Comparative Advantages, Transaction Costs and Factor Content in Agricultural Trade: Empirical Evidence from the CEE*

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Abstract— **The present study examines factor content in the CEE transition country agricultural trade. However, deviating from the traditional approach, we do not test the HOV prediction. Instead, we examine the theoretical predictions that relate the factor content of international trade to cross-country differences in technology and endowments. Our empirical findings suggest that factor content between agricultural exports and imports is rather similar in CEE. In order to explain the general lack of the CEE agricultural specialisation and the observed paradox, we attempt to identify the role of transaction costs and market imperfections in determining factor content in agricultural production and trade. We find that technological differences and factor endowment are only weak determinants of country specialisation. Transaction costs and market imperfections distort farm specialisation and organisation in CEE, and hence factor content in traded agricultural goods.**

Keywords— **Comparative Advantage, Transaction Cost, Factor Content, Trade.**

I. INTRODUCTION

Relative factor endowment models continue to play a prominent role in international trade literature. There are two principal reasons why one of the key objectives of international economic research has been to account for the factor content of trade. The first is that economists want to trace the effects of international influences on relative and absolute factor prices within a country. The Heckscher-Ohlin (HO) model and its variants, with their emphasis on trade arising from differences in the availability of productive factors, provide a natural setting for such investigations (*Davis* and *Weinstein* 2001).

The second reason for the focus on the factor content of trade is that it provides a precise prediction against which to measure how well the trade models work. The relative factor endowment models are extraordinary in their ambition. They propose to describe, with but a few parameters and in a unified constellation, the endowments, technologies, production, absorption, and trade of all countries in the world. This juxtaposition of extraordinary ambition and parsimonious specification have made these theories irresistible to empirical researchers (*Davis* and *Weinstein* 2001).

Complementing the previous studies, the main objective of the present paper is to analyse the factor content of net trade. More precisely, this paper attempts to examine the Leontief Paradox in the CEE agricultural trade.[1] Hence, the underlying driver for investigating the relative factor content of trade is somewhat different in the present study. In contrast to most studies in past, which mostly examined factor intensities in developed country manufacturing trade, this paper examines factor intensities in CEE agricultural trade. We are interested in empirically testing if CEE agricultural trade follows the trade pattern suggested by *HO*'s traditional trade theory based on relative factor endowments. Furthermore, since our focus is on agricultural trade, the land intensities of trade agricultural products will also be examined in addition to the traditional factors of capital and land.

The paper is organised as follows. Section 2 provides a brief overview of previous studies on factor content of trade. Section 3 presents the stylised facts about agriculture and trade in CEE. In section 4 we examine factor intensities in CEE agricultural trade. In section 5 we attempt to identify the role of transaction costs and market imperfections in determining factor content in farm specialisation and agricultural trade. Section 6 concludes and outlines avenues for future research on factor content in CEE agricultural trade.

II. PREVIOUS LITERATURE

First we discuss the theoretical literature on relative factor endowment. The theoretical relative factor endowment models provide the theoretical framework for the present study. In section 2.2 we discuss the key findings

[1] In the present study CEE refers to Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

of empirical studies and their implications for the present study.

A. The theory

The standard multifactor, multicommodity, and multicountry model for predicting factor content of trade is the Heckscher-Ohlin-Vanek (HOV) model. The key assumptions of the HOV model are identical technologies across countries, identical and homothetical preferences across countries; differences in factor endowment, free trade in goods and services and no factor intensity reversals. If all countries have their endowments within their core of diversification, then factor prices are equalised across countries.

Let $r = 1,\ldots,R$ index regions/countries, $i = 1,\ldots,I$ index industries; and $f = 1,\ldots,F$ index factors. Let $A = [a_{if}]'$ be the amount of production factors used to produce one unit in each industry, where rows of the A matrix index factors and columns industries. Matrix A_t measures the total factor demand, i.e. direct factor demand plus indirect use of input factors. In the case of more traded goods than factors the total factor intensities are relevant for explaining the trade flows (*Deardorff* 1984). This can be readily shown by post-multiplying the direct factor demand matrix, A_d, by the Leontief inverse:

$$A_{rt} = A_{rd}(I - B_r)^{-1} \quad (1)$$

where I is the identity matrix and B_r is the technical coefficient matrix (B_r matrix) computed from the region/country r 's input-output table.

Let Y_{ir} be the $(I \times 1)$ vector of each industry i 's input, D_{ir} be the $(I \times 1)$ vector of demand for each good. The net export vector of goods, T_r, originating from region/country r can then be written as:

$$T_r = Y_r - D_r \quad (2)$$

The factor content of trade, i.e. the $(F \times 1)$ vector of net trade in factor services, can then be defined as:

$$F_r = A_r T_r \quad (3)$$

Identical technologies across countries and factor price equalisation imply that $A_r = A$, which makes the interpretation of $F_r = AT_r$ straightforward: a positive value of an element in F_r indicates that the factor is exported and a negative value indicates that the factor is imported.

The HOV model relates factor content of trade to the relative country endowment with production factors. Calculating the demand for factor f in region/country r and assuming full employment of all primary factors, we can write $AY_r = V_r$, where V_r is the endowment of factor f in region/country r. With factor price equalisation, free trade and identical homothetic preferences across region/countries, region/country c 's consumption vector must be proportional to the total world consumption:

$$D_r = s_r D_w \quad (4)$$

where s_r is region/country r 's share in the world demand, D_w. Assuming full factor employment and world production is equal to world consumption, we obtain:

$$AD_r = s_r AD_w = s_r AY_w = s_r V_w \quad (5)$$

Together with the expressions for AV_r and AD_r we can derive the HOV equation:

$$F_r \equiv AT_r = V_r - s_r V_w \quad (6)$$

The left hand side of equation (6) captures the production side of the HOV theorem and is often labelled as the measured factor content of trade. The right hand side of equation (6) captures the consumption/demand and is often referred to as the predicted factor content of trade. For factor f the equation (6) can be rewritten as:

$$F_{fr} = V_{fr} - s_r V_{fw} \quad (7)$$

Equation (7) relates for each factor separately a country's net factor content of trade to its own and the world's endowments. If region/country r 's endowment with factor f relative to world endowment of that factor exceeds region/country r 's share in the world's GDP, i.e. $\frac{V_{fr}}{V_{fw}} > s_r$, then country r is abundant in factor f.

Equation (7) can be estimated either as a world version or country pair version. Most of previous studies have employed the world version (e.g. *Bowen*, *Leamer* and *Sveikauskus* 1987; *Trefler* 1995). Yet the country pair version have several methodological advantages of assessing the success of HOV. On the one hand, one does not have to employ and construct endowment data for the world as a whole. More specifically, the world endowment number is wrong as soon as countries are missing, or as soon as the data for a particular country are unreliable. On the other hand, and more importantly, it can be shown that the two-country version only requires that the specific HOV assumptions hold for the two countries considered (*Brecher* and *Choudri* 1988). As soon as the assumptions of HOV do not hold for the world as a whole, relying on world endowments is not correct.

In the present study we adopt a hybrid approach of the world and country pair version of equation (7). More precisely, we reformulate HOV for a smaller group of countries (yet larger than two).[2] This allows us to avoid constructing and employing endowment data for the whole world, which at a reasonable confidence level is not available for all agricultural activities and all world countries. In addition, by selecting similar CEE transition countries we hope to address the issue that all our sample countries rightly fit into the group (because they satisfy the HOV requirements and because their data are reliable).

B. The evidence

According to the neo-classical general equilibrium models of international trade, countries and regions trade with each other because of their differences or due to economies of scale. Ricardian model of international trade states that differences in technology between trading partners determine trade pattern while HO model states that countries trade because of differences in factor endowments.

Leontief (1954) provides one of the first attempts to examine the HO theory empirically. Although, this was not a formal test of the HOV theorem, in 1954 *Leontief* found that the U.S. (the most capital-abundant country in the world by any criteria) exported labor-intensive commodities and imported capital-intensive commodities, in contradiction with HO theory.[3] Hence, Leontief Paradox undermined the validity of the HO theorem, which predicted that trade patterns would be based on countries' comparative advantage in certain factors of production (such as capital and labour).

The Leontief Paradox has generated a huge literature in the subsequent years. Since *Leontief*'s findings in 1954 the HOV theorem has frequently been rejected for US and other developed economies in favour of statistical hypotheses such as a zero correlation between factor endowments and trade patterns (see *Davis* and *Weinstein* 2001 for an overview). The widespread view of nineties was well summarised by *Leamer* and *Levinsohn* (1995) appraisal of the empirical performance of factor endowment theories: *'It is more convenient to estimate the speed of arbitrage rather than test if the arbitrage is perfect and instantaneous'*.

Leontief's methodology has been criticised along many lines (see e.g. *Schott* 2003). One of the main objections to *Leontief*'s methodology is that *Leontief* used a two-factor model (labour and capital), thus abstracting from other factors such as natural resources (land, climate, mineral deposits, forests, etc). *Vanek* (1959) pointed out that a commodity might be intensive in natural resources so that classifying it as either capital or labour-intensive would clearly be inappropriate. *Vanek* argues that the omitted factors help to explain the Leontief Paradox and he stresses the importance of restoring the traditional triad of capital, labour and land in factor endowment considerations.

Stern (1975) emphasised the need for models of more than two factors because capital and labour are required to improve natural resources to give them economic value, and countries may certainly combine these factors in somewhat different proportions when producing natural resource-based products. Thus, consideration of natural resources is important in the examination of the effect of factor endowment on trade.

Summarising findings from the previous empirical studies we may draw the following conclusions. First, as the *Leontief*'s original study itself, most of the factor content studies to date have been applied to developed countries, because only these countries have the necessary input-output and trade data required for computing factor content of trade for each sector and trading partner. To date, there is no single study analysing factor content in all CEE transition country trade. This study departs from previous literature and examines factor content in the CEE transition country trade.

Second, there are very few studies of factor content of agricultural trade. The works by *Schluter* and *Lee* (1978)

[2]Our group of countries include 8 CEEs: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

[3]*Leontief* calculated labour-output ratios and capital-output ratios for a number of industries in the U.S. economy. Using these coefficients, he then calculated the amount of labour and capital embodied in U.S. imports and exports. *Leontief* found that the capital-labour ratio embodied in imports exceeded the ratio embodied in exports by approximately 30 %.

and *Lee, Wills* and *Schluter* (1988) are among the few exceptions. The present study aims at filling this research gap. More precisely, we examine the theoretical predictions that relate the factor content of agricultural trade to cross-country differences in relative factor endowment.

Third, previous findings suggest omitting other factors might yield biased factor content estimates. In light of these findings, our empirical analysis includes land in addition to the traditional factors such as capital and labour. Considering land in our study is additionally motivated by the fact that we examine factor content of agricultural trade.

III. DATA AND DESCRIPTIVE STATISTICS

In this section we present the empirical evidence of CEEs' comparative advantages. We examine two key determinants of comparative advantage in CEE: (i) primary factor endowment; and (ii) farm structure determining production technology.[4] In section 3.4 we summarise the key findings about CEEs' relative comparative advantages, which allow us to derive empirical hypothesis. We begin with a brief description of the data.

A. Data

The analysis is based on three major data sources. All regional data is extracted from the Farm Accountancy Data Network (FADN). The annual sample of FADN covers approximately 80.000 holdings. In 2004 they represented a population of about 5.000.000 farms in the 25 Member States, covering approximately 90% of the total utilised agricultural area (UAA) and accounting for more than 90% of the total agricultural production of the EU. In the present study we make use of FADN data only for eight CEE economies. The information collected, for each sample farm, concerns approximately 1000 variables. FADN data relating to individual farms is confidential. Consequently, data at the level of individual farms are not publicly released. However, aggregated results by farm type and for regions and Member States are published on a yearly basis, which we use in the present study.

The national trade data is extracted from the COMEXT trade data base *Eurostat* (2007). The COMEXT data base provides data of Member States of the European Union on external trade with each other and with non-member countries. It contains data on external trade collected and processed by the EU Member States and more than 100 other countries, including U.S.A., Japan and the EFTA countries. COMEXT contains several types of data from various sources (European Union, United Nations, IMF etc) and with different structures (corresponding to different nomenclatures like CN, SITC Rev2, SITC Rev3 etc).

In addition to bilateral international trade flows, the GTAP Data Base complements input-output flows in CEE and provides data for macroeconomic variables such as consumption, GDP, etc. The advantage of the GTAP Data Base is that it is a global data base representing the world economy compared to EU member countries' trade in the COMEXT Data Base.

In order to reveal sectoral differences in production, trade and demand, we disaggregate agricultural sector in eight sub-sectors, which are summarised in Table 6 in the Annex. In order to reveal regional differences in production and demand, we disaggregate CEE into eight countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) and 66 regions according to the FADN classification of the European Union (see table 7 in the Annex).

