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THE IMPACT OF DIRECT PAYMENTS ON THE PRODUCTION AREA – MODEL VIEW

Abstract

The paper proved, on theoretical grounds, that direct support scheme induces changes in the volume and structure of goods production in relation to production generated by market operations, thus having a reallocation function. Using the constructed model, the paper graphically presents the impact of applying individual instruments co-creating direct support scheme (area payments, production support and historical payments) on the level of land involvement in agricultural activity and agricultural production volume. This analysis was supplemented with a description of the impact of individual forms of aid on the structure of agricultural production.

Keywords: Common Agricultural Policy, direct support scheme, direct payments, outlays of factors of production in agriculture, agricultural production volume, agricultural production structure.

Introduction

The paper aims at showing, at a theoretical ground, that **the system of direct support changes the size and structure of goods production as regards production generated by the market operations, thus fulfilling a re-allocation function.**

The starting point for the research of the direct payment scheme impact on the production area was equilibrium in the free market situation, i.e. such in which the market is the regulator of economic relations and the state does not interfere in the economy using agricultural policy instruments. Next, by way of deduction, it was determined what were the consequences of introducing respective types of direct payments for formation of the variables determining the goal function

of agricultural producer, presenting functional dependencies in the graphic form. This made it possible to set a new point of producer equilibrium, thus to draw conclusions on the impact of applying respective types of direct payments at the level of land involvement in farming activity or agricultural production volume. Using the descriptive method the analysis was extended with the impact of individual forms of aid on the structure of agricultural production.

The model adopts a number of classical economics assumptions. The most important of them are assumptions on rationality of decisions, maximisation of goal function, perfect information and homogeneity of products (Forlicz and Jasiński, 2010).

Area support

The deliberations in this part covered area payments allocated to the current utilised agricultural area (UAA), i.e. UAA in a year for which the payment is executed. They included single/basic payments, single area payment and a group of instruments termed as sectoral area support. Hence, this scope does not cover payments, whose rate – although is expressed in monetary units per hectare – is not allocated to the current UAA only to UAA from a defined past period taken as the reference period. This type of payments was classified as historical support and are the object of analysis in the further part of the paper.

In the system based on entitlements, area support with the highest range, thus the most universal one, as of 2014 had the form of **single payment**, and as a result of Common Agricultural Policy reform of 2015, it was replaced with **basic payment**. The following analysis covers both payments, but to set the emphasis, only the presently used term of basic payment was used.

The amount of basic payment allocated to a given farmer is a sum of the value of entitlements activated by the farmer in the agricultural area eligible for payments that are part of the farmer's agricultural holding. The scope of the support is broad, since both agricultural area, on which agricultural production is held (any type of crops or livestock grazing), and agricultural area only maintained in a state which makes it suitable for production (cultivation or grazing) can be eligible for payments.

Increasing the utilised agricultural area by a farmer, as compared to the reference acreage of a farm (which corresponds to the number of entitlements to payments given to the farmer under the so-called primary distribution of payments), is linked to increasing the basic amount of payment obtained only in case of simultaneously getting additional – compared to those obtained via this breakdown – entitlements to payments. But then, getting additional entitlements to payments can be the result of allocation from the national reserve, acquisition, e.g. along with inherited farms, or purchase transaction in the market (Figurski and Sadłowski, 2013).

Overlooking the possibility to set entitlements to payments as a manner of distribution of the national reserve by a Member State[1], the sum of entitlements to payments in a given country is constant and corresponds to the total number of entitlements given to all farms under the first distribution. This means that – regardless of any possible changes in the UAA of individual farmers or in the number of entitlements to payments they hold individually – in each year the total area covered by the basic payment will not be greater than the reference area of the country.

Coupling the basic payment with entitlements, whose number depends on the reference acreage, incorporates into the instrument an element of historical nature. Consequently, payments are allocated to the current UAA, but not greater than the area following from entitlements to payments.

Figure 1 presents the impact of this type of payments on the level of land use for farming activities on the example of the regional model[2].

The Figure presents a coordinate system, in which the annual stream of land outlays – measured in physical units (ha/year) – is noted on the x-axis, while the y-axis shows the marginal income, expressed in monetary units per hectare.

Marginal income per area unit is a growth in total income resulting from a growth in land outlays by unit:

$$MI = \frac{\Delta TI}{\Delta L}$$

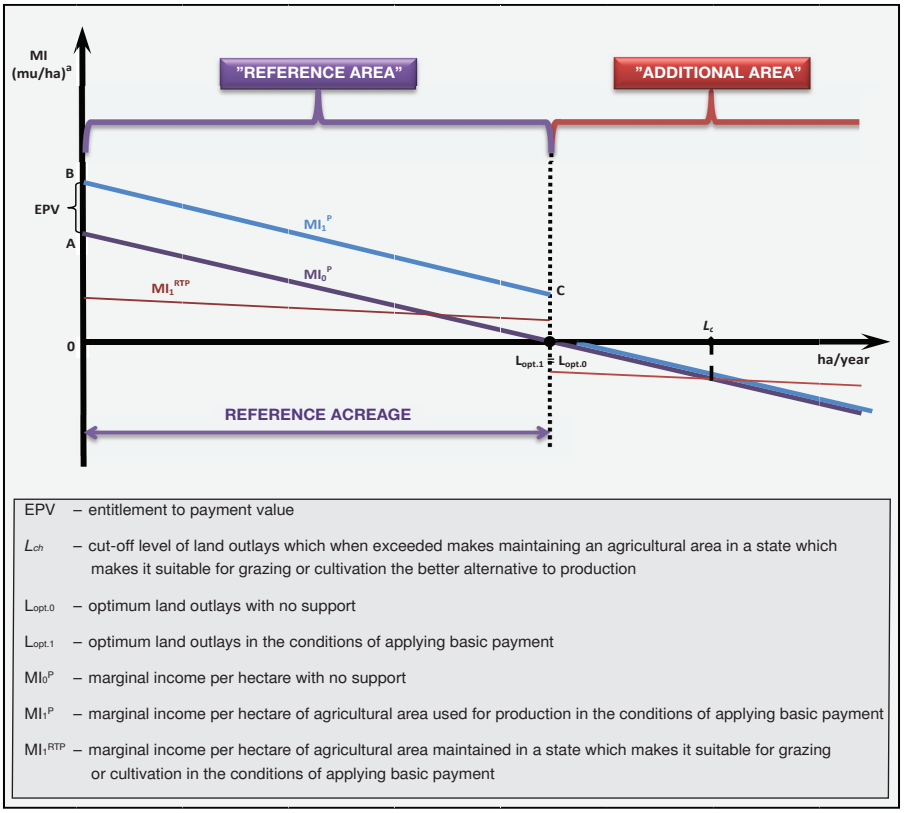
where:
MI – marginal income per area unit,
ΔTI – total income growth,
ΔL – growth in unit land outlays.

Total income is a result category and constitutes remuneration for land factor. It is *de facto* land rent according to the Ricardian economics, i.e. the residual left after payment for labour and capital (Ricardo, 1957).

The graph of the function: *f (L) = MI* is a sloping line. Negative slope of this line results from the fact that, firstly, the most fertile agricultural area, generating the highest income, is involved in production. Along with involvement of more and more peripheral agricultural areas (moving right along the 0X axis) the marginal income from each subsequent land unit is increasingly lower.

[1] Omission of the issue has no effect on the essence of the analysed problems especially that the national reserve is only a small percentage of the amount of funds allocated to payments.

[2] The range of the regional model can be limited to a defined area, forming a part of the territory of a Member State (e.g. federal states of Germany) or can cover an entire country. Not to complicate the description and the figure interpretation, it was assumed that the model is implemented country-wide. Nonetheless, the conclusions from the conducted analysis remain valid regardless of the implementation variant used in a specific case.



[a] monetary units/ha

Fig. 1. Basic payment versus agricultural use of land.
Source: own study.

In the initial situation, i.e. no support, the marginal income per hectare represents the MI_0^P line. After introduction of support in the form of basic payment, income generation enables not only agricultural area use for production purposes, but also maintaining it in a state which makes it suitable for grazing or cultivation. Consequently, two potential graphs of marginal income were drawn up for the variant with support: MI_1^P – for production use, and MI_1^{RTP} – for maintaining an agricultural area in a state which makes it ready for production. A farmer will choose this manner of land use of given agricultural area which ensures higher income. Hence, the finally achieved marginal income per given agricultural area, in case of support use, will be the higher value of the two values: MI_1^P and MI_1^{RTP}.[3]

[3] Subscript "0" means that the variable concerns the zero variant (no support), and the subscript "1" – that the variable concerns the variant with the use of support in the form of basic payment. The superscript "P" means that the variable concerns land used for agricultural production and the superscript "RTP" – that the variable concerns land kept ready for production.

