

Warsaw School of Economics
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**DECOMPOSITION OF FARM INCOME
USING THE COUNTERFACTUAL METHOD**

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Summary of the doctoral dissertation
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1. Introduction

The subject of the doctoral dissertation entitled “Decomposition of farm income using the counterfactual method” deals with the issues of income sources of agricultural producers, with particular emphasis on the part related to obtaining economic and political rent. Income in agriculture is the basic economic category, expressing both the material situation and the possibility of satisfying the needs of agricultural families, as well as conditioning the viability of a farm. The problem of income disparity in the Polish agricultural sector, related to continually deteriorating economic situation of agricultural holdings in comparison to the population from outside the agricultural sector, draws attention to the sources of income formation. The starting point for the discussion is the efficiency paradigm of classical economy, at the same time, considering the complementary role of interventionism. The amount of producer’s income, which is roughly a payment for the labour factor, should thus be determined by farmer’s marginal productivity. As a result of the market failure mechanism and ineffective allocation of production factors, an agricultural producer may, however, in a short run, achieve a certain surplus income resulting from the increase in productivity of the labour factor, not reflected so far in its price on the market, which is defined as an economic rent. The mechanism of rent-seeking is also applicable on the grounds of political economy, which results from a significant role of the institutions. Interventionism gives agricultural producers the possibility of an alternative way of maximising income through a political rent. The main reason is the lower productivity of the labour factor in agriculture and the increasing relation of the growth of prices paid to prices received by agricultural producers. Unfavourable income situation of agricultural producers is therefore a subject of interest of agricultural policy [cf. Kowalski, Rembisz 2005; Woś 2003; Zegar 2008; Ruttan 2002; Patra, Nayak 2012].

The starting point for the discussion is the efficiency paradigm of classical economy, at the same time, considering the complementary role of interventionism. When analysing the behaviour of agricultural holdings according to the producer model, it can be assumed that the objective function is to maximise profit in a given set of acceptable decisions, under certain restrictive conditions relating to the factors of production. However, each farm, i.e. an agricultural producer, is inseparably connected with the household belonging to it, which in the decisions taken by an agricultural producer requires taking into account also the function of the consumer’s objective. Therefore, the profit of an agricultural producer may be allocated both to savings, transformed in subsequent years into production investments, as well as to

consumption, and therefore the higher the profit is achieved by the producer, the higher utility should be achieved by the farm as a consumer. In the case of an agricultural producer, the category of income includes at the same time the difference between revenue and costs generated on the holding, on the other hand, approximately the producer's labour remuneration. Starting from the assumption of competitive equilibrium and the principle of zero profit condition, it should be stated that the price of goods determined on the market equals the average and marginal cost of its production. The remuneration of factors of production thus depends on the prices of products manufactured with their involvement, which is an exogenous condition, and on the productivity of these factors as an endogenous condition [Rembisz 2007]. Apart from external conditions and treating other factors as *ceteris paribus*, one may conclude the improvement of labour factor productivity as a fundamental basis for the growth of income of agricultural producers.

Optimal allocation of resources forces the remuneration of factors of production in the long term in line with their marginal productivity. As a result of the market failure mechanism and ineffective allocation of production factors, an agricultural producer may, however, in a short run, achieve a certain surplus income resulting from the increase in productivity of the labour factor, not reflected so far in its price on the market, which is defined as an economic rent [cf. Schoemaker 1990; Mahoney 1995; McChesney 1998; Czyżewski 2013]. Although the rent itself is therefore an example of market failure, in a market economy there is also a rent-seeking, which determines the competitive position of an agricultural producer. The mechanism of rent-seeking is also applicable on the grounds of political economy, which results from a significant role of the institutions. Interventionism gives agricultural producers the possibility of an alternative way of maximising income through a political rent [cf. Hindmoor 1999; Tollison 1982; Poczta-Wajda 2017].

Therefore, the increase in income of agricultural producers may occur not only as a result of purely market activities, but also as a result of institutional mechanisms. Therefore, it allows to separate two basic sources of growth of income in the agricultural sector, namely improvement of productivity relations at a given relation of prices received to prices paid and support within instruments of agricultural policy. Therefore, a question arises whether a rationally acting agricultural producer will be more oriented on income benefits resulting from institutional conditions or on benefits resulting from improvement of production effectiveness.

