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AGRICULTURAL INTERSECTORAL LINKAGES AND THEIR CONTRIBUTION TO ECONOMIC DEVELOPMENT

Vijayaratnam Subramaniam
University of Kentucky, vijay_sub5@yahoo.com

ABSTRACT OF DISSERTATION

Vijay Subramaniam

The Graduate School
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A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Agriculture
at the University of Kentucky

By

Vijay Subramaniam

Lexington, Kentucky

Director: Dr. Michael R. Reed, Professor of Agricultural Economics

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The transition from communism to capitalism at the end of the last century was one of the most significant events in the world economy since industrialization. During the latter part of the 1980s, people the Central and Eastern European countries and former Soviet Republics opted for a change from highly distorted command economic system to a market driven economic system. Privatization and liberalization policies led to major changes in the commodity mix and volume of agricultural production, consumption and trade. However, the changes and the impacts varied among countries as they followed different transition strategies.

This study investigated the impact of market liberalization on the agricultural sector, as well as how the inter-sectoral linkages among the agricultural, industrial and service sectors responded in Poland, Romania, Bulgaria and Hungary using time-series analysis. The study estimated an econometric model that incorporates the linkages among the sectors using a Vector Error Correction Model. The procedure identified long-run and short-run relationships for each country. The results showed that a sector can have a negative linkage to other sectors in the short-run; however, that does not mean that the linkage will be negative in the long-run.

Impulse response functions were constructed to determine how a system reacts to a shock in one of the endogenous variable in a model. The study explored how a shock in the agricultural sector was absorbed by the other sectors in the economy, and how a shock in the other sectors was absorbed by the agricultural sector, in all four countries. The responses reflected how the variables are interrelated within a country, and how the shocks are transferred through different linkages over a long period of time. Such dynamic analysis was used to identify the total impacts of different policy alternatives.

Keywords: Transition economies; Long-run relationships; Vector error correction model; Impulse response functions; Agricultural inter-sectoral linkages.

Vijayaratnam Subramaniam________
Author’s name

February 12, 2010_______________
Date

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By

Vijay Subramaniam

Michael R. Reed________________
Director of Dissertation

Michael R. Reed________________
Director of Graduate Studies

February 12, 2010_______________
Date

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To My Parents

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Chapter 1 : Introduction

Agriculture plays an important role in contributing to socio-economic development in many countries. It is the primary source for employment, livelihood, and food security for the majority of rural people. The success of this continuation depends largely on the direct impact it has on the national economy as well as how the agricultural sector stimulates the growth of other sectors in the economy. Consequently, understanding the role of agriculture and its linkages to the rest of the economy is important.

With the increased interest in growth theory, empirical work on economic growth has expanded enormously in the last decades. Most of the literature mainly focuses on the determinants of aggregate growth, however, while there has been less emphasis on sectoral economic growth. The sectoral growth literature mainly builds on the dual economic model originating in Lewis (1954) and Hirshmann (1958), and it seeks to explain economic growth by emphasizing the roles of agriculture and industry, and the interplay between them. The dual economic model views the agricultural sector as the basis for an emerging economy, a generator of a capital which is necessary for take-off toward the second stage of economic development, industrialization. However, developments in the sectoral growth literature dispute the passive role of agriculture, and argue that the agricultural sector could play an important role in economic growth in the industrialized countries by developing complex inter-sectoral linkages to other major sectors in the economies.

1.1 Problem Statement

There is a significant gap in the growth literature because most of the inter-sectoral linkage studies were conducted for the less-developed countries, and no research was conducted for the recently liberalized Central and Eastern European (CEE) Countries. This study focuses on how the agricultural sector is inter-related to the rest of the economy in Poland, Romania, Bulgaria and Hungary, in an attempt to fill the gap in the literature. Since the reform began in these countries in the late 1980s and early 1990s, agricultural and food systems of these transition economies went through four major restructuring processes: (1) market liberalization, (2) farm restructuring, (3) reform of upstream and downstream operations, and (4) the creation of supporting market infrastructure (Liefert and Swinnen, 2002). These restructuring processes led to major changes in the commodity mix and volume of agricultural production, consumption and trade. These changes have resulted in a more complex system of inter-sectoral relationships since the service and trade sectors were allowed to play a greater role in the economy.

As the transition process of former socialist countries entering into its third decade, economists, sociologists and policymakers are witnessing a number of macroeconomic puzzles. For instance, the transition process was not smooth as many people expected. The length and the effects of transition varied among countries. Some policies worked well for one country but not for another country. Many economists and policymakers are still puzzling with 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 in the economies. Once we have identified the complex linkages, the information could be used to determine the impacts of various policies adopted by the respective countries. For example, the existence of long-run equilibrium among different economic sectors could have affected certain policy outcomes. For instance, two sectors, say agricultural and industrial sectors, could have developed a negative relationship in the short-run and a positive relationship in the long-run. This means, a growth in the industrial sector will affect the agricultural sector negatively in the short-run; however, the long-run impact on the agricultural sector will be positive. Therefore, understanding the linkages and its implications on the time horizon could help to explain certain policy outcomes (Gemmel, Lloyd and Mathew, 2000). The short-and-long-run relationships also could be used to identify the optimal policy by measuring the total impacts of various policy alternatives. Therefore, determining the inter-sectoral relationship using appropriate econometric models could play a dominant role in the future growth literature.

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. This study is significant since all four countries experiences different sectoral compositions in their economy, and recently became members of the expanded European Union. After 20 years of the liberalization process, all four countries found themselves at different level of economic development. Therefore, understanding the inter-sectoral linkages could shed important insights on the transition process, and such information should assist policymakers to identify the optimal policies to continue further economic growth in these countries.

1.2 Objectives of the Study

Poland and Romania are the two largest countries in the Central and Eastern European (CEE) countries outside the former Soviet Republic states. During the pre-transition period, agriculture played an important role in these countries. On the other hand, the service sector dominated the Hungarian economy and the industrial sector dominated the Bulgarian economy. All four countries started the transition process at the same time, however, with different strategies (i.e., Poland and Hungary opted for a speedy transition while Romania and Bulgaria entered the process by following a gradual approach). Several researchers (Boeri, 2000; Brenton, Gros and Vandille, 1997) have pointed out that the speed of transition played an important role in the success of transition process. They argued that the speedy transition helped establishment of appropriate institutions within a short period of time. According to this view, Poland and Hungary should have developed advanced inter-sectoral linkages compared to Romania and Bulgaria. This study hypothesizes that the countries which followed speedy transition established stronger and more complex inter-sectoral linkages compared to countries that followed more gradual approach.

Specific objectives of this study are:

1. To understand the effects of market liberalization on agriculture and other sectors in the economy.

2. To understand the linkages between the agricultural and rest of the economies.
3. To identify the existence of long-run growth relationships among different sectors in the economies.
4. To understand the dynamics of short-run growth relationships among sectors during the transition periods.

1.3 Organization of the Study

This study consists of six chapters. The first chapter presents the problem statement and objectives of the study. The second chapter explains the transition process through liberalization and privatization policies and how these policies impacted various sectors in the economies. The third chapter provides a brief literature review on economic growth, the role of agriculture, and recent developments in inter-sectoral linkages. The fourth chapter presents the methodology and data sources. The fifth chapter presents the empirical results of long-run and short-run dynamics from the estimation of each country. The last chapter presents the summary of the study and conclusions.

Chapter 2 : Transition Process and Development of Structural Linkages

The transition from communism to capitalism at the end of the last century was one of the most significant events in the world economy since industrialization. The socialist economic model with central planning was initially promoted as an alternative to capitalism. During the first decades of communism, the system was taken very seriously, but in the late 1980s the proponents were convinced that the economic system was dynamically inefficient in the long-run. The system generated little innovation, but led to widespread shortages and poor product quality. Over the course of several decades, growth gradually came to a halt and the system collapsed in most of the follower countries.

During the latter part of the 1980s, people in the CEE and former Soviet Union (FSU) countries realized the fact that the existing political and economical systems will not lead to any substantial economic progress, so they opted for a market driven capitalist economic system. Following a number of political rallies and anti-communist demonstrations, people reinstated democracies in these countries. The change in governance was well accepted and acknowledged by the West, and the newly formed democratic governing authorities, with support of Western countries, initiated the economic reform strategies. The highly distorted economic policies combined with the inefficient trading systems were the initial conditions for the transition in many former communist countries.

Adopting price and trade liberalization along with privatization were the key economic objectives. New institutions were established; many countries and monetary organizations provided technical and monetary support for the greatly greeted transition process. The future prospects of being part of the expanded European Union accelerated the transition process in the CEE countries. Economists and world financial organizations predicted a smooth transition since the Chinese and Vietnamese transitions did not provide any significant shocks (output drop) during the transition (Rozelle and Swinnen, 2004).

As the transition process in the CEE countries took off, a number of macroeconomic shocks began to surface. Price liberalization caused output to fall sharply in all CEE countries, and the immediate reaction to the output fall was either to dismiss the phenomenon as a statistical artifact or the fault of macroeconomic policies. These results contradicted the view of many analysts who believed that the sales volume would reach maximum at the equilibrium price, and moving from fixed prices to equilibrium prices would lead to an increase in production. However, the neo-classical economic theory reveals that transition will create a number of shocks including aggregate output drop, increase in unemployment, high inflation, trade-deficit etc (See section 2.2).

The purpose of this chapter is to understand how the command system limits itself to sustainable economic growth, how the market oriented economic system overcomes the constraints faced by the command system, and why the countries experienced shocks during the transition. This chapter is organized as follows: The first part explores the major differences between the two economic systems. The second part introduces liberalization and privatization theories and how these theories explain the impacts on the economy using neo-classical economic theories. The third part demonstrates how the transition process leads to inter-sectoral linkages.

2.1 Economic Systems

To understand the transition process and why the command economy failed in the former socialist countries, the following section discusses the two fundamental questions: What are the essential characteristics of a command economic system and why the market systems perform better than the command system.

2.1.1 Planned or Command Economy

One of the major goals of former socialist countries was to provide basic human needs at low prices. In order to do this, the central planners offered subsidies for both producers and consumers of basic goods. Therefore, the prices of basic needs, say food, were lower than market-clearing prices. This encouraged people to consume more food than they would otherwise. As we can see in the following sections, such policies are economically unsustainable in the long-run since the country's resources were dumped into inefficient sectors, which lead to economic stagnation or even economic contraction (recession).

Under a planned economy, governments play a significant role in ownership and market regulation. The government owns all the physical factors of production and regulates the labor market. In this system, a politburo (group of government representatives) with the help of a planning office makes decisions on the production of all commodities, prices, wages and interest rates. Imposing production targets are the central point of the planning system, and the prices play a secondary role. The interdependencies of the production sectors are considered by input-output decisions, and the limits of production are provided by the amount of capital and labor available in the country. Full employment is always ensured. Consequently, more labor will be employed (over-employed) in each task and less effort (less marginal value product) is required from each worker. The employees enjoy greater comfort on the job since they can take more pauses, breaks and vacations. The firm's management, therefore, often understates its production capabilities by negotiating lower production targets. So, the firms are able to reach the production targets even with a significant number of absentees. Since prices, wage rates, and interest rates are also fixed by the planning office (or by a price board), the cost of production and the resulting profits or losses are not subject to management control and are no indicator for the efficiency of production. Profits go to government and losses are covered by the government.

As a result of such distortions, the efficiency of input factor is very low in the command economy. Moreover, production decisions generally do not reflect market conditions, because demand and supply of goods do not match since the production decisions for the current period are made by the planning authority, and the required resources for the specific combinations of the goods were allocated months ahead. In order to reflect market conditions, the firms should have the ability and power to produce alternative products. However, the system does not permit such flexibilities in the communist system. Labor supplies in the manufacturing and agricultural sectors are very large since the service sector is generally considered an unimportant sector. The greater labor supply combined with lower wage rates reduces the importance of efficient production technologies. Consequently, firms usually continue with outdated production technologies.

2.1.2 Market Economy

In contrast to a command economy, the factors of production in the market economy are owned by private persons who have the freedom to make economic decisions based on available initial resources and prices. The initial resources are used in production with available technologies, which connect input factors and outputs. Prices are determined by market forces on the basis of profit and utility maximization. The wage rates are determined based on the value of the worker's marginal product of labor (VMPL), and a return is paid to the capital owner based on the value of marginal product of capital (VMPK). Furthermore, production in the market economic system is ultimately determined by the demand of all individuals in the society. The demand is determined by the prices of own and other (substitutes and complements) goods as well as incomes of the people in the society. Firms supply the goods to satisfy the market demand. Firms which make profits will survive and others will exit from the market. In this system, each person will enjoy goods to the extent to he/she contributes to the value of production. Under the market clearing condition the solution will be pareto-optimal.

These fundamental differences between the two economic systems, and the strong legacy of more than 40 years of the communist system, did not make the transition easy. The planners adopted policies to fit the philosophies of communism, and such policies failed to provide robust economic growth in the long-run.

2.1.3 Communism and Trade

The government bias towards state owned enterprises (SOEs) was one of the most pernicious legacies of communism. This bias includes massive subsidization to state owned firms, and heavy regulations on entries and operations on private firms by government and its agents. During communism, SOEs were effectively part of the welfare system, and the providers of easy employment, extensive health care, child care and retirement. Therefore, the governments could neither simply let the SOEs go under privatization without putting a large strain on the state budget nor abandon the social safety net.

In addition to SOEs, trades between the member countries played an important role in the structure of communism. Trade theory underscores that benefits of trade largely depend on comparative advantage, specialization and terms of trade. The theories further suggest that market forces will lead to economic growth as the resources will be employed in the most efficient ways among the trading partners. In other words, in order to harvest the benefits of trade, the countries must satisfy two conditions: (1) an open market in which people can trade their goods and services freely, and (2) a vigorous private sector which can adjust its investments according to market conditions. In such a market, entrepreneurs will produce the comparative-advantaged products to maximize profits while consumers will increase their purchasing powers (income effect) by consuming products from a wide- range of alternative products to maximize their utility. However, the trade patterns in command economies failed to reap the benefits of trade fully since the countries allowed neither free trade nor private sectors. Instead, an organization called the Council of Mutual Economic Assistance (CMEA) "arranged" trades among the member countries. The CMEA played an important role in resource allocation, production technology, specialization, and infrastructure in member countries (Jeffries and Bideleux, 1998).

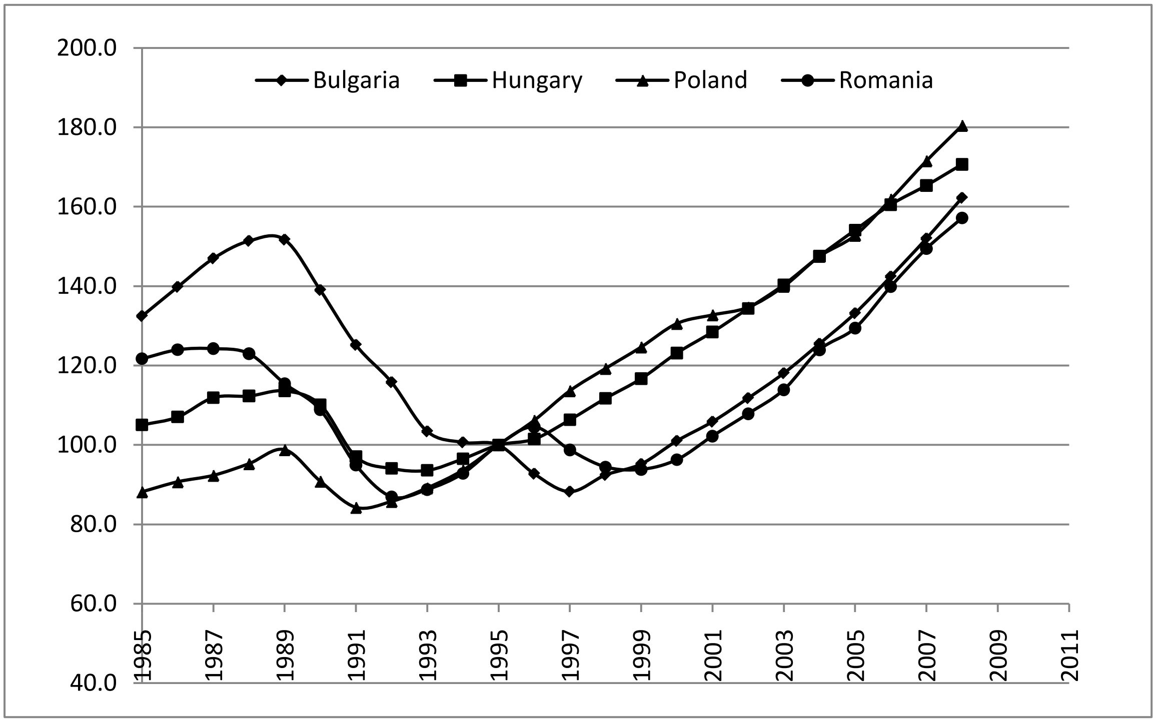
The CMEA was established in Moscow in January 1949 to assist and coordinate the economic development of its members. The original members were Bulgaria, Czechoslovakia, Hungary, Poland, Romania and the Soviet Union. At the early stages, the main objective of the CMEA was to foster bilateral trade. But, after the mid 1950s, it promoted economic specialization among its members. In the mid 1970s the CMEA nations jointly financed several major projects, notably to promote mining in Cuba, Poland and the Soviet Union, and also to build nuclear facilities in the member countries. A decade later, the member countries focused on increasing food production, developing high-tech industries and improving management efficiencies. However, rapid political and economical changes in the communist world led to the dissolution of CMEA in 1991 as the new non-communist governments of Eastern Europe saw the CMEA as an outmoded instrument of Soviet domination (Council for Mutual Economic Assistance - Encyclopedia). The dissolution of the CMEA engineered severe economic shocks in member countries since they could not find alternative marketing systems for their products. The lower product qualities compared to that of the world market made the problems even worse.

