

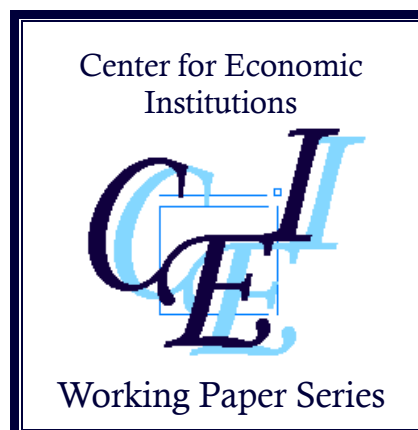
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**“The Structural Transformation in Central and
Eastern European Agriculture”**

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The Structural Transformation in Central and Eastern European Agriculture

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The paper analyses the agricultural transformation in ten Central and Eastern European countries between 1990 and 2010. We provide evidence that despite of diversity of farm structure, heterogeneous preconditions in agricultural policy and economic policy reforms these countries follow the Lewis path of structural transformation. Our results indicate that beyond to macroeconomic conditions and inter-sectoral linkages, micro-level factors especially farm structure play important role in agricultural development.

Keywords: Agricultural transformation, Central-Eastern European countries, convergence

JEL: Q12, P27, P32

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Introduction

The role of agriculture in the economic development is an old subject for both theoretical and empirical research (e.g. Mundlak, 2000, Timmer 2002, Gollin 2010). The recent price soaring at the international food markets has shifted back the attention to the agriculture in economic development in both academic and political circles. The early view on the role of agriculture based on the dual economy model developed by Lewis (1954) which became popular in development economics in the 1960s and 1970s. In this model the agriculture is a backward unproductive sector from which production factors were to be drawn to help development of dynamic and productive industrial sector. Alternative view of agriculture (Johnston and Mellor 1961, Schultz 1964 and Gollin et al 2002) emphasises the significant contribution of agriculture to the economic growth. They argue that investments and policy reforms in agriculture might lead to speed up the economic growth, although agriculture itself grows at slower rate than non agricultural sector. Recent empirical studies on the subject indicates that the debate has increased in intensity without any conclusive agreement (e.g. Awokuse and Xie 2014, Gardner 2005, Tiffin and Irz 2006, Tsakok and Gardner 2007) rather emphasising the econometric shortcomings of previous analyses.

Timmer (2009) analyses the paradoxical role of agriculture in structural transformation which may lead to the Lewis path of “a world without agriculture”. He concludes that “the structural transformation has been the main pathway out of poverty for all societies, and it depends on rising productivity in both the agricultural and non-agricultural sectors“(p. 64). However, Dorin et al. (2013) argue that the Lewis path is only one of four potential structural paths. Previous research focuses mainly on the developing countries, and the United States, but there is no paper on European transition countries. In addition, earlier studies neglect the role of microeconomic drivers in agricultural transformation. Thus, we investigate the main factors explaining the pattern of agricultural development in Central and Eastern European transition countries (CEECs) after 1990. This region is an interesting object for such research due to following reasons.

Although these countries have been already over first wave of industrialization at the beginning of transition, the agriculture still played a relatively important role in the overall economy comparing to the Western European or other developed countries. In addition, the transition period provides at least three quasi natural experiments for the CEECs. First, the transition process in former Communist countries including the economic, political and institutional reforms, particularly land policies, have resulted significant changes in agricultural sector in the CEECs. Second, the rapid globalization of food chain, especially the emergence of modern retailing sector in these countries leads to additional adjustment problems for agricultural producers especially in sub sectors dominating with fragmented and small-scale farms (Dries et al. 2004, Fertő 2009). Third, the CEECs accession to the European Union (EU) implied an adoption of the Common Agricultural Policy (CAP) and significant institutional and legal adjustments to the operation in the single European market. They have become the member states of the enlarged EU. These liberalisation processes have induced greater opportunities and treats in a more competitive market environment. Finally, the farm structures that have emerged from the transition process are much more diverse than expected *ex ante* (Swinnen, 2009).

The aim of the paper is to analyse the structural transformation in the CEECs between 1990 and 2011. More specifically, we are interested in the main drivers of this transformation with special attention on the structural characteristics of farm sectors and institutional and policy factors.

Transformation of CEECs agriculture –a selected literature review

The empirical and theoretical literature emphasise the importance of macroeconomic factors and inter-sectoral linkages explaining the role of agriculture in economic development. Furthermore, majority of these studies concentrate on the relationships between GDP per capita and agricultural value added per worker. More specifically, these studies intend to explain the economic growth employing agricultural GDP per capita as an explanatory variable. However, our interest is the opposite; we investigate the pattern of agricultural transformation, i.e. the relative performance of agriculture during transition period using economic development as an important driver. The development of agricultural GDP in both absolute and relative terms is also assumed to be strongly related to the efficiency and productivity of the sectors. Efficiency and productivity in agriculture depend on a combination of various factors such as technology used and relative factor abundance, institutional and policy reforms with input and output market environment, farm size and scale economies, organization and management, and farm's specialisation. Macours and Swinnen (2002) argue for the differentials in the transition path dependence concerning labour-intensive vs. land- or capital-intensive technologies in agriculture. In countries with labour-intensive technologies, gains in technical efficiency were achieved by a shift from large-scale collective farming to small-scale individual farming, but with a relative deterioration in scale efficiency. Swinnen (2009) argues that the association between the farm technical efficiency and the labour/land ratio can be mixed depending on the differential of farm and labour adjustment processes in labour-intensive vs. capital- and land-intensive countries. Thus, particular factors may have different impacts on the relative performance of agricultural production and farm employment. More specifically, we pay special attention on those elements of sectoral attributes which may affect significantly for the sectoral performance itself. Because there is a lack of unified theoretical framework to analyse the agricultural transformation, we provide a brief literature review on the potential factors which might be useful for the empirical analysis being fully aware the ad hoc nature of our procedure.

