

AGRICULTURAL DEVELOPMENT AND ECONOMIC GROWTH RELATIONSHIP IN TRANSITION COUNTRIES FROM AN EMPIRICAL PERSPECTIVE

Mahmut ZORTUK¹
Semih KARACAN²

ABSTRACT

After the dissolution of Union of Soviet Socialist Republics, Central and Eastern Europe (CEE) and Commonwealth of Independent States (CIS) countries are started reforms in every aspect of economic life in order to transition to a privatized and open market economy. As a consequence, agricultural sector, which is constructed on the basis of centrally planned Soviet Agricultural Model, undergo a set of structural transformations and ultimately become the most important key sector especially in CEE countries. Thus, agricultural sector is closely linked with economic development. In this context, our study is aimed to investigate the causal relationship between agricultural sector and economic development for 24 transition countries for 1995 – 2015 period, applying Pesaran (2007) second generation panel unit root test and Dumitrescu – Hurlin (2012) heterogeneous panel causality testing procedure. Results indicate that there is homogeneous causality running from economic growth to agricultural development and heterogeneous causality running from agricultural development to economic growth.

Keywords: Agricultural development, Economic growth, Transition Countries, Causality

AMPİRİK PERSPEKTİFTEN GEÇİŞ EKONOMİLERİNDEKİ ZİRAİ KALKINMA VE EKONOMİK BÜYÜME İLİŞKİSİ

ÖZ

Sovyet Sosyalist Cumhuriyetler Birliğindeki çözülmenin ardından Orta ve Doğu Avrupa ve Bağımsız Devletler Topluluğu ülkeleri özelleştirilmiş ve serbest bir piyasa ekonomisine geçiş yapmak için ekonomik yaşamın her alanında reformlara başladılar. Neticede, merkezi planlamaya dayalı Sovyet Tarım Modeli üzerine kurulmuş tarım sektörü de yapısal dönüşümler geçirdi ve özellikle Orta ve Doğu Avrupa ülkelerinde en önemli “kilit sektörlerden” bir tanesi haline geldi. Bu nedenle tarım sektörü ekonomik kalkınma ile yakından ilişkilidir. Bu bağlamda, çalışmamızda tarım sektörü ve ekonomik kalkınma arasındaki nedensellik ilişkisinin 24 geçiş ekonomisine ait 1995 – 2015 periyodunu kapsayan veriseti ile Pesaran (2007) ikinci nesil panel birim kök testini ve Dumitrescu – Hurlin (2012) heterojen panel nedensellik test prosedürleri uygulanarak incelenmesi hedeflenmiştir. Sonuçlar ekonomik büyümeden tarımsal gelişime doğru homojen nedensellik ilişkisi olduğunu, tarımsal gelişimden ekonomik büyümeye doğru ise heterojen nedensellik ilişkisi olduğunu göstermektedir.

Anahtar Kelimeler: Tarımsal gelişme, Ekonomik Büyüme, Geçiş Ülkeleri, Nedensellik

¹ Prof. Dr., Department of Econometrics, Dumlupınar University, mahmut.zortuk@dpu.edu.tr

² Res. Assist., Department of Econometrics, Dumlupınar University, semih.karacan@dpu.edu.tr

Introduction

Agricultural production has a vital role in all economies and in the long term it is the only way to provide sustainable and affordable food to population. Furthermore, nearly half of the population is still living in rural areas (FAO, 2015) and agriculture is their main source of income. Agricultural productivity, though, is another matter. Worldwide value added in agriculture as a share of gross domestic production is less than 5% (FAO, 2015). Food security oriented and often inefficient regulations toward further liberalization often severely harm the sector (EBRD, 2013) and affect its relationship with economic growth.

General literature about agriculture and economic growth relationship has shaped around two important hypotheses (Awokuse and Xie, 2015). While studies supporting agriculture-led growth hypothesis indicate a causal relationship running from agriculture to economic growth (e.g. Timmer, 1995; Thirtle et al., 2003; Gardner, 2005; Tiffin and Arz, 2006), advocates of growth-driven agricultural development hypothesis assert a reverse causal relationship running from economic growth to agriculture (e.g. Lewis, 1954; Jorgenson, 1961; Matsuyama, 1992).