2.2: Liberalization Theories and Understanding the Transition Shocks

Liberalization and privatization theories, which were considered as the cornerstones for understanding the transition process, clearly underscore the inefficiencies of a command system, and its inability to provide substantial economic growth in the long-run. Privatization theory, particularly the labor market theory, exposed the inefficiencies and potential economic stagnation under the command system. On the other hand, the labor market in a capitalistic system breaks all the constraints the command economy faced, and shows the potential for a sound and sustainable economic progress. These theories also substantiate the fact that during the transition, the economy (particularly at the early stages) would be subject to a number of macroeconomic shocks. As noted earlier, one of the major shocks was the drop in the aggregate outputs in all the transition countries.

Figure 2.1 shows the changes in GDP per capita of four transition countries--Bulgaria, Hungary, Poland and Romania. The pattern was consistent for all the countries. Output fell steeply in the first years of transition (beginning in 1989), however, the length of time between the beginning of reform and the lowest point GDP varied among nations. For example, the output declines in Poland and Hungary stopped after 2-3 years, and, subsequently, the countries followed a somewhat steady upward path.

Figure 2.1: Pattern of changes in GDP per Capita



Source: United Nations Statistics Division, 2009
Base year:1995

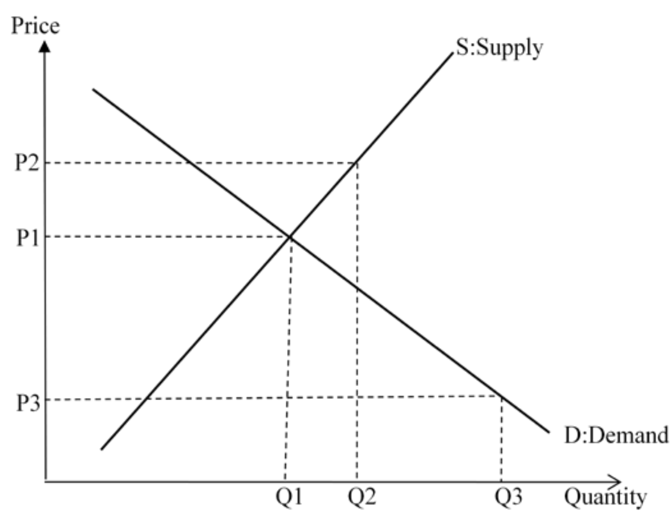
Nevertheless, Bulgaria and Romania suffered a longer period of recession (8-9 years) before their economies started on a steady upward path. The output trends imply the countries which adopted speedy transitions experienced shorter periods of recession compared to the countries following a gradual approach. However, the transition affected all the economies negatively in the early stages of reform.

The differences in magnitude and the length of the output drop attracted much research by economists, sociologists, anthropologists and policy analysts worldwide to explain the differences among the countries. This created a vast literature on the transition process and several hypotheses were tested -- for instance; effects of prices, rights and markets (Rozelle and Swinnen, 2004); initial level of development at the time of reform (Sachs and Woo, 1994; Macours and Swinnen, 2000); the speed of reform (McMillan and Nauhgton, 1992); political economy and regional tensions (Roland, 2000; Melo and Gelb, 1996); management of public investments (Huang and Rozelle, 1996; Csaki, 1998); and breakdown of institutions (Blanchard and Kremer, 1997). Since the major transition polices employed in these countries are price and trade liberalization and privatization, this study begins by studying how the underlining economic theories can explain the shocks observed during the transition process.

2.2.1: Price Distortion Policies and Food Shortages

During the communist era, countries experienced severe shortages of essential goods as a result of various government support programs. A simple demand-supply model can be used to explain the market conditions for an essential good (Figure 2.2). In this market, the state set prices for producers and consumers. Producers receive a price of P_2, which motivates them to produce Q_2 while the consumer price is P_3, such that consumers wish to buy Q_3.

Figure 2.2: Price Distortion and Shortages of Food in Socialist Countries



where;

P_1 is the producer and consumer price in the absence of price distortion policies;

P_2 is the pre-reform producer price;

P_3 is the pre-reform consumer price;

Q_1 is the market clearing quantity in the absence of distortion;

Q_2 is the pre-reform quantity of production; and

Q_3 is the pre-reform quantity demanded by consumers.

As the figure shows, consumers must settle for the actual level of production, Q_2. The pre-reform food economy in transition economies had low consumer prices for foodstuff, but output could not satisfy demand generated by those prices. The government must make up the price differences through subsidies. This resulted in a market shortage of the food, or excess demand, equal to Q_3-Q_2. In the pre-reform period, long lines of shoppers and food stores with empty shelves were commonly interpreted as signs of major food shortages. However, this was the result of low state-set consumer prices that overly stimulated demand (Liefert and Swinnnen, 2002). This model shows that one way to avoid the shortages is to take away the price-distorting policies and substitute with price liberalization, which leads to market-oriented or profit-oriented economy.

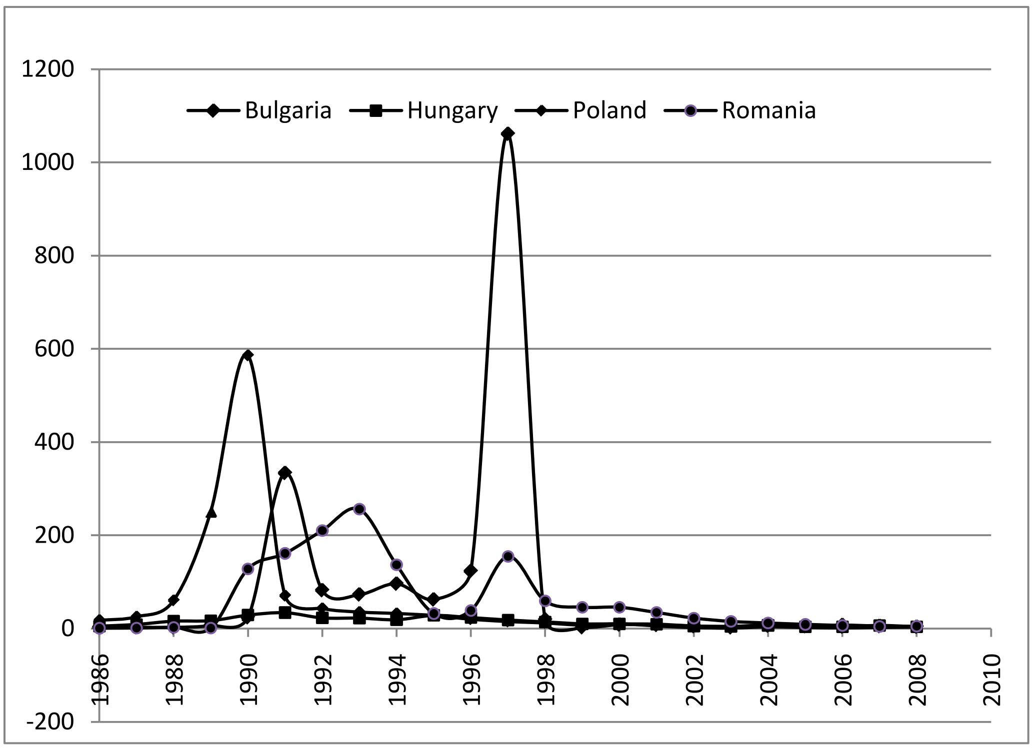
2.2.2: Effects of Price Liberalization

Price liberalization, which removes all price distorting policies such as subsidies and taxes to producers and consumers, allows the structure of relative prices to adjust and move toward that characterizing a market-oriented economy with similar per capita income. It involves the corollary policy of reducing or eliminating state budget subsidies needed to maintain the gaps between prices paid to producers and prices charged to consumers. Under price liberalization, the state allows the market to determine prices and quantities, which leads to significant changes in the price, production, consumption, and trading volumes.

The immediate effect of freeing prices by eliminating budget subsidies for the good in question is that both the producer price and consumer price move to P_1 (Figure 2.2). The marginal cost of production curve, S_1, now becomes the supply curve. Production and consumption fall from Q_2 to the market clearing level of Q_1. The drop in output from Q_2 to Q_1 measures the effect of reform on production from liberalizing the market for only this particular good. However, price liberalization has two other major effects on markets.

The first effect is decreasing the real value of money. The freeing of prices led to high economy-wide inflation, in most countries in the hundreds and in some cases in thousands of percent (Figure 2.3). The massive inflation substantially reduced consumers' real income as prices rose much faster than wages and this reduced purchasing power significantly.

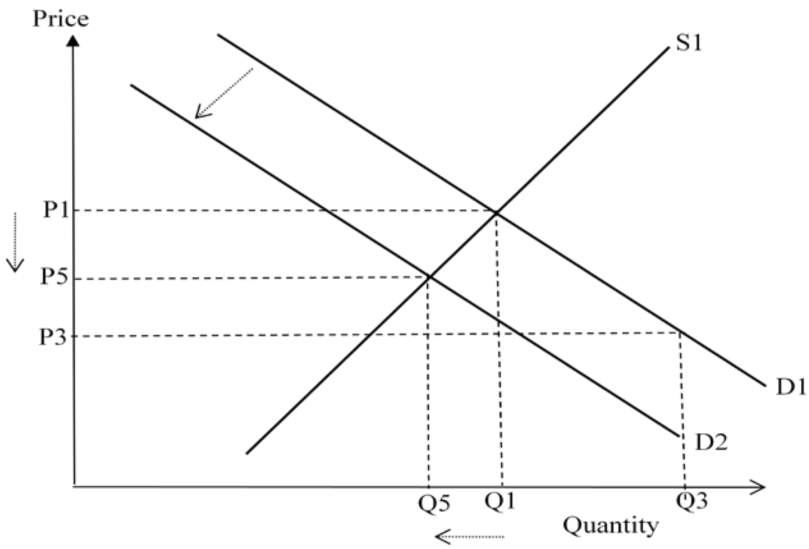
Figure 2.3: Annual Inflation-rates



Source: IMF, 2010

The fall of real income affected the demand for foodstuffs negatively, and this is presented in Figure 2.4 by a leftward shift in demand from D_1 to D_2. The drop in demand decreased both production and consumption from Q_1 to Q_5. The degree to which demand fell for a particular foodstuff depended on how sensitive the demand was to the changes in income (income elasticities). For certain foods, such as bread and potatoes, demand can rise even when income decreases (inferior goods). In figure 2.4, this would shift the demand curve to the right. During the transition, consumption of cereals and potatoes in some countries rose (Figures A2.1-A2.4), suggesting that the products might be inferior goods for these countries.

Figure 2.4: Effect of Inflation on Demand for an Essential Good



P_1 is the pre-reform equilibrium price;

P_3 is the pre-reform consumer price;

P_5 is the price after drop in demand;

Q_1 is the quantity of production and consumption before the inflation effect;

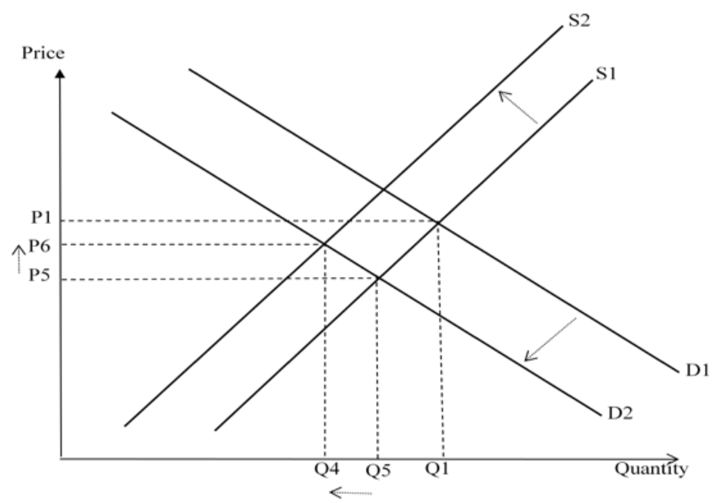
Q_3 is the pre-reform quantity demanded by consumers;

Q_5 is the quantity of production and consumption after drop in demand.

The second effect of price liberalization is (in addition to inflation) a supply-side effect, which is the result of raising real input prices. Following price liberalization, input prices will rise from the elimination of subsidies as well as higher inflation. For example, the prices of agricultural inputs rose by a much greater percentage than prices for agricultural output. Consequently, the real price of inputs paid by farmers increased significantly, i.e., the changes in input and output prices worsened the producers' terms of trade. The rise in input prices increased producers' per unit costs of production while the price of output decreased as the result of a decrease in demand for output.

Consequently, the marginal revenue product for all inputs decreased, and it encouraged the profit maximizing producer to use less inputs (e.g., fertilizers[1]), and reduce output. This effect is represented in Figure 2.5 by the leftward shift in the supply curve (from S_1 to S_2). This supply cut reduced production and consumption further to Q_4.

Figure 2.5: Effects of Supply Shift



where, P_1 is the pre-reform equilibrium price;

P_5 is the price after the drop in consumer demand;

P_6 is the equilibrium price after demand and supply adjusted;

Q_1 is the quantity of production and consumption before the price liberalization;

Q_4 is the equilibrium production and consumption quantity after the price liberalization;

Q_5 is the quantity of production and consumption after the drop in consumer demand.

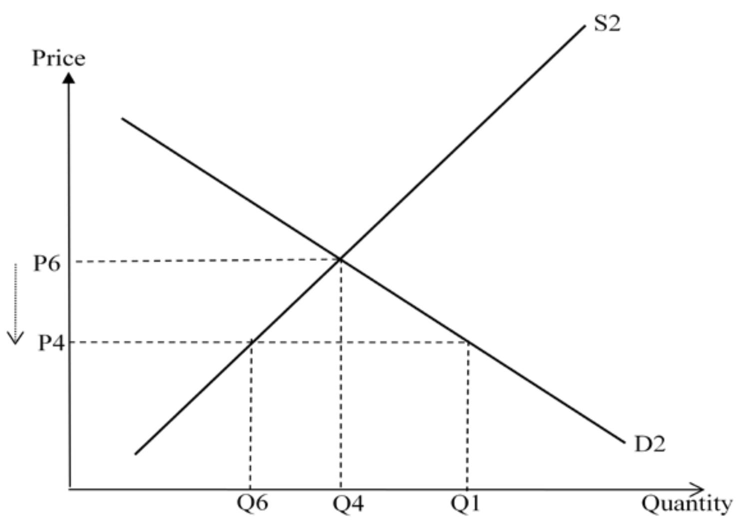
2.2.3 Effects of Trade Liberalization

Trade liberalization is the removal or reductions in trade practices that thwart free flow of goods and services from one country to another. It includes dismantling of tariffs, such as duties, surcharges, and export subsidies, as well as non-tariff barriers, such as licensing, regulations, quotas and arbitrary standards. Trade liberalization is the

[1] See Appendix A2.5

second major reform policy after price liberalization that affected commodity restructuring in the transition countries. Figure 2.6 shows how trade liberalization affects production, consumption, price and trade volumes. The figure assumes that the world price of the good (P_4) is lower than the domestic price after price liberalization (P_5).

