Microeconomic aspects of government subsidies in the agricultural market

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Abstract: It is known from the Czech practice that a very actual problem of economic policy is created by the subsidies on the prices of agricultural products. A price subsidy of agricultural product causes the price to be kept above its equilibrium level. We will use the microeconomic knowledge about the behaviour of average and marginal costs curves in the short-run and long-run. We assume two agricultural firms in a perfect competition market. The agricultural large-scale company reaches a normal profit, but the small family firm has higher costs, therefore it runs at a loss. Using the subsidy can ensure that the prices of agricultural products are set at a level, at which the farmers have appropriate incomes. However, a loss of efficiency can occur because of the subsidy as the surplus, which is purchased by the government, and actually stays unused.

Key words: efficiency, equilibrium, long-run average costs, long-run marginal costs, price intervention programs, subsidy of agricultural products

Governments are heavily involved in financing of research and development (R&D) in modern economies (Bohnstedt et al. 2012), but they also devote significant resources to agriculture subsidies. These subsidies fall into two general categories: (1) support based on production levels or prices (sometimes including limits to production) and (2) direct income support (Gottschalk et al. 2007). It is known from the practice of the Czech Republic that a very actual problem of economic policy is created by the subsidies on prices of agricultural products. The proportion of subsides in farmers' revenues reached 20% in 2008, one fourth of all sources during production comes from subsidies. Subsidies have been increasing every year since 2004, which is expressed in the growing yields per hectare. The price subsidy of an agricultural product causes the price to be kept above the equilibrium level.

We will use the mentioned conclusions for an analysis of the consequences of the governmental price intervention. According to the firm theory, the goal of a firm in the long and short run is to achieve (if possible) maximum profit. To point out the consequences of the governmental price intervention, we assume two agricultural firms in a perfect competition market.

MATERIAL AND METHODS

The results in the text can be demonstrated by the analysis using costs curves of big and small firms. (Soukup and Šrédl 2011). We will use the microeconomic knowledge about the behaviour of the average and marginal costs curves in the short-run and long-run. The presented model is naturally a simplified overview of the reality. However, it sufficiently explains the base of the issue. In the USA, "farmers who rent the land and cultivate it capture 75% of the subsidy, leaving just 25% for the landowners. This finding contradicts the prediction from the neoclassical models" (Kirwan 2009).

The land allocation decisions of smallholder farmers, including decisions to adopt the improved crop varieties, have interested researchers and policy makers for decades (Feder 1980; Just and Zilberman 1983).

RESULTS AND DISCUSSION

The proposal of the European Commission for the form of the Common Agricultural Policy of the EU after 2013, introduced in the autumn 2012, promises more righteous conditions for the distribution of

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subsidies among the farmers from the new member countries. These farmers feel discriminated on a long-term basis when compared to their West European colleagues.

Czech farmers will hopefully not lose 6–13 billion crowns a year on the EU subsidies, which could happen if the EU enforced a part limiting the subsidies only to the farms up to certain size as a part of the Common Agricultural Policy proposal after 2013. Czech farmers would be at a disadvantage, because the average farm size in the Czech Republic is, due to the consequences of the collectivization in the 1950s, cca 84 ha, that is six times more than the average in the EU. However, a coalition of six countries has opposed setting a ceiling for the subsidies, including the Czech Republic, its initiator. According to the Ministry of Agriculture CR, this agreement also resulted in a sufficient number of deputies, who would, in the case of the "capping" being effectively proposed by the Commission, vote against it in the European Parliament, and therefore they would block the proposal.

The European Commission considers three options in the paragraph version of the agricultural policy proposal: a ceiling of 100 000 EUR, 200 000 EUR, or 300 000 EUR. If the hardest option – 100 000 EUR – were selected, the Czech Republic would lose 59% of its national subsidy portion, which constitutes cca 13.3 billion Czech crowns (Europa 2011).

