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Sectoral Growth Interdependencies and the Role of Agriculture in Poland and Romania

V. Subramanian, S. Saghaian, L. Maynard, and M. Reed

The economic transition processes in the Central and Eastern European Countries were not as smooth as some expected. The length and the effects of transition varied among countries. Some policies worked well for one country but not for others. Many economists and policymakers wonder why some countries have experienced better success in the transition process than others. One way to solve the mystery is to understand the existence of inter-sectoral linkages among major economic sectors. Once the complex linkages have been identified, the information can be used to determine the effects of various policies. The information also could be used to identify the optimal policy by measuring the effects of various policy alternatives on different sectors in the economy. Therefore determining the inter-sectoral relationship using appropriate econometric models should play a dominant role in the future growth literature.

This paper identifies the pattern of changes in sectoral composition that characterizes the economic dynamics of two transition countries (Poland and Romania) by applying a multi-sectoral endogenous growth framework. This study employs the Johansen procedure of cointegration analysis to identify the existence of long-run and dynamic short-run inter-sectoral linkages among different sectors in the economies. The study is significant because Poland and Romania are the two largest countries in the Central and Eastern European region, and recently became members of the expanded European Union. After 20 years of the liberalization process, the countries are at different levels of transition, so understanding the inter-sectoral linkages could shed important insights on the transition process, and such information should assist policymakers in

identifying the optimal policies to continue further economic growth. This study determines the linkages between the agricultural sector and the rest of the economies, investigates the existence of long-run growth relationships among different sectors in the economies, and determines the effects of the transition on agriculture and other sectors in the economy.

Conceptual Framework

Agriculture played an important role in the early growth theories. The manufacturing and service sectors could have been detrimental to growth in the agricultural sector as a result of changes in productivity and differences in the income elasticities. Economies in industrialized countries show that there are positive relationship between the price of services and income. This means that as the economy grows, the share of the service sector will increase and more of the labor force will be attracted from less-efficient sectors such as agriculture to service sectors. Such inter-sectoral relationships suggest that during the transition period different sectors in the economy may establish unique inter-sectoral linkages, and such linkages play an important role in future economic growth.

In analyzing the inter-sectoral linkages we focus on the question of whether the agriculture, manufacturing, service, and trade sectors evolve inter-dependently. In order to identify the inter-sectoral linkages, we constructed the following model:

$$(1) G_j = g(G_A, G_M, G_S, G_T),$$

where G_j represents the economic growth of sector j and subscripts A, M, S, and T denote the agricultural, manufacturing, service, and trade sectors, respectively. In each case, growth is measured using real prices with a 1990 basis. Annual data from 1989–2006 for Poland and Romania were collected from <http://data.un.org>.

Subramanian is a graduate student and research assistant, Saghaian and Maynard are associate professors, and Reed is professor, Department of Agricultural Economics, University of Kentucky, Lexington.

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Sectoral Economies of Poland and Romania

Poland and Romania are the two largest countries in Central and Eastern Europe in terms of area and population. During the socialist period, the economies of these countries were heavily distorted under the command economic political system. Reorganization and institutional changes during the early transition period caused major disruptions in outputs, and the manufacturing sectors were severely affected. In response to such sudden changes, the countries experienced labor movements from one sector to the other. Boeri and Terrel (2002) noted that both Poland (7.9 percent) and Romania (14.2 percent) lost a significant number of manufacturing employees during the first nine years of transition. During the same time period, labor employment in the service sector increased by 7.4 percent and agricultural-sector employment increased by 0.6

percent in Poland. However, the pattern of changes in structural employment in Romania was different—agricultural employment increased by 12.1 percent and service-sector employment increased by 2.1 percent. These results imply that Romania and Poland experienced different structural employment patterns during the transition.

The sectoral outputs of Poland (Figure 1) show that the manufacturing and service sectors play the dominant roles in the Poland's economy, and the contribution of the agricultural sector to economic growth seems to be trivial. The speedy liberalization process and dismantling of entry barriers combined with an appropriate legal and institutional environment helped the service sector to establish itself much faster in Poland. Consequently, land markets and full user rights were established and incentives to work and invest in the agricultural sector improved. The productivity of land and labor