At the intersection of the MI_1^P line with the MI_1^{RTP} line, to which correspond the L_{ch} land outlays, the manner of land use changes from production use to maintaining in a state which makes it ready for production. This change will be realised when this point is situated in 1st quadrant of the coordinate system, because then, the marginal income is positive.

When there is no support, the optimum level of land involvement in agricultural production ($L_{opt.0}$) is marked by the point of intersection between the MI_0^P line and the 0X axis. At such level of land use the total income on farming activity is maximum, and its size is illustrated by the area of the $A0L_{opt.0}$ triangle.

After introduction of the basic payment, the marginal income per hectare, in case of production use, will be the sum of marginal income generated in relation to conducting agricultural production and marginal revenue on account of basic payment (for greater transparency of deliberations it was assumed that there are no costs linked to application for payment[4]):

$$MI_1^P = MI_0^P + RI_{BP}$$

where:
MI_1^P – total marginal income per hectare in case of production use,
MI_0^P – marginal income per hectare on account of sales of agricultural products,
RI_{BP} – marginal income per hectare on account of basic payment.

Revenue on account of payments will be generated only by the "first" hectares of UAA (counting from the left of the 0X axis), whose total number does not exceed the overall number of entitlements to payments (in the Figure it is termed as "reference area" and the other agricultural area as "additional area"). The overall number of entitlements to payments (reference acreage), in turn, equals the number of hectares forming the agricultural area used for production before the introduction of support ($L_{opt.0}$)[5].

The regional model is distinguished by a lack of differences in the nominal value of entitlements to payments between farms, and also constancy in subsequent years of the support scheme application. Thus, for the "reference area"

[4] The assumption that there are no costs of obtaining direct payments is supported with small share of these costs in the amount of awarded support. In case of basic payment, this assumption allows to avoid a discrepancy between the value of activated entitlements to payments, i.e. revenue on account of basic payment, and income being the resultant category on that account (revenue decreased, e.g., by costs of services of farm advisory centre).

[5] This is a consequence of adopting some simplifications under the constructed analytical model. In fact, the state "no support" did not directly precede either the introduction of the basic payment scheme or the introduction of the single area payment scheme. Hence, the "initial" UAA, which in practice was used to determine the number of entitlements to payments, failed to correspond to the theoretical area that was used in the free market conditions.

the marginal revenue on account of basic payment is constant and equals the unit nominal value of entitlement to payments (*EPV*). Whereas for "additional area", being the surplus over the reference value, the marginal revenue on account of basic payments equals zero, which results from a lack of entitlements to payments, which could be activated on them. In formal terms, this can be written as follows:

$$RI_{BP} = \begin{cases} EPV \text{ for } L \in (0; L_r] \\ 0 \text{ for } L \in (L_r; \infty) \end{cases}$$

where:
RI_{BP} – marginal income per hectare on account of basic payment,
EPV – entitlement to payment value,
L – land outlays,
L_r – reference acreage.

As a result:

$$MI_1^P = \begin{cases} MI_0^P + EPV \text{ for } L \in (0; L_r] \\ MI_0^P \text{ for } L \in (L_r; \infty) \end{cases}$$

where:
MI_1^P – total marginal income per hectare in case of production use,
MI_0^P – marginal income per hectare on account of sales of agricultural products,
EPV – entitlement to payment value,
L – land outlays,
L_r – reference acreage.

This means that for "reference area" the graph of the MI_1^P function moves up as regards the graph of the MI_0^P function by a section equal to *EPV*, while for "additional area" – it overlaps with the graph of the MI_0^P function.

Because the MI_1^P differs from MI_0^P by the support amount in the form of basic payment, the area between the graphs of the functions ($BAL_{opt.1}C$ parallelogram) illustrates the annual fund of resources allocated to basic payment, i.e. total value of all entitlements to payments.

Next, the MI_1^{RTP} line is the graph of the marginal income per hectare in case of alternative – as regards farming activity – land use, consisting in maintaining an agricultural area in a state which makes it suitable for grazing or cultivation.

This type of activity does not generate revenue on sales of agricultural products, but it, at the same time, involves specific costs; hence it will not be practiced when there is no support. Therefore, the MI^{RTP} line was drawn only for a variant with payment implementation[6].

In case of maintaining an agricultural area in a state which makes it suitable for grazing or cultivation, the marginal income is the difference between the marginal revenue on account of basic payment and marginal cost of maintaining an agricultural area in a state which makes it ready for production:

$$MI_1^{RTP} = RI_{BP} - MC^{RTP}$$

where:
MI_1^{RTP} – marginal income per hectare in case of maintaining an agricultural area in a state which makes it suitable for grazing or cultivation,
RI_{BP} – marginal income per hectare on account of basic payment,
MC^{RTP} – marginal cost of maintaining a hectare of agricultural area in a state which makes it suitable for grazing or cultivation.

Substituting relevant – constant in ranges – values for RI_{BP}, the formula for marginal income per hectare in case of maintaining an agricultural area in a state which makes it suitable for grazing or cultivation can be written as follows:

$$MI_1^{RTP} = \begin{cases} \text{EPV} - MC^{RTP} \text{ for } L \in (0; L_r] \\ -MC^{RTP} \text{ for } L \in (L_r; \infty] \end{cases}$$

where:
MI_1^{RTP} – marginal income per hectare in case of maintaining an agricultural area in a state which makes it suitable for grazing or cultivation,
EPV – entitlement to payment value,
MC^{RTP} – marginal cost of maintaining a hectare of agricultural area in a state which makes it suitable for grazing or cultivation,
L – land outlays,
L_r – reference acreage.

It was assumed that "maintaining an agricultural area in a state which makes it suitable for grazing or cultivation without preparatory action going beyond usual agricultural methods and machineries" (Regulation (EU) No 1307/2013

[6] Hence the subscript "1".

of the European Parliament and of the Council..., 2013) requires regular agro-technical treatments. The frequency and character of necessary treatments, and thus costs of such activities, depend on many factors, e.g. susceptibility of the given UAA to overgrowth. The necessary frequency of treatments aimed at stopping excessive expansion of vegetation can be greater at fertile agricultural areas, while the costs of agricultural equipment operation and fuel consumption can be higher in peripheral areas (e.g. due to large slope). It was finally assumed that the marginal cost of maintaining a hectare of agricultural area in a state which makes it suitable for production increases linearly, at a relatively slow pace, along with movement to the right on the 0X axis (on this axis the agricultural area is ordered from the most fertile ones to those of the lowest agricultural usability). As a result of adopted assumptions the MI_1^{RTP} line slowly drops. Given that the agricultural area generating income on account of basic payment is limited by a fixed number of entitlements, at a point corresponding to the reference area this line, just like the MI_1^P line, is discontinued – it falls by a section equal to *EPV*.

For $L \in (0;\ L_r]$, the MI_1^{RTP} line goes below the MI_1^P line. This means that maintaining "reference area" in a state which makes it suitable for grazing or cultivation is unjustified – production on the area makes it possible to achieve higher income[7]. For $L \in (L_r; L_{ch})$, the MI_1^{RTP} line it also goes below the MI_1^P line, and both lines are in the same range below the 0X axis, thus both land use methods bring losses (loss is lower in case of production). Only in case of the most peripheral agricultural areas situated to the right from L_{ch}, the MI_1^{RTP} line goes above the MI_1^P line, but both lines go below the 0X axis. This means that, although maintaining these areas in a state which makes them suitable for grazing or cultivation is a better alternative than production (it allows to decrease the loss), but not a better one than overall cessation of farming activities.

Finally, after introduction of the support the land outlays will amount to $L_{opt.1}$ and production will be held in all of the areas. Then, the total income will be maximum (its size is illustrated by the area of the $B0L_{opt.1}C$ trapeze).

In order to determine the impact of the direct payment on the level of land involvement, what needs to be compared are the land outlays in the new point of equilibrium (after introduction of support) with outlays of the factor in the initial situation (no support). From the Figure it follows that after introduction of the support in the form of basic payment, with other factors unchanged, the land outlays corresponding to the point of equilibrium, i.e. ensuring maximum total income, remained at the same level. The manner of land use also did not change. The only change against the initial situation is a growth in the income of farmers.

