IMPACT OF COMMON AGRICULTURAL POLICY REFORM ON THE CZECH ECONOMY – A GENERAL EQUILIBRIUM APPROACH

Zuzana Křístková, Czech University of Life Sciences[1]

Abstract

The objective of this paper is to quantify the impact of selected scenarios of the possible CAP reforms on the competitiveness of the Czech agrarian sector and connected industries. A dynamic general equilibrium model is applied to test three scenarios dealing with the removal of subsidies to agriculture considering different compensation options. Contrary to other CGE studies focused on agriculture, this paper presents preliminary results that were obtained based on individually constructed SAM for the Czech economy, with a detailed disaggregation of the sector of agriculture.

The findings show that if the support that is currently provided to the agriculture is removed, a significant decline of the agricultural production and connected food industry can be expected. This paper further shows that the effects on GDP are rather negative, even if resources are reallocated to tertiary sectors of the economy. This suggests that more attention should be devoted into the incorporation of specific effects connected with R@D sector into the CGE model.

Research presented in this paper is the result of a research grant MSM 6046070906 "Economics of Czech agriculture resources and their efficient usage within the framework of multifunctional agri-food systems".

Key words: CGE model, Social Accounting Matrix, the Czech Republic, Agriculture, Subsidies, the CAP.

1. Introduction

The Common Agricultural Policy (CAP) is one of the core policies, that since its establishment in the 1950s, has contributed significantly to the process of integration of the European Union.

The CAP in its current shape finishes in 2013. In connection to the approaching end, there has been opened a debate on the future shape of the CAP. Two main concerns are dominating this discussion; first of all, the size of the CAP budget, which needs to be reduced, and secondly, the modernization of the whole agricultural policy. Currently, most of the CAP budget is allocated to supports in the first pillar, which are mainly represented by direct payments. Even though the largest share of the direct payment subsidies concern payments that are fully decoupled from production, their system of distribution is a subject of criticism because of the unequal distribution among the new and old member states.

The need to reshape the CAP raises questions regarding the possible impacts of CAP reform on the economies of the EU member states. Czech Republic belongs to the group of countries

[1] Ing. Zuzana Křístková, Ph.D. (kristkova@pef.czu.cz), Czech University of Life Sciences, Faculty of Economics and Management, Department of Economics, Prague. (Kamýcká 129, 165 00 Prague 6).

that accessed the European Union in 2004 and thus fully adopted the principles of the CAP. Unlike some other Central and Eastern European member states, the sector of agriculture has a small role in the economy, as it contributes to total GDP only by 2% and employs less than 4% of workers. Yet, within the sector, a high representation of large scale agricultural companies exists, that benefit considerably from the direct payment subsidies granted per hectare of agricultural land. In view of this, the Common Agricultural Policy plays an important role in the competitiveness of agricultural companies and its possible reform is a sensitive issue for different stakeholders.

The objective of this paper is to quantify the impact of selected scenarios of possible CAP reforms on the competitiveness of the Czech agrarian sector and connected industries. Furthermore, the paper aims at contributing to the debate on the efficiency of supporting agriculture as opposed to other prioritized sectors of the national economy such as the sector of Research and Development.

In order to fully address the impact of the CAP on the economy, a general equilibrium approach is applied. It is calibrated on the economy of the Czech Republic in 2006 including a detailed disaggregation of the agricultural sector.

This paper presents preliminary results which provide a basic understanding of the role of the agrarian policy in the national economy. The relevance of the results is accentuated due to the application of a detailed SAM individually constructed for the Czech Republic, with a special focus on the sector of agriculture. Thus, the interpretability of the CGE model and the reliability of results is higher than of the results based on the GTAP applications.

The paper is organized as follows: in the first chapter, the main characteristics of the Czech agrarian sector with respect to the EU accession are presented and the debate on the future CAP is outlined, followed by the introduction of the scenarios which are applied in the analysis. Following chapters include the description of the CGE model and the process of the construction of the SAM matrix. The results chapter is structured following a bottom-up approach - the direct impacts on agriculture are described first, followed by the impacts on other industries and the impact on the total macroeconomic situation. The paper is concluded by a confrontation of the results with the other authors.

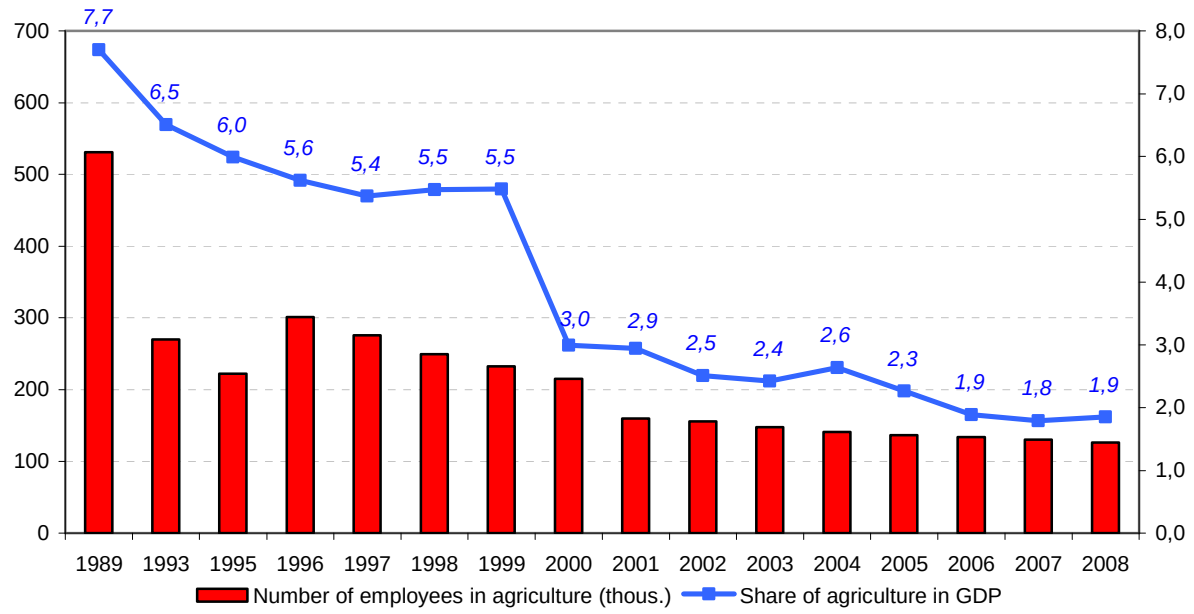
2. Characteristics of the Czech agrarian sector and the agrarian policy

2.1 Before the EU accession

During last twenty years, the Czech Republic faced a transformation process from the centrally planned economy to the system of market economy. With a change of the economic and political system, agriculture was one of the most affected sectors. In view of this, the agrarian policy needed to be carefully designed to enhance the process of transformation and respond the restructuring pressures. Serious problems were left after the period of centrally planned economy such as a liquidation of private ownership, food overproduction due to excessive subsidies and deterioration of rural regions. The transformation into market economy caused rapid decrease of the size of agricultural sector. The adaptation of the sector to market conditions has occurred in two waves. In the first wave, which took a decade from 1989-1999, the agricultural production measured in constant prices shrank by 30% which caused a drop in the GDP share of agriculture from almost 8% in 1989 to only 3 % in 2000. Serious reduction of agricultural activity affected dramatically employment in agriculture; already after four years of transformation, the employment decreased by 50% (as observed in Figure 1).

Several factors played role in this radical adjustment, such as the inefficiency of production associated with inappropriate allocation of resources, but also unfavourable macroeconomic conditions due to strong devaluation of Czech currency and high interest rate worsening access to agricultural credits. The agrarian policy was concentrated predominantly to establish a proper legislative and organizational framework to assure the functioning of the agricultural market. As an extensive subsidizing of agriculture was not in line with the principles of market economy, agricultural support was based mainly on market regulation concerning main commodities (mostly of animal production such as milk and pork) to respond the disequilibrium between domestic and world prices.

Figure 1: Development of basic indicators of agricultural sector

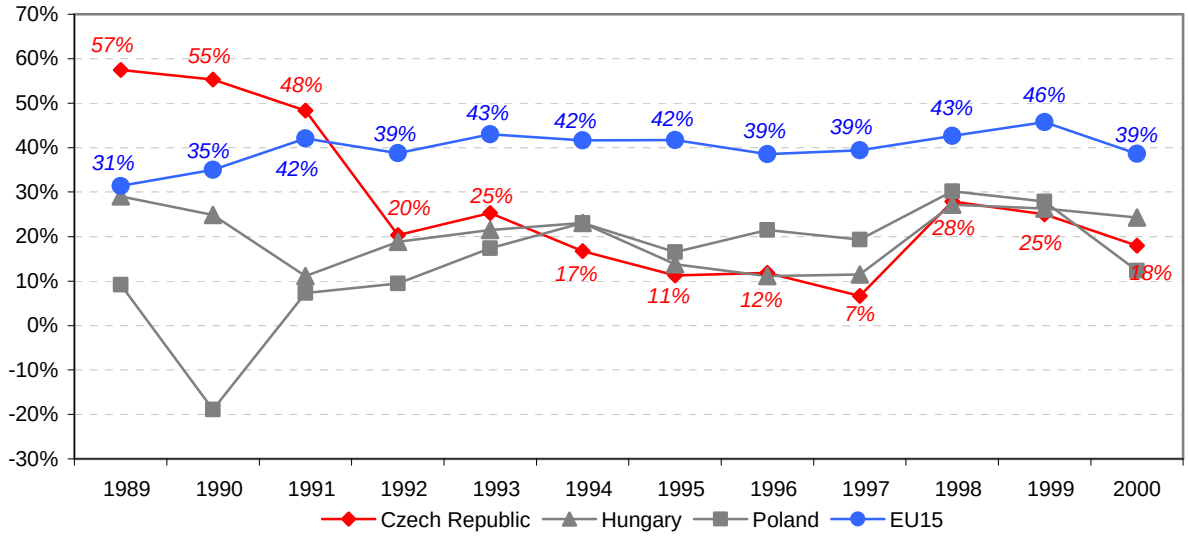


Source: Czech Statistical Office and Green Reports (Ministry of Agriculture)

The total size of support to agriculture declined dramatically; whereas in 1989, the subsidies to agriculture measured in Producer Support Estimate (PSE) reached CZK 68,683 mln., in 1992 they amounted only CZK 24,475 mln., which represents a 62% decline. Figure 2 provides an overview on the level of protection in the Czech Republic, other CEEC countries

and the European Union. In the period 1989-1992, the share of producer subsidies in the gross agricultural production decreased from 57% in 1989 to 20% in 1992 concerning the Czech Republic. Similar development can be found in case of Hungary, where the pre-reform level of subsidies reached 30% and declined to 10% in the first phase. As seen in Figure 2, producer support rates have been converging for all three post-Communist countries, and they stabilized around 25% of the gross agricultural production after the main part of the transformation period was completed. The figure also points to the fact, that the transformation in CEEC led to a considerably lower level of agricultural protection compared to the European Union where the share of support in total production reached 40%.

