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The relationship between the relative GDP share of agriculture and the unemployment rate in selected Central and Eastern European countries

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Abstract: The study empirically investigates the relationship between the relative GDP share of agriculture and the unemployment rate in a sample of ten Central and Eastern European countries. Utilising the annual data for the sample period 1996–2013, the empirical analysis is carried out using the dynamic panel regression analysis and the Granger causality tests. The estimation results based on the alternative specification of regression equations for the unemployment rate suggest that the unemployment rate is negatively related to the relative GDP share of agriculture. In addition, a similar effect has been obtained for some other explanatory variables we have included in the unemployment equation as controlling variables: higher investment rate and trade openness are likely to lower the rate of unemployment. The financial development has also been found to be negatively related to the unemployment rate, although the statistical significance of its effect depends on the estimation technique used. On the other hand, the GDP growth and the government consumption have been found to be insignificantly related to the unemployment rate. While the Granger causality tests performed for each country produced evidence of a causal effect of the relative GDP share of agriculture in some countries, in some other countries the direction of causality has been found to be from the unemployment rate to the relative GDP share of agriculture. Our findings suggest that agriculture may play a potential role in lowering the prevailing rates of high unemployment; but this potential is likely to vary between countries.

Keywords: dynamic panel regression, Granger causality, investment, trade openness

The main aim of this study is to empirically analyse and answer the following two questions with regard to a sample of ten Central and Eastern European countries: (a) Is the unemployment rate associated with (or related to) the relative GDP (gross domestic product) share of the agriculture (measured as the agriculture value added percentage of GDP) for the average country in our sample? and (b) Is there a (statistically significant) casual effect of the relative GDP share of agriculture on the unemployment rate in each country? We believe that answering these two questions may provide new insights for the policy makers of these countries in relation to the possible linkages between the rate of unemployment and policies regarding the sectoral allocation of resources in general and agricultural policies in particular. Moreover, recent findings concerning the growing relative importance of certain countries as producers of agricultural innovations through investment in research and development suggest that a fresh emphasis on investigating the role that agriculture can play in solving structural problems (such as unemployment), particularly in the Central and Eastern European countries, can be more than justified (Pardey et al. 2013).

Most of the prior literature investigating the relationship between the agricultural sector and the overall macroeconomic performance of a country has focused on the relationship between economic growth and the growth of agricultural output (or sometimes agricultural exports). As stated above, the present study attempts to add to the existing literature by examining the nature of the relationship between the relative GDP share of agriculture and the unemployment rate in selected high income and middle (upper) income countries of the Central and

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Eastern Europe by using the dynamic panel regression analysis and the Granger causality tests.

Kuznets' (1964) argument that as countries develop, their sectoral composition of output and employment is likely to change in favour of non-agricultural sectors has been accepted as almost an indisputable fact. Coupled with this argument, the fact that most of the poorest countries in the world today are usually the ones with a relatively higher GDP and employment shares of agriculture, it may seem counterintuitive to ask the following question: Is it possible to lower the rate of unemployment (which may also lead to reduced poverty) by increasing the relative income share of the agricultural sector through systematic policies (that may include investment, directed credit, subsidies, taxation and commercial policies among others) in at least some of the Central and Eastern European countries? We believe that this is a question worthy of careful empirical scrutiny while keeping in mind that the answer may differ from one country to another. The focus on "unemployment rate" (instead of economic growth) in the present study is based on the notion that attaining lower rates of unemployment can sometimes be more critical (or effective) than raising the rate of the GDP growth as an intermediate target in lowering the degree of poverty and improving the income distribution.

The main findings of our empirical work were generated by running alternative dynamic panel regressions of the unemployment rate on the relative GDP share of agriculture and several other control variables (including inflation rate, trade openness, investment rate, GDP growth, per capita GDP growth, government consumption, and financial development indicator) and applying the Granger causality tests separately for each country. These findings can be summarised as follows: (i) There is a statistically significant negative relationship (or association) between the relative GDP share of agriculture and the rate of unemployment for the average country in our sample; (ii) There exists a statistically significant causal effect of the relative GDP share of agriculture on the rate of unemployment in three of the ten countries examined. In the rest of this introductory section, we summarise and discuss the key insights from the prior literature in terms of both theoretical and empirical aspects of our work.

