Institutional Environment and Agricultural Production in Post-communist Central European Countries

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Abstract

This paper examines the significance of the institutional environment on agricultural production in post-communist Central European countries. It adds to the extensive research conducted into agricultural production functions by introducing a model which explains aggregate agricultural production using various inputs as well as variables that represent the institutional environment. The results with regards to the elasticities of material inputs (land, labour, capital) differ from those in previous research due to the specifics of the sample. More importantly, this paper identifies several institutions relevant to the agricultural sector and shows that in transitional economies institutional variables play a significant role.

Keywords: agricultural productivity, institutions, transition, economic freedom, international comparison.

Introduction

The new institutional economics is based on the assumption that institutions predominantly determine economic and human development (Williamson and Mathers 2011; Rodrik, Subramanian and Trebbi 2004; Acemoglu, Johnson and Robinson 2001). The testing of this assumption is the subject of this paper. The study in particular focuses on agriculture in post-communist Central European countries, which have witnessed a period of profound institutional change.

It is important to acknowledge the role of agriculture for human subsistence. It provides food and resources for manufacturing. From a different perspective, agriculture employs a certain proportion of the population and the well-being of these people is closely tied

to the development of the sector. Any analysis of a country´s development would be incomplete if it ignored the rural population and agriculture as its main occupation.

Agricultural production functions have been researched for some time. Recent studies in this field, notably those supported by the World Bank (e.g. Mundlak, Larson and Butzer 1997 and 2008), have employed institutional variables to some extent. However, the institutional variables used in the research were often inadequate, insufficient, or used in an inappropriate manner. For example, Vollrath (2007) uses a relevant measure for institutions, denoted as the "institutional quality index"; however, he extends the rating constructed for a specific time period to data representing a time span of 35 years. This index therefore does not reflect the institutional change that occurred over the time period.

The impact of the institutional environment on other economic variables is now widely recognized among economists. In the following analysis, we focus on three broad factors that affect the institutional environment, namely the rules affecting property rights, contracts and exchange, and relations between private persons and the government. These factors seem to have the most direct impact on economic activity. Property rights generally define who has the authority to make decisions about the use of particular assets. Limits on contractual freedoms put restrictions on which property rights can be traded among individuals and under what conditions. Finally, the government, which has the power to tax and regulate, can significantly affect the incentives to produce and trade.

The agricultural sector is specific. Although research conducted into the institutional environment and economic freedom suggests a positive relationship exists between these measures and economic performance (e.g. Gwartney and Lawson 2008; Gwartney, Lawson and Holcombe 1999), this may not exactly be the situation for agriculture. Important specific features of agriculture arise from and can be explained by the material conditions for agricultural production and the imperfections of the financial, insurance and factor markets in rural areas. According to Binswanger and Deininger (1997), agricultural production is characterized by heterogeneity, seasonality, spatial dispersion, and by large variations in weather and prices that affect similar producers within a region in the same way. The output and revenues of producers in the same area are covariant, which makes it difficult to provide efficient insurance on a regional scale. Moreover, the seasonality of agriculture requires hired labour, which does not share in the profits; thus, close supervision of labour is often needed which further increases costs.

The aforementioned issues are most salient in less developed countries. However, even in the most developed countries where they have succeeded in finding better arrangements to deal with the risks in agriculture, it remains true that agricultural producers require different policies than producers in other sectors of the economy.

Furthermore, since agriculture provides food and critical materials, governments are often willing to grant the sector special treatment.

Typically, the agricultural sector requires the domestic market to be protected against foreign competition, guaranteed prices and often direct monetary subsidies.[1] On the other hand, when it comes to business conduct, agricultural producers operate in similar ways to other producers i.e. they demand a flexible labour market, protection of property rights and the enforcement of contracts. We can therefore assume that most of the policies that are generally beneficial to business also help the agricultural sector, that is with a few exceptions, such as restrictions on international trade as is evidenced by current policies.