Tonini and Jongeneel (2006) using macro level FAO data find 2.9 per cent in growth of total factor productivity (TFP) between 1993 and 2002 due to technological change. Lissitsa et al (2007) estimate the TFPs between 1992 and 2002 for 44 countries including the EU-15, EU-10 and transition countries. Their results suggest that the weighted average of TFP has increased by 2.19 per cent per year for EU-15 countries, 2.68 per cent for EU-10 countries, and 5.10 per cent for transition countries. TFP growth was driven by technological progress for all country groups. Swinnen and Vranken (2010) report 2.1 per cent growths in TFP in seven CEECs between 1989 and 2001. Baráth and Fertő (2014) investigate the TFP in the enlarged EU using the framework developed in O'Donnell (2008). The results imply that the TFP level in the EU-15 was higher compared to the EU-10. This difference is mainly caused by the higher technological level in the EU-15. However, the results suggest a convergence between the EU-15 and EU-10.

Gorton and Davidova (2004) review papers on farm efficiency studies in six CEECs for the 1990s at the farm level employing Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA). They focus on the relationships between the organisational type of farms (family farms or corporate structures)/farm size and the farm efficiency. They conclude that there is no unambiguous evidence of corporate farms being inherently less efficient for all farming activities than family farms. Where significant differences have been found in favour of family farms against the average corporate farm, the best corporate farms still tend to perform as well as the best family farms. Regarding to farm size where small family farms are well established and managed continuously by the present farm household, they appear to be less

inefficient compared to larger cohorts as against countries where small family farms are a relatively new phenomenon. However, recent research tends to favour the positive relationship between technical efficiency and farm size (Bakucs et al 2012, Bojnec and Latruffe, 2011; 2013, Latruffe et al. 2004, 2008ab). Similarly, other less robust findings of these studies is that corporate farms are rather more efficient than individual farms. Note these studies are restricted only on four countries: Czech Republic, Hungary, Poland and Slovenia. However, we should interpret these outcomes with only care, because majority of studies is using one year or short time period for the analysis and focusing on specific subsectors.

The off-farm work by farm household member is a persistent and growing phenomenon in most industrialized countries. Off-farm income sources as a farm household risk management strategy are used by farm households to diversify and increase their incomes. Off-farm income is likely to be more important for smaller farms as a way to improve economic performance by compensating for the farm business scale disadvantages. It can improve adoption of innovations and increase household-level technical efficiency (TE) of smaller farm operations. The previous literature for transition countries in CEECs, i.e., Rizov *et al.* (2001) for Romanian and Hertz (2009) for Bulgarian family farming provides evidence on a positive association between off-farm income and farm performance. Brümmer (2001) finds that full-time farmers in Slovenia were more technically efficient than part-time farmers, while Bojnec and Fertó (2013) confirm that off-farm income may increase the farm efficiency performance and may help farms to stay alive in Slovenia.

The most CEECs countries can be characterised by dual agricultural structures with a large number of small-scale units and a small number of large farms. In addition, most small-scale farms are subsistence and semi-subsistence farms with limited access to labour markets (Mathijs and Novev 2004). Davidova (2011) argues that there are two main functions of the semi-subsistence farms in rural areas: their welfare function and their provision of environmental and cultural benefits. Davidova et al. (2012) analysing five CEECs find that the subsistence farms contribute significantly to household incomes.

Determinants of inter-sectoral labour adjustment from a macro-economic perspective are extensively discussed and summarized in the literature (e.g. Larson and Mundlak 1997, Bojnec and Dries 2005). In line with traditional theories of migration (Todaro, 1969) we expect that the differences in (expected future) incomes as the dominating force of labour adjustment away from agriculture. Agricultural labour adjustment usually can be explained by external (outside of agriculture) or internal (inside of agriculture) factors. Macours and Swinnen (2008) point out that labour market constraints, namely that labour resources were inefficiently allocated at the very beginning of the transition, which can also be easily substituted by capital, associated with the urban-rural income gap, were a determinant for migration from rural to urban areas or to other countries, which has contributed to the growth of farming. Herzfeld et al. (2011) analyse the heterogeneity in determinants of the use of agricultural labour over the transition period for a panel of 29 European and Asian transition countries. Their results reveal quite heterogeneous influences of the inter-sectoral income ratio, the relative size of agricultural employment, the unemployment rate, and the general level of economic development on a measure of sectoral labour adjustment across transition countries. Ciaian et al. (2012) focus on job creation and destruction in EU agriculture disaggregating employment patterns and job flows into detailed intra-sectoral labour adjustment dynamics based on farm level panel observations from 1989-2006. They find that a) job creation and destruction rates in EU agriculture are high compared to other sectors; b) there are important differences in job creation and destruction rates between different member states; c) member states with small average farm sizes display higher job creation and destruction rates than those with larger average farm sizes.

Focusing factors on more inside agriculture, Swinnen et al. (2005) identify two different patterns of agricultural labour adjustment in these countries. First, a fast decline of agriculture's share in total employment together with a moderate increase in the share of individual farms in total agricultural land applies to the development in Estonia, Hungary and the Czech Republic. Second, agricultural employment decreases slowly or even increases together with a high prevalence of individual farms applies to Poland, Romania, Lithuania, Latvia and Slovenia.

In sum, labour shedding in agriculture and the growth of farming can improve technical efficiency in agriculture. In addition, we expect that the greater the gap between the urban-rural incomes, the greater the outflow of labour from rural areas, which fosters labour outflow from agriculture, improving farm and technical efficiency in agriculture. However, this labour outflow from agriculture depends on the elasticity of demand for rural labour and on mobility in labour flows from rural to urban areas. If there are scarce job opportunities, there is little scope for out-migration from rural to urban areas (Todaro 1995). Moreover, Önel and Goodwin (2014) emphasise, the relationship between migration rate and wage differentials between agricultural and non agricultural sectors is not necessarily linear.