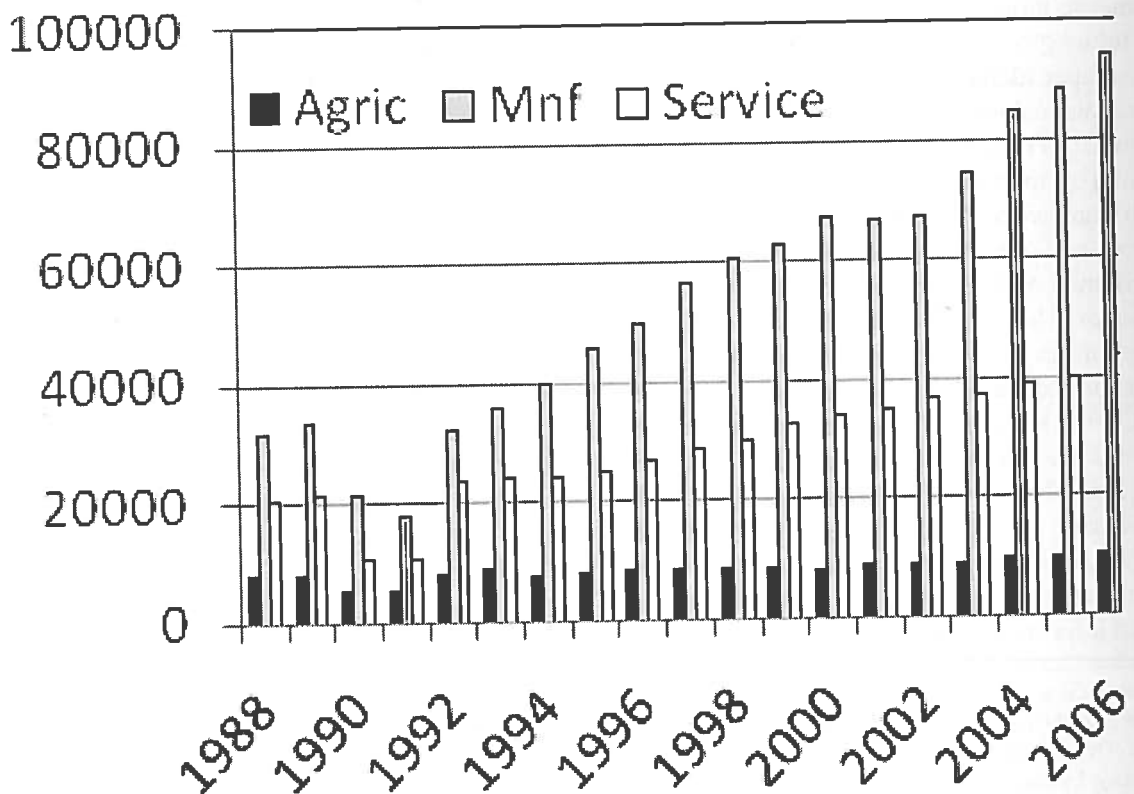


Figure 1. Sectoral Outputs of Poland.

increased as many farm workers found employment in the manufacturing and service sectors.

On the other hand, the Romanian economy (Figure 2) failed to recover the dominant manufacturing sector it had during the pre-transition period, and the agricultural sector seems to have played an important role during the transition period. The gradual liberalization policies in Romania forced the agricultural sector to absorb labor from the rest of the economy, since household farms often functioned as a more effective social safety net than did the national welfare system. Given the contradicting roles of agriculture in these countries, we develop an empirical model to understand the role of agriculture and how the agricultural sector contributes to the economic growth. The results should help policymakers determine the benefits and the costs of particular policy alternatives.

Empirical Model

This study uses time-series analysis to study the relationships among the sectors for Poland and Romania. The first step in this analysis is to explore the univariate properties and to test the order of integration of each series. The Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979; 1981) is used to perform unit-root tests. The tests failed to reject the unit-root hypothesis in levels, and rejected it in first-differences, for all four variables in both countries, suggesting that the series are integrated of the first order, $I(1)$. Since all the series are of the same order, the dataset is appropriate for further analysis.

Johansen and Juselius (1992) developed a procedure to estimate a co-integrated system involving two or more variables. This procedure is indepen-