In this work, we aim to investigate the linkage for transition countries case. Today, agriculture in transition countries still suffers from their socialist heritage even against recent European Union regulations on member and candidate Central and Eastern Europe countries. In Soviet Union, before its dissolution in 1989, the sector was mostly consisting of large scale state farms employed a huge population; state controlled product markets and input supply channels. However, central control led to inefficiencies through ignored market signals, consumer preferences and profit accountability (Lerman, 2001). Although state control is not as strong as in Soviet Union, it is still an issue for these countries even after three decades. In a wide range of transition countries there are restrictions on arable land ownership and transferability of them and they are mostly run by rural population instead of private organizations. Also, finance sector is still struggling to provide affordable financing at pre-harvest stage and it exposes farmers to expensive and often uncompetitive financing schemes (EBRD, 2014).

The study is organized as follows: second section contains a brief review of the literature, third section provides information on data and the methodology, fourth section presents empirical results and the final sections concludes.

1. Literature Review

Most of the studies contributed to the literature consider agriculture as a stimulant to the economic growth, especially in agriculture focused and developing countries where industrial and service sectors are still immature. Kuznets (1961) suggests that as countries develop agricultural sector's share in total output shrinks and results from different studies which offer varied datasets supports the inconsistency of agriculture's effect on economic growth among different stages of development. Timmer (2002) examines 65 countries for the period between 1960 – 1985 and finds a positive correlation between agricultural GDP growth and non-agricultural GDP growth. Inspiring work of Gardner (2005) investigates 85 countries for the period between 1960 – 2001 using regression analysis and suggests that growth of agricultural value added is independent of per capita economic growth of those who work in agricultural sector. Tiffin and Irz (2006) working with the data from Gardner (2005) further investigates the causality relationship between agricultural development and economic growth with cointegration and Granger causality analyses and asserts that while the agriculture-led growth hypothesis holds in developing countries, direction and appearance of causality is unclear in developed countries. Chebbi and Lachaal (2007) studies Tunisia example for the period between 1961 – 2005, using VAR analysis and including five GDP stimulating sectors to the model. Their results suggest that all sectors tend to move together in the long run, but agricultural

sector has a limited role as a driving force of growth in the short run. Self and Grabowski (2007) investigates 89 countries, using the average of the data between 1960 and 2001. Results from cross-sectional regression analyses show that technological progress in agricultural sector has a positive impact on both economic growth and human development. Apostolidou et al. (2015) employs ARDL and Granger causality tests to a sample of Northern and Southern European countries for the period between 1970 – 2011 and asserts that agriculture can lead economic growth in European Union countries, moreover can play stabilizer role and be an engine of growth in the time of economic crises. Awokuse and Xie (2015) investigates 9 countries from 3 different regions for the period between 1980 – 2011 using gross capital formation, real exports and terms of trade as control variables and employs ARDL and DAG methods. The study argues that agriculture-led growth hypothesis is valid for these countries. Though, study further argues that having a vibrant aggregate economic is a prerequisite for agricultural development, thus implying a bidirectional relationship. Lastly Bulagi et al. (2015) investigates South Africa for the period between 1984 – 2011. Results from pairwise Granger causality test show that there is a unidirectional relationship running from agricultural exports to economic growth.

In our study considering the above results we aimed to investigate the special case of transition economies. In our knowledge literature offers no empirical work on our dataset and we humbly attempt to fill this gap.

2. The Data And Methodology

In this study we used a panel dataset from 23 transition countries located at Central and Eastern Europe and Eurasia over the period between 1995 – 2015. Gross domestic production growth per capita is used to measure economic growth and agricultural value added (% of GDP) is used to measure agricultural development. Series can be found in World Bank Development Indicators, 2016.

