of return rates and most breakdowns are reported over short periods of time (low scales). On higher scales, breakdowns usually occur at a different time than they would on scale s4. It can be inferred that they are formed as a result of different impact forces on rates of return from indices, and that they concern behaviours over different time horizons. On higher scales, less significant turmoils die off, and only those remain that are capable of changing the trend. Particularly interesting are two phase breakdowns on scale s16 (Figure 2). As it turns out, they signal the beginning and end of the indices' downward trend. This raises the comparison with cyclical growth, in which annual rates of return signal peak levels in advance, and bottom levels with delay. This observation can help predict changes in the capital market.

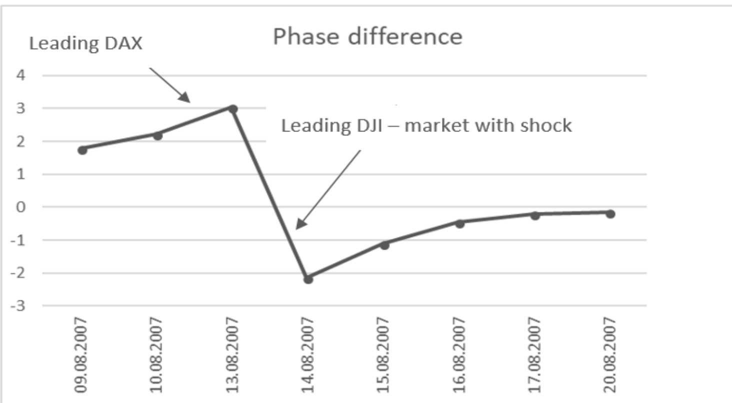
Fig. 2. The DAX and DJIA



Source: own calculations and elaboration.

As mentioned before, in the time domain, only those phase breakdowns were selected which were connected with a change in preceding responses between the markets. This inference is illustrated by Figure 3.

Fig. 3. Illustration of inferring a shock occurrence



Source: own calculations and elaboration.

The results presented in Table 1 point to significant differences in average rates of return at times of phase breakdown in comparison to the average over the whole period under examination, which stresses the need for those moments to be carefully considered and given particular attention.

Table 1. The basic description characteristics of rates of return

Period	DJI			DAX		
	Average	Standard deviation	Averagerate of change	Average	Standard deviation	Averagerate of change
crisis: 9.08.2007 – 31.07.2009	-0,077	1,416	0,003	-0,068	1,416	0,002
jumps – scale s4	-0,452	1,234	-0,081	-0,552	1,213	-0,264
jumps – scale s8	-0,472	0,860	0,130	0,061	1,210	0,078
jumps – scale s16	-0,330	0,818	-0,677	-0,020	1,357	-0,516

Source: own calculations and elaboration.

In terms of the jumps signalled on scale s4 (four-day oscillations), the average rate for both indices is considerably lower than the average for the whole period. The positive average rate of change on scale s8 signifies the efforts made by markets to regain stability, which, unfortunately, ends up in reversing the trend on scale s16. On lower scales, squeezed waves are considered, on higher scales – stretched ones. The latter help analyse a trend over a medium time period, and hence, a significantly higher average rate of decline.

The verification of shocks relevance in the AR and GJR models

For the verification of the relevance of shocks on a partner market, the author chose an approach proposed by Baur [2003] which allows the simultaneous verification of the changes in the expected value and variance, which is a measure of the insecurity in financial markets. In his research, the author used rates of return from periods of calm and crisis in financial markets. In this research, the model was referred to the time of crisis and the moments when phase breakdown occurred.

Let's assume that we are examining the relevance of the impact of shocks in the US market on the German market[2]. *The comovements of rates of return* in the period of crisis can be presented in the following form;

[2] It is assumed that the logarithmic series of rates of return from SE indices are covariantly stationary.

$$s_{DJI,t} = u_{DJI,t},$$

$$s_{DAX,t} = \mu_{DAX,t} + \beta_1 s_{DJI,t} + \beta_2 s_{DJI,t} \cdot D_{kt} + u_{DAX,t},. \qquad (4)$$

Where $u_{DJI,t}$ represents the stochastic shocks in the US market that we are examining, $\mu_{DAX,t}$ stands for the expected value of the rate of return on the DAX market, β_1 is a measure of how much the rate of return from the DJIA impacts the DAX in the time of crisis, and parameter β_2 is a measure of the impact exerted by the rate of return from the DJIA at the time of phase breakdown (the shock exerting its influence). Variable $D_{kt}$is a zero-one variable that assumes value 1 for k^{th} shock at moment t, and value 0 otherwise. Hence, parameter β_1 describes the comovements of markets manifested by simultaneous changes in rates of return; β_2 is a measure of how much the shock impacts the expected value which informs about the intensified transmission mechanisms. At the time of shock in the US market, the impact exerted on the German market is the sum of the estimated parameters $\beta_1 + \beta_2$. For the expected value $\mu_{DAX,t}$ the following model was assumed: ARMA(1,0): $\mu_{DAX,t} = \alpha_0 + \alpha_1 s_{DAX,t-1}$. Similar comovements could be assigned to the German market affecting the US market.

The model describing the impact of shocks at the time of crisis due to *changing variances* assumes the following form:

$$u_{DAX,t} = \xi_{DAX,t}\sqrt{h_{DAX,t}},$$

$$h_{DAX,t} = \alpha_0 + \alpha_1 u^2_{DAX,t-1} + \alpha_2 h_{DAX,t-1} + \alpha_3 s^2_{DJI,t-1} + \alpha_4 s^2_{DJI,t-1} \cdot D_{k,t-1},, \qquad (5)$$

Where $\xi_{DAX,t}$ is a stochastic variable of zero expected value and unitary variance. In the research, the variance variability model was the *GJR(1,1)* model, taking account of the additional impact exerted by negative rates of return, and which incorporated variables represent the impact exerted by the squared rates of return from the DJIA at the time of crisis and at the moment of phase breakdown. In model (5), the measure of the impacts exerted by additional shocks is parameter α_4.

The results obtained from the model for expected value (4) and variance (5) are presented in Table 2. An x in the table signifies the market from which the shock emerged. Therefore, its impact was examined in the partner market.

Table 2. Shock relevance in the model for expected value and variance

Date	Change of leading index	Scale_shocknumber	DJI to DAX		DAX to DJI	
			model 4 (β_2)	model 5 (α_4)	model 4 (β_2)	model 5 (α_4)
04.01.2008	DJI/DAX	s4_1	x	x	0,36	-0,58***
08.01.2008	DAX/DJI	s4_2	0,12	-0,57	x	x
09.01.2008	DJI/DAX	s4_3	x	x	-1,92**	-0,99***
30.01.2008	DAX/DJI	s4_4	0,17	-12,92**	x	x
09.04.2008	DJI/DAX	s4_5	x	x	-0,30	0,82*
11.04.2008	DAX/DJI	s4_6	0,15	-1,10***	x	x
04.07.2008	DAX/DJI	s4_7	-2,64	8,64**	x	x
14.07.2008	DJI/DAX	s4_8	x	x	0,17	-0,93
23.10.2008	DJI/DAX	s4_9	x	x	0,05	0,12
24.10.2008	DAX/DJI	s4_10	1,92*	-4,85	x	x
17.11.2008	DJI/DAX	s4_11	x	x	2,44**	1,30***
19.11.2008	DAX/DJI	s4_12	0,33	-0,62**	x	x
06.01.2009	DJI/DAX	s4_13	x	x	-0,77	-1,33
04.05.2009	DAX/DJI	s4_14	-0,17	-0,16	x	x
08.07.2009	DJI/DAX	s4_15	x	x	0,35	0,69***
09.07.2009	DAX/DJI	s4_16	4,25	-35,44	x	x
20.09.2007	DAX/DJI	s8_1	3,89	-23,09**	x	x
09.11.2007	DAX/DJI	s8_2	-0,84	-0,003	x	x
21.11.2007	DJI/DAX	s8_3	x	x	-16,21	-281,35
07.01.2008	DJI/DAX	s8_4	x	x	0,89	-1,63***
28.01.2008	DAX/DJI	s8_5	-43,17	896,46***	x	x
02.05.2008	DAX/DJI	s8_6	-0,32	0,22*	x	x
09.06.2008	DAX/DJI	s8_7	-0,33	0,35**	x	x
17.06.2009	DAX/DJI	s8_8	-0,21	-0,72	x	x
24.06.2009	DJI/DAX	s8_9	x	x	-0,98*	0,30*
14.11.2007	DAX/DJI	s16_1	-0,87	-0,16	x	x
27.12.2007	DJI/DAX	s16_2	x	x	-5,14	-14,40***

Date	Change of leading index	Scale_shocknumber	DJI to DAX		DAX to DJI	
			model 4 (β_2)	model 5 (α_4)	model 4 (β_2)	model 5 (α_4)
06.03.2008	DAX/DJI	s16_3	-1,25	-1,86**	x	x
17.03.2008	DJI/DAX	s16_4	x	x	-0,45	0,31***
04.04.2008	DAX/DJI	s16_5	-12,70	3014,89***	x	x
02.06.2008	DJI/DAX	s16_6	x	x	0,87	-5,71**
03.06.2008	DAX/DJI	s16_7	-0,27	0,13	x	x
10.12.2008	DJI/DAX	s16_8	x	x	-1,77**	-0,17
16.02.2009	DJI/DAX	s16_9	x	x	4,56**	-4,65***
11.10.2007	DAX/DJI	s32_1	4,09	-30,45***	x	x

Source: own calculations and elaboration.

Table 3 presents the estimates for overall parameters in both models. The results obtained confirmed the preliminary predictions that insecurity in financial markets is transmitted as a result of financial shocks, and the shocks' minor significance in terms of the expected value [Burzała 2016].

Table 3. Overall parameters in the model of excepted value (4) and variance (5)

Model for expected value (4)			Model for variance (5)		
Parameter	DAX	DJI	Parameter	DAX	DJI
α_0	0,02	-0,02	α_0	0,01*	0,01*
α_1	0,31***	-0,09***	α_1	-0,02	0,01
β_1	0,76***	0,76***	α_2	0,89***	0,88***
			α_3	0,04*	-0,01
			Additional effect of negative impulses in the GJR model	0,025***	0,18***
ADJ R^2	0,61	0,60	Log likelihood	-705,974	-700,922

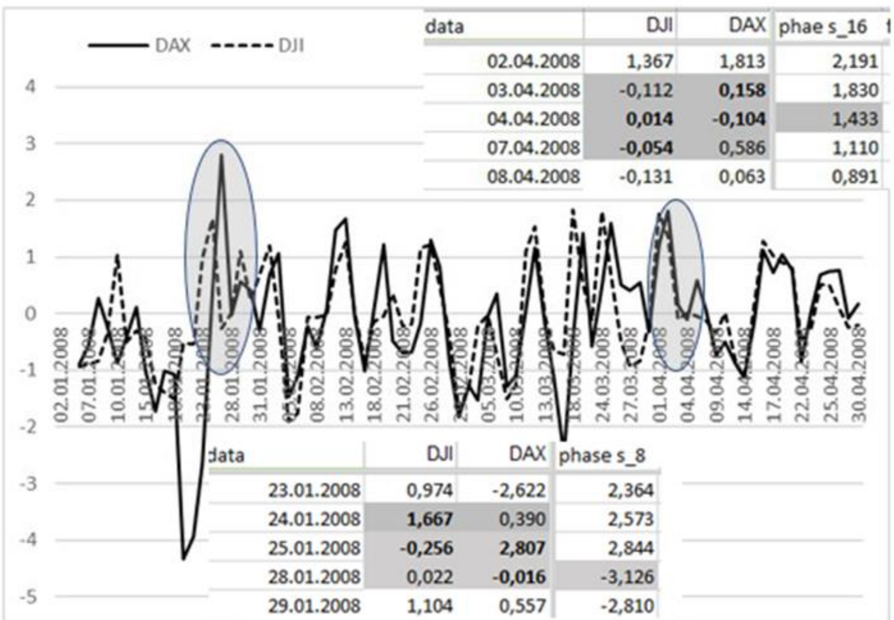
Source: own calculations and elaboration.

In model (4) for the expected value of return rates from both the DAX and DJIA, the significant parameter β_1 indicates simultaneous changes in rates of return. It confirms a massive comovement resulting from the interconnections of the two markets. The levels of rates of return are only impacted by single shocks from the two markets; however, more often, shocks from the German market were statistically significant. On the one hand, this conclusion comes as a surprise, but on the other, the information flowing from Europe did imply the scope and scale of the markets' involvement in toxic securities – hence the reactions of investors in the US market.

Then, the shocks following phase breakdowns exerted a big influence on the spreading insecurity in financial markets. Not only the positive but also the negative marks of the parameters obtained imply not only spreading insecurity but also a number of signals that, in the end, helped restore calmness in the markets. Despite the previous intentions, it was decided not to associate the moment of shock occurrence with specific incidents of that time. On the one hand, the large number of those incidents makes it difficult to associate phase breakdown with a formally made announcement, but on the other, investors react repeatedly to certain confidential information reaching the market before formal announcements are made.

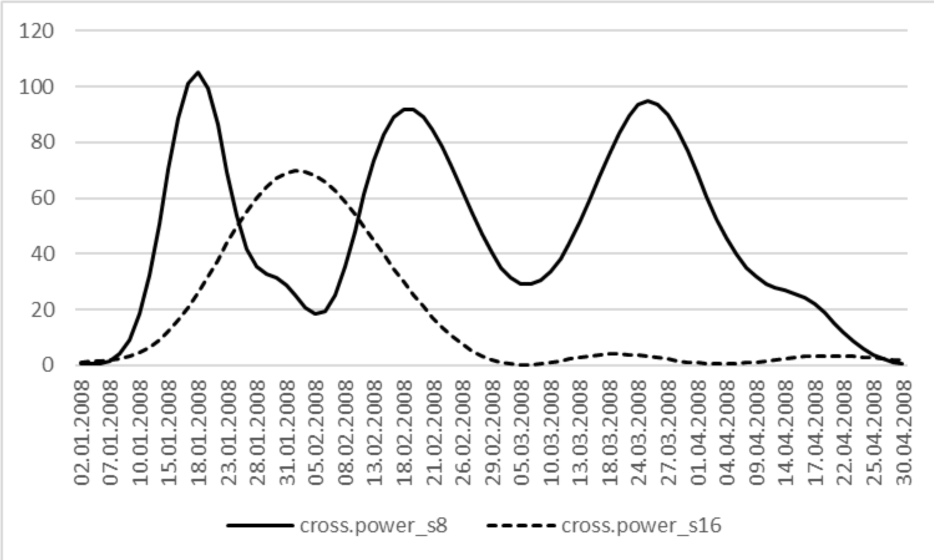
Analysis of the results indicate a very powerful impact of the shock in the US market on the German market in January and April 2008. Drops in capital markets were first reported in early January 2008. The forerunners of the upcoming crisis came from the US real estate market – on 27 January, Freddie Mac, a company that refinances banks offering mortgage loans, announced their decision to stop buying the most risky securities in the real estate market.

Fig. 4. Rates of returns from indices between January – May 2008



Source: own calculations and elaboration.

Fig. 5. Covariance between January – May 2008 (scales s8 and s16)



Source: own calculations and elaboration.

Figure 4 presents an attempt to combine the parameters in model (5) with the behaviour of rates of return. However, it should be noted at all times that the wavelet analysis results refer to particular scales – they represent the microstructure of the market. In the variance model, the shock was represented by the rates of return from the partner's market. The dates provided in Table 2 refer to (as indicated by Figure 4) to the moments of response (in January, following the decline – s8; in April, prior to the decline – s16). As the aim of studying markets is to predict their responses, it must be agreed that at this stage more detailed research is needed covering the responses of different markets. This would make inference more consistent over different time horizons. In order to assess whether the two shocks under analysis could cause contagion, Figure 5 was drawn up, in which the comovement of the two markets in shown on scales s8 and s16. In neither case is there a rise in the comovement of rates of return at the time of their occurrence. Nor are there moments connected with significant time periods for coherence coefficients above the cone of influence. Both markets are strongly correlated (Table 3). Such a huge growth of variance can be associated with liquidity shocks. Success in recognising them on scales s8 and s16, connected with the medium term time horizon, may imply the occurrence of strategic incidents that changed the behaviour of long-term investors. However, such an inference still requires confirmation provided by more results gained from broader empirical research.

Summary

The statistical significance of most phase breakdowns in econometric models confirms the occurrence of jumps (shocks) in the course of time series, which proves that the methodology used allows their verification. The financial shocks identified have much more significance in terms of assessing insecurity in financial markets than the changes in the expected value of rates of return. A bigger amount of phase breakdowns at the initial stage of a crisis foreruns growing instability in capital markets. Further, it could also be inferred that the strategic incidents which change the fractal structure of the market must be looked for on higher scales (s8 and s16), spanning longer time horizons. If our inference is confirmed by the results of a study involving a bigger number of capital markets, it will be possible to classify the identified jumps and examine the effects of their occurrence.

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Analysis of the effectiveness of vocational education in terms of labour market demand in Poland

Jan Polcyn
Stanislaw Staszic University of Applied Sciences in Pila, Poland
ORCID: 0000-0001-7847-2743, e-mail: Jan.Polcyn@pwsz.pila.pl
Maciej Gawrysiak
Stanislaw Staszic University of Applied Sciences in Pila, Poland
ORCID: 0000-0001-9945-9580, e-mail: mgawrysiak@pwsz.pila.pl

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Abstract: Vocational education is an important topic in the context of human capital. This is due to the mere fact of the Copenhagen process, which for over 15 years has been aiming to improve the quality of education in the European Union. Nevertheless, the state of vocational education in this area is far from expected. In this case, the Polish vocational education system is one of the most negative examples [Polcyn, Gawrysiak 2017, p. 13], both in the context of the level of unemployment, as well as the clarity and coherence of the system itself. The authors have attempted to explore the reasons for this condition in the context of the effectiveness of vocational education in terms of labour market demand, based on the data from 2016 at NTS-4 level. The analysis used the new database of the Occupation Barometer, data prepared by the Polish Central Statistical Office on the number of students trained according to the ISCED-F 2013 international classification, and social and economic measures were taken into account. The results of linear models indicate the lack of a direct relationship between education in five most numerous ISCED-F 2013 narrow fields in Poland and demand on the labour market, according to the data from Occupation Barometer. The authors additionally propose a new measure of effectiveness, based on the collected data, and present an example of its use in the logistic regression method. The results show possible issues resulting from vocational schools management and vocational education "inertia".

Keywords: economy, education, vocational education, VET, effectiveness

JEL: I25, I26, I28

Introduction

The Polish vocational education system is one of the most complex and diverse in the European Union [Onisep 2017]. Unfortunately, it has many negative features which, despite the Copenhagen process being implemented in Poland, still show symptoms of its inertia. This phenomenon occurs in many systems and results in further failure of the process itself in the European Union, where it is still difficult to find very similar systems, but at the same time there is a very large variation between them. In the article by Polcyn & Gawrysiak (2017), in which the discussion on the effectiveness of vocational education systems was presented, the authors analysed data from 2010 to 2015. There were significant differences between vocational education systems, and it was pointed out that Poland has many negative features.

With the large participation of vocational education in secondary education, Poland, together with Romania, is second in terms of the scale of unemployment among people with vocational education at secondary level. Although the share of vocational training after secondary school (post-secondary, non-tertiary education) is 28% in relation to the entire vocational training, Poland is characterised by higher unemployment than, for example, Lithuania or Estonia, which with a share of 40% have an unemployment rate of 3.5%. Most systems of vocational education in the European Union were characterised by coherence and simplicity, in Poland this system is complicated. These conclusions encouraged authors to attempt to specify the causes or the very assessment of the effectiveness of vocational education in Poland in terms of labor market demand.

Structure of the paper

In this paper, we present a literature review in which we show differences between different system vocational education approaches, their pros and cons, and common systemic problems related to its elements. We describe the important influence and dependence on local industry and foreign capital, which may solve some of the problems, as well as bring new challenges directly connected with education returns in terms of labour. This helps us show importance of the factors which were used in the statistical analysis where we try to answer the question: does the Polish vocational education system properly meet the needs of the labour market? It also lets us focus on an attempt at finding important socio-economic elements that may help in answering that question. In the analysis, we use linear and logistic regression as well as spatial analysis of the measure of education effectiveness on the NTS-4 level proposed by authors of this paper. At the end of the article, a conclusion regarding the results is presented, and the possible role and behaviour of socio-economic measures is discussed.

Vocational education – some systemic problems

Vocational training is often perceived as a way of solving the problem of unemployment among young people. In view of numerous publications on the issue, three types of vocational training can be distinguished. These involve 3 separate systems: 1) vocational and technical schools, 2) formal apprenticeship and 3) dual systems [Eichhorst et al. 2015]. The authors of the above article suggest that the most efficient system would consist of dual training based on: a) employer support through apprenticeships, b) acceptance of apprenticeships as a training component that is characterised by lower wages but allows for the acquisition of new skills, c) support from the government in the form of additional funds, establishing frameworks for apprenticeships, external monitoring of results.

Each of the systems generates different problems. In the case of the dual system, the difficulties are connected with the aspect of responsibility for the student's safety during an apprenticeship. The status of employment itself plays a significant role in this situation. The authors of the article highlight that the status of either a student or an apprentice is an important factor that has an influence on health and safety measures, as well as the scope of a supervisor's responsibility [Grytnes et al. 2018]. A comparison of two dual systems, the Swedish and the Danish one, suggests that when participants have apprentice status, the teachers have limited contact with them. Danish participants with apprentice status consider supervisors from the workplace as more important in the process of acquisition of professional competences than the Swedish ones, who maintain their student status. At the same time, Swedish students feel safer in the context of work, while the Danish apprentices mention issues with their employers, who consider introducing safety measures as an extra expenditure.

One of the problems concerning training could be the level and the system of remuneration of teachers, which was mentioned in, among others, an extensive publication by Polcyn et al. (2017). The teachers' lack of motivation for self-development caused by inadequate distribution of funds can lead to a deterioration of students' results and therefore to their lower position on the job market. The discussion on the professional development of vocational teachers has been ongoing for many years. In her article [Saunders 2012], the author notices the need for teacher training and presents the results of such formation based on the example of 27 Australian teachers. The author emphasises the importance of creating teacher communities, exchange of experience and continuous cooperation. It helps in spreading innovation and cooperative problem solving, where an experienced teacher can act as a mentor for others. In Australia, as the author points out, no forms of introducing positive changes can be employed without sufficient financial means or effective planning. Change for the better, whenever it happens, is always multidimensional and, considering its high level of complexity, must be based on hard evidence and evaluation. Importantly, the author underlines that teachers are valuable human capital. The example presented in her paper could be an answer to the requirements set by the job market for vocational training, as well as the people responsible for its evolution, most of whom are vocational teachers.

In 2012, an analysis was conducted to investigate the influence of broadening the opportunities for training vocational school graduates through reduction of differences between academic and vocational development paths. Hall (2014) indicates in the article that despite a raise in interest in such training form, the solution did not have an influence either on interest in higher education or on the level of remuneration in the later career.

Therefore, every vocational training system raises questions and problems, as even the three-category divisionmentioned can be insufficient. Many publications [e.g. Prasad and Tran 2013] emphasise the need for the development of general education in combination with specific professional skills. This influences the future of students on the job market.

Already in 2007, Wendy Smits [Smits 2007] claimed that in the case of imperfect matching of the industry-oriented skills included in vocational curricula with job market requirements, employees prefer to receive a general rather than a socially optimal education. The reason for this is that the level of such education is decisive for the lower salary limit they receive after completion of training, regardless of whether they remain in the industry or not. It is the professions that require specific competences (with strong emphasis on their acquisition), not the more general ones, that are characterised by a higher risk of employment loss. This issue is much broader, and also connected with worker mobility [Katz and Ziderman 1990]. Through activities, industry itself tries to come to terms with the ecology towards sustainable development [Topor 2017] that is reflected in a greater awareness of employees, as well as potential students in the dual studies system, however, it is difficult to perceive this in the prevailing vocational training programmes in Poland.

