**„Institutions in Transition –
Challenges for New Modes of Governance"**

IAMO Forum 2010, 16-18 June 2010 | Halle (Saale), Germany

Analysing agricultural productivity growth in a framework of institutional quality

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Abstract

This paper addresses the question whether the institutional environment of transition countries in Eastern Europe affects productivity growth in the agricultural sector. Situated in a neoclassical growth framework, a dynamic panel model for the period 1996-2005 provides evidence that poor institutional quality leads to a slowdown in agricultural productivity growth. Productivity growth is limited by a high degree of corruption, which is of particular importance given that corruption has been proven to be most prevalent in Eastern European countries. Moreover, agricultural productivity in countries where privatisation and transferability of land is restricted is found to grow at a slower rate than countries supporting market-oriented land reforms. Interestingly, the results suggest that a high degree of openness leads to a loss in agricultural productivity, suggesting that timing and sequencing of trade reforms matter. An improvement of the poor institutional quality is thus of central importance to accelerate productivity growth in Eastern European countries.

Keywords: Eastern Europe, Transition, Productivity growth

1 INTRODUCTION

The development of agricultural output in the Eastern European countries in the last decade has proven to be an interesting field for research. To this effect, a number of researchers have tried to quantify the causes of output change in the former communist states. A profound empirical study by Macours and Swinnen (2000) has come to identify a multiplicity of variables impacting the agricultural output in Eastern European countries, such as weather, uncertainty, farm restructuring and privatisation. This study examines the coherence of additional theoretically well-founded variables with growth in agricultural productivity. Special attention is given to the role of the institutional environment, i.e. trade openness, corruption and its antithesis good governance, on the development of the agricultural growth in Eastern Europe. This in particular seems highly important as corruption and "bad governance" has been proven to be most prevalent in Eastern European countries (Sprout, 2002).

The paper is organised as follows. A brief overview of the development of agriculture in Eastern Europe given in the next Section precedes the upcoming empirical analysis in Section 3. Having shed light on the theoretical framework and the specific methodology used, Section 4 moves on to present the major findings of the empirical investigation and outlines their key implications. The paper concludes with a short summary of major findings in the final chapter.

2 DEVELOPMENT OF THE AGRICULTURAL SECTOR IN EASTERN EUROPE

For the purpose of the present analysis Eastern Europe has been delimitated to ten countries, namely, Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Russia, Slovakia and Ukraine, based on the United Nations Statistics Division's proposed regional composition. How agriculture in this geographical region has developed, remains an important question to be addressed. Although the group of countries at study in many regards share homogenous traits, the development of agricultural productivity throughout the period considered from 1996 to 2005 shows a differential development. As Table 1 denotes, both level and growth of agricultural productivity in Eastern Europe show substantial differences. For the respective time period the average productivity growth in Bulgaria is recorded to be the highest among the selected set of countries, closely followed by Hungary and Romania. However, in terms of the agricultural output per worker, Hungary is found to be leading the group, narrowly followed by Bulgaria and at some marginal distance, the Czech Republic.

Table 1: Productivity of Eastern European Agriculture 1996-2005

Country	Agricultural output (1000I$)	Agricultural labour force	Agricultural output per worker (1000I$)	Average productivity growth 1996-2005 (%)
Belarus	4792178.1	695400	7.01	5.06
Bulgaria	2871647.3	286400	10.45	6.03
Czech Republic	3807906.6	462700	8.27	2.48
Hungary	5532909.4	513000	10.93	5.91
Moldova	1373093.0	491700	2.82	1.78
Poland	16748626.0	4289700	3.91	1.48
Romania	8099238.7	1564800	5.30	5.68
Russia	38575728.0	8103100	4.80	3.10
Slovakia	1633088.2	264700	6.18	1.75
Ukraine	17113495.0	3552500	4.90	4.16

Notes: I$ refers to International Dollars. All figures are annual averages over the period of the analysis.
Source: FAO (2008a), own calculations.