B. Agricultural transition in CEE

Our study is motivated by the recent systemic change taking place in Central and Eastern Europe (CEE),[5] which offers a natural (political) experiment for studying country specialisation and factor services trade. In free market economies the pattern of specialisation is fully determined by inter-industry differences in the expected profits. This is entirely different in centrally planned economies, where firm specialisation was largely determined by central planners. Central and Eastern Europe during the Soviet period was a great example of a system-wide central planning, where the central planning process has led to a high and arbitrary degree of regional division of labour and regional specialisation (*Swinnen* 1999; *Lerman et al* 2002).

The centrally planned pattern of regional specialisation became unsustainable, when the systemic transition to the market economy started. Facing hard budget constrains the formerly state-subsidised farms became unprofitable under free market conditions and had to be reorganised. Transition process in agriculture involved privatisation of agricultural recourses and farm restructuring. The predominant form of privatisation of agricultural land and other assets in CEE countries was restitution to former owners (*Swinnen* 1999; *Lerman* 2001).

[4]Other most often studies sources of comparative advantage are tastes, size (with increasing returns), market structure (with imperfect competition), location (with trade costs), and initial conditions (agglomeration).

[5]In the present study CEE refers to Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

The privatisation process was followed by farm restructuring. New private owners of farm assets and land were allowed to break away from cooperative farms and to start individual farming. This led to the creation of family farms that were significantly smaller in size than cooperatives, but comparable to their Western European or American counterparts. However, not all cooperative farms broke up into family farms. Some cooperatives were transformed into corporate farms. In these cases old socialist cooperatives were turned into cooperatives of new owners of agricultural assets (including land), joint-stock companies, limited-liability companies or partnerships (*Swinnen* 1999).

The adjustment in farm organisation is constrained by transaction costs, as the transition process did not succeed to eliminate all constrains in adjusting farm organisation. According to *Ciaian* and *Swinnen* (2006), there still exist significant transaction costs in farm organisation adjustment in CEE. For example, the new land owners face significant transaction costs if they want to withdraw their land from former cooperative farms and relocate it. The transaction costs of farm reorganisation include costs involved in bargaining with farm management, in obtaining information on land and tenure regulations, in implementing the delineation of the land and dealing with inheritance and co-owners etc. (*Mathijs* and *Swinnen* 1998; *Prosterman* and *Rolfes* 2000; *Ciaian* and *Swinnen* 2006).

These findings suggest that the current specialisation pattern of former centrally planned farms largely depends on farm ability to reorganise their production form and structure. The farm ability to reorganise in turn depends on transaction costs and expected profits from the reorganisation. According to *Swinnen* (1999), the transaction costs are heterogenous across and within CEE and are largely determined by political priorities which led to different institutional settings in agriculture. In the present study attempt to examine the role of transaction costs (which are region specific) in determining farm specialisation and hence factor content of agricultural trade.

C. Factor endowment

Several studies have found that differences in resources, rather than differences in technology (e.g. *Debaere* 2003), are the most important determinant of comparative advantage. According to the HO model of international trade, in order to exploit their comparative endowment advantages, countries should produce and export goods that utilise their abundant factor(s) of production and import products that utilise the countries' scarce factor(s).[6] In this section we examine differences in factor endowment across CEE.

First, we examine primary factor endowment in CEE, as according to previous studies (e.g. *Debaere* 2003), differences in resources are among the most important determinants of comparative advantage.[7] The standard approach of comparing relative country endowments is to consider factor ratios, although there is no preferred combination of factors in forming these ratios. Table 1 reports land and capital endowment for each CEE country. Land endowment is measured in hectares of agricultural land per worker. Capital endowment is measured in thousands of Euros per agricultural worker.

In addition to factor ratios, we also include a relative measure of agricultural labour force. Labour force is proxied by the share of agricultural employment in the total employment in 1990. We choose this particular proxy for agricultural labour force for two reasons: (i) it is highly correlated with the unobservable agricultural labour endowment;[8] and (ii) it is highly exogenous, i.e. it is not determined by farm labour demand in 2004.[9] Indeed, until the nineties the size of the agricultural labour force was determined (and educated) exogenously by the central planners. Those workers which worked in agriculture until the nineties are experienced, most of them have agricultural education and, most importantly, they live in rural areas (*Csaki* and *Lerman* 1996).[10]

[6]Although, similarities across countries can also promote trade. Indeed, volume of trade amongst 'similar' countries is greater than volume amongst 'very different' countries. Nevertheless, country 'differences' rather than 'similarities' are usually assumed as a more fundamental reason for trade.

[7]Generally, country endowment advantages capture many more variables than the three primary production factors. We focus on these three because the main focus of the present study is labour/capital and land endowment and content in agricultural goods.

[8]In the context of the present study the agricultural labour force captures both the size of agricultural workers and the size of agricultural employment seekers.

[9]We perform sensitivity analyses using alternatives measures of rural labour endowment (rural population density, rural unemployment rate and rural-urban wage gap). Given that the use of alternative proxies does not change the presented results significantly, they are not reported here for the sake of brevity.

[10]Although, a certain share of them have left the rural regions, worker decision to leave is an endogenous process largely driven by wage differences and employment opportunities. Hence, the

The figures reported in Table 1 suggest a substantial variation in country endowment with primary production factors. According to Table 1, the most land abundant countries are Lithuania and Latvia with 0.76 and 0.71 hectare of agricultural land per capita, respectively. In contrast, the least land abundant country Slovenia has only 0.25 hectare of agricultural land per capita.

Table 1 also suggest sizeable differences in capital endowment. The lowest amount of capital per agricultural worker is in Lithuania (2.92); the highest in Slovenia (6.54). These capital endowment figures are in line with the general perception that capital/labour ratio is increasing in GDP per capita. Indeed, per capita GDP in Slovenia is almost two times higher than in Lithuania.

Labour endowment is reported in column 4 of Table 1. The smallest agricultural employment share in 1990 was in Slovenia - 8.4%. This can be explained by the fact that Slovenia was (and still is) the most developed country (Yugoslav Republic) among all CEE economies in our sample. Also the Czech Republic and Slovakia are agricultural labour scarce countries compared to the rest of the CEE. The most agricultural labour abundant country is Poland, where in 1990 more than one quarter of all economically active workers were employed in agriculture.

Factor endowment as a source of comparative advantage is particularly important when factor intensity differences are sizeable across sectors. Therefore, first we examine inter-sectoral technology differences in CEE. The inter-industry differences (differences between agricultural activities) in the relative labour intensity across CEE are plotted in Figure 1. Labour content in percent is on the vertical axis and the seven agricultural activities on the horizontal axis. The dots represent the 8 CEE countries. The average values for each sector with the corresponding standard deviations are reported next to the columns.

According to Figure 1, labour intensity is highly heterogenous across agricultural activities (industries) in CEE. For example, on average the pig and poultry (14.6% labour) production is 2.4 times more labour extensive than horticulture (34.6%). Similarly, cereal and oilseed production (17.1% labour) requires almost two times less labour than permanent crops (33.9%). Hence, Figure 1 suggests potential gains from international specialisation in agricultural production and trade.

Based on figures reported in Table 1 and Figure 1, and the HO theory of international trade we can derive several predictions about country specialisation. For example, they suggest that land abundant countries, such as Latvia and Lithuania, would produce and export products with relatively high land content, and import products with relatively low land content. According to Table 1, Slovenia has the lowest land endowment per capita, which would suggest the opposite pattern of factor content of agricultural trade.

Given that Poland has three times higher agricultural labour endowment than other comparable CEE economies, e.g. Slovenia, the HO model suggests that Poland would specialise in production and export of relatively labour intensive goods compared to agricultural imports. Similarly, if other things were equal, agricultural labour scarce countries - the Czech Republic, Slovenia and Slovakia - would import relatively labour intensive goods and export labour extensive agricultural products. However, as we will see in the following sections, other things are not equal in agricultural production and trade conditions between (and within) the CEE transition economies.

D. Farm organisation and production technology

According to the *Ricardian* model of international trade, in order to exploit their comparative advantages, countries specialise in producing what they produce best. In other words, inter-industry differences in production technology determine the specialisation pattern of regions and countries.[11]

Among other factors, the *Ricardian* gains from specialisation and trade depend on how big are inter-industry differences in production technology and how large are international (inter-regional) technological differences. We explore both relative and absolute technological differences in turn starting with cross-country differences in production technology.[12]

In Western Europe, North America and other developed countries, where agricultural sector is dominated by relatively small and compared to CEE homogenous family farms, input and output markets are functioning well and transaction costs of adjusting farm organisation are relatively low, the inter-regional and international variation in production technology is little affected by farm organisation (*Jensen* and *Meckling* 1976; *Pollak* 1985;

current agricultural employment share cannot be considered as a measure of exogenous comparative advantages.

[11]In the present study the terms industries and activities are used as synonyms. Hence, inter-industry differences denote differences between agricultural activities, such as milk, grain, horticulture, etc.

[12]Generally, the production technology at firm level is determined by many factors (see e.g. *Jensen* and *Meckling* 1976). However, in the present study we particularly focus on farm organisation and deliberately abstract from other determinants of production technology.

Schmitt 1991, *Allen* and *Lueck* 1998). Hence, if farms can straightforwardly adjust farm organisation, a given farm organisation little constrains firm specialisation in developed market economies.

A distinctive difference of the CEE's agriculture is heterogeneity in farm organisation and presence of market imperfections, which heavily affect farm production technology in CEE (*Swain* 1999; *World Bank* 1999; *Dale* and *Baldwin* 2000; *Rozelle* and *Swinnen* 2004; *Ciaian* and *Swinnen* 2006). According to (*Lerman et al* 2004; *Rozelle* and *Swinnen* 2004), the agricultural sector in the CEE transition countries is characterised by a dual farm structure.[13] Some regions and countries are dominated by large corporate farms (CF), whereas in other regions and countries small individual farms (IF) cultivate most of the land. These cross-country differences in the CEE farm organisation are summarised in Table 2, which reports percentage shares of land cultivated by IFs and their share in the total agricultural output. The last column of Table 2 reports the average farm size in ha.

The figures reported in Table 2 suggest sizeable differences in farm organisation across the CEE transition economies. According to columns 2 and 3, Slovenia and Poland have the highest share of IFs in both land use and in agricultural output. In contrast, Slovakia and the Czech Republic have the lowest share of IFs.

Table 2 confirms the evidence documented in the previous literature that the share of IFs is negatively and strongly correlated with the average farm land size (e.g. *Pollak* 1985; *Allen* and *Lueck* 1998). Countries with relatively high share of CFs (low share of IFs), e.g. the Czech Republic and Slovakia, have considerably larger farms than countries with high share of IFs (e.g. Slovenia and Poland). Given that cultivating 12 or 15 ha land, as in Slovenia and Poland, requires a considerably different technology than cultivating 535 ha land, as in Slovakia, both farm organisation and size co-determine the production technology in CEE.

Generally, the IF share in land use is lower than the IF share in output (compare columns 2 and 3 in Table 2). This can be explained by the fact that, on average, IFs tend to specialise in more labour intensive products, which are also more cost intensive and hence have a higher value per output unit than output of CFs. For example horticulture, the production of which is dominated by IFs, has a considerably higher value per output unit and the cultivated land hectare than cereals or root crops, the production of which is dominated by CFs.

According to *Pollak* (1985) and *Allen* and *Lueck* (1998), one of the key distinctive differences in production technology between IFs and CFs is the relative labour and capital intensity. Indeed, several studies, which have evaluated the production technology of individual farms and corporate farms, have found significant differences in the relative labour/capital intensity (e.g. *Pollak* 1985; *Allen* and *Lueck* 1998). On average, IFs tend to use less capital compared to CFs, whereas CFs tend to use less labour compared to IFs in producing the same product.

Figure 2 plots the farm-type differences in labour intensity for CEE. Seven industries (agricultural activities) on the horizontal axis and labour/capital ratio by farm type on the vertical axis. The numbers are percentage differences in labour intensity between IF and CF. According to Figure 2, in the CEE transition countries IFs tend to use more labour in all agricultural activities - the share of labour/capital ratio is higher for IFs in all activities. Figure 2 also suggests that farm-type technological differences are rather heterogenous across agricultural activities. The most sizeable differences in labour intensity between IF and CF are in horticulture (17.3%). In contrast, IFs and CFs use almost the same technology for producing cereals, oilseed and protein crops.

These farm-type differences in labour/capital intensity are largely determined by differences in the relative factor costs and factor productivity (*Pollak* 1985; *Allen* and *Lueck* 1998). In terms of labour, usually IFs face lower labour costs. Given that farmer is the residual income claimant, IFs do not suffer from moral hazard problem, which is an important issue in CFs (*Schmitt* 1991). This leads to higher labour productivity in IFs compared to CFs. On the other hand, labour productivity of IFs might be hindered by lack of labour specialisation, which reduces the marginal product of labour. Usually, the former effect is larger than the latter (*Pollak* 1985; *Allen* and *Lueck* 1998).