[7] This statement is important assuming that business cycle does not change in agriculture, which will be revoked in the further part of the analysis.

From Figure 1 it follows that in a stable economic situation for agricultural products, introduction of the basic payment will not affect the size of the land outlays or the structure of its use.

Figure 2 shows the impact of a drop in agricultural production profitability on the analysed correlations. Economic downturn[8] was illustrated as a downward movement of the marginal revenue line from the initial MI_1^P position to the MI_1^P' position.

The distance of the dislocated marginal income line from its initial location is proportional to the scale of changes in the economic situation. In the case presented in the Figure, the vertical arrows joining together the initial and final location of the MI_1^P line are directed downwards and are only slightly shorter than the EPV section. This means that there was an economic downturn and the resultant drop in revenues from sales of agricultural products levelled a major part of revenues on account of payments. The amount of support in the form of the basic payment is, however, sufficient to ensure that the land outlays are maintained at a level from the reference period.

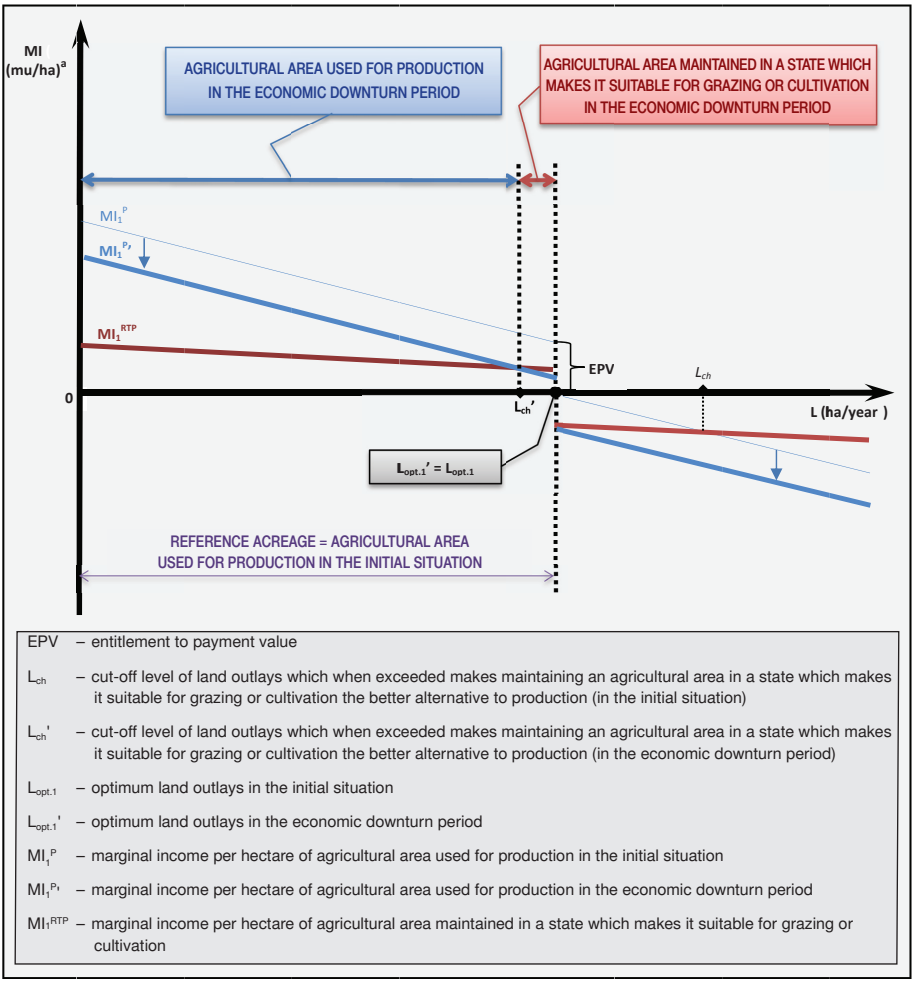
A drop in revenues from sales was strong enough to make the MI_1^P' line intersect the MI_1^{RTP} line to the left of $L_{opt.1}$. In the new situation, maintaining the "reference areas" from the range $(L'_{ch}; L_{opt.1}')$ in a state which makes them suitable for grazing or cultivation ensures higher income than production.

From the above analysis there comes a general conclusion that the stronger the economic downturn the higher the level of support will be necessary to keep the reference land outlays. At the same time, a strong enough drop in production profitability will cause a change in land use structure, and a growth in the fraction of agricultural area maintained in a state which makes it suitable for grazing or cultivation will depend on the scale of economic downturn.

Figures 1 and 2 can be used also to analyse a single farm. Respective variables would then stand for individual values of a farm, and the model would assume fixed economies of scale of the conducted activity.

An equivalent of basic payment **in the simplified system** is the **single area payment**. The amount of single area payment, to which a farmer is entitled, is calculated as a product of UAA approved for payments, forming the farmer's holding, and the rate of the payment. Just like in the case of basic payment, approval for support may go to all areas, where farming activity is being conducted, which is understood as conducting agricultural production or maintaining agricultural areas in a state which makes them suitable for grazing or cultivation.

[8] It was assumed that the profitability of agricultural production deteriorated because of a drop in prices of agricultural products at fixed costs of running farming activities. As a result, the M_1^{RTP} line did not move, since the course of the line is not affected by the situation in the market of agricultural products.



[a] monetary units/ha

Fig. 2. Effects of economic downturn in agriculture in the basic payment system.
Source: own study.

The manner of calculating the support amount significantly differentiates the single area payment from the basic payment. In case of basic payment, the fixed number of entitlements to payments, corresponding to the number of hectares of UAA in the reference period, causes that in a situation of possible growth in area eligible for payment against the reference acreage, this surplus in area over the reference acreage will not be covered by support. Whereas in case of single area payment, a growth in the area eligible for payment will, indeed, cause a drop in the payment rate, but the whole UAA will be covered by payment.

Figure 3 presents the effects of introducing single area payment. The meaning of symbols used is similar as in the model concerning the basic payment, presented in Figure 1. The equivalent of the entitlement to payment value (*EPV*) is the single area payment rate (PR_{SAP}).

The correlations presented in the Figure refer to a single agricultural holding with fixed economies of scale on the conducted activity. It was assumed that the changes in the UAA of this farm are negligible as compared to the total area of UAA in the country. As a result, the decisions taken by such a single farm as regards the amount of land outlays continue to have no impact on the single area payment rate. From the perspective of a farm the rate of this payment is independent from the UAA declared for payments in this farm. In order to emphasise this specific approach, the MI_1^P and MI_1^{RTP} lines for land outlays higher than the initial area were drawn as a dashed line.

In the no support variant, the land outlays in a state of equilibrium ($L_{opt.0}$) are set by the point of intersection of the MI_0^P line and 0X axis. Total income is then maximum and corresponds to the area of $A0L_{opt.0}$ triangle. Because of support introduction, a farmer will additionally include in use the areas for which:

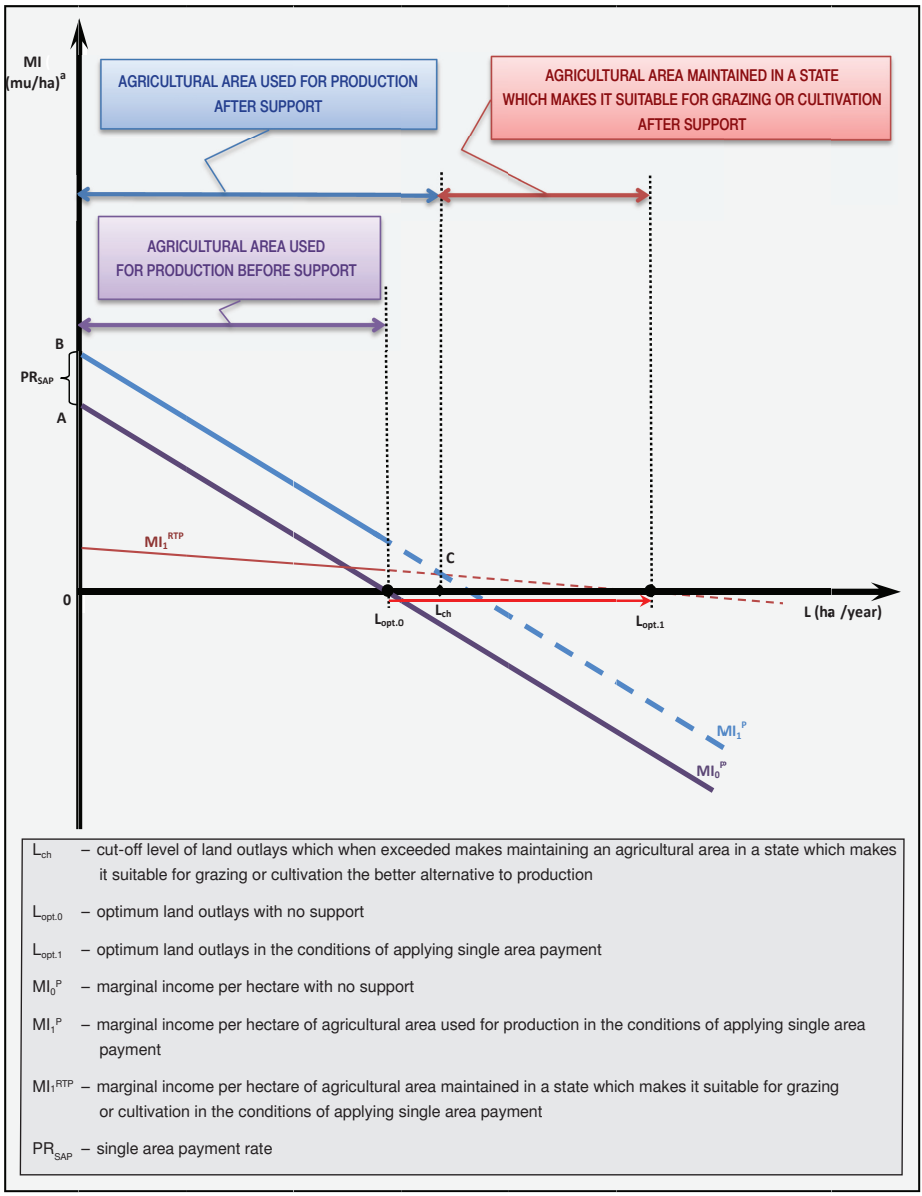
– the marginal income per hectare obtained as a result of conducting agricultural production (considering the single area payment), i.e. MI_1^P,
– or the amount of support per hectare less the marginal cost of maintaining a hectare of area in a state which makes it suitable for grazing or cultivation, i.e. MI_1^{RTP},

is larger than zero.

Consequently, land outlays corresponding to the new point of equilibrium will amount to $L_{opt.1}$. This will ensure maximum income, whose level is illustrated by the area of the $B0L_{opt.1}C$ quadrangle. Then, whether there will be production in agricultural areas included into use as a result of payments or will they only be maintained in a state which makes them suitable for grazing or cultivation, depends on the level of MI_1^P as compared to MI_1^{RTP}. If $MI_1^P > MI_1^{RTP}$, agricultural production will be conducted in the area. Whereas if $MI_1^P < MI_1^{RTP}$, the area will be maintained in a state which makes it suitable for grazing or cultivation.

Comparing the location of the point of equilibrium of the producer before introduction of support and after its introduction makes it possible to state that single area payment caused a growth in the land outlays at a farm from the level of $L_{opt.0}$ to the level of $L_{opt.1}$, and only some part of this increase in land outlays (from $L_{opt.0}$ to L_{ch}) was used in production[9]. Hence, single area payment has a stimulating effect on the level of agricultural area involvement in farming activities.

[9] A loss resulting from running farming activities in these areas, fully compensated with area support, is lower than the cost of maintaining these areas in a state which makes them suitable for grazing or cultivation.



L_{ch}	– cut-off level of land outlays which when exceeded makes maintaining an agricultural area in a state which makes it suitable for grazing or cultivation the better alternative to production
$L_{opt.0}$	– optimum land outlays with no support
$L_{opt.1}$	– optimum land outlays in the conditions of applying single area payment
MI_0^P	– marginal income per hectare with no support
MI_1^P	– marginal income per hectare of agricultural area used for production in the conditions of applying single area payment
MI_1^{RTP}	– marginal income per hectare of agricultural area maintained in a state which makes it suitable for grazing or cultivation in the conditions of applying single area payment
PR_{SAP}	– single area payment rate

[a] monetary units/ha

Fig. 3. Single area payment versus land outlays of a farm.

Source: own study.

Moving from an analysis at the farm level to an analysis at the country level, it is necessary to revoke the assumption on the constancy of the single area payment rate[10]. Joint decisions of atomised farms will translate into a growth in the total UAA, causing a drop in the rate. The created incentive will result in one-way, not mutually compensating changes in land outlays at farms, leading to an increase in the total UAA in the country as compared to the initial area. Consequently, the location of MI_1^P and MI_1^{RTP} lines will be different for each level of land involvement. They will run the lower, the larger is the UAA covered by payments, ending its course on the vertical line marking the given level of land outlays.

Automatic drop in the single area payment rate, accompanying a growth in the UAA approved for payment, is a mechanism self-supressing the stimulating impact of this instrument on the level of land involvement in the farming activities.

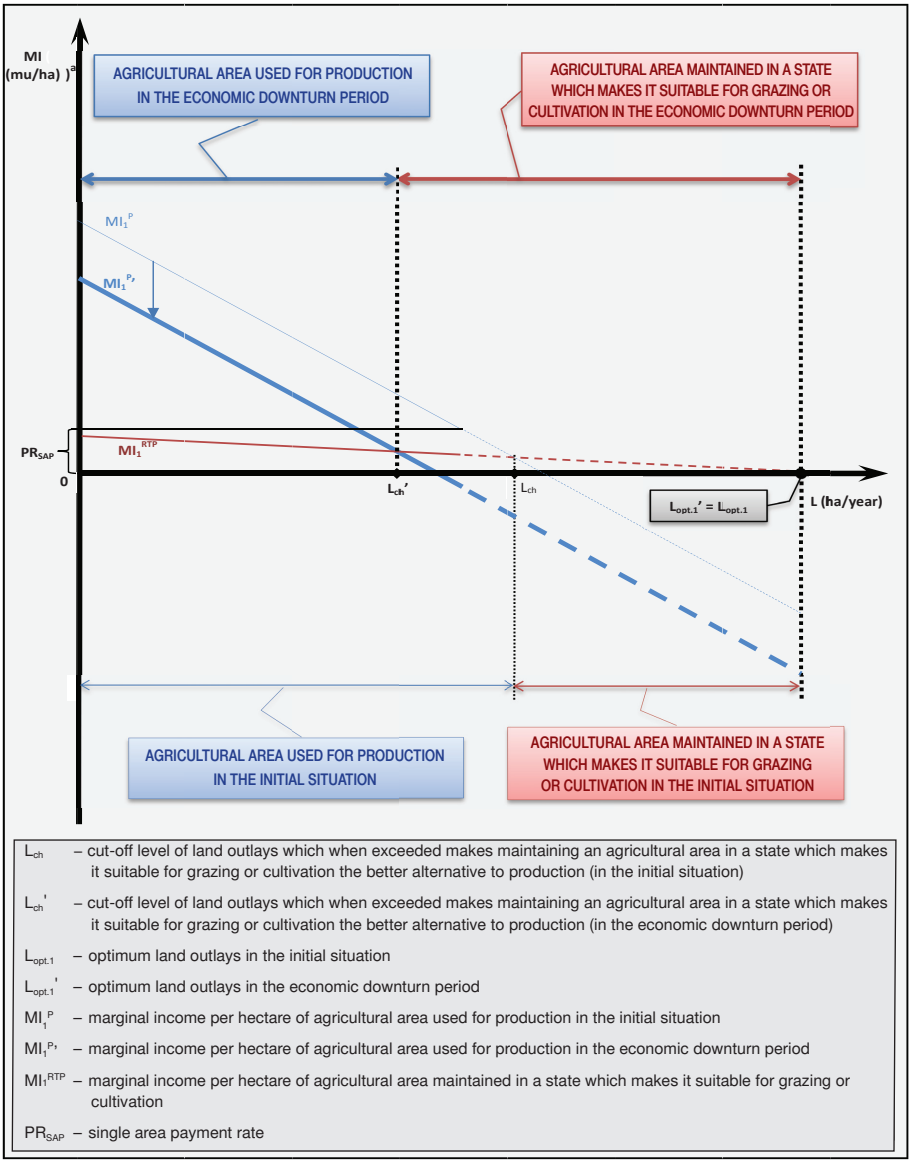
The location of the marginal revenue lines in Figure 3 is fixed, which happens only when economic situation in agriculture is stable. Figure 4 illustrates the impact of a drop in agricultural production profitability on the analysed correlations.

