EVALUATION OF EFFECTS OF AGRICULTURAL SUBSIDY ON PUBLIC WEALTH

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Introduction

Czech as well as European agriculture is significantly depended on subsidies. In economic literature, a subsidy is generally defined as a payment from government to a producer or a consumer of any commodity (see e.g. Samuelson, Nordhaus, 1991). Also definitions of subsidy created by economic organizations are connected with public expenditures. For example, Food and Agriculture Organization of the United Nations (2002) defines a subsidy as a direct or indirect payment by a government to private firms, households, or other governmental units in order to promote a public objective. Organization for Economic Co-operation and Development (2009) defines an agricultural subsidy as a sum of „transfers provided to farmers or the agricultural sector as a whole, which result from government policies that raise farmers’ revenues or reduce their costs”.

The definition of subsidy as a public expenditure, which is connected with redistribution of incomes and wealth, evoked a rise of tools for evaluation the effects on efficiency and equity. This paper provides the summary of methodological approaches to evaluation mentioned effects in the partial equilibrium model. Methods present in the article can be used also for evaluation of subsidy as a tool of regional policy.

Goals and methodology

The main goal of this paper is to create the summary of methodological approaches used for evaluation of effects of agricultural subsidy on efficiency and equity in the partial equilibrium model. To reach the mentioned goal the method of document analysis of discussion papers was used. The results of this paper will be used as theoretical base for next analytical work in an institutional research intention.

Results

In economic literature, the analyzing of a subsidy as its instrument has a long tradition. One of the first approaches to evaluate the efficiency of agricultural subsidies was introduced by Wallace (1962), who analyzed an agricultural price subsidy by using economic welfare measures to find the social costs of agricultural programs. The most common method of the welfare calculation is an economic surplus measure. This method is based on partial equilibrium analysis and Pareto efficiency, which can be defined as a situation when none chance can arise the wealth of one subject without decrease of wealth of someone else. Mathematically this situation happened when the utility of the consumption of the last unit equals to the cost for the production of last unit.

# Pieces of knowledge introduced in this paper resulted from solution of an institutional research intention MSM 6046070906 „Economics of resources of Czech agriculture and their efficient use in frame of multifunctional agri-food systems” and also from IGA 11110/1312/3106.
The economic surplus consists of two parts:

a) a consumer surplus, which is defined as the difference between aggregate willingness to pay and actual aggregate payments of some quantity of goods;

b) a producer surplus, which is defined as the difference between minimum aggregate payment that producers can accept and actual aggregate receipts. (Hirshleifer et al, 2005)

The social costs are modeled as the loss in both measures caused by a policy instrument (in economic term as the deadweight loss). Wallace (1962) simulated the deadweight loss as a result of deviations in prices and quantities from those determined by the Marhallian cross and quantified it using the price elasticities of demand and supply and the percentage change between optimal and real price.

This concept is especially used to compare different instruments and find the best one (e.g. De Gorter and Meilke (1989), Brännlund, Kriströn (1994)).

The economic surplus is also used for efficient redistribution evaluation (e.g. Alston, Hurd (1990), Bullock, Salhofer (1995)). This problem is usually visualized by a surplus transformation curve, which illustrates the trade off between consumer and producer surpluses after using a policy instrument and is analogous to the utility possibilities frontier. (Gardner, 1983)

Mathematically, Gardner (1983) solved this problem using the deadweight loss as the difference between a change in producer surplus and a change in consumer surplus and marginal deadweight loss, which is defined as ratio between mentioned changes:

\[ D = \Delta PS - \Delta CS, \]  

where \( D \).....deadweight loss;
\( \Delta PS \)....change in producer surplus;
\( \Delta CS \)....change in consumer surplus.

\[ MD = \frac{\Delta PS}{\Delta CS}, \]  

where \( MD \)....marginal deadweight loss.

Introduced approach is applicable for such government instruments, which transfer welfare from consumer to producer (especially quotas). For such instrument, is valid that higher absolute value of this ratio means more efficient redistribution. But for a subsidy, it is important to involve costs to taxpayers. Gardner (1983) introduced this concept on target price and deficiency payments. These instruments increase producer and also consumer surplus, but they add costs to taxpayers. Gardner (1983) assumed that taxpayers are the same group as consumers. Than the welfare of consumer is equal to consumer surplus less taxpayers costs. Salhofer (1995) enlarged this idea by net budgetary costs, which represents the budget’s gains and losses to taxpayers. All welfare changes are then defined as:

\[ \Delta W = \Delta PS + \Delta CS + \Delta BD. \]

where \( \Delta W \).....total welfare changes;
\( \Delta BD \).....net budgetary cost.

Salhofer (1995) also defined a new measure of efficient redistribution - the average transfer efficiency:

\[ ATE = \frac{\Delta PS}{\Delta CS + \Delta BD} \times 100. \]
where ATE...average transfer efficiency, which take a value between -100% and 0%, when consumer/taxpayers suffer loss and producers gain. An ATE of -100% means full efficient redistribution, because there is no deadweight loss. One unit, payed by consumers/taxpayers, increases producer surplus exactly by one unit. On the other hand, an ATE of 0% represents totally unefficient redistribution, which changes the payment of consumer/taxpayers only to deadweight loss.