Setting a ceiling of the subsidies is a critical issue with respect to the form of Czech agriculture. Enforcing it would mean lowering resources from the EU on the level of billion crowns a year. It concerns not only the classical large agricultural companies, but also family farms with land from cca 600 or 700 ha up.

The Czech Republic was supported not only by Slovakia and Germany, where the farms are, for similar reasons, also bigger than the EU average, but also by Romania, Italy and the Great Britain. The support of these countries is not redeemed by any concession; a topic of joining farms in order to better withstand the crisis and competition, at present often discussed in the EU, played its role as well.

Figure 1 shows the microeconomic consequences of the governmental decision to implement the price subsidy of agricultural products. Under the perfect competition market conditions, the supply and demand equilibrium would be at the point E, where the quantity of agricultural products Q_E is sold for the price P_E. But the government accepts the decision to support the prices of agricultural products. With the subsidy, the price is set above the price level, which clears the market. This results in the supply surplus, which the government has to buy back.

Figure 1 also shows the price after the subsidy in the amount of P_{AS}. It is obvious that the subsidized price is above the equilibrium price, whereby there arises the dominance of the supply ΔQ units of agricultural product per year. To keep the price at the same level P_{AS}, the government has to buy back a certain amount of agricultural production from the recent year, noted as the quantity ΔQ units. If the government did not do so, the farmers would be forced to lower their prices, which would lead to a decline in their incomes.

Now we will recall the following connections of the marginal and average costs curves, shown in Figure 2 (Samuelson and Nordhaus 2008).

It is clear from Figure 2 that the average costs in point B (showed as a tangent) are the same as the marginal costs in point B. In other words, the marginal costs curve always intersects the average costs curve at its minimum. Now we will use the analysis of the MC and AC functions in long-run in the algebraic analysis.

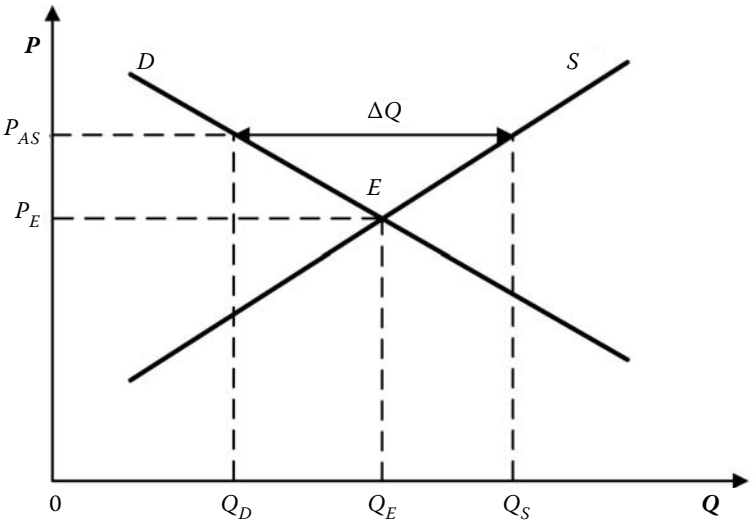

Figure 1. Equilibrium in the agricultural products market

D = demand curve
S = supply curve
P_E = equilibrium price before subsidy
P_{AS} = price after subsidy, where having the price P_E we supply and demand Q_E
ΔQ = supply surplus