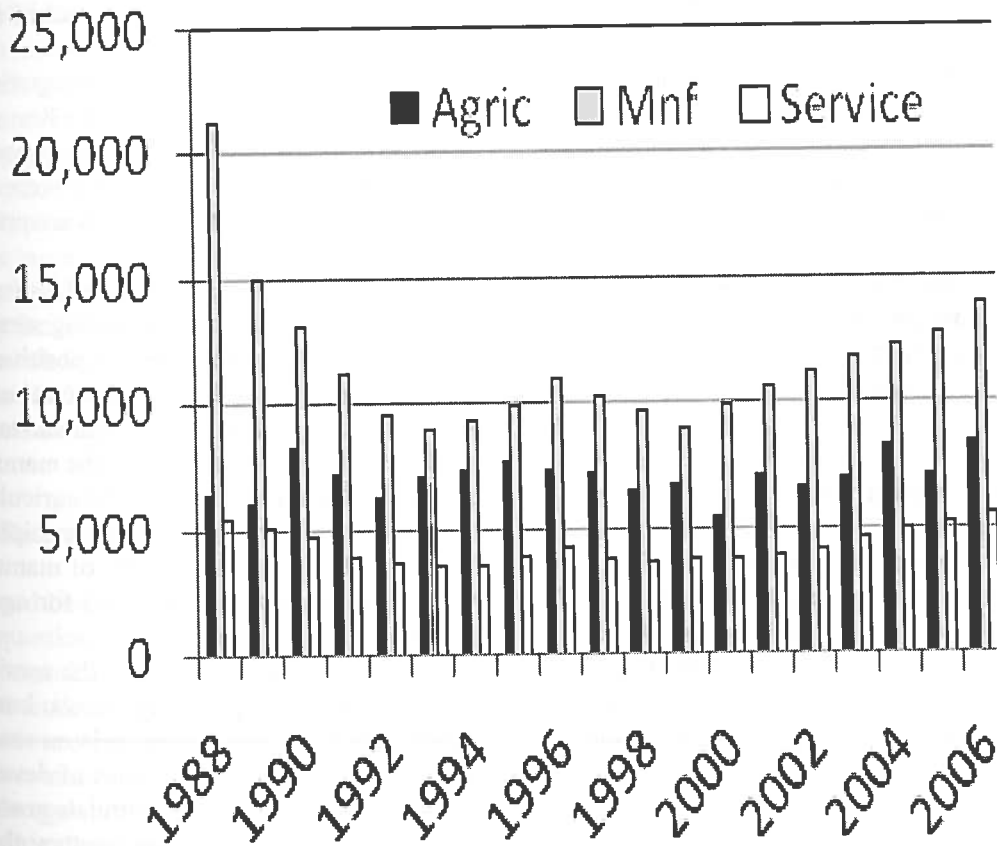


Figure 2. Sectoral Outputs of Romania.

dent of the choices of the endogenous variables, and it allows researchers to estimate and test for the existence of more than one cointegrating vector in the multivariate system. The general model can be described as

$$(2) \Delta Y_t = \Pi Y_{t-p} + \sum_{i=1}^{p-1} \Gamma_i Y_{t-i} + \mu D_t + \varepsilon_t,$$

where Y_t is the column vector of the current values of all the variables in the system (integrated of order one), D_t is a matrix of deterministic variables such as an intercept and time trend, ε_t is the vector of errors $E(\varepsilon_t, \varepsilon'_t) = \Omega$ for all t ; and Γ , Π , and μ are the parameters matrices. The number of lag periods is denoted as p , which is determined using the Akaike Information Criterion. The first term in Equation 2 captures the long-run effects of the regressors and the second term captures the short-run impact.

In the long-run parameter matrix, Π will be of order $n \times n$, with a maximum possible rank of n . Using the Granger representation theorem (Engel and Granger 1987), the rank of Π is found to be $r < n$, and the matrix Π may be factored as $\alpha\beta'$ where α and β are both of order $n \times r$. Matrix β is such that $\beta'Y_t$ is $I(0)$ even though Y_t itself is $I(1)$. In other words, β is the cointegrating matrix describing the long-run relationships in the model. The weighted matrix, α , gives us the speed of adjustment of specific variables on account of deviations from the long-run relationship. The cointegration rank is usually tested by using the maximum eigenvalue and trace statistics proposed by Johansen (1988). The long-run information of the series was taken into account in analyzing the short-run sectoral growth, and the resulting model is a short-run error-correction model.

Evidence for Cointegration

The sectoral growth VAR model for Poland includes a cointegration space and a constant and a time trend in the short run and two lags for each sectoral-growth variable. The model for Romania is identical to that of Poland except no time trend is present in the short run. The deterministic components of the VAR were identified according to the rank test based on the Pantula principle (Johansen and Juselius 1992) in order to satisfy the statistical properties of the models.

The procedure indicates one cointegrating re-

lationship among the sectors in the Romania and two in Poland. As the models have passed various statistical tests (details available from the authors upon request), and the number of long-run cointegration relationships having been identified, the next step is to estimate the long-run estimates, β , and the adjustment coefficients, α .