Finally, unlike previous studies (e.g. Mundlak, Larson and Butzer 1997 and 2008; Vollrath 2007) that focused on a broad cross-section of countries, this paper deals with a small and more homogeneous sample. Post-communist countries are quite homogeneous with regards to their recent history, the institutions that govern their agricultural operations and trade and also, to some extent, the level of development and technologies used in agricultural production, as well as the fact that they have all undergone substantial institutional change. This is not to deny the divergence that has occurred in the post-communist period as a result of the different ways of transformation (Lerman 2000 and 2001) and the differences in the initial endowment of land, labour and capital. The focus here is, however, on the impact of institutions on the operation of the agricultural sector rather than the fundamental institutional change that took place in the early years of the post-communist transition. We leave the discussion about the early reforms and land privatization schemes to other publications (e.g. Rozelle and Swinnen 2004; Tillack and Schulze 2000; Lerman 2001).

In summary, the following can be assumed about the impact of institutions on agricultural production. Firstly, the institutional environment matters. Although the impact may not be very sizeable, it should be large enough to be observed. Secondly, the impact of different policies is not uniform. Institutions can create a good business environment through the protection of property rights, access to credit and sensible regulations, which should boost agricultural production. On the other hand, government protection through the imposition of tariffs, non-tariff barriers and subsidies may also benefit the agricultural sector. Macours and Swinnen (2000) attribute most of the decline during the post-communist period to the deterioration of the agricultural terms of trade. Previous work (Jackson and Swinnen 1995) also points to price and trade liberalization among other factors. It is not necessarily true that the less government intervention the better. However, only some government interventions enhance agricultural production.

[1] The Common Agricultural Policy of the European Union may serve both as a catalogue of the frequently demanded policies and as an evidence that politicians are willing to grant the special treatment.

Model specification

Previous research into agricultural production functions was reviewed in Mundlak, Larson and Butzer (1997) and Mundlak (2000). In general, empirical studies suggest that the assumption of homogeneous technology represented by a production function applicable to all observations in a sample is not realistic and not supported by the data. It was therefore decided to follow the suggestion of Mundlak, Larson and Butzer (1997) to differentiate between functions estimated from observations within a country and time and those obtained from variability across countries and over time. However, the countries analysed in this study are quite homogeneous and the differences in technology and production functions are not necessarily too significant.

For the purpose of the econometric evaluation of the hypothesis about the significance of the institutional environment, a simplified model was used based on that used in Mundlak, Butzer and Larson (2008). This model is built on the assumption that at any time there are multiple techniques of production and that producers choose one technique with a choice of inputs and outputs. The production function is therefore a function of the output, state variables and inputs. The choice of technology depends on the state variables, as well as the choice of inputs.[2]

For the purpose of the econometric analysis, the production function may be approximated by a Cobb-Douglas-like production function, whereby the function implemented under state *s* is:

$$Y = \Gamma(s)\, X^{\beta(s)} e^{u}$$

where $\Gamma(s)$ represents the technology function and X is an array of inputs. As follows from the assumption with regards to the simultaneous choice of technology and inputs, both the vector of elasticities of different inputs β and the technology function are functions of state variables.

After logarithmic transformation ($y = \ln Y$, $\gamma(s) = \ln \Gamma(s)$, $x = \ln X$) this results in:

$$y = \gamma(s) + \beta(s)\, x + u$$

To simplify the analysis even further it was assumed, following previous literature (Mundlak, Butzer and Larson 2008), that the elasticities of different inputs do not depend on state variables, so that $\beta(s) = \beta$ and γ(s) was linearized, i.e. $\gamma(s) = s\,\gamma$. By applying these assumptions, the equation of the production function to be estimated by OLS was obtained:

$$y_{it} = \beta_0 + \gamma\, s_{it} + \beta\, x_{it} + u_{it}$$

where β_0 is the intercept and u_{it} is the error term. Firstly, the function for the pooled data was estimated. Time dummies and country fixed effects were subsequently

[2] For details on the microeconomic model and more advanced econometric analysis of the production function see Mundlak, Butzer, and Larson (2008). An extensive discussion on the econometric estimates of the agricultural production function is provided in Mundlak, Larson, and Butzer (1999).

employed to obtain results that were cleaned of variability over time and between countries.