A comparative analysis of vocational training methods in France [Bonnal et al. 2002] demonstrated that apprentices enjoy a significant advantage over vocational school students when looking for employment. In their analysis, the authors point out important socio-economic measures such as unemployment rate, ratio of number of employers to students, and diversification in the employment sector. The use of these measures was confirmed by the authors Franz and Zimmermann (2002). The analysis of the systems in Germany and Switzerland by Deissinger and Gonon (2016) indicates clearly that the dual training system, as well as vocational training itself, constitutes a cornerstone of economic wealth in these countries. This success is not only due to the efforts of government authorities, but also other institutions, trade unions and large companies.

The future of students – matched to the labour market and education returns.

The issue of financing vocational education and its expected effects also applies to the kind of return expected on investments in human capital back to a company, even in the case of employees already hired. Almeida and Carneiro (2009) indicate that, for the companies that participate in training, returns are significant, and hence, practical training in the enterprise provides returns comparable to either investments in physical capital or investments in schooling. In the article by Acemoglu and Pischke (2000), the authors analysed the impact of training certificates as providing an incentive to learn, such that employees want to get them and that employers value them and therefore participate in the costs. They showed that the certification process is the only institutional feature that helps to support apprenticeship and further vocational training, in an economy like Germany.

Of course, in the case of education in Poland, it still largely depends on the means available to technical schools, that is, by generalising expenditure in district budgets for vocational education. The share of the capital of external companies may, however, have a completely different effect. It happens that employees who are prepared according to the skill-weights scheme (a kind of matching of skills), in case of the forced change of work, achieve lower incomes, with prior training focused on the skills necessary for a given company. In the case of the combination of specific features, such as the combination of medicine and law, loss of work will lead to a much greater reduction in remuneration in the next job [Lazear 2009]. If the skills are more general, that is, they occur among a large number of companies, and differ only in the level of their needs, the loss of earnings will be lower. In case of the bankruptcy of companies, there are additional problems for journeymen, as the authors of an analysis of such cases for Austrian companies show [Fersterer et al. 2008]. In the United States in 2005, the statement describing vocational education at high school level was made as preparing students for professions requiring small and outdated skills [High School Reform, Round 1 2005]. This argument, however, even at that time, was ruined by the results of research on wages showing a greater increase in earnings for the so-called blue collar workers over office workers. Research on the comparison of student education on vocational and academic paths at secondary school level in 1988 showed that students on the technical path would not profit by changing their path to the academic one [Meer 2007]. In those years there was a great "knowledge revolution", which we are also experiencing today, and which can even be observed in the Polish context in the case of the proper adjustment of vocational education, graduates of these schools can get higher earnings even than employees who were devoted to their education for many years, dedicating themselves to academic and didactic work at universities. In this context, in 2007, this author pointed out that vocational education should not be stigmatised or treated as an inferior education choice. The moment of transit to so-called early employment from school to work (immediately after graduation) was analysed on the example of Western Germany in an article by Brzinsky-Fay and Solga (2016). Several birth cohorts were used, deriving from many different areas in terms of macroeconomics. Despite the differences, it was found that this transition maintains a linear character. However, gender differences were noticed. Men who find themselves in the labour market earlier than women seem to be in a better situation. These results relate only to the German education system.

Especially in the case of self-employment, on the basis of the results of a situational analysis of education in Poland [Turczak 2017], disproportions between gender considering the vocational training may be observed.

Nevertheless, the influence of such education on the entire period of work capacity is still debatable, in which an employee often has to adapt to the changing labour market. At the same time, there are theories that education [Hanushek et al 2011] better prepares for such a situation, as well as theories that vocational education itself is better than education directly in the workplace during employment [Adda et al. 2006], however, it is difficult to define it clearly.

More complex analyses, taking into account long-term effects based on data from Great Britain before the Great Recession, show a close dependence between success on the labour market and family background characteristics (eg. parental education), which has a fundamental impact on labour market performance. What can be observed here is a growing socio-economic polarisation characterising the moment of transition from school to work [Dorsett and Lucchino 2014].

Using the data on the entry into the labour market of young Germans from the period 1984-90, another author showed interesting facts describing how young people manage to function on the labour market, depending on employment. He compared the experience of journeymen, university graduates, vocational and post-secondary schools. As a result of the data analysis, he noticed that journeymen who completed training did better in their first job than others. Among them, those who had been educated in larger companies were most likely to gain regular employment, however, once employed, the stability of their work did not differ from the stability of the work of young people coming from other schools. Nearly 70% of apprentices left the company that trained them within five years, which indicates that journeymen develop more general, transferrable features as part of their education, rather than being strictly focused on a specific company [Winkelmann 1996].

Vocational education and its various forms can be an important factor in the strategies of encouraging work, i.e. in the so-called activation strategies including ALMPs – active labour market programmes. Here, in turn, one of the dangers of interrupting such a course can be getting a job before graduating and obtaining a certificate. Vocational training is an important element of ALMP in countries such as Finland, Japan and Ireland. These programmes often oblige participants to obtain/search for a job right after completing the courses. In countries such as Switzerland, Australia or the United Kingdom, participants receive jobseeker status during the courses. This support often also applies to people from groups of social exclusion (eg people with disabilities) [OECD 2013].

Foreign capital

It is not possible to omit the influence of companies from outside a country on vocational training. Foreign companies appearing in Poland often show a common tactic, they base the location of the firm depending on the available workforce that they ultimately educate themselves for their company needs. Because this approach most often requires specialisation, they choose a specific education that is strongly tailored to the company's profile. It is connected with financial outlays and, often, cooperation with local authorities, however, it results in effects which the employer has a strong influence on. Often, this also involves the use of specialists from the company as teachers, not only in the field of dual studies and focus on education directly in the workplace, but also through contact with practitioners directly in school classes. Thus, the nature of the company's contribution has not only a financial dimension, but also takes the form of investment by engaging its own staff in the entire process. Companies usually use (especially in the IT sphere) external certificates confirming the acquisition of competencies that are then necessary for employment (companies such as Quad, Alcatel, Atos, etc.).

Foreign companies operating in Portugal usually have a better educated workforce and pay higher rates, which allows them to closely control the quality of employees [Almeida 2007]. There is also a tendency to take over local companies that exhibit these desirable features. Mostly these are large companies that have an educated workforce and offer decent pay for people with lower education. Potential employees with a vocational education must see such employment opportunities as unique.

The exemplary research based on the analysis of data from the 1990s in Sweden by Bandick and Carpathians (2011), shows that the share of foreign capital significantly increases employment levels and, despite a clearly stronger effect for people who already have the skills necessary for companies, this effect was mainly related to large companies. The authors did not confirm the thesis that the participation of foreign companies reduces employment in any way. The effect is essentially the opposite. In the light of low loans which increases the growth in the number of local firms the effect may be even larger [Mitrovic and Ljubic 2015].

In the case of Poland, it is also worth noting that in a study analysing the period from 1995-2013 Strawiński et al. (2018) show that as a result of a significant reduction in the number of vocational education graduates, their relative salaries and the need for such employees increased. These results are important for educational policy in Poland.

Concluding the review of the literature, it is worth mentioning at the end of this chapter about the tool created in Sweden in the 1990s which is one of the potential cures for the problems of labour and population migration, and at the same time predicting labour market parameters and enabling various types of evaluations. It has been successfully adopted in Finland and makes it possible to monitor the skills of the available workforce. The main parameters are, among others: developing future goals for the technological development of education, and innovation factors either accelerating or slowing down development. On the basis of these achievements, the Occupational Barometer was developed and described in greater detail in the article [Pitukhina and Sigova 2015], later it was also adopted in Poland.

Methods of analysis

The analysis of the effectiveness of vocational education on the non-tertiary level, in terms of labour market demand, began with the collection of information on vocational education courses on secondary and post-secondary non-tertiary level in Poland.

The fundamental document currently in force, regulating and describing this education is the Regulation of the Minister of National Education of March 13, 2017 on the classification of vocational education occupations [Journal of Laws of 2017, item 622]. The most important information for the study included in this document is determined by the names of the professions, ordered by groups, corresponding to the classification of professions and specialties for the needs of the labour market, areas of education (referring to the classification of the Polish Classification of Activities) to which professions are assigned, types of schools providing training in these professions and the names of qualifications that are assigned to them [Regulation of the Ministry of Education of 13 March 2017].

The second fundamental document used for the analysis was the Polish Classification of Occupations and Specialties. In this case, the document is based on the classification of occupations and specialties for the needs of the labour market from 2014 – uniform text [Journal of Laws of 2018, item 227]. It contains appropriate keys and names of occupations, allowing for specifying the main professional tasks [MRPiPS 2018; Regulation of 27 April 2010 and further; Regulation of the Ministry of Education of 13 March 2017].

In the next step, statistical data on the number of students in a district (NTS-4) were collected on the basis of the Local Data Bank (BDL) of the Central Statistical Office (GUS): secondary and post-secondary (non-tertiary) schools for young people (excluding special schools) using the narrow fields from the ISCED-F 2013 classification of programmes and qualifications (International Standard Classification of Education introduced by the UNESCO Institute of Statistics for the European Commission, classifies educational programmes and related qualifications by fields and narrow fields of study (occupations are not directly related). Due to the fact that there is no direct link between the classification of occupations and the ISCED-F 2013 narrow fields of education (due to the large number of occupations), an attempt was made to link these values. This activity was carried out by Central Statistical Office staff from the Department of Social Research and Living Conditions Statistical Office in Gdansk. They proposed a key link (90 professions, afterwards, at the request of the authors and owing to the courtesy of the aforementioned Office, the key for most professions was made available) to connect ISCED-F 2013 with the classification of professions [GUS 2017]. This allowed the aggregation of data on the number of students trained according to the ISCED-F education courses in 2013. There are uncertainties about the fit of some professions using a detailed analysis of data resulting from the publication International Standard Classification of Education: Directions 2013 [POLON 2018; UNESCO 2015]. This publication indicates 12 large fields of education, as well as numerous narrow fields related to those used in the publication [GUS 2017]. Moreover, the UNESCO publication includes, in addition to descriptions, the examples of qualifications and programmes, as well as detailed narrow fields, with exclusions where some aggregates may overlap. Using this data, based on the knowledge derived from educational programmes [Regulation of the Ministry of Education of [March 13, 2017], Internet documentation [Ministry of Labour and Social Policy 2013) on standards of professional competences and professional qualifications and previously mentioned publications, the authors created a key (combination) of connections between 214 occupations of vocational education on the non-tertiary level and educational narrow fields ISCED-F 2013.

Data from this collection does not provide detailed information on the number of pupils per occupation within a district, however, for analysis based on the ISCED-F aggregation, this is sufficient.

The analysis also uses data from the recently created Polish Occupational Barometer [https://barometrzawodow.pl/]. These data are aggregated at the district level and relate to, among others, the relationship between the available workforce and the demand for employees. This document presents the aggregation to nearly 200 so-called “occupational classes” defined by the key links to the Occupations and Specialties Class (official Polish document) occupations in the documents [Occupation Barometer 2017] attachment. Each of the occupational classes is described by one of 5 features: “balance of demand and supply”, "jobseeker's deficit", "large jobseeker's deficit", "surplus jobseekers", "large surplus of jobseekers". For simplicity, aggregation into three groups was made: deficit, surplus and balance.

Since the most important information for the analysis is information on deficit professions covered by education in vocational schools, the occupational classes were linked to the Occupational Barometer through the aforementioned key with occupations in the Classification of Occupations and Specialties, and then with the key from this classification to ISCED-F 2013 and for this aggregation two sets of data were prepared. One contained the percentage of the number of occupational professions related to the ISCED-F 2013 education narrow field, in the total number of occupations listed in the Occupational Barometer (i.e. the number of professions in deficit, surplus and balance) in a given district, in a given narrow field of education in the ISCED-F 2013 classification. The second set of data contained the number of deficit occupations in a district in a given narrow field.

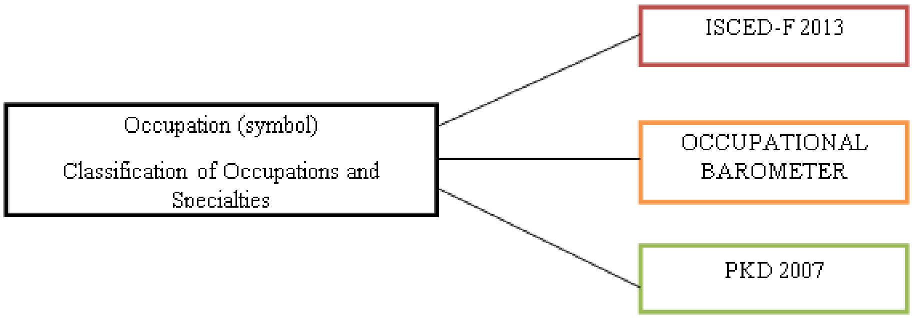
Using the prepared key connections, it was possible to link the professions resulting from the Classification of Occupations and Specialties with sections of the Polish Classification of Business Activities 2007 (PKD). This connection was made taking into account inaccuracies resulting from the fact that in the case of establishing a business there is, despite legal restrictions, a certain freedom resulting from the individual insertion of PKD codes by people setting up a business. At the same time, there are inaccuracies resulting from the fact that when determining the PKD code of larger companies with several activities, the activity constituting the largest share in the global operations of the company is taken into account and the remaining ones are omitted. It was assumed that vocational education aims to educate people for a particular profession and for isolated cases only it was assumed that they would work in an enterprise not belonging to the broad areas of the PKD (sections). In addition, in the case of professions which are difficult to assign, the previously mentioned documentation was used, including the Professional Competency Standards and Professional Qualification Standards [Ministry of Labour and Social Policy 2013]. In this document, the current Ministry of the Family of Labour and Social Policy[1] describes the qualifications and professional competences for the professions listed there, often giving the classification of PKD directly. In some cases, the occurrence of the PKD code of a given activity was also analysed directly in available business bases.

This resulted in dictionary key links between all the aforementioned classifications.

[1] Current ministry name after change that was introduced in 16 November 2015.

In addition, data on budget revenues from districts were used according to the budget classification from the Local Data Bank of the Central Statistical Office per person for 2016, however, it only approximately corresponds to the PKD. Since the PKD groups occurring in it are repeated, it was decided not to bind them directly with the key, and use them as an additional indicator that can determine the choice of the right narrow field of education in a given district [Ministry of Culture and Trade Regulation July 21, 2017.

Fig.1. Diagram of connections between used databases



Source: own study.

Linear modelling and additional data

Firstly for linear modelling, the 5 most numerous narrow fields, in terms of student numbers, in Poland, within ISCED-F 2013 were used: architecture and construction, engineering and engineering trades, personal services, manufacturing and processing, business and administration, and additionally an aggregation of these groups into one were taken into account. Apart from this, the modelling for narrow field of agriculture was made. The data used for each model were first standardised. In the process of cleaning, data with incomplete attributes, missing elements and outliers were removed from district datasets. There were 339 observations used to create the models.

Modelling was performed using a linear model with heteroscedasticity correction, taking into account the collinearity criterion and analysing p values (Gretl software).

The variables that were taken into account, corresponding to the district level data (NTS-4) for 2016, are:

Table 1. Table of variables used in linear modelling

R0	**Number of students currently in education in a given narrow field of ISCED-F 2013 education divided by the number of people aged 15-19 (explained variable)**
R1	Expenditure of district in secondary and post-secondary non-tertiary vocational schools budget chapter divided by the total number of students in these vocational schools
R2	Percentage of people working in one of 5 groups according to the Polish Classification of Activities aggregated into 5 groups among total employees. The groups were: 1) financial and insurance

	activities; real estate market services 2) trade; repair of motor vehicles; transport and storage management; accommodation and catering; information and communication 3) other services 4) industry and construction 5) agriculture, forestry, hunting and fishing,
R3	**Percentage deficit ratio of vocational education occupations from the Occupational Barometer for a given ISCED-F 2013 narrow field (described in the methodology)**
R4	**Number of vocational education occupations in deficit from the Occupational Barometer for a given ISCED-F 2013 narrow field (described in the methodology)**
R5	Revenue of the district according to the Budgetary Classification sections of districts divided by the number of people of working age
R6	The number of business entities (aggregation according to the Polish Classification of Activities) divided by the number of people of working age
R7	Value of gross fixed assets in millions of zloty (by the Polish Classification of Activities – aggregated into 5 groups as in R2) divided by the number of people of working age
R8	Investment outlays in millions of zloty (by the Polish Classification of Activities – aggregated into 5 groups as in R2) divided by the number of people of working age
R9	Percentage of unemployed with post-secondary and secondary (non-tertiary) vocational education in general
R10	The number of foreign capital entities divided by the number of people of working age
R11	The amount of foreign capital in Polish zloty per working age population

Source: own study.

Description of individual models

Table 2. Values of linear model coefficients with p values for architecture and construction

Variable	coefficient	Standard Error	t-Student	p value
const	0,01	0,04	0,19	0,85
R1	−0,39	0,05	−8,04	0
R6	0,1	0,04	2,42	0,02
R9	0,27	0,04	6,58	0

Source: own study.

In the model, in which the explained variable describing the ISCED-F 2013 architecture and construction narrow field, significant explanatory variables that fulfil the role of stimulant in the model, are: a coefficient describing the number of entities in section F of the PKD (construction) (R6) and a coefficient with almost three times greater value than the previous one (R9), i.e. the share of unemployed with a vocational education, among the unemployed in total. The destimulant is the coefficient referring to expenditures in the vocational school of the district budget chapter (R1), it is the strongest effect with a value close to -0.4.

The increase of this coefficient (R1) by unit decreases the explained variable, i.e. the standardised coefficient describing the scale of education in the architecture and construction subgroup by about 0.4 units.

Factors describing occupational deficits (R3 and R4) showed too high a value of parameter p and were omitted as insignificant, they also showed collinearity. The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,25 and for F test, F (3,335) = 37,7 with p value = 0.

Table 3. VIF values for the architecture and construction narrow field model

Variable	VIF
R1	1,02
R6	1,01
R9	1,01

Source: own study.

Narrow field: engineering and engineering trades

Table 4. Values of linear model coefficients with p values for a narrow field: engineering and engineering trades

Variable	coefficient	Standard Error	t-Student	p value
Const	0,05	0,05	0,98	0,32
R6	0,41	0,09	4,43	0
R7	0,56	0,09	6,2	0
R8	−0,15	0,05	−2,87	0
R9	0,13	0,04	3,35	0
R11	−0,26	0,1	−2,72	0

Source: own study.

For the ISCED-F 2013 engineering and engineering trades narrow field, the relevant explanatory variables in this model are: (R9) an indicator describing the share of unemployed with vocational education in the total unemployed, which is the smallest of them, with a value of approximately 0.13, (R6) a coefficient describing the number of entities in section M PKD (professional, scientific and technical activities) acting as stimulants with values of about 0.41, (R7) a coefficient describing the value of gross fixed capital formation per entity according to the aggregated classification of PKD – industry and construction, with the highest stimulant value of around 0.56. The strongest destimulant here is (R11) the coefficient describing the amount of foreign capital per capita (value approx. -0.26), and following it the coefficient (R8), describing investment outlays per person of working age with a value close to -0.15.

The increase in (R7), the largest coefficient by unit, results in an increase in the explained variable, i.e. a standardised coefficient describing the scale of education in the engineering and engineering trades narrow field by about 0.56 units.

The remaining coefficients were eliminated due to collinearity, or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,24 and for F test, F (5,333) = 20,5 with p value = 0.

Table 5. VIF values for the engineering and engineering trades narrow field

Variable	VIF
R6	1,531
R7	1,858
R8	1,523
R9	1,038
R11	1,451

Source: own study.

Narrow field: personal services

Table 6. Values of linear model coefficients with p values for the narrow field: personal services

Variable	coefficient	Standard Error	t-Student	p value
const	0,01	0,05	0,29	0,78
R3	-0,12	0,04	-3,16	0,00
R5	-0,27	0,09	-2,98	0,00
R6	0,61	0,06	9,76	0,00
R9	0,17	0,04	4,44	0,00

Source: own study.

In the model for the next narrow field (personal services) two stimulants and two destimulants can be distinguished. Again, as in the previous model, the coefficient describing the participation of deficit professions (R3), despite the fact that it has a size of p that allows it to be distinguished in the model, is destimulating (value approx. -0.12). Of similar character, but more than twice as large, is the R5 coefficient, describing the size of district income resulting from chapter 710 – services for the population according to the Budgetary Classification. In the case of stimulants, there are, again, the variables R9 and R6, which are the indicators describing the share of unemployed with vocational education among the unemployed, and the coefficient describing the number of entities in section S of the PKD (other services activities), which is dominant here, being almost 4 times larger than R9.

The increase of this coefficient by unit results in an increase in the explained variable, i.e. a standardised coefficient describing the scale of vocational education in the narrow field of personal services by about 0.61 units.

The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,27 and for F test, F (4,334) = 30,2 with p value = 0.

Table 7. VIF values for the model of narrow field of personal services

Variable	VIF
R3	1,12
R5	1,02
R6	1,14
R9	1,01

Source: own study.

Narrow field: agriculture

Table 8. Values of linear model coefficients with p values for the agriculture narrow field

Variable	coefficient	Standard Error	t-Student	p value
Const	-0,02	0,05	-0,42	0,68
R6	0,43	0,06	6,96	0,00

Source: own study.

In the model for the narrow field of agricultural education, in principle one stimulator is distinguished, which is the coefficient describing the number of entities in section A of PKD (agriculture). The increase of this coefficient by unit results in an increase in the explained variable, i.e. a standardised coefficient describing the scale of education in the subgroup of Agriculture, by about 0.43 units.

The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,13 and for F test, F (1,337) = 48,8 with p value = 0.

Narrow field: business and administration

Table 9. Values of linear model coefficients with p values for the narrow field business and administration

Variable	Coefficient	Standard Error	t-Student	p value
const	0,074	0,05	1,46	0,15
R1	−0,27	0,06	−4,48	0
R2	0,26	0,09	2,8	0

Source: own study.

This model is clearly different from the previous ones. The coefficient referring to expenditures in the vocational school budget chapter for districts (R1) (with a value of about -0.27) is a destimulant here. A strong stimulant here is the ratio, pre-existing in previous models, describing the percentage of people employed in the aggregate PKD department “financial and insurance activities; real estate market service” (R2).

The increase of this coefficient by unit results in an increase in the explained variable, ie a standardised coefficient describing the scale of education in the narrow field of business and administration by approx. 0.26 units.

The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,15 and for F test, F(2,336) = 31,5 with p value = 0.

Table 10. VIF values for the narrow field of business and administration model

Variable	VIF
R1	1,56
R2	1,56

Source: own study

Narrow field: manufacturing and processing

Table 11. Values of linear model coefficients with p values for narrow field of manufacturing and processing

Variable	coefficient	StandardError	t-Student	p value
const	-0,03	0,05	-0,51	0,61
R1	-0,3	0,05	-6,08	0
R2	0,29	0,05	6,14	0
R10	-0,2	0,06	-3,22	0

Source: own study.

In the next model, we notice significant variables, of which only one is a stimulant. It is the percentage of people employed in the aggregate PKD "industry and construction" department with a value of around 0.29 (R2). The remaining destimulants are the previously occurring (R1) ratio, referring to expenditures in the vocational school chapter of district budgets, with a value of around -0.3 and the previously absent ratio (R10) describing the number of foreign capital entities divided by the number of residents of working age (value approx. -0.2).

The coefficients R2 and R1 have almost identical values, but opposite signs. When they increase by a unit, they cause, respectively, an increase or decrease in the explained variable, ie a standardised coefficient describing the scale of education in the narrow field of manufacturing and processing for the population by approx. 0.3 units.

The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of R^2 = 0,18 and for F test, F (3,335) = 25,8 with p value = 0.