Figure 2: Producer Support Estimates as shares from total agricultural production



Data source: OECD

In the second decade (2000-2008), the situation in the sector of agriculture became more stabilized. The sector of agriculture continued to decline, but with a lower pace than in the previous decade. With the participation of 2% in the GDP, the sector employed about 140 thousand workers, which is roughly a 70% reduction compared to the pre-reform period. The agrarian policy implemented series of measures, formulated in the Revitalization and Adaptation policy programs with the aim to prepare the sector for the upcoming EU accession.

2.2 After the EU accession

By accessing the European Union in 2004, the Czech Republic adopted the EU Common agricultural policy (CAP) which resulted in a significant increase of agricultural income, most of which proceeds from the governmental support in form of the direct payments. The structure of the direct payments granted to agriculture consists of payments from the EU in form of the SAPS and the Top-Up payments from the Czech government to partially cover the gap between the levels of subsidies granted to Czech and EU 15 farmers. In the accession year, the Czech farmers obtained 25% of the EU 15 level, with an additional 30% covered from the Top-up payments. Despite the asymmetry in distribution of European subsidies, the Czech farmers were able to profit from considerable increase in support. Compared to the pre-accession level, the total amount of subsidies granted to agriculture in 2008 was 66% higher (Table 1).

It can be also observed, that the structure of total subsidies to the agricultural sector changed. This is especially visible in case of direct payments, which increased their share in total support from 19% in 2003 to 50% in 2008. In the same way, agroenvironmental support and support to regional development doubled in comparison to the pre-accession period which shows an increasing orientation of the policy to the non-production functions of agriculture. On contrary to that, national support, which participated in total support by almost 50% in the pre-accession period, decreased to 19%, reducing the burden of national budget on account of the European budget. In connection to ongoing world trade liberalization negotiations, the share of subsidies granted within the Common Market Organizations decreased and nowadays reaches only 2% share from the total budget.

Table 1: Structure of support to agriculture (in mln. CZK)

	2003	2004	2005	2006	2007	2008
Direct Payments Support	4262	12487	14287	16781	17738	18786
Regional Development and Agroenvi Support	3307	5657	8678	10547	9191	10295
National Support	10221	7309	6443	7283	6720	6814
Common Market Organization Support	4106	2500	1403	1282	882	591
Total	*21896*	*27953*	*30811*	*35893*	*34531*	*36487*

Source: Green Reports 2005-2008

According to the report of UZEI (2009), the effect of the EU accession for the Czech agriculture has been ambiguous. On one hand, the amount of subsidies increased considerably, which has brought several benefits. First of all, the situation of farmer income improved, especially of the smaller physical bodies. Secondly, subsidies have been converted to investments into modern technologies and to increase of capital stock. In addition to that, stable access to support improved the credibility of agricultural companies which could benefit from higher availability of credits. Finally, as more than half of subsidies is granted in form of direct payments per hectare of land, the CAP policy stimulates land ownership and thus has positive effect on stagnating land market in the Czech Republic. On the other hand, the efficiency of agricultural companies has not improved; most of the companies would operate in loss in the absence of the subsidies. Thus, the subsidies did not capitalize in an increase of competitiveness. More than that, the companies operating in the animal production sector have faced a dramatic decline, especially concerning producers of pork and milk. Given that the direct payments in their current form act as subsidies on land, animal producers are in disadvantage compared to the crop producers as they are more specialized and employ less land in the production process. This might be the reason why in longer term, the Czech agriculture with a traditionally higher competitiveness in sectors of animal production has reoriented to sectors of crop production.

The accession to EU has not brought major progress in the situation with land ownership. The share of rented land from total agricultural land reaches 80%, which is the highest in the whole European Union. Due to existence of transaction costs and asymmetric information (Ciaian and Kancs, 2009), the situation is more beneficial for the land renters, than for the land owners. There is an attempt to stimulate the purchase of land by national government which carries out a special support programme.

2.3 Future of the Common Agricultural Policy

The debates on the future Common Agricultural Policy are usually structured into three fields, namely the market support instruments, the direct payments and the rural development. Most of the critics of the current CAP is concentrated in the lack of transparency and equality in the distribution of the direct payments and the insufficiency in supporting environmental services

and standards. Buckwell (2009) represents possible steps of the CAP reform; first of all, the creation of a so-called transitive support, which would be based on the reduction of current amount of direct payments and their reallocation within the member states. Secondly, the supports in the second pillar of the CAP would involve more stress on the investments to infrastructure and the application of the research and development in agriculture. Furthermore, the incorporation of risk management into the CAP is considered. Among other ideas on the reform of CAP which Buckwell proposes belongs also the concept of a wider rural development, which is also discussed in the article of IEEP (2009). In this article, the need to modernize the current CAP is proposed and the role of rural development in supporting biodiversity, renewable resources and climate change is emphasized.

A topic which is common for most of the studies on future CAP is the incorporation of public goods into the future CAP. As many authors propose, the direct payments should not be distributed according the historical entitlements, but in line with the production of public goods. In the document of RISE (2009), public goods are discussed in a higher and it shifts the attention to inadequately developed market of environmental services.

Another concerns deal with the social situation of farmer households for which the agricultural policy could represent a form of a social policy that would provide a social net for farmer households.

Besides the focus of the Common Agricultural Policy, the size of the budget is also an important part of the debates. The opinions on the level of support to agriculture across member state countries are not homogenous. Whereas Great Britain, Ireland or Sweden would like to carry out a crucial reform of the CAP with significant reduction of budget, Bulgaria, Greece or Poland would prefer to maintain the status quo. Other group of countries including Czech Republic agree on the importance of the CAP but acknowledge the need to its modernization. One of the biggest subjects of criticism is the current system of direct payment distribution, which is based on historical entitlements. Many opinions agree on the idea that the future system of direct payments should incorporate the distribution mechanism based on the creation of public goods and environmental externalities. Another concerns deal with the social situation of farmer households for which the agricultural policy could represent a form of a social policy that would provide a social net for farmer households.

2.4 Scenario description

Whereas plenty of possible scenarios can be constructed that deal with possible future development of the Common Agricultural Policy, in this paper, two basic scenarios and one complementary are applied (table 2). In connection to the increasing voice of some European countries to reform CAP and decrease substantially the burden of agriculture in the European budget, the question on the impact of the reduction of budget on the national economy arises. Therefore, the Scenario 1 – "***Liberalization***" is focused on a complete removal of subsidies to agriculture (amounting to CZK 25 bln) with no compensational measures to outweigh the loss of protection in the economy. The scenario contains a one period shock carried out in 2015 and the effects calculated till 2020.

With respect to ongoing discussions on the social context of the agricultural support, the Scenario 2 – "***Decoupling***" models the situation of a complete decoupling of CAP subsidies, i.e. of transforming production subsidies to non-distortive policy support. In this scenario, the subsidies originally modelled as negative taxes on production are removed and distributed as pure financial transfers to farmer households, from 2015 on. This scenario is expected to show how would the market equilibrium be determined if farmer households were compensated for the production subsidies removal.

A complementary scenario – "***R&D*/services**" is considered to address the issue of possible reallocation of governmental support from the sector of agriculture to other sectors. In line with the priorities of Research and Development and other services, the Scenario reallocates 50% of the budget to the aggregated sector of services, 25% is distributed to the R&D sector and the rest is allocated to the industrial sectors.

Table 2: Overview of scenarios

Scenario	Name of the scenario	Simulations	Timing
Scenario 1	Liberalization	tp(secagri) = 0	from 2015
Scenario 2	Decoupling	tp(secagri) = 0, transfers to farmers = 100%	from 2015
Scenario 3	R&D/services	agri =0%, services= 50%, R&D= 25%,industry = 25%	from 2015
Baseline	Status Quo	No change in governmental policy	

Note: tp (secagri) are negative net taxes on production representing coupled subsidies to agriculture

The applied scenarios are assessed in relation to the following research questions:

- What is the competitiveness of the sector of agriculture under a zero level of subsidies?
- Which particular agricultural activities would be most affected by liberalization of the agrarian policy?
- How would the proposed policy changes affect welfare of farmer and other households?
- What would be the macroeconomic impact of considered scenarios and dynamics of economic growth?
- Can the reallocation of subsidies to sector of services and R&D bring economic benefits?

3. Description of the CGE model for the agriculture

In order to assess the effects of agrarian policy on the economy, the general equilibrium approach was applied. The choice of this approach is supported by various arguments. According to Piermartini (2006), the general equilibrium models (CGE models) provide a consistent, rigorous and quantitative way of assessing economic policies and they serve as supporting tools in the decision making process. Decreaux a Valin (2007) further emphasize, that the CGE models are based on robust and generally accepted behavioral patterns of the economic agents. Based on Elbehri, Umstaetter a Kelch (2008), the explicit modeling of production factors market which connects the production with the household economy makes the CGE models preferred over the partial equilibrium models. According to Gelan, Ayel and Schwarz (2006), the CGE models are suitable for a quantification of the spill-over effects, which comprise all effects in the economy.

The breakthrough in the application of the CGE models occurred in 1980s, after the progress achieved in the modelling techniques[2]. Commonly used CGE models follow a standard structure consisting of different types of equations derived under the assumption of perfect competition and constant returns to scale. Whereas the originally applied CGE models were static, further progress in CGE modelling enabled to develop dynamic models. One of the first dynamic CGE models was presented in 70s of the 20th century (Dixon, 2002). Two major approaches of dynamization have been profiled – a *recursive and* a *forward-looking*

[2] The progress was made by Arrow, Debreu and McKenzie with the fixed-point theorem (1950-1959) and by Scarf, Shoven and Whalley who constructed a computational algorithm for deriving the general equilibrium.

dynamization[3]. Until the 1990s, most of the CGE models preserved a recursive form. The development of the non-recursive models occurred after the 1990s, enhanced by an increased availability of modelling software such as GEMPACK and GAMS.
The presented CGE model is a recursive dynamic model built for the applications in agricultural policy simulations. In order to define the relationships that exist between the various elements of the model, choices need to be made on how to represent the behaviour of agents. Besides, the equilibria in all markets need to be defined by means of market clearing equations, and assumptions on the market structure lead to zero profit conditions. These elements of the CGE model will be elicited in the following section.