Figure 2.6: Effects of Trade Liberalization



P_6 is the equilibrium price before trade liberalization;
P_4 is the producer and consumer price after trade liberalization (world market price);
Q_1 is the quantity of consumption after trade liberalization;
Q_4 is the production and consumption before the trade;
Q_6 is the local production after trade liberalization.
(Q_1-Q_6) is the imported quantity

If the country is small country and allows free trade with perfect competition, the world price will determine the domestic price. The domestic price will drop to P_4. Production will fall from Q_4 to Q_6, consumption will rise from Q_4 to Q_1, and the country will import Q_1-Q_6 of the good. This implies that under the trade liberalization consumption and import will increase, and local production will decrease. This led to a number of short-run macroeconomic instabilities such as a drop in GDP and higher inflation (as illustrated in Figures 2.1 and 2.3, respectively). Higher unemployment, negative trade balance, and exchange rate depreciations were also observed in the early stages of transition. However, after the initial shocks, the liberalization policies will contribute to stabilize the economy as the country's resources are being relocated into more efficient sectors. Furthermore, foreign direct investment and modern technologies will enter and facilitate to increase the productivity of labor and wage-rate in the comparative advantage sectors. This leads to a movement of resources from inefficient to more efficient sectors.

2.2.4 Effects of Privatization

Privatization is another important transition policy which characterizes the changes in resource ownership. Industries in the former communist countries were mainly consisting of SOEs and large conglomerates. Similar to many other economically ineffective policies, SOEs were economically non-competitive and created inefficiencies from diseconomies of scale, large transport costs and lack of competition.

During privatization, the heavy manufacturing industrial structures, which were state monopolies in the communist years, were dissipated. The ownerships of these firms were dispersed among private agents who would respond faster and better to incentives, and budget constraints. Thus the dominance of large SOEs was reduced and a number of new private firms emerged in the market. Competition among the new private firms stimulated the evolution of competitive-marketing process. The enhanced competition drove some firms to exit or contract, others to enter and expand. The internal liberalization (entry, exit, and prices) and external liberalization (foreign trade and foreign direct investment) invigorated enterprise dynamics. There was considerable job creation, job destruction and job relocation within, as well as across, sectors. Ownership restructuring, industrial restructuring and size restructuring occurred through accelerated processes of enterprise dynamics—birth, growth, contraction and exit. These processes were extensive and contemporaneous, and some of these increased industrial concentrations, others decreased it.

Inefficiency in the labor market of the command system is another well-known factor which undermined development and growth in the former socialist countries. While privatization allowed change in the ownerships of resources, it also assisted the labor market to become more efficient and dynamic. Under the command system, labor was strongly unionized and the state had the duty to provide job for everyone in the society. The SOEs and the large conglomerates were the typical employers for most workers. The state subsidized the firms with budget allocations and the firms paid their employees a flat wage rate that was not linked to the ability of workers, but determined by the state and labor unions. The flat wage rate system in the command economy led to wages that were too low for higher ability worker and wages that were too high for lower ability workers. Such distortions produced a negative impact on the economy since the system does not provide any incentive for increasing the abilities of workers. For instance, the lower fixed wages to the higher ability worker will not provide any incentive for improving his/her abilities. Instead, the worker might work less than his or her full capacity/ability. On the other hand, the lower ability worker was already paid a higher wage and, therefore, the worker will not see any incentive to improve his/her skills. As a result of this, the growth of the economy could easily be stagnated or even depressed under the command economy's fixed wage system.

In contrast to the command economy, wage rates in the perfectly competitive market are determined by the ability of workers. This means the wages will reflect the value of marginal product of the labor (VMPL). The VMPL is defined as the product of marginal product of labor (MPL), which is the additional output that results from an increase in one unit of labor, and the price of output. Accordingly, every worker, regardless of their ability has an incentive to improve their abilities since it improves their wage. As a result, firms will enjoy greater returns for investments, and the economy will establish a sound and sustainable economic growth.

As the workers are paid their VMPL in the market driven economy, the labor allocations among the firms/sectors are efficient. This allows workers to move freely from one firm to another or one sector to another. Privatization and liberalization leads to efficient resource allocation since such policies bring economies toward their comparative advantage. On the other hand, wage distortions in the command economic system prevented efficient resource allocation since the state owned sectors were heavily concentrated in industries and away from consumer-oriented goods. For example, employment shares in agriculture in command economy were larger than in countries at a similar level of GDP per capita. Jobs were concentrated in large conglomerates and in the public sector, while non-agricultural self-employment was non-existent in most economies. Consequently, privatization of the SOEs and regulations of large conglomerates were necessary for a successful transition. These policies lead to important changes in the economies.

During the transition period, countries followed different strategies in adopting liberalization and privatization policies, and these strategies played an important role in the economies. Boeri and Terrel (2002) reported the changes in employment in different sectors during the period of 1989-1998. These results show that the countries, Czech Republic, Hungary, Slovak Republic and Belarus (CHSB) successfully relocated their surplus industrial and agricultural workers into the service sector by establishing a suitable environment for entrepreneurship. On the other hand, Romania relocated most of its industrial surplus workers into its agricultural sector. Table 2.1shows that service sector employment in Romania increased by a mere 2%, and it is the lowest among all other transition countries.

Agricultural employment in Poland did not change as much as in CHSB, which suggests that the agricultural sector during the pre-transition period was highly competitive. This may be due to the fact that 74 percent of land was already privatized during the pre-transition period. Table 2.1 shows that the transition policies worked very well for Poland and Hungary as the self-employed in the non-agricultural sector, and the percentage of workers employed in small firms are high among the other transition countries. On the other hand, the statistics of Romania imply that the transition policies did not work very well. Ownership changes, shares of small firms and non-agricultural employment were the lowest among the CEE countries.

Table 2.1: Changes in Employment in Former Communist Countries

Country	Change in the employment share (1989-1998)			Private employment share 1997	Small-Firms Employment share (<100 employees) 1996	Self-Employment Non-agriculture 1996
	Agriculture	Industry	Service			
Czech Rep.	-6.2	-5.9	12.1	59.7	46.9	13.2
Hungary	-9.1	-6.0	15.1	80.0	40.7	13.1
Poland	0.6	-7.9	7.4	64.0	50.3	16.0
Romania	12.1	-14.2	2.1	55.0	16.0	6.4
Slovenia	3.0	-12.5	9.5	59.2	31.4	9.2
Slovak Rep.	-6.0	-10.6	16.6	64.6	44.8	…
Russian Fed.	0.04	-10.5	11.1	65.0	13.0	6.3
Ukraine	2.3	-12.9	10.6	52.0	…	1.4
Belarus	-2.1	-7.3	9.1	…	…	…
Kazakhstan	3.1	-12.9	10.8	…	…	…

Source: Boeri and Terrel (2002).

2.3. Development of Inter-Sectoral Linkages

As stated in the chapter one, the dual economic theory suggests that agriculture plays an important role at the early stages in development as it provides important resources to the industrial sector. Wage rate in the early stages will be higher in the manufacturing sector since the VMPL in manufacturing sector is higher than in agriculture because productivity in the industrial sector, in general, is higher than the agricultural sector. So, resources will be transferred from agriculture to manufacturing. Rural agricultural workers will migrate to urban areas where manufacturing sectors are concentrated. This forward linkage is well recognized in the growth literature. However, the performance of agriculture in the latter stages of development could be mixed as the VMPL is equated among sectors.

Another factor that influences sectoral growth is changes in demand for goods. As the economy grows, people alter their consumption patterns, and these changes might lead to structural changes in the economy. Neo-classical economic theory suggests that demand for normal goods will increase as income increases. It further suggests that the magnitude of demand shifts depend largely on the income elasticities of goods. Several studies show that income elasticities are smaller for agricultural products than manufactured goods. Consequently, people are willing to spend a greater share of their additional income on manufactured goods, and therefore, the manufacturing sector will grow faster than the agricultural sector. However, the agricultural sector will be benefit from the increased income, therefore, a positive linkage is expected.

Increasing demand for manufactured goods may affect the agricultural sector negatively as well. For instance, under the perfect competitive assumptions, more manufacturing firms will be attracted to the market as the existing firms enjoy normal profits. As more firms enter into the market, the demands for land, labor and capital will increase, and the agricultural sector might shrink as more resources are transferred away. In order to offset the higher land price and wage rates farmers need to increase the productivity of their land and skills of labor to be competitive in the market. Demand for better production technologies (machineries) and skilled labors should increase in the agricultural sector. Both the manufacturing and service sectors must respond to the farmers need (machineries and skilled labors) to establish strong backward linkages to the agricultural sector. Otherwise, growth in the manufacturing sector will be detrimental (negative linkage) to the agricultural sector.

This cycle will continue until it reaches equilibrium where VMP (value of marginal product) of resources is equalized among the sectors. At that stage, the average wage rates and the productivity of resources would have increased, and the economy will have experienced higher growth. Most importantly, the number of farm workers will have decreased, but the change in output depends on adaptation of efficient technologies and resource transfers from the agriculture to other sectors in the economy.

Further economic growth in the manufacturing and agricultural sectors may be induced by changes in macroeconomic factors. For instance, lower interest rates may lead to higher investments and consumption[2]. People will consume more industrial goods with higher income elasticity, and firms will invest more in capital goods, i.e., new technologies will be adopted in both sectors. This will attract more labor from inefficient sectors, and the cycle will continue until a new equilibrium is reached. The technological changes lead to higher profits for firms and farms in the short-run, but the consumers will enjoy lower prices in the long-run.

As the people enjoy higher incomes and wealth, preferences for manufactured goods will decrease and service goods such as education, healthcare, entertainment, information, and tourism will increase (World Bank, 2004). Income elasticities for service goods are greater than for food and manufacturing goods as the economy enters into a higher level of development. In the two sector model, labor productivity increases as the agriculture and manufacturing sectors acquires more capital goods and modern technologies. However, labor productivity in the service sector cannot grow at the same speed as those of the agricultural and manufacturing sectors, because most of the service sector jobs cannot be performed by machines. Consequently, the service sector becomes more important and expensive compared to other sectors, and it accounts for an ever continually increasing share of GDP. The lower mechanization of services also explains why employment in the service sector continually increases while the employment in other sectors decrease due to technological progress that increases labor productivity and eliminates jobs. The service sector has replaced the manufacturing sector as the leading sector in most industrial economies. This points-out that the growth of the service sector will accelerate after the productivity of the manufacturing and agricultural sectors have taken off. This trend was also observed in many former communist countries (Table 2.1) as well.

As the global economy progresses, the service sector plays a more important role in most countries. For instance, from the early1980s to late 1980s, the service sector increased from 50% of the world GDP to 66% of the world GDP (World Bank, 2004). During this period, many countries showed double digit economic growth in GDP as a

[2]Investment will increase as opportunity costs for investment is lower than before. Consumption will increase because incentives for saving are lower, and cost of current spending will be less at lower interest rates.

consequence of changes in productivity, mainly due to modern information technologies and improved transport facilities. Furthermore, specialization and free-trade encouraged labor intensive manufacturing sectors into countries where agriculture was the major economic sector. The economies of most of high and middle-income countries were less reliant on manufacturing but focused mostly on service oriented industrial sectors. On the other hand, least developed countries found opportunities to transfer resources from less efficient agricultural sector to more efficient industrial sectors. This trend suggests that the agricultural sector seems to be losing while the manufacturing and service sectors are progressing in the current economy. An increasing share for the service sector is also due to the difficulty in outsourcing. However, modern information technologies, such as internet, telecommunication, and transport facilities, have made outsourcing more feasible for some of service sectors.

The traditional economic development path presented in this section (agriculture => manufacturing => service) is not the only path for economic growth and progress. Free trade agreements and integration into larger economic units can accelerate economic progress (for example, transitions of Central European countries versus former Soviet Republics). Furthermore, a country with a large pool of cheap labor could attract more labor intensive manufacturing industries, and highly skilled developing countries could attract a number of service sectors. Therefore, developing countries do not have to follow the traditional steps (Rostow's model of development) of sectoral economic progress. Furthermore, countries with huge agricultural resources could end up with an inefficient agricultural sector for longer periods (e.g., Romania) while countries with limited agricultural resources may achieve faster economic growth through investment in efficient manufacturing and service sectors (e.g., the Czech and Slovak Republics).

An influx of capital and technology in the comparative advantage sectors are the locomotives for economic growth in the countries where trade and integration are the major development strategies. The pattern of inter-sectoral linkages for comparative advantage sectors to rest of the economy will be critical factors for the future course of the economy. If the sectors are strongly linked, the spillover effects could be significant. However, the direction of linkages and the magnitude of multipliers will determine the end results. For instance, if the agricultural sector is negatively related to the industrial sector, a technology and capital influx into the industrial sector will affect the agriculture sector negatively. Therefore, policymakers should pay greater attention to how agricultural resources transfer to the industrial sector, and the consequences of this diminishing agricultural sector. Policymakers could underestimate the costs of the policy if they ignore the negative impacts on the agricultural sector. Furthermore, if the agricultural sector has a greater multiplier effect than the industrial sector, then diminishing the agricultural sector might have a detrimental impact on the overall economy.

Chapter 3 : Literature Review

A number of economic theories and models have been developed to understand the economic development in the past millennium. These theories seek to explain and predict how economies develop over time as well as how to identify and overcome the barriers to growth. This chapter is a review for studies of sectoral development, inter-sectoral linkages and major developments in econometric analysis.

3.1 Sectoral Development

According to certain characteristics, a country can be deemed to have reached a certain stage of development. The simplest stage theory was developed by Fisher (1939) and Clark (1940). They employed the distinction between primary, secondary and tertiary productions as a basis for a theory of development. Countries are assumed to start as primary producers and then, as the basic necessities of life are met, resources are shifted into manufacturing or secondary activities. Finally, owing to rising income, more leisure and increasingly saturated markets for manufacturing goods, resources move into service or tertiary activities-- producing goods with a high income elasticity of demand.

It is important to note that if one country produces predominantly agricultural products while another produces mainly manufactured goods, then this does not necessarily imply that they are at different stages of development. Such an assumption would ignore the doctrine of comparative advantaged which holds that countries will specialize in the production of those commodities in which they are relative advantage as determined by natural or acquired resource endowments. Therefore, a criterion for a country that reached a developed state will be that the productivity level in the agricultural sector should approximately match the productivity levels in the industrial and service sectors, provided that the level is reasonable high (Thirlwall, 1983).

A number of economists offered different explanations for the changes in pattern of development. For example, Fisher (1939), Clark (1951) and Kuznets (1966, 1971) mainly focused on the income elasticity of demand of goods and services of different categories. According to the Engel's law, the income elasticity of agricultural products is lower than that of manufactured goods. Consequently, as income increases, demand for agricultural goods would decline and the demand for manufactured goods would increase. As production responds to the demand pattern, the share of the agricultural sector will decline and the share of the industrial sector will increase. At some level of income, the income elasticity of services would exceed that of industrial goods, thus the share of the service sector will dominate the economy while the industrial sector will lose its dominant role in the economy.

The demand-based explanation could be useful in a closed economic system; however, in an open economy, the demand for manufactured goods could be met through import. Therefore, growth of the manufacturing sector does not need to match the growth of demand for manufactured goods in an open economic system. Kaldor (1966, 1967) argues that the structural changes can be explained also by the fact that the agricultural sector cannot sustain its growth beyond a certain level. For example, agricultural land, which is a major factor of production, is subject to diminishing returns (to land). The major inputs for industry, on the other hand, do not face diminishing returns and the same constraints as agriculture. Furthermore, the higher income elasticity of demand for manufactured products enables the industrial sector to act as the engine of growth.

3.2 Inter-Sectoral Linkages

The macroeconomic linkage between the agricultural sector and industrial growth has been one of the most widely investigated in the development literature. In the early stages, researchers paid great attention in studying the relationship between the agricultural and industrial sectors, and how these sectors were inter-related. They argued that agriculture only plays a passive role; which is to be the most important source of resources (food, fiber, and raw material) for the development of industry and other non-agricultural sectors (Rosenstein-Rodan, 1943; Lewis, 1954; Ranis and Fei, 1961). Many of these analysts highlighted agriculture for its resource abundance, and its ability to transfer surpluses to the more important industrial sector.