In terms of capital, usually IFs face higher per-unit capital costs. Because of missing collateral, IFs are more credit constrained than CFs, and in the presence of fixed capital transaction costs, IFs face higher per-unit capital costs than CFs. Moreover, capital productivity of IFs is often lower compared to CFs because of sub-optimal production scale and underemployment of farm equipment and machinery (*Pollak* 1985; *Allen* and *Lueck* 1998). Hence,

[13]The dual farm structure is undoubtedly one of the specific features of agriculture in CEE. This holds with regard to the farm size -- the CEE countries have both many small farms, which are often subsistence or part-time-oriented, and very large enterprises. The duality is also observed in farm size: IFs are relatively small and CFs are relatively big. In addition, land use fragmentation is another dual characteristic of the CEE's agriculture. Usually, the large holdings cultivate considerable lot sizes, while small IFs operate on very small and scattered plots, which often are too small and far away to efficiently use large machinery.

large CFs tend to have higher marginal productivity of capital than small IFs.

The relative profitability of IFs compared to CFs in CEE is summarised in Table 3. The first column reports labour intensity, which is calculated as labour cost share in final good value. The second column reports the corresponding IF/CF profitability ratios. Values <1 imply that IFs are less profitable than CFs, values >1 imply higher IF profitability compared to CFs.

The results reported in Table 3 suggests that CFs are considerably more profitable than IFs, when the share of labour is low and the share of capital is high. CFs are equally profitable with IFs, when the labour content in total costs reaches around 60%. Labour intensity over 60% is associated with a sharp decrease of CF (relative increase of IF) profitability. These results are in line with the theoretical literature on farm-type differences in production technology (e.g. *Pollak* 1985; *Allen* and *Lueck* 1998).

According to *Swinnen* (1999), farm reorganisation is costly and in some CEEs also politically constrained. The *Ricardian* theory of international trade suggests that, in presence of market imperfections and significant transaction costs of changing farm organisation, technological differences would lead to different specialisation patterns between IF-dominated and CF-dominated regions, and hence magnify the cross-regional differences in factor content of agricultural output and trade: IF-dominated regions would specialise in labour intensive goods, whereas CF-dominated regions would specialise in capital intensive goods.

Hence, in the presence of market imperfections and prohibitive transaction costs of changing farm organisation, we would expect that countries with high share of IFs (Slovenia and Poland) would produce and export relatively labour intensive products and import products with relatively high capital content. In contrast, if all other conditions were equal, we would expect that countries with high share of IFs (Slovakia and Czech Republic) would produce and export relatively more capital intensive goods and import relatively more labour intensive goods.

E. Relative comparative advantages of the CEEs' agriculture

This section summarises the key findings from sections 3.2 and 3.3 about primary factor endowment advantages, and technology advantages driven by farm organisation. Figure 3 maps out the agricultural labour endowment on the horizontal axis and the share of IFs is on the vertical axis. As in Table 1, the agricultural labour endowment is proxied by the share of agricultural employment in the total employment in the previous period.

Figure 3 positions countries according to their technological labour use advantages determined by farm organisation, and labour endowment advantages.[14] Those countries, which are located in the upper part in Figure 3 (Slovenia and Poland) have high share of labour intensive IFs, whereas those countries, which are located on the bottom (the Czech Republic and Slovakia) are dominated by labour extensive CFs. The most agricultural labour scarce countries are located on the left hand side in Figure 3 (the Czech Republic, Slovenia and Slovakia), whereas the most agricultural labour abundant countries (Poland) are located on the right hand side.

According to Figure 3, Poland has both technological and endowment advantages in labour intensive products. Compared to other CEE countries, the Czech Republic and Slovakia have strong technological disadvantages and some endowment disadvantages in labour intensive agricultural products. Slovenia has strong technological advantages and some endowment disadvantages in labour intensive products. The comparative advantages of Hungary are just the opposite of Slovenia. The remaining group of countries, the Baltic states, which are located in the central part of Figure 3, have slight labour endowment advantages, but do not have pronounced technological advantages/disadvantages in labour intensive agricultural industries.

IV. FACTOR CONTENT IN THE CEE AGRICULTURAL GOODS

In this section we examine to what extent the CEE economies specialise in production and export of goods, according to their technological and factor endowment advantages identified in this section. First, we calculate the relative factor content in the CEE agricultural production, after which we calculate factor content in the CEE agricultural product trade.

A. Factor content in farm output

We start the factor content analysis with production analysis as, according to previous studies, it may explain a significant part of factor trade.[15] For this purpose we

[14]Similar Figures can be drawn for the other two primary factors capital and land. Given country advantages in capital are inversely related to labour, they are not reported here for the sake of brevity.

[15]The role of firm specialisation in factor content of goods and services has been outlined among others by *Harrigan* (1997) and *Schott* (2003). For example, *Harrigan* (1997) argues that it is even

calculate input shares of three key agricultural production factors: land, labour and capital. The obtained results are reported in Table 4.

The figures reported in Table 4 suggest that capital is by far the most important input in the value of farm output (on CEE average 75.1 percent). On average, the labour share accounts for 22.4 percent of production costs. In contrast, the land content in the agricultural good value account to only 2.6 percent and hence is almost negligible.

According to Table 4, the three primary factor shares are different across the CEE transition countries. For example, on average the agricultural products in Hungary contain four times more land input than in Estonia. Also labour content in agricultural goods differs significantly across CEE. The most labour intensive agricultural products are produced in Slovenia, which on average contain 35.5 % labour input. The least labour intensive agricultural products are produced in Slovakia and Hungary with 15.9% and 17.9%, respectively. Also capital content in agricultural products is different across the CEE countries. For example, on average, Slovak farms use 30% more capital than Slovenian farms.

In order to see to what extent these results are line with our expectations, we compare them with country relative competitive advantages established in section 3. First, we compare country endowment and factor content in agricultural goods produced in the CEE transition countries. The figures reported in Table 1 suggest that Lithuania, the most land abundant country, has more than 300% higher land per capita endowment than Slovenia, which is the most land scarce country in our sample. However, this endowment ratio can only partially be recovered from figures reported in Table 4, which suggest that agricultural goods produced in Slovenia contain only 46% less land value than Lithuanian agricultural goods. Further, the highest and the lowest land content in agricultural good value have Hungary and Estonia - two countries with very similar land per capita endowment (0.58 and 0.57, respectively). Based on these comparisons we may conclude that land endowment plays only a limited role in firm production and specialisation decisions. This relative neglect of endowment with arable land might be partially driven by the fact that generally land has only a tiny share in the agricultural good value (2.6% on CEE average).

The figures reported in Table 1 also suggest that Poland is the most agricultural labour abundant country whereas Slovenia, the Czech Republic and Slovakia are the most labour scarce CEE countries. Comparing these figures with labour content reported in the middle column of Table 4, we note that the agricultural goods produced in Slovenia have the highest labour content. Hence, the specialisation pattern of Slovenia does not have the 'expected sign' in terms of agricultural labour endowment. Also the Czech Republic produces more labour intensive goods than we would expect from its agricultural labour scarcity reported in Table 1 (22% which is about the CEE average). Hence, in terms of agricultural labour endowment, the factor content ratio in the Czech agricultural output is suboptimal. It is more optimal for Slovakia, which has relatively scarce agricultural labour endowment and the produced agricultural goods are relatively labour extensive. The labour content of Polish agricultural goods is considerably lower than we would expect from the agricultural labour endowment reported in Table 1.

Next, we examine cross-country technological differences driven by differences in farm organisation. According to Table 2, Slovenia and Poland have the highest share of the labour intensive IFs in both land use and in agricultural output. According to Table 4, the agricultural goods produced in Slovenia have the highest labour content. Hence, in terms of technological advantages driven by farm organisation, the specialisation pattern of Slovenia has the expected 'sign'. Table 2 also suggests that Slovakia has the highest share of the capital intensive CFs. According to Table 4, the agricultural goods produced in Slovakia have the highest capital content. Hence, in terms of technological advantages driven by farm organisation, the specialisation pattern also of Slovakia has the 'expected sign'.

Figure 4 shows that labour intensity is increasing in the share of IFs - countries with more IFs relative to CFs tend to use more labour intensive production technology (or produce more labour intensive products). However, the relationship is not monotonic. The observed U shape in Figure 4 might stem from the fact that labour intensity in production is co-determined by land endowment. For a given share of IF in the total agricultural land use, land abundant countries tend to use less labour per hectare than countries with lower land endowment.

Next we examine the relationship between the share of IF in land use and labour cost share in production, which is plotted on Figure 5. According to Figure 5, labour content in production costs is linearly increasing in the share of IFs. This indicates that labour cost share in production is determined by farm structure and not by land endowment. Countries with more IFs have higher labour cost shares than countries with more CFs. Cross-country wage differences may explain why the relationship between labour per ha and IF share is non-linear in Figure 4, whereas the relationship between labour cost share and IF is linear in Figure 5.

more important to look at the pattern of specialisation than at the pattern of trade since *'economists won't be able to understand trade until they understand specialisation'*.

Summarising the key findings from this section we may conclude that the extent to which different CEE economies account for their relative comparative advantages in agricultural production is rather heterogenous. Generally, the technological differences driven by farm organisation are more accounted for in the agricultural production decisions in CEE than comparative advantages driven by country endowment with primary production factors.

B. factor content of agricultural trade

In this section we examine the extent to which different CEE economies account for their relative comparative advantages in agricultural commodity trade. For this purpose we calculate the relative factor content in two types of trade flows: gross and net factor trade. In the following we present the obtained results starting with the factor services content in exports and imports.

The content of factor services in the gross trade flows is reported in Table 5, where the left columns show factor content of agricultural imports and the right columns in agricultural good exports. The figures reported in Table 5 suggest a strong similarity in factor content between exports and imports. In both exports and imports the largest factor share represents capital, which on average accounts for almost three fourth of the internationally traded agricultural good value. On average, the imports of CEE countries have slightly higher labour content than exports (25.5% and 24.1%), whereas agricultural exports from CEE contain slightly more capital value than imports to CEE (73.0% and 71.7%). The third primary production factor land accounts on average for only 3 percent of the traded agricultural good value.

According to Table 5, in all countries except the Czech Republic the correlation between factor content in exports and imports is positive and pretty high. Slovakia has the highest share of capital content both in imports and exports, whereas labour is the largest component in agricultural good imports in the Czech Republic and Slovenia and exports of Slovenia.

Comparing factor content in farm output (Table 4) to factor content in agricultural exports (Table 5) suggests that, on average, exported goods are more capital intensive than agricultural goods produced and sold domestically (73% and 69%). In contrast, the locally produced and consumed agricultural goods are more labour intensive than exported goods (30% and 24%). This difference is rather surprising, given that labour costs in CEE are considerably lower than in EU-15 - the main trading partner. The average land content is slightly higher in the aggregate farm output compared to agricultural exports. Latvia, the Czech Republic, Slovenia and Estonia have the largest differences in factor content between farm output and agricultural exports, which raises important questions about differences in the drivers of factor content in agricultural production and trade.

Next, we calculate the net factor trade for agricultural goods. For this purpose we subtract the export column in Table 4 from the import column for each factor. The results for the net factor trade are mapped out in Figure 6, where positive values are net exports and negative values are net imports. The unweighted average net trade for each factor is shown right to the respective columns with standard deviation in parenthesis.

According to Figure 6, on average, the CEE countries are net exporters of land and capital and net importers of labour (first, third and second columns in Figure 6, respectively). This observed pattern in factor trade can be explained by trading country determinants and trading partner determinants.

In terms of the external factor trade determinants, the observed pattern in factor trade could be explained among others by the CEEs' main trading partner's EU-15 trade specialisation. On the one hand, the EU-15 countries are less land abundant and their farm structure is dominated by IFs, when compared to CEE. This implies comparative advantages to farmers in the CEE countries in land intensive products compared to the EU-15. On the other hand, the EU-15 has higher labour costs than the CEE countries. However, the figures reported in Figure 6 suggest that higher labour costs in EU-15 do not offset the comparative advantage of the CEE countries in land and capital.

Turning to country specific results, Figure 6 indicates a significant variation in the net factor trade across the CEE countries. Moreover, some of the presented results are counterintuitive. As expected, the Czech Republic with CF dominance is net capital exporter. In the same time, the Czech Republic is net land exporter and net labour importer. The same holds for Hungary, Estonia, Latvia and Lithuania but with less stronger net trade differences in all factors. According to factor endowments reported in Table 1, we would expect strong net export of land and weaker net export (or even net import) of capital in Baltic states, as these countries are land abundant and have relatively high share of IF in land use (see sections 3.2 and 3.3).

According to Figure 6, Poland is net exporter of labour and capital and net importer of land. However, one would expect that Poland would be net importer of capital as IFs dominate agricultural sector in Poland. Slovenia is net exporter of capital and net importer of land and labour. From sections 3.2 and 3.3 we know that Slovenia is scarce in land and its farming sector is dominated by the labour intensive IFs. However, Slovenia has the highest labour wage among all CEE countries. This could explain why

Slovenia is net labour importer while Poland is net labour exporter. Both countries have similar farm structure dominated by IFs. Contrary to our expectations, Slovakia, with a strong dominance of the capital intensive CFs, is net importer of capital and net exporter of land and labour. These results are against our expectations from Table 1, according to which we would expect similar factor trade pattern in agricultural goods to the Czech Republic, as both countries have the highest share of CFs in land use from all CEE countries.