3.1 Production Structure

The CGE model does not consider individual firms but rather groups of similar firms aggregated into sectors. The national economy is modelled in a disaggregation into 13 production sectors, of which 8 represent specific agricultural sectors and the other represent the sectors of industry and services (see table 3). It is assumed, that each production sector produces one particular commodity, providing thus a symmetric supply and use table.

Table 3: Production sectors in the CGE model

Sector	Land employment	Description
sec1	*Secland*	cereals
sec2		fruits and vegetables
sec3		oilseeds
sec4		sugar beet
sec5		cattle
sec6		pigs and poultry
sec7		milk
sec8		other agriculture
sec9	*Secnland*	forestry and fishing
sec10		food industry
sec11		other industry
sec12		R&D
sec13		other services

The various production sectors are characterized by their production structure describing the relation between inputs into the production process and the output resulting from the economic activity. In this context it is assumed, that total domestic supply is a fixed factor Leontief combination of intermediate consumption and value added under perfect competition and constant returns to scale, which can be expressed by a nested production structure as displayed in Scheme 1.
For modelling of value added, two groups of production sectors are distinguished: sectors that use land as a production factor (*secland*) and sectors that use only labour and capital (*secnland*).
In the first stage, the value added is formed by the combination of labour (L_i) and capital-land bundle (KD_i) based on the *CES I* production function (equation 1) based on which the demand functions of labour and capital-land are derived.

$$CES\ I:\ VA_i = aF_i \cdot \left(\chi F_i \cdot KD_i^{-\rho Fi} + (1-\chi F_i)\cdot L^{-\rho Fi}\right)^{-1/\rho Fi} \quad , \qquad (1)$$

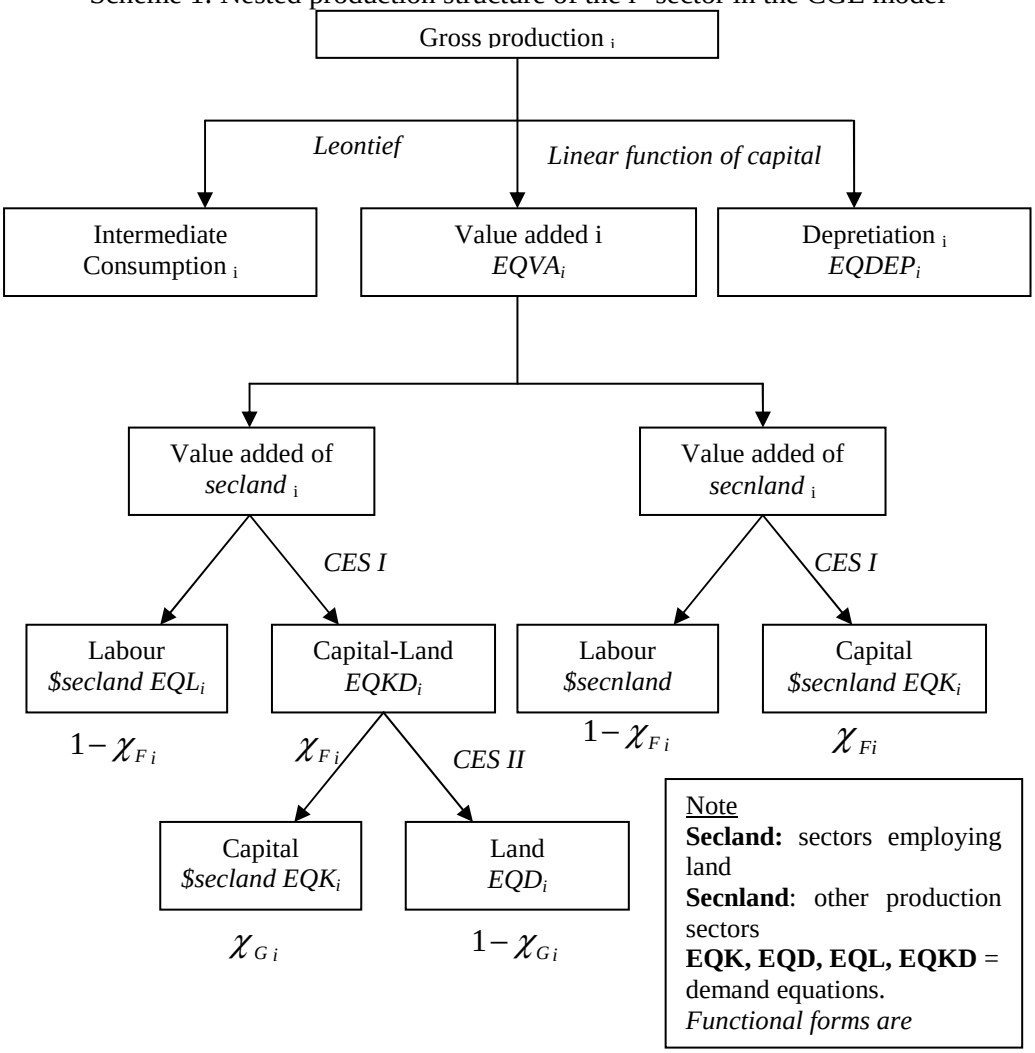
[3] Models with *recursive dynamization* introduce forward linkages with the assumption, that the amount of capital stock in the current period is derived from the accumulated investments from previous periods. *Forward-looking expectations* models are based on the assumption that agents are fully informed about the future state of the economy and they optimize their behaviour with the aim of maximizing profit and or minimizing their costs at the end of the future analyzed period.

where aF_i is the efficiency coefficient and χF_i a $(1-\chi F_i)$ are the distribution parameters of the production function. Parameter ρFi in the exponent is derived from the elasticity of substitution σFi between the production factors KD_i and L_i.
Analogically in the second stage, the optimal combination of capital and land is modelled with the use of the CES II production function (Equation 2):

$$CES\ II: KD_i = aG_i \cdot \left(\chi G_i \cdot K_i^{-\rho Gi} + (1-\chi G_i)\cdot D^{-\rho Gi}\right)^{-1/\rho Gi} \qquad (2)$$

The production structure further incorporates the depreciation of capital, which is modelled as a fixed proportion from the current level of capital stock.

Scheme 1: Nested production structure of the ith sector in the CGE model



3.2 Households´ behaviour

The behaviour of households in the Czech economy is simulated by introducing two representative households – farmer households and other households, which optimise their utility subject to a budget constraint. Whereas microeconomic theory provides numerous suggestions, a standard choice in the field of CGE models is the Stone-Geary Linear Expenditure System (LES) (Equation 3).

$$U = \prod_j \left(C_j - \mu Hj\right)^{\alpha HLESj} \quad , \quad \sum_j \alpha HLES_j = 1 \qquad \textbf{(3)}$$

where U is the consumer's utility, C_j is the amount of consumption of the j-th commodity, μH_i represents the subsistence level of consumption of each j-th commodity[4] and $\alpha HLES_i$ is a preferential parameter of the respective j-th commodity in the consumer basket.
The households' consumption budget is determined by the net value of its income after taxation and transfers, reduced by its savings.

3.3 Government's behaviour
The government maximizes utility modelled by the Cobb-Douglas utility function subject to the disposable budget which is derived from incomes received on basis of tax collections:

$$U = \prod_j CG_j^{\alpha CG_j} \text{ , where } \quad \sum_j \alpha CG_j = 1 \qquad \textbf{(4)}$$

Where CG_j is a governmental consumption of a commodity j and αCG_j represents a preferential parameter in the government´ s consumption basket.
The closure of governmental account is arranged by fixing a ratio of governmental consumption to GDP. Governmental savings are thus adjusted to the difference between governmental incomes and expenditures.

3.4 Modelling foreign sector
Total supply in the market is represented by a *composite commodity* consisting of the bundle of domestically produced goods supplied to domestic markets and imports. The composite commodity is a result of two simultaneous forces in the model, first the intention of producer to find the most profitable combination of supply between foreign and domestic markets, expressed by a Constant Elasticity of Transformation (CET) function, and the intension of consumer to find optimal combination of combination of imported and domestically produced commodity in the, expressed in the CES Armington function.
The functional form of the CET function is given in Equation 5.

$$CET\ (I)\ \ XC_j = aT_j\left(\chi T_j \cdot E_j^{-\rho Ti} + \left(1-\chi T_j\right)XDD^{-\rho Tj}\right)^{-1/\rho Tj} \qquad \textbf{(5)}$$

where XC_j is the amount of domestic production of the j-th commodity, E_j is the amount of exports of j-th commodity to the Rest of the World and XDD_j is the amount of domestic production of j-th commodity supplied to domestic market. Analogically to the CES function, aT_j, γT_j and $-\rho T$ are the parameters of the CET function.
CES function with Armington assumption is used to determine the extent of substitutability of the components of the composite commodity where it is assumed, that there is no perfect substitution between domestically produced and imported commodity. Functional form of the Armington CES function is provided in Equation 6.

$$CES \text{ Armington (I)}\ \ X_j = aA_j\left(\chi A_j \cdot M_j^{-\rho Ai} + \left(1-\chi A_j\right)XDD_j^{-\rho Aj}\right)^{-1/\rho Aj} \qquad \textbf{(6)}$$