Since the industrial sector is more productive than the agricultural sector, the modernization of the economy taxed agriculture as a means to develop the industrial sector by transferring resources from agriculture toward the other sectors (forward linkage effects). The taxation on agriculture had mixed results. For instance, during the early industrialization process, Japan was largely financed by a land tax, which represented over 80% of fiscal revenues at the time (Ghatak and Ingersent, 1984).

However, taxation on agricultural goods in Argentina to earn foreign exchange reserves and to industrialize its economy produced negative results. In this process, Argentina established a government monopoly to handle the export of primary commodities. The monopoly paid low prices (an implicit tax) for producers and attempted to bargain for the highest prices for commodities on the world market. This policy affected the agriculture sector negatively-- agricultural production increased by less than 10% between the periods 1945-1949 and 1959-1961. The taxation of agriculture dampened the incentives to produce and export agricultural commodities. Consequently, Argentina's income per capita today, ranked either as one of the less prosperous developed nations or one of the more prosperous developing nations, rather than the position it held in the 1920 as among the world leaders (Manzetti, 1992).

In traditional analysis of agriculture-industry linkages, agricultural performance was treated as exogenous to the economy while the industrial performance was endogenous. This means that the agricultural sector's economic role is a one-way path as the flow of resources is mainly towards the industrial sector and urban centers. Reason for this one-way approach is that the agrarian societies often have few trading opportunities and most resources are devoted to the provision of food. As national income increases, the demand for food increases much more slowly than other goods and services. However, the one-way path may change as the agricultural sector adopts new technologies which will increase the productivity of land, labor, capital and other farm inputs. The modernized (mechanized) agriculture will purchase more intermediate inputs from the industrial and service sectors. In open economies, agricultural exports may provide scarce foreign exchange used to import key industrial intermediate or investment goods. Thus agriculture is seen as providing both demand and supply side links to the manufacturing sector and may suggest that faster agricultural GDP growth causes faster growth in the manufacturing sector.

A number of development economists attempted to point that while agriculture's share fell relative to industry and services, it nevertheless grew in absolute terms, evolving increasingly complex linkages to the non-agricultural sectors. A group of economists (Singer, 1979; Adelman, 1984; Vogel. 1994) highlighted the interdependencies between agricultural and industrial development, and the potential for agriculture to stimulate industrialization. They argue that agriculture's productivity and institutional links with the rest of the economy produce demand incentives (rural household consumer demand) and supply incentives (agricultural goods without rising prices) fostering industrial expansion.

Another group of economists maintains the forward linkage effects of agriculture but also underline its backward linkages to other sectors of the economy (Haggblade et al., 1989; Delgado, 1994). The agricultural sector not only provides resources to the non-agricultural sectors, but it is also an important market for industrial products. Industries in turn, help agriculture in modernizing traditional production techniques by providing modern inputs, technology, and improved managerial skills. The end result is that both sectors benefit from each other, and the nation benefits from their growth and increased efficiency.

Vogel (1994) examined whether agriculture possesses the strong linkages necessary to drive industrialization in developing countries using a social accounting matrix (SAM). He compared agricultural production multipliers (forward and backward linkages) of different levels of development. He found that at lower levels of development, agriculture possesses strong backward linkages to nonagricultural production activities as rural household expenditures on nonagricultural commodities come from increases in agricultural income. At this level of development, the agricultural backward linkages (agricultural expenditures on nonagricultural sector) dominated its forward linkages (nonagricultural production expenditures on agricultural inputs). For example, a $1 expenditure on nonagricultural activities generates $1 expenditures on agriculture. As the economy progresses, overall industrial links to agriculture diminish to the extent that, at an income level of $7,000 per capita, a $1 in nonagricultural expenditure generates less than $0.20 of induced demand for agricultural output. He further found that both forward and backward linkages (input-output) were weak for the countries at very low levels of per capita income. These weak linkages are hallmarks of subsistent agriculture.

Stringer (2001) stressed that agriculture plays a number of nontraditional economic roles in the development process. For instance, as agriculture specializes in its primary production, it gives up some segments such as processing, storing, mechanizing, transporting and financing practices to the other sectors. This gives way to a more complex, specialized and integrated process. This transformation allows farm suppliers, assemblers, processors, wholesalers, brokers, importers, retailers, merchants, distributors, and consumers to join the linkage to the agricultural sector. Additional activities continually service these businesses, including research, transportation, packaging, storage, futures markets, advertising and promotions. The creation of strong linkages to various economic sectors shows the importance of agriculture and its evolving process in specialization. As agriculture evolves into more specialization and mechanization, the number of agricultural production workers will decrease as the new manufacturing and service sectors develop. The establishments of certain processing industries can lead to forward linkages, and development of many services will lead to backward linkages to the agricultural sector.

Linkages involving service sector activities are also well recognized (Gemmell, 1982; Bhagwati, 1984). As an economy grows, a number of structural changes will take place. Workers will shift from inefficient sectors to service industries. These include the effects of economies of plant scale which concentrate production in a limited number of localities, thus increase the need for distributive services, the increasing in financial services with growing personal wealth, the expansion of government services (police, sanitation, education) necessitated by the shift away from family and rural production to production by units employing wage earners concentrated in urban areas, and the increase in military expenditures.

The contributions of intermediate services such as distribution, banking, and retailing to both agriculture and manufacturing are obvious and frequently observed to increase over time. It is well known that differences in productivity could play an important role in structural changes. For example, in a two sector economy where one sector is stagnant with zero productivity growth and one progressive with positive productivity growth, Baumol (1967) concluded that the cost per unit of the stagnant sector will increase without limitation and this creates a tendency for demand to shift in favor of goods produced in the progressive sector. If, however, goods from different sectors are poor substitutes, more and more labor must be transferred to the non-progressive sectors. This tendency ultimately dominates in the determination of the sectoral composition of the economy. The macroeconomic growth rate will ultimately tend to converge to the stagnant sector. The implications of this simple model have become to be known as the 'cost disease of stagnant services'.

3.3 Sectoral growth and Econometric models

Prior to development of time series analysis, most investigations of the growth linkages employed augmented production functions of the type formulated by Balassa (1978) and Feder (1982). In such models, real output is specified as a function of capital, labor, and other macroeconomic variables such as exports, industrial outputs, etc. For example, a positive correlation between export growth and real output growth is then considered as an indication of contributions of export-oriented policies to economic growth. Inferences of such traditional tests were subject to several shortcomings since the time series data could easily violate a number of assumptions as the traditional statistical methods assume that the data should be generated by a stochastic or random process[3].

[3] A type of stochastic process that has received special attention and scrutiny by time series is the so-called *stationary stochastic process*. A stochastic process is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depend only on the distance or lag between the two time periods and not the actual time at which the covariance is computed. If a time series is not stationary, it is called a non-stationary time series.

One method often applied to investigate causal relationships empirically among variables is the Granger causality analysis. The basic principle of the Granger causality analysis (Granger, 1969) is to test whether or not lagged values of one variable help to improve the explanation of other variables from its own past. Simple Granger causality tests are operated on a single equation in which variable A is explained by lagged values of variables A and B. Then the coefficients of the lagged variables are tested to see whether they are equal to zero. If the hypothesis that the coefficients of the lagged values of B are equal to zero is rejected, it is said that variable B Granger causes variable A. However, the conventional Granger causality test, based on the standard vector autoregression (VAR) model, is defined in the assumption of stationarity. If the time series are non-stationary, the stability conditions for VAR are not met, implying that the Wald test statistics for Granger causality are invalid. In such a case, the cointegration approach and vector error correction model (VECM) are recommended to investigate the relationship between non-stationary variables.

Engle and Granger (1987) pointed out that when a linear combination of two or more non-stationary time series are stationary, then the stationary linear combination, the so-called cointegration equation, could be interpreted as a long-run equilibrium relationship among the variables. However, the long-run relationship cannot determine the direction of causality. But it can be determined by estimating a VECM that explicitly includes the cointegrating relations. In a VECM, long and short run parameters are separated, which gives an appropriate framework for assessing the long-run implications as well as for estimating the dynamic process involved. Therefore, by adopting the cointegration approach and corresponding VECMs, one can detect both long-run and short-run relationships among non-stationary variables.

Dawson and Hubbard (2004) studied the relationship between exports and economic growth in fourteen CEE countries for a period of 1994-1999. The model estimated both fixed and random effects to examine the impacts of capital, labor and export on economic growth. They found that export growth is a significant determinant of GDP growth, and concluded that there is potential for further economic growth by adopting outward-looking policies which shift resources into export sectors, rather than by adopting inward-looking policies which shift resources into domestic, non-export production.

Katircioglu (2006) analyzed the relationship between agricultural output and economic growth in North Cyprus, a small island which has a closed economy, using Granger causality. He observed bidirectional causation between agricultural output growth and economic growth. This study concluded that the agricultural sector still has an impact on the economy although North Cyprus suffers from political problems and drought.

Blunch and Verner (2006) examined growth relationship among agriculture, industry and service sectors using cointegration analysis. They found empirical evidence to support a large degree of interdependence in long-run sectoral growth in Cote d'Ivoire, Ghana, and Zimbabwe, and concluded that the sectors grow together or there are externalities or spillovers between sectors.

Kanwar (2000) studied the cointegration of the different sectors of the Indian economy in a multivariate vector autoregressive framework, and estimated the relations between agriculture and industry using the Johansen procedure. He implied that the agriculture, infrastructure, and service sectors significantly affect the process of income generation in the manufacturing and constructions sectors, but the reverse has not been true. He also suggested that the agricultural sector should not be assumed to be exogenous; rather, this should be first established.

All these studies have made useful contributions to understanding the links between different sectors in the economy and economic growth. These studies further imply that the contribution of agricultural growth to economic development varies markedly from country to country as well as from one time period to another within the same economy. However, there is a significant gap in the growth literature because most of the inter-sectoral linkage studies were conducted for the less-developed countries. Furthermore, no research was conducted for the recently liberalized Central and Eastern European Countries. In an attempt to fill the gap in the literature, this study focuses on how the agricultural sector is inter-related to rest of the economy in Poland, Romania, Bulgaria and Hungary.

Chapter 4 : Data and Methodology

This chapter explores empirical methods and data used to estimate the inter-sectoral linkages among different sectors in the Polish, Romanian, Bulgarian and Hungarian economies. As noted in the second chapter, the economic system and resource transfers from one sector to another could be complicated and multi-directional. Consequently, accounting for all resource transfers from each and every sector to other sectors in the economy is impossible. An alternative method is to identify the direction of resource transfers using causality analysis, and the causal linkages will help explain the direction of resource transfers. The magnitude of the estimates explains the impacts of one sector on the other.

This chapter is organized as follows: The first part describes the data source and how the different economic sectors are measured. The second part introduces the variables and the endogenous time series empirical model. The third part describes the estimation procedure of the empirical model, which includes long- and short-run inter-sectoral relationships. The fourth part explores a procedure to analyze the dynamic inter-relationships among the sectors. The fifth part will describe the methodology that is used to validate the empirical model.

4.1 Data

Annual time series data in 1990 US dollars (constant price) from 1985 to 2007 were collected from the World Bank dataset, which is published at http://data.un.org/. These data are used to identify the inter-sectoral linkages among different sectors in the economies of Poland, Romania, Bulgaria and Romania. Data on the pre-transition period (prior to 1989) was not used in the estimation since the heavily distorted command economic system is not comparable to the transition period[4]. The United Nations publishes the World Bank dataset using the International Standard of Industrial

[4] See the chapter 2.

Classification (*ISIC*). This approach defines three sectors (agriculture, industry and service) as broad aggregates, and the definition of each category is described in Table 4.1. The export share of GDP is used as a proxy (See Appendix 4.1) for all other factors such as institutional setting, legislation, and internal and external shocks that affect sectoral outputs. The export share data were obtained by using the following equation:

$$Export\ Share_t = \frac{Export_t}{GDP_t} \times 100$$

Table 4.1Description of Variables

Variable	Definition (constant price, basis=1990)	ISIC[5] categories	Data Description
Agricultural sector	Agriculture, hunting and forestry; and fishing	A,B	Annual data of different sectors in the economy of Poland and Romania was collected from the period of 1985 to 2007 at: http://data.un.org/ Online: May 06, 2009
Industrial sector	Mining and quarrying; manufacturing; electricity, gas and water supply	C, D,E	
Service sector	Wholesale, retail trade, repair of motor vehicles, motor cycles and personal and household goods; hotels and restaurants; transport, storage and communication; financial intermediation; real estate, renting and business activities; public administration and defense, compulsory social security; education; health and social work; other community, social and personal service activities; activities of household.	G, H, I, J, K, L, M. N, O, P	
Export sector	Export share of GDP	N/A	

Source: United Nations Statistical Division, 2009

[5] International Standard of Industrial Classification of All Economic Activities.

4.2 Empirical Model

The following endogenous growth model is established for each country to identify the inter-sectoral linkages and understand how they affect the economy.

$$G_j = g(Agric, Indus, Serv, Trade) \quad (4.1)$$

where G_j denotes the economic growth of sector j,

Agric = log of agricultural sector GDP;

Indus = log of industrial sector GDP;

Serv = log of service sectoral GDP; and,

Trade = log of export share.

4.3 Estimation of Empirical Model

This study conducts cointegration analysis using the technique developed by Johansen (1988, and 1991) and Johansen and Juselius (1990). They proposed a maximum likelihood estimation procedure which allows the simultaneous estimation of a system involving two or more variables to circumvent the problems associated with the traditional regression analysis. This empirical estimation is conducted in a four-step process. In the first step, the data set is tested for stationarity and unit root characteristics. If the null hypothesis of the non-stationary is not rejected by the stationary tests, the analysis moves to the second step. The second step involves cointegration tests with Johansen's (1991) framework to identify rank conditions. If the first two steps indicate that the data sets are non-stationary and cointegrated, the third step, estimating the vector error correction model (VECM) of equation, is performed. In the fourth step, impulse response functions (see section 4.4) are constructed to understand how a shock in one sector is transferred to the other sectors using the dynamic interrelationships.

4.3.1 Stationarity and Unit-Root Tests

Most time series data are non-stationary and must be transformed to a stationary series before models are fitted. If the series has non-stationary characteristics[6], the conventional asymptotic theory cannot be applied for these series. Taking the log of the series may result in stationarity. If the series has a trend over time, seasonality or some other non-stationarity pattern, the usual solution is to take the difference of the series from one period to the next period or to introduce an appropriate explanatory variable if the trend and seasonal effects are very regular. Sometimes the series needs to be differenced more than once or differenced at lags greater than one period in order to have stationarity properties.

The first step of this analysis is to test whether the series are stationary. A simple method to test stationary is based on the autocorrelation function (ACF). The ACF at lag k, denoted by ρ_k, is defined as

$$\rho_k = \frac{\gamma_k}{\gamma_0} \tag{4.2}$$

where $\gamma_k$is the $covaiance\ at\ lag\ k$ and $\gamma_0$is the variance. Equation 4.2 is simply the ratio of the covariance to variance, and a plot of ρ_k against k is the correlogram. If the correlogram indicates that the autocorrelation coefficient tapers off very gradually, then it is an indication that the time series is non-stationary. By contrast, if a stochastic process is purely random, its correlation at any lag greater than zero is zero.

An alternative test of stationarity is the unit-root test. This study applies the augmented Dickey Fuller (ADF) test to each series to assess the stationarity and unit-root characteristics. The ADF is a widely used test in time series analysis, and was developed from the Dickey-Fuller (DF) test[7] (Dickey and Fuller, 1979), which consists of three different regression equations (4.3-4.5) to test the presence of a unit root.

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[6] A series is non-stationary if its mean, variance, and covariance are not constant over time.

[7] A simple AR (1) model is $y_t = \delta y_{t-1} + \varepsilon_t$ where y_t is the variable of interest, t is the time index, δ is a coefficient, and ε_t is the error term. A unit root is present if $|\delta|$ =1 -- the model would be non-stationary in this case.