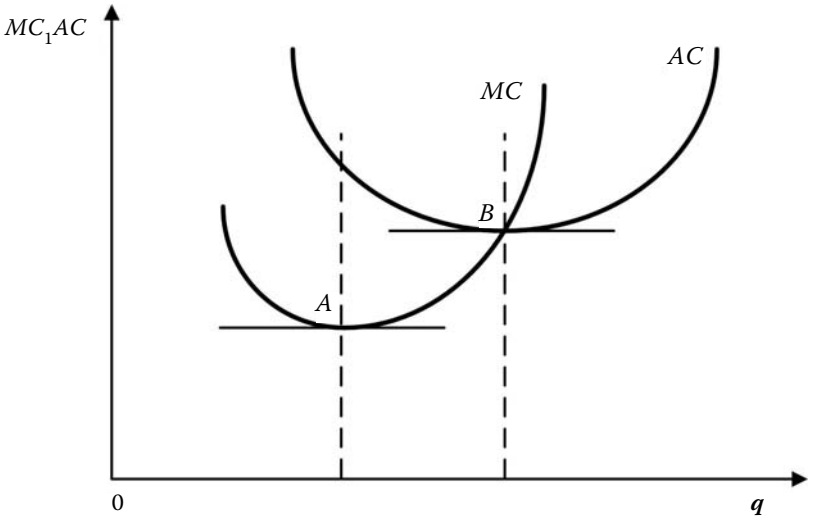

Figure 2. Short-run marginal costs (*MC*) and average costs (*AC*)

A = minimal margin costs
B = minimal average cost

Algebraic analysis

Using symbols:
q = quantity of final product units (agricultural products)
L = quantity of labour
T = level of land
r = technological coefficient of production function
e = coefficient in production function (expressing non- technological circumstances)
P_L = price of labour unit (wage)
P_T = price of land unit
SAC = short-run average costs
SMC = short-run marginal costs
LAC = long-run average costs
LMC = long-run marginal costs

When we know that a big firm and a small firm have the same production function, 1) we can derive the functions of the short-run total, marginal and average costs.

$$q = r^4 \times \sqrt{LT} - e \tag{1}$$

$$(q+e)^4 = r^4 LT \tag{2}$$

$$L = \frac{(q+e)^4}{r^4 T} \tag{3}$$

$$STC = \frac{P_L}{r^4 T} \times (q+e)^4 + P_T T \tag{4}$$

$$SMC = 4 \times \frac{P_L}{r^4 T} \times (q+e)^3 \tag{5}$$

$$SAC = \frac{P_L}{r^4 T} \times \frac{(q+e)^4}{q} + \frac{P_T T}{q} \tag{6}$$

We derive the long-run costs functions from the short-run ones

$$\frac{dSTC}{dT} = 0 \tag{7}$$

$$-\frac{P_L}{r^4 T^2} \times (q+e)^4 + P_T = 0 \tag{8}$$

$$P_T = \frac{P_L}{r^4 T^2} \times (q+e)^4 \tag{9}$$

$$T_2 = \sqrt{\frac{P_L}{P_T}} \times \frac{(q+e)^2}{r^2} \tag{10}$$

$$LTC = P_L L + P_T T \tag{11}$$

$$LTC = \frac{2}{r^2} \times \sqrt{P_L P_T} \times (q+e)^2 = A(q+e)^2 \tag{12}$$

We introduce variable A

$$A = \frac{2}{r^2} \times \sqrt{P_L P_T} \tag{13}$$

$$LMC = 2A(q+e) \tag{14}$$

$$LAC = A\left(q + 2e + \frac{e^2}{q}\right) \tag{15}$$

In the minimum point of the long-run average costs, this equation must hold: $LMC = LAC$

$$q_2 = e \tag{16}$$

$$P_2 = 4Ae \tag{17}$$

(16) and (17) represent the optimal level of the final product and the optimal price of a big firm, relation (9) results in

$$q_1 = r \times \sqrt[4]{\frac{P_T}{P_L}} \times \sqrt{T} - e \tag{18}$$

For noting the land level of a small firm, we can write

$$T = T_1 \tag{19}$$

q_1 in the equation (18) expresses the optimal quantity of a small firm production in the long-run. In the next one, we derive the optimal price and the optimal product quantity of a big firm in the long-run. ($T = T_2$)

$$P_2' = \frac{4P_L}{r^4 T_2} \times (q_2' + e)^3 \tag{20}$$

$$q_2' = \sqrt[3]{P_2' \times \frac{r^4 T_2}{4P_L}} - e \tag{21}$$

Now we will derive the relation for the price of a small firm in the long-run.

$$P_1 = A \times \left(r \times \sqrt[4]{\frac{P_T}{P_L}} \times \sqrt{T_1} + e \right) + \frac{Ae^2}{r \times \sqrt[4]{\frac{P_T}{P_L}} \times \sqrt{T_1} - e} \tag{22}$$

The given variables are shown in Figure 3.