Following Johansen (1992) the term Π in Equation 2 can be factorized into two matrices, α and β , such that $\Pi = \alpha\beta'$. The dimensions of the matrices of α and β are $(4 \times r)$, where r is the rank of Π .

$$(3) \Delta Y_{t-i} = \alpha(\beta'Y_{t-i}) + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \mu D_t + \varepsilon_t$$

The matrix α describes the adjustment speed for each sector after a deviation from the long-run relationship. In other words, the elements in α weight the error-correction term in each row of the VECM. Larger values of the coefficients indicate a greater response of the short-run dynamics (i.e., ΔY_{t-i}) to the previous period's deviation from the long-run equilibrium (i.e., $\beta'Y_{t-i}$). Furthermore, the matrix β contains the coefficients of the cointegration relation, i.e., the weights within the linear combination.

By imposing the number of cointegration restrictions—two for Poland and one for Romania (normalized to the agricultural sector)—the adjustment coefficients and long-run estimates were estimated for both countries, and the results are presented in Tables 1 and 2, respectively.

The estimated long-run relationships suggest that modernization of the manufacturing sector during the transition process developed a positive long-run stable relationship with the agricultural sector. The effects of foreign direct investment and technology spillovers in the modernizing of the manufacturing sector should have influenced the agricultural sector positively. The positive relationship may also be caused by increased income of manufacturing workers causing greater demand for agricultural goods.

As noted in Figures 1 and 2, the service sector will expand as the economy grows, but its relationship to other sectors depends on the level of development. At the early stages of development, the service sector is able to stimulate growth of the agriculture and manufacturing sectors; therefore a positive relationship is expected. However, as the economy grows, more resources such as land, la-

Table 1. Cointegration Relationships of Poland β Matrix and α Matrix.

$$\beta = \begin{bmatrix} \text{Agr} & -0.091 & -0.603 \\ \text{Mnf} & 0.062 & 0.357 \\ \text{Serv} & -0.010 & 0.001 \\ \text{Tra} & -0.03 & 0.083 \end{bmatrix} \text{ and } \alpha = \begin{bmatrix} \text{Agr} & \text{Mnf} & \text{Serv} & \text{Tra} \\ 1.000 & -1.007 & 7.118 & -2.579 \\ 1.000 & -1.536 & -1.216 & 1.185 \end{bmatrix}$$

Table 2. Cointegration Relationships of Romania β Matrix and α Matrix.

$$\beta = \begin{bmatrix} \text{Agr} & \text{Mnf} & \text{Serv} & \text{Tra} \\ 1.000 & -0.482 & 1.612 & -0.154 \end{bmatrix} \text{ and } \alpha = \begin{bmatrix} \text{Agr} & -0.819 \\ \text{Mnf} & -0.185 \\ \text{Serv} & 0.678 \\ \text{Tra} & -0.214 \end{bmatrix}$$

bor, and capital are transferred from the inefficient agricultural sectors to the efficient service sectors. Because of such resource transfers, we found a negative relationship between the agriculture and service sectors in both countries. Interestingly, the service sector in Poland has both a positive and a negative long-run relationship to agriculture (Table 1). This could be the result of aggregation of different service sectors, where some service sectors could have increased agricultural growth through a higher quality of agricultural inputs as well as better marketing facilities. At the same time, increased service growth facilitates more importation of agricultural goods from other countries, and this could have caused a negative effect on local agricultural growth.

Impulse-Response Functions

We analyzed how impulse-response functions address the question of how rapidly a single shock to a sector is transmitted to other sectors in an economy. The results render a distinct pattern of how impulses in one sector are transmitted to the other three sectors in the economy. Figure 3a shows responses to a shock in the agricultural sector and Figure 3b shows how the agricultural sector responded to shocks in other sectors in Poland. A shock in agriculture affects other sectors positively, and the highest growth

response was observed in the trade sector (2.43 percent), followed by manufacturing (1.68 percent), service (0.99 percent), and agriculture (0.90 percent). This implies agriculture has positive effects on other sectors in the economy of Poland. This may be because the agricultural sector transferred more resources to other sectors in the economy as the productivity of agriculture increased.