In case of no support, a drop in agricultural production profitability would cause a decrease in the land outlays of a farm. Whereas in the conditions of using single area payment, economic downturn did not translate into the size of land outlays of a farm ($L_{opt.1'} = L_{opt.1}$), it only caused a change in the structure of its use. The agricultural area maintained in a state which makes it suitable for grazing or cultivation increased to the disadvantage of area used for production purposes by area from the range (L_{ch}'; L_{ch}). The increase in the share of area maintained in a state which makes it ready for production is proportional to the scale of economic downturn.

Both in the scheme based on entitlements and in the simplified scheme, apart from support allocated to the total UAA where farming activities are being carried out (i.e. any crop cultivation or livestock grazing or maintaining an agricultural area in a state which makes it ready for production), it is possible to use sectoral area support. It is support targeted at cultivation of selected crops, e.g. sugar beets, hops, cereals.

In the simplified scheme, the sectoral area support always increases aid allocated to given agricultural areas in the form of single area payments. Whereas in the scheme based on entitlements accumulation of payments happens only in case of "reference area", i.e. in case of land where entitlements were activated.

[10] The single area payment rate is a quotient of the global amount allocated to support and the area approved for payment. At fixed amount of funds allocated to single area payment, the rate of this payment depends only on the area approved for payment and is inversely proportional to it, i.e. it gets lower, the larger area is covered by payment.



[a] monetary units/ha

Fig. 4. Effects of economic downturn in agriculture in the single area payment scheme (from the perspective of a farm).

Source: own study.

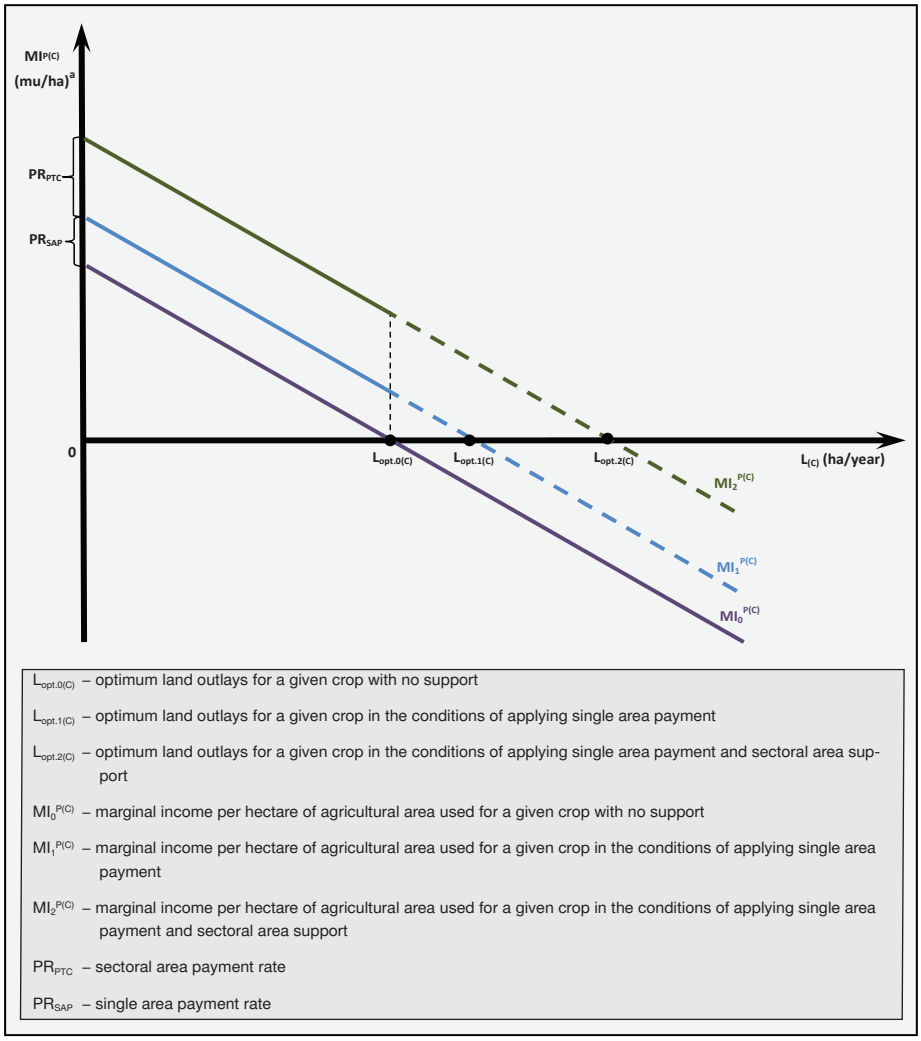
Figure 5 presents the impact of the sectoral area support at the level of land use for a given type of crop on the example of a simplified scheme[11]. Just like in the model concerning single area payment, it is an approach from the perspective of an agricultural holding, omitting the scale effects of production and assuming that the cultivation area covered by sectoral support at a farm has a negligible share in the total area of this type of cultivation in the country.

From the Figure it follows that after introduction of the sectoral area support with a rate at the level of PR_{PTC}, a farm will increase the level of involvement of land under cultivation covered by payments to the level of $L_{opt.2(C)}$. Thus, it will ensure to itself a maximum total income from this production direction, whose volume is illustrated by the area under the graph of the new marginal income function, i.e. $MI_{2P(C)}$ line.

Given the increased attractiveness of cultivating crops covered by sectoral support as compared to other production directions, farmers modify the structure of crops, making a preference for more strongly supported crops. For incomplete use of the production potential a respectively high level of support can encourage to include into cultivation areas not used to date for production purposes. First of all, the inclusion would cover agricultural areas maintained in a state which makes them suitable for grazing or cultivation. Changes in the production volume and structure, at fixed demand for agricultural products, will constitute a stimulus for market balancing price adjustments with a direction opposite to the supply change, i.e. the prices of products whose supply drops will grow, and the prices of products whose supply grows will drop. Hence, a different structure of production, consumption and prices will correspond to the new state of equilibrium.

In case of sectoral area support, just like in the case of single area payment, there is an automatic mechanism hampering stimulating impact of this instrument on the area of crop of the supported plant. The operation of this mechanism consists in automatic decrease in the payment rate along with a growth in the area approved for aid.

[11] A similar analysis for the system based on entitlements would require to make separate graphs for "reference area" and "additional area" (given the aforementioned lack of payment accumulation in case of the latter). In case of "reference area" the new line of marginal income per hectare of area would be dislocated against the $MI_{0P(C)}$ line by the section ($EPV + PR_{PTC}$), while in case of "additional payment" – only by the section PR_{PTC}.



[a] monetary units/ha

Fig. 5. The impact of sectoral area payment on the area of supported crop at a farm (on the example of the simplified scheme).

Source: own study.

Production support

Production support covers all sectoral payments executed under the direct support scheme, whose amount depends on the current production volume or number of owned livestock units.

The model presented in this part describes the impact on the production area of production support allocated to the production volume (quantity). Conclu-

sions from the analysis can also constitute a sort of approximation of the effects of support use to the number of owned livestock units.

The production support amount (QP), to which a farmer is entitled, is a product – expressed in weight units (kilogrammes or tonnes) – of the quantity of product approved for payment (q) and – expressed in monetary units per, respectively, a kilogramme or a tonne – of the rate of this payment (PR_q). In order to research the impact of this type of support on the production volume the following was used:

- function of a long-term total cost $f(q) = LTC$ and function of the long-term marginal cost $f(q) = LMC$ – for the description of the agricultural production process;
- total revenue function $f(q) = TR$ and marginal revenue function $f(q) = MR$ – for the description of the market situation.

As regards the correlations describing the agricultural production processes, it was assumed that for low production levels the total costs grow slower than the effects, for higher production levels – the increase in costs is faster than the increase in effects. Thus, the graph of the function $f(q) = LMC$ has a point of change of the growth rate, to which corresponds the minimum of function $f(q) = MTC$ in the graph of marginal values. Graph of function $f(q) = LMC$ goes from the start of the coordinate system, because in the long term, all costs are included in the category of variable costs, i.e. depending on the production volume (Samuelson and Nordhaus, 2004). A precise share and location of the *LTC* and *MTC* curves is an individual feature of a producer.