$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t \quad (4.3)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + \varepsilon_t \quad (4.4)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_1 t + \varepsilon_t \quad (4.5)$$

These models have been modified by incorporating autoregressive progresses (equation 4.6). The null hypotheses of equations 4.3- 4.5 are that $\gamma = 0$. Failing to reject the null hypothesis means that the data set has unit-root, and therefore the data set is non-stationary. In addition, the DF test provides *F* statistics of joint hypotheses for equations 4.4 and 4.5. The null hypotheses of *F*-tests are $\gamma = a_0 = 0$ for equation 4.4, and $\gamma = a_0 = a_1 = 0$ for equation 4.5. However, not all time series variables can be well represented by the first-order autoregressive process as presented above, so, the ADF test also provides higher order autoregressive relationships. A p-th order of autoregressive process can be written as:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 y_{t-3} + \cdots$$
$$+ a_{p-2} y_{t-p+2} + a_{p-1} y_{t-p+1} + a_p y_{t-p} + \varepsilon_t \quad (4.6)$$

By adding and subtracting $(a_{p-1} + a_p) y_{t-p+2}$:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 y_{t-3} + \cdots$$
$$-(a_{p-1} + a_p)\Delta y_{t-p+2} - (a_p)\Delta y_{t-p+1} + \varepsilon_t$$

Continuing this process, we obtain

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{j=1}^{p-1} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (4.7)$$

where $\gamma = -\left[1 - \sum_{i=1}^{p} a_i\right]$ and $\beta_i = -\sum_{j=1}^{p} a_j$

The coefficient of interest in equation 4.7 is the value of γ. As the dependent variable in equation 4.7 is a first difference, $\gamma = 0$ means that $a_1$in equation 4.6 equals 1. This concludes that the variable y_t has a unit root. As in the Dickey-Fuller test, the model can be written in three forms; with and without a trend or intercept. The tests assume that the errors are independent and have a constant variance. Therefore, including an appropriate lag length in the model is necessary.

4.3.2 Determination of Lags

Too few lags mean that the regression residuals do not behave like white-noise processes[8]. This means the model will not appropriately capture the actual error processes so that γ and its standard error will not be well-estimated. Including too many lags reduces the power of the test to reject the null of a unit root since an increased number of lags requires an estimation of additional parameters and a loss of degrees of freedom. Maddala and Kim (1998) described the guidelines for identifying the optimum number of lags. Enders (2004) proposes a rule to find the appropriate lag length. The process starts with a relatively long lag length and pares down the model by the usual t-tests or *F*-tests. If the *t*-statistic for the coefficient at specific lag length $P*$ is insignificant at a specified critical value, then the regression will be re-estimated using a $P*\text{-}1$ lag length. The process will be repeated until the lag coefficient is significantly different from zero. Hall (1994) called this rule "general to specific." The other rule Hall described is "specific to general" which starts with a small lag and increases the lags successively until a non-significant coefficient is encountered. Hall shows that the "specific to general" approach is not generally asymptotically valid.

In addition to the use of *F* and *t*-tests, it is also possible to determine the lag length using information criteria such as the Akaike Information Criteria (AIC) and the Schwartz Bayesian Information Criteria (BIC). The following formulas are used to estimate AIC and BIC criteria:

$$AIC\ (p) = nlog(\hat{\sigma}^2) + 2p, \tag{4.8}$$

$$BIC(p) = nlog(\hat{\sigma}^2) + plog(n) \tag{4.9}$$

[8] A white noise process is a random process of random variables that are uncorrelated, have zero mean, and a finite variance (s^2). Formally, e_t is a white noise process if $E(e_t) = 0$, $E(e_t^2) = s^2$, and $E(e_t e_j) = 0$ for $t \neq j$.

where n is the sample size and p is the total number of parameters estimated. If the residual sum of squares($\sum \hat{\varepsilon}^2$) is RSS then $\hat{\sigma}^2 = RSS/(n-p)$. In order to find the best fitted model, one should select a model with the lowest AIC or BIC.

If the stationarity tests show that the series have unit-root characteristics, the procedure enters into the second stage of tests. At this stage, we need to use the Johansen procedure to identify the order of integration, test for cointegration, and find the number of rank conditions.

4.3.3 Identifying Order of Integration

Before testing for cointegration, the order of integration of the individual time-series must be determined. The ADF for the unit root test can be used to determine the order of integration. As stated earlier in this chapter, differencing (de-trending) is one way to transform a non-stationary dataset. If the non-stationary series becomes stationary after differencing once, then the series said to be integrated of order one, and it is denoted by *I(1)*. If the series needs to be differenced *d* times (to make it stationary), the series is said to be *I(d)*[9]. If the variables in a system are integrated of different orders, it is possible to conclude they are not cointegrated in the usual sense of the term. However, if some variables are *I(1)* and some are *I(2)* then it is important to determine whether the variables are multi-cointegrated[10].

4.3.4 Cointegration and Tests for Rank Condition

Cointegration is an econometric property of time series variables. If two or more variables are non-stationary, but a linear combination of them are stationary, then the

[9] The I(d) series ($d \neq 0$) is also called a difference stationary process. Since the number of differences is equal to the order of integration, an autoregressive integrated moving average (ARIMA) process denoted as ARIMA (p,d,q) process.
[10] For example, suppose x_{1t} and x_{2t} are I(2) and another variable under consideration, x_{3t}, is I(1). There cannot be a cointegrating relationship between x_{1t} (or x_{2t}) and x_{3t}. However, if x_{1t} and x_{2t} are I(2), there exists a linear combination of the form $\beta_1 x_{1t} + \beta_2 x_{2t}$ which is I(1). It is possible that this combination of x_{1t} and x_{2t} is cointegrated with the I(1) variable, x_{3t} (Enders, 2004).

series are said to be cointegrated[11]. Prior to the 1980s, many economists applied linear regressions on (de trended) non-stationary time series data, which can produce spurious correlation.[12]

There are two main methods to test for cointegration: (1) The Engel-Granger two-step method, and (2) Johansen Procedure. This study employs the Johansen procedure which was developed by Johansen and Juselius (1992). The procedure is based on canonical correlations[13], which is assessing the relationship among variables. The standard Pearson correlation coefficient (r) depends highly on the basis in which the variables are described. However, the canonical correlation analysis is a way of measuring the linear relationship between two multi-dimensional variables. An important property of canonical correlation is that the correlations are invariant with respect to the affine transformations of the variables. Furthermore, the Johansen procedure is independent of the choices of the endogenous variables, and it allows researchers to estimate and test for the existence of more than one cointegrating vectors in a multivariate system.

The cointegrating rank test determines the number of linearly independent columns of long-run relationships (Π) and this will be determined by using the trace (λ_{trace}) and maximum eigenvalue (λ_{max}) statistics proposed by Johansen (1988). The tests identify the number of characteristics roots that are significantly different from unity using the equation 4.11 for λ_{trace} and 4.12 for λ_{max}.

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (4.11)$$

$$\lambda_{max}(r, r+1) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_{r+1}) \quad (4.12)$$

[11] For example, if two series are integrated at the order of one, *I(1)*, but linear combinations of these variables are integrated at the order of zero, *I(0)*, then these variables are said to be cointegrated.
[12] Spurious correlation is a correlation between two variables that does not arise from any direct relationship between them, but from their relation to other variables.
[13] Canonical correlation is a form of correlation that is relating to two sets of variables. It is also called characteristic root. Eigenvalues are approximately equal to the canonical correlations squared.

where $\hat{\lambda}_i$ is the estimated values of the characteristics roots (called eigenvalues) obtained from the estimated *Π* matrix, and *T* is the number of usable observations.

Equation 4.11 is called the *trace test*. It tests the hypothesis that there are at most *r* cointegrating vectors. In this test, λ_{trace} equals zero when all $\hat{\lambda}_i$ are zero. The further the estimated characteristic roots are from zero, the more negative is $ln\ (1-\hat{\lambda}_i)$ and the larger the λ_{trace} statistic. For instance, to test a hypothesis that the variables are not cointegrated ($r = 0$) against the alternative of one or more cointegrating vectors (r > 0), we need to calculate the $\lambda_{trace}(0)$ statistics:

$$\lambda_{trace}(0) = -T[\ln(1-\lambda_1) + \ln(1-\lambda_2) + \ln(1-\lambda_3)] \qquad (4.13)$$

Equation 4.12 is called the *maximum eigenvalue test*. It tests the hypothesis that the number of cointegrating vectors is *r* against the alternative hypothesis of $(r+1)$ cointegrating vectors. If the estimated value of the characteristic root is close to zero, then the λ_{max} will be small.

Similarly, $r = 0$ can be tested against $r = 1$ through $\lambda_{\max}(0)$ by using the following statistic:

$$\lambda_{\max}(0) = -Tln(1-\lambda_1) \qquad (4.14)$$

The calculated statistic will be compared to the critical value. If the statistics of (4.13) is rejected then the conclusion is that there exists at least one cointegrating relationship among the variables. Similarly, if the statistics from equation (4.14) is rejected, then the conclusion is that there exists one cointegrating relationship.

To determine the exact number of cointegrating vectors, the above processes will be continued by testing $\lambda_{trace}(1)$ and $\lambda_{\max}(1)$, $\lambda_{trace}(2)$ and $\lambda_{\max}(2)$ and so on until we fail to reject the null hypothesis. Based on these results, we can establish the number of cointegrating vectors. It is important to note that if the number of cointegrating vectors equals the number of endogenous variables (r = k, where k is the number of endogenous variables), then the series should be stationary, and the VAR is the appropriate model. When we have established the number of cointegrating vectors, the next step of this analysis is to estimate the long-run estimates and the speed of adjustment coefficients using the appropriate deterministic terms.

4.3.5 Estimation of Long-and Short-Run Estimates

Use of cointegration information in the error correction model is the key process in non-stationary time-series analysis, and the general model can be described as follows:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \mu D_i + \varepsilon_t \tag{4.15}$$

where Y_t is a column vector of the current values of all endogenous variables in the system, D_t is a matrix of deterministic variables such as intercept and time trend, ε_t is the vector of errors assumed $E\left(\epsilon_t \epsilon_t^{'}\right) = \Omega$ for all t; Γ, Π, and μ are the parameter estimate matrices. The *p* is the number of lag periods included in this model, which is determined by using the AIC and BIC. The first term in equation 4.15 captures the long-run effects on the regressors and the second term captures the short-run impact. The long run parameter matrix, Π (equation 4.15), will be of the order *n x n*, with a maximum possible rank of *n*. According to the Granger representation theorem (Engel and Granger, 1987), if the rank of Π is found to be $r < n$, the matrix Π may be factored as $\alpha\beta'$ where α and β are both of order *n x r*. In such a case, the combination of $\beta' Y_t$ is *I(0)* even though Y_t itself is *I(1)*. In other words, it is the cointegrating matrix describing the long-run relationships in the model. The weighted matrix, α, gives us the speed of adjustment for specific variables when they deviate from the long-run relationship.

4.3.6 Testing Restrictions

One of the most interesting aspects of the Johansen procedure is that it allows for testing restrictive forms of the cointegrating vectors. If there are *r* cointegrating vectors, only these *r* linear combinations of the variables are stationary; all other linear combinations are non-stationary. In a cointegrated system, if a variable does not respond to the discrepancy from the long-run equilibrium relationship, it is weakly exogenous.

Hence, if the speed of adjustment parameter, α_i, is zero, the variable is weakly exogenous.

4.4 Impulse Response Functions

In order to estimate the total impacts of one sector on the other, the model should include all the inter-sectoral linkages in the model. One-way to estimate the total impact is by constructing an impulse response function (IRF). An IRF traces the effect of a one standard deviation shock in one of the endogenous variables. In other words, a shock in one variable will be transferred to the other variables in the system through the dynamic structure model.

To impose a one-period shock to one of the endogenous variables, say the agricultural sector, the error term of the agricultural sector equation will be increased by one standard deviation at time t=0. The shock will be maintained for only one period. Since the agricultural sector will affect the other sectors, the shock will filter through the system, affecting all other variables in the model. In later periods it may even have a greater impact on the agricultural sector than it did initially because of feedback effects through the other variables in the system. This study constructs IRFs to determine how a shock in the agricultural sector will be transferred to the other sectors, and how the agricultural sector responses to shocks in the other sectors.

4. 5 Structural Stability Test

All the former socialist countries experienced several shocks during the process of transition. These events might have influenced the estimates of the model and therefore it is important to test the structural stability of estimated coefficients. One of the most common tests to test the structural stability is CUSUM of square test. An advantage of this test is that you do not need to know any information on structural breaks for the analysis. The null hypothesis of this test is that there is no structural break. If the estimated residuals crossed either of upper or lower bound limits, which are determined by using 95 percent confidence intervals, the null hypothesis is rejected. The CUSUM of squares test uses squared residuals (Brown, Durbin and Evans, 1975) and based on a plot of the quantities:

$$S_r = \frac{\sum_{j=k+1}^{r} w_j^2}{\sum_{j=k+1}^{T} w_j^2} \tag{4.12}$$

where T = total number of observations; k = number of regressors; $r = k+1, \ldots .T$; and w_j^2= squared residuals at j^{th} observation.

If the test shows evidence of a structural break, the model should incorporate a set of dummy variables to reflect the structural break and to obtain efficient estimates.

Chapter 5 : Results and Discussion

To understand the impact of transition on the agricultural, industrial and service sectors in the economies of Bulgaria, Romania, Poland and Hungary, this study focuses on the inter-sectoral linkages by examining the long-run, short-run and dynamic properties of the series by conducting cointegration analysis. The first part of this chapter discusses how the transition process altered the sectoral compositions. The second part focuses on univariate properties of each series. The third part presents the results of rank conditions. The fourth part presents the long-run estimates. The fifth part presents the results of short-run estimates. The sixth part presents the dynamic nature of short-run estimates by constructing impulse response functions, and the seventh part presents the results on structural stability of the models.

5.1 Sectoral Compositions and Transition Process

One of the notable differences among the countries (Poland, Romania, Bulgaria and Hungary) is that each country had a specific sectoral composition during the pre-transition period, and these compositions played a major role in the transition process. For instance, the economies of Bulgaria and Romania were dominated mostly by the industrial sector, and the contribution of service and agricultural sectors to the national GDPs were relatively low. On the other hand, the Hungarian economy was dominated by a well-established service sector, and the Polish economy was diversified between the industrial and service sectors. Such unique sectoral dominances impacted the outcomes of transition. As stated in chapter two, the privatization and liberalization polices affected the industrial sector severely, and therefore, impacts of transition in Bulgaria and Romania are expected to be more severe than in Poland and Hungary.

5.1.1 Sectoral Outputs and Composition - Bulgaria

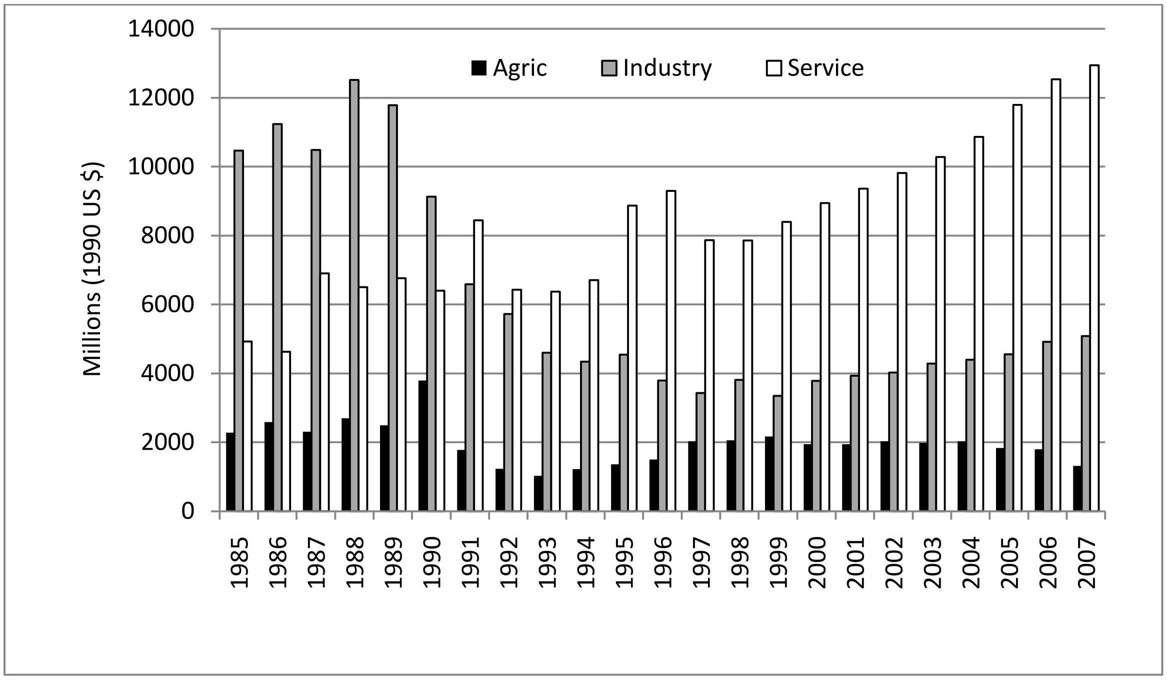
The sectoral outputs and their share in the Bulgarian economy are presented in Figures 5.1 and 5.2, respectively. The contribution of the industrial sector to the GDP (value added) was 53 percent in 1988, which reiterates the dominant role the sector played in the economy during the pre-transition period. The impact of transition is clearly shown in Figure 5.2 as the industrial share dropped by 8 percentage points during the first year of transition, and it continued to drop until 1997. The total drop in the industrial sector was 72 percentage points compared to the 1988 level.