Since our macro-economic datasets consisting of historically, politically or geographically connected countries such as ours generally suffer from cross-section dependence and heterogeneity among slope parameters, we first employed several tests to investigate the appearance of such violations. Then run an appropriate unit root test and finally a Granger panel causality test to determine the existence of the causality relationship between agricultural development and economic growth.

In panel data analysis, it is assumed that slope parameters are heterogeneous under the null hypothesis of $H_0 = \beta_1 = \beta_2 = \dots = \beta_i$, where β_i is slope parameter and cross-sections are independent under the null hypothesis of $H_0 = \rho_{ij} = \rho_{ji} = cov(u_{it}, u_{jt}) = 0$, where $i \neq j$. In our work we test these assumptions with $\hat{\Delta}$ slope homogeneity test and Pesaran CD cross-section dependence test.

2.1 Pesaran and Yamagata (2008) Slope Parameter Homogeneity Test

Pesaran and Yamagata (2008) developed Δ tests for general conditions of N and T modifying former Swamy (1970) slope parameter homogeneity test. Swamy (1970) assumes $(\underline{b}_j - \hat{\underline{\beta}})$ are distributed $N_{\Lambda}(0, \sigma_{ii}(X_i'X_i)^{-1})$. Under this condition Swamy test statistics are given by equation (1).

$$\hat{S}_{\beta} = \sum_{i=1}^N \frac{(\hat{\beta}_i - \hat{\underline{\beta}})' X_i' M_{\tau} X_i ((\hat{\beta}_i - \hat{\underline{\beta}})}{\hat{\sigma}_i^2} \quad (1)$$

where

$$\hat{\underline{\beta}} = \left[\sum_{i=1}^N \frac{X_i' M_{\tau} X_i}{\hat{\sigma}_i^2} \right]^{-1} \sum_{i=1}^N \frac{X_i' M_{\tau} y_i}{\hat{\sigma}_i^2} \quad (2)$$

and

$$\hat{\sigma}^2_i = \frac{(y_i - X_i\hat{\beta}_i)'M_\tau(y_i - X_i\hat{\beta}_i)}{T - k - 1} \quad (3)$$

Modifying \hat{S}_β , $\hat{\Delta}$ test statistics are given by equation (4)

$$\hat{\Delta} = \sqrt{N} \left(\frac{N^{-1}\hat{S} - k}{\sqrt{2k}} \right) \quad (4)$$

where N is the number of cross sections, k is the number of explanatory variables in the model, \hat{S} is Swamy test statistic. Test statistics can be improved by mean and variance corrections shown in equation (5).

$$\hat{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1}\hat{S} - E(\hat{z}_{it})}{\sqrt{Var(\hat{z}_{it})}} \right) \quad (5)$$

where

$$E(\hat{z}_{it}) = \frac{k(T - k - 1)}{T - k - 3} \quad (6)$$

and

$$Var(\hat{z}_{it}) = \frac{2k(T - k - 1)^2(T - 3)}{(T - k - 3)^2(T - k - 5)} \quad (7)$$

2.2. Pesaran (2004) Cross-section Dependence Test

Traditional cross-section dependence test developed by Breusch and Pagan (1980) has several shortcomings stemming from matrix dimensions and it is not possible to calculate LM test statistics while $N \rightarrow \infty$. Therefore, Pesaran (2004) suggests an augmented form of LM test statistics, which can be used for general purposes.

Breusch and Pagan (1980) LM test statistics are given by equation (8)

$$CD_{LM} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \quad (8)$$

where

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^T e_{it}e_{jt}}{(\sum_{t=1}^T e_{it}^2)^{1/2}(\sum_{t=1}^T e_{jt}^2)^{1/2}} \quad (9)$$

Pesaran (2004) directly uses $\hat{\rho}_{ij}$ instead of $\hat{\rho}_{ij}^2$ and weights CD_{LM} . Pesaran CD test statistics are given by equation (10).