Figure 7 shows that farm structure is an important determinant of factor content in agricultural exports. Farm structure determines what type of products CEE countries export. Higher share of IFs in land use leads to higher share of labour content in exports. Moreover, significant transaction costs of changing farm organisation imply rigidity of farm structure.

Figure 7 also shows a similar correlation for imports. Compared to exports, one would expect the opposite sign - countries with IF dominance should import more capital intensive products. However, the results reported in Figure 7 for imports do not confirm this hypothesis. Factor content in the CEE imports is similar to exports, though the correlation is considerably weaker (more than three times).

Summarising this section we may conclude that the traded factor value in imported and exported agricultural goods is rather similar across CEE. Second, the CEE transition countries only weakly specialise their international trade in agricultural goods according to their comparative advantages in primary factor endowment, and production technology driven by farm organisation. Third, factor content in agricultural goods produced and sold domestically differs from factor content in exported agricultural goods.

V. THE ROLE OF TRANSACTION COSTS AND MARKET IMPERFECTIONS

In this section we investigate the potential role of transaction costs and market imperfections in determining the pattern of country specialisation and factor content in the CEE agricultural trade. We investigate two types of transaction costs: (i) the cost of adjusting the specialisation pattern; and (ii) the cost of changing farm organisation. In contrast to the previous sections, the analysis here are performed at regional level. Our analysis is limited to a graphical exposition, as absence of farm-level data prohibits formal quantitative analysis.

A. Transaction costs of inter-industry respecialisation

In section 3.2 we established significant cross-country differences in the endowment with primary production factors. The inter-regional endowment differences are likely to be even more pronounced. According to the *HO* model of international trade, in order to exploit their comparative endowment advantages, regions should produce and export goods that utilise their abundant factor(s) of production and import products that utilise the countries' scarce factor(s). Given that during the Soviet period the specialisation pattern was not driven by comparative advantages, during the transition agricultural farms had to adjust their production structure according to comparative advantages, which maximise their profits. Given that entry into and exit from an industry is associated with fixed costs, not all farms and not fully have adjusted their profit maximising specialisation.

In this section we investigate the potential role of transaction costs and market imperfections in inter-sectoral farm respecialisation. Given that these costs are unobservable, they need to be estimated indirectly. Hence, we need to use indirect indicators of sectoral re-specialisation costs. Therefore, in order to explore the role of sectoral re-specialisation costs in determining firm specialisation and hence factor content in the aggregate agricultural output, we calculate output shares and sectoral profitability for each region. By comparing the sectoral profitability and output shares with region's top profitability, which is defined as profitability in the sector where the ratio of output value to production costs is the highest, we determine whether the shares of sectoral output of particular region are in line with inter-industry differences in sectoral profitability.

The obtained results are mapped out in Figures 8 - 14 in the Appendix, where sectoral output shares for each region are on the left vertical axis and profitability on the right vertical axis. Profitability is calculated as the ratio of revenue against production costs. The concurrence of region's top profitability and sectoral profitability indicates that the particular region has the highest profitability in this particular sector. Hence, if markets were perfect, a region should have high output share in the particular sector. Conversely, the bigger is the difference between region's top profitability and sectoral profitability, the less productive is region in the particular activity.

The interpretation of Figures 8 - 14 is following: high output share together with high profitability indicates that inter-sectoral specialisation is optimal in the particular region and sector. The same indicates low output share and low profitability. In contrast, low sectoral profitability together with high output share, or high sectoral

profitability together with low output share suggest presence of transaction costs or market imperfections, which hinder inter-sectoral adjustments to more profitable activities.

In order to facilitate the intuition of our calculations, we briefly discuss the cereal and oilseed sector, which is mapped out in Figure 8.[16] According to Figure 8, firms located in regions HUN 9, SVK 2 and SVK 4 are very profitable in cereal and oilseed production. However, cereal and oilseed production is not their main specialisation. Given that these regions are specialised in less profitable activities, we may conclude that there are other reasons, such as transaction costs and market imperfections, which hinder these firms of re-specialising their production towards the highly profitable cereals and oilseed. In contrast, the output share of cereals and oilseed is rather high in Hungarian regions HUN 5 and HUN 20, which as above suggests presence of transaction costs and market imperfections. The results for other sectors are qualitatively similar to the cereal and oilseed sector and, therefore, are not repeated here.

The results reported in Figures 8 - 14 suggest that not all regions specialise their production in sectors they have the highest profitability. Moreover, the general adjustment of farm production to inter-industry profitability is rather low in CEE. These results indicate the presence of transaction costs of changing farm structure. Moreover, the transaction costs of adjusting farm structure seem to be both region and sector specific. Based on these results we may conclude that transaction costs of adjusting firm specialisation co-determine agricultural production in CEE.

B. Transaction costs of farm reorganisation

In section 3.3 we identified significant cross-country differences in farm organisation and production technology. Moreover, farms located in different regions have different regional comparative advantages, e.g. due to differences in factor endowment. Hence, we would expect that profit maximising farms located in labour abundant regions would specialise in labour intensive goods and choose the most efficient technology (farm organisation). Given that IFs are more productive than CFs in labour intensive goods, the less productive CFs would reorganise into IFs, increasing in such a way their productivity and hence profits. We would expect the opposite from capital abundant regions. However, as hypothesised above, market imperfections and transaction costs may prohibit farm reorganisation. In this section we examine the potential role of inter-sectoral transaction costs and market imperfections in adjusting firm organisation in CEE.

The transaction costs of farm reorganisation are unobservable. Hence, as above, they need to be estimated indirectly. We proceed as follows. First, from the *FADN* data we calculate the total output, and the CF and IF output shares for each agricultural activity. Next, we estimate the average sectoral profitability for each agricultural activity by farm type (as above, profitability is calculated as the ratio of farm output to total production costs). Finally, we calculate the ratio of CF output to IF output and express it in percent. The same is done for profitability. The obtained results are reported in Figures 15 - 21 in the Appendix. Deviations in output and profitability between CF and IF are on the vertical axes and the 66 FADN regions on the horizontal axes.[17]

All positive values in Figures 15 - 21 suggest that CF have higher output (profitability) in the particular sector than IF; negative values suggest the opposite. If transaction costs of adjusting farm organisation would be zero and markets were perfect, then profit maximising farms would always choose the most profitable form of farm organisation. Hence, in Figures 15 - 21 for each region both output and profitability ratio should be either positive or negative and of similar magnitude. The bigger is the vertical difference between output and profitability ratio in a particular region, the more significant are transaction costs and market imperfections.

According to Figures 15 - 21, the sectoral farm-type profitability is not equal across CEE regions. These inter-regional differences are determined e.g. by different input prices, differences in production technology, geo-climatic conditions etc. Generally, the results reported in Figures 15 - 21 suggest low correlation between farm-type profitability and output share. They also suggest significant differences between regions and sectors. For example, the most profitable cereal, oilseed and protein crop CF producers are located in the Polish region POL 788. Hence, if transaction costs of adjusting farm organisation would be zero and markets were perfect, the IFs specialising in cereal, oilseed and protein crop production would merge into CFs. However, according to Figure 15, in POL 788 the IFs have a bigger output share than CFs. Hence, there must be other factors, which prohibit farms to adjust their organisation. According to theoretical literature on agricultural transition and market imperfections (e.g. *Ciaian* and *Swinnen* 2006), a large portion of these other factors contain transaction costs and market imperfections.

[16]Note that due to technical constrains, names only of selected regions are displayed on the horizontal axis. However, the 66 regions are orderer alphabetically on the horizontal axis.

[17]Only names of selected regions are displayed in the Figures.

On the other hand, there are also regions, which either do not face such transaction costs and market imperfections or farms behave more rationally. For example, the regions CZE 4100, HUN 11 and HUN 12 have perfectly adjusted their farm organisation to farm-type differences in profitability. Hence, the transaction costs and market imperfections are not only significant, they are also highly different across the CEE regions.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

The objective of the present paper is to examine factor content in the CEE transition country agriculture. In addition, the paper attempts to identify the potential role of transaction costs in farm organisation and sectoral re-specialisation, and market imperfections in determining agricultural specialisation and factor content of different regions in the CEE countries. The present paper is one of the first attempts in two respects: (i) to examine factor content in the CEE agricultural output and trade; and (ii) to examine how transaction costs and market imperfections may affect the relative factor content in the CEE agricultural production and trade.

Drawing on *FADN* data for the new EU member states we identify significant differences in factor content of agricultural goods produced in different CEE countries and different regions within countries. Matching these regional production results with national trade data we find that, on average, exported goods are 4% more capital intensive than the aggregate farm output in CEE. In contrast, locally produced agricultural goods contain 6% more labour than exported goods. Generally, our results suggest that factor content between exports and imports is rather similar in the agricultural trade flows. In both exports and imports the largest factor share represents capital, which on average account for almost three fourth of produced good value. These results are new for CEE and have not been reported in the literature before.

Analysing the potential determinants of cross-country and inter-regional differences in factor content, we find strong evidence that transaction costs and market imperfections may indeed co-determine sectoral specialisation and farm organisation, and hence factor content in agricultural goods. However, these first results have to been verified econometrically, in order to be able to draw general conclusions about the relationship between factor content in production and trade, and transaction costs in farm organisation and sectoral respecialisation. Our results suggest that this is a promising avenue for future research and should be followed in future, when the required data for formal tests become available.

Our results suggest two potential policy implications. First, in the presence of significant transaction costs and hence rigid farm structure, certain agricultural subsidies may be efficient in some regions while inefficient in other, depending on the regional variation in farm structure. For example, before Slovakia joined the EU, the government granted farmers investment subsidies for fruit production. However, such policy is not efficient in the context of Slovakia where CFs dominate the agricultural production and transaction costs of reorganising farm structure are considerable, because according to section 3.3, CFs do not have competitive advantages in fruit production. A considerably more efficient policy would be to tackle transaction costs facilitating farm organisation adjustment.

Second, the existence of transaction costs of farm reorganisation may provide one explanation of variation in protection implemented across regions within CEE countries. Given that the marginal benefit of lobbying is decreasing in firm profitability, the political demand for protection may emerge for inputs or outputs in which farms are less competitive. Given that different types of farms have different competitive advantage in terms of labour/capital ratio and regions are heterogenous in terms of farm organisation, the demand for protection will vary across regions. Regions with high share of CFs will demand subsidies for capital, whereas regions with high share of IFs will demand subsidies for labour. These issues need to be accounted for in designing agricultural policies in the enlarged EU.

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Table 1 The relative endowment of CEE's with land, capital and labour in 2004

	Arable land/worker *Ha*	Capital/worker *Thousand Euro*	Agricultural labour *%*
Czech Republic	0.36	4.07	9.6
Estonia	0.57	3.41	16.3
Latvia	0.71	3.28	19.5
Lithuania	0.76	2.92	18.0
Hungary	0.58	4.06	17.5
Poland	0.43	4.36	25.8
Slovenia	0.25	6.54	8.4
Slovakia	0.36	3.95	10.7

Source: Own calculations based on the Eurostat (2008) and FAO (2008) data.

Table 2 Farm organisation and size in CEE in 2004

	IF share land *%*	IF share output *%*	Average farm size *ha*
Czech R.	11.8	19.5	250.1
Estonia	63.5	48.9	119.6
Latvia	55.2	63.9	64.0
Lithuania	77.4	83.8	42.5
Hungary	36.2	47.5	53.2
Poland	94.5	96.2	15.8
Slovenia	99.9	99.9	12.7
Slovakia	10.8	13.6	535.5

Source: Own calculations based on the FADN (2008) data.

Table 3 Productivity and labour intensity by farm type in 2004

Labour cost share	Profitability IF/CF
<10%	0.07
10-20%	0.14
20-30%	0.24
30-40%	0.38
40-50%	0.59
50-60%	0.84
>60%	1.26

Source: Own calculations based on FADN (2008) data.

Table 4 Factor content in farm output in 2004

	Land*	Labour*	Capital*
Czech R.	2.5	22.0	75.5
Estonia	0.9	21.2	77.9
Latvia	1.8	19.6	78.6
Lithuania	3.2	25.7	71.1
Hungary	4.6	17.9	77.5
Poland	2.8	21.1	76.1
Slovenia	1.7	35.5	62.7
Slovakia	3.0	15.9	81.0

*Percentage share in total costs. Source: Own calculations based on the FADN (2008) data.

Table 5 Factor content in agricultural trade in 2004

	Land*		Labour*		Capital †	
	Imports	*Exports*	*Imports*	*Exports*	*Imports*	*Exports*
Czech R.	2.4	3.0	31.8	26.1	65.9	70.9
Estonia	0.9	1.0	27.2	25.6	72.0	73.4
Latvia	2.1	2.5	27.6	26.3	70.3	71.2
Lithuania	3.1	3.2	25.8	24.0	71.1	72.8
Hungary	4.1	4.3	22.0	20.4	73.9	75.3
Poland	3.3	3.0	23.9	24.0	72.8	73.0
Slovenia	2.8	2.5	30.7	29.8	66.5	67.8
Slovakia	3.4	4.0	15.2	16.6	81.4	79.4

*Percentage share in total costs. Source: Own calculations based on GTAP (2008) and Eurostat (2007) data.

