DETERMINANTS OF CHANGES IN THE REMUNERATION OF THE LABOUR FACTOR

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Abstract. The publication addresses the issue and the mechanism of remuneration of the labour factor in agriculture. An analytical approach with empirical examples was used, the reasoning is carried out in the microeconomic convention. Basing on analytical formulas the relationships between (a) proportion of food in consumer's expenditure, (b) supply and demand for factors of production and the prices thereof, (c) prices of agri-food goods and remuneration of factors of production, in particular labour factor, were examined in the paper. That constitutes the mechanism of remuneration of labour factor and its level (level of farm incomes).

Key words: labour factor, agriculture, income of agricultural producer

INTRODUCTION

These considerations are aimed at illustrating the relations that define the remuneration of the factors of production, in particular labour factor which generates the income of producers. The aim of the paper was to shown the relationships between (a) proportion of food in consumer's expenditure, (b) supply and demand for factors of production and the prices thereof, (c) prices of agri-food goods and remuneration of factors of production. Through a theoretical analysis, on the basis of the assumptions of the neoclassical economy theory, we document the thesis that the remuneration of the factors of production of agricultural producers, just like in the case of other producers, is defined by the marginal productivity of such factors of production. An effective demand for factors of production results from such conditions and the applied production technology is defined. It is ultimately the basis of income.

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The considerations have a primarily theoretical and cognitive message, where we extend the object of theoretical analysis over its conventional microeconomic scope. The presented analytical formulas can represent a certain point of reference against the actual changes taking place at agricultural producers' in the field of production, production efficiency, demand for factors of production, policy support, which is ultimately reflected in the income. In addition, the presented reasoning has some predictive properties, notably in the area of forecast of changes in the relations of factors of production, and hence in the remuneration thereof and in consequence in the income in agriculture.

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MATERIAL AND METHODS

The generality rule is maintained, which means the reflections refer to the most important relationships and determinants, in particular those of measurable character. The analytical model can be arrived at in various ways. In this publication, the deductive and speculative approach was adopted, resulting from literature search and the analysis of the state of the matter, additionally, simple algebra was employed. The majority of formulas serving as basis for the line of thought were derived in this way. The result is a rather complex model of thinking.

The deductive method is also named as analytical, abstract or prior method. The deductive method consists in deriving conclusions from general truths, takes few general principles and applies them draw conclusions. The classical and neo-classical school of economists notably, Ricardo, Senior, Cairnes, Mill, Malthus, Marshall, Pigou, applied the deductive method in their economic investigations.

Without prejudice to the general character of the analysis, some more specific relationships and connections with reference to agricultural producers and agriculture are highlighted. The methodology of theoretical analysis presented in this paper is also a certain alternative or complementation of a traditional verbal reasoning in agricultural economics. Such approaches prevail in the current literature on microeconomics, just as in modern agricultural economics, in particular among American scientists. The presented considerations are placed in the framework of microeconomics – in the so-called modern current – and at the same time they contribute to the economics of agriculture. Under this presupposition on the status of agricultural economics, Schultz and Heady attempted to combine empirical inductivism with *a priori* deductivism to produce a scientific method of agricultural economics. The new methodological frame provided by the works of Schultz and Heady has provided a fundamental change in agricultural economist's perspective of their scientific discipline [Hamdar 2012].

In the paper we stayed with the assumptions arising from the adoption of a homogenous production function as the analysis basis and with the assumption that the revenue from production is divided into the remunerations of the factors of production. Basing on analytical formulas the relationships between (a) proportion of food in consumer's expenditure, (b) supply and demand for factors of production and the prices thereof, (c) prices of agri-food goods and remuneration of factors of production, in particular labour factor, were shown in the paper.

ANALYSIS OF THE MECHANISM OF REMUNERATION OF THE LABOUR FACTOR IN AGRICULTURE

Proportion of food in consumer's expenditure

It can be demonstrated that just like in the case of other fields, also in the agriculture as a sum of agricultural producers, the final remuneration of the factors of production depends on the proportion of such products in the consumers' expenditure, where such factors were employed for the production of such products. In other words, the remuneration of a given factor of production is in fact a relevant part of consumers' expenditure, or differently – the remuneration of a given factor of production is financed from that source, i.e. from a given part of consumer's expenditure on those products.