During the first year of transition (in 1990), agricultural output reached its record high; the share of agriculture reached 18 percent (an increase of 8 percentage points) of GDP, and it was equivalent to a 53 percent increase compared to the 1989 output level. However, the sudden increase in agricultural output was transitory, and output dropped quickly until 1993, when it reached a low in percentage of output. Thereafter, the agricultural output slightly increased until 1999 before the sector reach its record low in 2007 (in terms of agricultural share).

The impact on the service sector was not significant in the first year; however, the sector grew at a high rate between 1990 and 1996. During this period the service sector grew by 42.8 percent. Consequently, the service sectoral share increased to 61 percent while the industrial share shrunk to 24 percent by 2007. The figure further suggests that industrial resources were relocated to the service sector, and the service sector became the dominant economic sector in the Bulgarian economy.

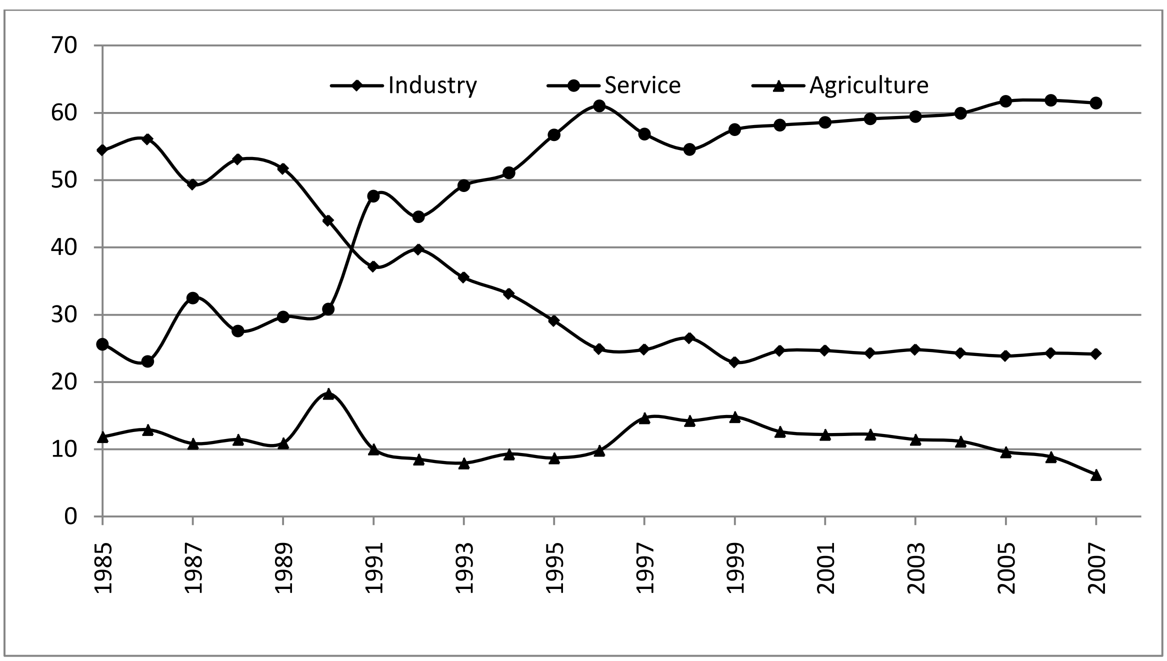
One of the most striking observations in the Bulgarian transition is that in spite of the speedy relocation of industrial resources into the service sector, Bulgarian GDP (value added) still has not reached its pre-transition period (1988) level. The data show that the 2007 GDP remains 10.7 percent lower than the 1988 level. These results clearly show that the transition of the Bulgarian economy has been very difficult.

Figure 5.1: Sectoral Outputs - Bulgaria



Source: United Nations Statistical Division, 2009

Figure 5.2: Sectoral Shares - Bulgaria



Source: United Nations Statistical Division, 2009

5.1.2 Sectoral Outputs and Composition - Romania

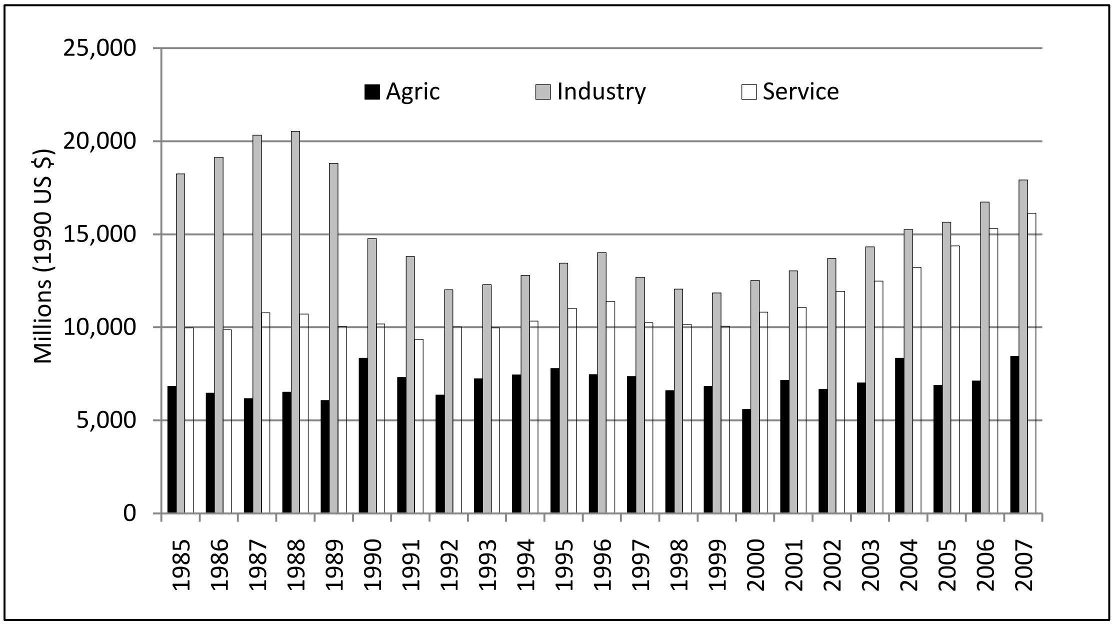
The sectoral outputs and their contribution to the Romanian economy are presented in Figures 5.3 and 5.4, respectively. During the pre-transition period, the industrial sector dominated the Romanian economy, and its contribution to the GDP was 51 percent. The contribution of the service sector was 28 percent. Similar to the Bulgarian economy, the industrial sector in Romania shrank 9 percentage points and the agricultural share increased by 7 percentage points in the first year of transition. However, the Romanian transition differed from the Bulgarian transition in a number of ways.

First, the Romanian economy experienced a “double bottom” during the transition period. In the beginning of the transition, sectoral outputs dropped gradually and reached the first bottom in 1992. Then, the economy grew until 1996, and reached another bottom in 1999 before its growth stabilized. Notably, the industrial and agricultural outputs dropped lower than the 1992 level. These results show that the transition policies adopted during the period (1989-1999) did not provide sustainable economic growth.

Second, during the pre-transition period, the industrial sector dominated the Romanian economy; however, as Figure 5.3 shows, industrial output still hasn’t reached its 1989 level after 18 years of transition. It suggests that the Romanian industrial sector was hit severely by its transition policies (as it was in Bulgaria). Yet, the main difference is that the industrial sector is still maintaining its dominant role in the Romanian economy.

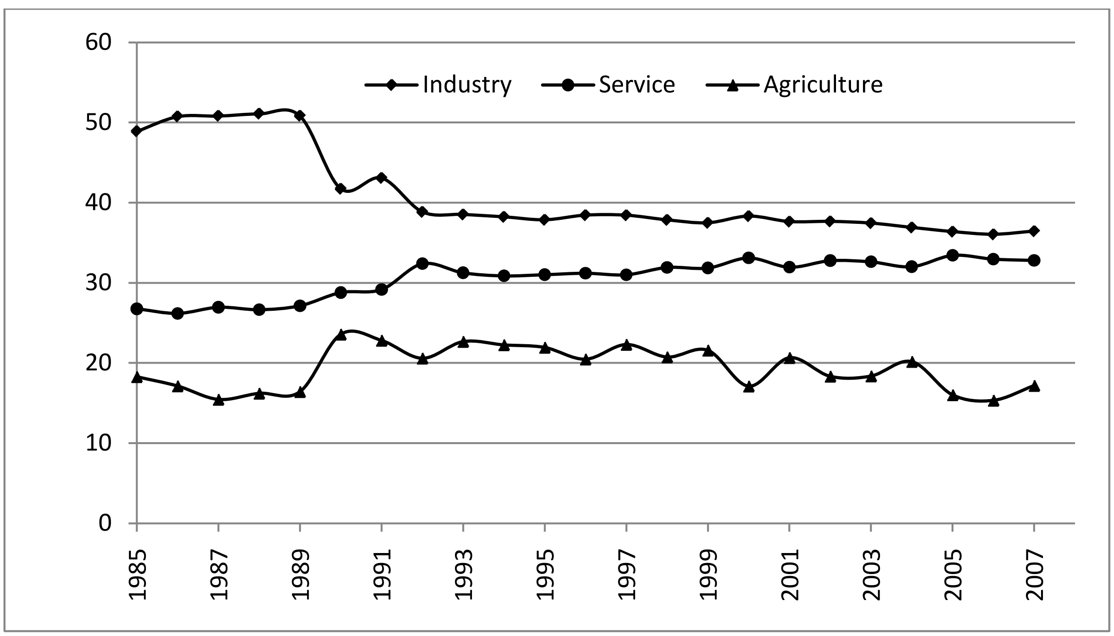
Third, the agricultural sector still plays a significant role in the total GDP in Romania, and it accounts for a larger share of GDP compared to other transition countries examined in this study. Therefore, the agricultural sector and its inter-sectoral linkages could play a significant role in the other sectors of the Romanian economy. Furthermore, the agricultural sector played an important role during the early transition period. For instance, while industrial outputs contracted during the early stages of transition, agricultural output showed the opposite trend -- a record high agricultural output was observed during this period.

Figure 5.3: Sectoral Outputs - Romania



Source: United Nations Statistical Division, 2009

Figure 5.4: Sectoral Shares – Romania



Source: United Nations Statistical Division, 2009

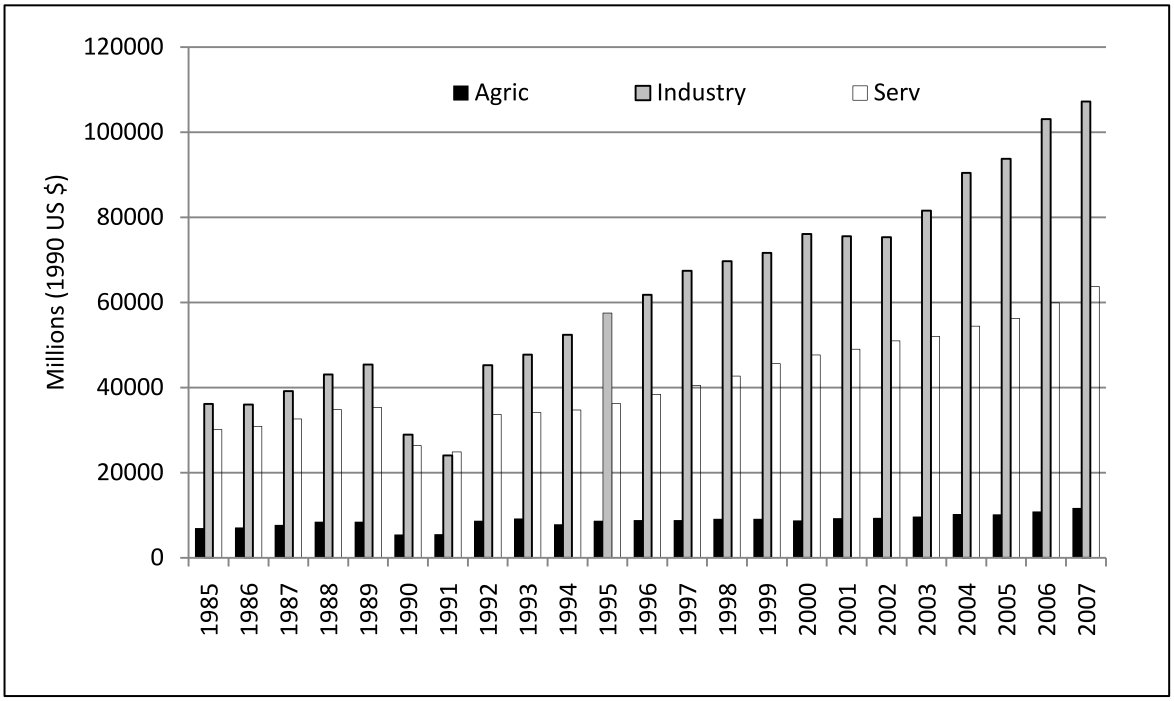
This increase suggests that the agricultural sector played a buffer role by absorbing a significant number of laid-off industrial workers during the early transition. In contrast to the Bulgarian economy, the Romanian economy surpassed its 1988 GDP in 2004, after 15 years of transition.

5.1.3 Sectoral Outputs and Composition - Poland

The sectoral outputs and their contribution to the Polish economy are presented in Figures 5.4 and 5.5. During the pre-transition period both the industrial and service sectors played dominant roles in the Polish economy. This is a significant difference from the Romanian and Bulgarian economies, where the industrial sector alone played the dominant role. Figure 5.4 further implies that all three sectoral outputs dropped significantly in the first three years (1989 to 1991), with the lowest outputs for each in1991. However, the country experienced the highest economic growth in its history in 1992. The industrial and agricultural sectoral outputs reached the pre-transition period level within a short period of time. Since 1992, the two major sectors, industry and services, have grown steadily and have dominated the Polish economy. The agricultural sector has not attained such high growth; however, its outputs are still growing.

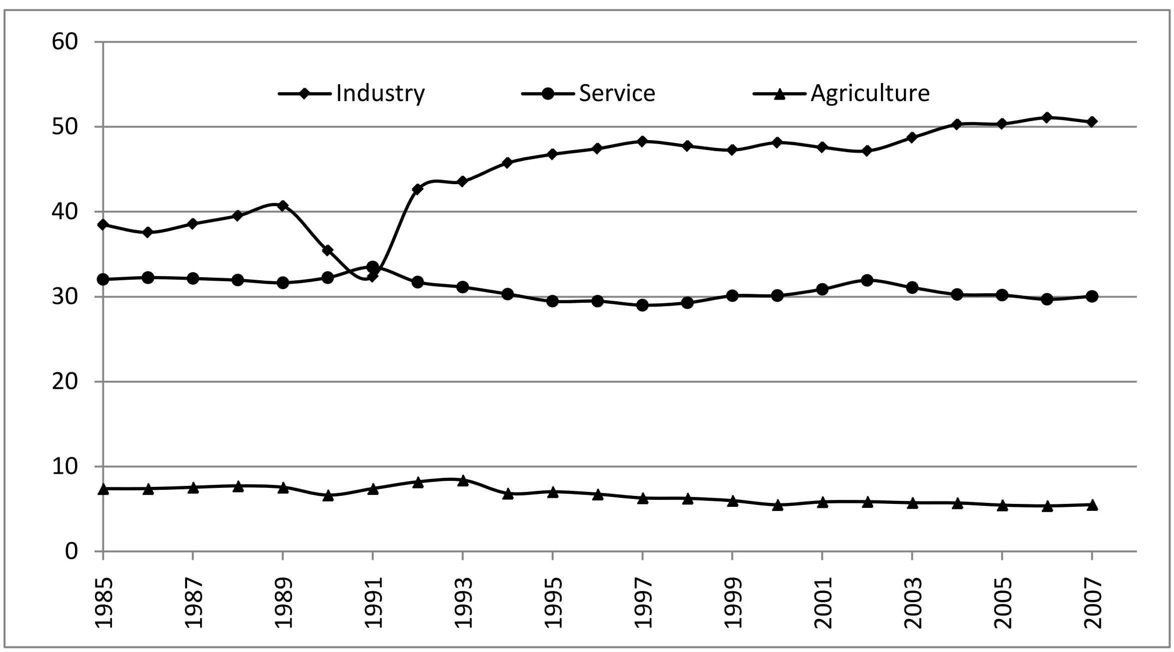
Figure 5.5 further implies that while the contribution of the industrial sector to the economy is steadily increasing, the contributions of the agriculture and service sectors have shrunk slightly over time. This means the growth of the industrial sector is exceptional. The industrial output in 2007 is 148 percent higher than its 1988 output level. Similar values for the service and agricultural sectors are 83 and 39 percent, respectively. These results show that the Polish industrial sector has gone through a very successful transition, while the Romanian and Bulgarian industrial sectors failed to do so.