2. Motivation for the research

The research topic discussed in the thesis concerns the issue of income in agriculture, which is based on the phenomenon of permanently worse economic situation of agricultural holdings in comparison to the population from outside the agricultural sector. The problem of income disparity, occurring also in the Polish agricultural sector, leads to drawing attention to the sources of income formation. The subject of interest in this dissertation were, therefore, two basic factors catalysing changes in agricultural producers' incomes, i.e. improvement of production effectiveness and agricultural policy. The part of agricultural income that corresponds to the economic and political rent was distinguished. A direct inspiration to address the issue of income decomposition was the phenomenon of rent-seeking, especially raised in the context of political rent. Knowing the scale and relation of economic and political rent allows to fill in the research gap for the important in the cognitive sense problem of the mechanism of making decisions by agricultural producers and thus sources of increasing their incomes. However, the application aspect of the dissertation, resulting in particular from the quantification of the political rent and the determination of the scope of its substitutability in relation to the economic rent, is connected to the possibility of increasing the efficiency of public expenditures.

3. Main thesis and research hypotheses

The scope of the research problem was the basis for the main thesis, according to which *the growth of farm income in Poland is conditioned by the improvement of labour productivity and interventionism within the agricultural policy*. In order to respond to the main thesis, four research hypotheses had to be formulated and verified.

First hypothesis: Improvement of labour productivity supported by agricultural policy instruments influences the increase in income of agricultural producers in Poland.

Second hypothesis: Support under the agricultural policy translates into an increase in the income of agricultural producers in Poland.

Third hypothesis: Improvement of labour productivity is reflected in the increase in income of agricultural producers in Poland.

Fourth hypothesis: Interventionism within agricultural policy weakens the pressure on improving the efficiency of labour factor in Poland.

The main research objective of the dissertation is to examine the impact of the improvement of production techniques on farms, i.e. increase in production efficiency, which for the purposes of the dissertation is simplified to the increase in labour productivity, and agricultural policy mechanisms on farm incomes, which is related to the achievement of economic and political rents by agricultural producers, respectively. Two partial objectives were formulated for the implementation of such a main objective:

- Discussion on the basis of the classical theory of microeconomics of the mechanism of creating economic and political rents in agriculture.
- Estimation of average economic and political rents for Polish agricultural producers using statistical methods used to study cause and effect relationships.

4. Research method

The first partial objective referred to the analysis of the literature concerning the incomes of agricultural producers, in particular in the context of obtaining an economic and political rent. The second partial goal, and thus empirical verification of the hypotheses, was achieved by applying the inverse probability of treatment weighting method, based on a counterfactual approach [cf. Quandt 1972; Rosenbaum, Rubin 1983; McCaffrey et al. 2014; Lee, Lesser, Stuart 2010; Szulc 2012; Strawiński 2014]. In the conditions of observational studies, this method, based on controlled randomized experiments, allowed to distinguish in the income of agricultural producers the effect related to the improvement of productivity, which by definition constitutes an economic rent, and the effect related to the agricultural policy, which in turn is associated with political rent.

The application of the method based on propensity score analysis, i.e. the probability of being treated, required the use of micro data on agricultural producers. Therefore, the hypotheses were verified on the basis of data from the Polish Farm Accountancy Data Network (Polish FADN), which is a unique source of information on the economic and financial situation in individual farms. Taking into account the availability of information on Polish agricultural producers, the delay in publishing qualitatively verified data by the Polish FADN in relation to a given calendar year, as well as the schedule of launching activities under the agricultural policy, the research was conducted for the years 2008-2015, i.e. the period of functioning of the Rural Development Programme for 2007-2013, which is one of the basic sources of support for agricultural holdings.