In view of the disparities among the countries displayed in Table 1, the question why some countries are more successful in improving agricultural labour productivity than others arises and calls for clarification. In his study on agricultural productivity in the European Union and Eastern Regions (Bulgaria, Hungary, Romania and Poland), Serrao (2003) identifies an impact of the Union's Common Agricultural Policy not solely on members, but also on states having applied for a membership. Furthermore, he finds that the success of the Eastern European countries in his sample is closely related to a relatively high technical change over the period 1980-1998. Consistent with his results, except for Poland, Table 1 indicates highest productivity growth for Bulgaria, Hungary and Romania, countries that were first to apply for an EU membership. Technology, having been identified as one crucial factor for productivity growth and as a reason for differences among Eastern European countries, addresses a fraction of the above stated question. Nevertheless, a multiplicity of factors has to be analysed when investigating the complex issue of productivity in agriculture, most notably when addressing the Eastern European region. This especially seems crucial in the case of formerly planned economies, where production targets were formulated in the national agendas for the purpose of achieving self-sufficiency. Moreover, in the centrally planned economy the policy of full employment was a key element. This led to an over-employment in the agricultural sector as well, consequently resulting in a reduction of the productivity levels. The degree of

success in implementing reforms in the agricultural sector which came along with the move towards more market orientation has varied across the Eastern European region (OECD, 2001). The upcoming analysis tries to consider this multiplicity of factors impacting the growth in productivity in order to identify the isolated effect of poor institutional quality on productivity growth among the selected set of countries.

3 METHODOLOGY

3.1 Theoretical Framework and Model Specification

An appropriate framework to analyse productivity growth in Eastern Europe is the neo-classical growth model first proposed by Solow (1956). Basically, the model is derived from a production function of a given country where productivity, i.e. output per worker, is determined by capital and labour growth rates as well as technology parameters. The general formulation of the production function is $Q = A(t)f(K,L)$ where Q denotes the output, K and L are, respectively, capital and labour. The factor $A(t)$ measures productivity shifts over time which may be induced by technological progress or changes in the institutional environment. Following Rizov (2004), we assume a Cobb-Douglas production function with labour augmenting technological change. L and A are assumed to grow exogenously at the rate of l and a, which denote the rate of employment growth and of technological progress in the agricultural sector.

In order to implement the above framework consider the following model using conventional panel data notation

$$GROWTH_{it} = \alpha + \ln \beta_1 ALP_{it-1} + \ln \beta_2 AEG_{it} + \beta_3 RQ_{it} + \beta_4 VA_{it} + \beta_5 CPI_{it} + \ln \beta_6 FDI_{it} + \ln \beta_7 OPEN_{it-3} + \beta_8 LR_i + \delta_i$$

where δ_i is the composite error term consisting of the time-invariant country-specific effects α_i and the idiosyncratic error term ε_{it}. An overview of the abbreviations, definitions and data sources is given in Table 2 and will be explained in greater detail in the next subsection.

The use of panel data methodology offers the advantage of controlling for unobserved country-specific effects (the term α_i) and thus allows accounting for heterogeneity across countries. Moreover, year-specific dummy variables are included in order to account for events with major impacts on agricultural production in the Eastern European region in a particular year, as for instance extreme weather events.

Table 2: List of Variables and Data Sources

Variable	Definition	Data Source
GROWTH	Productivity growth defined as growth of agricultural output per worker (%)	FAO (2008a)
ALP	Agricultural labour productivity ('000 International Dollars)	FAO (2008a)
AEG	Agricultural employment growth (adjusted for the rate of technological progress and depreciation) (%)	FAO (2008a)
VA	Voice and Accountability (-2.5 lowest level, 2.5 highest level of voice and accountability)	World Bank (2008a)
RQ	Regulatory Quality (-2.5 lowest level, 2.5 highest level of regulatory quality)	World Bank (2008a)
CPI	Corruption Perception Index (0 highest level, 10 lowest level of corruption)	Transparency International (2008)
FDI	Foreign Direct Investment (Mio. US Dollars)	UNCTAD (2008)
OPEN	Degree of Openness (%)	FAO (2008b), World Bank (2008b)
LR	Land Reform (0 no market attributes, 10 ideal market attributes)	Lerman et al. (2004)

Source: Authors' own composition.