Table 12. VIF values for the narrow field of manufacturing and processing model

Variable	VIF
R1	1,1
R2	1,1
R10	1,18

Source: own study.

Narrow field: data aggregation without agriculture

Table 13. Values of linear model coefficients with p values for data aggregation without agriculture

Variable	coefficient	StandardError	t-Student	p value
const	0,23	0,02	9,50	0
R1	−0,32	0,02	−19,62	0
R2	0,29	0,03	11,20	0
R6	−0,25	0,02	−11,59	0
R8	−0,04	0,01	−3,14	0
R9	0,09	0,02	4,87	0

Source: own study.

The last model uses the aggregated data from the previous models, omitting agriculture, which clearly stands out from the others on account of the small number of educated students in Poland – 11,480. The linear model based on the agriculture narrow field contained only one explanatory variable.

The destimulants present in this model are the following variables: (R1) the coefficient referring to expenditure on vocational schools in the budget chapter (value approx. -0.3), (R6) the coefficient describing the number of entities in the corresponding PKD section per person of working age and (R8) the coefficient describing investment expenditure per person of working age, with values of -0.25 and -0.04 respectively. In the case of stimulants, we have: (R2) describing the percentage of people employed with vocational education (non-tertiary) in the aggregate department of PKD with a value of 0.29, and (R9) the indicator describing the share of unemployed with vocational education among the unemployed, with a value of 0.09.

The increase in the strongest stimulant factor (R2) by a unit causes an increase in the explained variable, i.e. a standardised coefficient describing the scale of education in the data aggregation without agriculture by about 0.29 units.

The remaining coefficients were eliminated due to collinearity or too high a value of parameter p. The presented model is characterised by values of $R^2 = 0,25$ and for F test, $F(5,1689) = 113,6$ with p value = 0.

Table 14. VIF values for the data aggregation without agriculture model

Variable	VIF
R1	1,03
R2	1,78

R6	1,56
R8	1,22
R9	1,03

Source: own study.

Coefficients summary

Table 15. Comparison of the values of linear models' coefficients

Variable	Number of occurrences	Frequency	Destimulant	Stimulant
R1	4	57%	4	0
R2	3	43%	0	3
R3	**1**	14%	1	0
R5	1	14%	1	0
R6	**5**	**71%**	**1**	**4**
R7	1	14%	0	1
R8	2	29%	1	1
R9	**4**	**57%**	**0**	**4**
R10	1	14%	1	0
R11	1	14%	1	0

Source: own study.

As can be seen in table 15, the most important coefficients occurring in the models are R6, R9 and R1, which are the corresponding factor for the number of entities according to the corresponding PKD section, the coefficient corresponding to the share of unemployment with vocational non-tertiary education in general unemployment and the ratio referring to expenditure in the vocational schools district budget chapter per student. In most models, these variables are significant. For R6 and R9, almost every time they occur, they are factors stimulating the explained variable, only once a non stimulating factor can be seen for the data combined without agriculture. In the case of R1, it is always destimulating. Additionally, in three models there is a stimulating factor corresponding to the percentage share of the structure of people working in a given group of the corresponding aggregated PKD classification.

Very rarely, a significant deficit ratio resulting from the Occupation Barometer can be seen. When it occurs, its character is destimulating (!). This may indicate a lack of dependency between the demand for a group of professions from the ISCED-F 2013 education narrow field and the number of students educated in a given field of study or, worse, the destimulating character of that variable.

Modelling using logistic regression

The logistic regression method has been in use for many years in many different fields of science, not only economics [for example: Menon 1998]. In short, the representation of a dependent variable as a binary value (0,1) is needed. In the process, we try to predict and explain the relation between one dependent binary variable and independent variables that can be nominal, interval, ratio level and many more. It is used to determine the probability, for example, of the possible answers yes/no, and the influence on that of the variables used. It can therefore be used in determining the probability of classification observations between two groups. In the method, it is important to avoid outliers in data, as well as collinearity between data.

The authors assumed that the effectiveness of vocational education can be evaluated through analysing cases in which there is a deficit in a given occupation belonging to a given narrow field of the ISCED-F 2013, and at the same time there is vocational education in that field (R0> 0 and R3> 0). This situation should be evaluated positively (variable value=1), when there is no deficit or education (R0 = 0 and R3 = 0), and negatively in the absence of such education with the occurrence of a deficit, or the reverse situation, that there is education, but there is no deficit (variable value=0). In addition, it was assumed that the ratio of the number of students enrolled divided by the number of people aged 15-24 must be at least 3% – otherwise we consider education as negligible, perhaps extinguishable or unprofitable. As a result of these activities two similar sized groups were obtained. R modelling software was used for the modelling process.

Table 16. Summary of logistic regression model coefficients

Variable	Odds ratio	p value
Intercept	1,29	0
R1	0,633	0
R2	2,17	0
R6	0,546	0
R8	0,72	0

R9	1,24	0
R10	1,46	0

Source: own study.

Based on the results, it can be stated that R2 is the strongest factor, i.e. the percentage of employed persons with vocational education in the aggregated PKD department. The increase of this value by one unit, while keeping the others with a fixed value, increases the chance of being in a positive group by as much as 117%. The remaining variables R9 – describing unemployment and R10 – foreign capital, respectively, increase the chances by 24% and 46%.

The growth of variables R1, R6 and R8, related respectively to expenditure on vocational education, the number of business entities and the share of foreign capital, cause a decrease in the chance of getting into the positive group.

In addition to the variable R10, which does not appear in the linear model, these results coincide with the 7th linear model, i.e. the aggregation of the data without the agriculture narrow field. The remaining models, including p and the collinear criterion, behave in most cases similarly to the stimulatory or destimulating character found in the corresponding variable models. A more detailed analysis of each narrow field of education is shown separately below. The results presented in the table all have p values <0.05:

Table 17. Values of logistic regression coefficients for 5 narrow fields of the ISCED-F 2013 education classification

Narrow field	**Variable**	**Odds ratio**
architecture and construction	(Intercept)	0,46
architecture and construction	R1	0,53
architecture and construction	R2	1,65
architecture and construction	R9	1,68
business and administration	(Intercept)	0,78
business and administration	R1	0,62
business and administration	R10	1,97
engineering and engineering trades	(Intercept)	8,34
engineering and engineering trades	R1	0,31
engineering and engineering trades	R2	2,72

Narrow field	Variable	Odds ratio
engineering and engineering trades	R8	0,70
manufacturing and processing	(Intercept)	0,08
manufacturing and processing	R1	0,65
manufacturing and processing	R2	2,50
manufacturing and processing	R9	1,66
personal services	(Intercept)	3,79
personal services	R1	0,66
personal services	R2	7,33

Source: own study.

Table 18. Summary of the characteristics of the logistic regression model coefficients from the 5 narrow fields of ISCED-F 2013 education and the aggregated group

Variable	Increases chance	Decreases chance
R1	0	6
R2	5	0
R6	0	1
R8	0	2
R9	3	0
R10	2	0

Source: own study.

Logistic regression models seem more unambiguous than linear regression modelling. The character of all variables appearing in models, increasing or decreasing depending on the explained variable, is always the same. From the results we are able to see that the variable determining expenditures in district budgets in the vocational education chapter, unfortunately, indicates that its increase does not mean a greater chance of being in the positive group. Actually, the reverse is true. There is an increase in the chances if there are more foreign capital entities (R10) and an increased percentage of people employed in the corresponding aggregated PKD group (R2). The variable (R8) describing investment outlays, unfortunately, unambiguously reduces the chance for two models, namely: the engineering and engineering trades narrow field of education and the data aggregation model. Again, the variable R9 describing the share of unemployed people with vocational education in general unemployment increases the chance of finding a positive group, which is a very specific result.

The dominant variable in previous linear models, R6, describing the number of business entities in logistic regression models, is much less common. It appears only once for the aggregated data group, reducing the chance of being in a positive group if its value increases.

Conclusions from the analysis of the models

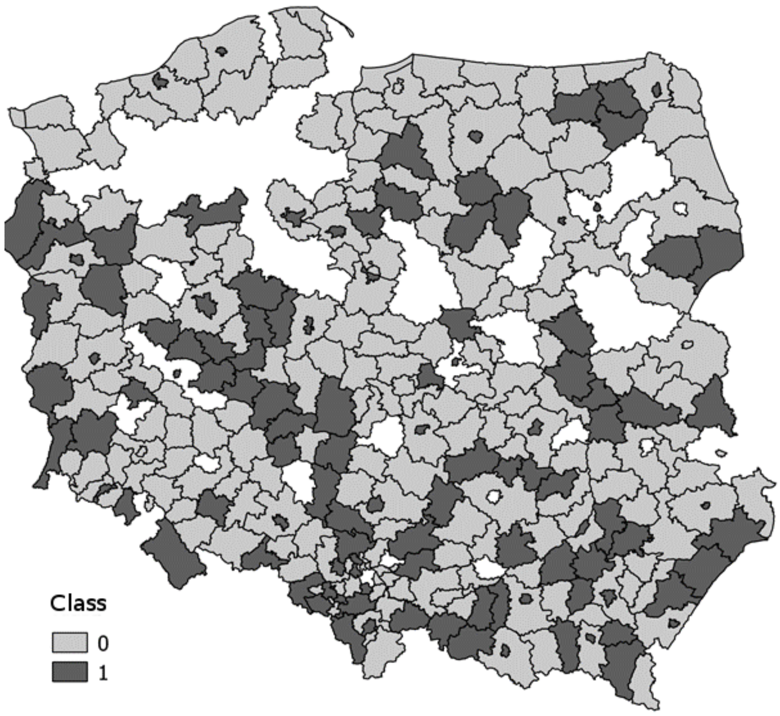
It seems that defining the effectiveness of vocational education as a link between the scale of education in ISCED-F 2013 narrow fields and labour market demand resulting from the occupational barometer, presented as a number of deficit professions or their percentage share (their dependence in models seems to be mostly linear), can serve as an important indicator in the analysis of the education system vocational training in Poland. Both linear and logistic regression models achieved similar results with significant character.

Due to its wide variety, it seems difficult to clearly assess the effectiveness of vocational education in Poland, even taking into account only 6 out of the 14 narrow fields of ISCED-F 2013 education. The differences between its individually defined narrow fields containing different occupations and the general tendency (data aggregation) can be large. Nevertheless, some common features of these models emerged. In the case of destimulants, we can see that the coefficient referring to expenditure in the chapter on vocational schools per student (R1), remains mostly at a value in the vicinity of -0.35. On the other hand, in the case of stimulants, the percentage of people employed in the aggregated PKD (R2), maintains its value around 0.28 and the share of unemployed with vocational education, among the total unemployed (R9), fluctuating between 0.09 for the aggregated data, 0.13 for the engineering and engineering trades narrow field, and 0.27 for architecture and construction. There is no dependence on the labour market or destimulating character of variables referring to occupational deficit (R3 or R4) for the linear models. The coefficient describing the number of entities in the corresponding PKD section per person of working age (R6) occurs most frequently. For models of four different subgroups of ISCED-F 2013, it is a stimulant and ranges from 0.1 for the narrow field of architecture and construction to 0.61 for the narrow field of personal services, however, for the aggregated data, it works destimulatively, at a level of -0.25. Other variables occur individually, or do not have a clearly defined role in the models.

Graphic representation of the proposed classification results

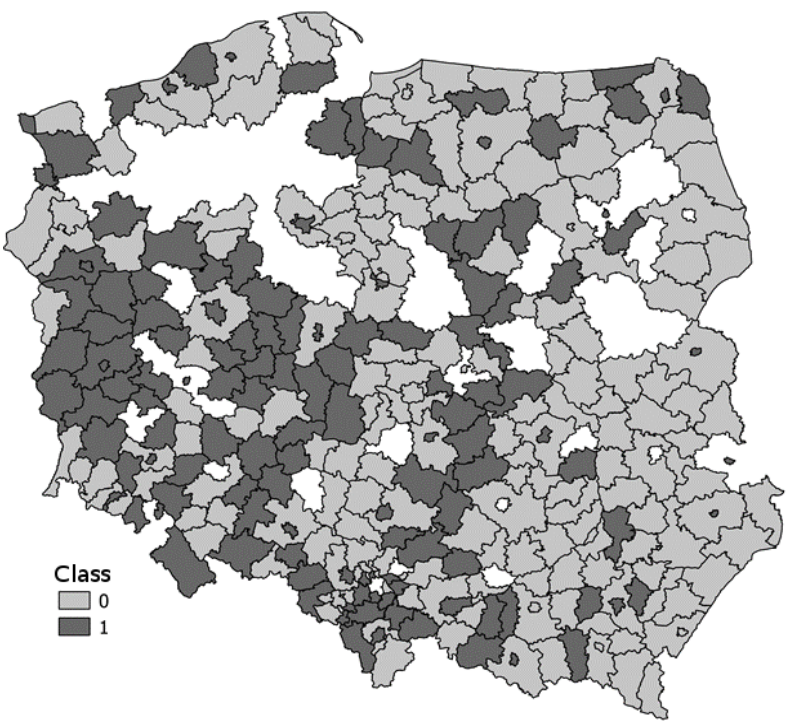
The following figures show a graphic layout of the distribution of districts with classes 0 (negative adjustment) and 1 (positive fit), for 5 narrow fields of ISCED-F 2013 on the map of Poland for the districts which were used to create the models. Qgis software was used to create the images.

Fig. 2. Classification of districts according to the classification of educational effectiveness for the education narrow field: architecture and construction.



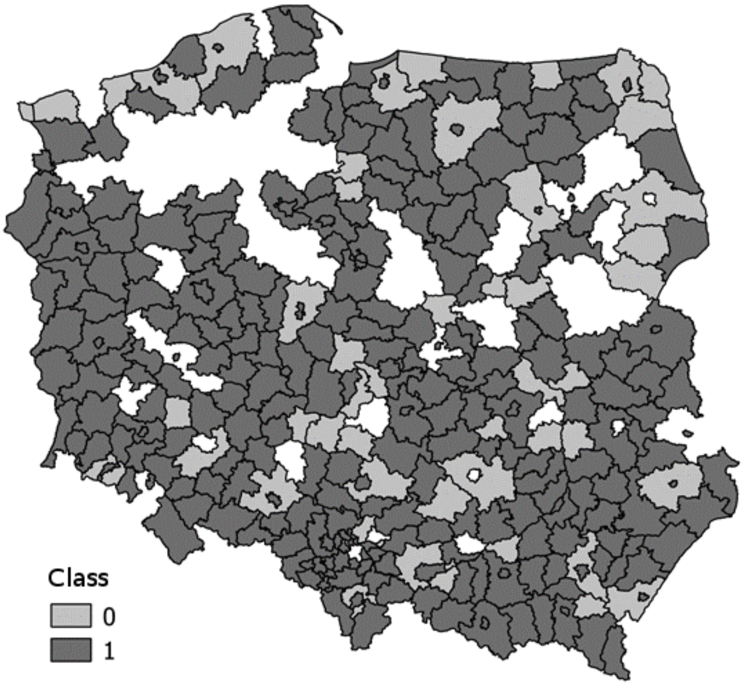
Source: own study.

Fig. 3. Classification of districts according to the classification of educational effectiveness for the education narrow field: business and administration



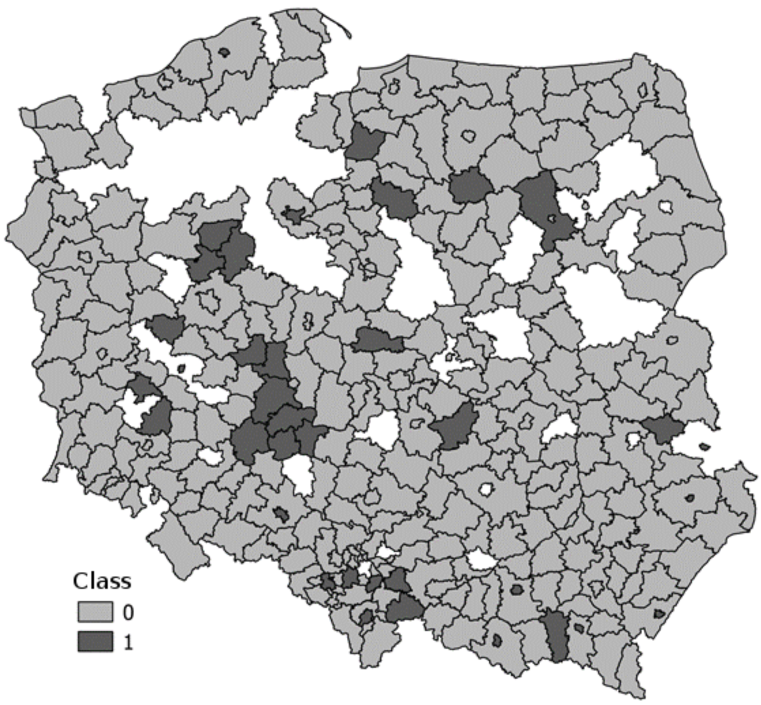
Source: own study.

Fig. 4. Classification of districts according to the classification of education effectiveness for the educational narrow field: engineering and engineering trades



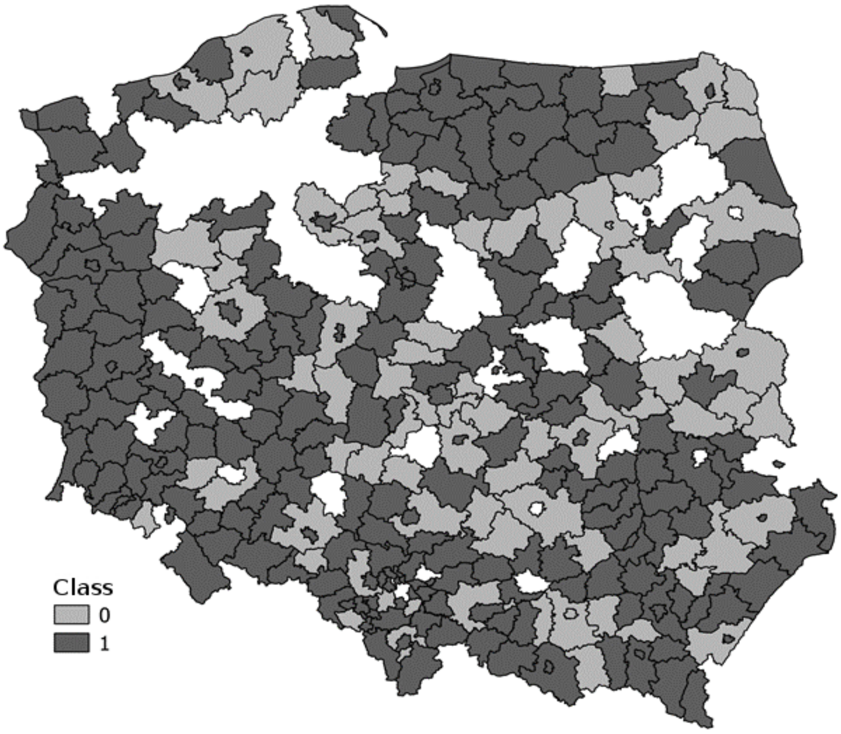
Source: own study.

Fig. 5. Classification of districts according to the classification of education effectiveness for the educational narrow field: manufacturing and processing



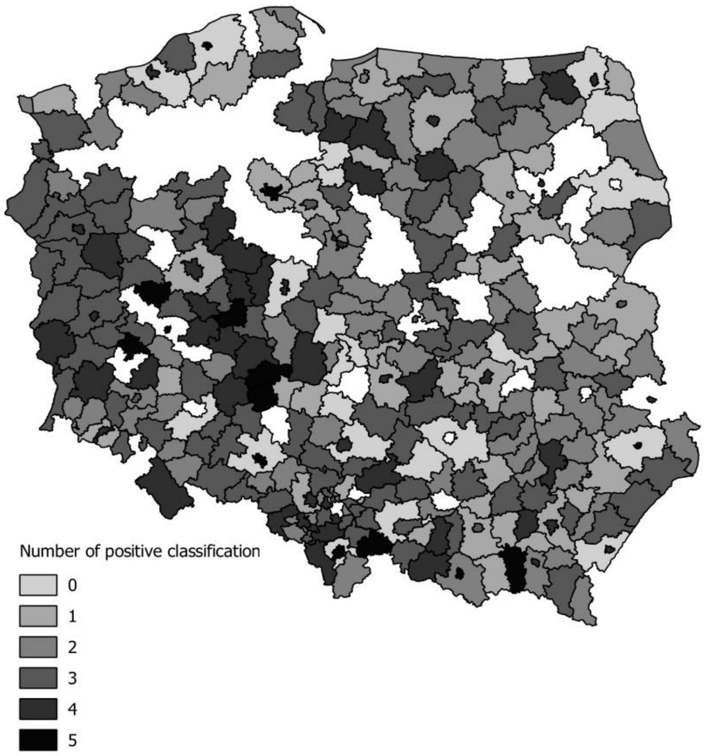
Source: own study

Fig. 6. Classification of districts according to the classification of educational effectiveness for the education narrow field: personal services



Source: own study.

Fig. 7. Classification of districts according to the classification of educational effectiveness: sum of positive classifications



Source: own study.

In the graphic presentation of the classification on the map of Poland, only in the case of the narrow field of business and administration education does it seem to be clearly shown that the concentration of the positive classification is clearly on the western side of the country. Other groups do not seem to stand out in the context of spatial distribution on the map of Poland in any way. The presented maps show, however, that the narrow field of production and industry education seems to be the worst in terms of matching the labour market. There are very few districts that have been classified positively. The situation is the opposite in the case of the engineering and engineering trades narrow field, where a positive classification in almost all Polish districts seems to dominate. Also positively, although to a lesser extent, the situation looks like in the case of a narrow field of personal services. In the case of other groups, the negative classification dominates.

Aggregation of data from Figures 2-6 is shown in Figure 7. We can see here that the most often positive classification of districts occurs in West-Central Poland. It is not unequivocal, but it seems that in the western part of Poland, however, the rather good adjustment of education to the demand of labour market in comparison with the eastern part prevails.

Models' implications and literature comparisons

As a result of the methods used, we can identify the factors that have the biggest impact on the effectiveness of vocational education. The expenditure of districts in the secondary and post-secondary non-tertiary vocational schools budget chapter divided by the total number of students in these vocational schools (R1) is a factor that can (and should), directly result in increased wages of teachers [Polcyn et al. 2017] and their development possibilities [Saunders 2012] as well as the advancement of standards of infrastructure accessible to students, and thus their effectiveness on the labour market. Since it can be seen in the presented models that, contrary to expectations, it works as a destimulant, this might imply a very big problem with the system as well as possibly a large issue on the level of the management of individual and general vocational school governance that does not cause a positive effect on educational effectiveness. This seems to be the most important conclusion.

The percentage of people working in one of 5 groups (R2), according to the Polish Classification of Activities aggregated into 5 groups among total employees, is a factor that describes the situation of the labour market directly surrounding students. The continuation of industrial development in terms of human capital seems to represent the natural order, and as such we can see in the models that it also increases the chances of a good fit to labour market demands. The "labour tradition" is visible around the world [Soutero-Otero et al. 2012] (example of Japan – oldest trades/firms, as well as Germany [Deissinger and Gonon 2016]) and we can clearly see from the results that it also may be taking place in the analysed regions.

The next variable (R6), which is the number of business entities (aggregation according to the Polish Classification of Activities) divided by the number of people of working age, which in a way shows the "density" of business type, perhaps should, in a way, exhibit the same behaviour as the previous one. In fact, almost all the linear models presented do so (although in the logistic regression models we do not see many significant results), only one shows a decrease in the chances of a positive result. It may seem that the effects may be mixed or unclear, since we are dealing here with a more detailed and direct classification of activities than in the previous variables, which may result in a larger error. It also seems to be less significant than the other ones shown in this chapter.