The measurement of income effects related to the improvement of production efficiency and agricultural policy, which is the same as the measurement of economic and political rents, was carried out at four levels, i.e. at all analysed agricultural holdings and divided into their location, economic size and specialisation. This was dictated by the methodology of data collection by the Polish FADN, which ensures the representativeness of the sample in the macro-regions, economic size classes and types of specialisations based on the standard production coefficient. Due to the specificity of the experimental and control group structure, the estimation of the average economic and political rents could only be carried out separately for each year. Therefore, it was not possible to build a panel of agricultural holdings and thus guarantee the observation of the same holdings in the whole analysed period. Due to the necessity to construct separate propensity score models for particular years, it forced the need to estimate and verify 448 models. In order to reduce the bias of conclusions connected with observing different groups of farms in subsequent years, the quantification of economic and political rents was carried out both in nominal and real prices.

5. Structure of dissertation

The main part of the dissertation consists of four chapters, the first two of which are the theoretical part, the next one concerns the characteristics of the models constructed, and the last one presents the results of the original approach to the measurement of the economic rent, political rent and their substitutability in case of Polish agricultural producers.

The first chapter contains a formal description of a holding as an agricultural producer, aiming at maximizing its objective function, which, as shown, is income. In this chapter, the characteristics of agricultural holdings are presented, starting from the efficiency paradigm as a superior imperative. Referring to the concept of economic and political rent, the income of agricultural producers was decomposed into two basic sources of their change. The first source of income, depending on the producer's decision, i.e. endogenous for him, is the improvement of productivity. The second source, in turn, is an exogenous factor for the agricultural producer, which in the case of the agricultural sector is related to the mechanisms of agricultural policy.

The second chapter presents an outline of a inverse probability of treatment weighting, i.e. an approach based on the propensity score analysis, used to quantify the average economic and political rents achieved by agricultural producers. The bases of application of

counterfactual approach are presented, with particular emphasis on the assumptions accompanying this method and the possibility of their verification. The way of using the inverse probability of treatment weighting method for the purposes of the research conducted in the doctoral dissertation is also specified.

The third chapter is a full description of the model constituting the basis for estimating the economic and political rent, together with the empirical material used. A description of the Polish FADN database containing unique unit data on the economic and financial situation of Polish agricultural producers is presented. This part of the paper contains a description of the construction of models used to estimate the probability of obtaining an economic and political rent, as well as the results of verification of the assumptions of the inverse probability of treatment weighting method. Due to the multiplicity of estimated models, only models estimated for the whole sample of agricultural holdings were verified in this chapter. The results of the verification of models constructed for agricultural holdings divided into regions, economic size classes and agricultural types were included in the electronic appendix attached to the dissertation. Positive verification of the assumptions of the inverse probability of treatment weighting method allowed for the conclusion based on the applied approach.

The last chapter, the fourth, contains the results of the conducted research, which constitute an original contribution to the problem of measuring the economic and political rent for Polish agricultural producers. Although in the literature there are known attempts to quantify both rents, their estimation was made at the level aggregated to the whole agricultural sector, i.e. to the collection of agricultural producers. This paper proposes a new approach to the issue of measuring the rents with the use of microeconomic methods. The approach used to quantify the economic and political rent is therefore consistent with the microeconomic approach of the study adopted in the dissertation. The division of this part of the paper resulted directly from the way research hypotheses were defined.

The dissertation was concluded with a summary and discussion of the obtained results in the light of the literature review.

6. Results

The verification of the first hypothesis included an assessment of whether the improvement of labour productivity supported by agricultural policy instruments influences the increase in income of agricultural producers (see fig. 1).