Data

Data from two different sources were used to estimate the production function. The data on agricultural inputs and output came from the database of the Food and Agriculture Organization (FAO). The measure of economic freedom was taken from the Index of Economic Freedom published jointly by the Heritage Foundation and the Wall Street Journal. The sample includes data from ten post-communist countries[3] for the years 1995 to 2006. The starting year was selected on the basis of data availability. The last time period used in the analysis is 2006 because the transition of agriculture in the majority of the countries was already completed by then. Further developments would subsequently have been influenced by EU membership.

Agricultural output and inputs

Output is measured as "gross production" as reported by the FAO. These data are calculated using FAO indices of agricultural production that are based on the sum of price-weighted quantities of different agricultural commodities. The production quantities of each commodity are weighted by the 2004-2006 average international commodity prices and summed for each year. "Gross" means that the production is calculated without any deductions for feed and seed. Output is expressed in thousands of international dollars. The "international commodity prices" are used to facilitate an international comparison of productivity at the national level. International prices are expressed in so-called "international dollars" using the Geary-Khamis formula that assigns a single price to each commodity, so that, for example, one metric ton of wheat has the same price regardless of the country where it was produced.

Land is measured as "agricultural area" as reported by the FAO (ResourceSTAT). This category is the sum of areas of arable land, land under permanent crops and permanent meadows and pastures. Arable land is considered that which is under temporary agricultural crops, temporary meadows for mowing or pasture and gardens. Permanent crops are long-term crops which do not have to be replanted for several years (e.g. apple orchards, vineyards) and nurseries (except those for forest trees). Permanent meadows and pastures are those used permanently, i.e. five years or more, to grow forage crops. Data are expressed in 1000 hectares.

Labour is measured as the agricultural labour force or "total economically active population in agriculture" as reported by the FAO (PopSTAT). This refers to that part of the economically active population engaged in or seeking work in agriculture, hunting, fishing or forestry. Tractors are "agricultural tractors" as reported by the FAO

[3] Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia, and Slovenia.

(ResourceSTAT). The term as defined by the FAO refers to wheel and crawler or track-laying type tractors (excluding garden tractors) used in agriculture. Fertilizers stand for fertilizer consumption. This is the sum of nitrogenous fertilizers, phosphate fertilizers and potash consumption[4] as reported by the FAO (ResourceSTAT). Data are expressed in metric tons. Due to a change in methodology in 2002, there is no continuous time series on this variable. Two series were therefore used in the analysis, namely the pre-2002 consumption and the post-2002 consumption of fertilizers.

Livestock is measured as the number of different animals kept for agricultural production expressed in cow equivalents. The original data came from the FAO database (Production). To calculate the aggregate numbers, the following weights were used: 1 horse = 1 mule = 1 buffalo = 1.25 cattle = 1.25 asses = 0.9 camels = 5 pigs = 10 sheep = 10 goats = 100 chickens = 100 ducks = 100 geese = 100 turkeys (Hayami and Ruttan, 1985).

Permanent crops and land equipped for irrigation were used as further measures (or rather proxies) of capital. "Permanent crops", as reported by the FAO (ResourceSTAT), are as defined above. The land equipped for irrigation is the "total area equipped for irrigation" as reported by the FAO (ResourceSTAT). It is the area equipped to provide water to crops via irrigation. This includes areas equipped for full and partial control irrigation, equipped lowland areas, pastures, and areas equipped for spate irrigation. Data for both variables are expressed in 1000 hectares.