Theoretical arguments may provide arguments for either positive or negative impacts of public supports on farms' technical efficiency (Zhu and Oude Lansink, 2010; Kumbhakar and Lien, 2010). Positive relationship assumes that agricultural subsidies may improve technical efficiency if they are used to invest in new technologies and enabling farmers to keep on or to achieve scale economies through investments. The negative impact of support on technical efficiency is based on a non-stochastic wealth (income) effect (Zhu et al., 2012). In this case, subsidies may distort farmers' incentive to produce efficiently, if a larger part of their income is guaranteed by subsidisation. There is a growing literature on the impacts of agricultural subsidies on farmers' technical efficiency in the CEECs (e.g. Bakucs et al. 2010, 2012, Bojnec and Fertő, 2013, Bojnec and Latruffe 2009, 2013, Dourain and Latruffe 2011, Latruffe et al, 2013. Mala 2011) supporting rather the negative views on subsidies. Mitviel and Latruffe (2014) investigate in a broader context the relationships between public subsidies and technical efficiency in agriculture using meta-analysis regression framework from a systematic literature review from 1972 to 2014. Their key finding is that empirical studies using total subsidies received by farms and not specific types of supports usually show a negative effect of subsidisation on farms' technical efficiency. However, the agricultural subsidies also influence the agricultural labour market. Unfortunately, there is no research on the effects of public support on agricultural employment in the CEECs. However, there are some papers in Western European countries. Olper et al. (2013) reviewing relevant studies conclude that „the effect of CAP payments on off-farm migration is not only quite inconclusive, but also suffers from several drawbacks” (p. 176). They investigate the impact of CAP subsidies and the reallocation of agricultural labour using a comprehensive data covering 150 EU regions during the 1990-2009 period; they find that CAP payments contributed to maintaining jobs in agriculture, but that this effect is small.

The impact of institutions on transaction costs has received a lot of attention in the research on economic growth and development (e.g., North, 1990, Hall and Jones 1999). This literature builds on the notion that poor governance entails negative externalities for private transactions, and consequently raises transaction costs with negative effects on growth and development. Last two decades institutional and policy reforms have induced changes in factor and output markets, which are both affecting technical efficiency in agriculture. Capital and output markets deregulation and liberalisation have opened a window of opportunities in purchases of inputs and in selling of outputs, which can directly or indirectly influence the economic performance. At the same time, there has been an increase in risk and uncertainty, which have been caused

by institutional and policy reforms and by more competitive market conditions. Different institutional, land, and other agricultural and macro-economic policy reforms have had important implications for economic performance in agriculture (Rozelle and Swinnen 2004). Swinnen and Vranken (2010) investigate the productivity in the CEECs and the Former Soviet Republics between 1989 and 2005. They find that all transition countries witnessed an initial decline in productivity, and virtually all countries currently witness an increase in productivity. Their results indicate that the productivity changes were related to the extent of the pre-reform distortions, initial resource endowments and technology use, and the reform implementation in the countries. Bojnec et al. (2014) analyse 10 CEECs between 2000 and 2006 reaching similar conclusions. Their results indicate that reform and institutional developments, large-scale privatisation and price liberalisation, are associated with country level technical efficiency in agriculture positively.

The EU accession has influenced the agriculture in the CEECs in many ways. Bakucs et al. (2010) confirm that the EU accession had positive effect on the technical efficiency in the Hungarian agriculture. Bojnec and Fertő (2012) argue that EU enlargement has positive impacts on agri-food trade in the CEECs. Csáki and Jámber (2013) find that the EU accession has had a significant impact on the CEECs' agriculture, although these countries capitalised their opportunities different ways due to initial conditions and the adoption of pre and post accession policies.

Empirical approach and data

We focus on the drivers of agricultural transformation. Based on the existing empirical and theoretical literature, agricultural transformation mechanism could be thought of as a function with the form:

$$AT_{it} = f(M_{it}S_{it}, P_{it}) \quad (1)$$

where AT denotes the variable that characterizes the particular features of agricultural transformation, M describes macroeconomic factors. S is controlling for sectoral attributes and P capturing to policy variables, all referring to country i and year t . Given the fact that the within country variation in variables included in all groups of variables is limited, we focus on exploiting the between country variation.

We apply several models to equation (1) in order to ensure the robustness of the results. Having time invariant variables the fixed models are excluded. There are some issues that we have to be addressed when are estimated such panel models including heteroscedasticity, autocorrelation and contemporaneous correlation across panels. Preliminary analysis (likelihood ratio tests, Wooldridge test for autocorrelations and Pesaran tests) confirms the presence of heteroscedasticity, autocorrelation and cross-sectional dependence. To address these issues of contemporaneous correlation the panel corrected standard error model (PCSE) is applied which controls for heteroscedasticity and the AR(1) type of autocorrelation and contemporaneous correlation across panels (Beck and Katz, 1995, 1996).

The empirical analysis is usually restricted by the availability of appropriate data. Consequently, we try to use such indicators which are relatively well related to our hypothesis. Majority of variables for empirical analysis are collected from the World Bank's (2013) World Development Indicator (WDI) database. More specifically, for dependent variables we use the agricultural value added in per cent of GDP (*Agricultural GDP share*), the employment in agriculture in per cent of total employment (*Agricultural employment share*). In addition, we define two structural transformation indicators. First, the *Agricultural GAP share* which equals

to Agricultural GDP share minus Agricultural employment share. Second, the *Relative agricultural GAP*, which is the ratio of Agricultural GDP share to Agricultural employment share. The standard proxy for economic development is the log of GDP per capita at PPP at constant 2005 international \$ ($\log GDP/capita$);