We indicate the issue because it illustrates the essence of market regulation and the importance of the producer consumer relationship where the consumer determines the conditions of the manufacturer and not *vice versa*. This issue is often misunderstood or forgotten in the work of the scientific and practical agricultural policy. No one sees that the ultimate payer covering the effects of changes in pricing policy is the consumer and that the consumer income opportunities and its willingness to buy agri-food products are not indifferent to the remuneration of the factors of production on farms.

Here, the basic relationships are only signaled, showing how part of the remuneration of the consumer determines the remuneration of the factors of production in agriculture. We have the following relation

$$C_N = \frac{\alpha \cdot \dot{Z}}{N} \tag{1}$$

and

$$\frac{\Delta C_N}{C_N} = \frac{\Delta \alpha}{\alpha} + \frac{\Delta \dot{Z}}{\dot{Z}} - \frac{\Delta N}{N} \tag{2}$$

where: C_N – prices of factors of production;
      α – $N/\dot{Z}$ – share of factors of production in consumers' expenditure on food;
      $\dot{Z}$ – consumers' expenditures on food;
      N – factors of production used in the production of agricultural raw materials which are part of food products;
      $\Delta \dot{Z}/\dot{Z}$ – growth rate of expenditure on food.

From the formula it can be seen that at a given share of agricultural products in consumer spending on food, remuneration of the factors of production in agriculture is the smaller the greater their supply and the smaller their share of the value of food products (in consumer spending on food). Here is shown the impact of both the consumer and his purchases on the final remuneration of factors of production.

On the basis of a equation (2) one can visualize the dependencies between changes in wages and changes in the factors of production like: the share of agricultural products in spending on food; changes in demand for food and changes in the supply of factors of production. The options to increase the share of agricultural products as food raw materials in the consumers' expenditure on the final food products are limited. It is connected, among other things, with the decreasing proportion of the agricultural raw material in the food product and the Engel's law. Hence, the opportunities to increase the remuneration of the factors of production, including in particular the remuneration of the labour factor that is a residual value in the agriculture. The opportunities of increasing the growth rate of the demand (expenditure) for food at a rate that makes it possible to increase the remuneration of those factors, i.e. mainly increase in the income of agricultural producers, are also limited.

On the basis of equation (2), the positive relation between the loss of employment of factors of production in the agriculture is also confirmed – it applies mainly to the relative reduction in the employment of labour factor (effective substitution of labour resources by the capital factor) and the growth of remuneration of the factors (mainly remuneration of the labour factor)[1]. As a result of increase in labour productivity, as it is expressed by the reduction of employment of a labour factor in the value of supplied value in use, more falls to this factor from this value meaning that it get a better remuneration.

Supply and demand for factors of production and the prices thereof

In the part of paper we have focused on supply and demand for factors of production and the prices thereof in relation to the remuneration of the labour factor.

It can be assumed that the price of a given factor of production is shaped primarily by its supply. Let's conduct the reasoning on the scale of the entire agriculture as a sum of single agricultural producers[2]. If we assume that the prices of factors of production (C_N) are formulated by the balance between the supply and demand for factors of production in the entire agriculture and that we have to do with a state of balance between the demand for factors of production ($n \cdot R$) and their supply (N), we get[3]:

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[1] Meredyk [1994, pp. 32–35] writes: "the growth rate of labour productivity equals more or less the employment decrease rate and the productivity growth rate is negatively correlated to the growth rate of employment and the growth rate of expenditure".

[2] The reasoning for a single producer was made in Rembisz, Bezat-Jarzębowska [2013a].

[3] For calculation needs, instead of the cognitive ones, to the left of this equation, there should be multiplication of the matrix of expenditure of the factors of production per product unit by the agricultural production vector, and to the right, the vector of supply of factors of production by the vector of prices of factors of production.

$$N = n \cdot R \tag{3}$$

where: R – output (production) of agricultural producer,
$\quad\quad n$ – use of resources.