In addition, three control variables were employed in the regression. First, the agricultural tradition of a country, which was approximated on the basis of the percentage of the agricultural population in the total population. Second and third, longitude and latitude, which were used as a proxy for the natural conditions of a country.

(Table 1 about here)

A measure of the institutional environment

Institutions are measured in terms of economic freedom. Data were taken as is from the Index of Economic Freedom (Miles, Holmes and O'Grady 2006). The index is calculated as an average of nine different components measuring different aspects of economic freedom. All partial indices are constructed to range from 0 to 100, whereby a higher score means more economic freedom. In the regression analysis both overall index and several partial indices were used.

The business freedom index reflects several factors that burden the starting up and closing down of a business, the index is based on the World Bank's Doing Business study. The trade freedom index uses a trade-weighted average tariff rate, plus a

[4] These are the main types of fertilizers used in agriculture. They account for more than 50% of fertilizer consumption in the world. The same measure is used in Mundlak, Larson and Butzer (1997) and Vollrath (2007).

penalization for non-tariff barriers. The fiscal freedom index reflects top tax rates on personal and corporate income and total tax revenue as a percentage of GDP. The government spending index measures total government expenditure as a percentage of GDP. Both of these indices use non-linear (quadratic) formulae to penalize higher taxation or spending more severely.

Monetary freedom assesses price stability. The lower the inflation, the better the awarded score; a country may be penalized for extensive price controls. Financial freedom reflects the efficiency of banking and the independence of the financial sector from government control. The investment freedom index evaluates various restrictions on investments. It is produced by deducting several points from the ideal score for each particular restriction that is harmful to investors.

Property rights are evaluated categorically, with eleven different levels reflecting the various levels of protection of private property. Finally, freedom from corruption reflects perceived corruption in a country based on data from the Corruption Perceptions Index as produced by Transparency International.

The choice of particular institutions and the method of their quantification may be disputed. Several partial indices depend on subjective evaluations, although based on data from external sources other than the Heritage Foundation or the Wall Street Journal. Some partial indices are not really continuous, such as the property rights index, due to the nature of the evaluated institutions. The construction of the overall index could be criticized for the choice of particular aspects of the institutional environment and equal weights given to all partial indices. The decision to use the Index of Economic Freedom as is rather than to produce another measure for the institutional environment is justified due to the comparability of this research to other studies using the same measure.

Finally, membership of the European Union is considered to be another institutional variable because accession to the EU changed several aspects of the institutional environment, as well as the ability of the post-communist economies to trade with their European partners.

Regression results

The hypotheses were tested using the data described in the previous section. A simple plot of the relationship between various aspects of economic freedom and the agricultural productivity of land i.e. total production per hectare, suggests that the impact of different freedoms is diverse (Figure 1). Some of the partial indices showed a positive correlation with productivity, in particular the property rights index, business freedom and freedom from corruption. In contrast, other indices showed a negative correlation with productivity, namely trade freedom, investment freedom and the

freedom from government spending. The regression analysis that follows presents the impact of these freedoms net of other relevant factors.

(Figure 1 about here)

The model was tested with several specifications, of which the results are presented in Table 2. The first specification without any institutional variables made it possible to compare the results to previous analyses (see Mundlak 2000, for a summary). There was a significant difference in the elasticity of land. Previous studies using broad cross-sections of countries reported low elasticity of land, especially in the between-country analysis. This is chiefly due to differences in the use of land in different countries. The sample in this study is quite homogeneous, therefore the high elasticity of land is not surprising. Similar logic can be applied to the slightly higher coefficients for permanent crops and irrigated land; the elasticity of livestock was lower compared to previous studies. The elasticities of machinery and fertilizers were in line with previous research. Bearing in mind the specificity of the sample in this study, it was possible to proceed with testing the effect of the institutional environment.