We assume two agricultural firms in a perfect competition market. The first firm (a small family firm) has a capital, which is expressed in Figure 3 as a short-run average costs curve SAC_1 and short-run marginal costs curve SMC_1. The costs curves of an agricultural large-scale company represent the short-run average costs curve SAC_2 and the short-run marginal costs curve SMC_2. As a consequence of competition, the long-run equilibrium price gets closer to P_2, which corresponds to the minimum of the long-run average costs curve LAC. As is obvious from the graph, the agricultural large-scale company reaches normal profit with price P_2, but the small family firm has higher costs, therefore it runs at a loss, which is expressed as the area of the rectangle.

The pressure of the small-scale producers on the government to intervene in the agricultural product market leads to the fact that the government keeps the prices high enough, so that the small agriculture - oriented firms do not go bankrupt. This can lead to a fulfilment of certain social goals, but it can cause an efficiency loss, as shown in Figure 4.

In Figure 4, the consequences of the government price interventions in favour of a certain agricultural product are shown. The political goal of the government is, in this case, (usually) to prevent the bankruptcies of small agricultural firms. For a better understanding of the base of the problem, we have simplified our assumptions. The government guarantees the price of a certain agricultural product and buys out any surplus which is not purchased by the private sector. The price without intervention is in our case P_2. After the governmental intervention,

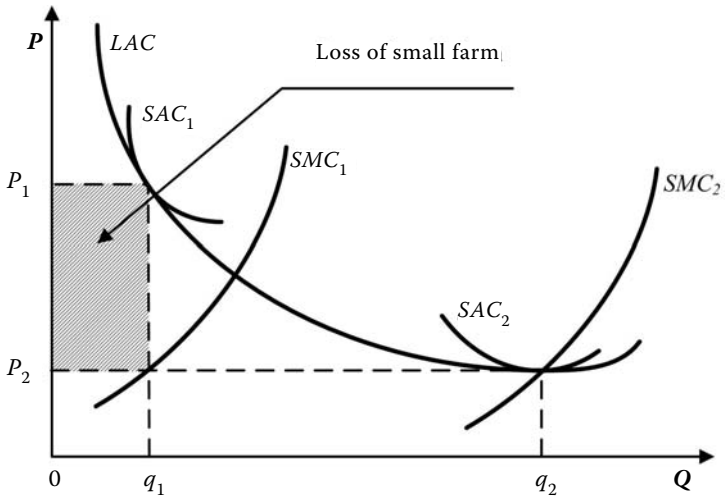

Figure 3. Average and marginal costs

SAC_1 = short-run average costs curve of small family farm
SMC_1 = short-run marginal costs curve of small family farm
SAC_2 = short-run average costs curve of large-scale agriculture company
SMC_2 = short-run marginal costs curve of large-scale agriculture company
LAC = long-run average costs curve
P_1 = price for which the family farm realizes production
P_2 = long=run equilibrium price (price, for which the large scale company realizes its production)
q_1 = quantity of production of family farms before government intervention
q_2 = quantity of production of agriculture large-scale company before government intervention