As stated above, most of the prior literature investigating the relationship between the agricultural sector and the overall macroeconomic performance of a country has focused on examining the nature of the relationship between the growth of agricultural output and economic growth (growth rate of GDP). This stream of research has given rise to two alternative hypotheses in development economics: The Agriculture Led Growth (ALG) hypothesis and the Growth Led Agriculture (GLA) hypothesis. The ALG hypothesis is simply the idea that an increase in the value-added of agriculture (particularly per worker) is a precondition for the development of the non-agricultural sectors of the economy. On the other hand, the GLA hypothesis argues that the development of non-agricultural sectors in general (and industry in particular) is necessary for the development of the agricultural sector. The results and insights of previous studies investigating these two hypotheses are mixed and contradictory. The relevant studies here include the work of Lewis (1954), Fei and Ranis (1961), Schultz (1964), Echevarria (1997), Kogel and Prskawetz (2001), Gardner (2005), Tiffin and Irz (2006) and, most recently, Awokuse and Xie (2015). For example, the Granger causality tests carried out by Tiffin and Irz (2006) for 85 countries suggested that while the agricultural value added is the causal variable for GDP per capita in developing countries, the direction of causality in developed countries is unclear. In their article, Tiffin and Irz (2006) suggested that an increase in the supply of agricultural products may have expansionary effects on the non-agricultural sectors, both in terms of output and employment through the following channel: an increase in agricultural output (by lowering the price of food) may allow the industrialists to pay lower wages, which leads, in turn, to an increase in the profitability and competitiveness of the industrial sector. This would ultimately lead to an increase in savings and investment. Also, the decrease in the price of food may exert additional expansionary effects by increasing the effective real income of the net purchasers of food.

Steger (2000) suggests another channel through which an increase in the relative GDP share of agriculture can (under certain conditions) lead to a lower rate of unemployment: If the total factor productivity growth is relatively higher in the agricultural sector, then an increase in its relative size can lead to a higher (average) productivity growth for the entire economy, thereby leading to a higher GDP growth and a higher saving rate. This can allow for a higher rate of investment and a lower unemployment rate.

A recent study by Awokuse and Xie (2015) investigating the causal linkages between agriculture and

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GDP growth produced mixed results: For some countries, the ALG hypothesis seems to be valid, while for others the GLA hypothesis is supported. However, it is worth noting that their empirical analysis was carried out with the aid of "directed acyclic graphs" that are reported to be based on a recently developed algorithm for inductive causation. Even though their study does not provide any direct evidence concerning the effects on (un)employment of an increase in agriculture output, their theoretical model (which is partly based on the earlier work by Hwa (1988)) offers interesting insights into how an increase in the agricultural output might lead to an increase in the total factor productivity and lower unemployment. Their model assumes that agricultural production can be taken as a measure of the linkages between the rural sector and the industrial sector. The employment effects of a higher agricultural output can be operational through both the production and consumption linkages between agriculture and the non-agricultural sectors. For example, agriculture can provide raw materials for the non-agricultural production or demand inputs from the industry. On the consumption side, the higher productivity in the agricultural sector can increase the incomes of the rural population, thereby creating demand for the domestically produced industrial output. As Dethier and Effenberger (2012) observe, such linkage effects can increase employment opportunities in the rural non-farm sector, thus indirectly generating rural income. In addition, agricultural goods are traded goods that can be exported to earn foreign exchange in order to import capital goods.