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \quad (10)$$

2.3. Pesaran (2007) Cross-sectional Augmented IPS Unit Root Test

In order to investigate long-term Granger causality between agricultural development and economic growth stationarity of the data should be investigated carefully. Dumitrescu – Hurlin (2012) causality test is only efficient when all variables are stationary in levels.

Standard panel unit root tests assume that the cross-sections in the panel are independent, yet this is a strong assumption and generally does not hold for macro-economic indicators. Therefore, a new approach to standard tests is developed by Pesaran (2007). The test augments standard ADF regression with cross-sectional averages of the lagged levels and first differences of individual series. Assuming that under the null hypothesis all series are nonstationary CADF model proposed by Pesaran (2007) is given by equation (11),

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \gamma_i \bar{y}_{t-1} + \delta_i \Delta \bar{y}_i + u_{i,t} \quad (11)$$

where α_i is deterministic term, β_i , γ_i and δ_i are slope coefficients, \bar{y}_{t-1} is lagged level cross-sectional average of y_i for $t - 1$, $\Delta \bar{y}_i$ is cross-sectional average of y_i for first differences and $u_{i,t}$ the error term.

Individual t-bar statistics obtained from (11) can be used to derive cross-sectional augmented IPS (CIPS) test statistics, CIPS statistics are given by equation (12),

$$CIPS = \frac{1}{N} \sum_{i=1}^N t_i(N, T) \quad (12)$$

Where t_i are individual t-bar statistics of equation (11).

We also performed a simple first generation unit root test in this study. Yet, it is conducted only to show the effect of cross-section dependence on our data. Therefore, we do not delve into specifics of Maddala-Wu panel unit root test.

2.4. Dumitrescu – Hurlin (2012) Heterogeneous Causality Test

Dumitrescu – Hurlin (2012) tests homogeneous non causality (HNC) hypothesis against heterogeneous non causality (HENC) hypothesis (equation (13)). Doing so, the test tackles slope parameter homogeneity assumption as it gives individual test statistics. Furthermore, Dumitrescu – Hurlin (2012) proposes a block bootstrap approach to calculate critical values, which are robust against the violation of the assumption of cross-sectional independence.

$$\begin{aligned} H_0: \beta_i &= 0, \forall i = 1, 2, \dots, N \\ H_1: \beta_i &= 0, \forall i = 1, 2, \dots, N \\ &\beta_i \neq 0, \forall i = N_1 + 1, N_1 + 2, \dots, N \end{aligned} \quad (13)$$

where N_1 is unknown but satisfies the condition $0 \leq \frac{N_1}{N} < 1$. This condition suggests that when $N_1 = N$ there is no causality and when $N_1 = 0$ there is causality for all the cross-sections.

Individual test statistics can be obtained by a simple Wald test given by equation (14),

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^N W_{i,T} \quad (9)$$

where $W_{i,T}$ denotes the individual Wald test statistics for the i th cross-section unit.

3. Empirical Results

Results belonging to 23 countries over the period between 1995 – 2015 are presented in this section. First, two main assumptions of panel data analysis are tested with $\hat{\Delta}$ and Pesaran CD tests. Test results reported at Table (1) show that these assumptions are vigorously violated. Maddala – Wu test results suffer from assumption violations and show that there are unit roots in levels. However, Pesaran CIPS test results are robust against cross-section dependence and show that variables are stationary in levels.

Table (1): Test Results

Variables	$\hat{\Delta}$ Test	Pesaran CD	Maddala – Wu	Pesaran CIPS
<i>lgdpc</i>	761.120***	69.906***	58.094	-4.822***
<i>lagri</i>	342.368***	58.242***	25.901	-4.681***

Respectively ***, ** and * represent 0.01, 0.05 and 0.1 significance levels.

Long term causal relationship can be investigated since both variables are stationary in levels. Table (2) and Table (3) shows Dumitrescu – Hurlin (2012) panel causality test results.