(Table 2 about here)

Columns 2 and 3 include the institutional variables proposed above. The overall index, which lumps together different institutions with diverse effects (see Figure 1), shows a positive correlation with agricultural production. The magnitude may not seem impressive, 0.4% for each extra point in the economic freedom index. However, the improvement of the index score in several countries was considerable over the period 1996 - 2006 (e.g. Lithuania saw an improvement of almost 23 points). Similarly, the effect of EU membership was positive, with > 5% increase in agricultural production.

When the effect of particular indices was examined separately, not all of them appeared to be significant. The results confirm the rough estimates presented in Figure 1. Trade freedom and investment freedom showed a negative correlation with agricultural output. This confirms the train of thought that agriculture prospers better under protectionism than under free international trade and competition. In contrast, property rights, business freedom, financial freedom and fiscal freedom showed a positive correlation with agricultural output. Again, this is in line with the train of thought that farms do better if they can operate in an environment of secure property, reasonably low regulation, unimpeded access to credit and low taxation, even though the absolute values of coefficients were rather small, 0.2% or 0.3% for an extra point in the respective index.

In columns 4 and 5, time dummies and country fixed effects were used to control changes in technology over time and the specifics of the countries, respectively. Of course, since institutions in transition countries improve over time, there was a risk of undervaluing the effect of the institutional variables. However, for the most part the results did not differ from the previous regression; only the EU membership variable is

clearly absorbed by the time trend (this was as expected, since 8 out of the 10 countries in the sample entered the EU at the same time). In the last model specification, the effect of institutions was absorbed in the country fixed effects.

The analysis supports the hypothesis repeatedly discussed in literature about the nature of returns to scale in agriculture. It is frequently claimed that the agricultural production function has constant returns to scale. In this analysis, the sum of elasticities of material inputs is not statistically significantly different from 1, which is consistent with existing literature (Mundlak, Larson and Butzer 1997).

Discussion and conclusions

There are many other state variables that could (and maybe should) have been included in the presented analysis. As a technology measure, this may have included the peak yield and schooling (Mundlak, Larson and Butzer 1997 and 2008), research and development expenditure (Vollrath 2007) and land distribution (as shown in Vollrath 2004 and 2007). Physical environment measures include potential dry matter and water availability variables (Mundlak, Larson and Butzer 1997 and 2008) or some measures of land quality (used for example in Vollrath 2007; extensive analysis in Wiebe 2003).

The economic environment, or motivation, could also have been introduced using relative prices in the agricultural and non-agricultural sectors (i.e. trading terms of agriculture), price variability and inflation (Mundlak, Larson and Butzer 1997 and 2008). It would have also been possible to employ a variable for wealth or income distribution, such as the Gini coefficient (Allcott, Lederman and Lopez 2006). There are some alternative, or additional, institutional measures as well. These include variables for different forms of government (Przeworski and Limongi 1993), government expenditure, and legal origins (La Porta et al. 1998).

As previously stated, agriculture is specific. Fiscal policies are clearly relevant. However, the argument that less government spending is per se beneficial to agriculture is not clear cut. The structure of expenditure requires careful examination in order to assess its impact on rural economies. Similarly, government policies in the area of international trade need to be reviewed with regards to agriculture. Even though some economies may be generally open, with low tariffs and insignificant non-tariff barriers, agricultural products often have different regimes. With regards to legal protection, the enforcement of laws may be quite advanced in urban areas but insufficient in rural areas where most of the agricultural production takes place. Traditions and various informal rules may be of major significance here. This also applies to access to credit for farmers as compared to manufacturers.

The analysis justifies our interest in both production functions and the institutional environment. Indeed, it appears that institutions in post-communist countries did matter for agricultural production. Considering the extent of institutional change during

the post-communist transition, the effect on the agricultural sector was significant and sizeable. This study identified a group of institutions that promote agricultural production through the protection of property rights, by easing access to credit through a reasonably regulated financial market, and low taxation. In contrast, openness to foreign competition, neither in the form of foreign trade nor foreign investment, does not seem to be beneficial to agriculture. This is consistent with previous findings (Macours and Swinnen 2000). Although this paper analyses a specific historical event, the post-communist transition, it provides a more general insight into economic policies. Reformers should therefore be aware of the impact of different institutional changes.