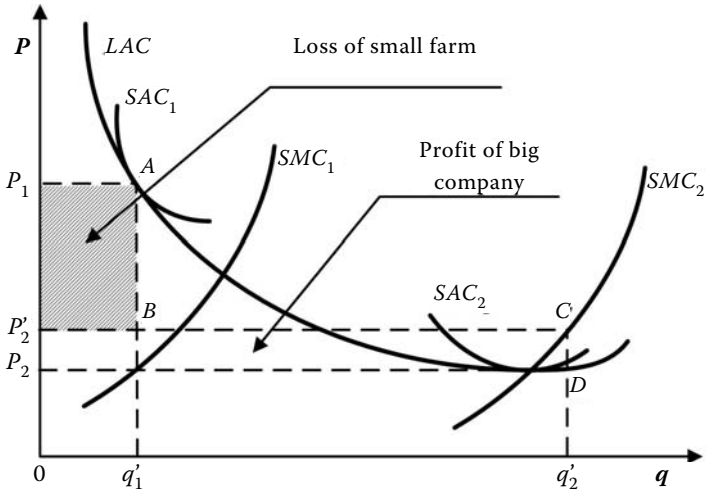

Figure 4. Impacts of subsidies on the profit of a big company and a small farm

P_2 = price without government intervention
P'_2 = price after government intervention
q'_1 = quantity of production of family farms after government intervention
q'_2 = quantity of production of agriculture large-scale company after government intervention

the guaranteed price is P'_2 which causes family farms production to reach the quantity q'_1 and the large-scale producers to increase it to q'_2. With this production, the large-scale companies reach a profit expressed as the area of the rectangle $P_2DCP'_2$, while the family farms run at a loss showed by the area of P'_2BAP_1.

In the short-run, the range of the new loss suffered by the family farms after the governmental intervention is smaller than the loss before the governmental intervention, but the large-scale producers record higher profits. However, it is not possible to keep their positions for too long, because other entrepreneurs will be attracted (now running the non-agricultural businesses) and willing to reach higher profits. This will lead to an increase in land prices and therefore to a shift out of the costs curves of all agricultural producers. A new intervention round will appear, let us say a vicious circle, in which the constantly increasing government price interventions will lead to a land price increase and to a shift of all costs curves (Ochrana 2001). It is known from the equations (13) and (17) that the prices P_2 and P_1 increase when the land price P_T increases.

Agricultural subsidies under conditions of Czech economy

The dependence of Czech farmers on subsidies is constantly growing. In the entire EU-27, only Finnish

Table 1. Yields per hectare of utilised land (in EUR per ha)

	2003	2004	2005	2006	2007	2008
Czech Republic	878.2	1078.2	1156.1	1237.0	1448.3	1699.0
subsidy	62.9	62.4	179.6	210.7	211.4	345.6
Germany	2496.0	2698.5	2646.5	2723.8	3066.1	3247.2
subsidy	92.5	90.5	357.1	376.1	380.1	383.1
Austria	2145.4	2192.1	2176.6	2277.1	2504.0	2637.2
subsidy	350.3	353.6	477.2	487.6	479.4	486.2
Poland	822.0	1045.5	1102.8	1176.9	1425.1	1536.7
subsidy*	4.9	65.1	80.0	107.0	134.3	126.0
Slovakia	822.6	961.9	991.0	1039.3	1207.7	1424.7
subsidy	62.9	32.1	89.4	110.4	165.5	173.8