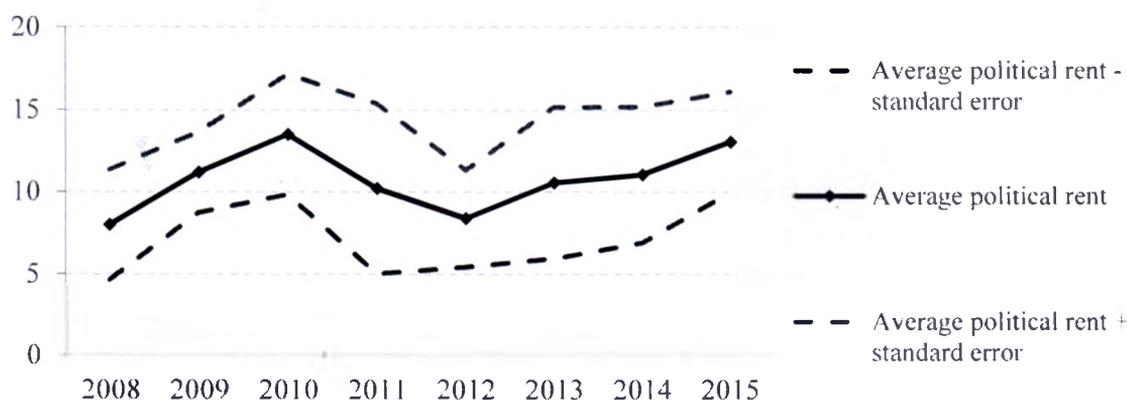
Figure 1. Average economic and political rent in constant prices, reference year 2007 (in thousand PLN per Family Work Unit)



Source: own elaboration based on Polish FADN.

The first research hypothesis was verified positively. Farms that improved productivity relations in the agricultural holding, while simultaneously receiving subsidies, achieved a positive average economic and political rent, considered together. In terms of location of farms, usually higher rent was received by agricultural producers from the north-western part of Poland, while lower rent was received by agricultural producers from the south-eastern regions of the country. Higher economic and political rents were also achieved by farms with larger economic size, determined by the parameter of standard production. In terms of the type of farming, higher economic and political rents were awarded by agricultural producers specialising in field crops or granivores, whereas lower rents fell to farms specialising in dairying.

Figure 2. Average political rent in constant prices, reference year 2007 (in thousand PLN per Family Work Unit)



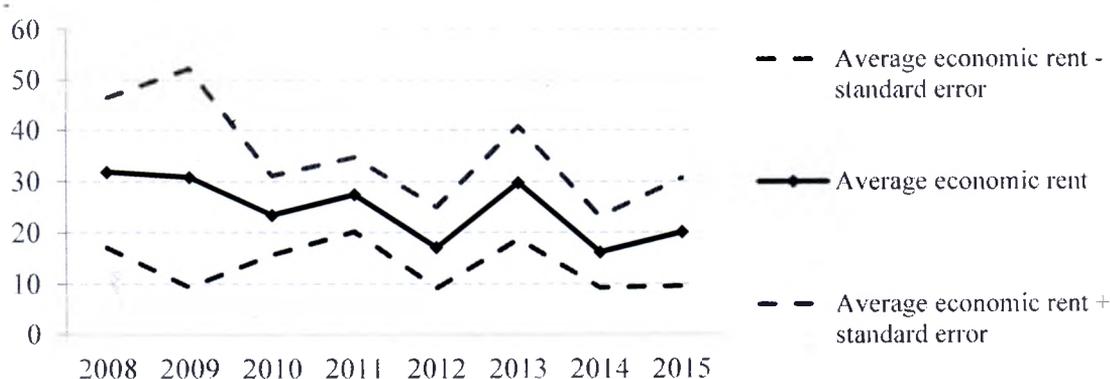
Source: own elaboration based on Polish FADN.

The verification of the second hypothesis referred to the separation of the impact of external factors on income, i.e. to the assessment whether support under the agricultural policy translates into an increase in the income of agricultural producers (see fig. 2).

The second research hypothesis was also verified positively. Farms, which received support granted within the agricultural policy mechanisms, achieved on average a significantly positive political rent. In terms of the location of farms, there were no significant differences in the amount of the average sum of political rent received by agricultural producers from various regions. Slightly higher value of the average political rent was, however, recorded by farms from “Pomorze i Mazury”, “Wielkopolska i Śląsk” as well as “Małopolska i Pogórze” region, while lower rent by farms from “Mazowsze i Podlasie” region. Similarly as before, also in the case of estimating pure political rent, economically larger farms were accompanied by higher income effects from support under the agricultural policy. In terms of type of farming, higher income effects resulting from subsidies were achieved by agricultural producers specialising in field crops or granivores, while lower ones – in farms specialising in dairying.