Dethier and Effenberger (2012) also argue that the agricultural growth can reduce poverty, not only through its direct effects on the farm employment and profitability, but also indirectly through its positive effects on the job creation in the upstream and downstream non-farm sectors as a response to the higher domestic demand. However, if the agricultural output growth is due to the technological progress that is labour saving, then the farm employment might not necessarily increase (Irz et al. 2001). Under these conditions, the net employment effect of an increase in the agricultural output growth is likely to be ambiguous. Another source of ambiguity in the net growth and employment effects of an increase in the relative output supply of the agricultural sector could be related to the "openness" of an economy and the relative productivity of the agricultural sector. Matsuyama (1992) suggested that if a country has a comparative advantage in terms of agriculture, its openness to trade will draw resources away from the non-agricultural sectors and into agriculture, which could in turn exert adverse effects on the long-run economic growth and employment. On the other hand, according to Foster and Rosenzweig (2003), a greater agricultural productivity might have negative effects on employment in the non-agricultural sectors under certain conditions regarding the labour elasticity of demand in different sectors. If the agricultural sector (as well as the rural (non-farm) non-tradable sector) has a relatively inelastic demand for labour, while the sub-sector producing tradable goods in the non-agricultural sector has a more elastic labour demand, a given increase in wages (due to an increase in agricultural productivity) could result in a higher rate of unemployment simply because the factories producing tradable goods (which are assumed to be operated by foreign producers) may move abroad in order to escape higher labour costs.

Intuitively, as the World Bank (2000) pointed out, not all growth processes generate an equal amount of the overall growth or an equal amount of the poverty reduction. In this context, Christiaensen et al. (2011) suggested that the poverty reducing effect of growth in a particular sector may differ for two reasons. First, the sector may be bigger. Second, even if both sectors are of an equal size, the marginal effect on the overall poverty of an additional percentage point of the overall GDP growth originating from one sector may still be larger than the marginal effect of an additional percentage point of the overall GDP growth originating from the other sector. These insights imply that whether or not a given increase in the growth rate of output of one sector (such as agriculture) will have a relatively more significant effect on poverty than an equal increase in the output growth rate of another sector (such as a non-agricultural sector) is ultimately an empirical issue. For example, if relatively higher percentages of the existing (involuntarily) unemployed labour force are found in the rural sector, then an increase in the relative output growth of agriculture may lead to a decrease in the economy-wide unemployment rate.

The relationship between the growth of agricultural output and poverty reduction has been empirically investigated by a number of authors. For instance, Mellor (2001) reported that agricultural output growth can reduce poverty through employment generation in the non-agricultural sector. Further, this effect is mostly driven by increased consumption demand and

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hence not so much by production linkages. The estimates reported by Christiaensen and Demery (2007) suggest that a 1% growth of per capita agricultural output reduces poverty by 1.6 times more than the same growth in industry and three times more than the growth in the service sector.

The importance of the linkages between the agricultural sector and non-agricultural sectors differs between countries depending not only on the "degree of openness" (as pointed out earlier), but also on the level of development. In this context, the findings of Bravo-Ortega and Lederman (2005) show that while a given increase in agricultural output raises the non-agricultural output in developing countries, a reverse relationship exists for the developed countries.

The research results concerning the productivity growth in agriculture and other sectors can provide interesting insights into the role that agriculture can potentially play in at least some economies. In relation to this, Christiaensen et al. (2011) argued that contrary to the conventional wisdom, since the 1960s, the labour productivity in agriculture has in average been growing faster than the labour productivity in non-agricultural sectors in most countries. This argument is at least partly supported by the findings of other authors. For example, the panel data analysis of 50 low and middle income countries over the period 1967–2002 carried out by Martin and Mitra (2001) suggested that the annual TFP (total factor productivity) growth in agriculture has (on average) been by 0.5 to 1.5 percentage points larger than that in the non-agricultural sectors, depending on the estimation technique used. The findings of Dawson (2005) are also highly insightful in terms of the relative efficiency of investment in different export sectors. Dawson's (2005) panel data analysis of a sample of less developed countries showed that investment in either the agricultural export sub-sector or the non-agricultural export sub-sector produces a statistically identical GDP growth rate. Furthermore, his estimates suggest that the total factor productivities in the non-export production are by 30% lower than those in the production of exports. Based on these findings, Dawson (2005) argues that an exclusive focus on non-agricultural exports in general, and manufactured exports in particular, seems misplaced.