Figure 1: Labour content in agricultural goods at farm gate in CEE, 2004.

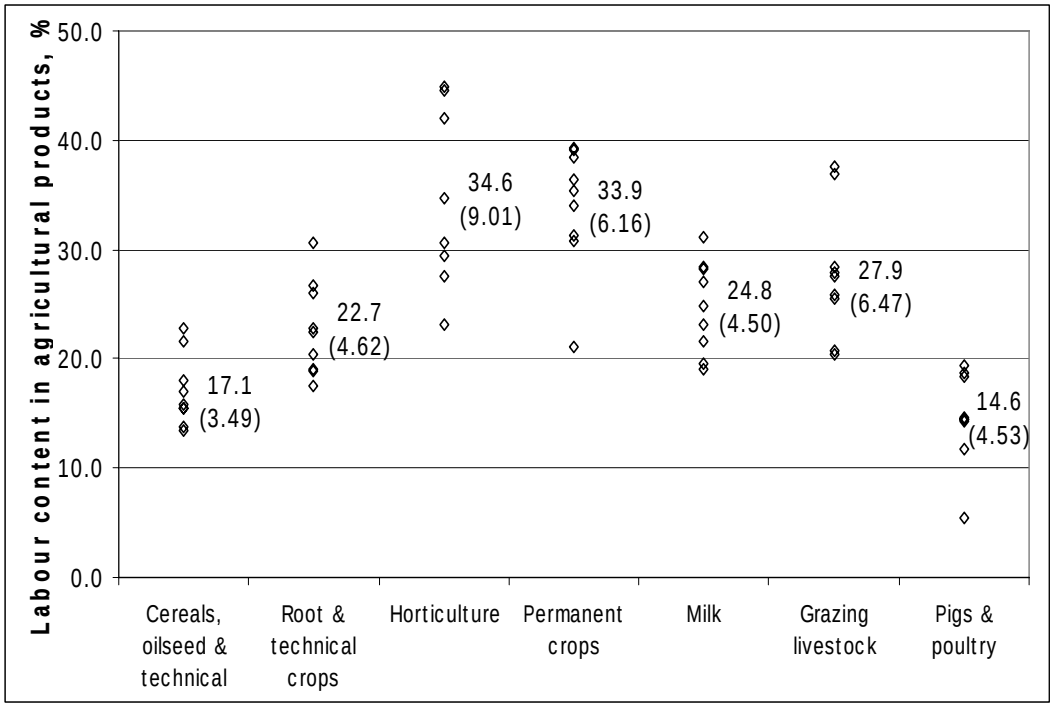


Figure 2: Factor intensity di¤erences in production technology between IF and CF

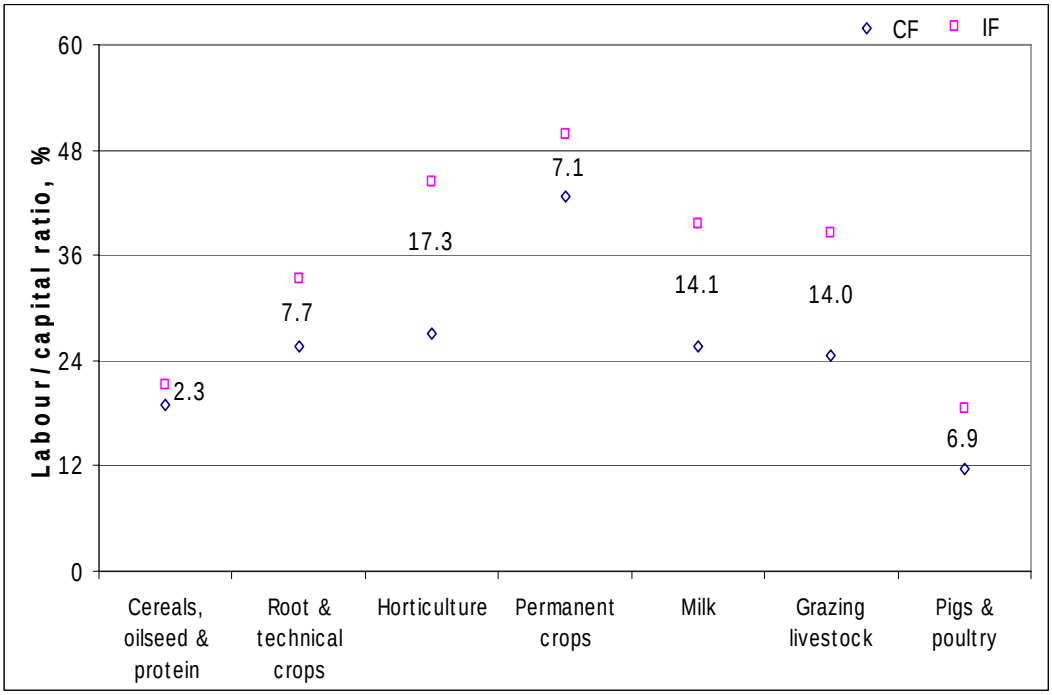


Figure 3: Comparative advantages of farm organisation and labour endowment

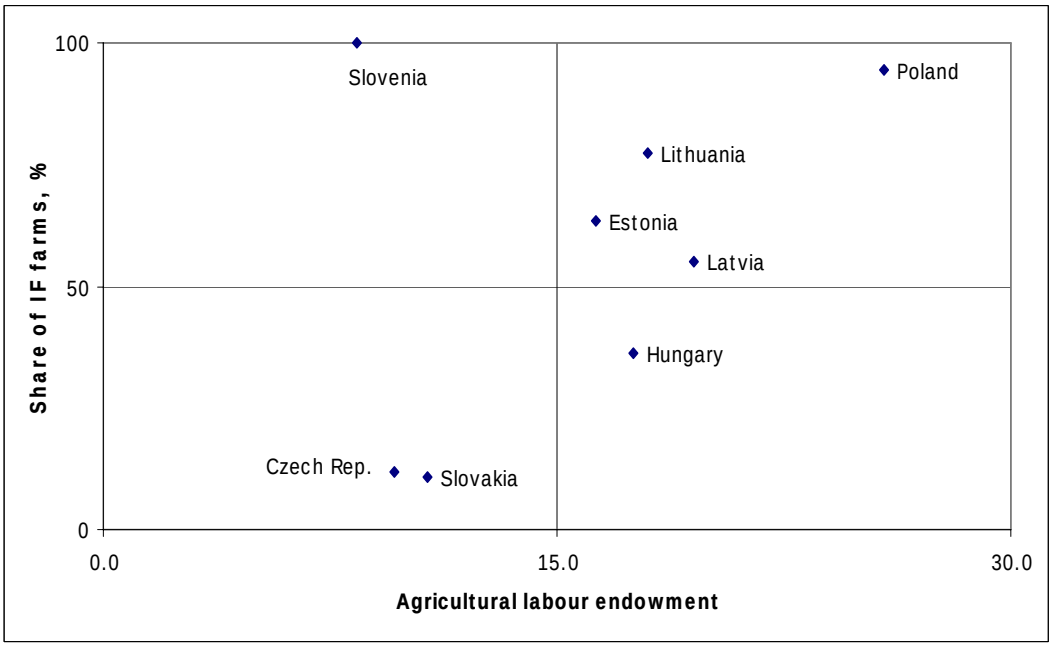


Figure 4: Labour and land ratio in agricultural goods and farm structure in CEE

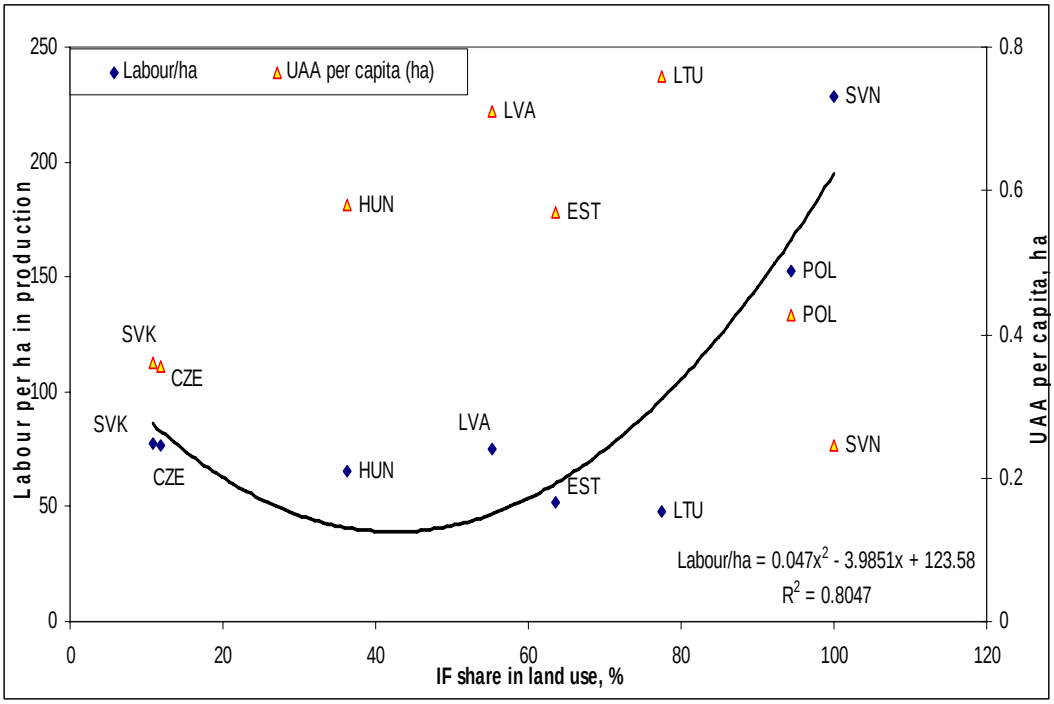


Figure 5: Labour content in agricultural goods and farm structure in CEE

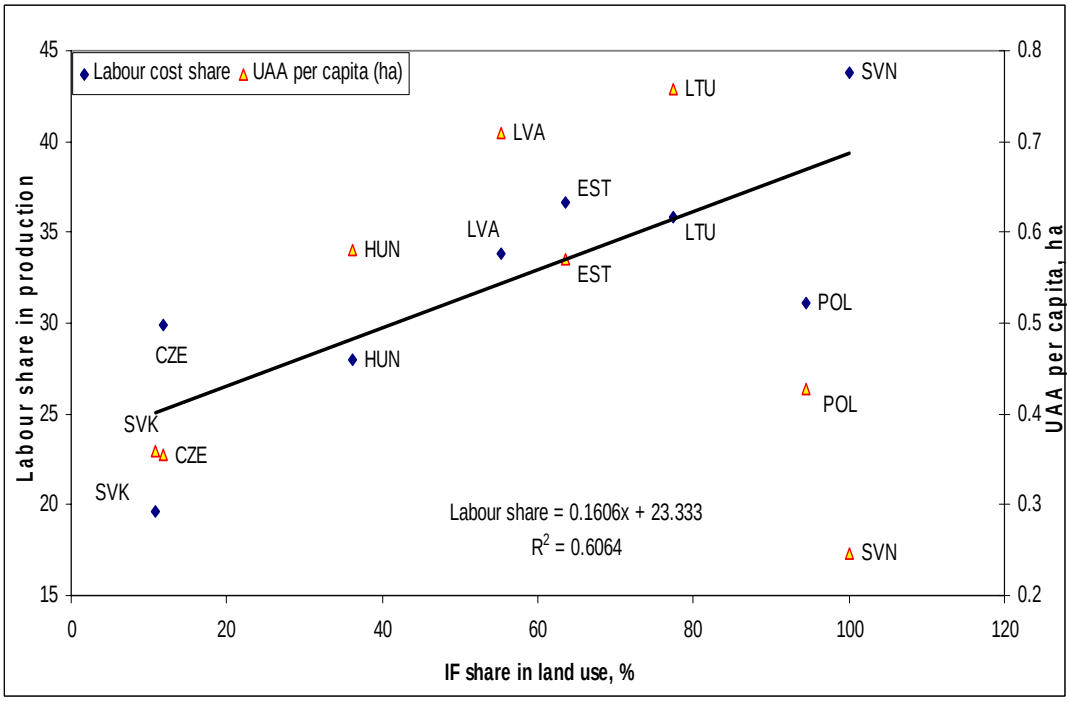


Figure 6: Net factor trade: agricultural commodities in 2004

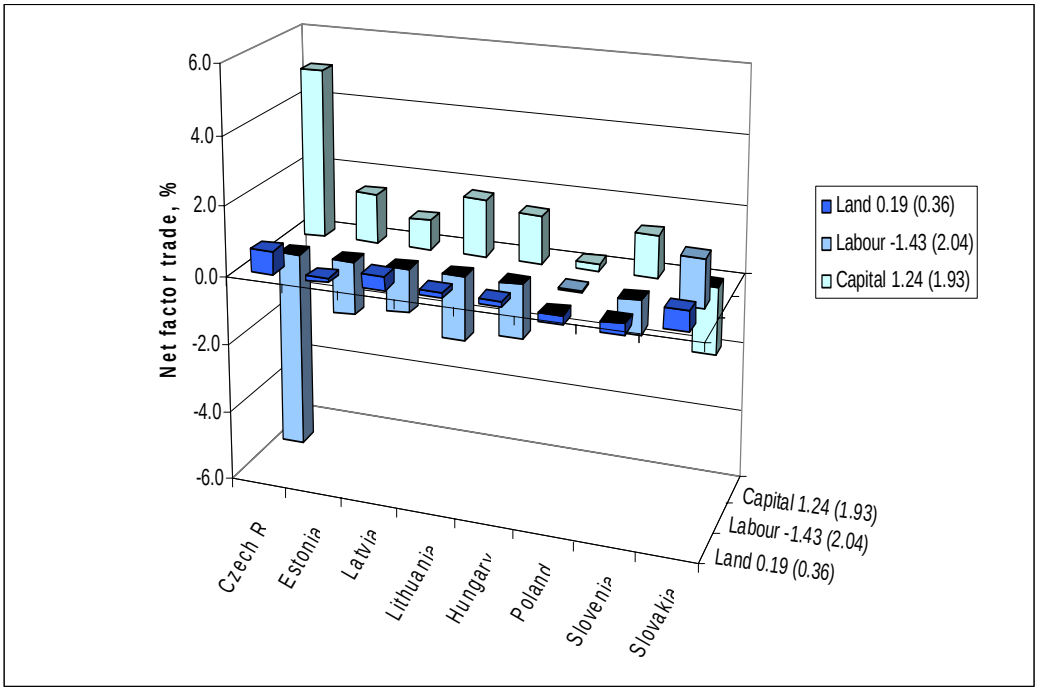
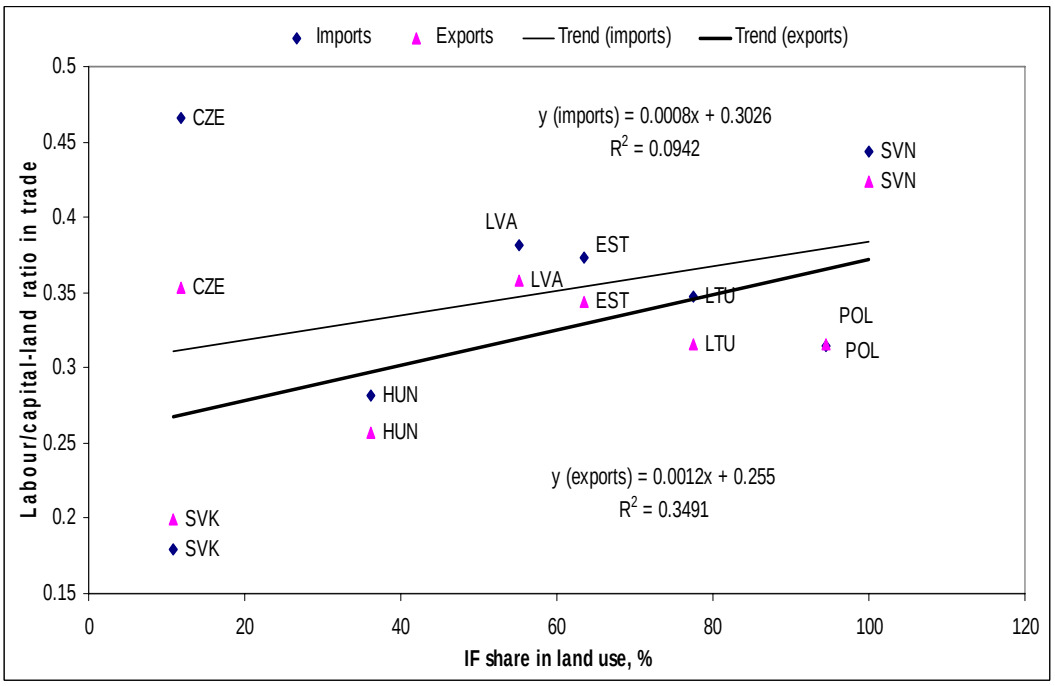


Figure 7: Farm structure and factor content in trade in 2004



VII. APPENDIX

Table 6 Sectoral classification and concordance with FADN sectors

Sectors	FADN classification
Cereals, oilseed and protein crops	13 Specialist cereals, oilseed, protein crops
Root crops and technical crops	141 Specialist root crops
	142 Cereals and root crops combined
	143 Specialist field vegetables
	144 Various field crops
Horticulture	201 Specialist market garden vegetables
	202 Specialist flowers and ornementals
	203 General market garden cropping
Permanent crops	31 Specialist vineyards
	32 Specialist fruit and citrus fruit
	33 Specialist olives
Milk	41 Specialist dairying
Grazing livestock	42 Specialist cattle-rearing and fattening
	43 Cattle-dairying, rearing and fattening
	44 Sheep, goats and other grazing livestock
Pigs and poultry	50 Specialist granivores (pigs and poultry)
Rest of agriculture	60-82 Rest of agricultural activities*

Notes: *Rest of agricultural activities capture also mixed (non-specialist) farming.

Table 7 Regional classification and concordance with FADN regions