Table (2): Causality running from *lagri* to *lgdpc*

Countries	1. Lag Model (1)	2.Lag Model (2)	3.Lag Model (3)
Albania	1.710	78.228***	7.570*
Armenia	0.398	3.262	1.944
Azerbaijan	8.256***	2.879	4.762
Belarus	3.700*	1.572	9.798**
Bulgaria	0.217	1.850	9.253**
Croatia	0.179	0.741	0.615
Czech Rep.	0.917	2.155	3.085
Estonia	0.024	2.000	2.549
Georgia	0.817	0.452	3.127
Hungary	0.091	1.137	0.565
Kazakhstan	0.597	1.471	0.537
Kyrgyzstan	0.017	8.666**	6.154*
Latvia	0.775	6.256**	2.628
Lithuania	0.4371	2.612	5.578
Makedonia	0.694	0.857	1.085
Moldova	1.980	1.147	1.562
Poland	0.350	1.311	0.299
Romania	1.754	6.871**	7.714*
Russia	0.082	0.006	1.400
Slovakia	1.835	2.519	1.775
Slovenia	0.146	0.169	0.144
Ukraine	0.046	3.258	5.354
Uzbekistan	0.194	5.706*	0.071
W Bar Statistics	1.044	11.374***	3.185
Z Bar Statistics	-0.243	5.130***	-0.597

Respectively ***, ** and * represent 0.01, 0.05 and 0.1 significance levels.

According to Table (2), there is long term causality running from agricultural development to

Countries	1.Lag Model (4)	2.Lag Model (5)	3.Lag Model (6)
Albania	0.598	2.049	3.121
Armenia	6.351***	5.259*	40.931***
Azerbaijan	0.000	8.362**	7.566*
Belarus	2.196	0.369	11.502***
Bulgaria	16.071***	10.154***	9.835**
Croatia	1.623	0.249	2.451
Czech Rep.	0.948	3.776	16.114***
Estonia	8.877***	10.407***	27.247***
Georgia	2.650	1.249	2.093
Hungary	2.884*	4.336	11.578***
Kazakhstan	14.068***	4.139	25.428***
Kyrgyzstan	12.058***	4.939	7.210*
Latvia	5.048**	20.284***	39.570***
Lithuania	4.029**	12.121***	21.147***
Makedonia	3.586*	15.438***	31.730***
Moldova	1.362	8.496**	7.923**
Poland	2.641	3.306	3.780
Romania	9.146***	5.190*	9.980**
Russia	7.445***	6.396**	12.344***
Slovakia	1.116	8.069**	18.183***
Slovenia	34.011***	65.115***	68.661***
Ukraine	0.187	2.032	3.944
Uzbekistan	4.117**	97.797***	4.582
W Bar Statistics	5.770***	11.374***	13.495***
Z Bar Statistics	12.477***	15.639***	11.920***

economic growth in model (2) for the general sample ($Z - \text{bar statistics} = 5.130$). Nevertheless, individual statistics give limited support. There is causality running from agricultural development to economic growth only for Azerbaijan and Belarus in model (1); Albania, Kyrgyzstan, Latvia, Romania and Uzbekistan in model (2) and Albania, Belarus, Bulgaria, Kyrgyzstan and Romania in model (3).

Table (3): Causality running from *lgdpc* to *lagri*

*Respectively ***, ** and * represent 0.01, 0.05 and 0.1 significance levels*

Results from Table (3) shows that there is causality running from economic growth to agricultural development in all models for general sample (respectively $Z\text{-bar statistics} = 12.477; 15.639; 11.920$). Also majority of country specific results support the same. In sum, general sample results suggest that feedback hypothesis is valid for transition countries. At the other hand, country specific results have mixed results, where the majority supports a unidirectional causality running from economic growth to agricultural development.

4. Conclusion

In this study, we aimed to investigate causal relationship between agricultural development and economic growth in a general sample of transition countries. For this purpose, we employed Dumitrescu – Hurlin heterogeneous panel causality test and obtained general sample results as well as individual results. While general sample results support bidirectional causality between variables, results from majority of individual countries indicate unidirectional causality running from economic growth to agricultural development. Considering the argued unproductiveness of agricultural sector,

our findings are far from surprising. Agricultural development is dependent to economic growth and in many transition countries it does not have a positive effect on economic growth.