Under certain conditions, the linkages from agriculture to non-agriculture are likely to be relatively stronger (Mellor 1976; Tiffin and Irz 2006). This could certainly be the case if the inputs into non-agricultural sectors and the urban consumption patterns are more import intensive. Under these conditions, it may be possible (or even likely) to lower the unemployment rate by systematically changing the sectoral composition of GDP in favour of agriculture. Naturally, whether or not this is the case for a specific sample of countries, either collectively or individually, is ultimately an empirical matter. This insight is also supported by the earlier results of Lawler et al. (2003), who showed that an increase in the relative labour force share of agriculture is likely to have different effects on the growth rate of the potential output (and therefore both the natural and cyclical unemployment) in different European Union (EU) economies: while the growth rate of potential output in some member states increases, in others it either decreases or stays the same. Based on these findings, Lawler et al. (2003) argued that the application of common agricultural policies across all EU member states may be questionable because of the different anticipated effects of these policies on different economies.

A recent study by Gozgor (2013) found that there exists "hysteresis" (i.e., unemployment persistence) in a sample of ten Central and Eastern European (CEE) countries. In the light of this finding, we believe that empirically analysing the nature of the relationship between the relative GDP share of agriculture and the unemployment rate in at least some of the CEE countries can provide new insights not only for the policy makers in these countries, but also for those in Brussels.

As explained at the beginning of this section, our emphasis is on investigating the relationship between the relative GDP share of agriculture and unemployment. In other words, we are not directly examining the relationship between the growth of agricultural output and the unemployment rate, which is why our work differs from most of the prior literature. We therefore hope that the present study can assist the policy makers from the Central and Eastern Europe in addressing the unemployment problem, the sectoral allocation of resources and the agricultural sector.

The rest of the paper is organised as follows. The next section details the study's materials and methodology. The third section is devoted to presenting and discussing the empirical results obtained from the dynamic panel regressions (of unemployment rate) and the Granger causality tests. Finally, the fourth section concludes the paper with a brief summary of the results and their policy implications.

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MATERIALS AND METHODOLOGY

Data sample and descriptive statistics

In order to investigate the relationship between agricultural growth and important macroeconomic variables, we used yearly data from 1996–2013 for ten countries. The countries under study were Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Poland, Romania, the Russian Federation, Slovenia and Turkey. Transition economies are characterised by serious missing data and those that only had data available after 1996 were not included, since the aim of this study was to run strongly balanced panel regressions that require a sufficient observation in order to obtain better results. In addition, examining the causal relationship between two or more variables requires a longer series; therefore, in order to check the causality between agriculture and unemployment, we used the starting data depending on the availability of each country (Table 3). Table 1 provides descriptive statistics for all of the variables based on the dynamic panel data. All of the data were obtained from the World Bank's development indicators.

Dynamic panel regression

Conventional approaches such as the ordinary least squares (OLS) and other models that are used in studying the cross-section and time series panel data suffer from several drawbacks. For example, the panel estimation under the OLS neglects the cross-sectional and time series nature of the data. However, using the generalised method moments (GMM) dynamic panel data estimator developed by Arellano and Bond (1991) has some advantages. For instance, the dynamic panel regression control for causality between the dependent and independent variable can tackle the presence of the unobserved country fixed effects. The specific form of the equation we estimated using the dynamic panel regression is given below:

$$UN_{i,t-1} = \beta_0 + \beta_1 UN_{i,t-1} + \beta_2 AGR_{i,t} + \beta_3 X_{i,t} + \vartheta_t + \epsilon_{it} \quad (1)$$

where UN is an unemployment rate at time t for country i; $UN_{i,t-1}$ is one period lagged unemployment, which measures the persistence of the dependent variable; AGR is a measure of the share of agriculture in GDP; X is a set of control variables (investment rate, trade openness, share of exports in GDP, government expenditure, financial development, annual GDP growth and annual per capita GDP growth); β_0 represents the constant; ϑ_t is the country-specific effect; and ϵ_{it} is an error term that captures unobserved shock.