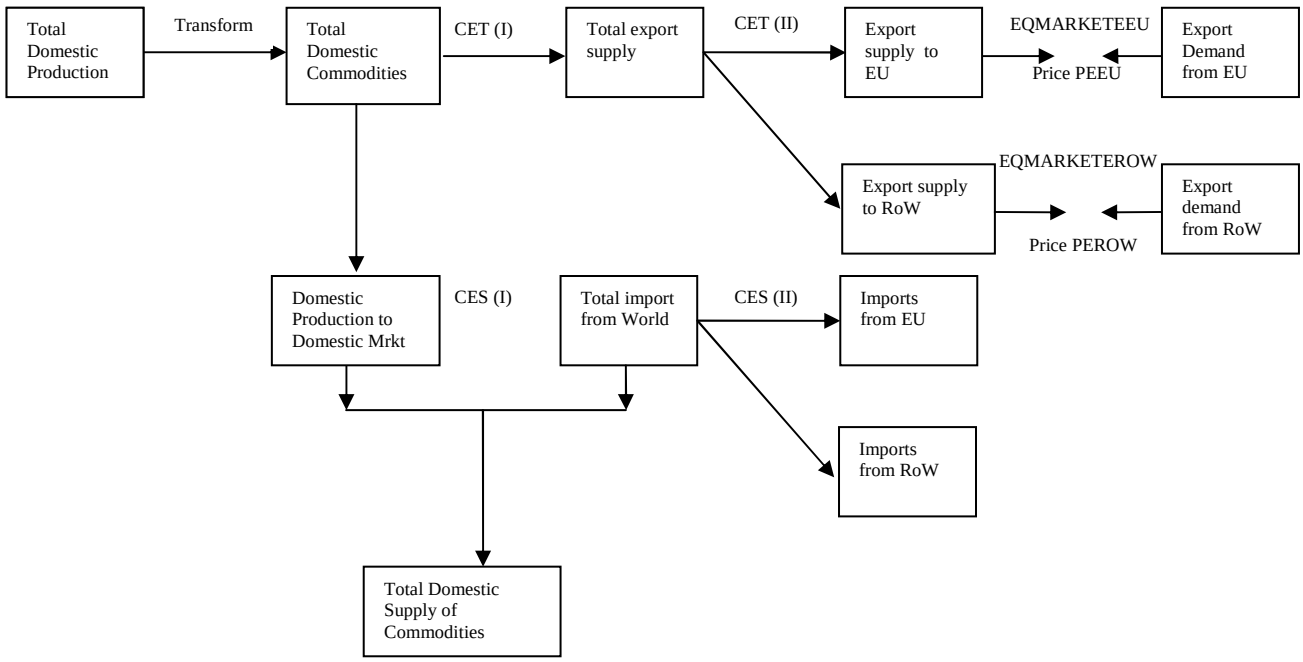
where X_j is the amount of total supply of the j-th commodity in the domestic market, M_j is the amount of imports of jth commodity from the Rest of the World, XDD_j is the amount of domestic production of jth commodity supplied to domestic market. Analogically to the CES function, aA, γA_j and $-\rho A$ are the parameters of the CES function.
An extension of the foreign market equations has been carried out in order to disaggregate the foreign sector in the EU and the Rest of the World (the scheme of flows is displayed in Scheme 2). Following assumptions has been made to address this issue:

- It is assumed that there is an aggregated CET function that distributes total domestic production between domestic and foreign markets (CET I).
- Exports defined in CET I are further disaggregated in the second nested level between exports to EU and Rest of the World (RoW) based on the CET II function.

[4] If μH = 0, LES utility function is reduced to the Cobb-Douglas utility function.

- The equilibrium between export supply and export demand determines the export prices in both foreign markets.
- An aggregated CES function that combines domestic production delivered to domestic markets and imports in one bundle is applied.
- Imports defined in the CES I function are disaggregated on the second nest level to imports from EU and the ROW with the use of the CES II function.

Scheme 2: Incorporation of foreign sector into the CGE model



3.5 Dynamization of the CGE model

The CGE model follows a recursive form of dynamization with a Tobin's Q form of investment function. For the implementation of Tobin's *q* approach in recursive CGE models, various alternatives can be found. The most cited are modifications developed by Bourguignon and Jung and Thorbecke. Among more recent works, the use of Tobin's Q approach to modelling investment behaviour can be found in Lemelin (2007), who derives a constant elasticity increasing function of Tobin's Q based on the work of Jung and Thorbecke (2001). A similar approach can be found in the works of Annabi (2005), elaborated in the CIRPEE institute[7].

In the CGE model, the investment allocation function is modelled following the Tobin's Q specification as used by Lemelin or Thorbecke:

$$\frac{ISi}{KSi} = \gamma_i \left(\frac{RKi}{USCi} \right)^{\delta IS} \qquad \textbf{(7)}$$

where ISI_i is the investment allocation per sector, KS_i is capital stock per sector, and (RK_i / USC_i) is the Tobin's Q ratio where RK_i represents the return to capital and USC_i are the respective user costs per sector. γ_i is a calibrated distribution parameter of the investment function, and parameter σ_{IS} is the elasticity of substitution which indicates the response of investments to the change in the Tobin's q value.

Equation (7) specifies that the proportion of new investment allocation to the capital stock in each sector (ISI_i/KS_i) is determined by the ratio of the return to capital and the respective sector's user cost of capital. Tobin's Q theory indicates that if the Q ratio > 1, the particular sector will attract new investments since the expected profit from unit of capital exceeds its costs, whereas if Q ratio <1, there are pessimistic conditions for attracting new investments.

In this paper, the calculation of return to capital follows the classical Return on Capital (ROC) calculation which is adopted on the sector level. Whereas the ROC is usually calculated as a ratio of net operating profit to invested capital, in the calculation of RK_i, the net operating profit was replaced by value added. Another modification has been made with respect to the differences between the included production sectors. For the sectors of manufacturing and service, the return to capital indicator is calculated as follows:

$$RK_i = \frac{PVA_i.VA_i - PL_i.L_i}{KS_i}, \qquad \textbf{(8)}$$

where PVA_i is the price of value added in the i-th sector, VA_i is value added of the i-th sector, PL_i is the price index of labour and L_i is the amount of labour employed in the production of the i-th sector.

For the agricultural sectors where land is considered as another production factor, the return to capital is formulated as:

$$RK_i = \frac{PVA_i.VA_i - (PL_i.L_i + PLD_i.D_i)}{KS_i}, \qquad \textbf{(9)}$$

where PLD_i is the price index of land and D_i is the amount of land employed in the production of the agricultural sectors.

User costs per unit of existing capital in the sector were specified on basis of the following formula:

$$USC_i = PINVT.(ir + sdep_i), \qquad \textbf{(10)}$$

where $PINVT$ is the weighted average price of investment, ir represents the exogenously set real interest rate and $sdep_i$ is a sector specific rate of depreciation. The user cost definition thus incorporates two sources of costs; first the real interest rate which shows the opportunity cost of a unit of invested capital and second the physical deterioration of the capital as a real cost of the capital usage.

After having specified the investment allocation function, a recalibration of the investment must be carried out in order to achieve balance between the value of investment goods produced and their allocation into the respective production sectors.

The dynamic link between the amount of capital stock in the current and following period is expressed in equation 7.

$$KS_{i,t+1} = (1 - sdep_i).KS_{i,t} + IS_{i,t}, \qquad \textbf{(11)}$$

Equation 11 indicates that the amount of capital stock in the current period is determined by the depreciated amount of capital stock in the previous period, raised by the investments.

4. Construction of the Social Accounting Matrix with agricultural focus

A Social Accounting Matrix (SAM) represents a consistent accountancy framework which is used in the set of simultaneous equations to quantify the intensity of shocks introduced in the system (Taylor and Von Arnim, 2007). The SAM contains information about the economy recorded in the System of National Accounts. Nowadays, after a pause in the field of

economic modelling caused by a lack of relevant data, the Czech national accounts are fully compatible with the other countries of the European Union (Janovskij and Rojíček, 2004)[5].

The general form of the Social Accounting Matrix used is based on data provided by the Czech Statistical Office (CSO) in their published version of the SAM for the year 2006. Given that the purpose of the CGE model is to provide agriculturally oriented policy simulations, the general SAM does not provide view on the agricultural account in a sufficient detail. This refers namely to the proper disaggregation of production account, representing key agricultural activities, the commodity accounts, representing flows of domestically produced, imported and exported key agricultural commodities, production factors account with a specific treatment of land and last but not least, the institutional account with independent farmer households treatment.

A crucial problem in the construction of agriculturally detailed SAM is the unavailability of certain parts of the respective accounts. For instance, the highest possible disaggregation in the supply and use tables, which are commonly used for the derivation of the production and commodity accounts, is the NACE[6] 01 level, which represents the aggregate sector of agriculture including hunting.

Most of the authors solve the problem of data unavailability of their local agricultural accounts by adopting the GTAP database[7], which contains all necessary accounts in a great agricultural detail. GTAP database is also one of the only publically available databases for agriculturally oriented CGE models[8]. Besides the GTAP CGE model itself, GTAP database is used as a major data source for LEITAP (GTAP model developed specifically for CAP analysis), MIRAGE (an upgrade of GTAP for the agricultural trade agreements simulations). A combination of GTAP and SPEL database (providing mainly input-output data based on 1995) is used for SAM applied in GOAL (developed by the National French Research Institute with similar focus such as LEITAP and MIRAGE), with focus on EU15.

However, despite its great detail and comfortability, it is obvious, that the GTAP database cannot reflect perfectly local conditions in agriculture. Discrepancy follows from several reasons. First of all, commodities that can be relevant locally do not need to be considered important from the world point of view. In the Czech Republic, this is particularly the case of potatoes and hop, which are not individually listed in the GTAP database. With neglecting these minor differences, problems also arise with the cost structure and evaluation of production factors income in agriculture. In the Czech Republic, where the land market is very rigid and the land price is undervalued compared to EU15, the estimation of cost structure differs with GTAP. In addition to that, for a long time the latest GTAP database was available for 2001, only recently there has been an update covering 2004. Taking 2001 as a benchmark for the Czech economy would cause a serious bias given that this was the period before the entry to the European Union and hence the convergence process. Furthermore, the shape of agriculture in 2001 was substantially different, with remaining importance of animal production sectors and pre-CAP structure of subsidies.

However it is precisely the quality of the SAM that determines significantly the quality of the CGE model outputs. In view of this, it is of the highest importance to apply a realistic and

---

[5] Input-output tables (supply and use tables) of the Czech Republic covering the years 1995-2007 are available at the EUROSTAT (http://epp.eurostat.ec.europa.eu).

[6] NACE („Nomenclature générale des Activités économiques dans les Communautés Européennes“) is a European systém of classification of economic activities.

[7] GTAP (*Global Trade Analysis Project*) is a database containing data in form of the Social Accounting Matrices for 83 countries of the world, (Dinamaran, 2006).

[8] Nowadays, the AGROSAM database, developed by the European´s Commission Joint Research Centre in Sevilla is also available, which combines data from EUROSTAT and GTAP database.

reliable SAM reflecting the agricultural sector of the Czech Republic in the constructed CGE model.
In light of these facts, the SAM that was used in this CGE model was built on basis of data provided by the Institute of Agricultural Economics and Information (UZEI). Two major sources of information were used – the commodity balances and the cost surveys of agricultural enterprises.