Explanatory variables are dividing into two main groups. First, we intend to measure the characteristics of farm structure. However, we face to serious difficulties to collect appropriate and comparable data for the long period in questions. We choose the following procedure. The European Commission has established the Farm Accounting Data Network (FADN) providing farm level data for the public. The FADN public database includes a rich set of indicators at national average by the member states. Unfortunately, data for the New Member States are available only after 2004 except Bulgaria and Romania, where data start only with 2007. However, we are also interested in the cross-country variations beyond to the general trend in agricultural transformation. Thus, we create five time invariant variables for different attributes of farm structure. Controlling the dualistic nature of farm structure in the CEECs we introduce two variables. First, we measure the average size of farms with European Size Unit (*ESU*)¹. Second, we add the small farm variable as a share of farm with less than 8 ESU in total number of farms (*Small farm*). The organization of farm is proxied by the share of unpaid labour in total number of labours (*Unpaid labour*). This indicator intends to measure importance of family farms. Third, we measure the role of off-farm income as a share of income from other work to total farm income (*Off farm income*). The income ratio between agricultural and non agricultural sectors is a classical indicator for inter-sectoral labour adjustment. To derive this relative income index, we apply the ratio of GDP/capita in rural areas to the national average of GDP/capita (*Rural GDP/cap gap*). Data are collected from the Eurostat's Regional Agriculture Statistics for predominantly rural areas and national averages in the NUTS3 level. Core data were weighted by the number of the regional population in order to obtain country level data for period 2001-2010. To check the possible non-linearity in relative income indicator, we added the squared term of this variable to our models. Due to lack of data for the analysed time span, we calculate the arithmetic mean for all variables from available data for whole period.

Second, we analyze the potential impacts of agricultural and general economic policy environment. Thus, we use the Nominal Rate of Assistance (*NRA*) to measure the agricultural supports based on the World Bank project on the "Estimates of Distortions to Agricultural Incentives, 1955–2011". Positive values of the *NRA* imply protection to agricultural sectors, whilst negative values mean taxation on it. However, we are also interested in the role of the *transition and reform progresses* in explaining technical efficiency. Our dataset includes indices produced by the EBRD (2013) dataset. The EBRD assesses progress in transition through a set of transition indicators. Progress is measured against the standards of industrialized market economies, while recognizing that there is neither a "pure" market economy, nor a unique end-point for transition. Assessments are made in nine areas: large-scale privatization, small-scale privatization, governance and enterprise restructuring, price liberalization, trade and foreign exchange system, competition policy, banking reform and interest rate liberalization, securities markets and non-bank financial institutions, and infrastructure. The measurement scale for the indicators ranges from 1 to 4+, where 1 represents little or no change from a rigid centrally planned economy and 4+ represents the standards of an industrialized market economy. Taking arithmetic mean these variables as *Reform* is introduced as additional control explanatory variables to investigate the stability and consistency of the findings for the baseline econometric model. Namely, during the analyzed

¹ One ESU is equivalent to 1,200 Euros of gross margin

years, most of the NMS-10 were completing transitional reforms and restructurings, and adjusting for EU membership and for competition on the enlarged EU markets. We are also interested in the potential impact of globalization on agricultural transformation. So, we employ KOF Index of Globalization (<http://globalization.kof.ethz.ch/>) which measures the three main dimension of globalization: economic, social and political (Dreher, 2006). Finally, we employ the overall globalization index encompassing all three areas of the globalization. Because the Reform and the Globalization index are highly correlated with each other, thus we estimate models with these variables separately as a robustness check.

The pattern of agricultural transformation in the CEECs

We describe the main characteristics of agricultural transformations with special emphasis on the cross-country differences (Figure 1). First striking observation is that CEECs seems to follow rather the Lewis path of structural transformations, the role of agricultural in GDP and employment declines with economic development during the analysed period. As a consequence of it, the agricultural gap is approaching to the zero. However, relative agricultural GAP shows a much diverse patterns without a less clear trend.

[Figure 1 about here]

The Figure 2 shows four structural indicators by country over time. Confirming Swinnen et al. (2005) observation, we can distinguish two groups of countries. First, where agricultural employment presents a rapid fall up to mid nineties and then share of agricultural employment stabilised around 5 per cent level (Czech Republic, Estonia, Hungary and Slovakia). Second, countries with increasing (Bulgaria and Romania) or slowly decreasing (Latvia, Lithuania and Poland) agricultural employment in the first half of nineties, then an increasing drop in agricultural employment after 2000, except Bulgaria where decline started already earlier.

[Figure 2 about here]

The ratio of agricultural GDP also presents a declining trend. However, CEECs have started this transformation at very different starting point. The share of agricultural GDP was still above 20 per cent in Latvia, Lithuania and Romania in 1990. Interestingly the role of agriculture in GDP has increase in Bulgaria above 20 per cent in second half of nineties. Other group of countries can be characterised by small proportion of agricultural GDP including Czech Republic, Estonia, Slovakia and Slovenia. However, the share of agricultural GDP has declined below 8 per cent in all countries at the end of period.

Bottom part of Figure 2 displays two transformation indicators. Two groups of countries can be identified based on both measures. First group of countries can be characterised by closing GAP between the share of agricultural GDP and the proportion of agricultural employment including Bulgaria, Czech Republic, Estonia, Hungary and Slovakia. Note these countries have begun with different initial conditions. Second country group presents a different adjustment path with a constant or increasing relative agricultural GAP.

[Figure 3 about here]

Farm structures also present a considerable cross-country diversity (Figure 3). First, we can identify two extreme poles in our sample. One group consisting of Romania, Bulgaria Slovenia with small average farm size, and other group includes countries with large scale farms (Czech Republic and Slovakia). Second, the share of family labour is especially high for Slovenia, Poland and Romania, while its ratio is negligible for Slovakia and Czech Republic. Third, the

off farm income plays important role in Slovakia and Slovenia, and it is not significant in Poland and Romania. Finally, the ratio of small farms is extremely high Bulgaria and Romania, and their shares are relatively small in Slovakia and Czech Republic.

Figure 4 indicates that the rural-urban gap is the smallest in Slovenia, Czech Republic and Slovakia, and the largest Latvia and Estonia between 2001 and 2010. The extent of income gap is varying 20 and 30 per cent in the half of CEECs. However, the relative similar median values occur with very different distributions in rural-urban income gap (Bulgaria and Hungary) implying significant differences within this country group.