Granger causality test

The Granger causality (GC) is widely employed to investigate the causal relationship between two or more variables. According to equation (2), UN (unemployment rate) and AGR (share of agriculture in GDP) are two variables that are investigated when determining a causality relationship. From equation (2) below, the variable UN is said to Granger-cause the variable AGR if the past and present values of UN assist in predicting the direction of AGR (while equation (3) gives the reverse). It is worth noting that

Table 1. Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min.	Max.
UN	180	9.49	3.51	3.90	20.50
AGR	180	6.10	3.91	1.68	22.59
GDPG	180	3.11	4.14	–14.74	11.74
GDPP	180	3.24	4.27	–14.57	13.02
INV	180	24.44	5.35	0.30	39.36
TO	180	92.65	33.88	38.73	176.43
EX	180	45.49	17.35	19.44	88.76
GOV	180	17.28	4.08	5.69	23.52
INF	180	18.05	80.68	–0.08	1 058.37
DC	180	50.77	21.70	12.86	106.44

UN = unemployment rate, AGR = agriculture value added in % GDP, GDPG = GDP growth annual %, GDPP = GDP per capita growth annual %, INV = investment in % of GDP, TO = trade in % of GDP, EX = export in % of GDP, GOV = government consumptionin % of GDP, INF = inflation rate, DC = domestic credit provided by financial sector in % of GDP

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two-way causality is possible if the UN is causing the AGR and the AGR is causing the UN.

$$UN_t = b + \sum_{i=1}^{plag} \delta_i \, UN_{t-i} + \sum_{j=1}^{Plag} \gamma_j \, AGR_{t-j} + \varepsilon_t \qquad (2)$$

$$AGR_t = a + \sum_{i=1}^{plag} \alpha_i \, AGR_{t-i} + \sum_{j=1}^{Plag} \vartheta_j \, UN_{t-j} + \theta_t \qquad (3)$$

where b and a are constant terms, while ε_t and θ_t are serially uncorrelated white-noise residuals.

EMPIRICAL RESULTS

The estimation results from the analysis of the relationship between the unemployment rate and the relative GDP share of agriculture, as well as other macroeconomic variables, obtained through using the dynamic panel regression are presented in Table 2, while the Granger causality analysis results are presented in Table 4. The results in Table 2 are derived from seven different models, with each model featuring two or more different control variables. Besides, all of the models estimated with the GMM (A) and GMM robust standard errors (B). The major finding of Table 2 can be summarised as follows. The lagged independent variable (which is the persistence coefficient) is negative and highly statistically significant at 1% in all seven models. It remains significantly robust when the control variables are changed. In others words, the last year's unemployment rate can be helpful in predicting this year's unemployment rate for an average country. Similarly, the AG coefficients are negative and highly statistically significant at 1% in all seven variables. Again, the significance remains robust when the control variables are changed. This means that for the average country in our sample, improving the value-added of agriculture will help in reducing the rate of unemployment and/or one way of reducing unemployment is to enhance the agricultural sector. In addition to this, the investment rate coefficient is negative and highly significant, which can be understood to suggest that an increase in investment will reduce the rate of unemployment for an average country. Trade openness (OP) and export are also coefficients that are statistically significant and negatively related to the unemployment rate, with the sign and significance being expected since the increase in exports means more demand for the local production, which has to be met by employing more workers. Financial development has also been found to be negatively related to the unemployment rate, although the statistical significance is only observed when the GMM technique (A) is used. Moreover, the coefficients of inflation rate, GDP growth and GDP per capita growth are found to be negatively related to the unemployment rate, albeit insignificantly. On the other hand, government consumption has been found to be positively and insignificantly related to

Table 2. Unemployment rate and the relative GDP share of agriculture: Dynamic panel regression