Similarly – the third hypothesis – distinguishes the internal factor as the change in income of agricultural producers. Thus, the hypothesis that the improvement of labour productivity is reflected in the increase in income of agricultural producers was subject to verification (see fig. 3).

Figure 3. Average economic rent in constant prices, reference year 2007 (in thousand PLN per Family Work Unit)



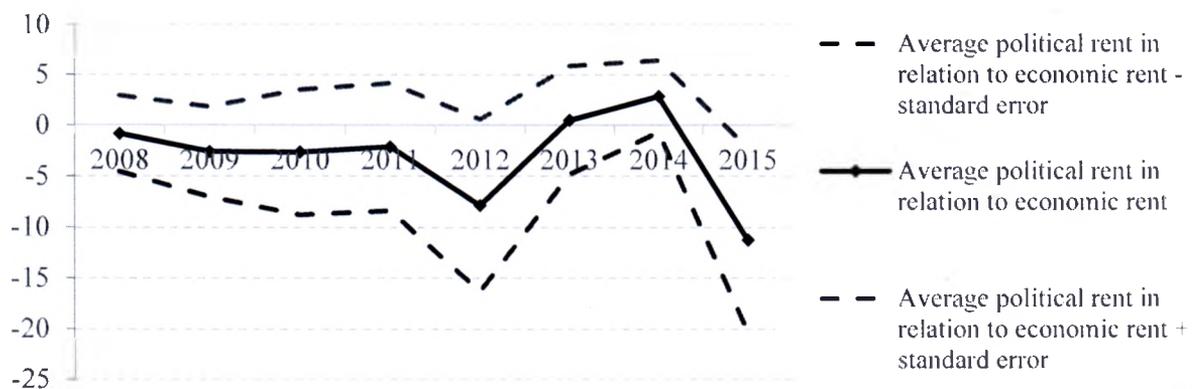
Source: own elaboration based on Polish FADN.

The third hypothesis was also positively verified. Agricultural producers improving production techniques on the farm, which was understood as an increase in labour productivity, achieved significantly higher income effects on this account, i.e. a positive

average economic rent. Although in the case of farms with different locations, there were no clear discrepancies in terms of economic rents, slightly higher income effects resulting from improved labour productivity were achieved by farms from the eastern part of Poland, i.e. from “Mazowsze i Podlasie” region, while lower ones – from “Wielkopolska i Śląsk” region. Similarly to the previous cases, farms of larger economic size were accompanied by obtaining an average higher political rent. In terms of type of farming, the relatively highest average value of political rent was obtained by farms specialising in granivores, while the lowest – by dairy and in mixed farms.

The hypotheses, aimed at assessing the degree of substitutability of two basic sources of income of agricultural producers, were complemented by the fourth hypothesis, according to which interventionism within agricultural policy weakens the pressure on improving the efficiency of labour factor (see fig. 4).

Figure 4. Average political rent in relation to economic rent in constant prices, reference year 2007 (in thousand PLN per Family Work Unit)



Source: own elaboration based on Polish FADN.

The fourth research hypothesis was verified negatively. Agricultural producers supported under the agricultural policy mechanisms did not record significantly higher (or significantly lower) incomes in comparison with farms improving production efficiency. However, noticeable (but not statistically significant) discrepancies were observed in terms of the location and type of farming. The replacement of economic rent by political rent was clearly observed on farms from “Pomorze i Mazury” region. An opposite process, consisting in substitution of political rent with economic rent, took place in the case of farms located in “Wielkopolska i Śląsk”, “Mazowsze i Podlasie” and “Małopolska i Pogórze” regions. Considering the agricultural type of farming, the effect of displacing the economic rent by

political rent was visible among agricultural producers specializing in field crops. Farms specialising in horticulture, in turn, preferred to improve the labour productivity on support within the agricultural policy instruments. While in terms of economic size of farms there were no clear trends in the substitutability of both rents, it can be noted that with the increase in the size of farms more often and on a larger scale there was a replacement of political rent by economic rent.