[Figure 4 about here]

Nominal rate of assistance show again a diverse picture on the level of agricultural subsidies in CEECs (Figure 5). At the beginning of transition most subsidised countries are Slovenia, Slovakia and Czech Republic, while Bulgaria and Baltic countries are on the other pole. Majority of countries exhibit an upward trend in agricultural supports up to the EU accession, then the level of subsidies converge together with a declining trend. This fact is partly contradict to the conventional wisdom, namely that level of agricultural subsidies has increased in the CEECs after the EU accession. The phenomena can be explained at least by two factors. First issue is the nature of calculation of the NRA index which focuses on difference between domestic and international prices. After price hike at the international food markets in 2007 the gap between domestic and world market prices had strongly declined. Second, the agricultural policy in the CEECs was dominated by market distorted price supports before the EU accession. After adoption of Common Agricultural Policy, these subsidies had to be abolished, meantime in the CEECs farmers have received more direct income payment as before.

[Figure 5 about here]

Previous research emphasise the role of initial condition in agricultural transition (Csáki and Nash 1997, Csáki and Zuschlag 2003, Lerman 2001, Rozelle and Swinnen 2004). Significant differences can be observed at the start of transition in the level of economic reforms (Figure 6). The most advanced reform countries are in 1990 Poland, Hungary, Slovenia, and Czech Republic, Latvia, Romania and Slovakia are a least developed. The ranking has changed for 2011; best performing reform countries are Estonia, Hungary and Slovakia, whilst on the bottom of list are Bulgaria, Romania and Slovenia. Note that at the end of period economic reforms in these countries considerably have converged to each other.

The globalization shows slightly different pattern. The more globalised countries in 1990 are Czech Republic, Hungary and Slovakia, while the least globalised states are Romania, Latvia and Lithuania. Interestingly, almost the same countries are in top and bottom of this list in 2011. Figure 6 indicates an increasing trend in globalisation in last two decades, however with still considerable difference between top and bottom countries.

[Figure 6 about here]

In sum, graphical inspection of potential drivers of agricultural transformation confirms the main findings of previous research. Namely, we conclude that CEECs consist of very heterogeneous countries in terms of economic development, farm structure, and agricultural and reform policy environment.

Results

We estimate our models with both levels and logs of dependent variables (Table 1). In line with findings of earlier results we find strong negative relationship between economic development and the share of agricultural employment for all specifications. Estimations on key variable of immigration confirm the possible non-linear relationship emphasised by Ölen and Goodwin (2014). The growth of income rural-urban income gap in an earlier stage of difference increase the employment in agriculture, but the latter phase foster the immigration from agriculture.

[Table 1 about here]

Turning to farm sector attributes, our estimations show that farm structure specific variables have strong effects on the relative agricultural employment. The positive coefficients of ESU and small farm imply that both pole of farm structure including small and large farms and family farms able to absorb relatively more agricultural labour force. The positive sign for small farms variable is consistent with findings by Swinnen (2009) and Ciaian et al (2012) Bojnec et al (2014) reinforcing the argument on the existence of an positive association between land use fragmentation and labour market constraints by the share of agriculture in employment. In other words, the coexistence of large number of small farms and small number of large scale farms increase the relative level of employment in agriculture. The family farm based agriculture has also positive effects on agricultural employment. Off-farm income has not significant impact on the share of agricultural employment.

The insignificant coefficients on NRA indices imply the inefficiency of agricultural policy to lessen the immigration of farmers from agriculture which partly confirm the inconclusive results of previous research (Olper et al. 2013). Interestingly, the impacts of the EU accession are also insignificant. However, the reform and globalization (in log specification) speed up the immigration from the agricultural sector.

The GDP per capita has strong negative effects on the share of agriculture in GDP (Table 2). Similarly to agricultural employment ratio we find non-linear relationships between rural-urban income gap and the share of agricultural GDP. This indicates that the gap in the urban-rural incomes is to foster labour outflow from agriculture in order to improve the productivity and technical efficiency in agriculture. However the larger income gap combining labour market imperfections may indicate less efficient farm sectors leading a decline in the relative agricultural performance.

Interestingly, all farm structure variables affect positively the share of agricultural GDP. This implies that dual farm structure dominating by family farms and higher level off farm income increases the share of agricultural GDP. The positive impacts of farm size may confirm the importance of economies of scale in transition agriculture. In addition, our results on family farms contradict to some findings of efficiency literature which can be explained by longer period in questions comparing to cross-sectional or short time span based farm level efficiency analyses. However, positive contribution of small farm and off farm income to the agricultural GDP share provide some support the small (poor), but efficient agriculture argument developed by Schultz (1964).

[Table 2 about here]

The significant negative coefficients of NRA indices imply that agricultural subsidies have negative effects on relative agricultural performance reinforcing the findings from the efficiency literature (e.g. Mitviel and Latruffe 2014). The insignificant coefficients of the EU accession suggest that CEECs agriculture was not able to exploit the new chances and improve the relative agricultural performance. The reform and globalization also foster the agricultural transformation with decrease the share of agricultural GDP.

The definition of agricultural gap obviously causes the variable to be negative in sign for almost all observations (see Figure 1), which shows the gap approaching zero. Note, this implies opposite interpretation of the sign for coefficients. Positive sign of variables suggest that particular variable move the gap variable towards zero value and vice versa. Timmer (2009) argues that agricultural gap variables can translate into sectoral Gini index that implies the inequality of labour productivity between the two sectors. The negative of the agricultural gap variable is equal to the Gini coefficient for agricultural GDP per worker compared with non agricultural GDP per worker. In addition, we employ the relative agricultural gap as a dependent variable.

[Table 3 about here]

Table 3 shows that estimations based on agricultural GAP share report better results than relative agricultural GAP variable in terms of statistical significance. Thus, we focus on results based on agricultural GAP share specifications. The economic development closes the gap between the share of agricultural GDP and the proportion of agricultural employment.

The impact of rural-urban income gap shows a U shape pattern. Keeping mind the time invariant nature of this variable, it indicates that sectoral labour productivity gap is tend to be larger, where rural-urban income differences are small, and vice versa.

The farm size, unpaid labour and small farms decrease the agricultural gap share. The positive coefficients on off farm income imply that off farm income rise the gap ratio. Agricultural subsidies and the EU accession have no impact on the agricultural gap. However, reform and globalization increase the inequality in sectoral labour productivity.