	Model 1		Model 2		Model 3		Model 4	
	A	B	A	B	A	B	A	B
L.UN	0.73966*** [0.04222]	0.73966*** [0.04722]	0.732736*** [0.042202]	0.732736*** [0.046992]	0.709546*** [0.036863]	0.709546*** [0.049911]	0.729852*** [0.04215]	0.729852*** [0.04656]
AGR	−0.23514*** [0.081944]	−0.23514*** [0.087533]	0.247672*** [0.081714]	−0.24767*** [0.089279]	−0.29235*** [0.075626]	−0.29235*** [0.082903]	−0.25628*** [0.080753]	−0.25628*** [0.085281]
GDPG	−0.04792 [0.03123]	−0.04792* [0.029067]	−0.04376 [0.032536]	−0.04376 [0.027896]				
GDPP							−0.03677 [0.03129]	−0.03677 [0.023477]
INV	−0.28237*** [0.035492]	−0.28237*** [0.042622]	−0.32045*** [0.037482]	0.320452*** [0.053521]	−0.35275*** [0.028811]	−0.35275*** [0.041931]	−0.32693*** [0.036793]	−0.32693*** [0.050664]
INF	−0.00091 [0.001555]	−0.00091 [0.001267]	−0.00074 [0.001623]	−0.00074 [0.001119]	−0.000019 [0.001607]	−0.000019 [0.000912]	−0.00055 [0.001622]	−0.00055 [0.001044]
OP	−0.04003*** [0.008244]	−0.04003*** [0.013919]						
EX			−0.07629*** [0.015447]	−0.07629*** [0.025525]	−0.07914*** [0.015081]	−0.07914*** [0.025327]	−0.07711*** [0.01533]	−0.0771^{1***} [0.02539]

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Continuation Table 2

	Model 1		Model 2		Model 3		Model 4	
	A	B	A	B	A	B	A	B
GOV			−0.02118 [0.088452]	−0.02118 [0.05074]	−0.00042 [0.084897]	−0.00042 [0.061361]	−0.0226 [0.08837]	−0.0226 [0.053521]
DCF								
C	14.75943*** 1.656193	14.75943*** 2.915725	15.94247*** 2.506099	15.94247*** 3.6331	16.84486*** 2.420523	16.84486*** 3.472009	16.22108*** [2.48881]	16.22108*** [3.60784]
Wald chi2	755.68	2636.7	757.06	2931.13	770.56	1515.49	760.99	2876.58
AR (1)	−2.1209** (0.0339)		−2.1261** (0.0335)		−2.0393** (0.0414)		−2.1306** (0.0331)	
AR(2)	−0.33602 (0.7369)		−0.39434 (0.6933)		−0.21076 (0.8331)		−0.45334 (0.6503)	
Sargan test	124.6343 (0.2335)		124.4841 (0.2364)		124.1173 (0.2435)		123.778 (0.2502)	
	Model 5		**Model 6**		**Model 7**			
	A	**B**	**A**	**B**	**A**	**B**		
L.UN	0.710342*** [0.04506]	0.710342*** [0.050431]	0.707992*** [0.044984]	0.707992*** [0.05089]	0.735868*** [0.04237]	0.735868*** [0.04773]		
AGR	−0.34043*** [0.08195]	−0.34043*** [0.11474]	−0.34165*** [0.081502]	−0.34165*** [0.11359]	−0.25263*** [0.08133]	−0.25263*** [−0.87443]		
GDPG	−0.05418 [0.03309]	−0.05418 [0.03575]						
GDPP			−0.04657 [0.03183]	−0.04657 [0.03050]	−0.03639 [0.03140]	−0.03639 [0.02401]		
GDPP			−0.04657 [0.03183]	−0.04657 [0.03050]	−0.03639 [0.03140]	−0.03639 [0.02401]		
INV	−0.29316*** [0.03600]	−0.29316*** [0.04585]	−0.29976*** [0.03548]	−0.29976*** [0.0444]	−0.28883*** [0.03515]	−0.28883*** [0.03910]		
INF					−0.0005 [0.00162]	−0.0005 [0.00110]		
OP	−0.03097*** [0.00980]	−0.03097* [0.01754]	0.031661*** [0.00972]	−0.03166* [0.01731]	−0.04052*** [0.00828]	−0.04052*** [0.01420]		
EX								
GOV	0.053954 [0.08323]	0.053954 [0.03772]	0.048322 [0.083219]	0.048322 [0.03999]	0.026388 [0.08678]	0.026388 [0.04149]		
DCF	−0.01913* [0.01077]	−0.01913 [0.01610]	−0.0184* [0.010733]	−0.0184 [0.01594]				
C	15.12596*** [2.38376]	15.12596*** [3.50362]	15.42367*** [2.37060]	15.42367*** [3.52073]	14.60975*** [2.31766]	14.60975*** [3.14435]		
Wald chi2	755.74	2610.31	760.84	2576.96	755.53	2245.77		
AR (1)	−2.1879** (0.0287)		−2.1932* (0.0283)		−2.1197** (0.034)			
AR(2)	−0.2813 (0.7785)		−0.35947 (0.7192)		−0.35902 (0.7196)			
Sargan test	122.78 (0.2705)		122.193 (0.283)		124.299 (0.2420)			