Given the negligible share of individual agricultural producers in market supply and relative homogeneity of agricultural products, it was assumed that a producer is not able to affect the price of these products. This made it possible to describe the market situation using the perfect competition model, in which the price is fixed across the entire production volume growth range (Mansfield, 2002). Therefore, the graph of function $f(q) = TR$ is a line going from the beginning of the coordinate system, and the increase in total revenue following from the production growth by a unit[12] is fixed across the entire production volume growth range and, at the same time, it equals the price. This means that marginal revenue (MR) equals the price (P) and average revenue (AR), and their graph is a line parallel to the x-axis. Changes in the production volume of a single farmer have no effect also on the payment rate, thus it is also (just like price) fixed, from the perspective of the producer.

Following the adopted assumption on zero costs of acquiring payments, the production support rate fully increases the remuneration obtained by a farmer per product unit, translating into the level of production of a good covered by

[12] As a result of adopted assumptions, a growth in production simultaneously means the same sales growth.

aid, just like a growth in its price. In the graph of total values it is illustrated with a growth in the pitch of total revenue line against the x-axis, and in the graphs of marginal values – in the upward dislocation of the horizontal marginal revenue line[13].

Figures 6-8 present different effects of introducing production support depending on:

1. location of the total revenue line against the graph of the long-term total revenue function, and
2. location of the marginal revenue line against the graph of the long-term marginal cost function.

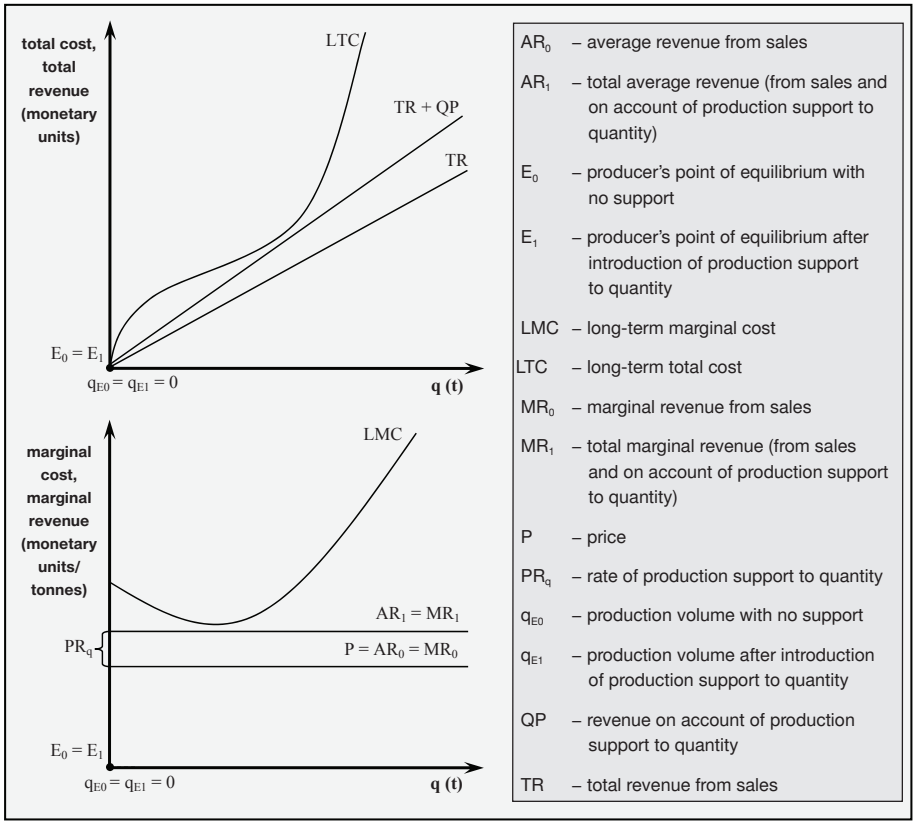


Fig. 6. Production support at the level of insufficient incentive to start production.
Source: own study.

[13] As a consequence of the assumption on the horizontal course of the demand function on a product of a single producer, any production growth of this producer, caused by the introduction of production support, will always find purchasers at market price. Thus, the marginal revenue from sales of subsequent product units is fixed.

In the situation presented in Figure 6, a farmer will not be inclined to provide a product to the market, because at none of the production levels the price – even increased by the payment rate – ensures such a level of total revenue (area under MR_0 line – when payment is not applied, or under MR_1 line – when the applied payment rate is in the amount of PR_q), which would cover long-term total cost (area under the *LMC* curve). Total revenue line considering production support $f(q) = TR + QP$ at each production level lies below the *LTC* curve. This means that the payment rate is too low to cause economic effects at this producer's.

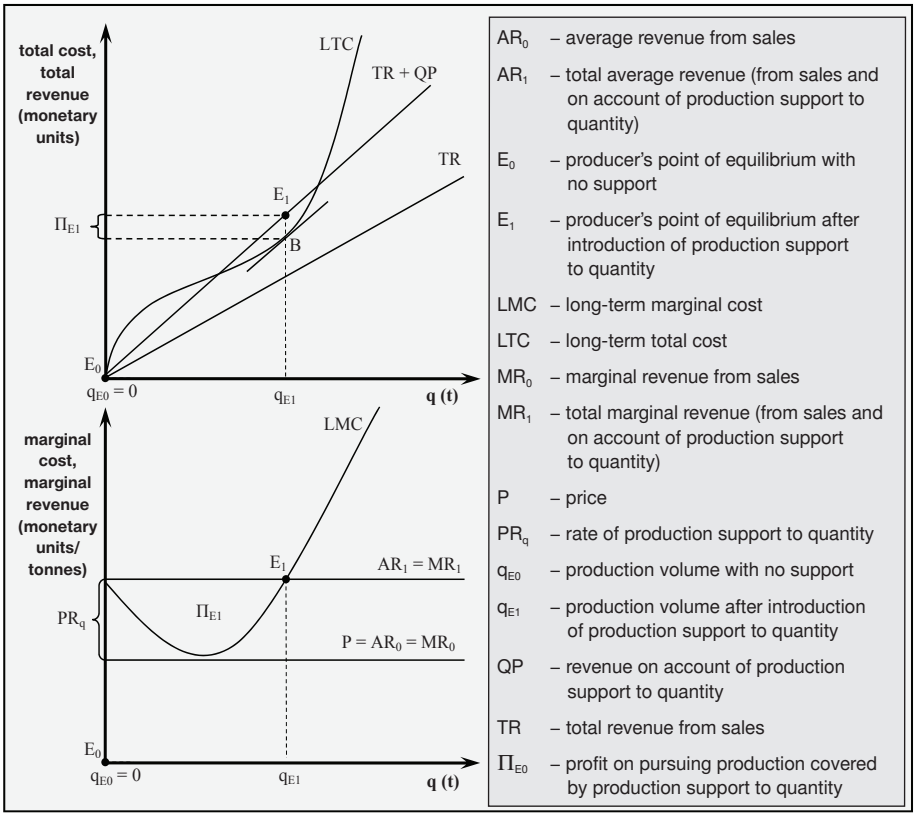


Fig. 7. Production support at a level inclining to start production.
Source: own study.

In the situation presented in Figure 7, the payment rate was set at the level ensuring, to a producer at a new point of equilibrium E_1, profit whose amount is illustrated by the BE_1 section in the graph of total values and the Π_{E1} area in the graph of marginal values. In the graph of total values the new point of equilibrium is in the section of the line $f(q) = TR + QP$ going above the *LTC*

curve, at a point where the distance between them is the largest. Whereas in the graph of marginal values, the new point of equilibrium is at a point of intersection between the MR_1 line and the *LMC* curve in its growth range. Production in the quantity of q_{E1} corresponds to the new point of equilibrium, while in case of no support the production volume of the analysed good at the farmer's would amount to 0.