The literature on panel data basically proposes two different approaches to estimate the country-specific effects, the random effects (RE) and the fixed effects (FE) approach. The RE approach has the advantage of allowing for the estimation of time-constants variables, such as the type of land reform, and is thus considered as more appropriate. However, for the estimation coefficients to be unbiased, the RE model requires independence of the country-specific effects and the explanatory variables (the so-called orthogonality assumption). In order to assure that the assumption holds true and the appropriate model specification is used, a Hausman test is carried out. As the null hypothesis of no correlation between the country-specific effects and the regressors could not be rejected, a RE model is considered as the appropriate approach (Greene, 2008). Moreover, in order to detect misspecification problems the Durbin-Watson statistic modified by Bhargava et al. (1982) to test for serial correlation and the panel-adjusted Breusch-Pagan test to test for heteroscedasticity are carried out. The results clearly indicate the presence of both autocorrelation and heteroscedasticity. Consequently, in order to ensure reliable statistical inference robust standard errors are calculated by use of Generalized Least Squares (GLS).

3.2 Data and Variables

The dataset covers the period 1996-2005 for the selected set of Eastern European countries. As outlined above several explanatory variables are included in the model, which are chosen upon theoretical consideration explained in greater detail below. The selection of explanatory variables allows us to isolate the effects of changes in the institutional environment on productivity growth. Table 3 summarizes the basic descriptive statistics of explanatory variables.

Table 3: Summary Statistics of the Variables (n = 100)

Variable	Mean	Standard Deviation	Minimum	Maximum
GROWTH (%)	3.74	9.54	-17.11	30.74
ALP (1000I$)	6.46	2.80	2.34	14.50
AEG (%)	-.04	.02	-.07	-.02
CPI	3.54	.95	1.5	5.57
VA	.20	.79	-1.71	1.22
RQ	.05	.83	-2.01	1.24
FDI (Mio US Dollars)	2,901.94	3,241.53	23.74	15,444.37
OPEN (%)	.81	.41	.12	1.59
LR	8.04	2.53	1.3	10

Note: Remaining units are explained in Table 2.

Source: Authors' own composition.

The growth rate of the gross agricultural production per economically active individual of the same sector is taken as dependent variable, computed by dividing the gross agricultural production by the value of each year's total economically active population in agriculture.

In order to test for convergence across Eastern European transition countries the value of agricultural output per worker lagged by one year, i.e. the initial productivity, is chosen as explanatory variable. Moreover, the agricultural employment growth rate (calculated as the difference of the natural logarithms of agricultural employment) is included in the model. Following Rizov (2004), the employment growth rate l was adjusted to the rate of technical progress and depreciation as $\ln(l + a + d)$ using 0.05 for a constant rate of technological progress and depreciation.

Moreover, the following variables are included as proxies of technological progress and the institutional environment incorporated in the factor $A(t)$. We use the inward foreign direct investment (FDI) as a measure for investments, which allows accounting for enhanced agricultural productivity through spill-over effects and technology transfers between sectors which are not covered by sector-specific investments. As such, FDI is of central importance for transition economies in Eastern Europe to achieve convergence through improving their productivity and competitiveness (Sohinger, 2005).

The model specification is further augmented by including governance indicators representing changes in the institutional environment (included in factor $A(t)$). Good governance indicators are the corruption perception index, voice and accountability, and regulatory quality, with the latter being obtained from the Worldwide Governance Indictors database based on Kaufmann et al. (2008). As already mentioned in the introduction, these measures are most essential for an empirical analysis in the case of Eastern Europe, which has been ranking worst at these scales.