Model A stands for GMM and B for GMM (robust standard error). The numbers given in [ ] are standard errors while the numbers given in ( ) are the *p*-value ***, **, and * are statistically significant at 1%, 5%, and 10%, respectively

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Table 3. ADF test for selected countries

Country	AGR		UN		Starting years
	ADF in levels	ADF first differences	ADF in levels	ADF first differences	
Bulgaria	−3.06331 (0.1389)	−6.933909 (0.0001)	−2.493944 (0.3272)	−4.312438 (0.0137)	1991–2013
Croatia	−2.969463 (0.1664)	−6.263747 (0.0005)	−1.837170 (0.6417)	−2.990294 (0.0560)	1995–2013
Czech Republic	−0.193557 (0.9882)	−4.220201 (0.0181)	−2.556110 (0.3011)	−3.889493 (0.0351)	1993–2013
Estonia	−1.983043 (0.5710)	−5.320559 (0.0029)	−3.385683 (0.0866)	−3.57000 (0.0656)	1995–2013
Hungary	0.207191 (0.9954)	−5.252081 (0.0037)	−2.818097 (0.2101)	−4.150605 (0.0262)	1995–2013
Poland	−2.30959 (0.4085)	−4.079027 (0.0278)	−2.891989 (0.0671)	−2.729159 (0.2392)	1995–2013
Romania	−2.839257 (0.1993)	−5.786434 (0.0007)	0.0027 (0.1110)	−5.110594 (0.0027)	1991–2013
Russian Federation	−12.817 (0.0000)	−13.95739 (0.0000)	−4.368692 (0.0146)	−6.436307 (0.0002)	1991–2013
Slovenia	−1.61225 (0.7469)	−6.465884 (0.0004)	0.046976 (0.9934)	−2.74443 (0.2333)	1995–2013
Turkey	−11.44033 (0.0000)	−5.040826 (0.0029)	−2.692545 (0.2478)	−4.144825 (0.0170)	1988–2013

The numbers given in () are *P*-values

the unemployment rate. Table 2 also reports tests for each model, with the results showing that all regressions reject the null of no first-order autocorrelation, although they do not reject the null of second-order autocorrelation. This means that the models are valid and correctly specified, since we cannot reject the null of second-order autocorrelation. The Sargan test for over-identifying restrictions was also carried out. The results never reject the null and hence provide support for the validity of the exclusion of restrictions.

Table 4 reports the causality between the AGR and the UN, as well as the Augmented Dickey-Fuller (ADF) tests (Table 3). The Granger causality tests reveal the existence of causality for three countries (the Russian Federation, Croatia and Estonia) from the unemployment rate to the relative GDP share of agriculture. Therefore, in those three countries, an increase in the unemployment rate leads to an increase in the relative GDP share of agriculture. On the other hand, for the Russian Federation, Bulgaria and Turkey, there is causality from the relative GDP share of agriculture to the unemployment rate. Consequently, the bi-directional causality (i.e., from UN to AGR and AGR to UN) only exists in the Russian Federation.

Table 4. Granger causality between AGR and UN for selected countries

Country	Null hypothesis		Results
	UN does not Granger-cause AGS	AGS does not Granger-cause UN	
Bulgaria	0.82117 (0.4576)	3.39417* (0.0591)	AGS=>UN
Croatia	4.33676** (0.0382)	0.23262 (0.7959)	UN=>AGS
Czech Republic	0.80975 (0.4648)	0.21403 (0.8099)	NO
Estonia	4.2762** (0.0396)	0.24314 (0.7879)	UN=>AGS
Hungary	1.50011 (0.2621)	2.34922 (0.1377)	NO
Poland	0.19464 (0.8257)	0.18453 (0.8338)	NO
Romania	2.08605 (0.1567)	1.71072 (0.2122)	NO
Russian Federation	2.9910* (0.0788)	5.78371** (0.0129)	UN=>AGS AGS=>UN
Slovenia	0.24266 (0.7883)	0.5505 (0.5906)	NO
Turkey	2.01520 (0.1608)	3.7994** (0.0409)	AGS=>UN