In our belief, agriculture is not just an economic tool. It is also a vital tool to provide cheap and sustainable food sources to population. Nevertheless, the sector should not be a burden for the economy. Therefore, we humbly recommend serious policy reforms on agricultural finance and further privatization of agricultural sector and arable lands in transition countries.

6. REFERENCES

- Apostolidou, I., Mattas, K., Loizou, E., & Michailidis, A. (2015). Agriculture's Role in Economic Growth: An Exploratory Study Among Southern and Northern EU Countries EU Crisis and the Role of the Periphery (pp. 147-162): Springer.
- Awokuse, T. O., & Xie, R. (2015). Does agriculture really matter for economic growth in developing countries? *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 63(1), 77-99.
- Breusch, T. S., & Pagan, A. R. (1980). The Lagrange Multiplier Test and Its Applications to Model-Specification in Econometrics. *Review of Economic Studies*, 47(1), 239-253. doi:Doi 10.2307/2297111
- Bulagi, M., Hlongwane, J., & Belete, A. (2015). Causality relationship between agricultural exports and agricultures share of gross domestic product in South Africa: A case of avocado, apple, mango and orange from 1994 to 2011. *African Journal of Agricultural Research*, 10(9), 990-994.
- Chebbi, H. E., & Lachaal, L. (2007). Agricultural sector and economic growth in Tunisia: Evidence from co-integration and error correction mechanism.
- Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450-1460. doi:10.1016/j.econmod.2012.02.014
- European Bank for Reconstruction and Development (2013). <http://www.ebrd.com/documents/comms-and-bis/pdf-transition-report-2013.pdf>
- European Bank for Reconstruction and Development (2014). <http://www.ebrd.com/documents/comms-and-bis/pdf-transition-report-2014.pdf>
- Food and Agriculture Organization of the United Nations (2015). <http://www.fao.org/documents/card/en/c/383d384a-28e6-47b3-a1a2-2496a9e017b2/>
- Gardner, B. L. (2005). Causes of rural economic development. *Agricultural Economics*, 32(s1), 21-41.
- Jorgenson, D. W. (1961). The development of a dual economy. *The Economic Journal*, 71(282), 309-334.
- Kuznets, S. (1961). Economic growth and the contribution of agriculture: notes on measurement. Paper presented at the 1961 Conference, August 19-30, 1961, Cuernavaca, Morelos, Mexico.
- Lerman, Z. (2001). Agriculture in transition economies: from common heritage to divergence. *Agricultural Economics*, 26(2), 95-114.
- Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The manchester school*, 22(2), 139-191.
- Matsuyama, K. (1992). Agricultural productivity, comparative advantage, and economic growth. *Journal of economic theory*, 58(2), 317-334.
- Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels.
- Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), 265-312.
- Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, 142(1), 50-93. doi:10.1016/j.jeconom.2007.05.010
- Self, S., & Grabowski, R. (2007). Economic development and the role of agricultural technology. *Agricultural Economics*, 36(3), 395-404.

- Swamy, P. A. V. B. (1970). Efficient Inference in a Random Coefficient Regression Model. *Econometrica*, 38(2), 311-323. doi:10.2307/1913012
- Thirtle, C., Lin, L., & Piesse, J. (2003). The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. *World Development*, 31(12), 1959-1975.
- Tiffin, R., & Irz, X. (2006). Is agriculture the engine of growth? *Agricultural Economics*, 35(1), 79-89.
- Timmer, C. P. (1995). Getting agriculture moving: do markets provide the right signals? *Food Policy*, 20(5), 455-472.
- Timmer, C. P. (2002). Agriculture and economic development. *Handbook of agricultural economics*, 2, 1487-1546.
- World Bank Development Indicators (2016).