The percentage of unemployed with post-secondary and secondary (non-tertiary) vocational education in general (R9) may be seen as the rate of unsuccessful education returns, or, in a way, a saturated labour market. It is clear from the results of the models that we cannot see a logical relation taking place in the analysed data, such as, for example, low numbers of students in an ISCED-F 2013 narrow field related to occupations with high unemployment. On the contrary, we see an increase in the chances of a positive effect, but also an increase in the number of students in vocational education. This may refer to the "inertia effect" where we see schools training students in occupations no longer needed [Attwell 1997]. From the models, we can derive that this might be a huge issue in the current situation in Poland.

The number of foreign capital entities divided by the number of people of working age (R10) stands for the interest of foreign capital in a presented area as it may be seen by many authors [Bandick and Carpathians 2011, Almeida 2007 and many others], investment in local society and human capital. In the presented models we see this exact behaviour, increasing the chance of a positive fit of vocational education to labour market demands and an increase in student numbers. This may suggest there are no problems in this field of analysis regarding the situation in the Polish vocational education system.

Conclusions

The presented analysis shows that it is not currently possible to confirm the existence of a positive relationship between labour market demand and vocational education at the secondary level indicating the effectiveness of such education.

The developed models may lead to contradictions. The increase in scale of vocational education in a given narrow field of the ISCED-F 2013 classification also seems to indicate that in a given district the share of those unemployed with vocational education among all those unemployed will increase, while at the same time employment in the corresponding aggregated group will rise. The destimulating character of the variable R1 may at the same time result from the effect of scale (i.e., lower costs of education per student in larger centres), and at the same time indicate the diffuse nature of this education and the large number of small centres, which may affect its unprofitability and lack of relation to the labour market.

Despite the spatial analysis for engineering and engineering trades, it can be seen that across almost the whole country there are “positive” relations between labour market demands and the scale of vocational education, it is still hard to clearly determine if the system of education produces precisely the skills and competences needed by the companies in the labour market.

The great diversity and specificity of each of the narrow fields of education indicates rather its individual problems and possibilities. The speed of technological development of the corresponding fields also does not seem to be the same, and thus the rate of demand for innovation and changes in education programmes may be different. It may be worth noting here that even though innovation usually results from cooperation with industry, at a time when vocational training on a non-tertiary level is more controlled and ordered by the government, it has begun to lose importance for academic centres and higher education [Toner and Woolley 2016]. The very phenomenon of innovation in vocational education on a European scale still remains inconsistent and differs between countries of the European Union.

The current situation of vocational education in Poland, combined with the decrease in the number of students which causes an increase in the wages of people with such an education, makes it difficult to unequivocally assess whether education is properly adapted to the labour market and whether it is effective in this sense. For example, taking into account the discussion about the relation of the amount of content of “general education” in vocational education to education focused on a specific occupation, or, as in the case of dual education, focused on the skills needed for a given company. Even though the proposed changes can be positive, still in some cases determine a kind of polarisation of education and lower flexibility of students competences in the labour market. However, one can not deny the existence of a large influence of foreign capital on these phenomena. The topic certainly requires more detailed analysis, perhaps, as some authors propose, also a direct examination of the paths of employment of individual students (tracking) and a deeper analysis of the cooperation of the environment (companies and institutions) with vocational education at secondary level in Poland.

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Shaping the image of a hotel facility in the context of sustainable development

Katarzyna Orfin-Tomaszewska
Stanislaw Staszic University of Applied Sciences in Pila, Poland
ORCID: 0000-0001-9040-0355, e-mail: korfin@pwsz.pila.pl
Marta Sidorkiewicz
University of Szczecin, Poland
ORCID: 0000-0001-7559-7794, e-mail: marta.sidorkiewicz@wzieu.pl

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Abstract: The current deliberations of economists more and more often concern the issue of scarcity of resources and ways to solve this problem. A particular challenge lies before tourism, which faces a major problem regarding the necessity to meet the needs of tourists without adversely affecting future generations. The concept of sustainable development constitutes an answer to the example question of how modern enterprises should function and affect the environment, seen in the light of economic, social and environmental aspects. Moreover, pro-ecological and pro-social activities can be a valuable means of communication with the public, including potential and current buyers. The aim of the article is to develop the characteristics of solutions adopted by the hotel industry in terms of sustainable development, as well as identify these solutions in Polish hotels in the context of creating a positive public image of the entity. The article consists of four substantive parts, as well as the introduction and conclusions. The first and second parts discuss the theoretical aspects of the image and the concept of sustainable development in the hotel industry. The third and fourth parts, which are of an empirical and analytical nature, present the methodology of primary research and its results together with the interpretation. The theoretical-research considerations led to the conclusion that the concept of sustainable development is not popular among the Polish hotels surveyed, and the solutions applied within it are selective and aimed mainly at environmental protection or reducing the operating costs of facilities.

Keywords: sustainable development, image, hotel industry

JEL: A13, M14, M31, O44

Introduction

In an era of strong competition in the hotel market, it is a great challenge to stand out in a given context. In order to achieve this goal, it appears necessary to look for creative solutions in terms of shaping the creative images of hotels and their offers. One of them is to apply solutions that are in line with the concept of sustainable development, which is often associated with a pro-ecological policy constituting a part of the business activities performed.

The aim of the article is to develop the characteristics of solutions adopted by the hotel industry in terms of sustainable development, as well as identify these solutions in Polish hotels in the context of creating a positive public image of the entity. For the purpose of this article, the following hypothesis was formulated: the implementation of the assumptions of sustainable development by a hotel facility allows it to create a positive public image.

The study was prepared using the *desk research* method, which was applied in the theoretical part, in the form of a critical analysis of national and foreign literature on the subject, as well as industry reports concerning sustainable development, marketing and the hotel industry available on the Internet. The empirical-analytical part is based on the results of original studies performed in hotels using the CAWI method. Moreover, the method of logical operators (mainly deduction and induction) and the method of observation (in particular in the context of practical aspects) were applied.

Image as a marketing category

The concept of image has been characterised in many fields of science [Nawrocka 2012, p. 24], among others, psychology, sociology and management, which explains the ambiguity in defining the term. In psychology, image is understood as visual representation, a reflection of previously perceived components of reality [Przetacznikowa, Makiełło-Jarża 1982 as cited in Stawicka-Tkaczyk 2008, p. 14]. Image is "the result of all past experiences, and can be subject to the process of shaping, i.e. forming a specific psychological shape" [Stawicka-Tkaczyk 2008, p. 14].Whereas in marketing, image factors relating to consumer behaviour are highlighted [Jenkins 1999, pp. 1-15 as cited in Nawrocka 2012, p. 25].

The root of the word "image" (Latin: *imago*) means representation, likeness, or notion that may refer to a person, company or product [Wieseneder 2008, p. 35]. In the context of *public relations*, image is understood as a reflection of the perception of an organisation by individual groups from its environment, which means image is not an objective, but a subjective factor [Ćwiklińska 2012, p. 34]. According to R. Cohen, image exists in people's minds, and consists of knowledge, convictions and emotions. Moreover, it derives from social attitudes and value systems. As underlined by P. Kotler and H. Barich, image is the sum of beliefs, attitudes and impressions that a person or a group of people has in relation to a given object [Cohen 1963, pp. 48-63, Kotler, Barich 1991, Cornelissen 2000, Dąbrowski, 2010, pp. 65-67]. On the other hand, W. J. Crissy highlights its diversity, due to the variety of human values, experiences, knowledge and needs. It is essential that an entity may shape it by means of various instruments (including marketing ones). According to S.H. Britt, once an image is shaped, it more strongly affects people's behaviour than the sum of its elements [Crissy 1971; Britt 1985].

Image may comprise a number of elements, including, [Tkaczyk, Rachwalska 1997, p. 6]: name (proper, trademark, colour, etc.), age, traditions, size and scope of activities (local, national, international), financial strength and prospects of future development, company mission, product offer, management philosophy, company policy, external appearance and employees' behaviour, market behaviour, or building design (internal and external).

B. Rozwadowska and J. Ćwiklińska point to the concept of a comprehensive image of a company [Rozwadowska 2002, p. 56 as cited in Ćwiklińska 2012, p. 35] understood as a combination of three elements that constitute its basis, namely internal, market and socio-political perspectives (table 1).

Table 1. The elements of comprehensive image

Perspective	Internal	Market	Socio-political
Components	Internal image	Market image	Public image
Dimension	- remuneration - social benefits - management style - respect towards employees - employment security - communication	- market position - market policy - company's profitability - management - innovations, including pro-environmental - communication	- ecological orientation - public involvement - investment policy - entity/product positioning - communication

Source: B. Baerns (1995), [as cited in:] Rozwadowska (2002), Ćwiklińska (2012, p. 35).

As underlined by J. Ćwiklińska, not only positive features of a given entity (varying for different groups in society), but also the way in which these features are communicated to individual groups in society are especially relevant in the process of creation a positive image. The internal perspective refers to the internal image, which is based on, first of all, personnel policy or, more broadly, internal marketing. In this dimension, the key factors will be those concerning employees, such as social benefits, respect towards employees or employment security. The dimension of market perspective and market image is based on the position in society, the company's profitability, communication and implementation of innovations, including pro-environmental initiatives. The image existing in public opinion (the socio-political perspective) includes ecological orientation, public involvement or positioning of the entity or its products in the market [Orfin-Tomaszewska 2016, p. 40 as cited in Ćwiklińska 2012, p. 35].

The elements indicated in table 1, especially remuneration, social benefits, market position, ecological orientation or public involvement, at the same time constitute the key aspects of sustainable development that are more and more often described in the literature. According to the definition coined in 1987, which was included in the report of the World Commission on Environment and Development (the so-called Brundtland Commission) called

Our Common Future, sustainable development constitutes development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The approach to sustainable development adopted by the Brundtland Commission emphasises the need to integrate activities in the field of social and economic development, as well as environmental protection [*The Central Statistical Office in Poland*, 2016, p. 11]. In light of the above, it was especially important to prepare characteristics of the solutions applied in terms of sustainable development, as well as identify these solutions by analysing the case of Polish hotels in the context of creating the positive public image of an entity.

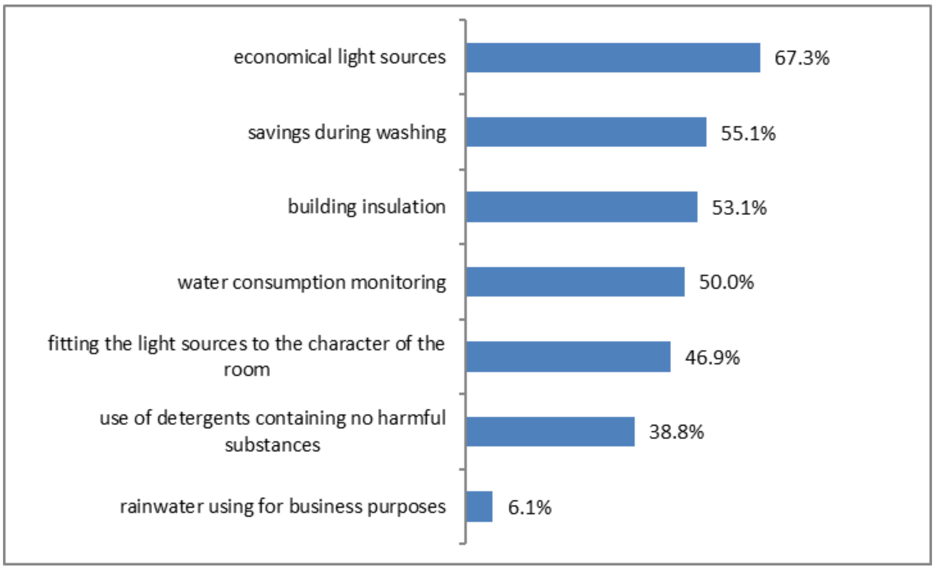
Theoretical aspects of the concept of sustainable development in the hotel industry

Modern literature concerning tourism development in the world more and more often focuses on its sustainability. F. Higgins-Desbiolles strongly voices an opinion stating that modern tourism faces a significant problem regarding meeting the needs of tourists without adversely affecting future generations. In his opinion, the concept of sustainable development is an oxymoron, as sustainability requires some restrictions on development. As the researcher points out, sustainable development is currently directly related to sustainable growth, which is a symbol of imbalance [Higgins-Desbiolles 2018, pp. 157-160]. The goals of sustainable development are also described in the literature as a great challenge that, at the same time, creates specific problems (e.g. limiting tourist traffic, and thus renouncing some income for environmental protection) [Dobrzański, Borkowska-Niszczota, Kiryluk, Szymańska 2010, p. 158]. On 25 September 2015, the General Assembly of the United Nations adopted the Transforming our World: the 2030 Agenda for Sustainable Development resolution. This document is being implemented by all countries and stakeholders through actions undertaken in partnership. The Agenda has 17 Sustainable Development Goals and 169 related tasks that are integrated and indivisible, as well as balance the three dimensions of sustainable development: economic, social and environmental [UN 2015, p. 1].

The concept of sustainable tourism means development with due respect for the balance between visitors' needs, environmental protection, and the interest and culture of the local community. Among the mentioned areas, environmental protection is highly important, as natural assets preserved in unchanged form determine the existence of tourism [Świstak, Świątkowska, Stangierska 2016, pp. 133-142]. The development of tourist business in accordance with sustainable development primarily includes aspects forming a coherent whole: economic (financial efficiency), ecological (minimising the negative impact on the environment), socio-cultural (creating new jobs, improving the quality of life) [Kowalczyk 2011, pp. 3-4 as cited in Świstak, Świątkowska, Stangierska 2016, p. 134].

The term "sustainable hotel" was coined by H. Houdré in order to highlight the role of the hotel industry in the creation of public awareness on the subject of sustainable development, especially environmental protection. A hotel facility which operates in a pro-ecological way, especially located in non-urban area, facilitates maintaining the environmental situation, brings financial savings by decreasing operating costs, and generates a direct, positive impact on the local community (e.g. jobs) [Kasprzak 2006, p. 135]. As research conducted by P. Gryszel, D. Jaremeni and A. Rapacz [2008, pp. 365-386] on a group of almost 50 hotels indicates, the most frequently applied ecological solutions were those related to the reduction of costs and environmental protection – figure 1.

Fig. 1. Environmentally friendly solutions applied in hotels



Source: Gryszel, Jaremen, Rapacz (2008, pp. 365-386).

The most frequently recommended activities (in practice usually in a narrower scope) in the area of ecological solutions applied in hotel facilities, which were partly listed in figure 1 and described in the literature, are [Krupa 2014, p. 11; Sidorkiewicz 2012, pp. 47-56]:

– applying ecological criteria when designing facilities;
– selection of building materials which are environmentally friendly and safe for humans;
– proper water supply and sewerage system;
– rational energy and water management;
– assuring food safety and nutrition;
– serving regional and ecological dishes;
– protection of natural and cultural landscape;
– limiting the use of own transport;

- modern and efficient transport (electric and gas vehicles);
- waste minimisation and its management at source;
- attempting to build small hydroelectric or wind power plants;
- use of solar thermal collectors and heat pumps;
- offering hotel products related to business tourism (e.g. conferences) in accordance with the protection of the natural environment;
- organisation of training courses in terms of pro-environmental activities for the personnel of the facility, suppliers; co-workers and clients.

As highlighted by J. Krupa, the actual activities in the field of sustainable development (or rather narrowed to environmental protection) are limited by the tourism industry to installation of energy saving bulbs and timer switches, solar thermal collectors, water saving devices, computer-controlled heating, air-conditioning and light systems. The most popular ones also include limitation of bedding and towel change (on guests' request), creation of an integrated facility management system and preliminary sorting of waste that facilitates its recycling.

Hotel facilities in Poland and in the world can try to obtain a kind of confirmation for their solutions or pro-ecological attitudes through certification. Certification indicates that the appropriately labelled product, process or service is in accordance with a specific standard or other normative documents. The national certification body in this area is the Polish Centre for Testing and Certification – PCTC. The overwhelming majority of tourism sector representatives (83%) stated that they fully or partly agreed with the thesis that current quality systems for tourism are very fragmented and highly inconsistent [European Commission studies 2012; Walas 2017, pp. 7-16]. In Poland, there are a significant number of certificates awarded by national and international institutions, with many of them having a small number of certified facilities. The most important certificates in the hotel industry, which are available on Polish market, are [Walas 2017, pp. 7-16]:

- SPA Quality Standard (certification of SPA service quality);
- Green Key (certification of tourist facilities that meet the criteria of environmental liability, cooperation with local community, building stakeholders' ecological awareness);
- Złoty Standard (Gold Standard) (a guarantee of the highest quality hotel services for guests);

- Hotel Przyjazny Rodzinie (a Family Friendly Hotel) (a competition that aims at evaluating and promoting hotel facilities which create attractive recreation conditions for families with children);
- Ecolabel (an ecological labelling system that defines the criteria for effective and economical water and energy management as well as waste minimisation);
- Green Globe (certification for a wide range of tourist facilities – hotels, restaurants, organisations, travel agencies and others, which verifies over 300 criteria in the field of sustainable management, effective management of natural resources, environmental protection activities etc.);
- Mercure Quality Guarantee (Accor Group certificate for Mercure hotels);
- Thalassa sea&spa (care for well-being, allows using the services of qualified thalassotherapy specialists and spas located right next to the seashore);
- Green Tourism (recognises hotels that strive to introduce clear changes in the way of running their business, focusing primarily on reducing energy consumption);
- Sustainable Bonn (the aim is to valorise the ecological and environmentally friendly location of conferences in hotels and restaurants);
- Hotel z Pomysłem (Innovative Hotel) (a contest organised by "Hotelarz" magazine – recognising the hotel that presents the best idea for its business activities and presence on the hotel market).

The attempts of the hotel industry to eliminate environmental pollution more and more often concerns green management, green marketing or green innovations [Pawlicz, Sidorkiewicz 2013, pp. 195-207]. The technical and technological solutions available today, introduction of legal standards or restrictions, as well as building pro-ecological consumer awareness, may together positively affect the gradual thinking process in terms of sustainable development in the world [Chen, Lai, Wen 2006, pp. 331-339 as cited in Chen 2008, pp. 531-543].

The methodology for the primary research

The aim of the article is to thoroughly describe the solutions adopted by the hotel industry in terms of sustainable development, as well as identify these solutions in Polish hotels in the context of creating a positive public image of the entity. In order to fulfil the above-mentioned objective, hotels representing all quality classifications (1*-5*) were chosen as research entities.

After determining the research problem, the methods that would provide answers to the research questions were analysed. From among numerous survey methods a CAWI online survey, which was sent to hotel facilities was selected.

According to official data compiled by the Marshal Offices for the Ministry of Sports and Tourism, which is available in the Central Record and Registers in Tourism (turystyka.gov.pl/cwoh/index, date of access: 20.04.2018) (specifically – the Central List of Hotel Facilities) as constituted on 20 April 2018, there were 68 five-star hotels, 419 four-star hotels, 1,584 three-star hotels, 825 two-star hotels and 251 one-star hotels – a total of 3,147 hotels in Poland. The list includes the email addresses of the hotels, which were used to contact the facilities regarding the online survey carried out for the purposes of this research. When analysing the Central List of Hotel Facilities, and the Internet contact details provided by hoteliers, it turned out that 618[1] of such facilities did not provide contact details, and in 492 cases, the hotel's online system did not accept the message sent, which resulted in the request for participation in the survey being returned. Therefore, 2,037 hotels were taken into account in the final survey. Furthermore, the survey was published on social media – in the *Polish Hoteliers* group, which was opened on *Facebook*. *Polish Hoteliers* is an "open group" that brings together the broadly-defined hotel industry.

The substantive scope of the conducted survey concerned, among others, such issues as:

- possessing a sustainable development strategy;
- identifying the solutions used in the field of sustainable development;
- certificates obtained;
- use of pro-ecological solutions for promotional purposes.

The surveys were conducted in April 2018. The survey questionnaire included 13 questions (4 open and 9 closed) and a questionnaire regarding the category of the facility, the location of the facility by region and the functioning of the facility within hotels chain. The message sent to the respondents underlined that the survey questionnaire would be short and not take long to complete. The respondents were also assured that all information obtained during the survey would be subject to data protection, the survey would be anonymous and the results obtained would be processed in aggregated form.

The survey resulted in 56 responses, and so only 2.7% of the research sample was examined. Therefore, the obtained results are purely for reference purposes and cannot constitute a basis for statistical generalisations.

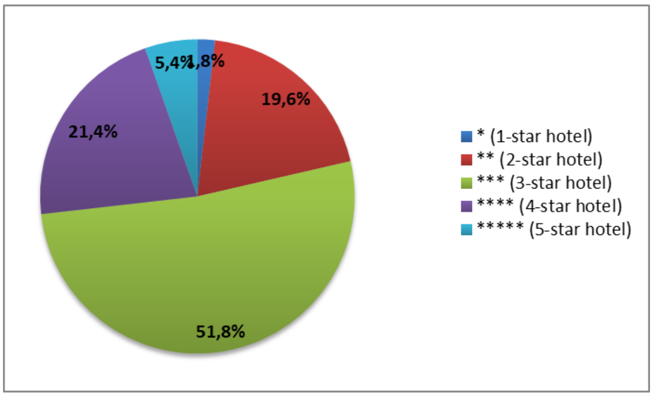
[1] No mail address in the Central List of Hotel Facilities: in 1* hotels – 87; in 2* hotels – 219, in 3* hotels – 263, in 4* hotels – 41, in 5* hotels – 8.

From the experience obtained from the above-mentioned survey, and such a low number of returned filled-in questionnaires, it can be concluded that examination of hotel facilities may involve significant difficulties. One of the arguments explaining such low feedback was certainly the date of the survey. On the one hand, the survey was conducted in the peak season for business hotels, when the occupancy rate of accommodation was high, due to conferences organised and business trips carried out by guests, and hotel staff were preoccupied with various duties. Therefore, devoting even a short amount of time to completing a questionnaire, which did not involve any direct profit, seemed for respondents to be a waste of precious time. On the other hand, the low participation in the survey was also affected by the fact that the message with the request to fill out the questionnaire was sent not to a particular person (a personal account) but to the main address of the hotel – a fact that may have resulted in the message being sent to the wrong person.

Identification of solutions in the area of sustainable development in Polish hotels in the context of creating a positive image

The survey conducted using the CAWI method included 56 Polish hotels located in various regions. As underlined in the methodology, in order to reach the set objective, hotels representing all quality classifications (1*-5*) were chosen as research entities. The structure of these facilities is presented in figure 2.

Fig. 2. Structure of the examined facilities by the quality classification.



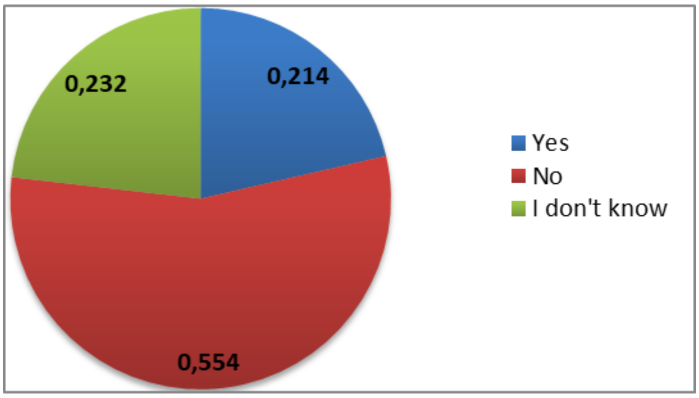
Source: own research.

3-star hotels constituted the largest group among all surveyed facilities – 51.8%, followed by 4-star hotels – 21.4%, 2-star hotels -19.6%, 5-star hotels – 5.4% and 1-star hotels – 1.8%. Only 14.3% of the surveyed entities indicated that they belonged to a hotel chain.

The aim of the article was to thoroughly describe the solutions adopted by the hotel industry in terms of sustainable development, as well as identify these solutions in Polish hotels in the context of creating a positive public image of the entity. The conducted research showed that 42.9% of the surveyed hotels operate in accordance with the principles of sustainable development, 12.5% do not have such rules, while 44.6% lack knowledge in this area. When analysing the research results, it is worth noting that in the case of a large group of hotels, the respondents did not know if any sustainable development principles were applied in the hotel. This lack of awareness among the representatives of facilities, or lack of basic knowledge in terms of the concept is an important area for discussion.