The numbers given in () are *P*-values. ***, ** and * denote rejection of the null hypothesis at the 1%, 5% and 10% levels, respectively

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CONCLUSION

This article contributes to the existing literature concerning the relationship between the agricultural sector and the general macroeconomic performance in three ways. First, it focuses on the unemployment rate as a measure of macroeconomic performance instead of economic growth, which has been the predominant choice of most of the prior studies. Second, instead of using the growth of agricultural output (again, the preferred choice of most prior studies), it uses the relative GDP share of agriculture as the explanatory variable that may be partly responsible for driving the changes in the unemployment rate. Third, it focuses on a specific sample of countries (from the Central and Eastern Europe), seven of which can be categorised as high income and the remaining three as middle (upper) income countries where the relative GDP and employment shares of agriculture are neither very low nor very high We empirically examined the possible relationship between the agricultural sector and the unemployment rate using two alternative empirical methodologies. First, we used the dynamic panel regression analysis to estimate the nature of the relationship between the two variables. In addition to the relative GDP share of agriculture, we used combinations of several other possible explanatory variables as controlling variables in the alternative regression equations that we estimated for the unemployment rate. Second, we applied the Granger causality tests to determine the direction of causality between agriculture and unemployment in each country.

In the light of the above, our main findings can be summarised as follows: The relative GDP share of agriculture has been found to be negatively related to (or associated with) the unemployment rate. The fact that the estimated coefficient of agriculture has been found to be statically significant in all alternative specifications of the regression equations suggests that for the average country in our sample, changes in the sectoral composition of GDP in favour of agriculture are highly likely to be associated with lower rates of unemployment. In addition to the relative GDP share of agriculture, our estimation results suggest that the investment rate and trade openness are highly likely to be negatively associated with the unemployment rate. The effect of the financial development on the unemployment rate was also found to be negative, although the statistical significance changes depending on the estimation technique used. The estimated coefficients of the inflation, GDP growth and per capita GDP growth are all negative (as expected), but they are all statistically insignificant. Similarly, the estimated coefficient of the government consumption (as a % of the GDP) has been found to be insignificantly related to the unemployment rate in the relevant estimated equations.

The results of the Granger causality tests that we carried out for each country have produced evidence of the statistically significant effect of the relative GDP share of agriculture on the unemployment rate in only three of the ten countries in our sample, namely Bulgaria, the Russian Federation and Turkey. Further, in Estonia, Croatia and the Russian Federation the direction of causality is from the unemployment rate to the relative GDP share of agriculture. In other words, the Russian Federation is the only country for which we found evidence of a bi-directional causality between agriculture and the unemployment rate. These causality tests suggest that the negative relationship we found between agriculture and unemployment in our panel data analysis must be interpreted cautiously in the terms of policy insights. In other words, the capacity to lower unemployment through systematic policies aimed at changing the sectoral composition of GDP in favour of agriculture is likely to differ between countries. It seems that in certain countries (such as the Russian Federation, Turkey and Bulgaria) where the comparative advantages of agriculture and/or the degree of linkages between agriculture and the rest of the economy are relatively strong, it may be relatively easier to generate an additional employment potential through alternative policies such as the encouragement of investment and innovation in the agricultural sector, subsides for certain types of inputs used in agricultural production, a directed credit and the price support for certain agricultural products.

A future research may try to shed an additional light on this issue by focusing on investigating the nature of the same relationships for the high income and low income countries. Additionally, investigating this issue for certain EU countries (such as Spain, Italy and Greece), where the prevailing unemployment rates are relatively high, could also provide new insights for the policy makers of these countries in terms of designing new kinds of macro- and micro-based policies to tackle the unemployment problem. Along similar lines, a future research could attempt to extend our analysis to the economic growth and to examine the nature of the relationship between economic growth

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and the relative GDP share of agriculture in the high income, middle income and low income countries.

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