Region	UAA	No	GAO	CF	Region	UAA	No	GAO	CF
CZE 21	106.9	3429	121.7	63.1	LTU 1	170.5	52201	85.0	16.2
CZE 31	122.3	1297	108.7	88.2	LVA 11	7.9	1259	14.5	35.1
CZE 32	50.9	949	40.3	55.6	LVA 12	30.1	2356	15.6	33.5
CZE 41	25.6	185	11.8	78.0	LVA 20	30.6	3459	16.7	32.3
CZE 42	41.7	845	37.8	67.5	LVA 30	23.2	4789	12.9	22.2
CZE 51	11.7	114	12.3	86.4	LVA 40	32.0	3723	13.6	15.3
CZE 52	42.2	1584	61.7	77.0	LVA 51	52.8	2343	57.7	59.3
CZE 53	70.6	1101	78.3	84.4	LVA 52	6.6	1281	7.8	36.1
CZE 61	106.0	1312	122.3	86.3	POL 786	21.2	34781	18.9	0.0
CZE 62	102.1	1233	128.2	89.5	POL 787	28.4	25734	30.9	9.0
CZE 71	84.0	626	116.3	93.9	POL 788	34.4	13749	26.7	13.6
CZE 72	59.2	612	71.7	90.6	POL 789	14.8	10867	20.2	7.2
CZE 81	51.2	923	51.3	75.8	POL 791	38.1	45978	52.5	5.7
EST 0	108.8	6701	61.4	51.1	POL 792	53.9	85357	96.4	5.9
HUN 13	27.3	4330	24.0	45.7	POL 793	28.9	29659	23.4	2.2
HUN 7	23.9	2260	23.1	52.1	POL 794	19.8	20696	23.0	16.8
HUN 11	7.6	1699	6.5	37.0	POL 796	21.3	42956	25.9	0.0
HUN 19	29.8	1804	49.1	87.5	POL 797	21.1	80629	22.9	0.3
HUN 8	31.3	4021	35.2	49.2	POL 798	34.1	108394	56.7	3.6
HUN 18	17.5	1028	17.8	49.8	POL 799	20.4	53591	32.1	0.4
HUN 20	10.4	1274	7.7	22.0	POL 801	9.6	35090	17.4	1.5
HUN 2	16.9	2744	26.7	52.5	POL 802	6.8	87679	11.2	0.0
HUN 14	21.0	2195	31.9	57.9	POL 803	7.9	37810	12.6	1.1
HUN 17	51.5	3204	75.3	79.8	POL 804	6.8	44341	7.3	0.0
HUN 5	39.7	3002	35.8	56.2	SVK 1	23.6	143	21.4	91.2
HUN 10	19.4	2105	16.5	43.1	SVK 2	71.8	494	89.8	88.4
HUN 12	10.9	2864	7.6	26.9	SVK 3	35.2	195	35.4	95.8
HUN 9	16.9	5755	27.5	34.4	SVK 4	103.4	810	103.0	84.0
HUN 15	26.2	8938	32.5	43.8	SVK 5	36.6	213	29.3	95.3
HUN 16	36.5	5528	37.5	68.5	SVK 6	110.0	506	65.5	86.3
HUN 3	23.1	13270	17.2	5.6	SVK 7	89.3	651	40.7	83.9
HUN 4	29.3	6142	28.0	52.0	SVK 8	96.0	669	56.0	78.2
HUN 6	35.6	7779	42.2	54.7	SVN 0	10.5	36231	18.2	0.0