The history of the Soviet states has shown that closed borders lead to inefficient production due to neglecting comparative advantages in production as well as reduced exchange of technology and knowledge. As markets open up it is generally expected to be followed by an increase in productivity. Thus, the degree of openness defined as $(IMP_{AGR} + EXP_{AGR}) / GDP_{AGR}$ in included in the model as a proxy for $A(t)$.

Finally, the analysis employs an alternative measure for land reform which has not been commonly used in previous studies, namely the Composite Land Policy Index proposed by the Lerman et al. (2004). This index in aggregate provides an overview of the different developments in the selected sample with respect to potential private ownership, privatization strategy, allocation strategy and transferability of land.

4 RESULTS AND DISCUSSION

In general the statistical tests show that the model has a quite satisfactory explanatory power over productivity growth in the Eastern European countries' agricultural sector. The detailed results of the models estimated, reported in Table 4, show that the differences in the results between the models are minimal.

Table 4: Estimation Results (dependent variable = productivity growth in %)

Variable	Full model	Reduced model I	Reduced model II
Constant	-26.911	-20.647	-16.562
	(11.994)	(8.738)	(8.216)
	**	**	**
ln ALP(t-1)	4.045	3.827	4.462
	(1.981)	(1.972)	(1.950)
	**	*	**
ln AEG	-54.592	-53.870	-54.162
	(8.587)	(8.516)	(8.555)
	***	***	***
CPI	2.794	2.706	1.811
	(1.107)	(1.101)	(.899)
	**	**	**
VA	-4.463	-4.173	-
	(3.132)	(3.058)	
RQ	-4.681	-3.405	-6.091
	(3.435)	(3.045)	(2.383)
			**
ln FDI	.428	-	-
	(.650)		
ln OPEN	-1.628	-2.324	-1.936
	(1.655)	(1.365)	(1.354)
		*	
LR	2.148	1.838	1.554
	(.809)	(.718)	(.689)
	**	**	**
Wald test	198.04	195.04	190.07
	***	***	***
Log-Likelihood	-310.89	-311.06	-312.10
Observations	100	100	100

Notes: Standard errors are robust to heteroscedastic and contemporaneous correlated disturbances. ***, **, and * denote 1%, 5%, and 10% significance level, respectively. Results for year-specific dummy variables are not reported.
Source: Own calculations.

Within the selected set of countries, the significant and positive coefficient of the lagged value of agricultural output per worker indicates that countries with a higher initial agricultural productivity generally have a higher rate of productivity growth. That is to say, the results provide evidence that productivity across Eastern European countries diverge, contrasting the results of many other studies finding convergence across Eastern European countries (see for instance Rizov, 2004). This difference to other studies may be due to the particular set of

countries included in the analysis. It is reasonable to argue that countries neither supported by the EU (at least not in a comparable extent as accession candidates) nor in close proximity to the EU, such as Belarus, face high difficulties in increasing agricultural productivity. In contrast, the agricultural sector of EU member countries, as for instance Romania and Bulgaria, are likely to grow at a more rapid rate due to considerable support of the EU in the pre- and post-accession phase.

As expected, the significantly negative coefficient of agricultural employment growth suggests that a negative growth of employment in the agricultural sector increases the output per worker. The reduction of dispensable employment in the agricultural sector has thus a major impact on productivity growth.

As the impact of good governance on productivity growth is concerned, the analysis suggests that only corruption has a significant negative effect on productivity growth in the agricultural sector, whereas no consistent evidence is provided that other good governance indicators influence productivity growth. The results clearly indicate that an increase in the Corruption Perception Index, which is interpreted as a reduction in the corruption level, has a positive impact on productivity growth. Moreover, this finding implies that farm level changes in the organisational structure and management additionally have to be supplemented by the creation of supporting commercial and public infrastructure as well as institutions that a market-driven agricultural system requires. Such an infrastructure involves, for example, systems of credit, market information, and commercial law (Liefert and Swinnen, 2002). If the regulatory quality in these institutions is weak and transparency is missing, corruption can easily infect these channels and thus undermine the required institutional quality for substantial productivity increases. For a sustainable productivity growth in the Eastern European region anti-corruption measures will play a significant role. If they are not implemented effectively, corruption will distort the market outcome and divert costs to the weak private sector, hampering growth.