The very narrow scope of sustainable development solutions applied in the majority of facilities implies the lack of strategic documents in this area – figure 3.

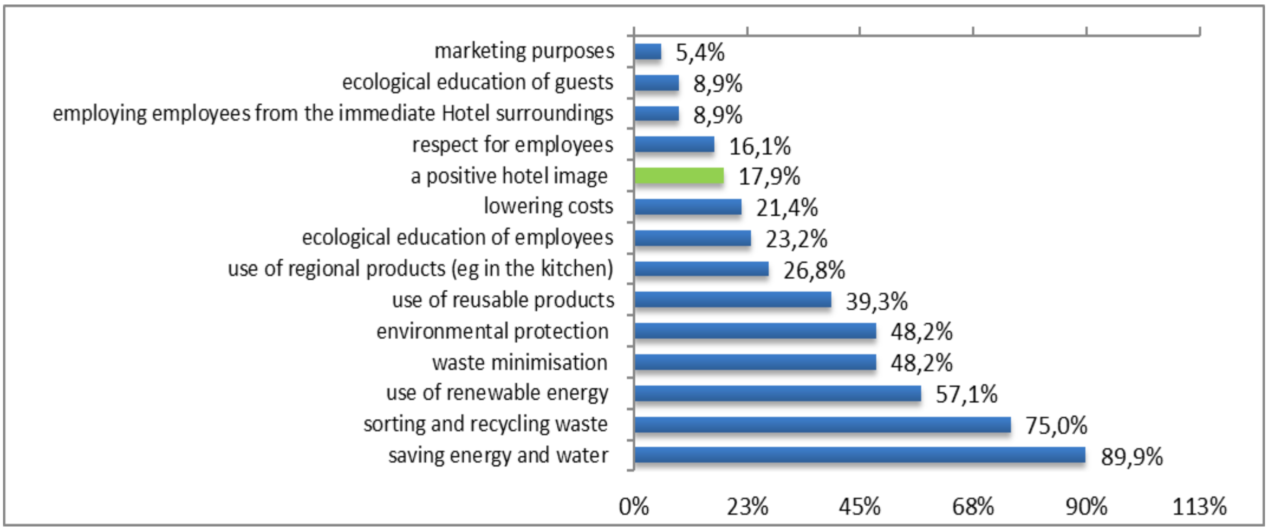
Fig. 3. The percentage of facilities with a sustainable development strategy (including eco-development)



Source: own research.

As seen in figure 3, 21.4% of the hotels surveyed declared that they had a strategic document in the field of sustainable development (network strategies, resource efficiency, waste sorting or eco-products), with more than half of them not possessing such a plan. In the case of 23.2% of the facilities, the respondents could not indicate whether such strategy had been developed in the hotel. Among the aspects which the respondents associated with the operation of the facility in a sustainable manner (the maximum number of answers amounted to 5), the most frequently given answer was saving energy and water (89.9% of respondents) – figure 4.

Fig. 4. Aspects associated with a hotel operating in a sustainable manner



Source: own research.

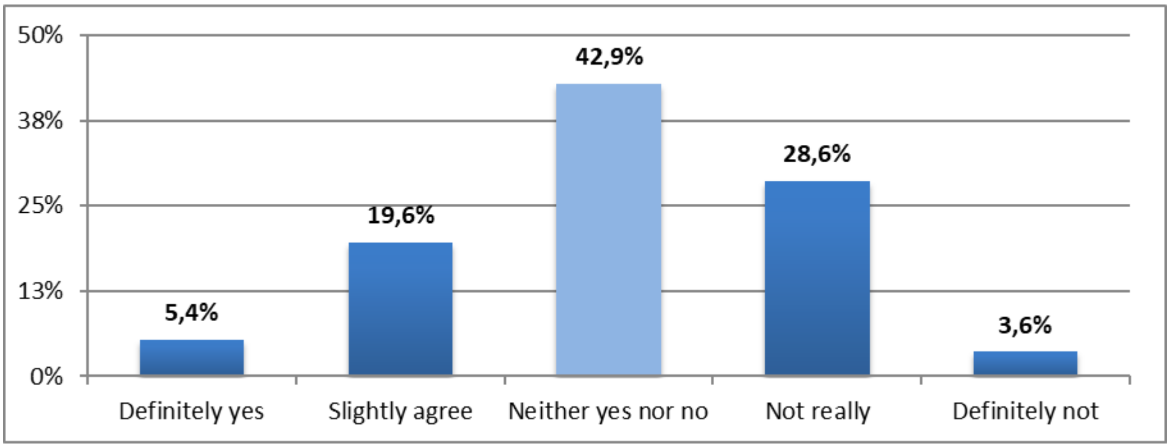
The five aspects that the respondents most often associated with the concept of sustainable development of hotels included:

- saving energy and water (associated by almost 90% of respondents);
- sorting and recycling waste (75%);
- use of renewable energy (57.1%);
- waste minimisation (48.2%);
- environmental protection (48.2%).

The other aspects (figure 4) were less often associated with sustainable development, including building a positive hotel image being indicated by only less than 18% of respondents. Only 17.9% of respondents use activities, especially ecological ones, for marketing purposes. The ways of informing the environment about the implementation of sustainable development aspects (including 17.9% of facilities) included: information printed in rooms about the procedures of changing towels and saving water, organising a conference entitled “Construction towards the global challenges of a circular economy”, information on social media, website and leaflets of the facility.

The fairly low percentage of answers indicating the implementation of sustainable development tasks for marketing purpose, as well as shaping a positive image of a facility, may be dependent on whether its guests pay attention to ecological solutions implemented in a hotel – figure 5.

Fig. 5. Opinion of respondents on the subject of eco-friendly solutions in the hotel



Source: own research.

As figure 5 shows, guests pay little attention (in the opinion of the respondents) to ecological solutions in a hotel or are indifferent to them – 42.9% of respondents indicated the statement "neither yes nor no". 32.2% of respondents chose the "definitely not" and "not really" answers, which may indicate a rather low level of ecological education of guests. In addition, the respondents were asked to assess whether the fact that the hotel uses ecological solutions was the main reason for choosing a hotel by guests. The answer "not really" was chosen by 37.5% of respondents, "definitely not" by 32.1%, and "neither yes nor no" by 26.8%. Whereas, 3.6% of respondents indicated "definitely yes" and "slightly agree".

The most important solutions in the field of sustainable development indicated by 82.1% of the examined facilities were:

- energy saving, water saving (e.g. photovoltaics, cogenerator, windmills, ozonisation);
- recycling, waste sorting;
- environmental protection;
- energy-saving bulbs (LED bulbs);
- use of reusable products (including, for example, cosmetics dispensers);
- solar panels;
- use of regional products;
- relations with personnel.

In the case of the vast majority of hotels, the respondents mentioned the solutions used in the field of sustainable development, while in case of the first question in the survey (does the hotel operate in accordance with the principles of sustainable development?) 44.6% of them did not have knowledge in this respect. This may indicate insufficient education of personnel in terms of the concept.

The analysis of the research results made it possible to determine that only 8.9% of hotels have eco-certificates that confirm the level of implemented objectives.

The results obtained so far point out to a relatively low level of education in terms of sustainable development (including eco-development) on both the supply and demand sides of the hotel services market in Poland. The respondents' opinions about the generally understood ecological expectations of guests may negatively affect the implemented solutions and the way they are communicated to the public. The surveyed facilities carry out various activities, but only those which have a direct impact on costs.

26.8% of respondents think that ecological solutions carried out by hotels definitely affect the process of creating a positive public image, whereas 30.4% of respondents answered "slightly agree", 33.9% – "neither yes nor no", and 8.9% – "not really". A positive aspect is that over 80% of respondents indicated that in the future it will become increasingly important to apply solutions in the field of sustainable development (slightly agree – 57.1%, definitely – 26.8%).

Summary and conclusions

The empirical and analytical content presented in this article positively verifies the hypothesis stated in the introductory part, stating that the implementation of sustainable development assumptions by a hotel facility allows it to create a positive public image (57.2% of respondents in favour).

Moreover, analysis of primary research, secondary materials, industry reports and online sources lead to the following conclusions:

1. 42.9% of respondents had knowledge about whether a hotel operates in accordance with sustainable development principles. The insufficient level of information about the concept is indicated by the fact that 82.1% of respondents mentioned the applied solutions in open questions but were not fully aware that these solutions may also be included in a sustainable development strategy.
2. The respondents most often associated the concept of sustainable development with: saving energy and water (almost 90% of respondents), sorting and recycling waste (75%), use of renewable energy (57.1%), waste minimisation (48.2%), and environmental protection (48.2%). The use of ecological solutions for building a positive image was indicated by 17.9% of respondents – a fact that implies an as yet unused promotional area.
3. The most commonly used solutions in the field of sustainable development in the hotels surveyed include:

- in economical terms: saving energy and water;
- in environmental terms: use of environmentally-friendly cleaning products, proper waste management;
- in social terms: purchase of regional products (especially catering), building relations with staff.

4. The certification of hotel facilities is not very popular in Poland, due to significant fragmentation and inconsistency. Only 8.9% of the surveyed facilities declared having a certificate. In the near future, possessing a certificate demonstrating a positive impact on the environment, local community and economy will become more and more desirable.
5. There is a need to educate hotel guests and employees about sustainable development. Guest awareness of sustainable development is relatively low. 28.6% of respondents stated that guests do not notice the ecological solutions used by the hotel, while 42.9% of respondents said they were indifferent to this issue.
6. Over 80% of respondents indicated that the implementation of sustainable development solutions will become more and more important in the future (slightly agree – 57.1%, definitely yes – 26.8%).
7. The use of ecological solutions in a hotel is an element building a positive image (in the opinion of 57.2% of respondents).

Theoretical considerations, numerous industry reports, forecasts and global trends clearly indicate that the development of hotel enterprises is heading towards sustainability. The attempt to find a common ground in economic, social and environmental terms will become an essential condition from the point of view of the representatives of supply on the hotel market and the needs and expectations of consumers.

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The importance of labour and capital inputs in the evolution of the food industry in Poland

Krzysztof Firlej
Cracow University of Economics
ORCID: 0000-0001-7870-046X, e-mail: krzysztof.firlej@uek.krakow.pl
Sebastian Kubala
Cracow University of Economics
ORCID: 0000-0003-4021-9173, e-mail: kubalas@uek.krakow.pl

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Abstract: The issue of modernisation of the job market for international needs in every country, even those well developed economically, arouses wide interest not only among practitioners acting in the broadly understood world economy, but also among analysts and researchers. Human capital is one of the most important resources of economies, societies and businesses. The main aim of this article is to show that the modern job market is closely connected with human capital, it evaluates with human capital and strengthens financial results, which is shown in the article on the example of food industry businesses in Poland in the post-accession period. The research process is supported by survey conducted in the period from the beginning of March to the end of May 2016 on a group of 438 businesses. The second stage of studies was conducted in 2018 and concerned research into human capital in the period 2011-2016. On the basis of certain indicators, an evaluation was made of the effectiveness of the human capital possessed, through effective of management. The results of the study confirmed that, in the research period, there was an increase in the role of human capital in businesses dealing with the manufacture of food products and beverages. This capital has enabled increases in work quality and an increasing ability to generate profit. In addition, in the businesses studied, there were different levels of use of human resources through those years, which demonstrates that the production capital of food industry enterprises was not always fully used.

Keywords: capital, labour, evolution, food industry

JEL: E24, J24

Introduction

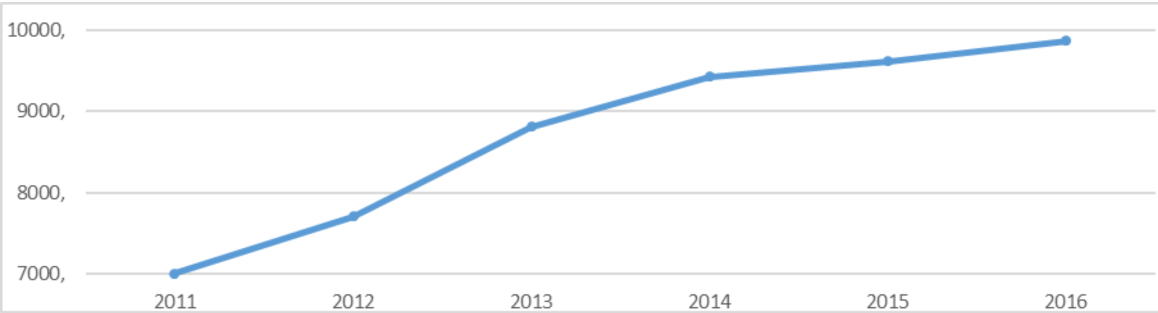
The modern job market, approaching the end of the political and economic transformations in Poland, faced a special kind of challenge. The economy was exposed to new demands, especially in the period when it became a symbol of economic success in Europe. This kind of opinion, supported by statistical data showing twice the amount of GDP per capita than at the beginning of the transformation, underlines the developmental possibilities of a national economy supported by the resources possessed. The issue of the modern job market is closely connected with the quality of human capital, which is the one of the most important resources in every economy. Human capital most often determines the final level of functioning of the economy in total. Human capital is also very useful to gain a competitive advantage, so it affects companies' market position. It is treated as a resource in companies because it combines capital, labour and entrepreneurship as well, as it is the knowledge, efficiency and skills of a human being which determine the growth in productivity. As A. Pocztowski underlines '… the new economy emerging, whose main determinants are globalisation, computerisation and knowledge, prompts new developments that are challenges in the field of human resources management. The main among them include changes in the content and conditions of work, building involvement around organisational learning, changes in traditional managerial roles, appreciation of cultural diversity, maintaining a balance between work and personal life, and personal risk" [Pocztowski 2003, p. 9]. Human capital focuses on primary values such as the knowledge, skills and qualifications of employees, the relations between them and their potential for development. Human beings develop their ability to work, which is a source of their future income, and skilfully adapt to changes in environment, try to solve the problems they meet efficiently, and thus obtain satisfaction, while businesses generate income proportional to the quality of work performed. On the other hand, a market economy forces enterprises to search for new sources of competitive advantage, which can include the strategic use of intellectual capital [Firlej 2008, pp. 85-89]. Intellectual capital is a vital factor that distinguishes enterprises in the current economy, where knowledge, its related elements and their total use influence the results achieved by a company [Firlej, Palimąka, Mierzejewski 2016, pp. 190-209]. Owing to the proper management of intellectual capital, it may be possible to significantly influence a company's success in implementing the adopted strategies.

The role of human capital in the development of the food industry – theoretical aspects

The food industry plays a number of roles in a market economy, among the most important should be listed: production, responsible for producing and processing products; a social function, creating jobs, the development of production techniques and improving living conditions; a spatial function that facilitates the development of cities, accelerates urbanisation processes and influences all kinds of transformations in the environment; an economic function, that is de facto the most important for entrepreneurs and fulfilled by the production of various goods [Firlej 2017, p. 13]. The social function of industry takes the main role in human capital development and this function is reflected not only in the development of production technologies but also contributes to the improvement of living standards and is responsible for providing decent jobs. Especially in the food industry, this function is performed and strengthened by innovative business activities that are often connected with people's qualifications and the proper organisation of work. Carrying out this function also means creating jobs for local people. The second function in the development of human capital is the production function, which determines the production capacity of a business, and so the theoretical production volume possible within a defined time with a fixed amount and structure of investments. A production method is usually defined by the general structure of the inputs, which includes human resources.

In the period of transformation, businesses functioning not only in the food industry but in the economy as a whole, invested a lot in development and strengthening the human capital they possessed, and it became a basis for the economic upturn in Poland (fig. 1). Investment outlays on the manufacture of food products and beverages in Poland increased year on year (between 2016 and 2011 by 40.88%).

Fig. 1. Investment outlays in the manufacture of food products and beverages in Poland in the years 2011-2016 (at constant 2011 prices)



Source: own studies based on the Central Statistical Office (GUS).

J. Czapiński emphasises that '… human capital involves individual competitiveness based on intellectual, motivational and symbolic resources (e.g. prestige) and the indexes of these resources may include: education, job experience, migration and – less frequently taken into account – skills [Hause 1972, pp. 108-138], physical health [McDonald, Roberts 2002, pp. 271-276; Mushkin 1962, pp. 129-157] and, completely ignored, mental well-being [Luthans, Luthans, Luthans 2004, pp. 45-50]. In the literature concerning this subject human capital was also defined as a resource useful in achieving the economic aims of an organisation, conditioning economic success, which in the global economy determines the market power of enterprises [Czapiński 2008, pp. 5-7]. In the Polish literature, the definition by Domański is most often quoted, that human capital is a resource of knowledge, skills, health, strength and a person's vital energy [Domański 1993, pp. 35]. B. Wawrzykowski sees human capital as a resource composed of the skills, knowledge, health and energy of an employee determining their abilities to learn, work and create new values, as well as their ability to adapt to changes and, at the same time, to anticipate and taking advantage of the opportunities that appear. Thus, it is a set of inherent qualities of a given employee that only they possess, it is a personal resource that may be used to fulfil their needs, or implement company's aims [Wyrzykowska 2008, p. 163]. The development of human capital directly influences the growth of modern technologies through research and inventions, as well as being a proper response to changes in the market, with the absorption of innovations which continually appear. This evolution most often takes place due to the employees themselves, who try to perform many transformations, being the de facto creators of innovations and the initiators of modernisation in their enterprises. As R. Urban [Urban 2014, pp. 2-6] emphasises, one of the main opportunities for the development of the food industry is the development of qualitative and innovative advantages. In addition, he notes that the development of human labour and human capital is fast, therefore increasing the productivity and effectiveness of management should be supported by productive capital.

Aim and methodology of the study

For the purposes of this study, in the first stage of the research, food industry enterprises functioning in Poland in the years 2005-2014 were considered as a population, namely those enterprises defined in accordance with the Polish Classification of Businesses Code (PKD 2007) in Section C Industrial processing, Division 10 Manufacture of food products, Division 11 Manufacture of beverages and Division 12 Manufacture of tobacco products. As a random frame, that is a consolidated list of units of the analysed population, the list of enterprises included in the information on national economic entities in the REGON statistical number register determined by the Central Statistical Office (GUS) for 32.12.2015 was adopted.

In order to obtain a representative sample of population units a probabilistic (random) technique of sampling was applied. Within the random technique of sampling, stratified sampling was used. A stratified characteristic in the conducted study was the number of economic entities (food industry enterprises) belonging to the following divisions of Section C Industrial processing, namely Division 10 Manufacture of food products, Division 11 Manufacture of beverages and Division 12 Manufacture of tobacco products (table 1)[1].

[1] Miesięczna informacja o podmiotach gospodarki narodowej w rejestrze REGON, http://bip.stat.gov.pl/dzialalnosc-statystyki-publicznej/rejestr-regon/liczba-podmiotow-w-rejestrze-regon-tablice/miesieczna-informacja-o-podmiotach-gospodarki-narodowej-w-rejestrze-regon/; dostęp 18.01.2015.

Table 1. The number of food industry enterprises in Poland (state as of 31.12.2015)

Section C Industrial processing	Number of entities
Division 10 Manufacture of food products	33 514
Division 11 Manufacture of beverages	1 841
Division 12 Manufacture of tobacco products	81
In total	35 436

Source: own studies based on monthly information on national economic entities in the REGON statistical number register.

During the calculations, the necessary minimum sample size was identified as 267 units (food industry enterprises). Within this number, the necessary number of units in the individual strata was determined:

Division 10 Manufacture of food products – 252 enterprises;

Division 11 Manufacture of beverages – 14 enterprises;

Division 12 Manufacture of tobacco products – 1 enterprise.

The available national and international literature was used in the study, as well as source data from the national and regional Central Statistical Office; the data of the international statistics EUROSTAT and the European Commission, the given trades (The Polish Chamber of Commerce (KIG) Food industry, 'Food industry'), studies and publications of the government administration bodies (the Ministry of Agriculture and Rural Development), publications of economic and business press and trade portals.

As a main research tool, questionnaires were used that concerned the functioning of the food industry and were conducted in the period from the beginning of March to the end of 2016 on a group of 438 enterprises. The coverage of the studies included external and internal factors that limit the functioning of these enterprises in all trades. The structure of the questionnaire provided both broad and detailed data on the studied entities. The statistical part of the questionnaire included the characteristics of the companies during the studied period, their sizes and range of activities, as well as their ownership structure and the organisational and legal forms, and the trade area in which the given entity operated. Most questions gave not only an opportunity to describe the environment of the analysed enterprises, but also effectively specify the degree to which economic processes influence them, and identify challenges for the immediate future. The questions concerned many aspects of the functioning of enterprises, such as financial, legal, organisational, marketing and strategic.

The second stage of the study was conducted in 2018 and concerned research into human capital in the period 2011-2016. In spite of having non-material character, in the process of evaluation of management effectiveness of human capital, financial indexes were also considered, since they are perceived as effective and commonly used instruments for measurement of the trend. Monitoring of ongoing phenomena to a large extent enables us to perceive the changes that took place in a given research area, being at the same time a good source for formulating forecasts. The appropriateness of using indices is based on a complex process of good index construction by rethinking its definition, considering all kinds of variables, the relations occurring between them and analyses showing their suitability in an economic practice. Consequently, the effectiveness of expenditure on human resources was prepared in accordance with the measures of human resources function developed by Fitz-Enza [Fitz-Enz, 2001] and these are used to present the increase of the role of human capital in the food industry enterprises. The study is focused on five indices:

- HCR (*Human Capital Revenue*). This is the main index of human productivity and indicates the amount of time allocated to achieve a specific amount of income. It takes into consideration the total number of working hours invested in generating given revenue.

(1) HCR = sales revenue/ the number of employees per FTE

- Profit per FTE (*Profit per Full Time Equivalent*). This index presents what amount of profit on sales is generated by an individual employee. Sales revenue is corrected by its tax-deductible costs.

(2) Profit per FTE = profit on sales/ the number of employees per FTE

- Pre tax & interest profit per FTE (*Pre tax & interest profit per Full Time Equivalent*). This is an improved version of Profit per FTE index. It allows us to indicate actual productivity of human capital taking into account profit before deductions.