When introducing the prices of factors of production (C_N), assuming fixed product prices (solely in the aggregative function, therefore we disregard them here), we obtain

$$C_N \cdot N = n \cdot R \tag{4}$$

and

$$N = \frac{n \cdot R}{C_N} \tag{5}$$

and also

$$C_N = \frac{n \cdot R}{N} \tag{6}$$

As can be seen, the demand for the factors of production is enhanced by expenditure--intensity ($n = N/R$) and production volume, and it is reduced by the amount of prices of the factors (the higher the price, the lower the demand).

As a result of transformations of the absolute values found in the equations (5) and (6) in the relative relations (of the growth rate), we obtain the following equation that defines the formulation of prices of factors of production depending on the supply with a given demand for them

$$\frac{\Delta N}{N} = \frac{\Delta n}{n} + \frac{\Delta R}{R} - \frac{\Delta C_N}{C_N} \tag{7}$$

and

$$\frac{\Delta C_N}{C_N} = \frac{\Delta n}{n} + \frac{\Delta R}{R} - \frac{\Delta N}{N} \tag{8}$$

Increasing supply of factors of production with a given demand for them, defined by the production volume and unit expenditure-intensity index may lead to a decrease in their price. A decrease in supply according to this formulas leads to an increase in factor prices, also an increase in the unit expenditure-intensity indicator with fixed prices of products as adopted in the assumption lead to a decrease in the prices of factors of production.

It applies to the labour factor as well. After decomposition of the above equation and isolation of the labour factor and its price, we obtain

$$\frac{\Delta C_L}{C_L} = \frac{\Delta n}{n} + \left(\frac{\Delta R}{R} - \frac{\Delta L}{L} \right) \tag{9}$$

As can be seen in the case of *ceteris paribus*[4], a decrease in employment leads to an increase in the remuneration of the labour factor (increase in the income of agricultural producers). The source of this increase in the remuneration of the labour factor obviously results from an increase in labour productivity, which illustrates the difference between the last indicators to the right of the above equation. This reasoning was conducted on the scale of the entire agriculture and not on the scale of an agricultural producer. The same system is adopted in the further reasoning.

Prices of agri-food goods and remuneration of factors of production

We make a hypothesis here that the remuneration of factors of production depends for a given marginal productivity – which was addressed in the comment in the first point of considerations – on the price of goods for the production of which those factors are used. Next, we assume that under competitive conditions, i.e. zero-profit conditions, the average production cost for a given good equals its price. To put it synthetically, we simply assume that the remuneration of factors of production in agricultural holdings depends on the price of agricultural goods and the production technology [Bartosik 2004]. What results from it and is very important is that an agricultural producer is a "price-taker" rather than "price-maker".

For the above-mentioned proof for the dependency of remuneration of the labour factor on product prices with a given labour productivity, it will suffice to show that in the quoted conditions of equal competition, the remuneration of factors of production, including the payment of the labour factor, meaning the farmer's income from work in an agricultural holding, actually depends on the price of final goods (agri-food goods) formed on the market. It is because the average production cost for a given good under the conditions of perfect competition should equal its price. Therefore, the remuneration of factors of production, including the remuneration of the labour factor depends directly on the price of agricultural products and relevant technologies.

Therefore, we have the following analytical formula for the theoretical and cognitive objectives[5]

$$C_R \cdot R = N \cdot C_N \tag{10}$$

and

$$C_R = \frac{N}{R} \cdot C_N \tag{11}$$

and also

$$C_N = E \cdot C_R \tag{12}$$

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[4] The *ceteris paribus* condition refers mainly to expenditure-intensity mainly labour-intensity of production.
[5] The matrix calculus was shown in Bartosik [2004, p. 239].

where: C_N – prices of the factors of production as a weighted sum of C_L and C_K;

$\quad\quad C_R$ – prices of the final agricultural products;

$$\frac{N}{R} = \frac{K+L}{R}$$ – expenditure of the factors of production, material assets and labour per production unit;

$$E = \frac{1}{R}$$ – labour productivity (the reverse of expenditure-intensity of production).