Conclusions

Despite of different initial conditions, diverse farm structure, heterogeneous economic policy and agricultural policy reforms implementations (Swinnen and Vranken, 2010) the role of agriculture in the overall economy has declined in the employment and the GDP in the CEECs. These facts imply that the CEEC region can follow the Lewis path of structural transformation after 1990 that is where the share of agriculture in both total labour and value added is 2-3 per cent once productivity and income across the agricultural and non-agricultural sectors have converged.

We find that the economic development has strong negative effect on the relative performance of agriculture. Our calculations reveal non-linear relationships between rural-urban income gap and the share of agricultural employment and GDP.

The various attributes of farm structures differently influence the structural transformation in agriculture. The dual farm structures with small number of large farms and many small-scale farms plus family labour affect positively on both agricultural employment and GDP, while the off farm income has opposite impacts on these indicators. In line with recent research (Olper et

al. 2013), the agricultural subsidies help to keep the labour in agriculture, but decrease the share of agricultural GDP reinforcing the findings of micro-level efficiency studies (Minviel and Latruffe, 2014). The economic reform and globalization speed up the agricultural structural transformation. Interestingly, the EU accession has negligible impacts on transition process.

Finally, the economic development closes the agricultural gap and farm structure, economic reform and globalization have also played an important role in structural transformation.

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Figure 1: The agricultural transformation in CEECs, 1990-2011

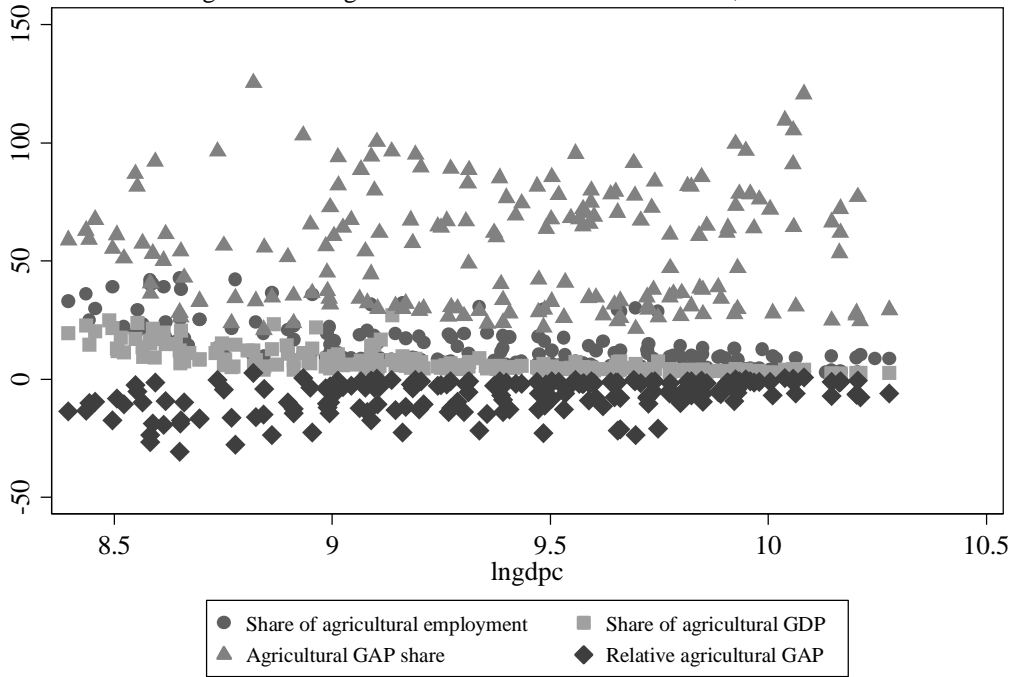
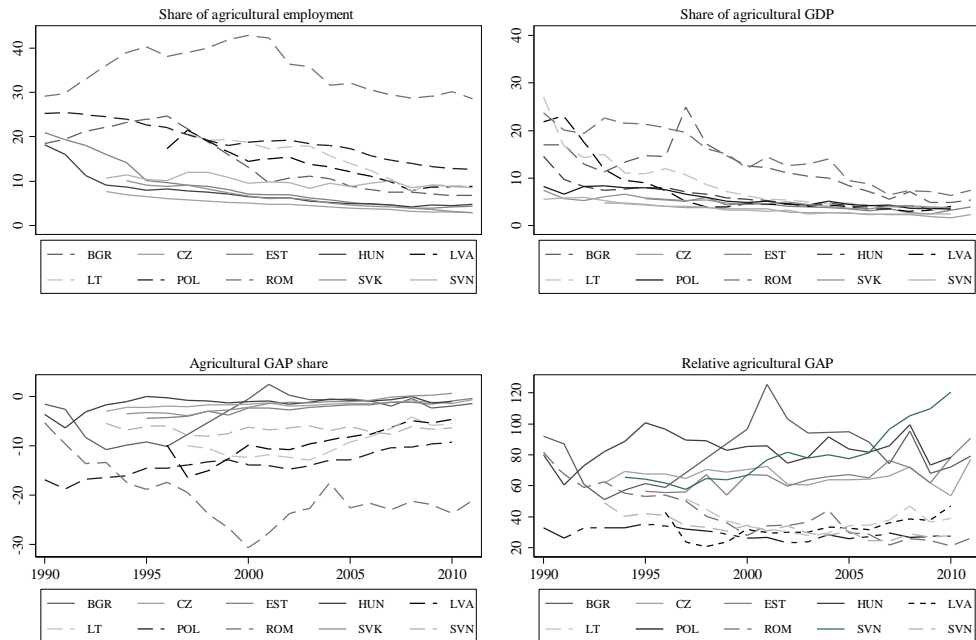
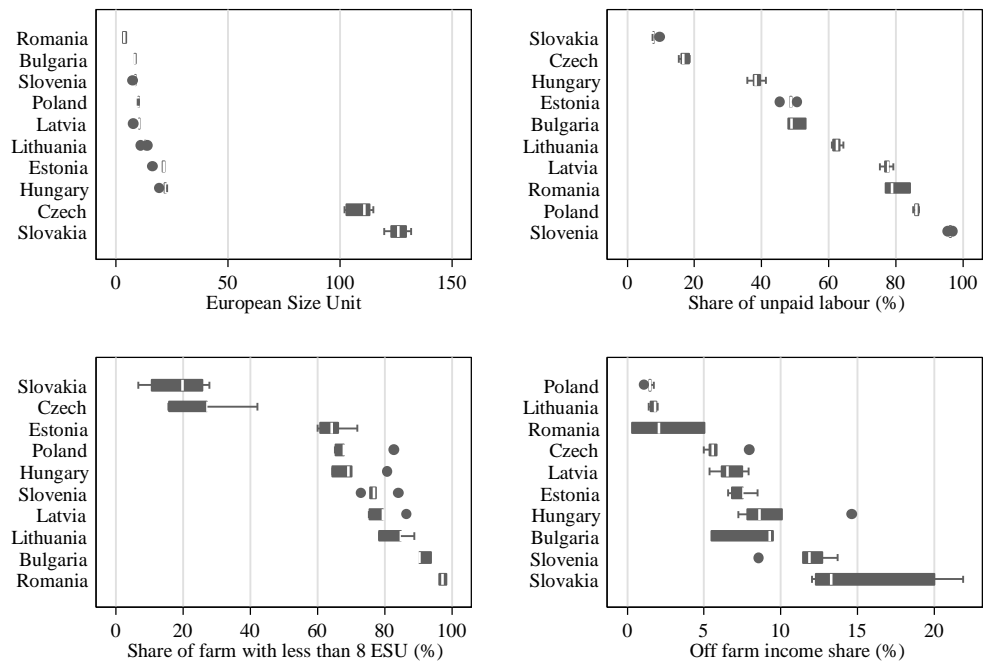