(3) Pre tax & interest profit per FTE = gross profit/ the number of employees per FTE

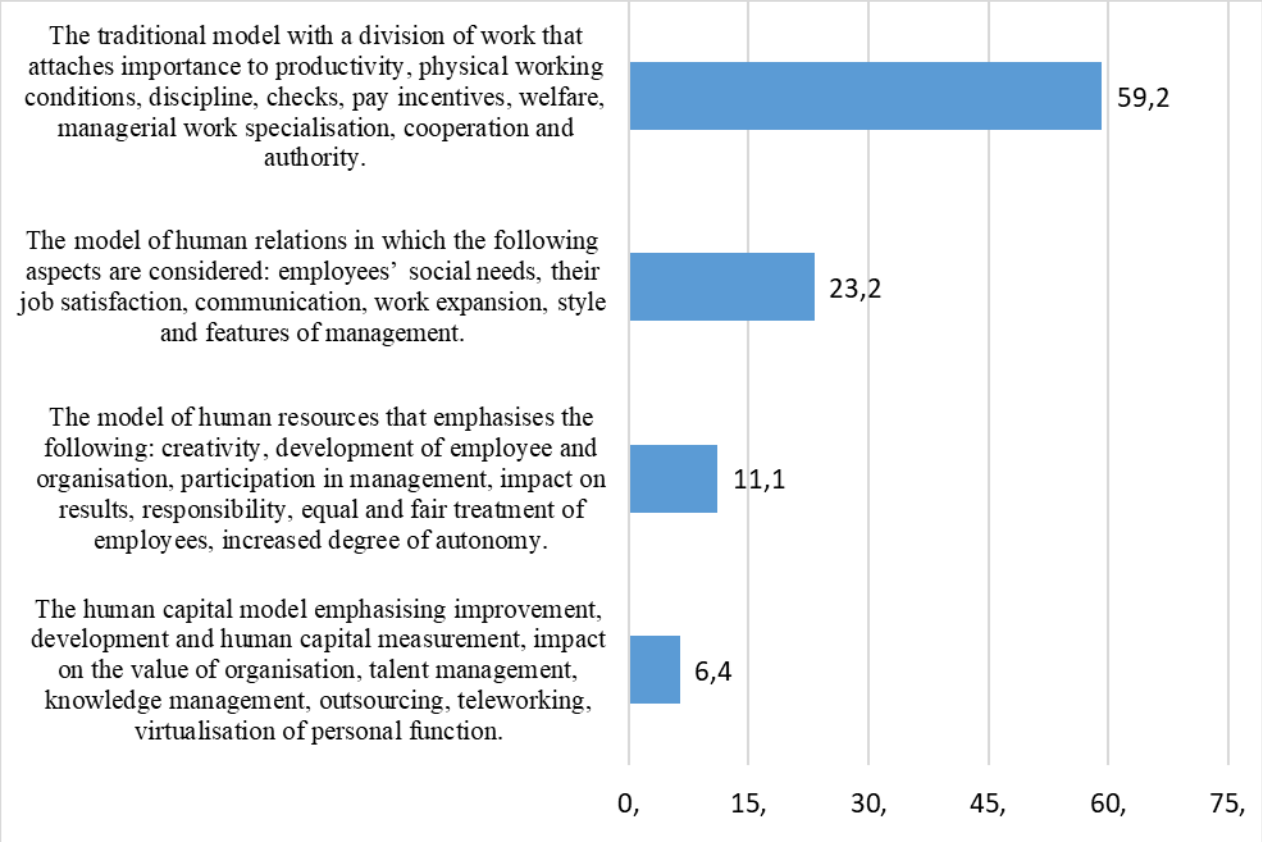
- The relation between capital input (expressed as the gross value of fixed assets in the manufacture of food products and beverages in Poland (at constant 2011 prices)) to labour input (expressed as the number of people employed in the production of food and drinks).
- Work efficiency dynamics measured by gross value added per employee. This index allows us to identify the amount and economic value added per work unit.

Study results

The questionnaire on food industry enterprises enabled us to assess the level of awareness of a company's mission statement by management and employees. The results of the study indicated an over 82%, very good company's mission statement awareness by management, and a good degree of awareness, of 62%,by employees. The group that was not aware of the company's mission statement amounted to 3.5% in the case of management and 7.1% in the case of employees. Analysing the results concerning the classification of the essential elements of the company's mission statement by employees, it was stated that they were recognised as an essential area of business specialisation at a level of 24.9%, and regarding responsibility, sensitivity to the needs and requirements of stakeholders, and priorities in their realisation at a level of 24.2%. After that, they were indicated in descending order as standards of success and a measure of long-term functioning in the finance, market and marketing area (23%), as key competences, skills and technologies necessary for success (18.4%) and as a vision of organisation seen as a system of hierarchies in the business, culture, tradition and internal folklore (17.7%). The study results showed that, in spite of the different perceptions of the essential elements of a company's mission statement by employees, they appear to have the characteristics of a professional approach to its realisation as a whole, and engenders optimism concerning pro-developmental issues of units.

Considering the role and importance of human capital in the food industry, the respondents were asked to define the model of personal functioning used in their company (fig. 2). It turned out that the most important, and at the same time the most useful element in the practical functioning of a company was the traditional model, in which employees pay most attention to such categories as division of work, work productivity, physical working conditions, discipline, control, pay incentives, welfare, managerial work specialisation, cooperation and authority (59.2%). Second, the model of human relations was indicated, in which employees' social needs were considered as well as their job satisfaction, communication, work expansion, management style and features (23.2%), and third, the model of human resources, that emphasises the following: creativity, development of employee and organisation, participation in management, impact on results, responsibility, equal and fair treatment of employees, increased degree of autonomy, system organisation and personal activities (11.1%).

Fig. 2. Classification of the main models of personal functioning used in food industry enterprises in the years 2005-2014 (in percents)



Source: own studies.

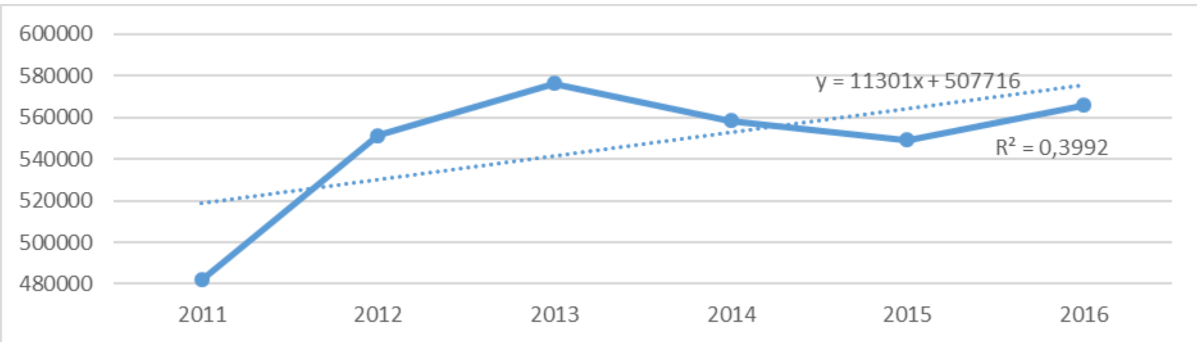
The least popular was the human capital model emphasising improvement, development and human capital measurement, impact on the value of an organisation, talent management, knowledge management, outsourcing, teleworking, virtualisation of personal function, social responsibility of an enterprise, leadership, internationalisation, use of information technologies (6.4%). The study results show that not only technology, but also identical managerial skills are necessary and required in all sectors of economy [Stonehouse, Hamill and others 2001, p. 177. On the basis of these results, it may be concluded that the entrepreneurs functioning in the food industry apply very pragmatic solutions in their enterprises regarding the realisation of personal functioning, as well as a common sense and considered approach in the implementation of planned activities and development in the achievement of goals set.

In the second stage of the study, which concerned the evaluation of the effectiveness of the human capital possessed through the effectiveness of management the following indices were used: HCR, Profit per FTE, Pre tax & interest profit per FTE, the relation of capital input to labour input for manufacturing food products and beverages in Poland and the level of work efficiency dynamics measured by gross value added per employee in the manufacturing of food products and beverages in Poland.

The starting point is to present the trends in the number of people employed in the manufacture of food products and beverages (fig. 3). In the years 2011-2012, there was a decrease in the total number of people employed in the manufacture of food products and beverages in Poland (a decrease of 2,500 people between 2012 and 2011). In the following years, a steady increase was recorded until 2016 (up to a total of 414,300 people). Over the analysed period, the number of people employed in the food industry increased by 3.86%.

Between 2011 and 2016 the HCR index increased by 17.41% in enterprises manufacturing food products and beverages (fig. 4). The rising tendency over these years shows the increase in the level of productivity of human capital, and the process of the food industry adapting to the requirements of competition. In 2014 and 2015, a decrease in value was recorded (respectively by 3.1% and 1.7%), mainly caused by the decreasing level of sales revenuesgenerated.

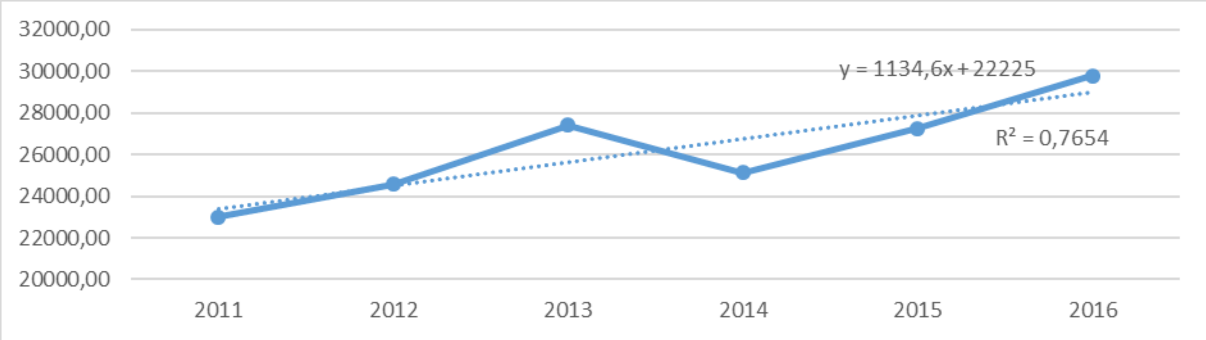
Fig. 4. HCR index for the manufacture of food products and beverages in Poland in the years 2011-2016 (at constant 2011 prices)



Source: own studies based on the Central Statistical Office (GUS).

In the later years, profits from sales in relation to the number of employees per FTE maintained an upward trend (fig. 5). In 2016, one employee of an enterprise manufacturing food products and beverages generated a profit on sales amounting to 29,788.97 PLN (the value of this index increased compared to 2015 by 9.26%, and compared to 2011 by 29.49%). The upward trend mainly resulted from sales revenues growing year by year. A decrease in value took place only in 2014, when, despite an increase of employment in the manufacture of food products and beverages (of 1.95%) profits from sales were more dynamic (a decrease in value between 2014 and 2013 of 6.49%).

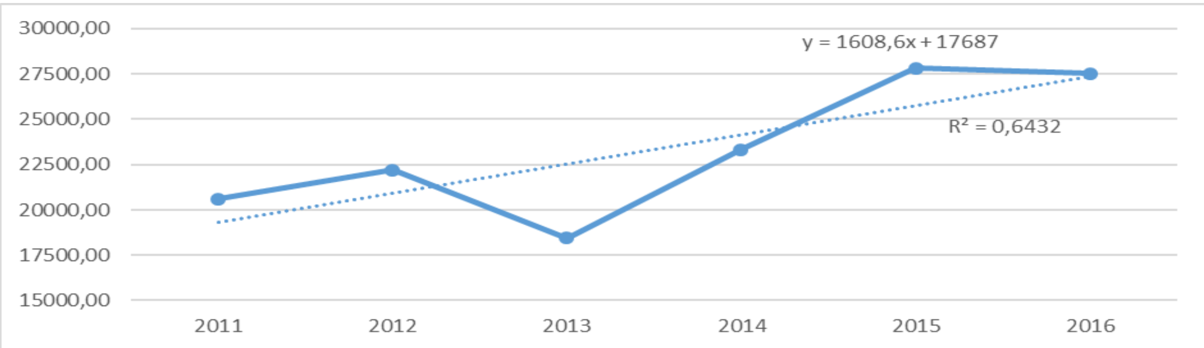
Fig. 5. Profit per FTE index for the manufacture of food products and beverages in Poland in the years 2011-2016 (at constant 2011 prices)



Source: own studies based on the Central Statistical Office (GUS).

As presented in figure 6, gross profit, that is profits not taking into account the part designated for tax and other obligatory payments, per employee in enterprises dealing with the manufacture of food products and beverages in 2016 amounted to 27,513.48 PLN (a slight decrease of 1.14% compared to 2015). The average value of the index in the years 2011-2016 amounted to 23,317.23 PLN (with relative standard error amounting to 3,752.54 PLN) and the actual productivity of human capital between 2011 and 2016 increased by 33,55%.

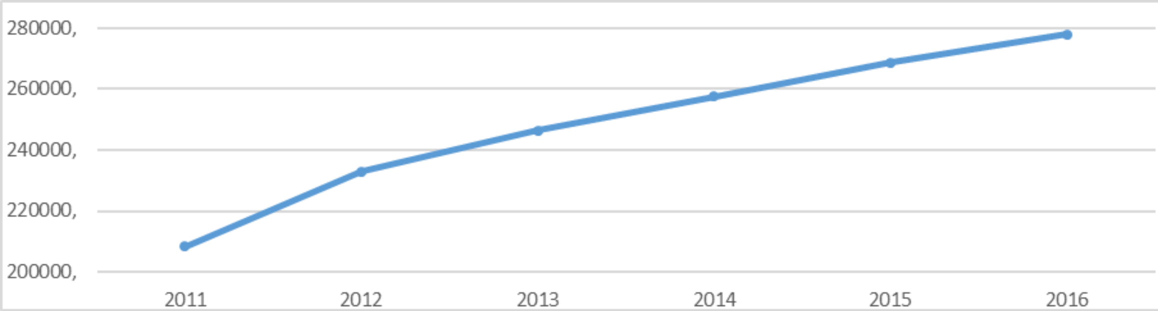
Fig. 6. Profits pre-tax & interest per FTE index for the manufacture of food products and beverages in Poland for the years 2011-2016 (at constant 2011 prices)



Source: own studies based on the Central Statistical Office (GUS).

Another important aspect is presenting the relation of capital to labour input (fig. 7). Also in this aspect, a growing tendency is visible (from 208,429.68 PLN per employee in 2011 to 277,920.57 PLN per employee in 2016). Between 2011 and 2016, the index increased by 33.34%.

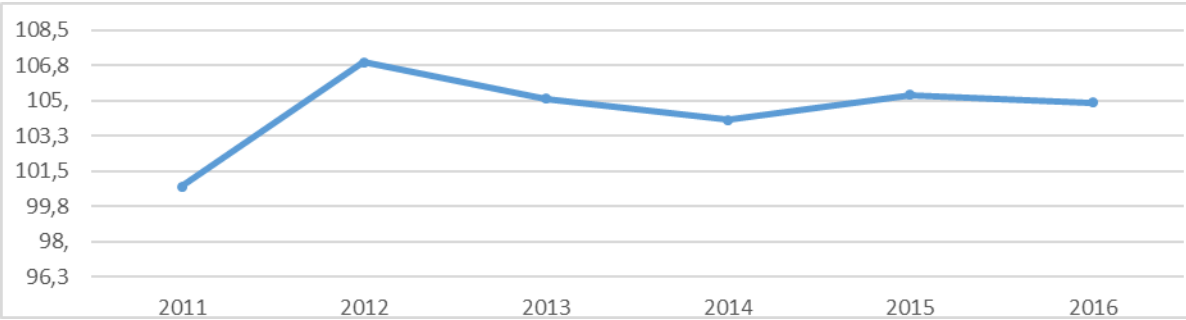
Fig. 7. Gross value of fixed assets in relations to total number of people employed in the manufacture of food products and beverages in Poland in the years 2011-2016 (at constant 2011 prices)



Source: own studies based on the Central Statistical Office (GUS).

In each of studied years, the value of the index of gross value added per employee in enterprises dealing with the manufacture of food products and beverages increased (fig. 8). The average level of increase in the years 2011-2016 amounted to 4.5%. This means that during the studied years the effectiveness of employees manufacturing food products and beverages increased, as well as global production corrected by the value of intermediate consumption generated by a single employee.

Fig. 8. Work efficiency dynamics measured by gross value added per employee for the manufacture of food products and beverages in Poland in the years 2011-2016



Source: own studies based on the Central Statistical Office (GUS).

The results of these studies show that the main index of human productivity HCR in enterprises dealing with the manufacture of food products and beverages between 2011 and 2016 increased significantly. This is a clear signal showing the increase in the level of the human capital productivity and the practical confirmation of the process of the adaptation of the food industry to the requirements of competition. The impact of human capital on the development of food industry companies should also be positively defined, as shown by the significant growth in profits obtained from sales by the enterprises studied in relation to the number of employees, which took place in the case of the FTE. A very good result was achieved on the level of human capital productivity between 2011 and 2016, increasing by almost a third, after the calculation the of index of Profits pre-tax & interest per FTE for the manufacture of food products and beverages in Poland. The value of gross value added also increased per employee, which means an improvement in the effectiveness of employees dealing with this kind of manufacturing.

Conclusions

Taking into consideration the top-down assumption that the human capital plays one of the most important roles in the process of the development of the modern job market in the food industry, and is closely connected with human capital, the study attempted to show that an improvement in its value strengthens the financial results achieved by enterprises. The source search conducted, as well as the analytical studies performed, indicate several reflections and conclusions.

1. The success of the food industry results from the increase in labour productivity, the inflow of capital, investments in development, increasing concentration of production and the implementation of new technologies and innovations.
2. In the studied enterprises the level of use of human resources varied over the years (the coefficient of variation is 95,7%), which shows that the production capital of food industry companies was not always fully utilised, due to high costs of work, production and energy, as well as competitors' activities.
3. It has been stated that the majority of management staff and employees in food industry enterprises present a good degree of awareness of their companies' mission statements, which enables their goals to be achieved.
4. The entrepreneurs studied used pragmatic solutions during the realisation of personal functioning, as well as a common sense approach to the implementation of planned activities.
5. The increasing productivity indices between 2011 and 2016 are one of the determinants of an increase in the role of human capital, which enables an increase in quality of work and increasing abilities to generate profits for an enterprise.

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Subsidising sustainability by farming types in Poland in the years 2004-2015

Marta Guth
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-9332-1193, e-mail: marta.guth@ue.poznan.pl
Katarzyna Smędzik-Ambroży
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-5228-2263, e-mail: katarzyna.smedzik@ue.poznan.pl

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Abstract: The common agricultural policy of the EU aims to stimulate the sustainable development of agriculture regardless of the types of agricultural production. The aim of the study was to determine whether there are significant differences between supporting farms of various production types in Poland with subsidies from the Common Agricultural Policy of the EU, stimulating sustainable development in 2004-2015. The research was based on FADN farm data. As a result, it was proved that subsidies from CAP contributed the most to increasing the sustainability in the environmental dimension of farms specialising in animal husbandry using grazing, and the smallest – of farms specialising in field crops and granivores. It has been proved that in agriculture in Poland there is a positive effect of single area payments for balancing agriculture in its economic dimension, regardless of the production types of farms existing in a given area. In addition, it can be concluded that subsidies from CAP in 2009-2015 stimulated the sustainability of agriculture in the economic order at the expense of its sustainability in the environmental order.

Keywords: Common Agricultural Policy, CAP, subsidies, sustainable development, FADN

JEL: E02, H23, Q12, Q18

Introduction

The influence of agricultural policy on the development of agriculture results from the concept of induced agricultural development formulated by Y. Hayami and V.W. Ruttan (1985). According to them, agriculture generates too weak internal forces to trigger the growth process and keep it in a state of dynamic equilibrium. Therefore, development requires impulses from outside, or else exogenous stimuli [Hayami, Ruttan 1985]. Agricultural policy plays the role of such a stimulator. It also results in the possibility of this policy to influence the type of progress made in agriculture. It can be extensive (based on increasing the involvement and durability of production factors) or intensive (increase the productivity of production endowments). In agriculture, intensification is associated with the industrial (conventional) model of agriculture, which operated from the end of World War II up to the first oil crisis [Zegar et. al. 2014, p. 198-199, 203]. The intensification of production in agriculture was influenced by the instruments of the Common Agricultural Policy of the EU, which since the inception of the MacSharry reform was of a pro-supply nature, stimulating increases in agricultural productivity which resulted from the pursuit of ensuring EU food self sufficiency [Ruttan 2005, pp. 65-99]. In relation to this, it can be said that the instruments of this policy directed the development of European agriculture along the "paths" of production intensification [Judzińska, Łopaciuk, 2011, pp. 26-30, Brouwer, Lowe 2000]. This resulted in the overproduction of agriculture in the EU, at the expense of reducing the quality of its natural resources [Fiedor 2004]. This underlined the necessity of reforming the Common Agricultural Policy towards instruments supporting sustainable development [Czyżewski B., Matuszczak 2013, p. 229]. The basic claim of the concept of sustainable development is the conviction that it is necessary to maintain a balance (sustainability) in the three elements of the macrosystem, i.e. the economy, the environment and the social system [Harris, Goodwin 2001].

The concept of sustainable development is present in various strategic documents of international, national, regional and local scope [Borys 2011, p. 76]. Already in 1997, sustainable development became a basic challenge for the EU and was included in the Treaty of Amsterdam as the overarching objective of EU policy [European Commission 1997, pp. 7 and 24]. With regard to agriculture, the concept of sustainable development assumes simultaneously striving to improve the living conditions of the population and to conduct agricultural activity, while not harming the specific resources of villages, such as the natural environment, landscape and cultural heritage [Żmija 2014, pp. 150-151]. The beginning of the process of reforming the Common Agricultural Policy to stimulate sustainable development in agriculture dates back to 1992, when it became a policy for demand. All subsequent reforms and changes in CAP, introduced after 1992, were a continuation of the ideas included in the MacSharry reform [Poczta et. al. 2007, Poczta 2010, p. 39].

It can therefore be said that only subsidies from CAP whose value depends on the volume of production, i.e. the subsidies for crop or animal production, as well as subsidies to intermediate consumption and to the costs of external factors, stimulate increases in farm productivity. However, these are gradually being phased out [Marcinkowski, Narojczyk, Stępień 2011, p. 83], which means that EU agricultural policy is becoming a policy supporting sustainable development of agriculture. Subsidies from EU agricultural policy: to less-favoured areas (LFA), agri-environmental areas, set-aside and other subsidies for rural development increase the quality of the natural capital of rural areas because farmers receive them for carrying out specific practices for the natural environment. On the other hand, decoupled payments, i.e. single farm payments (EU-15 plus Malta and Slovenia) or single area payments

(EU-12 countries without Malta and Slovenia), due to the lack of dependence between their value and production volume, and their positive impact on the incomes of EU farmers stimulate an increase in the economic and social sustainability of European agriculture. To the best of our knowledge, however, there is no literature stating that the CAP aims to stimulate the sustainable development of agriculture, regardless of the types of production farms. Therefore, the study aims to investigate whether there are significant differences between supporting farms of different types in Poland, with subsidies from the Common Agricultural Policy, stimulating sustainable development in 2004-2015.

Methodology

The accounting data from FADN (Farm Accountancy Data Network) representative farms from Poland was used. FADN accounting is a farm accountancy data network that requires access to income data obtained from different types of farms and their production results. The obligation to create such a network has been imposed on every country in the European Union. It is used for the evaluation and programming of the Common Agricultural Policy. The data obtained form the basis for the Commission's reports on the situation in agriculture and on individual agricultural markets. Annual reports are submitted to the Council and the European Parliament and are analysed within the system, serving the annual determination of farm incomes operating within the EU, analysis of agricultural activity and the impact assessment of proposed changes concerning European Union agriculture [Gazda 2014]. The division of farms into production types according to this methodology was applied. In it, the following production types of farms were distinguished, specialising in: field crops, horticulture, other permanent crops, milk, other grazing livestock, granivorous animals and combinations of different types of plant and animal production (mixed). Then, using this division, the shares of subsidies supporting the tasks included in the concept of sustainable development in the total value of subsidies for particular types of farms were calculated. These payments were divided into two groups. The first of these included subsidies for the implementation of tasks favourably affecting the quality of the natural environment of rural areas, and thus positively affecting the environmental order. The following types of subsidies belonged to this group: to less-favoured areas (LFA), agri-environmental, set-aside and other subsidies for the development of rural areas. The second group was the values of single area payments. Decoupled payments in Poland, i.e. single area payments, have a positive impact on farm incomes, which stimulates both the economic and social order of agriculture. Then, in order to determine the statistical significance of differences in average values of these shares in the period 2004-2015 between the analysed types of farms and holdings of other production types, t-test was applied, as it is a suitable tool to determine statistical differences between average values [Stanisz 2006]. The time range covered the years 2004-2015, the representative – FADN representative farms according to their production types and spatial dimension concerns Poland.

Results and discussion

The highest average share of subsidies for tasks favouring sustainability in the environmental order in the total value of subsidies obtained in the years 2004-2015 was found in farms specialising in animal husbandry using grazing (29.3%). Second place in this respect was occupied by farms specialising in permanent crops (23.6%). Table 1 shows that farms with these types of production find it easiest to meet the requirements of agro-environmental programmes, therefore the share of subsidies is the highest for tasks that positively affect the sustainable development of rural areas with a predominance of these production types. On the contrary, in farms specialising in the cultivation of granivorous animals and in field crops, the share of these subsidies in 2004-2015were the lowest. These were, respectively, in farms specialising in granivores – 16.5% and in farms specialising in field crops – 13.9%.