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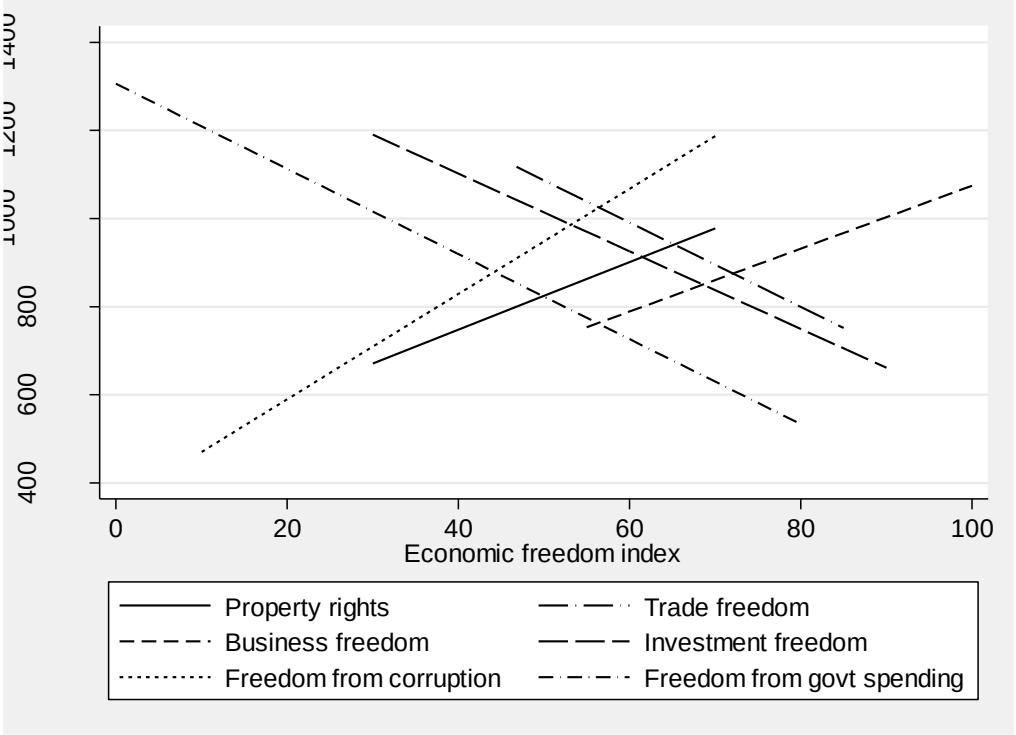
Figure 1. Relationship between different economic freedoms and productivity (agricultural output per Ha), pooled data for all countries and time periods, linear fit



Source: Author

Table 1. Summary statistics for output, inputs and institutional variables

Variable	Mean	SD	Min	Max
Production per ha (intl. $)	866.52	341.82	436.95	1734.52
Labour per 1000 ha (number)	91.73	48.18	22.40	227.80
Tractors per 1000 ha (number)	44.35	55.96	5.81	222
Fertilizers per 1000 ha (tons) (pre-2002)	57.95	36.78	12.01	157.19
Fertilizers per 1000 ha (tons) (post-2002)	70.82	21.84	24.48	135.78
Livestock per 1000 ha (cow equivalents)	382.53	188.41	195.89	943.67
% Permanent crops	2.61	1.56	0.69	6.46
% Land equipped for irrigation	4.49	6.63	0.03	22.49
Agricultural tradition (% of agric. population)	10.91	4.60	1.00	21.48
Latitude	49.56	6.85	34	59
Longitude	21.48	3.92	14.8	26
EU membership	0.2	.40	0	1
Index of Economic Freedom	61.10	7.69	42.9	77.7

Number of observations, N = 120 (in 10 countries and 12 annual periods, pooled)

Source: Author

Table 2. Regression results
Dependent variable: log Agricultural Output (1000 intl. $)
All regressions are controlled for agricultural tradition, longitude and latitude.