The positive response in the agricultural sector due to the shock in the manufacturing growth indicates the existence of backward linkages. However, the effects of the trade and service sectors on the agricultural sector were negative (-0.25 percent and -0.48 percent, respectively), which may suggest that the policies which encourage the trade and service sectors (globalization) would affect the agricultural sector negatively. This is not an unexpected trend in the advanced economies where the resources such as land, labor, and capital transferred from the (inefficient) agricultural sector to more efficient sectors such as manufacturing and service. Speedy transition policies and Poland's geographic proximity to the West made its path easier. A similar analysis was conducted for Romania; the results are depicted in Figures 3c and 3d.

Figures 3a-3d show the responses to a one-standard-deviation rise in one sector by other sectors of the economy over 20 years.

The responses to an agricultural shock are posi-

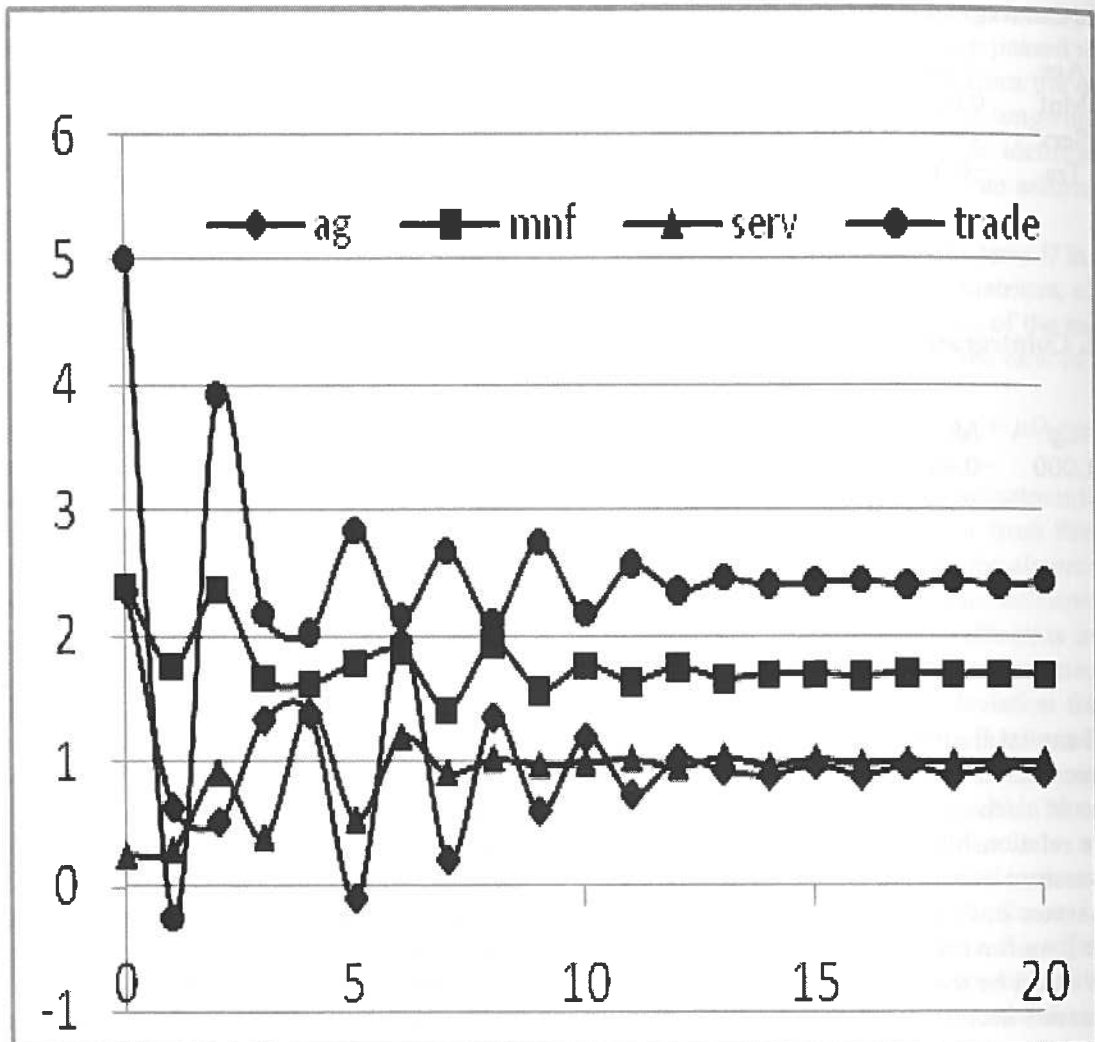


Figure 3a. Responses to a Shock in the Agricultural Sector: Poland.

tive on agriculture, manufacturing, and services but negative on trade. The Romanian economy shows positive backward linkages to the agricultural sector from all three sectors. Based on the characteristics of inter-sectoral linkages, the Romanian economy seems to be behind the Polish economy; this is consistent with many other researchers who ranked the success of these transition economies.