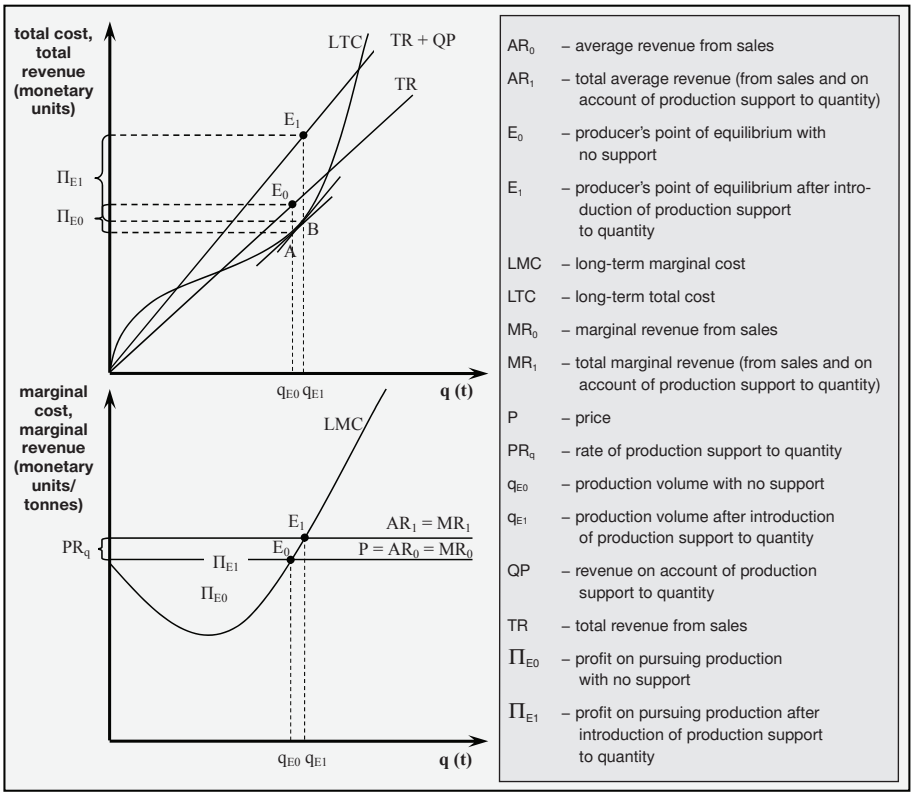


Fig 8. The impact of production support on the production volume of a farm, which in the initial situation manufactured a product covered by support.

Source: own study.

Whereas Figure 8 presents a situation in which a farmer supplies a product to the market, even if no production support is applied, because the price ensures him revenue at a level enabling profit generation (illustrated by section AE_0 in the graph of total values and Π_{E0} area in the graph of marginal values). The introduction of support in a form of payment to the current production value allows to achieve a higher profit (section BE_1 in the graph of total values and Π_{E1} area in the graph of marginal values) at higher production level ($q_{E1} > q_{E0}$).

Concluding, production support can have a different impact on the production level of farms, depending on the individual curves of production costs of a supported good at respective producers'. The stimulating impact of this type of support on production is proportional to the payment rate.

Adopting, in the above considerations, the perspective of a farm having a negligible share in the market of a product covered by support made is possible to use the horizontal graphs of price and payment rate. Hence, neither the product price nor the payment rate depends on the production volume of a farm, which was the independent variable in the model. Analysis at the country level requires leaving the simplification behind, i.e. it is required to take into account the fact that the production support rate is inversely proportional to the production volume. Automatic drop in the payment rate along with a growth in production acts as an automatic stabiliser reducing the stimulating impact of support on production[14].

Figure 9, using the partial equilibrium model of the market of a product covered by the payment, presents the effects of introducing the production support, taking into account the negative inclination of the market demand line and payment rate, opposite to the direction of changes, resulting from changes in the production volume.

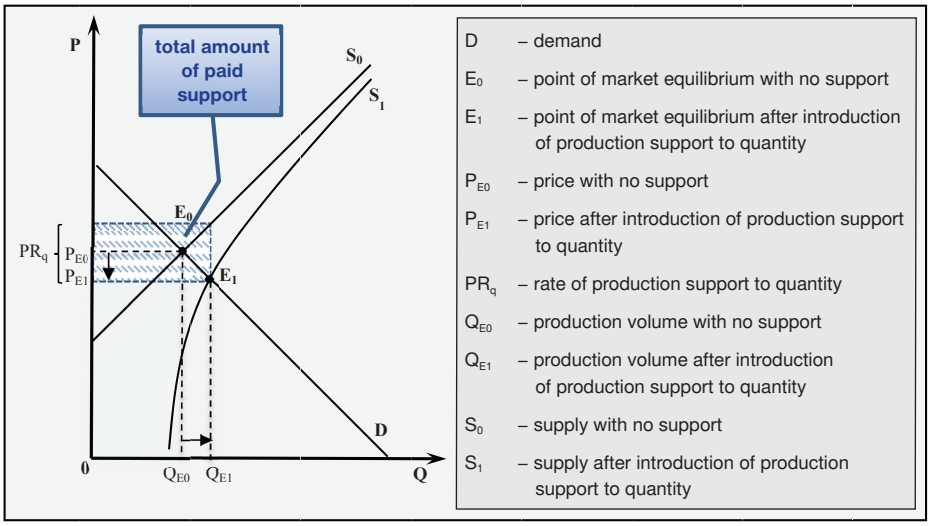


Fig. 9. Impact of production support on the market of the product covered by payment.
Source: own study.

[14] There is a mutual correlation between the payment rate and the quantity of product covered with support. The payment rate in a given year depends on the quantity of product approved for payment in a given year, while the quantity declared for support in a given year largely depends on the payment rate in the past year.

The volume and price of equilibrium in the initial situation, i.e. no support, is marked by coordinates of the point of intersection between the demand line D and the supply line S_0, thus coordinates of point E_0. As a result of introducing production support, the new graph of the supply function will go below the graph of the original supply function, thus – because of the mechanism automatically decreasing the payment rate along with a growth in the quantity of agricultural products covered with support – this graph will take on the shape asymptotically approximating the S_0 line. The market will stabilise with quantity and price marked by the point of intersection of the demand line D with the S_1 supply curve, i.e. at a price lower than the initial level and at greater production volume.

Historical support

The subject of the analysis in this part are the payments to cultivation area or to production volume from the reference period (possibly to the number of livestock units owned in the reference period). The reference period is a past period already at the moment of establishment of a given support instrument. Exactly because of this link with the cultivation area, production volume or number of owned livestock units in the past, these payments were termed as historical support.

The amount of historical support, to which a farmer was entitled, to cultivation (e.g. of hops, soft fruit) is calculated as a product of the area of the cultivation at a farmer's holding in the reference period and the payment rate for a given crop, which is expressed in monetary units per hectare. Whereas the historical support amount is the product of the amount of owned livestock units, expressed in kilogrammes or tonnes of production volume of a given farm in the reference period, and the payment rate, expressed in monetary units, respectively per kilogramme or tonne. Such principle of awarding support implies that a farmer has no possibility of impacting the amount of awarded payments with current decisions on the sowing area, volume of outlays, etc.

Figures 10 and 11 show that historical support has no impact on the production volume of a farm, regardless of its initial situation. Historical payments have no impact on the marginal revenue, but increase the total revenue moving the *TR* line up, by a distance equal to the support amount (*HP*). Hence, to illustrate the impact of this type of aid on the location of the point of equilibrium of a producer, the graphs of total values were used.

In the situation presented in Figure 10, today, a farmer fails to manufacture the product covered by the historical payment ($q^{E0} = 0$), because the sales revenue would not cover the production costs at any of the production levels (*TR* line all along runs below the *LTC* curve). However, the farmer is entitled to obtain historical payment in the *HP* amount on account of running production of the good in the reference period. The maximum possible profit on produc-

tion of the good covered by support, considering the historical payment, could amount to Π_P. It is lower than the profit generated, due to the received support without running production ($\Pi_P < \Pi_{E1} = HP$). Hence, optimum production volume of this good, even after introduction of the support, is zero ($q_{E0} = q_{E1} = 0$).