An obvious relationship between the prices of the agricultural products and the prices of factors of production results from the above equations. The direction of that relationship is determined by the basis of the price formulation system (whether a market or cost formula).

If we choose equal competition as the basis, where the prices obtained (product prices) C_R are an exogenous parameter for the producers, then the prices of factors of production C_N should result – in case of a given technology, i.e. in fact a given productivity of those factors – directly from the prices of agricultural products.

On the other hand, if we choose cost formulas as the price formulation basis or assume absence of equal competition, then we have an opposite situation. It is the product prices that will result from or adjust to the remuneration of factors of production and the resultant production costs in case of a given technology (they do not change as there is no such necessity).

Let's specify the reasoning on the basis of equations (11) and (12) with reference to the remuneration of the labour factor. Assuming that the level of farmers' income is established exogenously, for instance politically, on the basis of the income parity in relation to other professional groups, then, in the absence of change in the technology (productivity), one has to adjust agricultural product prices to this level. Hence, product prices will result from the prices of the factors of production, in this case from the assumed amount of income (as the price of the labour factor). What is more, the adjustment of the increase in the prices of agricultural products as a source of financing of the assumed increase in the agricultural income will not force a change in the technology and the production technology that lead to improvement in the productivity, including in particular an increase in labour productivity[6].

The issue of intrinsic substitution between an increase in the remuneration of factors of production, including the remuneration of the labour factor, or on the account of improvement in productivity or on the account of increased prices of products for the production of which they were used, is illustrated by the below formula. With[7]

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[6] Many other ascertainments important for the agricultural policy and agricultural producers also result from the above-mentioned equations. Those equations directly prove the veracity of the foregoing, i.e. of the dependency of agricultural income on the prices of agricultural products. The most important one is the one that under the conditions of equal competition, i.e. when the options of increase in the prices of agricultural products are nearly zero or precisely zero ($\Delta C_R \approx 0$), then to achieve an increase in the payment of labour, it is necessary to improve the productivity ($\Delta E > 0$).

[7] The substantive and formal contents of the indicator $\Delta E/E$ arising from the production function is discussed in Rembisz [1990, p. 200].

$$\frac{\Delta E}{E} = \frac{\Delta R}{R} - \frac{\Delta N}{N} \tag{13}$$

we obtain, basing on equation (12),

$$\frac{\Delta C_N}{C_N} = \left(\frac{\Delta R}{R} - \frac{\Delta N}{N} \right) + \frac{\Delta C_R}{C_R} \tag{14}$$

The formula (14) shows that an increase in the remuneration of factors of production, including in particular the remuneration of the labour factor, may be a result of improved productivity and increased prices of agricultural products, jointly or alternatively. We can assume in simpler terms (choosing a linear function as the basis) that the structure of changes in the remuneration of factors of production is specified by $\frac{\Delta C_N}{C_N} = \frac{\Delta C_L}{C_L} + \frac{\Delta C_K}{C_K}$. This means that the growth rate for prices of the factors of production is the sum of the growth of prices of the capital factor and the growth rate of the remuneration of the labour factor (producers' income growth rate).

Back to the formula (14), we point out that since an assumption of equal competition was made, the price growth rate should amount to zero or almost zero percent[8]. This, on the other hand, forces the improvement of the productivity as the only sustainable source of increased remuneration of the labour factor, assuming that the prices of the capital factor remain unchanged. It is not possible then to transfer the cost effects of the possible increase in the remuneration of labour and the actual increase in the price of the prices of the capital factor onto the price of agricultural products (received prices)[9]. This issue is illustrated better by the following transformation of formula (14)

$$\frac{\Delta C_R}{C_R} - \frac{\Delta C_N}{C_N} = \frac{\Delta N}{N} - \frac{\Delta R}{R} \tag{15}$$

or

$$\frac{\Delta R}{R} - \frac{\Delta N}{N} = \frac{\Delta C_N}{C_N} - \frac{\Delta C_R}{C_R} \tag{16}$$

Leaving a broader discussion of the implications of the relations arising from the above-mentioned formulas for another occasion, let's note the following scenarios. If an increase in the prices of factors of production ($\Delta C_N/C_N$) is not compensated (balanced) by an increase of product prices ($\Delta C_R/C_R$) – as an assumption of equal competition was

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[8] Anyway, an increase in product prices as the main source of growth of the remuneration of the labour factor would be possible solely with a zero price elasticity of demand for food and with deficits. Irrespective of that, it would not be possible in a longer perspective as it would give rise to even greater supply – and hence a decrease of the prices of those products – as a result of the fact that the value of the price elasticity of supply in the agriculture is usually positive.