Conclusion

This study estimates an econometric model that incorporates the linkages among economic sectors

(agriculture, manufacturing, service, and trade) using a Vector Error-Correction Model (VECM). This procedure is employed to identify the existence of long-run and short-run relationships among sectors in the economies of Poland and Romania. The empirical findings from the analysis confirm that the sectors in the Romanian and Poland economies moved together over the sample period, and for this reason their growth was interdependent. This implies that once the sectors deviate from the stable long-run path, the sectors have a tendency to return to the long-run equilibrium.

In order to identify the dynamic nature of the

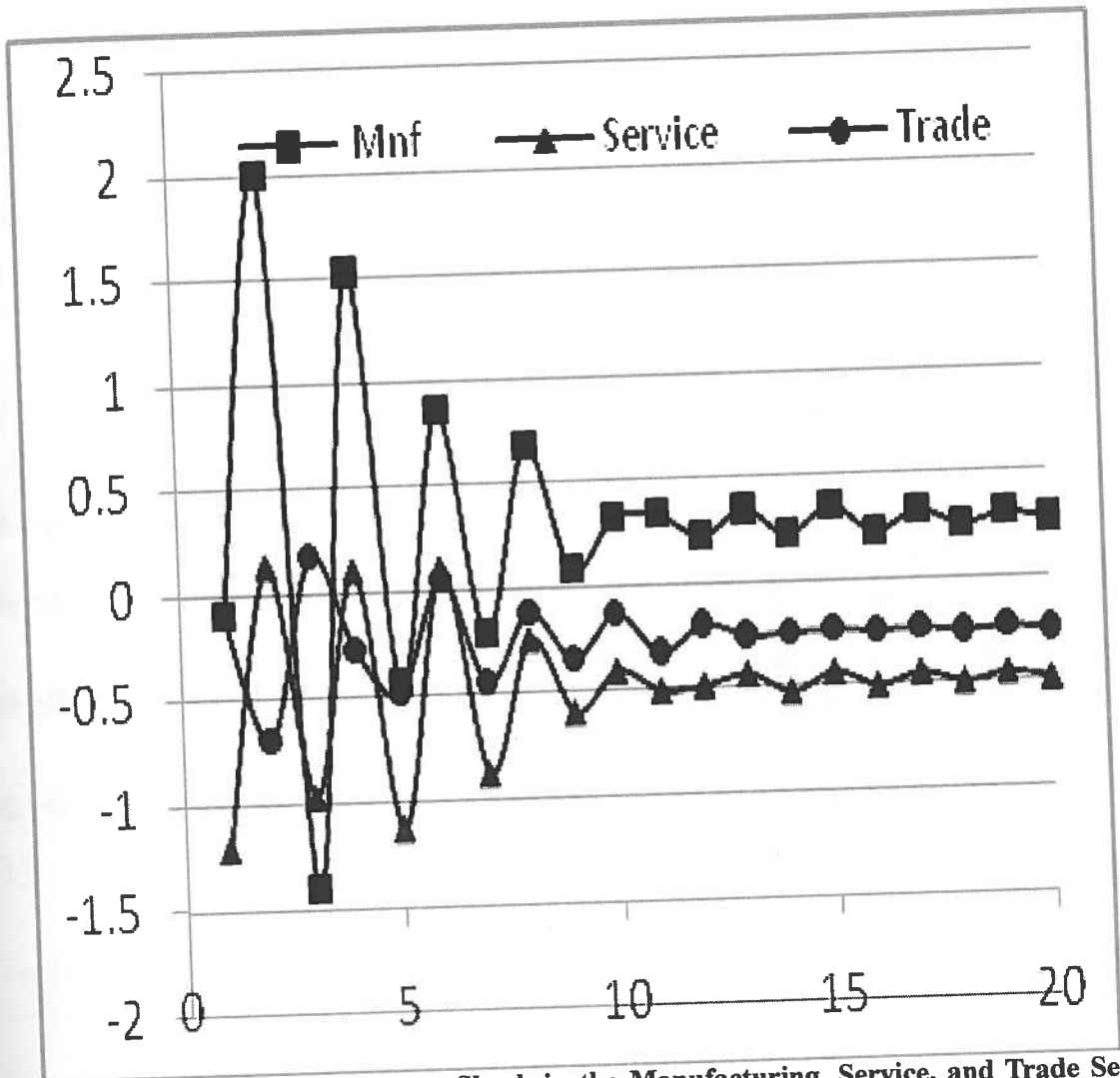


Figure 3b. Agricultural Responses to a Shock in the Manufacturing, Service, and Trade Sectors: Poland.