The empirical quantification of economic surplus is usually done by a partial equlibrium model. This trade model describes a subsection of the total economy using the supply and demand curves. In economy literature, there exist different types of supply and demand function estimation. Salhofer (1995) simply defined demand and supply functions as:

\[ Q_d = \alpha + \beta P, \]  

(5)

where \( Q_d \).....demand quantity;
\( P \)......price;
\( \alpha \)......intercept of demand function;
\( \beta \)......slope of demand function.

\[ Q_s = \gamma + \delta P, \]  

(6)

where \( Q_s \).....supply quantity;
\( \gamma \)......intercept of supply function;
\( \delta \)......slope of supply function.

The changes in producer and consumer surplus after policy intervention (a production quota, a coreponsibility levy and deficiency payments in Salhofer case) were calculated with integrals.

Bullock and Salhofer (1998) adapted the model of Gisser, who derived the supply function from the traditional Cobb-Douglas production function and derived a supply function from CES \(^1\)-production function. In their model, the land is considered fixed and the input price of variable factor is assumed to be constant. These assumptions allow to derive a conditional demand function for variable input. Because the land is supposed to be own by producers, total variable costs of production equal to the cost of variable factor. The supply function is gained as the first derivation of the cost function with respect to the amount of production. The demand function in their model is described as the constant elasticity demand function. The producer surplus is than equivalent to the producer quasi-rents which can be quantified as revenues less costs. The change in consumer surplus is computed as:

\[ \Delta CS = (P_e - P_d) \left( \frac{Q_e + Q_d}{2} \right), \]  

(7)

where \( P_e \).....nonintervention price;
\( P_d \).....demand price;
\( Q_e \).....nonintervention quantity;
\( Q \).....demand quantity.

This formula is valid for close economy.

Brännlund and Kriström (1994) introduced the derivation of a supply curve of agriculture product from a profit function of producer and demand curve of agriculture product from profit function of processor. The consumer market was not taken into account in their analysis. The deadweight loss was calculated with integrals.

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\(^1\) Constant elasticity production function
A similar approach was used by De Gorter, Nielson and Rausser (1992), who derived a supply function from a profit function of producer and a demand function from a utility function of consumer, which represented the dependence between consumer’s utility and the quantity of the commodity consumed. On the other hand, they did not calculate the deadweight loss, but they tried to define effects of subsidy on a market clearing quantity and a market clearing price, because they emphasized that the main role of government is to correct market failures. These authors also suggested how to choose the political optimal level of subsidy. Their idea came from a government preference function, which represents the politically weighted welfare of consumers and producers, and the assumption that subsidy increases producer welfare and decrease welfare of consumer. The optimal subsidy is such that the weighted marginal cost of subsidy to consumers is just equivalent to the weighted marginal benefit of subsidy to producers.

**Discussion and conclusion**

The evaluation of subsidy efficiency with economic surplus and partial equilibrium model is used by a huge number of economist, because of quite easier estimation of supply and demand curves in one market and lower data requirement. On the other hand, there exist criticism of mentioned incomplete approach. Economists usually argue against partial equilibrium models that distortions in one market affect welfare in other markets. De Janvry and Sadoulet (1987) compared results on economic surplus modulated by a partial equilibrium model with results from a computable general equilibrium model. They identified the same general results, especially in short-run. Thurman and Wohlgenant (1989) argued back that the complete deadweight loss, net of adjustments in other market, is less than the deadweight loss quantified with partial equilibrium model. On the other hand, Bullock (1993) proved that effects of government instruments on welfare can be analyzed fully by a partial equilibrium model only in a close economy. In spite of mentioned fact, partial equilibrium models are still widely used, for example EU Commission’s models for agricultural policy stimulation – WATSIM, SPEL/EU, AGLINK – is based on partial equilibrium models.

The analysis of agricultural policy, which take into account the complex effects of government instruments on the agricultural and non-agricultural sectors, is based on a general equilibrium model. These models allow to analyze effects of subsidies, e.g. effects on wage, exchange rate, unemployment. For example, De Janvry and Sadoulet (1987) used a computable general equilibrium model to analyze effects of food subsidy and other instruments on consumer price, real incomes of households and Gross National Products. These methods are applicable on evaluation of regional policy too. The most problem of using mentioned CGE models is a heftiness of data and mathematical ripening of complexity of economic reality.

In regional point of view, the method of input-output analysis is used. It is especially focused on effects of subsidies on changes in the regional production.

The another approach which can be used for evaluation of a subsidy is an econometric modelation, which can be especially used for measuring the impact of a subsidy on agricultural production and profit function. Mentioned methods of evaluation effects of subsidy can be also completed by mathematical programming models, which are especially used for analysing the impact of policy on agricultural supply.
Literature


Title: Evaluation of effects of agricultural subsidy on public wealth

Název: Hodnocení dopadů zemědělských dotací na společenský blahobyt

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Abstract: The agriculture of most countries depends significantly on agriculture policy. As the most of economic policies, the agriculture policy is connected with public resources distribution. Because this distribution effects efficiency and equity in the society, it is important to evaluate mentioned policy and its tools. This evaluation has a long tradition in economic literature. More than 50 years economists try to evaluate the efficiency of public expenditure to agriculture and the effects of redistribution of incomes and wealth. This paper provides the summary of methodological approaches to evaluation mentioned effects in the partial equilibrium model. Pieces of knowledge introduced in this paper resulted from solution of an institutional research intention MSM 6046070906 „Economics of resources of Czech agriculture and their efficient use in frame of multifunctional agri-food systems” and also from IGA 11110/1312/3106.


Key words: subsidy, wealth, economic surplus, efficiency, equity, agriculture

Klíčová slova: dotace, blahobyt, ekonomický přebytek, efektivnost, rovnost, zemědělství

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