Table 1. Average values of share of subsidies (per cent)

Years	Field crops	Horticulture	Other permanent crops	Milk	Grazing livestock	Granivores	Mixed	Average
2004	0.9	1.5	0.7	2.4	4.3	1.5	1.7	1.7
2005	10.5	18.7	22.6	24.0	32.9	18.2	19.7	18.4
2006	16.8	29.6	28.3	42.3	55.4	33.1	33.5	32.0
2007	17.7	30.3	36.9	24.6	34.9	23.7	26.5	24.3
2008	18.7	25.6	37.9	24.8	38.3	22.3	26.7	24.6
2009	17.7	26.4	37.4	19.4	33.3	17.5	22.1	20.6
2010	17.1	24.9	31.4	18.9	34.0	17.6	21.2	19.9
2011	15.0	7.6	26.6	18.1	30.9	14.1	19.0	17.8
2012	15.1	9.3	21.1	15.8	28.9	13.6	16.2	16.2
2013	15.5	9.3	20.7	16.1	16.1	15.5	16.6	16.7
2014	15.0	12.6	12.4	15.0	30.5	12.2	16.3	15.9
2015	6.2	6.7	7.5	8.9	12.4	8.1	8.7	7.9
Average	**13.9**	**16.9**	**23.6**	**19.2**	**29.3**	**16.5**	**19.0**	**18.0**

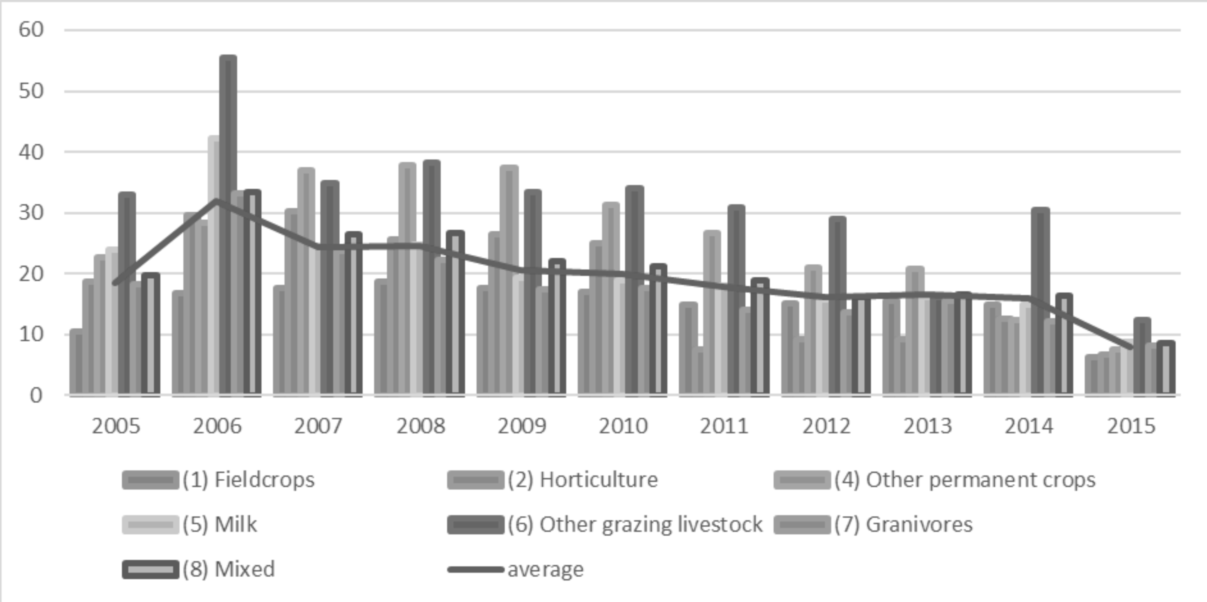
Source: own study based on FADN data.

The example of farms with granivorous animals is confirmed by T. Sobczyński's statement (2012, pp. 176-182) that the concentration of breeding of granivorous animals (pigs, poultry) creates significant environmental problems in the EU. Also J. Jankowiak, J. Bieńkowski, M. Holka (2010), in a study on farms from areas located in zones with the greatest sensitivity to nitrogen emissions to the environment, showed that the size of nitrogen surpluses in the surveyed farms depends mainly on the intensity of the organisation of agricultural production, especially including the intensity indicator of animal production organisation. By far the largest share of subsidies for tasks favourably affecting environmental sustainability in all farms in Poland occurred in 2006 (32%). Since 2008, it has been decreasing every year, on average in 2008-2015 by 2.6% annually.

The largest decrease in this share (by as much as 8%) occurred in 2015 compared to 2014 (Table 1). The annual values of share of subsidies for tasks favourably affecting environmental sustainability in the total subsidies of farms of various production types in Poland were characterised by high volatility in individual years 2004-2015. The largest spread in this area occurred in farms specialising in animal husbandry using grazing. It ranged from 4.3% in 2004 to 55.4% in 2006. The lowest differences between the value of shares and tasks favourably affecting environmental sustainability in total payments in the years 2004-2015 occurred in farms specialising in field crops (Table 1). The high volatility of the share of subsidies for tasks that favourably affect environmental sustainability in the total subsidies of farms of various production types in Poland is also confirmed in Figure 1.

By far the biggest changes in the value of share of subsidies for tasks favouring environmental sustainability in the total value of subsidies in 2005-2015 occurred in farms specialising in animal husbandry using grazing, farms specialising in permanent crops and in horticulture. In the latter type of production, the decline in the share of subsidies to tasks favourably affecting the environmental sustainability in the total amount of subsidies obtained was particularly visible in 2011 relative to 2010 (Figure 1). In addition, in Fig. 1. there is a visible decline in the share of contributions to the tasks favourably affecting environmental sustainability in total value of payments in 2005-2015 in all types of production farms. The only exception in this respect was 2006, in which the share in all types of farms increased in comparison to 2005, and 2014 in farms specialising in animal husbandry using grazing and in farms specialising in horticulture (Figure 1).

Fig. 1. The average values of share of subsidies in total of farms in percent)



Source: own study based on FADN data.

Next, the statistical significance of differences between the average value of share of subsidies for tasks favourably affecting environmental sustainability in the total amount of subsidies of farms of various production types in the years 2004-2015 was assessed Table 2).

Table 2. Statistical significance assessment of differences between average shares of subsidies for sustainability in the total value of subsidies in farms of different production types in Poland in 2004-2015

	Field crops	**Horticulture**	**Other permanent crops**	**Milk**	**Other grazing livestock**	**Granivores**	**Mixed**
Field Crops	-	0.3717	**0.0174**	0.1106	**0.0011**	0.3580	0.0851
Horticulture	0.3717	-	0.1515	0.5745	**0.0170**	0.9101	0.5784
Other permanent crops	**0.0174**	0.1515	-	0.3318	0.2817	0.0986	0.2871
Milk	0.1106	0.5745	0.3318	-	**0.0443**	0.4583	0.9628
Other grazing livestock	**0.0011**	**0.0170**	0.2817	**0.0443**	-	**0.0086**	**0.0327**
Granivores	0.3580	0.9102	0.0984	0.4582	**0.0086**	-	0.4488
Mixed	0.0851	0.5784	0.2871	0.9628	**0.03273**	0.4488	-

Source: own study based on FADN data.

Statistically significant differences between the average values of the share of subsidies for tasks favourably affecting environmental sustainability in the total values of payments obtained in the years 2004-2015 occurred in farms specialising in animal husbandry using grazing against other production types of farms, except only for farms specialised in permanent crops. These differences were also significant in the case of farms specialising in field crops and in animal husbandry using grazing. On this basis, it should be stated that the highest average share of subsidies for tasks favourably affecting environmental sustainability in the total values of payments obtained in 2005-2015 in farms specialising in animal husbandry using grazing in relation to other production types of farms was statistically significant. Certainly, through subsidies from the CAP, the sustainable development of these farms was stimulated to the greatest extent. Going further, it can be assumed that rural areas dominated by this type of farm production will show the greatest environmental sustainability of agriculture, which should favourably affect the quality of natural resources of these resources.

Table 3 compares the average values of the share of single area payments in the total subsidies of farms with specific types of production in Poland in the years 2004-2015. Differences in this regard between farms of different types of production in particular years of the period 2004-2015 did not occur (see Table 3).

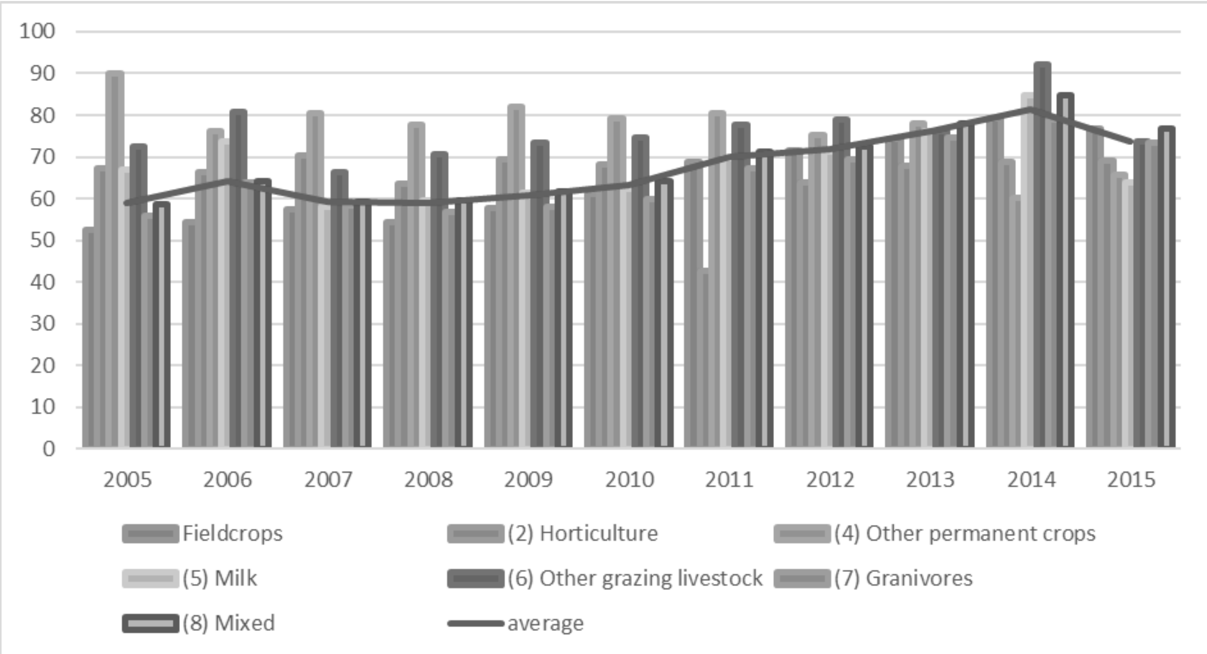
Table 3. Average values of shares of single area payments in the total value of subsidies obtained by farms of different production types in Poland in 2004-2015 (per cent)

Years	Field crops	Horticultre	Other permanent crops	Milk	Other grazing livestock	Granivores	Mixed	Average
2004	36.2	44.3	51.3	33.6	34.4	36.5	35.9	43.8
2005	41.9	48.3	67.5	43.0	39.7	37.7	39.1	48.5
2006	37.6	36.8	47.9	31.3	25.5	30.9	30.6	37.4
2007	39.7	40.0	43.4	33.4	31.5	34.5	32.8	38.9
2008	35.8	38.0	39.8	34.9	32.3	34.6	33.0	38.1
2009	40.1	43.1	44.4	42.1	40.1	40.4	39.6	41.9
2010	43.9	43.3	47.7	43.5	40.6	42.3	43.0	42.9
2011	53.9	35.0	54.0	51.5	46.8	53.1	52.3	46.9
2012	56.4	54.7	54.2	55.3	50.1	55.8	56.4	52.3
2013	59.0	58.6	57.4	60.2	53.6	59.2	61.5	55.4
2014	64.3	56.2	47.7	69.8	61.6	66.8	68.4	58.9
2015	70.3	62.3	58.2	55.0	61.4	65.2	68.1	58.1
Average	48.3	46.7	51.1	46.1	43.1	46.4	46.7	46.9

Source: own study based on FADN data.

Therefore, it should be stated that uniform area payments affect the economic balance of farms in Poland, regardless of their production type. It also shows the lack of statistically significant differences between the average values of the share of single area payments in the total value of subsidies in farms of different agricultural production types (see Table 4). In tab. 3, the systematic growth of the share of single area payments in the total value of subsidies obtained by farms of different agricultural production types is evident in 2006-2015. This increase was, on average, about 2.7% annually in these years. This is even more evident in Figure 2.

Fig. 2. The values of shares of single area payments in the total value of subsidies of farms of different production types in Poland in 2005-2015 (in percent)



Source: own study based on FADN data.

According to Figure 2, in the years 2006-2015, there was an increase in the value of shares of uniform area payments in the total subsidies of farms of all production types. A comparison of Figure 1 and Figure 2 shows that the share of subsidies for environmental sustainability in total subsidies is lower due to an increase in the share of single area payments in the total value of subsidies in Polish farms, regardless of their type of production. This allows us to state that the support of CAP for tasks that favourably affect the environmental sustainability of agriculture is being replaced by an increase in the share of single area payments in the total value of payments obtained. Therefore, the economic sustainability of agriculture in Poland should be expected to increase.

Table 4. Results of a statistical significance assessment of differences between shares of single area payments in total value of obtained subsidies for farms of different production types in Poland in 2004-2015

	Field crops	Horticultre	Other permanent crops	Milk	Other grazing livestock	Granivores	Mixed
Field crops	-	0.7264	0.4911	0.6711	0.3004	0.7195	0.7755
Horticulture	0.7264	-	0.2145	0.8961	0.4136	0.9481	0.9986
Other permanent crops	0.4911	0.2145	-	0.2435	0.0606	0.9481	0.3493
Milk	0.6711	0.8961	0.2435	-	0.5462	0.9564	0.9132
Other grazing livestock	0.3005	0.4136	0.0606	0.5462	-	0.5199	0.5026
Granivores	0.7195	0.9481	0.2869	0.9564	0.5199	-	0.9557
Mixed	0.7755	0.9986	0.3493	0.9132	0.5026	0.9557	-

Source: own study based on FADN data.

The lack of significant differences between the average values of shares of single area payments in the total value of subsidies obtained in the years 2004-2015 by farms of various production types in Poland allows us to state that CAP stimulates the sustainable development of agriculture in the economic order regardless of the type of production dominating in a given area.

Conclusions

Due to the subsidies from the EU's CAP in the years 2004-2015, the sustainable development of farms specialising in animal husbandry using grazing was stimulated the most. To the smallest extent, subsidies from CAP after Poland's accession to the EU stimulated the sustainable development of farms specialising in granivores and field crops. In particular, this concerned the environmental order of sustainable development. This was a disadvantageous phenomenon because, as shown by studies of various researchers, the concentration of rearing granivorous animals poses significant environmental problems. On this basis, it can also be concluded that rural areas with a predominance of farms specialising in animal husbandry using grazing will demonstrate the greatest environmental sustainability of agriculture. On the basis of the research conducted, it was also found that CAP stimulates the sustainable development of agriculture in the economic order regardless of the type of farms prevailing in a given area. The study also showed a reduction in the share of subsidies for tasks that favourably affect environmental sustainability in the total value of subsidies obtained across all production types of farms. Within this survey, it should be noted that this was accompanied by an increase in the share of single area payments in the total value of obtained subsidies irrespective of the type of production of the farm. Therefore, it should be concluded that in Poland, through the impact of CAP, the economic sustainability of agriculture is gaining in importance at the expense of environmental goals.

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Energy intensity in European Union countries after 2000

Michał Borychowski
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-6256-2680, e-mail: michal.borychowski@ue.poznan.pl
Radosław Stochmal
Poznan University of Economics and Business, Poland
ORCID: 0000-0001-9340-8248, e-mail: radoslaw.stochmal@gmail.com

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Abstract: The improvement of the functioning of the energy sector through increasing energy efficiency or decreasing energy intensity is a crucial challenge for all economies and their sectors. This results from the fact that the positive changes in this sector can contribute to higher economic development and improvement of economic welfare. The aim of the paper was to identify the tendencies in energy intensity in European Union countries, and their causes and effects since 2000. The hypothesis that with economic growth (measured by GDP per capita) the energy intensity of an economy decreases and energy consumption per capita falls too, was tested. Descriptive statistics methods, Pearson correlation coefficient and analysis of intensity (intensity indicators) were used in the paper. The changes in variables are presented mainly using dynamics and geometric mean indexes. The source of data is the European Commission, Eurostat and the World Bank. The hypothesis was proved in 20 countries and for the European Union as a whole. For 7 countries it was not proved (Austria, Bulgaria, Croatia, Estonia, Latvia, Lithuania, Poland). Although some medium-developed countries increased the use of energy per capita during the period from 2000-2015 (Bulgaria, Estonia, Lithuania, Poland), these countries improved their energy efficiency much more (they reduced energy intensity). Finally, the effects are positive in these countries. There is the lowest energy intensity in highly-developed countries: Ireland, Denmark, United Kingdom, France, but there were the highest nominal and real decreases of energy intensity in countries with various GDPs (different GDP per capita levels): Ireland, Slovak Republic, Romania, Czech Republic, Bulgaria, Sweden, Poland. Among the most important determinants affecting the lower energy intensity belong restructuring of the economy and structural changes, technological changes, putting more capital into research and development and improvement of energy management systems.

Keywords: energy intensity, energy use, energy consumption, GDP

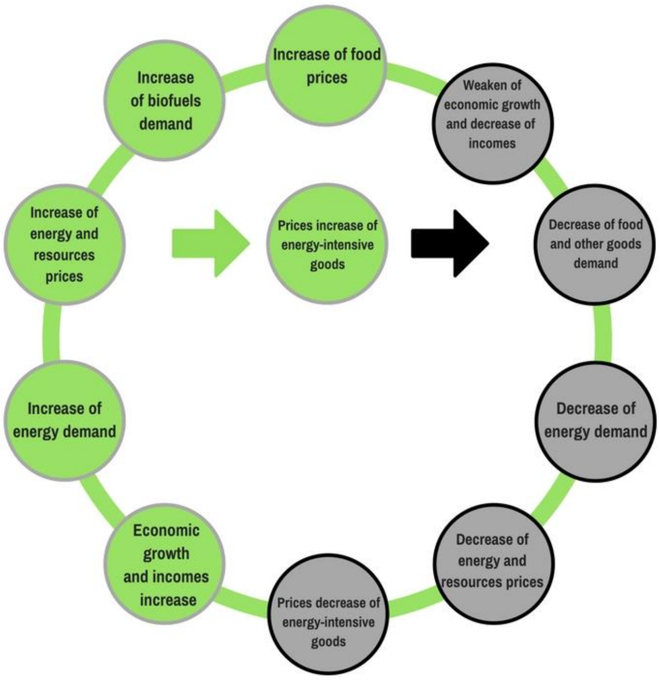
JEL: O13, Q43

Introduction

Currently economies strongly depend on energy resources (mainly crude oil, natural gas and coal) and their prices, which are determined on global markets by numerous and various factors, including economic, political and technological ones. In turn, changes in the prices of energy raw materials and energy are crucial for an economy, as their prices indirectly affect production costs, the prices of goods and services, and the competitiveness of the economy, and they also influence economic cycles, by determining their phases. This dependency becomes all the more significant and serious the more energy-intensive is the economy. As Hryszko and

Szajner point out [2013] (for Msangi, Tokgoz and Zhang 2012), the impact of energy price changes on the economic situation can be illustrated using a closed cycle (Figure 1). An increase in the prices of energy commodities and energy is accompanied by an increase in the prices of energy-intensive goods (due to higher production costs), which in turn leads to a decrease in demand for goods and services. Next, the demand for energy decreases and prices of energy commodities and energy decrease, too, assuming that significant changes do not occur on the supply side of energy raw materials and the energy market (e.g. supply shock). Prices of energy-intensive goods fall, due to the decrease in raw materials and energy prices (because production costs have fallen), which in turn contributes to increased consumer demand, and thus – economic growth [Filipović, Verbić and Radovanović 2018]. Therefore, as can be seen in the first figure described above, and as Maciejewski stresses [2017, p. 121], the low energy intensity[1] of an economy is a stimulus for its development, and therefore a reduction in energy intensity contributes to improving the efficiency of the economy [Rajbhandari and Zhang 2018].

Fig. 1. Influence of changes in prices of energy resources and energy in the business cycle



Source: Hryszko and Szajner (red.) 2013, p. 77 for: Msangi, Tokgoz and Zhang 2012.

[1] Energy intensity is measured as the amount of energy required per unit of output or activity. Similarly, energy efficiency is measured as the output per unit of energy used [U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy].

Energy intensity can be reduced, among others, by [Aydin and Esen 2018; Huang, Du and Tao 2017; Karimu et al. 2017; Tan and Lin 2018; Verbić, Filipović and Radovanović 2017; Wurlod and Noailly 2018]:

- higher efficiency of production factors;
- structural changes in the sectors of the economy, transforming energy-intensive industries;
- technological changes, technical efficiency, innovation in green technologies;
- energy-saving technology;
- capital-energy substitution;
- changes in the structure of commodities use (switch from fossil fuels to renewable energy sources);
- effective economic policy, including energy policy (energy prices, energy taxes).

Energy sector has strategic importance (as well as agriculture), because it is a commodity sector, thus changes in it have an influence on further sectors and industries of the economy. In that way, improvements in the functioning of this sector through increasing energy efficiency or decreasing energy intensity becomes a crucial challenge for an economy and its competitiveness [Choi, Park and Yu 2017]. Moreover, efficiency (the criterion of efficiency), which is the opposite of intensity, is of key importance to modern economics. It concerns the management of scarce resources (production factors including energy resources) and optimising their use for the production of goods and services [Staniszewski 2018].

According to Okun's law, every 1% over the natural rate of unemployment causes more than a 1% (about 2-3%) decrease in GDP [Okun 1962]. When we take into account the quite low unemployment rates in many European Union countries (Czech Republic 2.4%, Germany 3.5%, Hungary 3.7%, Netherlands 4.1%, UK 4.2%, Poland 4.4%, Romania 4.6% [Unemployment statistics]), it turns out that this is close to the natural rate of unemployment. In that situation there is no great potential for economic development (for GDP growth) through an increase of employment rates. There is little potential in the reduction of labour costs, in order to be more competitive in the global context, in many developing countries of the EU, as well. In this case, because of the high use of production factors, including land, labour and capital, improvement of the factors of productivity (including energy resources), organisational and technological changes and innovation seem to have the highest potential for an economy and its development. Mahmood and Ahmad [2018] stress that if Europe is able to exploit the maximum potential of energy efficiency, it will be able to gain significantly economically and environmentally over the next few decades. This can even be done on the basis of currently available technologies. Thus, the report underlines the importance of improving energy efficiency (by reducing energy intensity). It could have many benefits for the economy, society and environment [Aydin and Esen 2018].