Figure 8: Output share and profitability of cereals and oilseed in 2004

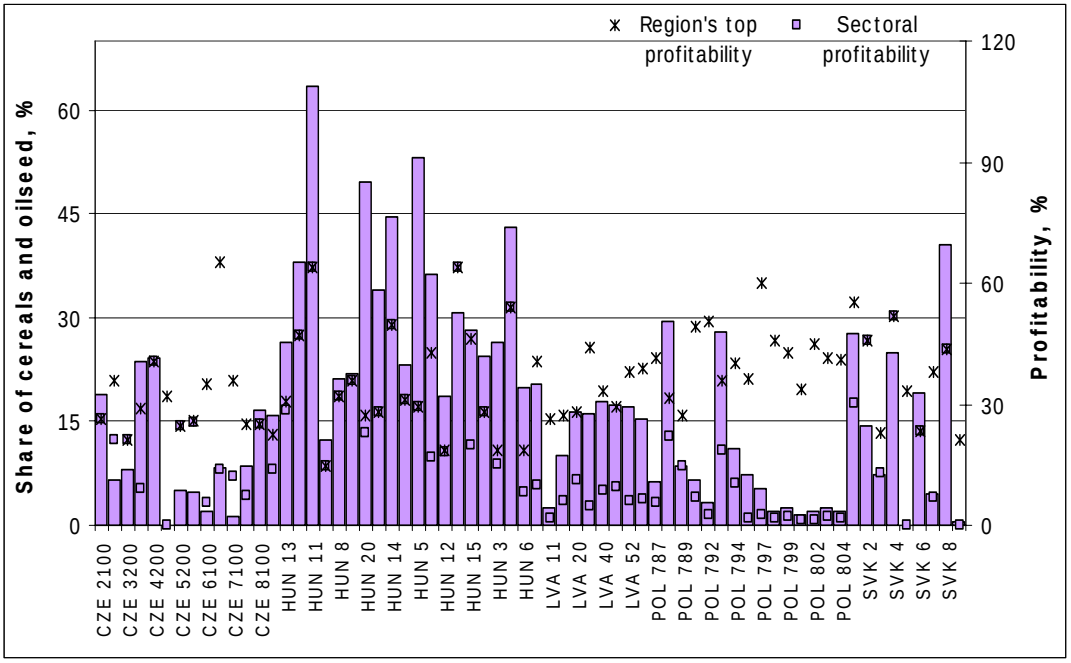


Figure 9: Output share and profitability of technical crop in 2004

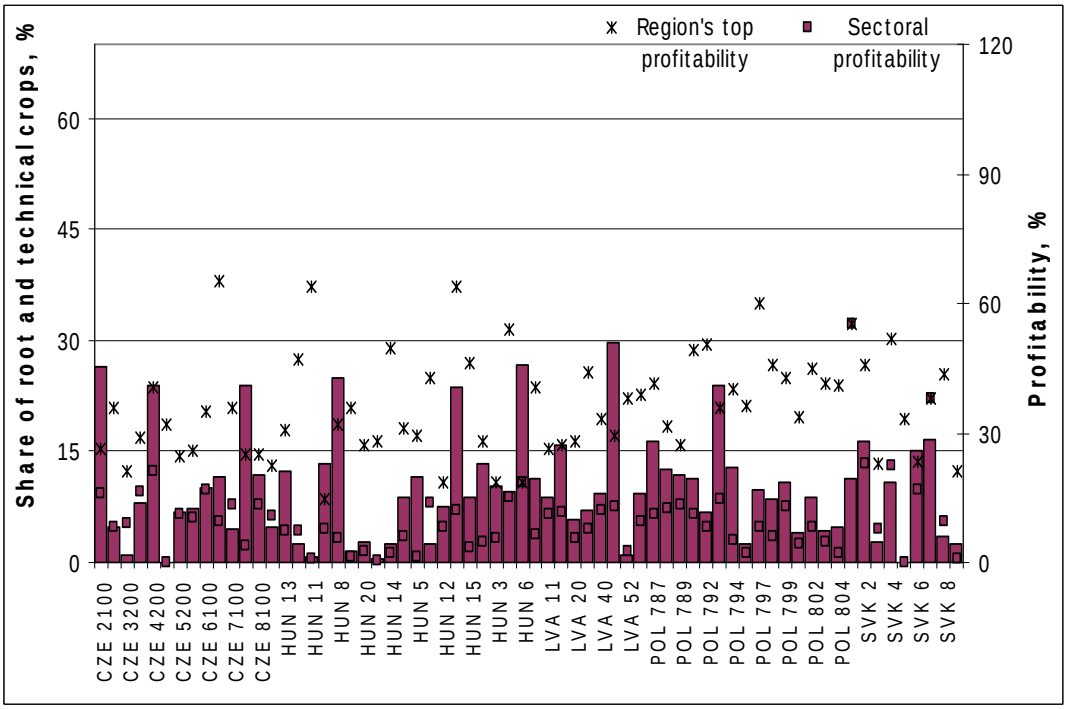


Figure 10: Output share and profitability of horticulture in 2004

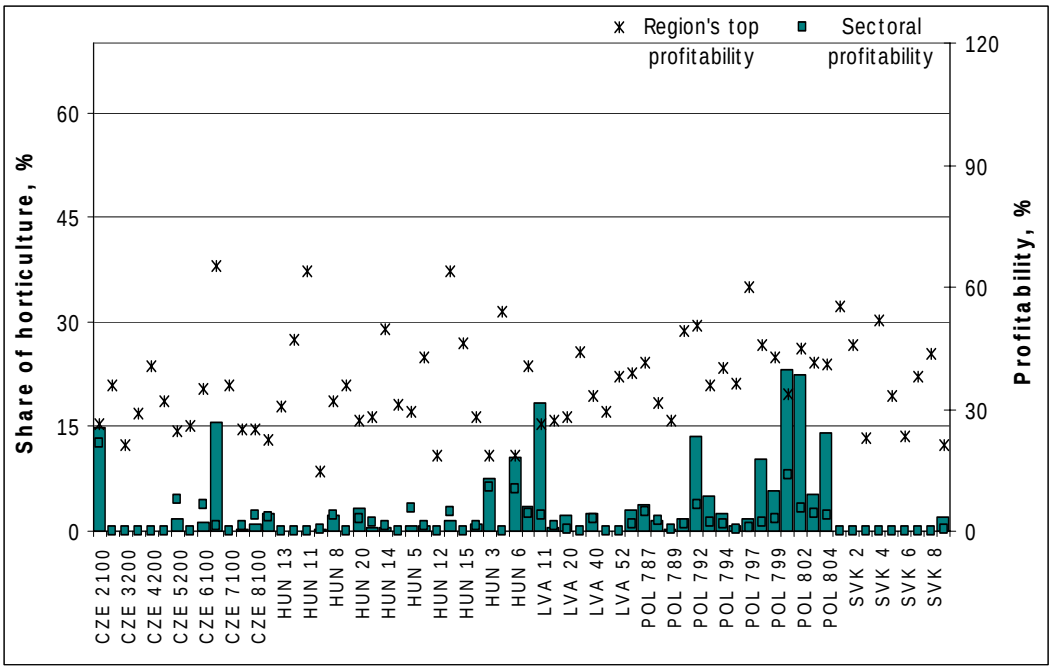


Figure 11: Output share and profitability of permanent crops in 2004

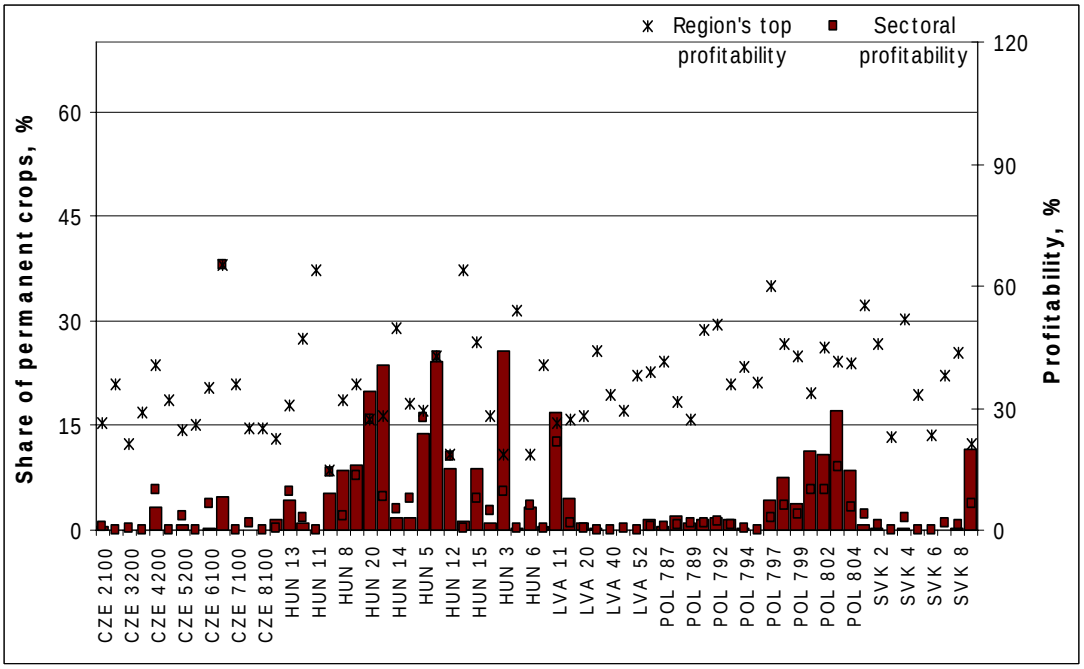


Figure 12: Output share and profitability of milk in 2004

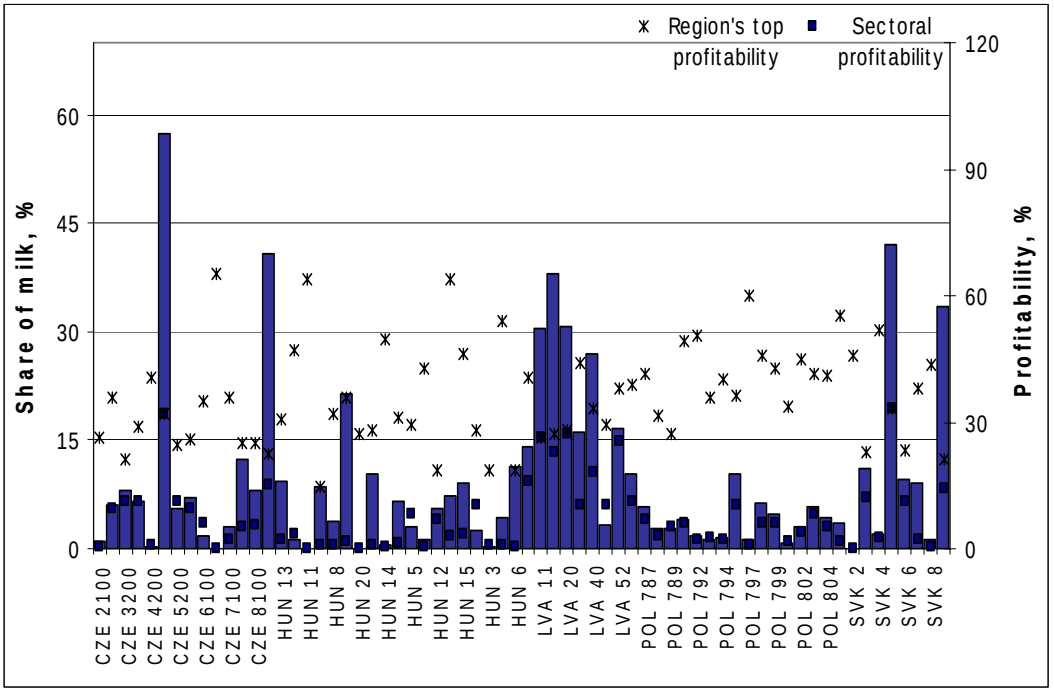


Figure 13: Output share and profitability of grazing livestock in 2004

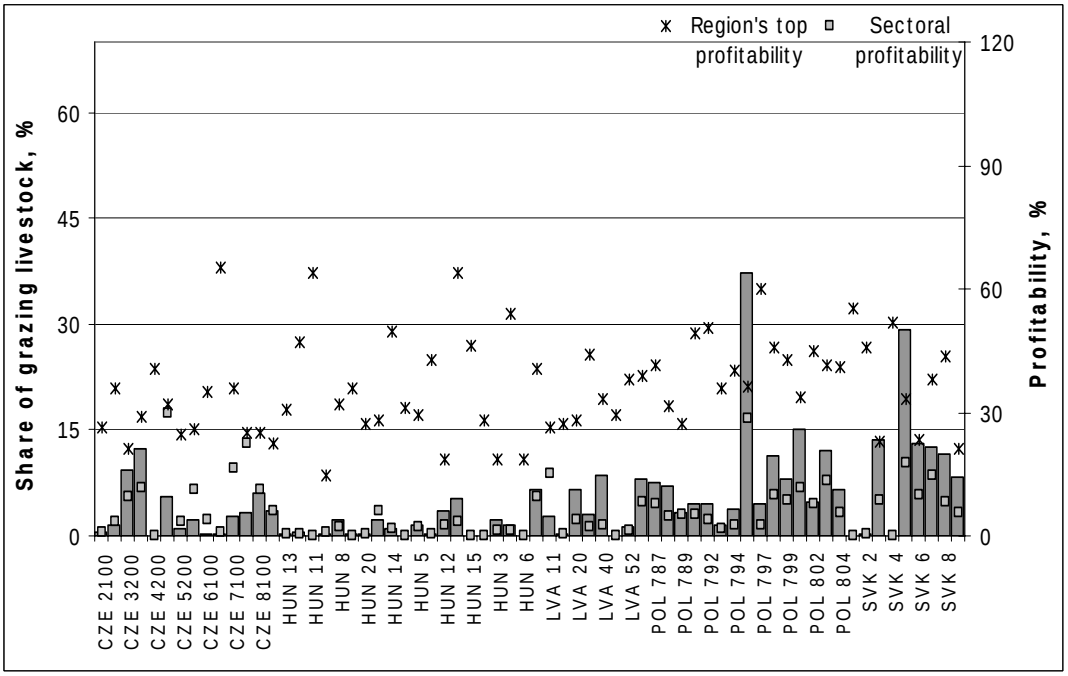


Figure 14: Output share and profitability of pigs and poultry in 2004

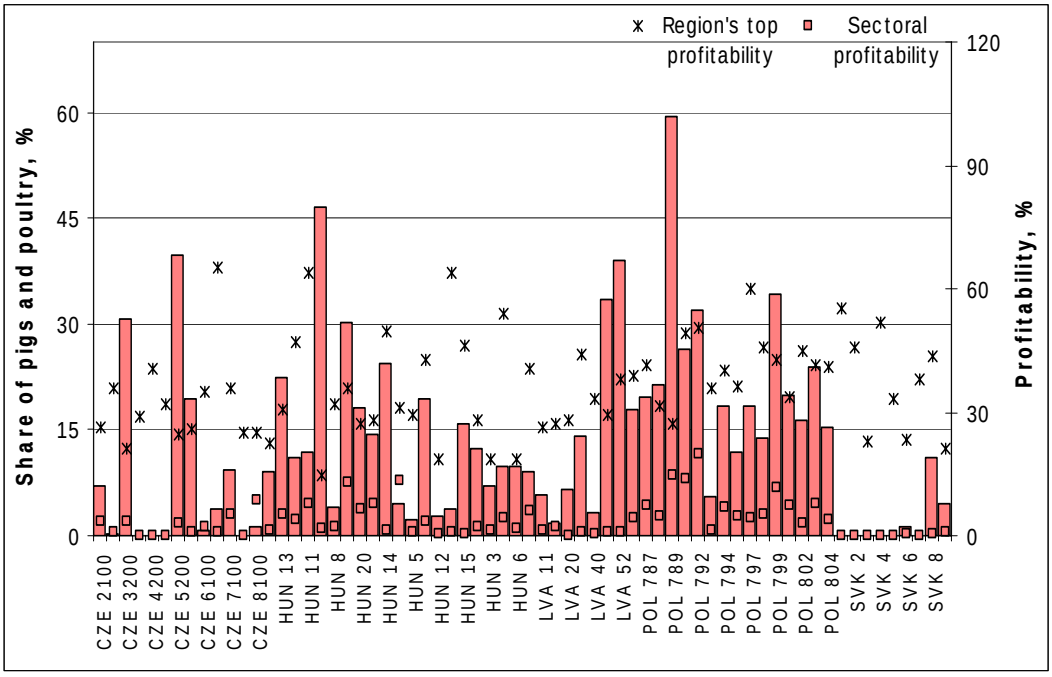


Figure 15: Farm type differences in cereal, oilseed and protein crop production and profitability in percent, (IF<0<CF)