Figure 5.5: Sectoral Outputs - Poland



Source: United Nations Statistical Division, 2009

Figure 5.6: Sectoral Shares - Poland



Source: United Nations Statistical Division, 2009

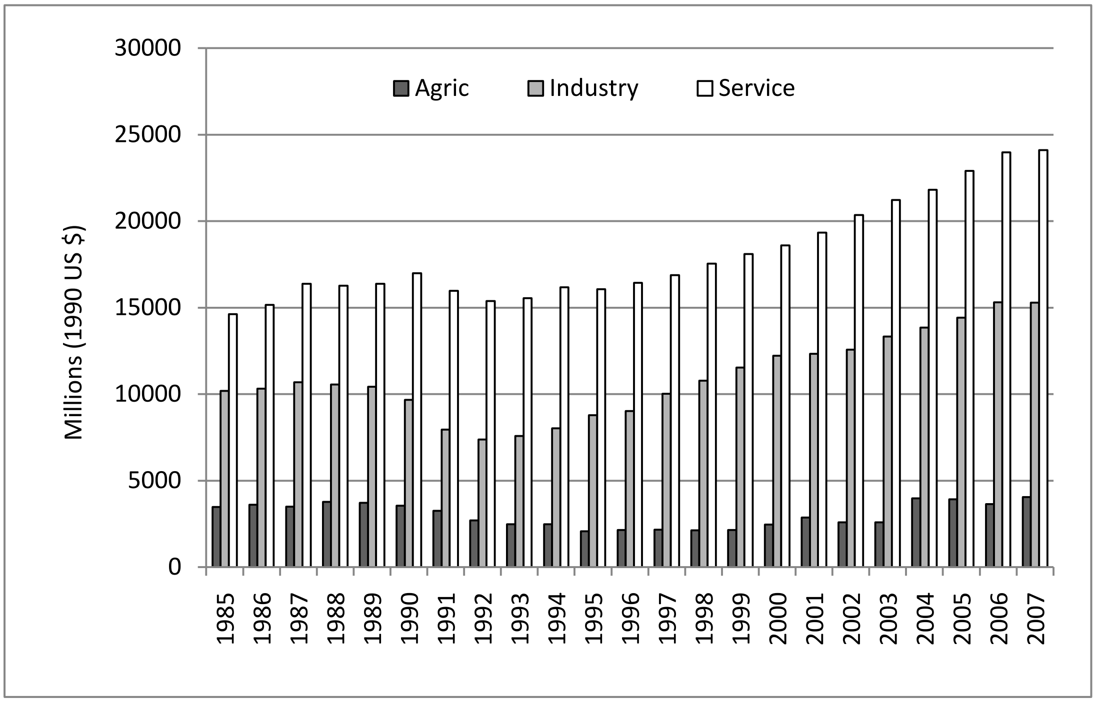
5.1.4 Sectoral Outputs and Composition - Hungary

The sectoral outputs and their contribution to the Hungarian economy are presented in Figure 5.7 and 5.8, respectively. The Hungarian sectoral composition and the transition process differed from the other three countries in a number of ways. First, during the pre-transition period, the Hungarian economy was dominated by the service sector. For instance, in 1988, the share of the service sector to the GDP was 50 percent, and the contributions of industrial and agricultural sectors were 33 and 11 percents, respectively. The Hungarian economy had the highest service orientation and the least industrialized economy among these four transition countries.

Second, the impact of transition in the Hungarian economy was not as severe as the other three industry-dominated economies. Poland and Hungary experienced their lowest GDP in 1992; however, the drop was severe in Poland (20 percent) compared to Hungary (15 percent). It shows that the Hungarian economy was better able to cope with the transition impacts and, consequently, the transition policies produced better results in Hungary than in many other countries. Major reasons for such a smooth transition were that (1) the size of the industrial sector -- since the impacts of transition were highest in the industrial sector, the smaller industrial sector (30 percent of GDP) ignited a relatively smaller shock. (2) the relatively smaller shock (in the industrial sector) was absorbed by the well-established service sector. Figure 5.8 clearly illustrates how the sectoral composition changed in the early transition period.

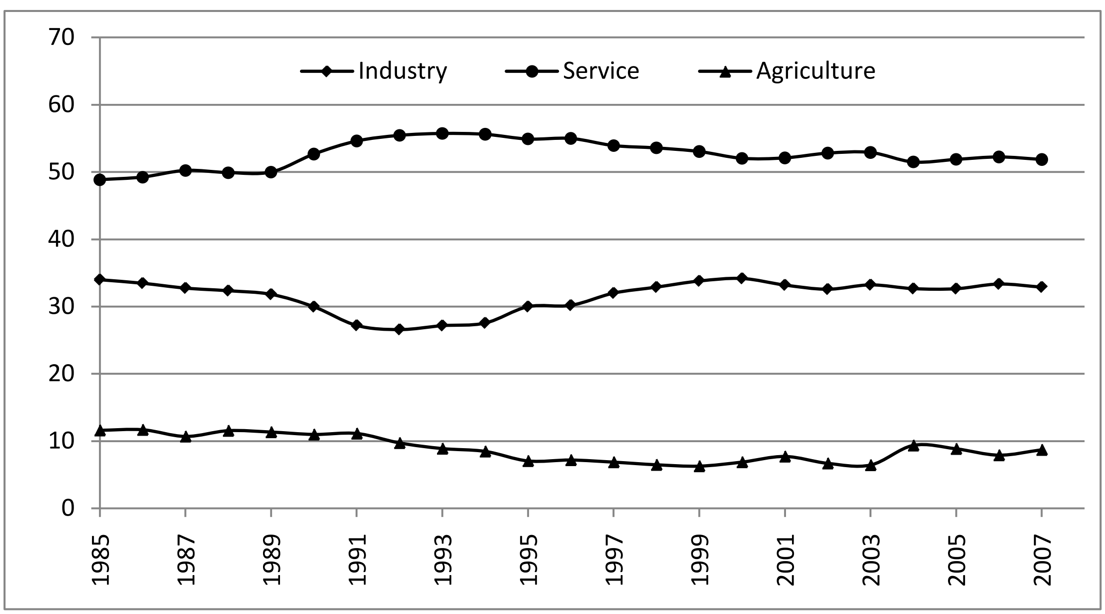
Third, the Hungarian sectoral composition did not change as significantly as in the other three countries. This suggests that the major sectors, the industry and service grew, on average, at a constant rate. Our data show that during the transition period (from 1989-2007) both the service and industrial sectors increased by 46 percent, while, the agricultural sector grew by 9 percent in the same period.

Figure 5.7: Sectoral Outputs - Hungary



Source: United Nations Statistical Division, 2009

Figure 5.8: Sectoral Shares - Hungary



Source: United Nations Statistical Division, 2009

5.1.5 Summary

These results suggest that the transition from command economy to the market oriented economy causes changes in sectoral compositions. These changes occurred as the resources were transferred from inefficient sectors to more efficient sectors. Speed and the direction of transfers could be influenced by a number of factors, including government policies, market conditions, as well as pre-existing conditions. Therefore, each county found itself in a unique position in their transition process. As the sectoral compositions change, the inter-sectoral relationship among the sectors will also follow suit. The old linkages may be substituted by new, and the roles of each sector might have changed.

For instance, the agricultural sector seems to play an important role in the Romanian economy since the contribution of agriculture to the GDP is between 15-20 percent. Similar values for all other three countries fluctuate between 7 and10 percents. These results show that the agricultural sector could play mixed roles in these countries. Similarly, the industrial sector plays a very important role in Poland while the service sector leads both Bulgaria and Hungary. Therefore, identifying the established inter-sectoral linkages will provide important information in understanding the transition process in these countries. This information could be useful for future planning and for policy making in these countries.

5. 2 Univariate Properties

Each series is tested for stationarity properties using the augmented Dickey Fuller (ADF) test for Poland, Hungary, Bulgaria and Romania. The results are presented in Tables 5.1 and 5.2. The null hypothesis for this test is that the series has a unit root. The results show that the hypothesis was not rejected for all the series, meaning that all series are non-stationary in levels. This is not unexpected since most macroeconomic time series variables are generally known to have unit-root characteristics as past values of the series are strongly correlated with subsequent values. The series were differenced once, and the differenced series were tested for unit-roots. The results are presented in Tables 5.1 and 5.2 (columns 4 and 6).

Table 5.1: Augmented Dickey Fuller Unit-Root Test- Poland and Hungary

	Type	Poland		Hungary	
		Level	First differences	Level	First differences
Agriculture	Zero mean	-0.46	-2.71	0.21	-3.13*
	Single mean	-2.43	-3.29*	-0.60	-3..04*
	Trend	-2.97	5.19**	-1.77	-6.00**
Industry	Zero mean	-1.01	-3.56*	3.28	-1.86*
	Single mean	-1.66	-4.14*	-1.55	-4.41*
	Trend	-3.23	-4.86*	2.50	3.64*
Service	Zero mean	1.30	-4.46*	1.38	-1.72
	Single mean	-2.62	-5.00*	0.66	-3.55*
	Trend	-3.72	-3.71*	-2.03	-3.95*
Trade	Zero mean	3.73	-2.13*	3.89	-2.03*
	Single mean	-0.32	-3.82*	0.27	-3.64*
	Trend	-2.60	-3.69*	-2.24	-3.49*

*, ** indicate that the tau-values are significant at 5% and 1%, respectively.

Table 5.2 Augmented Dickey Fuller Unit-Root Test- Bulgaria and Romania

	Type	Bulgaria		Romania	
		Level	First differences	Level	First differences
Agriculture	Zero mean	-0.02	-3.57*	-0.15	-4.98*
	Single mean	-2.58	-3.42*	-2.47	-4.80*
	Trend	-1.58	-4.05*	-2.26	-4.79*
Industry	Zero mean	-0.45	2.97*	-0.85	-3.27*
	Single mean	-1.65	-2.72*	-0.90	-3.58*
	Trend	-2.86	3.27*	-1.69	-5.23**
Service	Zero mean	-0.60	-3.68*	-0.96	-2.95*
	Single mean	-0.79	-4.05*	-0.34	-3.47*
	Trend	-3.00	-4.38*	-0.90	-4.34*
Trade	Zero mean	-0.50	-3.03*	-1.06	4.81*
	Single mean	-2.19	-4.84*	-1.96	-2.76*
	Trend	2.48	4.64*	-0.40	-4.04*

*, ** indicate that the tau-values are significant at 5% and 1%, respectively.

The results show that all the series are non-stationary at levels and stationary at first differences. Since the series became stationary after one differencing, the series is said to be integrated at the order one, I(1).[14] The next step of this analysis is to test whether the series are cointegrated.

5. 3 Long-Run Estimates and Adjustment Coefficients

The results of rank tests along with critical values for both maximum eigenvalue and trace tests for Bulgaria, Romania, Poland and Hungary are presented in Tables 5.3, 5.4, 5.5 and 5.6, respectively. The eigenvalues (shown in column 4) play the major role in

[14] An important property of *I(1)* variables is that there can be linear combinations of the variables that are *I(0)*. If this is so, then these variables are said to be *cointegrated.*

determining the λ_{max} and λ_{trace}. The estimated values of λ_{max} (column 5) and λ_{trace} (column 8) are compared to the respective critical values at the 5% and 10% levels (which were obtained from Maddala and Kim, 1998).

Table 5.3 Evidence of Cointegration - Bulgaria

Hypotheses			Maximum eigenvalue test				Trace statistical test		
Ho	H1[1]	H1[2]	Eigen value	λ_{max} values	5% critical value	10% critical value	λ_{trace} values	5% critical value	10% critical value
r = 0	r = 1	r ≤ 1	0.9727	61.20*	27.07	24.73	122.6*	47.21	43.84
r = 1	r = 2	r ≤ 2	0.8984	38.87*	20.97	18.60	61.42*	29.38	26.70
r = 2	r = 3	r ≤ 3	0.7344	22.54*	14.07	12.07	22.56*	15.34	13.31
r = 3	r = 4	r ≤ 4	0.0012	0.02	3.76	2.69	0.02	3.84	2.71

* denotes reject the null hypothesis.[1, 2] denote alternative hypothesis for maximum eigenvalue and trace statistical tests, respectively.

Table 5.4 Evidence of Cointegration - Romania

Hypotheses			Maximum eigenvalue test				Trace statistical test		
Ho	H1[1]	H1[2]	Eigen value	λ_{max}values	5% critical value	10% critical value	λ_{trace} values	5% critical value	10% critical value
r = 0	r = 1	r ≤ 1	0.8685	37.74*	27.07	24.73	61.15*	47.21	43.84
r = 1	r = 2	r ≤ 2	0.5735	15.82	20.97	18.60	23.41	29.38	26.70
r = 2	r = 3	r ≤ 3	0.2929	6.71	14.07	12.07	7.59	15.34	13.31
r = 3	r = 4	r ≤ 4	0.0568	0.88	3.76	2.69	0.88	3.84	2.71

* denotes reject the null hypothesis. [1, 2] denote alternative hypothesis for maximum eigenvalue and trace statistical tests, respectively.

Table 5.5 Evidence of Cointegration - Poland

Hypotheses			Maximum eigenvalue test				Trace statistical test		
Ho	H1[1]	H1[2]	Eigen value	λ_{max} values	5% critical value	10% critical value	λ_{trace} values	5% critical value	10% critical value
r = 0	r = 1	r ≤ 1	0.9325	45.82*	27.07	24.73	87.62*	47.21	43.84
r = 1	r = 2	r ≤ 2	0.7257	21.99*	20.97	18.60	41.80*	29.38	26.70
r = 2	r = 3	r ≤ 3	0.6752	19.17*	14.07	12.07	19.80*	15.34	13.31
r = 3	r = 4	r ≤ 4	0.0367	0.64	3.76	2.69	0..64	3.84	2.71

* denotes reject the null hypothesis. [1, 2] denote alternative hypothesis for maximum eigenvalue and trace statistical tests, respectively.

Table 5.6 Evidence of Cointegration - Hungary

Hypotheses			Maximum eigenvalue test				Trace statistical test		
Ho	H1[1]	H1[2]	Eigen value	λ_{max} values	5% critical value	10% critical value	λ_{trace} values	5% critical value	10% critical value
r = 0	r = 1	r ≤ 1	0.9137	41.64*	27.07	24.73	94.17*	47.21	43.84
r = 1	r = 2	r ≤ 2	0.8387	31.02*	20.97	18.60	52.53*	29.38	26.70
r = 2	r = 3	r ≤ 3	0.7065	20.84*	14.07	12.07	21.51*	15.34	13.31
r = 3	r = 4	r ≤ 4	0.0386	0.67	3.76	2.69	0.67	3.84	2.71

* denotes reject the null hypothesis. [1, 2] denote alternative hypothesis for maximum eigenvalue and trace statistical tests, respectively.

Both the λ_{max}, and λ_{trace} results show that null hypotheses of r = 0, 1 and 2 for Bulgaria, Poland and Hungary, and the null hypotheses of r = 0 for Romania are rejected at the 5% level (the estimated values are greater than the critical values). This suggests that there exists a maximum of three cointegrating vectors for Bulgaria, Poland and Hungary, and one for Romania. The existence of cointegration is consistent with our earlier unit root diagnostic tests, which predicted that all the data series were non-stationary. Since the rank tests confirmed the existence of cointegration, the resulting model should be a vector error correction model (VECM). The next step of this analysis is to impose the number of rank conditions, which is three for Bulgaria, Poland and Hungary, and one for Romania, to the VECM. The resulting model will estimate cointegrating vectors, which would reflect the stable long-run equilibrium relationships, dynamic short-run relationships and other deterministic components such as intercept and time-trend based on our model specifications.