Figure 2: Agricultural transformation by countries, 1990-2011



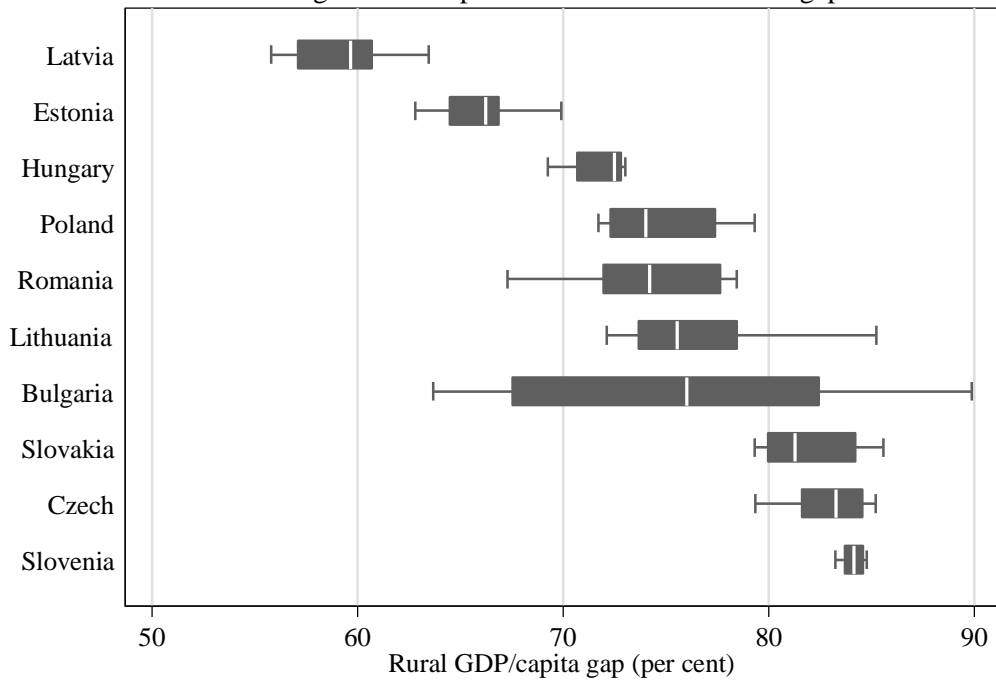
Source: Own calculations

Figure 3: Box plots for farm structure variables



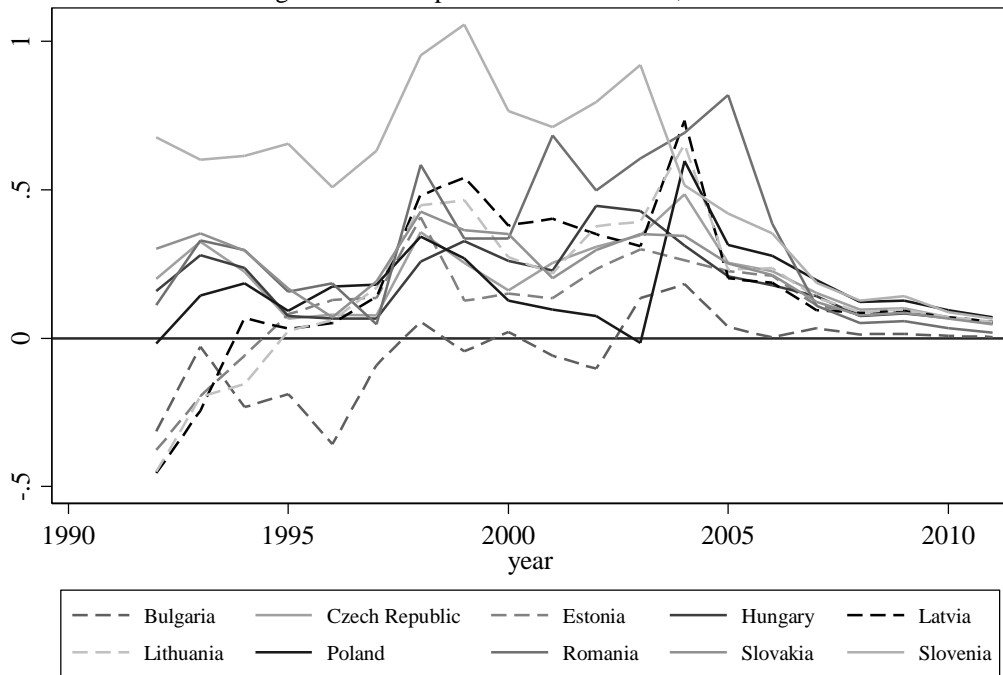
Source: Own calculations

Figure 4: Box plots for rural-urban income gap



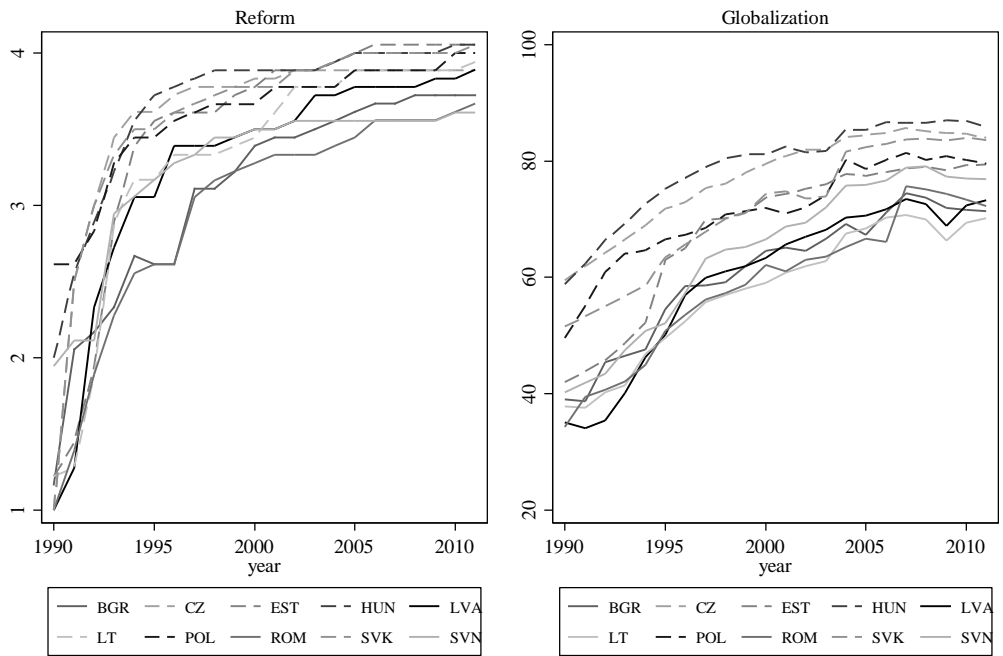
Source: Own calculations

Figure 5: Development of NRA indices, 1992-2011



Source: Own calculations

Figure 6: Development of reform and globalization



Source: Own calculations

Table 1: Results for agricultural employment share

	agricultural employment share		ln(agricultural employment share)	
	model 1	model 2	model 3	model4
logGDP/capita	-6.714***	-7.394***	-0.575***	-0.603***
Rural GDP/cap gap	6.487***	6.797***	0.291***	0.287***
Rural GDP/cap gap2	-0.022***	-0.023***	-0.001***	-0.001***
ESU	0.509***	0.507***	0.023***	0.022***
Unpaid labour	0.413***	0.424***	0.025***	0.024***
Off farm income	-0.025	0.056	-0.003	-0.002
Small farm	0.512***	0.507***	0.022***	0.021***
NRA	0.645	0.113	0.038	0.005
EU	0.007	0.216	-0.008	0.013
Reform	-1.419***		-0.133***	
Globalization		-0.041		-0.005*
Constant	-463.233***	-481.151***	-16.552***	-15.949***
R-squared	0.877	0.880	0.973	0.971
N	193	193	193	193

Source: Own calculations

Note: * p<0.05, ** p<0.01, *** p<0.001

Table 2: Results for agricultural GDP share

	agricultural GDP share		ln(agricultural GDP share)	