According to Farajzadeh and Nematollahi [2018] determinants for the changing of energy intensity in developing countries are imported technologies and new devices for local firms. That situation played an important role especially in the early 2000's, as European countries opened up to other nations. Developed countries could export their energy-efficient devices to Central and Eastern European Countries like Poland, Latvia or Belarus. Another factor can be price changes. However they create a different result. According to the above-mentioned authors [Farajzadeh and Nematollahi 2018] and their literature review, there are some interesting conclusions. High energy prices are expected to lower energy intensity. Many studies focused on that issue. Barkhordari and Fattahi [2017] proved that increases in natural gas and electricity prices have both positive and negative impacts on energy intensity. A policy of increasing energy prices will result in increased consumption of gas which in the long term causes a decrease in energy intensity. People will change their main energy source for a more efficient one. Gas has proved to be more caloric, and much better in terms of calories-to-price ratio than coal. However, there are some contradictory opinions and research about it. Fisher-Vanden et al. [2004] created firm-level data in China. Their results are: an increase in the relative price of various energy prices causes an increase of energy intensity. On the other hand, Song and Zheng [2012] completed provincial-level data. They showed that there is only a weak positive effect between energy prices and energy intensity. Their conclusions were supported by Yang et al. [2016] who also revealed the same evidence. Farajzadeh and Nematollahi [2018] after research in Iran, concluded that one of main indicators lowering energy intensity is urbanisation and high capital-labour ratio. When capital accumulation occurs and the output mix is unchanged, we can expect higher incomes, which lead to higher energy intensity by lowering energy efficiency. As a country develops, more urbanised territories should be created. In urban area energy intensity decreases, because transfer can be more efficient. According to Farajzadeh, Zhu and Bakhshoodeh [2017], there is high potential at household level. Developing technologies become more efficient and do not need as much energy as old ones. Introducing them can result in a positive effect in terms of lowering energy intensity. According to Dong et al. [2018] we can look for a resolution to energy intensity problems in research and development investment when it comes to China. This conclusion has been repeated many times in other economic publications. Furthermore, the authors proved that urbanisation has a beneficial influence on energy intensity (decrease). That conclusion varies when we compare household, urban or national level. The researchers mentioned point out that the most important factor determining energy intensity and conservation of energy is economic structure (especially the structure of industry). A highly developed heavy industry sector will cause higher energy consumption. According to the paper by Liu et al. [2018] reducing the proportion of state-owned firms and increasing the amount of non-public enterprises in the heaviest industrial sectors can lower energy intensity. This will promote energy savings, ecological businesses and lower emissions. In addition, an increase in industrial concentration and integration of energy resources can reduce the energy intensity of heavy industry.

The importance of the energy intensity reduction is one of the main purposes of energy policy in the EU. The 2020 package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020. The package sets three key targets (the 3x20% package[2]): (1) a 20% cut in greenhouse gas emissions (from 1990 levels); (2) 20% of EU energy from renewables and a 10% share of renewables in the transport sector; (3) 20% improvement in energy efficiency. The most important benefits of achieving the goals of the 2020 package should be an increase in the EU's energy security – reducing dependence on imported energy and contributing to achieving a European Energy Union and create jobs, advance green growth and make Europe more competitive [2020 climate & energy package]. In turn, the 2030 climate and energy framework sets three key targets for the year 2030: (1) at least 40% cuts in greenhouse gas emissions (from 1990 levels); (2) at least a 27% share for renewable energy; (3) at least 27% improvement in energy efficiency [2030 climate & energy framework]. The long-term plans (for 2050) are as follows – the low-carbon economy roadmap suggests that by 2050 the EU should cut greenhouse gas emissions to 80% below 1990 levels [2050 low-carbon economy]. These assumptions are reflected in documents at national level – in EU countries, for example in Poland, where the climate and energy goal are formulated in the Polish Energy Policy until 2030 and Polish Energy Policy till 2050 or in the Czech Republic – National Climate Change Plan / Climate Protection Policy [International Energy Agency[3]].

Material and methods

The aim of the paper was to identify the tendencies in energy intensity in European Union countries, and their causes and effects. The focus is on the energy intensity viewed as the ratio between energy use and gross value added. It is hypothesised that with the economic growth of a country, the energy intensity of its economy decreases and energy consumption per

[2] The national targets under the 2020 climate & energy package: see Eurostat, Europe 2020 indicators.
[3] For crucial documents in countries – see the database of International Energy Agency.

capita falls, too. Such a hypothesis results from the fact that more developed EU countries (this development is measured using GDP per capita) are usually more efficient in the use of factors of production, including energy resources. As a result, these countries have lower energy intensity and higher energy efficiency. Therefore, as GDP per capita increases in EU countries, energy intensity should decrease. As regards energy consumption – it was assumed that energy consumption per capita is decreasing because of the fact that currently electronic devices are becoming more energy efficient (they use less energy).

According to the climate and energy package in some EU countries (mainly new member states) CO_2 emissions can increase, as the aim of 20% is overall and obligates the EU as a whole. These rising greenhouse gas emissions are directly connected with the increase of energy use, and this should be a consequence of economic growth and increased consumption of goods and services. In these cases, an improvement in energy intensity becomes an important challenge in order to meet the growing needs in those societies, and to face the problem of limited energy resources. At the same time, as it was mentioned, energy commodities and energy are necessary for economic growth (figure). The general formula for energy intensity is the ratio of energy use to gross value added (or Gross Domestic Product). In this paper, energy intensity is measured as the ratio of final energy consumption [in toe[4]] to gross value added [in 1 million USD in constant prices 2010].

$$Energy\ intensity = \frac{\text{final energy consumption [toe]}}{\text{gross added value [1 } M\text{\$2010]}}$$

According to Eurostat's methodology[5] final energy consumption is the total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself [Eurostat, Statistics Explained, Glossary: Final energy consumption]. It is assumed in this paper that energy consumption includes final energy use (consumption) in agriculture, industry, services, transport and others[6] – thus, it is the use in production sectors of the economy. Therefore, the use of energy in residential[7] households was omitted. This was done in order to get a common structure – in gross added value in the economy, and in final energy

[4] toe = Tonne(s) of oil equivalent, is a normalised unit of energy. By convention it is equivalent to the approximate amount of energy that can be extracted from one tonne of crude oil. It is a standardised unit, assigned a net calorific value of 41 868 kilojoules/kg and may be used to compare the energy from different sources [Eurostat, Statistics Explained, Glossary: Tonnes of oil equivalent (toe)].

[5] There are more indicators on energy use on the macroeconomic level, i.e. gross inland consumption, primary energy consumption – see more: Eurostat, Statistics Explained.

[6] Services, transport and other are counted together as a service sector.

[7] In 2015 it amounted, depending on the country, to 19-36% of total final energy consumption [European Commission].

consumption by individual sectors. For the hypothesis there are two variables used: (1) economic growth, which is measured as the changes in Gross Domestic Product (GDP) per capita at 2010 USD constant prices and (2) energy use per capita – in kg of oil equivalent, which is calculated as gross inland energy consumption[8] per capita. Data on GDP and gross value added are in constant prices (USD) from 2010, thus the impact of inflation was eliminated. In the paper the term "medium-developed" countries of the EU is used – this refers to the European Union's average level of GDP, and to the best countries in this area (with the highest income per capita). It does not concern third world countries (developing countries all over the world). Thus, medium-developed countries are, for example, Poland, Czech Republic, Slovak Republic or the Baltic states. The research period is 2000-2015 and all European Union countries are analysed (except Malta – because of a lack of data). Descriptive statistics methods, Pearson correlation coefficient and analysis of intensity (intensity indicators) were used in the paper. The changes in variables are presented mainly using dynamics and geometric mean[9] indexes. The source of data is the European Commission and Eurostat – mainly data on energy use (by sector – agriculture and fishing, industry, services, transport, residential, others) and the World Bank – data on gross value added (in agriculture, industry, services and total), Gross Domestic Product (per capita, constant prices 2010 USD) and energy use (per capita). Calculations were made using MS Office Excel and Statistica.

Results and discussion

In 2000, the highest energy intensity was in new member states (those that acceded to the EU in 2004 or 2007): Bulgaria (about 250 toe/1 million USD), Slovak Republic (170), Romania (150), Czech Republic, Latvia, Poland (over 130). On the other hand, the lowest level of energy intensity was in 2000 in Denmark (41 toe/1 million USD), Italy, France, Germany, Ireland – about 52-57 toe/1 million USD, i.e. primarily in the high-developed countries of the European Union (table 1). The situation did not change much in 2015. There is low energy intensity in rich countries, however, some countries changed places – Ireland (under 30 toe/1 million USD), Denmark (33), United Kingdom (39) and France (42 toe). The highest level

[8] Gross inland energy consumption, sometimes abbreviated as gross inland consumption, is the total energy demand of a country or region. It represents the quantity of energy necessary to satisfy the inland consumption of the geographical entity under consideration. Gross inland energy consumption covers: (a) consumption by the energy sector itself; (b) distribution and transformation losses; (c) final energy consumption by end users; (d) statistical differences (not already captured in the figures on primary energy consumption and final energy consumption). See Eurostat, Statistics Explained, Glossary: Gross inland energy consumption.

[9] The geometric mean is very useful when values tend to make large fluctuations. If statistical data inform about average increments of the examined value in relation to the previous period, the geometric mean is more appropriate than the arithmetic mean or median for examining the average rate of change of phenomena, for example growth rates, returns on portfolio of securities.

of energy intensity in 2015 was in Bulgaria (156 toe/1 million USD), Latvia (109), Estonia (95), Hungary (92) and Finland (90). According to research done by Locmelis et al. [2016] we can identify the main reasons for the still existing high level of energy intensity in some countries. There are high energy prices in Latvia (as high as in Germany), but the Latvian economy is less efficient. It is worth noting that prices increased by nearly 50% between 2010 and 2015. The result, in this situation, is high energy intensity. Over 25% of energy in Latvia is used in industrial sectors, from which 85% is consumed by only 4 of the most valuable industry sectors: manufacturing of wood, food, non-metallic mineral products and manufacturing of fabricated metal products. Therefore, there is high potential in making the Latvian industrial sector more energy efficient. As the authors mentioned conclude – the general aim of energy policy should be decreasing energy intensity through the implementation of new, accurate energy management systems which are measurable and have precise monitoring methods. This solution should lead the country to gain greater control over its energy sector and should ease decreasing energy intensity. Moreover, after the financial crisis in 2008, Latvia restructured its own economic sectors. After that, there appeared high energy demanding industrial sectors. According to Gamtessa and Olani [2018] the green gas emission problem is the main issue of many energy policies. After the launch of many environmental (ecology) movements in global politics, we can observe a decrease of energy intensity and improvement (higher efficiency) in energy production.

There is an interesting situation in Finland – the energy intensity amounted in 2000 to almost 107 toe/1 million USD – similar to Slovenia, and much more than other highly-developed countries. In 2015 it was over 90 toe, thus Finland is among the most energy-intensive economies in the EU. However it is due to the fact that there are very energy-intensive industries in this country, especially the forestry industry, which is responsible for about 50% of energy use in the industrial sector [Zakeri, Syri and Rinne 2015]. The European Union has energy intensity at a level of 64 toe/1 million USD and it amounted 50 toe in 2015. There is a moderate/strong negative relationship between GDP per capita level and energy intensity. The Pearson correlation coefficient was -0.63 in 2000 and -0.61 in 2015, which means that the more developed (the richer) the country, the lower is the energy intensity of its economy. However, it is worth noticing that the tendencies and changes in energy intensity (its decreases) do not follow such a simple relationship.

The highest progress in reducing energy intensity was mainly made by less- or medium-developed countries of the European Union. The annual decreases in energy intensity (measured through geometric means of changes in the period 2000-2015) amounted to 4.4%

in Ireland, 4.2% in the Slovak Republic, 3.5% in Romania, 3.1% in Czech Republic, 3% in Bulgaria, 2.9% in Sweden and 2.6% in Poland (tables 2 and 3). When we take into account the change in energy intensity in 2015 compared to 2000 (table 1), the values of this indicator decreased in Ireland and the Slovak Republic by almost 50% (Ireland: by 28 toe, from 57 to 29 toe/1 million USD and Slovak Republic: by 80 toe, from 168 to 88 toe) and by 33-41% in Romania (a decrease of 61 toe), Czech Republic (52 toe), Bulgaria (91 toe), Sweden (28 toe), Poland (44 toe) and Great Britain (19 toe). In the European Union, energy intensity decreased every year by 1.58% and across the whole analysed period by 21.3% (from 64 to 50 toe/1 million USD).

Table 1. Energy intensity in toe/1 million USD [constant 2010], GDP per capita [constant 2010 USD] and energy use per capita in kg of oil equivalent in the European Union countries in 2000-2015 and changes 2015/2000

Specification	Energy intensity in toe/1 million USD [constant 2010]				GDP per capita [constant 2010 USD]				Energy use per capita in kg of oil equivalent			
	2000	2008	2015	2015 / 2000	2000	2008	2015	2015 / 2000	2000	2008	2015	2015 / 2000
Austria	58,12	61,41	58,03	99,8%	42 123	48 028	47 835	113,6%	3 570	4 032	3 804	106,6%
Belgium	76,48	64,74	60,57	79,2%	40 170	44 956	45 068	112,2%	5 669	5 455	4 688	82,7%
Bulgaria	247,53	179,61	156,14	63,1%	4 011	6 914	7 612	189,8%	2 277	2 649	2 478*	108,8%
Croatia	93,19	86,36	83,63	89,7%	10 570	14 779	13 936	131,8%	1 895	2 216	1 898*	100,2%
Cyprus	88,21	72,40	64,79	73,5%	27 318	32 652	27 587	101,0%	2 265	2 389	1 712*	75,6%
Czech Republic	137,30	101,70	85,55	62,3%	14 807	20 521	21 382	144,4%	3 988	4 331	3 860	96,8%
Denmark	40,62	38,87	32,96	81,1%	55 851	60 505	59 968	107,4%	3 490	3 502	2 817	80,7%
Estonia	122,87	108,70	94,98	77,3%	10 108	16 717	17 734	175,4%	3 375	4 105	4 173	123,7%
European Union	63,69	56,35	50,13	78,7%	30 293	34 671	35 230	116,3%	3 472	3 512	3 207	92,4%
Finland	106,96	89,42	90,38	84,5%	40 450	49 364	45 087	111,5%	6 262	6 669	5 925	94,6%
France	54,32	47,45	42,42	78,1%	38 522	41 545	41 690	108,2%	4 135	4 111	3 688	89,2%
Germany	55,84	49,98	47,71	85,4%	37 998	42 365	45 413	119,5%	4 094	4 037	3 818	93,2%
Greece	63,32	55,66	55,22	87,2%	23 275	29 875	22 649	97,3%	2 507	2 745	2 182	87,1%
Hungary	116,10	97,20	92,26	79,5%	10 490	13 869	14 629	139,5%	2 448	2 637	2 433	99,4%
Ireland	57,06	48,68	29,14	51,1%	42 945	50 918	67 590	157,4%	3 627	3 294	2 835	78,2%
Italy	52,45	50,59	44,92	85,7%	36 181	37 585	33 984	93,9%	3 012	3 088	2 482	82,4%
Latvia	135,51	107,37	109,04	80,5%	6 935	13 270	14 294	206,1%	1 618	2 106	2 177*	134,5%

Specification	Energy intensity in toe/1 million USD [constant 2010]				GDP per capita [constant 2010 USD]				Energy use per capita in kg of oil equivalent			
	2000	2008	2015	2015 / 2000	2000	2008	2015	2015 / 2000	2000	2008	2015	2015 / 2000
Lithuania	109,92	92,86	87,41	79,5%	6 934	13 405	15 342	221,3%	2 038	2 976	2 387*	117,2%
Luxembourg	82,48	81,01	64,10	77,7%	93 463	108 577	107 649	115,2%	7 677	8 612	6 548	85,3%
Netherlands	63,53	55,96	49,36	77,7%	46 133	52 118	51 410	111,4%	4 739	4 848	4 233	89,3%
Poland	132,62	108,25	88,77	66,9%	8 525	11 800	14 640	171,7%	2 320	2 565	2 490	107,3%
Portugal	78,39	72,32	66,42	84,7%	21 513	22 830	22 017	102,3%	2 390	2 337	2 132	89,2%
Romania	146,82	103,65	86,10	58,6%	4 901	8 873	9 567	195,2%	1 614	1 929	1 592*	98,6%
Slovak Republic	168,14	114,48	88,44	52,6%	10 297	16 748	18 679	181,4%	3 293	3 406	3 004	91,2%
Slovenia	105,08	93,18	83,04	79,0%	18 571	25 447	23 731	127,8%	3 224	3 837	3 175	98,5%
Spain	64,68	58,34	50,50	78,1%	28 335	32 303	30 531	107,7%	3 004	3 026	2 571	85,6%
Sweden	79,24	60,12	51,23	64,7%	44 694	52 711	55 395	123,9%	5 360	5 380	5 103	95,2%
United Kingdom	58,33	46,93	39,09	67,0%	35 577	40 536	41 537	116,8%	3 786	3 362	2 764	73,0%

* Data on energy use per capita in 2015 in Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Romania – these are data from 2014.

Source: Own study based on data: European Commission, DG ENER, Energy Statistics, By country, Country datasheets: EU-28; The World Bank, Data Bank, World Development Indicators (see references).

At the bottom of this ranking are mainly high-developed EU countries and PIGS-countries[10]. Energy intensity decreased in the years 2000-2015 in Croatia by 10%, Germany by 14.6%, in Denmark and Finland by 15.5-18.9% only. Interestingly, in Austria, energy intensity was at the same level in 2015 as in 2000 (58 toe/1 million USD), thus, in Austria there was no progress in this area. In turn, in the PIGS-countries this ratio fell during the analysed period by only 13-15%. Annual changes (decreases of energy intensity) in Portugal, Italy and Greece did not exceed 1.1%.

In transition economies (especially in the countries of East-Central Europe) the main reasons for energy intensity decreases after 1990 were [European Environment Agency; Petrović, Filipović and Radovanović 2018; Timma, Zoss and Blumberga 2016; Verbić, Filipović and Radovanović 2017; Wysokiński, Trębska and Gromada 2017, p. 239]:

[10] PIGS is acronym used regarding to 4 countries: Portugal, Italy, Greece, Spain, in which the debt crisis and as well the economic crisis had the most negative consequences after 2008/2009. Sometimes there is used broader acronym "PIIGS”, which encompasses these countries and Ireland, however it is not very precise, because Ireland only had an economic recession in the period 2007-2009, and these other countries – much longer [The World Bank].

- restructuring of the national economy and change in the structure of the economy (in the sense of the three sector theory of Fisher, Clark and Fourastie [Zajdel 2011]);
- technological changes, according to which new technologies (machines, and devices)were introduced which were resource-efficient, including more energy-efficient ones;
- changes in the structure of energy commodities consumption, including decreasing consumption of coal in favour of growing consumption of hydrocarbon fuels and renewable energy sources;
- privatisation in an economy that fosters energy efficiency;
- improvement of energy efficiency in manufacturing branches and in the electricity and heat industries;
- improvement of energy efficiency in housing and industry;
- consistent implementation of EU regulations and support from EU structural funds (especially after 2004);
- and – to some extent – reduction of fuel consumption in transport through higher efficiency in logistics and implementation of new technologies in transport.

Table 2. Geometric means of changes (year to year) for three variables: energy intensity, GDP per capita and energy use per capita, in %, in the period 2000-2015 (rejection of the hypothesis)

Specification	Geometric mean of changes (year to year) in energy intensity in %	Geometric mean of changes (year to year) in GDP per capita in %	Geometric mean of changes (year to year) in energy use per capita in %
Austria	-0,01%	0,85%	0,42%
Bulgaria	-3,03%	4,36%	0,60%
Croatia	-0,72%	1,86%	0,01%
Estonia	-1,70%	3,82%	1,43%
Latvia	-1,44%	4,94%	2,14%
Lithuania	-1,52%	5,44%	1,14%
Poland	-2,64%	3,67%	0,47%

Source: Own study based on the data from table 1.

Table 3. Geometric means of changes (year to year) for three variables: energy intensity, GDP per capita and energy use per capita, in %, in the period of 2000-2015 (confirmation of the hypothesis)

Specification	Geometric mean of changes (year to year) in energy intensity in %	Geometric mean of changes (year to year) in GDP per capita in %	Geometric mean of changes (year to year) in energy use per capita in %
Belgium	-1,54%	0,77%	-1,26%
Cyprus	-2,04%	0,07%	-1,98%
Czech Republic	-3,10%	2,48%	-0,22%
Denmark	-1,38%	0,48%	-1,42%
European Union	-1,58%	1,01%	-0,53%
Finland	-1,12%	0,73%	-0,37%
France	-1,64%	0,53%	-0,76%
Germany	-1,04%	1,20%	-0,47%
Greece	-0,91%	-0,18%	-0,92%
Hungary	-1,52%	2,24%	-0,04%
Ireland	-4,38%	3,07%	-1,63%
Italy	-1,03%	-0,42%	-1,28%
Luxembourg	-1,67%	0,95%	-1,05%
Netherlands	-1,67%	0,72%	-0,75%
Portugal	-1,10%	0,15%	-0,76%
Romania	-3,49%	4,56%	-0,10%
Slovak Republic	-4,19%	4,05%	-0,61%
Slovenia	-1,56%	1,65%	-0,10%
Spain	-1,64%	0,50%	-1,03%
Sweden	-2,87%	1,44%	-0,33%
United Kingdom	-2,63%	1,04%	-2,08%

Source: Own study based on the data from table 1.

Considering the empirical data on energy intensity in the sectors of the economy and the use of energy per capita in 2015, it can be concluded that there is no significant link between these variables. There are countries with high levels of energy use per capita and with both – quite low (Sweden, Netherlands) and high (Finland, Estonia, Czech Republic) levels of energy intensity. In turn, obviously, there is a positive relationship (Pearson correlation coefficient close to 0.7) between energy use per capita and GDP per capita in 2015. The more developed the economy, the higher the energy consumption – good examples are Luxembourg, Netherlands, Sweden, but on the other side, there are highly-developed countries with low energy consumption per capita level (Denmark, Ireland). These are, however, very rich countries, based on effective ecological processes. Although there is a tendency in most European Union countries that GDP is growing and energy use per capita is decreasing, because production processes and the efficiency of machines and devices are improving, as it was mentioned, some less- and medium-developed European Union countries could increase CO_2 emissions in order to reduce the economic gap between themselves and the best countries. These are countries in which the energy consumption per capita increased during 2000-2015, but where they improved energy efficiency (they decreased the energy intensity) much more, therefore the final effects are positive. Such a situation concerns Bulgaria, Croatia, Estonia, Lithuania and Poland.

Conclusions

The aim of the paper was to identify the tendencies in energy intensity in the European Union countries and their causes and effects. The focus has been on energy intensity as the ratio between energy use and gross value added. The following hypothesis was tested: with economic growth, the energy intensity of an economy decreases and energy consumption per capita decreases, too. The hypothesis was confirmed in 20 countries and for the European Union as a whole. For 7 countries it was rejected (Austria, Bulgaria, Croatia, Estonia, Latvia, Lithuania, Poland). The lowest energy intensity is in highly-developed countries: Ireland, Denmark, United Kingdom, France, but there were the highest nominal and real decreases of energy intensity in countries with different GDPs (different GDP levels): Ireland, Slovak Republic, Romania, Czech Republic, Bulgaria, Sweden, Poland. The lower the energy intensity, the more ecological the economy. However, not all highly-developed European Union countries have low energy intensity (e.g. Finland, Luxembourg, Belgium, Austria).

Although the use of energy increased during the period 2000-2015 in some medium-developed countries of the European Union (Bulgaria, Estonia, Lithuania, Poland), these countries improved energy efficiency much more (they reduced the energy intensity). Ultimately, the effects are positive in these countries. An increase in energy use per capita was observed in countries in which there were the highest GDP growth rates. Higher energy consumption resulted from dynamic economic development. This can be connected with the catch-up effect (convergence).

Putting more capital into research and development (R&D) investment can lead to a decrease in energy intensity. Furthermore, this will promote energy efficiency. Countries should possess, or introduce new energy management systems which are measurable, transparent and easy to control. This could support improving energy efficiency in the long term. Another important determinant for decreasing energy intensity are: restructuring of the national economy, structural and technological changes, privatisation of the economy. State policy can play special role in the support of entities (companies, households) in order to achieve these changes through structural funds (European Union funds) or implementing a loan and credit system for energy efficiency. The final effect of these activities would be lower energy intensity and higher efficiency of production factors, which could lead to an increase in national income and economic welfare.

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