The commodity balances
In the Czech Republic, the domestic production, exports, imports and the use of each agricultural commodity is reported in the commodity balances. As the balances are recorded in physical units, the average market prices were used to derive the flows in monetary representation. The estimation of the investment in agricultural commodities was carried according to the estimated share of the replacement in the cattle and pig herd. Final disaggregation excluding the sector of other commodities is presented in table 4. Most of the commodities are predominantly used in the connected industries, particularly in the food industry, with the exception of fruits and vegetables, which are mainly delivered to consumer markets (this is in line with the nature of these products that are almost ready-to-eat, but it also reflects a declining level of fruit-veg processing industry in the Czech Republic). The table further shows that the cereals, cattle (in the form of live animals) and milk are the most export oriented commodities. Contrary to that, sugar beet is a commodity that is traded solely in the domestic market. Finally, oilseeds contain a considerable share of their use in the other industry, as they provide raw material for the production of biofuels.

Table 4: Use of agricultural commodities in the Czech Republic (2006)

	IC agri	IC food industry	IC other industry	FC hous	FC gov	Stocks	INV	Exports	Total
Cereal	5%	65%	5%	0%	0%	0%	0%	26%	100%
Fruits and veg	0%	13%	1%	69%	7%	-1%	0%	11%	100%
Oilseeds	6%	52%	25%	0%	0%	4%	0%	13%	100%
Sugar beet	0%	95%	5%	0%	0%	0%	0%	0%	100%
Cattle	11%	37%	0%	0%	0%	-1%	28%	26%	100%
Pigs and poultry	0%	82%	0%	4%	0%	-1%	1%	12%	100%
Milk	13%	65%	0%	0.1%	0%	0%	0%	22%	100%
Total	**5%**	**57%**	**3%**	**15%**	**1%**	**0%**	**2%**	**17%**	**100%**

Note: IC=intermediate consumption, FC=final consumption

The cost surveys of agricultural enterprises
As the sector specific data on the production structure in agriculture is not available, estimations need to be made on basis of the cost surveys of individual companies. The cost survey of UZEI is carried out on a yearly basis and records the economic situation of sample group of companies, mostly legal bodies. The collected data are arranged according the production zones and record information on the structure of the farms´ expenditures on energy inputs, seeds, feedstuffs, other material inputs and services, personnel costs and depreciation. The problem with these cost surveys arise from the absence of capital record in the economic balances. In order to estimate the income from capital used in agriculture, two methods can be used. Either, the capital is calculated as a resulting item knowing the net value added and the personnel costs, or it is estimated on the basis of the depreciation. The first method was proved inapplicable due to the fact, that some of the agricultural sectors would thus have a negative value of capital inputs, which is not feasible from the modelling point of view. Therefore, the method of capital derivation by means of the depreciation has been used. It is assumed that the proportion of capital that is depreciated in each of the eight agricultural

sectors follows the aggregated rate of depreciation, derived from the national accounts. Furthermore, it is assumed that the rate of return to capital in agriculture reaches 3% and is not sector specific. Based on these assumptions, the total capital stock per sector was calculated and consequently, the capital income in each sector was derived. The structure of production in each agricultural sector is presented in table 5.

As the table displays, the average share of intermediate consumption in the gross production is 75%. However, particular differences exist among the sectors. The sectors of cattle production and sugar beet display the highest share of material inputs in the production and also a considerable high share of subsidies. Regarding the capital income, the highest shares are registered in the sector of milk, cereals and oilseeds which are the sectors that require higher level of mechanization. For instance, in case of milk production, the investments to the milking machines represent a considerable part of the farmer savings.

Another important issue in building the production account in agriculture is the estimation of land income. For the sectors of crop production, this can be done quite explicitly. The specificity of land market, where 90% of land is rented, enables to estimate land income on basis of the rent per hectare recorded in the cost surveys and the number of hectares employed in each specific crop activity. However, it is necessary to take into account, that certain part of land is also consumed in the animal production. This is due to the fact that important part of animal feedstuffs is represented by fodder which is cultivated on land. Thus, it is necessary to implicitly involve land as a production factor in the animal sectors as well. With the use of conversion coefficients, it was possible to estimate the amount of land required for the production of animal feedstuffs in each animal category.

Table 5: Production structure in the agricultural sectors

	Cereal	Fruits and veg	Oilseeds	Sugar beet	Cattle	Pigs and poultry	Milk	Total
Agriculture	31%	28%	26%	36%	68%	17%	36%	30%
Food industry	0%	0%	0%	0%	14%	55%	13%	18%
Other industry	35%	18%	44%	33%	8%	7%	6%	18%
Services	9%	7%	10%	24%	6%	6%	8%	8%
Total intermediate consumption	**75%**	**53%**	**80%**	**93%**	**96%**	**85%**	**63%**	**75%**
Labour	17%	23%	14%	18%	31%	10%	18%	17%
Land	1,0%	0,2%	0,5%	0,9%	0,2%	0,1%	0,1%	0,4%
Capital	19%	14%	15%	8%	6%	5%	17%	13%
Net production subsidies	-29%	-2%	-23%	-27%	-39%	-5%	-14%	-17%
Consumption of fixed capital	17%	13%	14%	7%	6%	5%	15%	12%
Gross value added	**25%**	**47%**	**20%**	**7%**	**4%**	**15%**	**37%**	**25%**
Gross agricultural production	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***

Source: own estimations based on national cost surveys

The disaggregation of household account into farmer and other households was carried out with the use of the Statistics of Household Accounts, where the groups of incomes and expenditures are recorded individually for each type of household. Slight correction has been made, as the Statistics reports up to 10% share of incomes and expenditures of the farmer households in total households, however the value of production factors employed in agriculture reaches maximally 3%. Therefore, the subsidies to agriculture compensate farmers with their lower share of factor income in total income. In order to reach consistency with the production accounts, the average size of farmer households in the economy is assumed to be 7%.

5. Results of the simulations

5.1 Impact of the subsidy reduction on the sector of agriculture

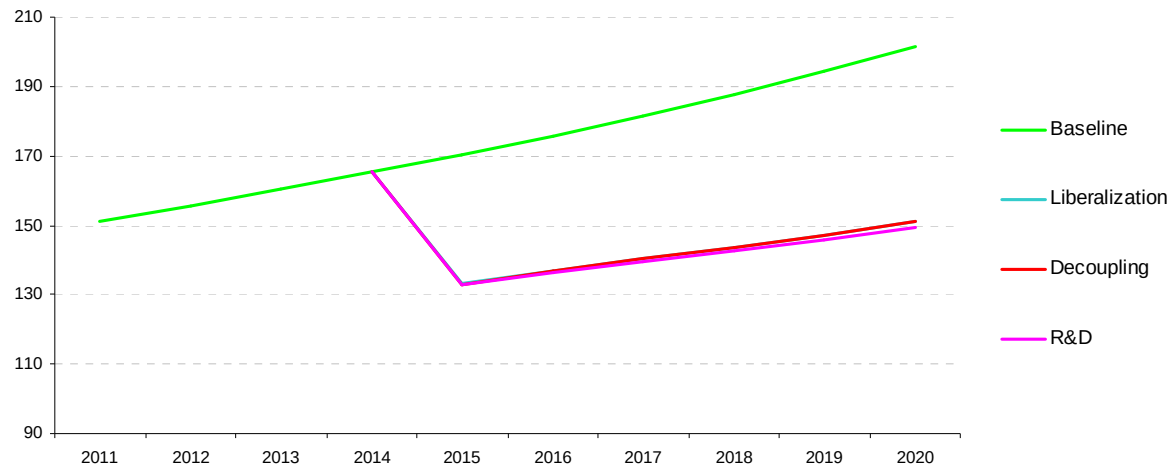
All scenarios have direct impact on the competitiveness of the agricultural sector. Since the *Liberalization* and the *Decoupling* scenarios model removal of coupled subsidies, their impact on the agricultural production is almost identical. As displayed in Figure 3, the complete removal of subsidies in the amount of CZK 25 bln. causes a sharp decline of the agricultural production. It can be seen, that the agricultural policy produces a shock in the market, which is driven by a radical increase of producer costs, which are not covered by subsidies. Producer prices bounce by 25% which causes a decline of competitiveness in both domestic and foreign markets:

- Consumers decrease demand for domestically produced agricultural commodities (drop by 16%) as they shift their demand to imported agricultural goods (imports increase).
- The producers can partially compensate for the loss in the domestic markets by selling abroad, but in fact, the exports fall even stronger than the domestic production, with a decrease up to 35%.

Because the agricultural goods are basic goods with a high level of subsistence, even a high increase in domestic price does not lead to a dramatic decrease of the domestic demand. The resulting 20% decrease of gross domestic production represents an average of the sales´ declines in both the domestic and foreign market.

The homogeneity of reaction concerning the other scenarios shows that if the subsidies to agriculture are paid directly to the farmer households as social transfers to compensate for coupled support removal, they cannot mitigate the reaction towards the decline of agricultural production.

Figure 3: Development of gross agricultural production (CZK bln., stable prices)



As the CGE model incorporates 8 specific agricultural sectors, it is possible to assess the impact of considered scenarios on each particular agricultural activity. In order to compare the effects, relative changes in year 2020 with respect to baseline are calculated and arranged in a descending order (table 6). Concerning the liberalization scenario, it is possible to expect a major decline in the *sector of cereal production* which is currently one of the strongest agricultural sectors. In the absence of subsidies, namely the direct payments, the cereals could decline by 39%. Major reason for the noticeable decrease of cereal production is the subsidy rate, which reaches almost 30% of the sector's production value. Therefore, the subsidies

removal is reflected quite strongly in an increase of the production costs. Furthermore, the cereal sector is the sector with the highest share of exports in the domestic production; hence, the sensitivity to exports is quite high compared to other sectors. If the subsidies are removed, the competitiveness of exports is highly affected and it negatively impacts the whole domestic production.

More than a 20% decline is also expected concerning the sectors of sugar beet, cattle, oilseeds and milk. On contrary to that, sectors of pigs-poultry and fruits-vegetables would face a lower decline, due to the current asymmetry in the agricultural policy.

Table 6: Relative changes of crop and animal production to Baseline (2020)

	Liberalization vs. Baseline	Decoupling vs. Baseline	R&D vs. Baseline	Subsidy rate
cereals	-38.6%	-38.4%	-38.9%	29%
sugar beet	-32.3%	-32.1%	-32.3%	27%
cattle	-30.9%	-30.6%	-31.4%	39%
oilseeds	-27.5%	-27.5%	-29.6%	23%
milk	-25.4%	-25.2%	-26.0%	14%
pigs and poultry	-17.7%	-17.4%	-18.4%	5%
fruits and veg	-7.4%	-7.1%	-7.6%	2%

Resulting changes in the agricultural activities caused by the agricultural policy have repercussions in the final structure of agriculture. As seen in figure 4, the sectors with a previously lower level of protection such as pigs-poultry, fruits-vegetables and eventually also milk would increase their share in the total agricultural production. On contrary to that, the importance of cereals would decline from 25% to 21%. In general, the share of animal products would increase on account of the crops.