subsidy = from that other subsidies for production

Source: Czech Statistical Office

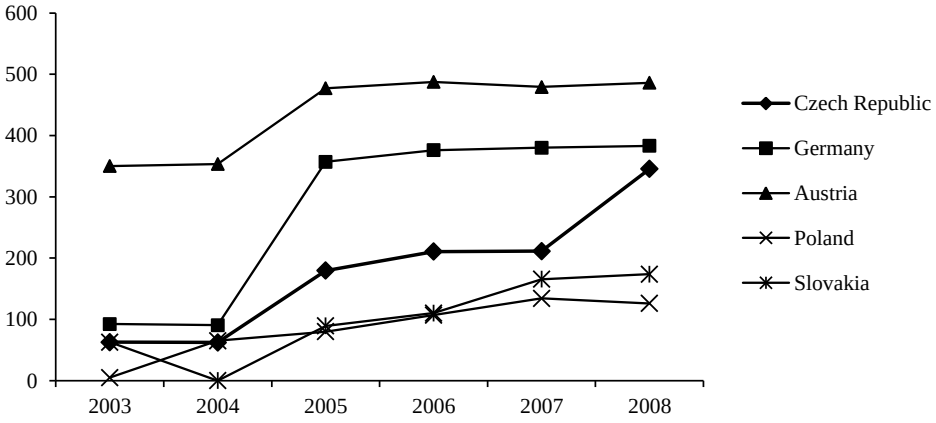

Figure 5. Subsidy per hectare of utilised land (in EUR per ha)

farmers are more dependent on the incomes from fund programs, as implied by an analysis of agriculture based on overall agricultural account, done by the Czech Statistical Office. Correspondingly, there is a general consensus that most subsidies to fisheries, particularly fuel subsidies, are harmful to both the economy and the environment (Harper et al. 2012).

The proportion of subsides in farmers' revenues reached 20% in 2008, one fourth of all production sources comes from subsidies. Subsidies have been increasing every year since 2004, which is expressed in the growing yields per hectare. At the same time, the value of Czech farmers' products is decreasing, which in turn increases the dependency on subsidies (Hanibal et al. 2010).

Farmers are not able to generate profit from their own sources on a long-term basis. They had to spend 934 EUR in costs per 1000 EUR of yields. Without subsidies, Czech agriculture would not be able to compete, especially with the countries of former EU-15.

The overall production of the Czech agricultural sector increased in 5 years since 2003 by more than 60%, as opposed to less than 8% in the EU-15. Plant production is growing with only small fluctuations; animal production is – on the other hand – decreasing, especially the pig breeding. Farmers are producing by 60% more feeding crops and 1.5 times more technical crops by volume, which is related to the support of biofuels. This is given by the fact that the farmers do not have a more attractive market for their commodities for food-processing or feeding purposes. The economic aspect of agricultural companies is unambiguously winning (Hanibal et al. 2009).

According to the statistics, Czech agriculture also has the highest labour costs in the EU. As opposed for example to Austria, where family farms prevail, most workers in agriculture of the Czech Republic have the employee status and the companies pay partially for their health and insurance payments as well as their wages, which makes the difference.

CONCLUSION

Several practical conclusions arise from the presented facts. The government price interventions can fulfil political goals in the short-run, but from the economic point of view, their effectiveness is problematic. More suitable tools can be for example the use of some tax instruments (lowering the income tax) or, in an extreme case, a directly addressed support. Using subsidies can ensure that the prices of agricultural products are at such a level that the farmers have appropriate incomes. However, an efficiency loss can occur because the subsidy, as the surplus, which is purchased by the government, actually stays unused. For example, in the consequence of the price support, all households happen to have increased food budgets. Subsidizing goods on which the households spend a high proportion of their budget can create large wealth effects (Jensen and Miller 2011). Also, the small-scale producers are disadvantaged compared to the big agricultural companies. From every single crown of the supported price, the prosperous large-scale companies experience a larger total utility compared to the small-scale ones, on whom the subsidy is usually focused. Defenders of the price subsidies of agricultural goods argument with the possible social consequences, that is by a wider understanding of all contexts. The given budget constraints faced by governments, a good targeting performance of public subsidies is important for the poverty reduction (Angel-Urdinola and Wodon 2012). Several studies have been devoted to assessing the targeting performance of a wide range of programs in the developing and transition economies (e.g. Baker

and Grosh 1994; Subbarao et al. 1997; Braithwaite et al. 2000; Coady et al. 2004). In such a case, different tools for this analysis should be used (e.g. the social costs and benefits analysis).

A theoretical model of the modern food consumption is presented built on the assumption that the utility from different food characteristics is accumulated over time. The characteristics considered include energy content, taste, health, status and environmental (as well as political and ethical) proprieties, time and financial costs (Horská and Sparke 2007).

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