[9] As a side note, it *implicite* proves also that the growth rate for the remuneration of the labour factor (the income of agricultural producers) is residual and results from improved productivity.

made – then, it is necessary to improve labour productivity or the reverse thereof, it is necessary to decrease (reduce) the expenditure on a production unit (the minimum cost principle $\Rightarrow$ max profits), which is included in those formulas by the relations of production and expenditure growth rates. If the increase in the prices of the factors of production, in particular increase in income, is compensated or exceeded by increasing prices of agricultural products, then there is no pressure to improve the productivity. An increase in agricultural income lead to inflationary effects, which, in case of a relatively high share of food in the expenditure of consumers, it not only of economic importance, but also of social ones, and it has effects on the demand.

Let's point out as well that according to formula (14), it does matter how the labour productivity is improved. If it takes place as a result of increase in the production volume ($\Delta R/R$), then it has to have impact on the conditions of equal competition and negative price elasticity of demand[10] for food products for an increase in product prices ($\Delta C_R/C_R$) when considered on the scale of the entire agriculture. On the other hand, there is no such negative relationship when the attention is focused on a single agricultural holding, but only in case when it is assumed that the number of agricultural holdings will be decreasing. It has to be accompanied by an increased share of a single agricultural holding in the market, which is based on the concentration of production and capital, and by associated structural changes[11].

CONCLUSIONS

In the paper the relationships between (a) proportion of food in consumer's expenditure, (b) supply and demand for factors of production and the prices thereof, (c) prices of agri-food goods and remuneration of factors of production were shown. Basing on the undertaken analysis some conclusions can be made.

Firstly, in the case of *ceteris paribus*, a decrease in employment leads to an increase in the remuneration of the labour factor (increase in the income of agricultural producers). The source of this increase in the remuneration of the labour factor obviously is driven from an increase in labour productivity.

Secondly, from the own developed formulas it can be seen that at a given share of agricultural products in consumer spending on food, remuneration of the factors of production in agriculture is the smaller, the greater their supply and their share of the value of food products (in consumer spending on food). Here is shown the impact of both the consumer and his purchases on the final remuneration of factors of production.

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[10] Perhaps one of the most significant developments in the history of agricultural economics during the 1920s and the 1930s was the development of statistical analysis. Initial emphasis was on making empirical estimates of elasticity of demand, elasticity of supply, and prices of farm products based upon the neoclassical economic theory. Some of the leading contributors to the analysis of demand and price during this period were Mordecai Ezekiel, Henry Schultz, and Frederick V. Waugh [see Hamdar 2012].

[11] More in Meredyk [1994] and Rembisz [2005].

Thirdly, an increase in the remuneration of factors of production may be a result of improved productivity and increased prices of agricultural products, jointly or alternatively.

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UWARUNKOWANIA ZMIAN W WYNAGRADZANIU CZYNNIKA PRACY

Streszczenie. W publikacji podjęto zagadnienie i problem mechanizmu wynagrodzenia czynnika pracy w rolnictwie. Wykorzystano podejście analityczne z przykładami empirycznymi, rozumowanie było prowadzone w konwencji mikroekonomii. Opierając się na analitycznych zależnościach, ocenie poddano relacje między (a) udziałem żywności w wydatkach konsumenta, (b) podażą i popytem na czynniki produkcji i ich cenami, (c) cenami towarów rolno-spożywczych a wynagrodzeniem czynników produkcji, w szczególności czynnika pracy. Stanowi to o mechanizmie wynagradzania czynnika pracy i jego poziomie (poziomie dochodów gospodarstw rolnych).

Słowa kluczowe: czynnik pracy, rolnictwo, dochody producentów rolnych