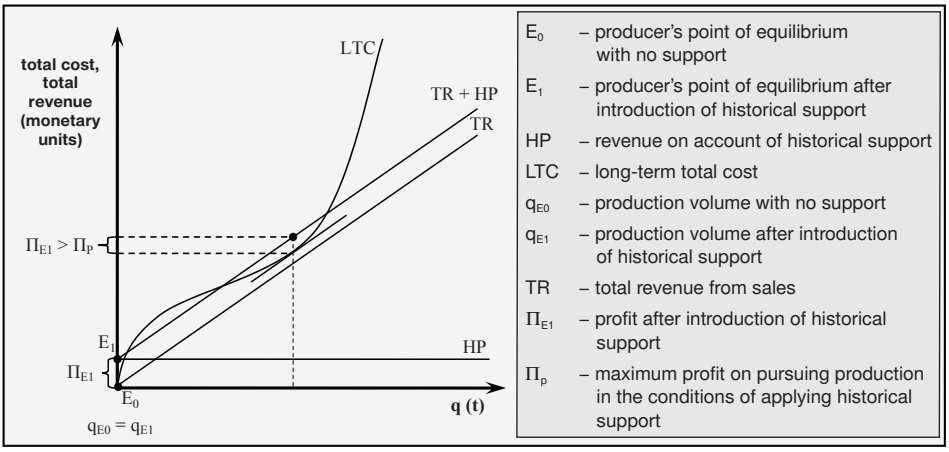


Fig. 10. Historical support versus production volume of a farm in a situation when the current market price is not sufficient to stimulate production.

Source: own study.

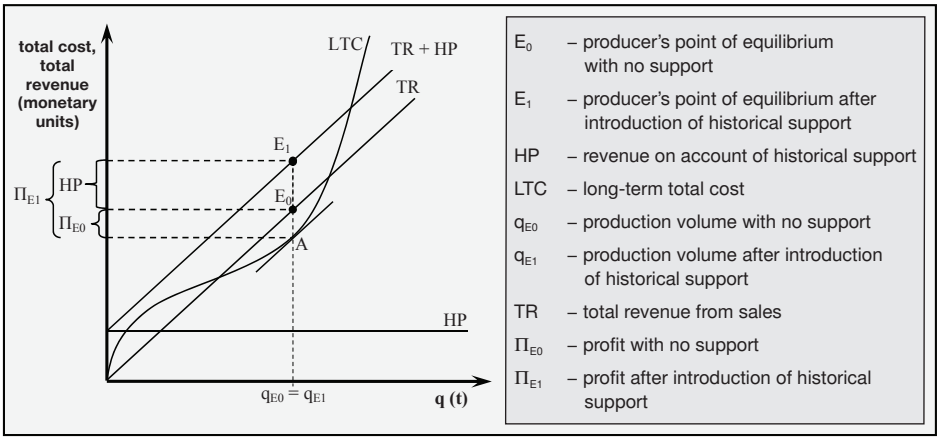


Fig. 11. Historical support versus production volume of a farm in a situation when the current market price is not sufficient to stimulate production.

Source: own study.

In turn, Figure 11 presents a situation in which a farmer presently manufactures a product covered by a historical payment because production generates profit, whose amount at optimum production level (q_{E0}) is illustrated by section AE_0. Considering the historical payment, the profit grows to the AE_1 level, while – similarly as in the situation presented in Figure 10 – the fact of applying historical support has no effect on the production volume corresponding to the point of equilibrium ($q_{E0} = q_{E1}$).

Hence, historical support still has no impact on the production volume of a farm, which continues to be determined only by market conditions and production function of a farm.

Conclusions

The manner and strength of impact of the direct support scheme on the manufacturing area depends on the significance of respective types of payments in the system.

Basic payment, single area payment and sectoral **area support** are instruments included as area support, which, however, have different impact on the allocation of funds.

Because of coupling **basic payment** with entitlements, this instrument does not encourage to increase UAA. This payment, though, counteracts lowering of the production potential of agriculture in a situation of deteriorating profitability of agricultural production. It acts as a compensator of the loss from agricultural production or a compensator of costs of maintaining agricultural areas in a state which makes them suitable for grazing or cultivation, maintaining, respectively, production or readiness for agricultural production. In this sense, the use of entitlements to payments favours petrification of UAA at the level from the reference period. Counteracting the cessation of farming activities in the least fertile areas, in the conditions of deteriorating profitability of agricultural production, however, offsets (in case of moderate drops in profitability) or mitigates (in case of strong drops) a negative impact of economic downturns on the production potential of agriculture, thus preventing reduction in food security level or limiting its scale.

A similar role is fulfilled by **single area payment**, which can additionally be an incentive for farms to increase the land outlays, resulting in a growth in the total UAA in the country. A growth in the area, caused by other reasons than the positive changes in the economic situation, is, nonetheless, unjustified from the perspective of rationality of resources use, the more that the total income of all farms would be the highest in the cases of land use at the initial level. Then, the economic result of agricultural production would be maximum, and, at the same time, the total amount of funds allocated to this support would be distributed under the single area payment. Growth in the land outlays of a farm stimulated by single area payment does not lead to a real growth in income, because

of the same production decisions of other farms, thus weakening the effects of coordinating function of the market. However, because of the elasticity of the single area payment rate the growth in the land outlays in a country will cause a proportional drop in the support rate, and thus the strength of the incentive to increase the land outlays will weaken along with a growth in UAA.

Both the basic payment and single area payment continue to have no impact on the absolute differences in profitability of running the respective directions of agricultural production, which determine the production structure. Therefore, also after the introduction of this type of support, the price relations created as a result of the market mechanism functioning decide on the structure of crops.

Whereas **sectoral area suppor**t, i.e. support to cultivation area of selected crops, increases the profitability of cultivation of crops covered by this support as compared to other production directions. It is, at the same time, just like the basic payment and the single area payment, neutral to the intensity of production run in individual agricultural parcels. Introduction of this type of support leads to modifications of the structure of crops, consisting in the growth in the share of crops supported more strongly. For incomplete use of the production potential a respectively high level of support will cause simultaneously a growth in the production extensiveness by inclusion into cultivation areas not used so far for production purposes.

The effects of applying **production support** in the field of stimulating production volume are similar to the effects caused by price growth. Given the direct correlation between the amount of allocated payment and production volume, the support has a higher potential of influencing the agricultural production volume and structure than the sectoral area support.

Whereas the **historical suppor**t does not affect either the land outlays or agricultural production volume and structure. After introduction of this type of payments, the production volume and structure of a farm will still be determined by market conditions and production function of a given producer. This instrument has a positive impact on the financial result of farms, keeping neutrality as regards the production area.

Reformed direct support scheme, which has been in use since 2015, gives Member States (to some extent) the possibility to shape the applied instrumentation and decisions on the level of financing of individual forms of aid. In this context, the above conclusions can have **application meaning** facilitating designing of a relevant set of instruments – depending on the targets adopted at the national level and their hierarchy.

In case of efforts to maintain the production potential in agriculture (to ensure food security), with possibly low impact on agricultural production volume and structure, it is recommended to use area support. The efficiency of this instrument is, however, dependent on the lack of excessive discrepancy between land use and ownership, because otherwise the payment can be taken

over by the land owners by increasing the lease rent rates. Whereas if countering atrophy of specified directions of agricultural production is a priority, the production support can be the most efficient instrument. But then, historical payments, which are characterised by neutrality towards production volume and structure, and lack of impact on the outlays of the factors of production, should be considered as an instrument of support for farmer income, especially when the agricultural sector or a defined group of potential beneficiaries shows a slight dynamics of changes[15]. Significant inertia of the sector counteracts fast increase in the discrepancy between the amounts of awarded historical support and current size of a farm.

[15] Presently, the historical payments can be implemented only under transitory national support.

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WPŁYW PŁATNOŚCI BEZPOŚREDNICH NA SFERĘ WYTWARZANIA – UJĘCIE MODELOWE

Abstrakt

W artykule wykazano na gruncie teoretycznym, że system wsparcia bezpośredniego powoduje zmiany w wielkości i strukturze produkcji dóbr w stosunku do produkcji wykreowanej działaniem rynku, pełniąc w ten sposób funkcję realokacyjną. Przy pomocy zbudowanego modelu zobrazowano w formie graficznej wpływ stosowania poszczególnych instrumentów współtworzących system wsparcia bezpośredniego (płatności obszarowych, wsparcia produkcyjnego i płatności historycznych) na poziom zaangażowania ziemi w działalność rolniczą i wolumen produkcji rolnej. Analizę tę uzupełniono opisem oddziaływania poszczególnych form pomocy na strukturę produkcji rolnej.

Słowa kluczowe: Wspólna Polityka Rolna, system wsparcia bezpośredniego, płatności bezpośrednie, nakłady czynników produkcji w rolnictwie, wolumen produkcji rolnej, struktura produkcji rolnej.

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