model we employed impulse-response analysis, and the results suggest that agriculture plays a positive role in the growth of all other sectors in both countries except the trade sector in Romania. Resources transferred from the agricultural sector to other sectors in the economy play a positive role, which is consistent with agriculture's role in the traditional dual economic growth theory model. The agricultural sector responded positively to positive shocks in all three sectors in Romania, and manufacturing produced the greatest impact. In Poland, however, only the manufacturing sector was positively linked to agriculture. The other two sectors (service and

trade) experienced negative growth from a positive agricultural shock.

These results shed important insights for future policy in these countries. Agriculture plays an important role in contributing socio-economic development in the rural areas, and globalization and industrialization could affect the role of agriculture significantly. This study shows the importance of paying attention to the possible long-run interdependencies and linkages among other sectors in the economy. In this regard, the country's policy makers should pay greater attention to the problem of resources transfer from agriculture.

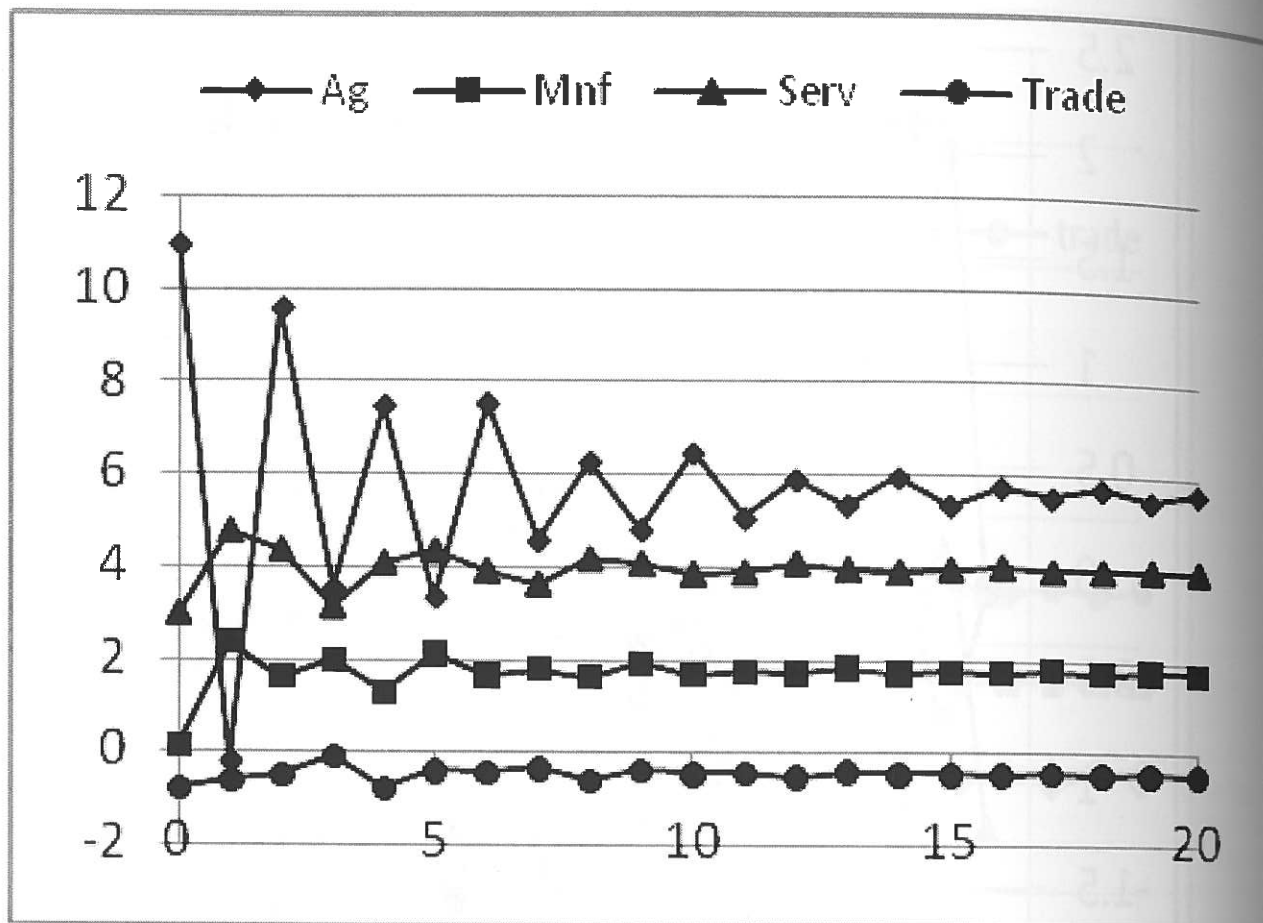


Figure 3c. Responses to a Shock in the Agricultural Sector: Romania.