Figure 4: Structural changes in agriculture in 2020

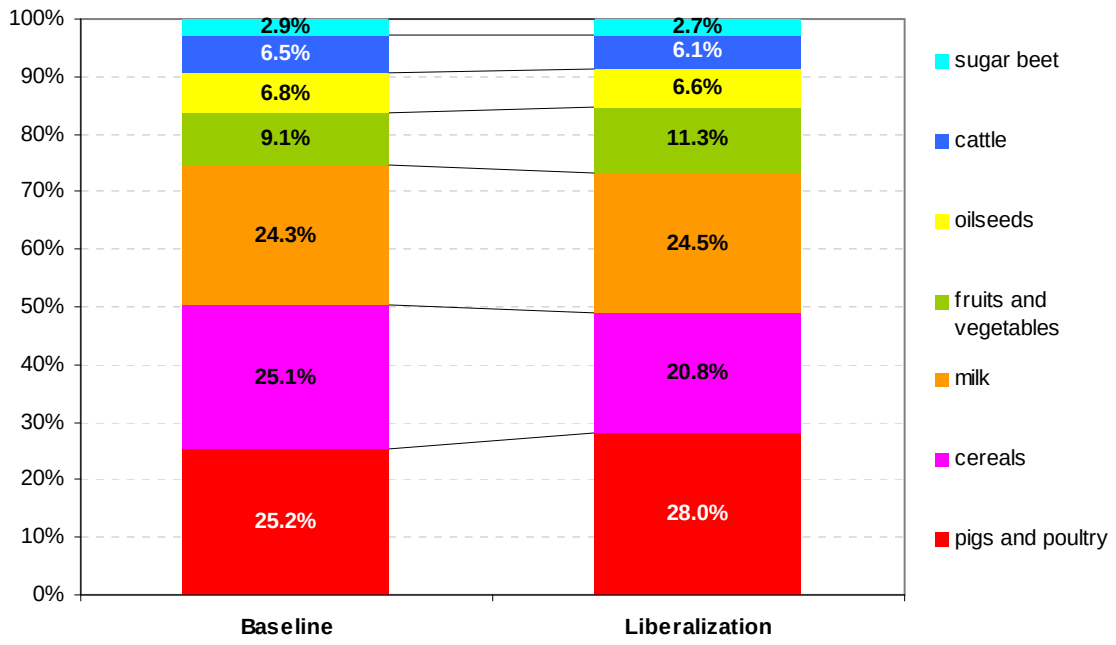
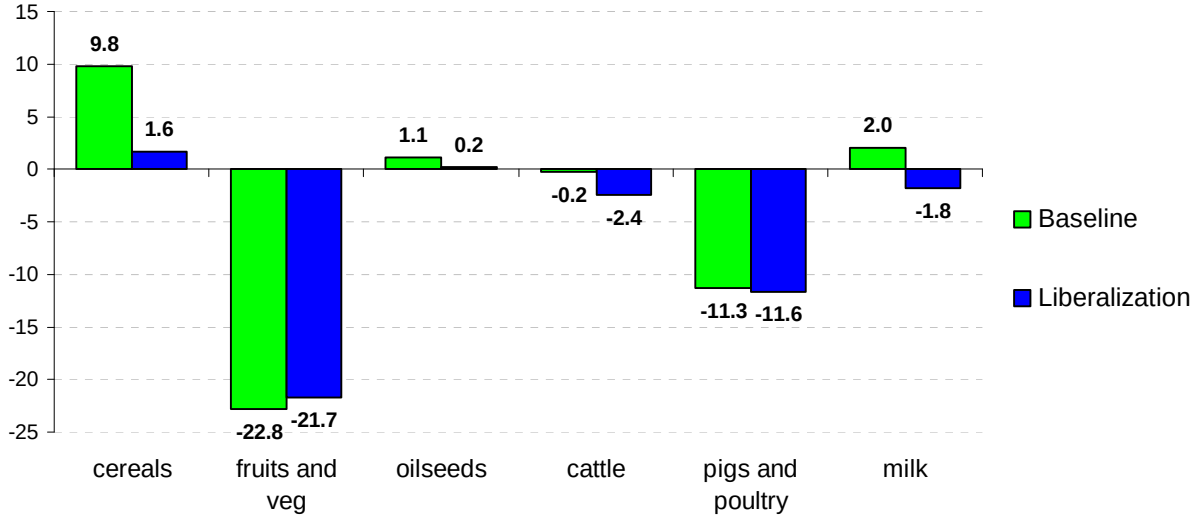


Figure 5 provides an overview about the competitiveness of the agricultural commodities in the world markets. The balance of trade shows that most of the commodities except for fruits

and vegetables would see a deteriorating position in the foreign market. The biggest impact is noticed concerning cereals where the balance of foreign trade would decline from almost CZK 10 bln. to less than CZK 2 bln. Worsening external position would occur in case of milk, where the originally surplus situation would turn to the foreign trade deficit.

Figure 5: Balance of foreign trade in 2020 (bln. CZK, stable prices of 2006)



The considerable decline of agricultural production in case of the subsidy removal is reflected into the market of production factors. The reactions are determined by the assumptions about the flexibility of supply on the specific factor markets and by the factor's endowment in each production sector. Concerning the aggregated sector of agriculture, the share of value added in total production reaches 34% (with the rest 66% being intermediate consumption), which is more than in industry (21%), but less than in services (43%). It can thus be expected that the stimuli coming from the upper level of the nested production structure would have less effect on factors´ demand in agriculture than in services, but higher than in industry. The structure of the value added is variable per each agricultural sector, in the aggregated terms, the sector employs 53% of labour, 46% of capital and only 1% of land. The value of land employed in the production process is very low, which is determined by the rigidity of labour market and low demand for land in the Czech Republic, which enables to maintain a considerably low land rents. Compared to agriculture, sector of industry is the most capitally endowed in the national economy, the share of capital reaches 64%. Contrary to that, the sector of services is the biggest employer, as it consumes 61% of labour in the creation of value added.

The structure of value added within each agricultural sector is presented in table 7. As the nature of production activities differs significantly between the animal and crop production, the share of each production factor is variable. In general, sectors of crop production are less labour intensive, with high capital substitution. This is the case of cereals and oilseeds. The exceptions are the sector of fruits and vegetables where the machinery cannot be used into such an extent and the sector of sugar beet. The sectors of animal production have a higher participation of labour in the production process. With respect to land, as most of the land is employed in the sector of crop production, its share is the highest in these sectors. However, the sectors of animal production are also land dependent, given that an important source of the animal feedstuffs comes from the on-farm cultivation of fodder.

Table 7: Structure of value added in agriculture

	cereals	fruits and veg	oilseeds	sugar beet	cattle	pigs and poultry	milk
labour	46.5%	61.7%	48.4%	67.6%	82.4%	65.7%	51.4%
capital	50.8%	37.7%	50.0%	29.2%	17.2%	33.9%	48.2%
land	2.6%	0.6%	1.6%	3.2%	0.4%	0.4%	0.4%
total	100%	100%	100%	100%	100%	100%	100%

Source: own estimations based on national cost surveys

Based on the evidence on the production structure, it can be assumed, that the decline of agricultural production in consequence of the subsidy removal will cause different pressures in each sector. In the sectors of cereals and oilseeds, there will be a high pressure to decrease the demand for capital and land, in the other sectors, higher pressures will occur in the labour market in agriculture.

The resulting price effects in the production factor markets are not only influenced by changes in demand, but they are also determined by the rigidity of factor supply. First of all, the capital supply is sector specific and constant in the short term. Furthermore, all capital must be employed, therefore, as the actual capital employment cannot change; the price of capital is the only mechanism to adjust to this situation. In the longer term, the supply of capital is not constant, but it changes with the accumulation of investment in the economy. The impact on each sector is displayed in table 8, where the relative changes in 2020 are reported against the baseline. As expected, major declines in the capital prices occur in the sector of cereals and oilseeds, where the price index compared to baseline falls by more than 25%. Following declines in capital stock in these sectors reflect worsened rate of return to capital, which determines the attractiveness of these sectors for investment and consequently decreases the dynamics of capital stock creation.

Regarding the market of labour, price changes against the baseline are minimal. This is due to the fact that the CGE model does not consider specific labour market. Labour price is thus a result of an interaction between total labour demand and a fixed labour supply. Therefore, the agricultural sectors are free to decrease their labour employment, yet their effect on the final wage rate is minimal. In line with the magnitude of reaction concerning the gross production, the highest decline in employment is in the sectors of cereals, sugar beet, cattle and oilseeds.

The changes occurring in the land market are determined strongly by its rigidity. Supply of land is fixed and does not change over time; in addition, all supplied land must be employed in the production process. This is why the price of land in 2020 is 58% lower than in baseline, reflecting a significant decline in the demand for land. Furthermore, a land reallocation can be observed when comparing the situation with baseline. Following the structural changes in the sector of agriculture, the land reallocation is also adjusted in favour of the sectors of fruits-vegetables, and the sectors of animal production. This goes hand in hand with a significant decrease of land cultivation in the cereal sector.