Positive verification of three research hypotheses and negative verification of one research hypothesis, finally, contributed to the confirmation of the main thesis of the doctoral dissertation, with an additional conclusion for the lack of a clear orientation of Polish agricultural producers on the mechanisms of agricultural policy, which would take place at the cost of improving the efficiency of the labour productivity on farms. The conclusions presented in the doctoral dissertation are both cognitive and application-oriented. The cognitive contribution refers to the size of the estimated rents. As it was proved in the dissertation, although income effects achieved due to improvement of production techniques or transfers were usually reflected in discrepancies in income of agricultural producers, the opposite conclusions could be drawn in the case of analysing farms due to their location or specialization. The application aspect of the dissertation, resulting in particular from the quantification of the political rent and the determination of the scope of its substitutability in relation to the economic rent, is connected to the possibility of increasing the efficiency of public expenditures.

7. References

- Czyżewski, B. (2013). *Renty ekonomiczne w gospodarce żywnościowej w Polsce*, Warszawa: PWE.
- Hindmoor, A. (1999). *Rent Seeking Evaluated*, The Journal of Political Philosophy, vol. 7, no. 4, s. 434-452.
- Kowalski, A., Rembisz, W. (2005). *Rynek rolny i interwencjonizm a efektywność i sprawiedliwość społeczna*, Warszawa: IERiGŻ-PIB.
- Lee B. K., Lessler J., Stuart E. A. (2010). *Improving propensity score weighting using machine learning*, Statistics in Medicine, vol. 29, s. 337-346.
- Mahoney J.T. (1995). *The Management of Resource and Resource of Management*, Journal of

- McCaffrey D.F., Griffin B.A., Almirall D., Slaughter M.E., Ramchand R., Burgette L.F. (2013). *A tutorial on propensity score estimation for multiple treatments using generalized boosted models*, *Statistics in Medicine*, vol. 19, s. 3388-3414.
- McChesney, F.S. (1998). *Rent form regulation*, w: *The New Palgrave Dictionary of Economics and the Law*, Londyn, s. 310-311.
- Patra S., Nayak S.R. (2012). *A theoretical study on the relationship between wages and labor productivity in industries*, *International Journal of Economics and Research*, vol. 3, no. 3, s. 157-163.
- Poczta-Wajda, A. (2017). *Polityka wspierania rolnictwa a problem deprivacji dochodowej rolników w krajach o różnym poziomie rozwoju*. Warszawa: Wydawnictwo Naukowe PWN.
- Quandt R. (1972). *A New Approach to Estimating Switching Regressions*, *Journal of the American Statistical Association*, vol. 67, no. 338, s. 306-310.
- Rembisz W. (2007). *Mikroekonomiczne podstawy wzrostu dochodów producentów rolnych*, Warszawa: VIZJA PRESS&IT.
- Rosenbaum, P.R., Rubin, D.B (1983). *The central role of the propensity score in observational studies for causal effects*, *Biometrika*, vol. 70, no. 1, s. 41-55.
- Ruttan V.W. (2002), *Productivity Growth in World Agriculture: Sources and Constraints*, *Journal of Economic Perspectives*, vol. 16, no. 4, s. 161-184.
- Schoemaker P. J. H. (1990). *Strategy, Complexity and Economic Rent*, *Management Science*, t. 36.
- Strawiński, P. (2014). *Propensity score matching. Własności małopróbkowe*, Warszawa: Wydawnictwo Uniwersytetu Warszawskiego.
- Szulc, A. (2012). *Ocena efektu oddziaływania: estymacja przez dopasowanie*, w: *Mikroekonometria. Modele i metody analizy danych indywidualnych*, M. Gruszczyński (red.), Warszawa: Wydawnictwo Wolters Kluwer, s. 309-336.
- Tollison, R.D. (1982). *Rent seeking: a survey*, *Kyklos*, t. 35.
- Woś, A. (2003). *Konkurencyjność polskiego sektora żywnościowego. Synteza*, Warszawa: IERiGŻ-PIB.
- Zegar J. S. (2008). *Dochody w rolnictwie w okresie transformacji i integracji europejskiej*, Warszawa: IERiGŻ-PIB.

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