	model 1	model 2	model 3	model4
logGDP/capita	-2.448**	-0.385	-0.504***	-0.369***
Rural GDP/cap gap	1.349*	3.235***	0.224***	0.308***
Rural GDP/cap gap2	-0.005*	-0.011***	-0.001***	-0.001***
ESU	0.128**	0.187***	0.016***	0.019***
Unpaid labour	0.028	0.085**	0.004*	0.007**
Off farm income	0.008	0.288**	0.007	0.017**
Small farm	0.207**	0.228***	0.026***	0.027***
NRA	-2.661***	-2.915***	-0.119*	-0.203***
EU	-0.531	0.044	-0.072	-0.039
Reform	-3.088***		-0.250***	
Globalization		-0.256***		-0.018***
Constant	-77.687	-234.295***	-11.375***	-18.708***
R-squared	0.796	0.739	0.905	0.879
N	206	206	206	206

Source: Own calculations

Note: * p<0.05, ** p<0.01, *** p<0.001

Table 3: Results for agricultural GAP share

	agricultural GAP share		relative agricultural GAP	
	model 1	model 2	model 3	model4
logGDP/capita	4.750***	5.984***	10.697	12.060*
Rural GDP/cap gap	-3.810***	-3.634***	5.895	5.518
Rural GDP/cap gap2	0.013***	0.012***	-0.021	-0.020
ESU	-0.374***	-0.388***	-0.041	-0.112
Unpaid labour	-0.359***	-0.380***	-0.797***	-0.873***
Off farm income	0.173**	0.146**	1.701***	1.594**
Small farm	-0.347***	-0.361***	0.405	0.352
NRA	-1.251	-1.356	-8.149	-7.757
EU	-0.178	0.510	-2.328	-1.479
Reform	-2.705**		-4.451	
Globalization		-0.214***		-0.349
Constant	289.813***	274.519***	-431.091	-393.540
R-squared	0.661	0.692	0.862	0.867
N	182	182	182	182

Source: Own calculations

Note: * p<0.05, ** p<0.01, *** p<0.001