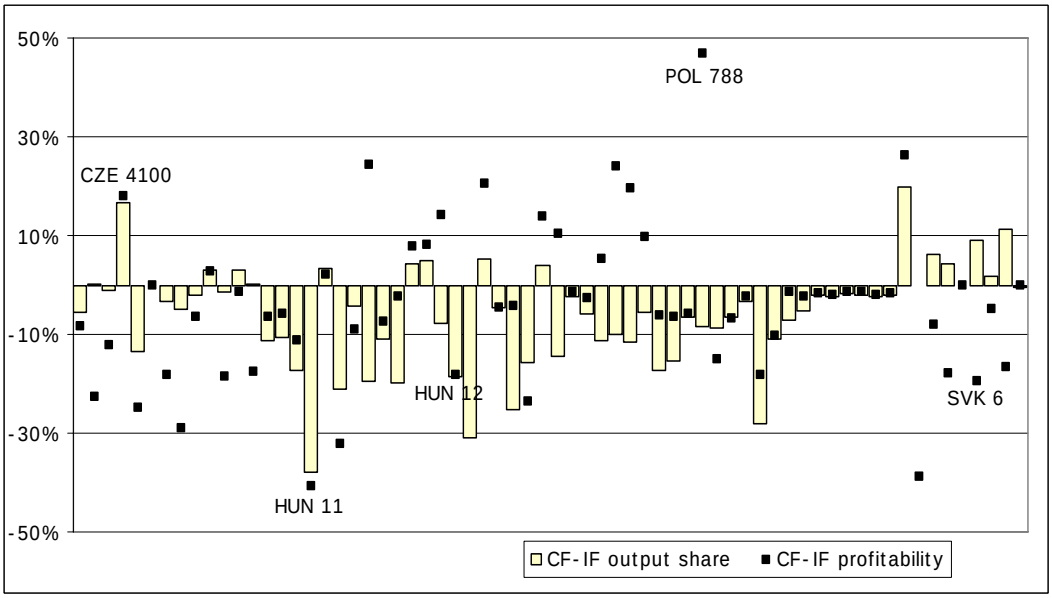


Figure 16: Farm type differences in root and technical crop production and profitability in percent, (IF<0<CF)

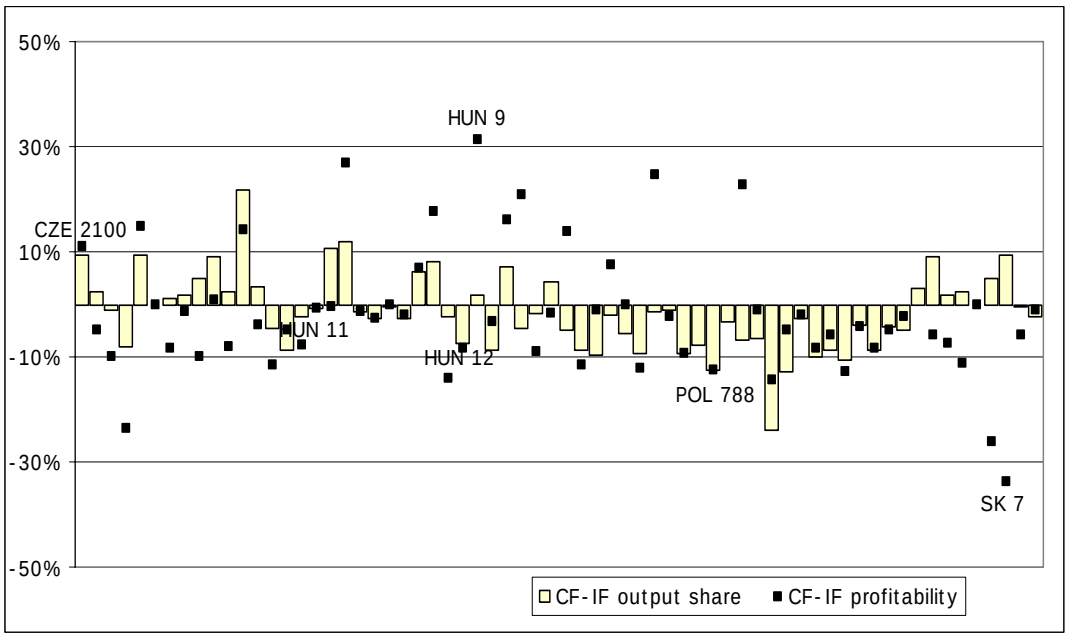


Figure 17: Farm type differences in horticulatural production and profitability in percent, (IF<0<CF)

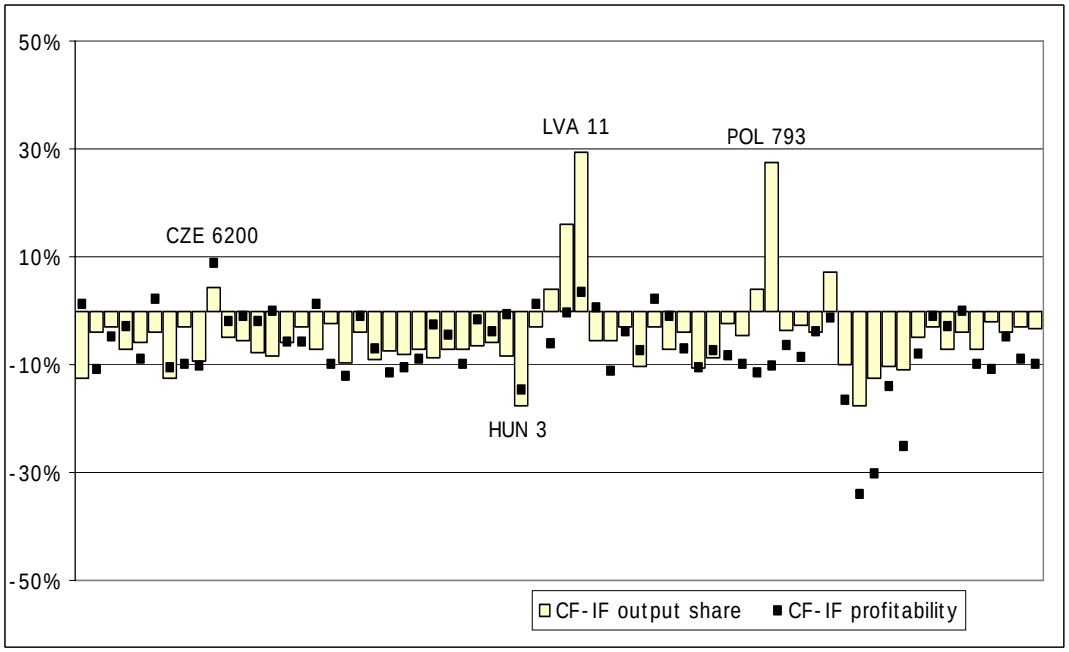


Figure 18: Farm type differences in permanent crop production and profitability in percent, (IF<0<CF)

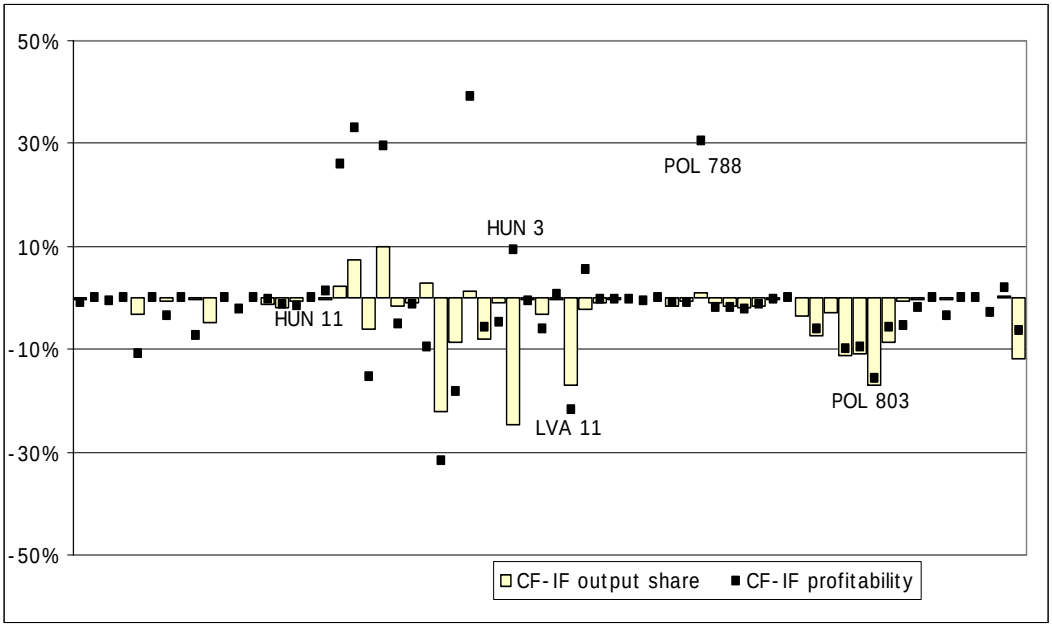


Figure 19: Farm type differences in milk production and profitability in percent, (IF<0<CF)

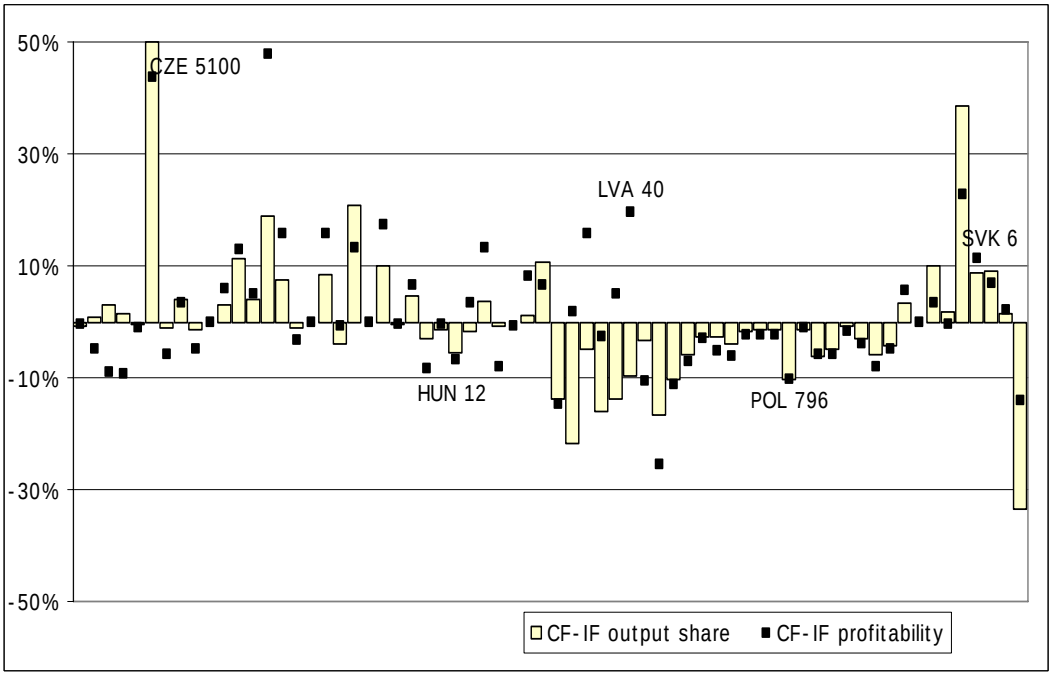


Figure 20: Farm type differences in grazing livestock production and profitability in percent, (IF<0<CF)

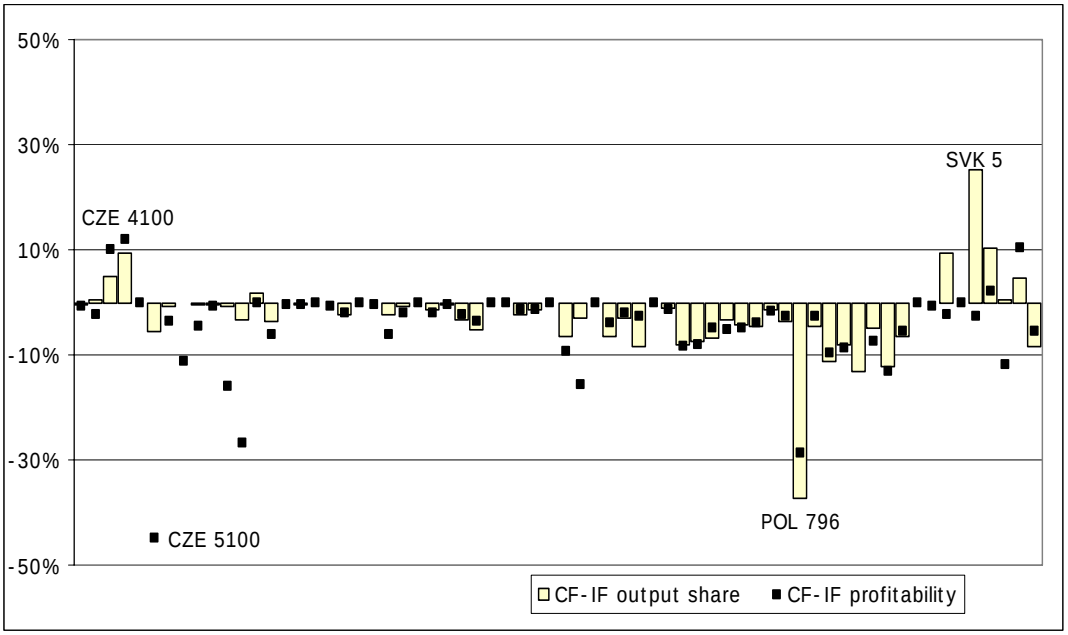


Figure 21: Farm type differences in pig and poultry production and profitability in percent, (IF<0<CF)