Explanatory variable	(1)	(2)	(3)	(4)	(5)
log Land	0.516 ***	0.514 ***	0.533 ***	0.504 ***	0.273
	(0.073)	(0.069)	(0.066)	(0.071)	(0.166)
log Labour	0.089 **	0.049	-0.024	-0.026	0.016
	(0.035)	(0.034)	(0.044)	(0.046)	(0.074)
log Tractors	0.116 ***	0.108 ***	0.133 ***	0.102 ***	0.032
	(0.028)	(0.026)	(0.034)	(0.046)	(0.058)
log Fertilizers (pre-2002)	0.099 ***	0.068 *	0.046	0.037	-0.007
	(0.034)	(0.041)	(0.041)	(0.039)	(0.040)
log Fertilizers (post-2002)	0.104 ***	0.071 *	0.044	0.025	-0.009
	(0.034)	(0.040)	(0.041)	(0.041)	(0.040)
log Livestock	-0.087	-0.007	0.081	0.149	0.355 **
	(0.071)	(0.065)	(0.096)	(0.105)	(0.131)
log Permanent crops	0.202 ***	0.195 ***	0.143 ***	0.154 ***	0.048 *
	(0.032)	(0.033)	(0.037)	(0.037)	(0.023)
log Land equipped for irrigation	0.043 ***	0.043 ***	0.066 ***	0.050 ***	0.049
	(0.011)	(0.012)	(0.015)	(0.014)	(0.010)
EU membership		0.051 *	0.070 ***	-0.002	0.071 **
		(0.029)	(0.026)	(0.042)	(0.031)
Index of Economic Freedom		0.004 **			
		(0.002)			
- Business freedom			0.002 **	0.002	0.001
			(0.001)	(0.001)	(0.001)
- Trade freedom			-0.002 *	-0.001	-0.002 *
			(0.001)	(0.001)	(0.001)
- Fiscal freedom			0.003 ***	0.003 **	0.001
			(0.001)	(0.001)	(0.001)
- Freedom from govt. spending			-0.000	-0.001	0.001
			(0.001)	(0.001)	(0.001)
- Monetary freedom			0.001 *	0.000	0.001
			(0.001)	(0.001)	(0.001)
- Investment freedom			-0.002 **	-0.002 **	-0.001
			(0.001)	(0.001)	(0.001)
- Financial freedom			0.003 ***	0.003 ***	0.001
			(0.001)	(0.001)	(0.001)
- Property rights			0.002 **	0.002 **	0.001
			(0.001)	(0.001)	(0.001)
- Freedom from corruption			-0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
Time and country effects	No	No	No	Time effects	Fixed effects
Adjusted R^2	0.995	0.996	0.997	0.997	0.970
Sum of elasticities of material inputs	1.082	1.041	1.024	0.996	0.776
N of observations	118	115	115	115	115

Standard errors (in parenthesis) are robust to heteroscedasticity. Single asterisk (*) denotes significance at 10%, double asterisk (**) denotes significance at 5%, triple asterisk (***) denotes significance at 1%. All figures are rounded to three decimal places.

Source: Author

MINÁRIK, P., 2017. Institutional Environment and Agricultural Production in Post-communist Central European Countries. *Littera Scripta* [online]. České Budějovice: Institute of Technology and Business in České Budějovice, **10**(1), 88-101 [accessed: 2017-06-27]. ISSN 1805-9112. Available at: http://journals.vstecb.cz/category/littera-scripta/10-rocnik-2017/1_2017/.