The expectation that a high degree of openness is associated with higher productivity growth cannot be confirmed by the analysis. In contrast, the results slightly suggest that the opening of markets actually led to a slowdown in productivity growth. Although this result seems to be contra intuitive at first sight, it may hint to inappropriate timing and sequencing of trade reforms in Eastern Europe (for a discussion of this issue see for instance Falvey and Kim,

1992, and Greenaway, 1998). Reforms that quickly liberalise the agricultural sector may deter farmers from undertaking necessary adjustments. In this context Goletti and Chabot (2000) find that the grain sector in Kazakhstan was severely hurt by a preceding liberalisation of the input sector, leading to a duplication of grain prices within one year. That is to say, an inappropriate sequence of reforms – especially when accompanied by institutional weakness – may lead to a deterioration of productivity of the agricultural sector as a whole. However, as the analysis focuses on aggregate agricultural productivity growth without accounting for differences across the range of production activities, a detailed examination of determinants and agricultural reforms of specific production activities is required to shed more light on the issue of timing and sequencing in Eastern Europe.

As another interesting result, the coefficient of FDI is found to be not significant, implying that the agricultural sector is isolated from the rest of the economy. As a consequence, agricultural production does not profit from technological progress in other sectors through technology spill-over.

Finally, the analysis finds that the nature of land reforms matter. In line with Lerman (1998) and Rizov (2004) it can be shown that land reforms strengthening market attributes, most importantly private ownership of land, transferability of property and use rights as well as land allocation in the form of physical plots or paper shares, are most likely to improve productivity in the agricultural sector. In contrast, countries which supported less market-oriented land reforms – or even no land reform at all, as in the case of Belarus – are hampered in their ability to increase agricultural productivity.

5 SUMMARY AND MAJOR CONCLUSION

The transition economies in Eastern European are characterised by a persisting high degree of corruption and "bad governance". The poor institutional environment is expected to be a major limitation in the path of transition. In this context, the paper empirically investigates whether a poor institutional environment leads to a slowdown of productivity growth in the agricultural sector in the Eastern European region. Embedded in the framework of Solow's neoclassical growth model, a theoretically well-founded dynamic panel model is proposed to analyse the relationship between institutional quality and productivity growth. In order to isolate the effect of institutional environment on agricultural productivity several factors influencing productivity in Eastern Europe are extracted from the literature.

In general, the results provide strong evidence that the poor institutional quality in Eastern Europe is one major limitation of productivity growth in these countries. Especially countries with highest degrees of corruption are found to have a significantly lower productivity growth. Moreover, countries which failed to implement privatisation and transferability of land are handicapped from a lower growth in agricultural productivity compared to those countries supporting market-oriented land reforms. Surprisingly, a negative impact of openness on agricultural productivity is found which may be owed to sequencing problems of trade reforms in Eastern Europe. However, to come to a final conclusion the issue of timing and sequencing has to be analysed in greater detail.

In line with previous studies investigating the determinants of transition in Eastern European agriculture, the cutback of dispensable employment in the agricultural sector after the breakdown of the centrally planned system is found to increase productivity growth to a considerable extent. Moreover, the results provide evidence that agricultural productivity in the Eastern European region diverges, meaning that countries with low initial productivity face particularly high difficulties to catch up.

Overall, the study finds that an improvement of the poor institutional quality is central in accelerating productivity growth in Eastern European countries. Thereby priority should be given to the reduction of the persisting high level of corruption. Besides the reduction of corruption, a stronger linkage of the agricultural sector to the rest of the economy is important in order to ensure that agricultural production profits from technology spill-over. Finally, attention should also be paid to an appropriate timing and sequencing of reforms in order to avoid market distortions which may adversely affect the productivity in the agricultural sector and, eventually, Eastern European farmers' competitiveness on international markets.

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