Table 8: Production factor's market (relative change against baseline in 2020)

	PK	Capital	PL	Labour	PLD	Land
cereals	-28%	-37%	-1.1%	-41%	-58%	-12%
fruits and veg	-2%	-8%	-1.1%	-8%	-58%	53%
oilseeds	-26%	-25%	-1.1%	-29%	-58%	5%
Sugar beet	-20%	-32%	-1.1%	-33%	-58%	0%
cattle	-12%	-30%	-1.1%	-31%	-58%	10%
pigs and poultry	-5%	-18%	-1.1%	-18%	-58%	35%
milk	-8%	-25%	-1.1%	-26%	-58%	20%

Note: PK- capital price index, PL-wage index, PLD-land price index

5.3 Impact on other sectors of national economy

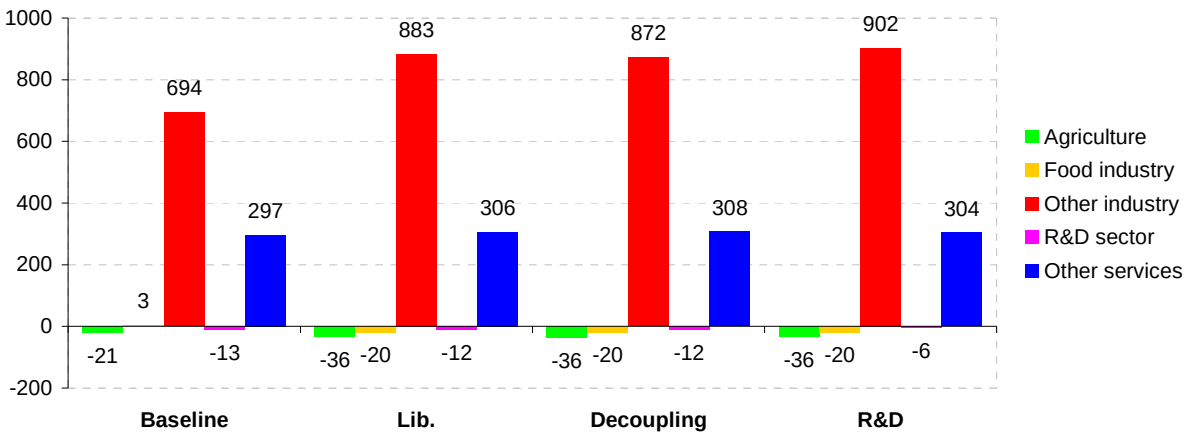
By loosening resources in agriculture, it is expected that other sectors of the economy could gain. On the other hand, as the sector of agriculture is a major supplier of inputs to other sectors such as food industry, it can be expected, that the reduction of agricultural production will have negative repercussions in the other sectors.
Impact of considered scenarios is presented in table 9. Concerning the scenario of full liberalization, the decline in agricultural production negatively affects the food industry, which reacts with an 18% reduction of production volume. Free resources from agriculture and food industry will be used in other sectors of industry including the sector of R&D, which would see a modest increase of production. On the other hand, a negative impact can be expected regarding the aggregated sector of services. This can be explained by high income elasticity of consumers with respect to services and a low ability to export produced goods and services. Based on higher income elasticity, with a decrease of income consumers react more sensitively concerning the demand for services than on demand for goods. Furthermore, as the sectors of services have the lowest share of exports in total production, the producers are in disadvantage compared to other sectors, where the fall in consumer demand can be partially compensated by an increase in exports.

Table 9: Gross production per sector in 2020 (bln. CZK, stable prices 2006)

	Baseline	Lib.	Decoupling	R&D/ services	% Lib. vs Baseline	% Decoupl. vs Baseline	% R&D vs Baseline
Agriculture	202	151	151	149	-25.2%	-25.0%	-25.9%
Food industry	555	456	458	452	-17.7%	-17.4%	-18.5%
Other industry	8,535	8,742	8,744	8,690	2.4%	2.4%	1.8%
R&D sector	15	16	16	27	5.5%	4.9%	76.8%
Other services	6,599	6,524	6,561	6,475	-1.1%	-0.6%	-1.9%

This finding is supported by figure 6 which displays the balances of foreign trade concerning each scenario. The highest surplus is reached in the industrial sectors, which benefit from the subsidy removal in agriculture. Whereas the balance of foreign trade in industry would grow up to 30%, the growth of net exports in services would not exceed 3%. Furthermore, as a result of the subsidy removal, the Czech Republic would change its position from the net exporter of food to the net importer.

Figure 6: Balance of foreign trade in 2020 (bln. CZK, stable prices 2006)



It is also possible to assess whether the scenarios have a significant effect on the structure of the economy. Table 10 presents a contribution of each sector in the gross value added. As seen from the table, without any policy interventions, the participation of agriculture in the total gross value added would reach 1.7% in 2020. If the subsidies to agriculture were removed, the share of the sector would decrease to 1.2%. In this consequence, the sector of food industry would also face a declining position, from 2.5% of GVA to 2.1%. It can be concluded, that with the removal of subsidies it is possible to expect only small structural changes in the economy.

Table 10: Structure of gross value added in 2020

	Baseline	Lib.	Decoupling	R&D
Agriculture	1.7%	1.2%	1.2%	1.2%
Food industry	2.5%	2.1%	2.1%	2.1%
Other industry	37.5%	38.6%	38.5%	38.6%
R&D sector	0.2%	0.2%	0.2%	0.3%
Other services	58.1%	57.8%	58.0%	57.7%
Total	100%	100%	100%	100%

5.4 Impact of the scenarios on GDP and the economic growth

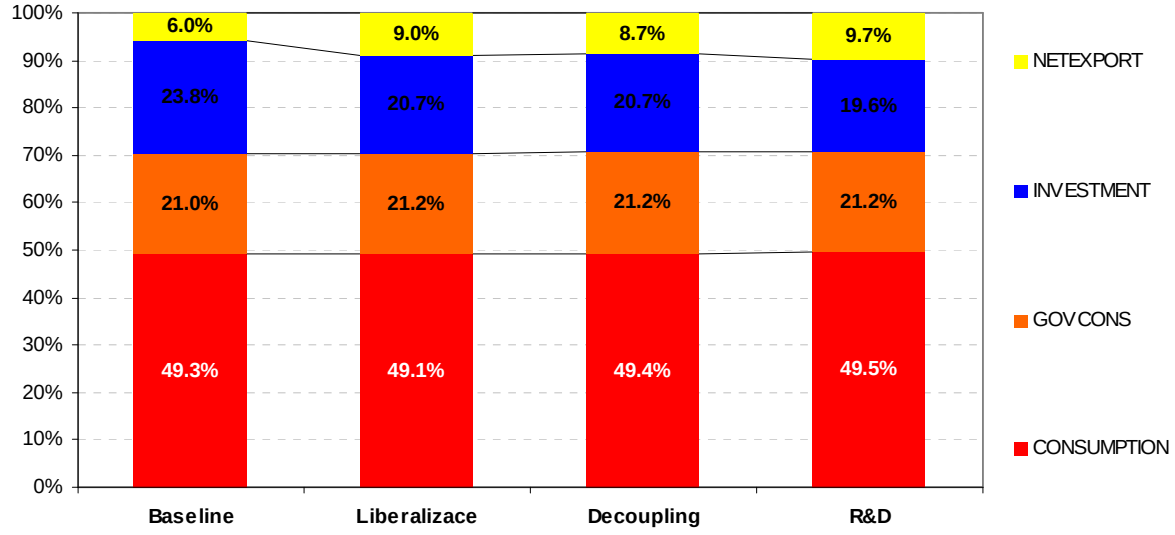
Even though the simulations concern the sector of agriculture in the first place, due to its linkages to other sectors and institutions, a certain impact on GDP could be expected. In order to understand better the driving forces, it is useful to observe changes in all GDP components. Following table 11, the most volatile components of GDP are investments and net exports. As the subsidies to agriculture are removed, the resources are employed in the sector of industry, which is the highest exporter. As a result of that, the balance of foreign trade is strongly stimulated. The highest is the reaction in case of the R&/services scenario, where the net exports would be 60% higher than the baseline level.
With respect to the total reaction of the economy, in all scenarios, a small decline of GDP against the baseline is reported. The lowest impact would occur in the scenario of decoupling, where the economy would be compensated by transferring production subsidies to farmer households. The strongest reaction would occur in case of the R&D/services scenario, in which the reallocation of subsidies would cost the 1% of GDP. Observing the changes in GDP components, it can be concluded, that the decline in GDP is mostly driven by the decline in investments.

Table 11: Comparison of GDP with baseline (2020)

	Lib.	Decoupling	R&D
CONSUMPTION	-0.8%	0.0%	-0.7%
GOVCONS	0.6%	1.0%	0.1%
INVESTMENT	-13.4%	-13.0%	-18.3%
NETEXPORT	49.3%	45.3%	60.2%
GDP	**-0.5%**	**-0.2%**	**-1.0%**

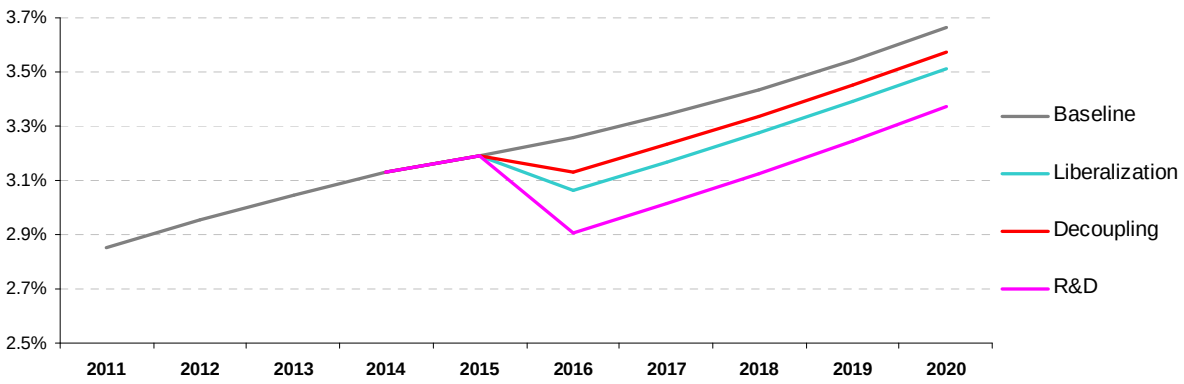
Figure 7 reports changes in the structure of the GDP at the end of the analyzed period. Whereas the share of the final consumption in GDP remains relatively stable across the scenarios, the contribution of investments and net exports is variable, which is in line with the previous findings. Concerning the R&D/services scenario, the share of investments would be only 20% compared to 24% in baseline.

Figure 7: Structure of GDP in 2020



The explanation of the different levels of GDP produced by the scenarios can be found in the development of the capital stock, which influences the dynamics of the economic growth. Figure 8 shows the percentage year-to-year change of total capital stock in each scenario. Major shock in the capital stock formation occurs in 2016, which is precisely one period after the scenarios are in effect. This is due to the fact, that the capital stock reacts on the investments carried out in the previous period and thus it reflects the previous investment behaviour. As seen from the figure, the strongest decline of capital dynamics occurs in case of the R&D scenario, causing thus a slowing of economic growth and a lower level of GDP at the end of the analyzed period.