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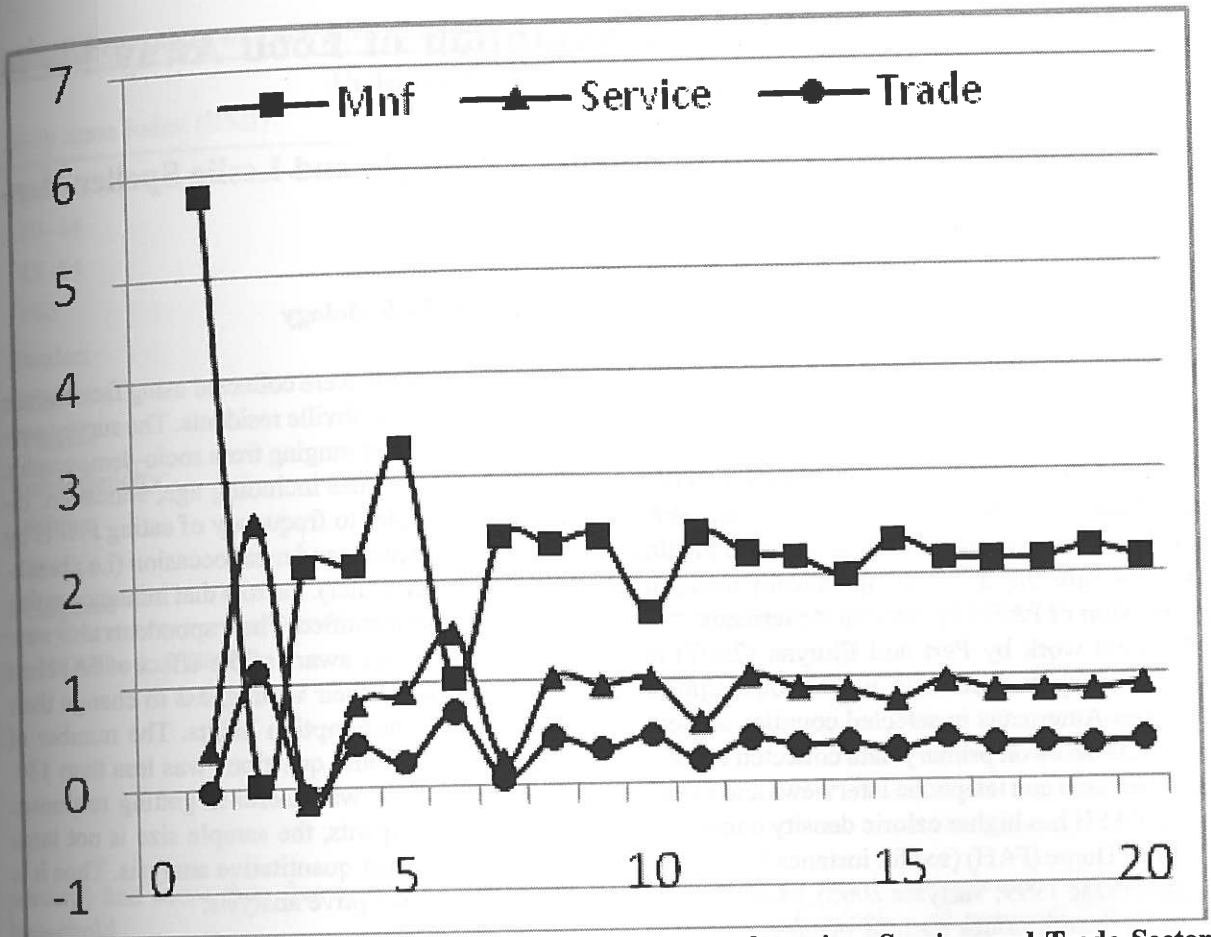


Figure 3d. Agricultural Responses to a Shock in the Manufacturing, Service, and Trade Sectors: Romania.