Figure 8: Growth rate of capital stock in the economy



The divergence in economic growth under the evaluated scenarios can be principally attributed to the formation of savings in the economy. The table 12 presents a percentage change of each of the domestic savings accounts with respect to the baseline. Concerning the household savings, the only scenario which causes an increase in their volume is the Decoupling scenario. This is mainly supported by the growth of farmers´ savings, as a response to the subsidy transfers that are distributed from 2015. With respect to savings of firm, a decline can be expected in the liberalization and decoupling scenario. The firm savings are thus the main contributors to the slowdown of economic growth in the respective

scenarios. Concerning the R&D/services scenario, the domestic savings are influenced by two opposite forces, firstly a significant increase of firms savings (namely due to growth of factor prices in the supported sectors) and a dramatic decrease of government savings. Due to the fact, that the decline of government savings overweighs the increase of firms' savings, the final effect on the domestic savings is negative.

Table 12: Change of savings against the baseline (2020)

	Lib.	Decoupling	R&D
savings of farmer households	-5.3%	4.3%	-5.5%
savings of other households	-0.6%	-0.3%	-0.4%
savings of firms	-20.4%	-19.0%	46.0%
savings of government	-1.0%	2.4%	-51.7%
total savings	**-5.9%**	**-3.8%**	**-10.8%**

5.5 Impact of the scenarios on other macroeconomic variables

Other economic indicators can be related with the economic performance. First of all, the attention should be paid on the household incomes, which reflect the overall economic situation. In view of this, the incomes of households are expected to decrease, except which is not the case of the Decoupling scenario, that would cause an increase of incomes. The table 13 shows, that the removal of subsidies to agriculture would cost a 5.31% decline of farmer incomes. However, if the subsidies are granted as financial transfers, the incomes would on raise by 4%. The effects on other households' income are very modest; the drop of incomes would be lower than a percentage.
With respect to the unemployment rate, the highest decline occurs in case of the liberalization scenario, where the subsidy removal would cost 0.5 percentage points increase against the baseline. Finally, the inflation expressed by the consumer price index would increase by 1%, modestly reflecting increase of prices in the agricultural and connected sectors.

Table 13: Change of savings against the baseline (2020)

	Lib.	Decoupling	R&D
Income of farmer households	-5.31%	4.26%	-5.52%
Income of other households	-0.57%	-0.29%	-0.38%
Unemployment rate (p.p.)	0.51%	0.44%	0.47%
Inflation (CPI)	1.11%	1.14%	1.13%

6. Discussion

The results of this research can be partially compared with the other papers, however it should be taken into account, that the multiple economy CGE models, such as the GTAP have a different structure and hence might provide slightly different results. In view of this, the comparisons of the subsidy removal effects on the agricultural sector are more straightforward, as opposed to the macroeconomic effects.
The research has shown that the sectors of cereals, oilseeds and cattle would see a major decline of their production. This is in line with the other findings; according to the Scenar 2020, a decrease of the cereal and cattle production can be expected on account of pork and poultry, if the subsidies are removed. These findings are also supported by Frandsen and Jensen (2002) who identify different cross-commodity effects showing a decline in cereal and cattle production with an increase of fruit-vegetables production in case of the subsidies

decoupling. With respect to the overall effect on the sector of agriculture, the evidence of the other authors report a decline in the interval of 5% - 15%. For instance, Dixon (2006) calculates a decrease of the agricultural output by 9% if the direct payments and the other forms of subsidies are decoupled. The results of Gelan, Ayel and Schwarz (2006) show a 15% decrease of the agricultural production. These effects can be comparable to the result of this research, which reports a 20% reduction of the agricultural production.

Diverging evidence can be found in the case of the macroeconomic impacts. Whereas most of the studies report a modest increase in GDP (for instance Scenar 2020 reports a growth of 0.2%, Dixon (2006) calculates a growth of 0.03%), in this setting, a decline against the baseline is expected concerning all scenarios. Even though these results do not necessarily need to be comparable, this might suggest that the role of agriculture in other models is underestimated.

7. Conclusion

This paper presents preliminary results of the possible impacts of the future CAP on the Czech economy. Three scenarios were tested, which considered a complete removal of subsidies without compensation, a decoupling of subsidies as financial transfers to farmer households and a reallocation of subsidies to the sectors of R&D and services.

In order to quantify the effects, a recursive dynamic CGE model was applied. Contrary to the standard use of GTAP database in other agriculturally oriented CGE applications, this study has been carried out with the use of individually constructed Social Accounting Matrix for the economy of the Czech Republic, with an agricultural disaggregation.

It has been found out, that with a complete removal of subsidies to agriculture, a considerable reduction of the agricultural production can be expected, accompanied by a sharp decrease of the employment, which results from the rigidity of capital and land markets. Furthermore, the repercussions could be also seen in the sector of food processing, for which the agriculture is the major supplier. As discussed in the introductory chapters, the agriculture has been constantly weakening its social function with respect to a constant decline of employment. Therefore, removing subsidies to agriculture would further worsen the social imbalance between rural and urban households. As a solution to that, the compensation of farmers via total decoupling of support through the distribution in form of the social transfers could provide a socially acceptable solution.

Due to the present asymmetry of subsidies across particular agricultural sectors, the production of cereals, oilseeds and cattle would see the strongest decline, on account of pigs-poultry and fruits-vegetables, which would increase their share. As a consequence, the balance of the agrarian foreign trade would be further deteriorated as the cereals and the oilseeds are one of the main export commodities.

With respect to the impact of the agrarian policy on the other sectors of national economy, no significant structural changes can be expected, though some negative repercussions on the sectors of services would be seen as a result of their specific characteristics. In terms of the GDP effects, the decrease of subsidies without compensation would create a loss of GDP reaching 0.5%. If farmers were compensated, the loss would be only 0.2% compared to baseline.

Unfortunately, the results do not show positive effects if the resources are reallocated to other sectors. It has been found out, that in the current CGE setting, the reallocation does not stimulate the economic growth, which is mainly based on the fact that the R&D effects are not properly endogenized. Therefore, further research will be devoted to capture the positive

effects of research and development in the CGE models, either via the inclusion of knowledge as a specific production factor, or by means of the total factor productivity gains.
Finally, comparing obtained results with the evidence of the other authors, it has been found out, that whereas the macroeconomic effects are strictly positive, if subsidies are totally removed or decoupled from production, the results of this research report negative effects in all considered scenarios. With respect to the fact that this model is based on SAM which is tailored to the local economic conditions, it can be concluded, that the role of agriculture in the Czech economy is not negligible, which is in contradiction to other CGE based studies using GTAP or other databases.

Acknowledgments

An important contribution in the elaboration of this paper has been made by the Institute of Agricultural Economics and Information (UZEI) which has provided valuable inputs for the construction of the Social Accounting Matrix.

8. List of the cited literature

Annabi, N., Bazlul, H.K. et al. "Implications of WTO Agreement and Domestic Trade Policy Reforms for Poverty in Bangladesh: Short vs. Long Run." Working Paper MPIA, 2005a, pp 39.
Annabi, N. Cissé, F. et al. "Trade Liberalisation, Growth and Poverty in Senegal: a Dynamic Microsimulation CGE Model Analysis", CIRPEE Working Paper 05-12, **2005b**, pp 30.

Buckwell, A.: E*lements of the post 2013 CAP*. DG for Internal Policies, Structural and Cohesion Policies, 2009.
http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=28379#search=%20The%20future%20of%20the%20CAP%202013:%20The%20Budgetary%20Aspect%20of%20the%20New%20CAP

Decreux Y., Valin, H.: MIRAGE, *Updated Version of the Model for Trade Policy Analysis Focus on Agriculture and Dynamics.* CEPII, 2007.

Dixon P.B.,Rimmer M.,T. "Dynamic General Equilibirum Modelling for Forecasting and Policy. A Practical Guide and Documentation of MONASH. *North-Holland, Elsevier Science*, Netherlands, 2002. 338 s. ISBN 0-444-51260-8.

Elbehri, A., Umstaetter, J., Kelch, D.: The EU Sugar Policy Regime and Implications of Reform. *Economic Research Report* Nr.-59. Economic Research Service/USDA, July 2008.

Gelan, A., Schwarz, G.: *Policy Impact Evaluation Model for Scotland: Decoupling Single Farm Payments.* Aberdeen Discussion Paper Series: People, Environment and Development, Scotland, 2006. ISSN 1743-9965.

IEEP: *The Post 2013 Budget – the Sneak Preview, Debating the Future of the Common Agricultural Policy*, říjen 2009.
http://cap2020.ieep.eu/2009/10/29/the-post-2013-budget-a-sneak-preview?s=2&t=7

Institute for Agricultural Economics and Information (UZEI): Internal Materials, 2009.

Janovskij, J., and M. Rojíček. 2004. “CGE Models Applied on New European Union Members: Case of the Czech Republic.” Proceedings of the Ecomod Conference. Available at www.ecomod.net/conferences/iioa2004/iioa2004_papers/506.pdf (accessed January 5, 2009).

Jensen, H. G., Frandsen, S. E.: Impacts of the Eastern European Accession and the 2003 reform of the CAP. Consequences for Individual Member Countries. Paper prepared for the 7th Annual Conference on Global Economic Analysis, Washington, D.C., June 2004.

Jung, H.-S. and Thorbecke, E. 2001. The Impact of Public Education Expenditure on Human Capital, Growth, and Poverty in Tanzania and Zambia: A General Equilibrium Approach. IMF Working Paper WP/01/106. 36 pages. Washington.

Lemelin, A.: „Bond Indebtedness in a Recursive Dynamic CGE Model“. Working paper 07-10, CIRPEE, 2007. pp 73. Electronic copy available at: http://ssrn.com/abstract=984310

Pavel Ciaian, P., Kancs, A.: The Capitalization of Area Payments into Farmland Rents: Theory and Evidence from the New EU Member States. EERI Research Paper Series No. 04/2009. March 2009, 37 p. ISSN: 2031-4892

Piermartini, R.: *Modelling Methods for Trade Policy I: Simulations Models* Economic Research and Analysis Division, WTO, Bankgkok, April 2006.

Rural Investment Support for Europe (RISE): *Public Goods from Private Land*. December 2009.

European Commission*: Scenar 2020. Scenario study on agriculture and rural world.* Directorate-General Agriculture and Rural Development. 2007. ISBN 978-92-79-05441-9.

Taylor, L., Von Arnim, R.: Projected Benefits of The Doha Round Hinge on Misleading Trade Models, Policy Note. New York: *Schwartz Centre for Economic Policy Analysis*, March2007. Available at: http://www.newschool.edu/cepa/publications/policynotes/Doha%20Policy%20Note%20Final%2003_12_07.pdf 5.1.2009.