5. 4 Cointegrating Vectors

Since we have established the number of cointegrating vectors using both maximal and trace eigenvalue test statistics, the cointegrating vectors are determined for both countries. The most appropriate model was selected using the diagnostic characteristics such as Durbin-Watson, AIC and BIC, Jargue-Bera normality statistics, and autoregressive conditional heteroscedasticity (ARCH) disturbances. Consequently, models for Poland, Romania and Bulgaria included an intercept and a linear-trend while model for Hungary included an intercept term to determine the long-run relationships and short-run dynamic estimates. Recall that the difference between the case 3 and case 5 is that the former does not have the linear trend (γ_t).

$$\Delta y_t = \Pi y_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + \gamma_0 + \gamma_t + \varepsilon_t \tag{5.3}$$

$$\Delta y_t = \Pi y_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + \gamma_0 + \varepsilon_t \tag{5.4}$$

The Π is a *4x4* matrix as the model contains four endogenous variables. Three cointegrations for Bulgaria, Poland and Hungary, and one for Romania were imposed to estimate the Π matrix, and the results are presented in Tables 5.7-5.10, respectively.

Table 5.7: Long-Run Matrix - Bulgaria.

$$\begin{bmatrix}\Delta Agric_t\\ \Delta Indus_t\\ \Delta Serv_t\\ \Delta Trade_t\end{bmatrix}=\begin{bmatrix}-0.2633 & -0.8023 & -0.0399 & -0.1004\\ -0.1314 & -0.0576 & -0.6160 & -0.0999\\ -0.0597 & 0.3799 & -1.1237 & 0.0844\\ -0.1749 & 0.1489 & -0.1215 & -1.6548\end{bmatrix}\begin{bmatrix}Agric_{t-1}\\ Indus_{t-1}\\ Serv_{t-1}\\ Trade_{t-1}\end{bmatrix}$$

Table 5.8: Long-Run Matrix - Romania.

$$\begin{bmatrix}\Delta Agric_t\\ \Delta Indus_t\\ \Delta Serv_t\\ \Delta Trade_t\end{bmatrix}=\begin{bmatrix}-0.4516 & -2.3702 & 2.7110 & 0.4520\\ -0.0926 & -0.4858 & 0.5556 & 0.0926\\ 0.1824 & 0.9574 & -1.0951 & -0.1826\\ -0.1279 & -0.6712 & 0.7677 & 0.1280\end{bmatrix}\begin{bmatrix}Agric_{t-1}\\ Indus_{t-1}\\ Serv_{t-1}\\ Trade_{t-1}\end{bmatrix}$$

Table 5.9: Long-Run Matrix - Poland.

$$\begin{bmatrix}\Delta Agric_t\\ \Delta Indus_t\\ \Delta Serv_t\\ \Delta Trade_t\end{bmatrix}=\begin{bmatrix}-0.5606 & 0.2352 & -2.4279 & -0.6697\\ 0.1493 & 0.0580 & -3.1876 & -0.0073\\ 0.0081 & 0.2409 & -1.8315 & -0.2741\\ -0.7356 & 0.7157 & -0.9775 & -1.02686\end{bmatrix}\begin{bmatrix}Agric_{t-1}\\ Indus_{t-1}\\ Serv_{t-1}\\ Trade_{t-1}\end{bmatrix}$$

Table 5.10: Long-Run Matrix - Hungary.

$$\begin{bmatrix}\Delta Agric_t\\ \Delta Indus_t\\ \Delta Serv_t\\ \Delta Trade_t\end{bmatrix}=\begin{bmatrix}-1.3187 & -0.8428 & 7.0340 & 0.0608\\ -0.0432 & -0.4481 & -0.6061 & 0.0457\\ 0.1164 & 0.1399 & -0.9545 & -0.0768\\ -0.1716 & 1.7153 & -2.6136 & -1.1788\end{bmatrix}\begin{bmatrix}Agric_{t-1}\\ Indus_{t-1}\\ Serv_{t-1}\\ Trade_{t-1}\end{bmatrix}$$

The Π estimates represent the product of long-term estimates, β, and the adjustment coefficients, α, for each sector in the growth equations. Since the objective of this study is to understand the contribution of the agricultural sector and to what extent it is influenced by other sectors in the economy, this study concentrates on the first row of the Π matrix (standard errors are in parentheses).

Bulgaria:

$$[\Delta Agric_t] = \begin{bmatrix} -0.2633 & -0.8023 & -0.0399 & -0.1004 \\ (0.1232) & (0.1697) & (0.5673) & (0.6298) \end{bmatrix} \begin{bmatrix} Agric_{t-1} \\ Indus_{t-1} \\ Serv_{t-1} \\ Trade_{t-1} \end{bmatrix} \tag{5.4}$$

Romania:

$$[\Delta Agric_t] = \begin{bmatrix} -0.4516 & -2.3702 & 2.7110 & 0.4520 \\ (0.1667) & (0.8747) & (1.0005) & (0.1668) \end{bmatrix} \begin{bmatrix} Agric_{t-1} \\ Indus_{t-1} \\ Serv_{t-1} \\ Trade_{t-1} \end{bmatrix} \tag{5.5}$$

Poland:

$$[\Delta Agric_t] = \begin{bmatrix} -0.5606 & 0.2352 & -2.4279 & -0.6697 \\ (0.2039) & (0.2402) & (0.4078) & (0.3794) \end{bmatrix} \begin{bmatrix} Agric_{t-1} \\ Indus_{t-1} \\ Serv_{t-1} \\ Trade_{t-1} \end{bmatrix} \tag{5.6}$$

Hungary:

$$[\Delta Agric_t] = \begin{bmatrix} -1.3187 & -0.8428 & 7.0340 & 0.0608 \\ (0.2629) & (1.1134) & (2.3850) & (0.6324) \end{bmatrix} \begin{bmatrix} Agric_{t-1} \\ Indus_{t-1} \\ Serv_{t-1} \\ Trade_{t-1} \end{bmatrix} \tag{5.7}$$

Equations 5.4 to 5.7 illustrate how agricultural growth is affected by the past values of all the sectors in Bulgaria, Romania, Poland and Hungary, respectively. It is important to note that the estimates in the equations 5.4 to 5.7 are based on the fact that there exists a maximum of three cointegrating vectors for Bulgaria, Poland and Hungary, and one for Romania.

The long-run relationships will be identifiable when one of the βs is arbitrarily normalized. Since this study is mainly focusing on the agricultural sector, it is convenient to normalize on the agricultural sector. The following section discusses the results of the long-run relationships among the variables for all four countries.

5.4.1: Long-run Relationship - Poland

The estimates for stable long-run equilibrium and the adjustment coefficients were estimated (Table 5.11) and normalized to the agricultural sector (Table 5.12).

Table 5.11: Estimated Long-Run Estimates and Speed of Adjustment - Poland

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 11.61 & 15.99 & 25.90 \\ Indus & -9.10 & -35.08 & -13.43 \\ Serv & 30.26 & 55.86 & -14.39 \\ Trad & 17.96 & 48.46 & 31.63 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -.098 & 0.013 & 0.014 \\ Indus & -0.094 & 0.006 & 0.045 \\ Serv & -0.042 & -0.004 & 0.022 \\ Trad & -0.020 & -0.010 & -0.013 \end{bmatrix}$$

Table 5.12: Normalized Long-Run Estimates and Speed of Adjustment Coefficients - Poland

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 1.00 & 1.00 & 1.00 \\ Indus & -0.78 & -2.19 & -0.52 \\ Serv & 2.61 & 3.49 & -0.56 \\ Trad & 1.55 & 3.03 & 1.22 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -1.14 & 0.21 & 0.37 \\ Indus & -1.10 & 0.09 & 1.16 \\ Serv & -0.49 & -0.06 & 0.57 \\ Trad & -0.23 & -0.16 & -0.34 \end{bmatrix}$$

The stable long-run equilibria for of Poland, presented in Table 5.12, can be written as:

$$Agric = 0.78\ Indus - 2.61\ Serv - 1.55\ Trade \tag{5.8}$$

$$Agric = 2.19\ Indus - 3.49\ Serv - 3.03\ Trade \tag{5.9}$$

$$Agric = 0.52\ Indus + 0.56\ Serv - 1.22\ Trade. \tag{5.10}$$

5.4.1.1 Impact of Industry on Agriculture - Poland

The positive signs of the industrial sector in all three stable long-run relationships suggest that there exists a strong positive relationship to the agricultural sector. This implies that an increase in the industrial sector will affect the agricultural sector positively, holding all other variables that affect the agricultural sector constant. This relationship is reiterated in Figure 5.5, in which, both sectoral outputs are continually increasing, but at different rates. This positive relationship (between the agricultural and the industrial sectors) contradicts the view of the traditional economic growth theory, which predicts that as the economy grows, the significance of the agricultural sector will diminish as the resources, such as land, labor and capital, are transferred to more efficient sectors, such as the industrial sector. If this proposition is true, we would have negative signs on the industrial sector. Yet, the positive signs for all three long-run relationships imply the existence of strong forward and backward relationships between the industrial and agricultural sectors.

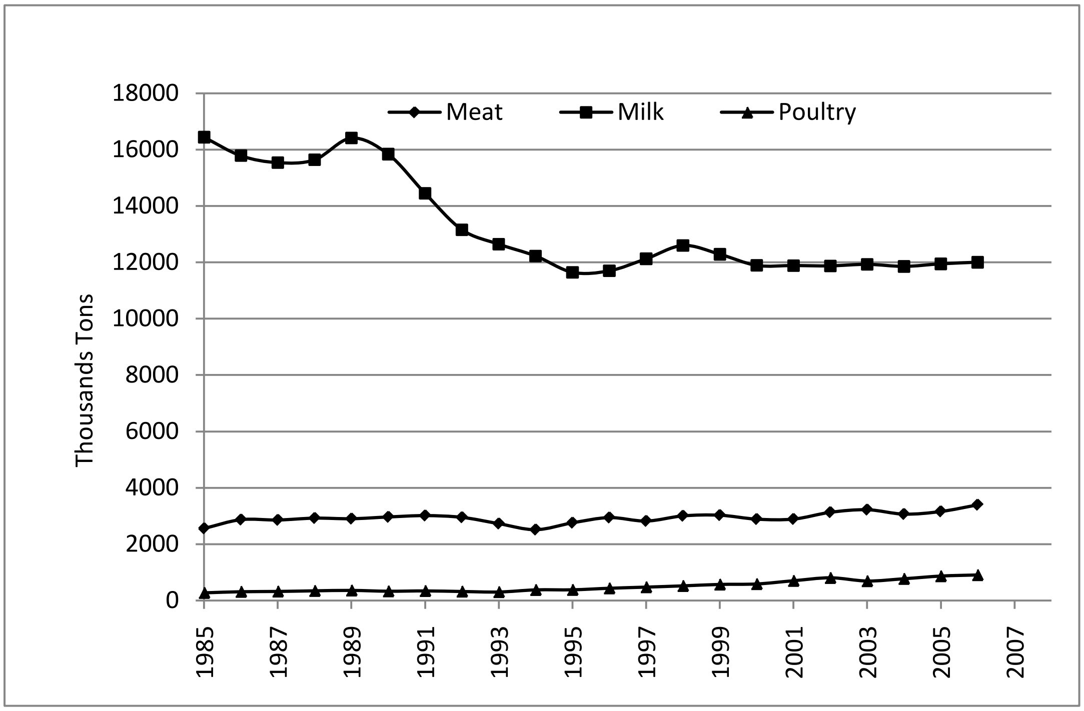
The forward relationship represents the impacts of agricultural outputs on the industrial sector. For instance, a number of agricultural food processing firms employ the agricultural outputs as its inputs. For example, meat products are used in other meat processing industries to produce sausages, burgers, hotdogs, ground meat etc; nuts and grains are used in oil extraction firms; fruits and vegetables are used in various beverage firms. Therefore, an increase in food processing outputs will stimulate the demand for farm outputs, and this will cause the positive relationship between the agricultural and industrial sectors.

Figures 5.9 show how some of major agricultural processing industries evolved during the transition period. The figure further reveals that during the pre-transition period, the food processing industries were dominated by processed milk. However, its dominance was reduced by 26 percent during the transition period. Liberalization and privatization policies attracted a large amount of foreign direct investments into Poland.[15]

[15] Walkenhorst (2001) found that Poland has attracted US$17.7 billion FDI inflows during the period between 1991 and 1997. During the period, the total investment in the food industry was US$3.3 billion, or 18.5% of total FDI. It turned Poland into a country with the biggest stock of FDI among all other CEE countries.

In the period between 1991and 1997, investment in meat and poultry processing industries increased by 20 and 152 percents, respectively.

Figure 5.9: Processed Livestock Output - Poland



Source: FAOSTAT, 2009

A backward relationship is also noted in the Polish agricultural sector. For example, agricultural land in Poland has continually decreased (Figure A5.1), and therefore, a drop in agricultural output is expected. However, the increasing agricultural output implies that the Polish agricultural sector managed to outweigh the negative effect (land loss) by increasing its productivity by using modern technologies and better input factors. For example, since 1990, the use of agricultural tractors has continually increased in Poland (Figure A5.2).

The increasing number of tractors indicates that Polish farmers are adopting modern technologies to expand production, and therefore agricultural productivity is continually increasing. Another indication of increasing productivity is the use of fertilizers in the Polish agricultural sector (Figure A2.5). All these results validate our findings that there exist strong positive long-run relationships between the agricultural and the industrial sectors through forward and backward relationships.

Changes in the sectoral economies are closely associated with movement in employment. During the transition period, the labor movement from industry to agriculture and agriculture to other sectors is well-documented. For example, Boeri and Terrel (2002) noted that in the early transition period, industrial labor in Poland decreased by 7.9 percent while the agricultural labor increased by 0.6 percent. However, the service sectoral employment increased by 6.9 percent. This labor transfer indicates that the service sector played an important role, and its contribution to the economy was crucial during the early transition period.

5.4.1.2 Impact of Service on Agriculture- Poland

The long-run impacts of the service sector on the agricultural sector are mixed (Table 5.7). The results suggest that there exists two negative and one positive relationships. This means growth in some components of the service sector affect the agriculture negatively while some other components affect positively.

The strong service sector combined with private landownership helped agriculture to be a competitive sector in Poland. At early stages of development, the service sector is able to stimulate growth of the agricultural and industrial sectors, and therefore, a positive relationship is expected. However, in more mature economies, resources such as land, labor and capital will be transferred to the service sector due to higher income elasticities for services compared to the industrial and agricultural products. This leads to a negative relationship between the service and agricultural sectors.

Two of three stable long-run relationships show that the service sector is detrimental to the agricultural sector (equations 5.8 and 5.9) in Poland. This means that either agricultural resources are transferred to the service sector as a result of a higher demand for the service sector, or the demand for local agricultural production decreased as a result of a greater demand for imported food from the rest of Europe. The latter could be significant because of Poland's proximity to Western Europe, and its openness to the rest of the world. Imported food (both fresh and processed) could easily dominate the local market, and therefore, reduce the importance of local production.

5.4.2 Long-run relationship - Romania

The estimates for the stable long-run equilibrium and the adjustment coefficients were estimated (Table 5.13) and normalized to the agricultural sector (Table 5.14).

Table 5.13: Estimated Long-Run Estimates and Speed of Adjustment - Romania:

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 8.83 \\ Indus & 46.32 \\ Serv & -52.98 \\ Trad & -8.83 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -0.05 \\ Indus & -0.01 \\ Serv & 0.02 \\ Trad & -0.01 \end{bmatrix}$$

Table 5.14: Normalized Long-Run Estimates and Speed of Adjustment Coefficients - Romania

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 1.00 \\ Indus & 5.25 \\ Serv & -6.00 \\ Trad & -1.00 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -0.45 \\ Indus & -0.09 \\ Serv & 0.18 \\ Trad & -0.13 \end{bmatrix}$$

The stable long-run equilibrium of Romania, presented in Table 5.14, can be written as:

$$Agric = -5.25\, Indus + 6.00\, Serv + 1.00\, Trade \qquad (5.11)$$

5.4.2.1 Impact of Industry on Agriculture - Romania

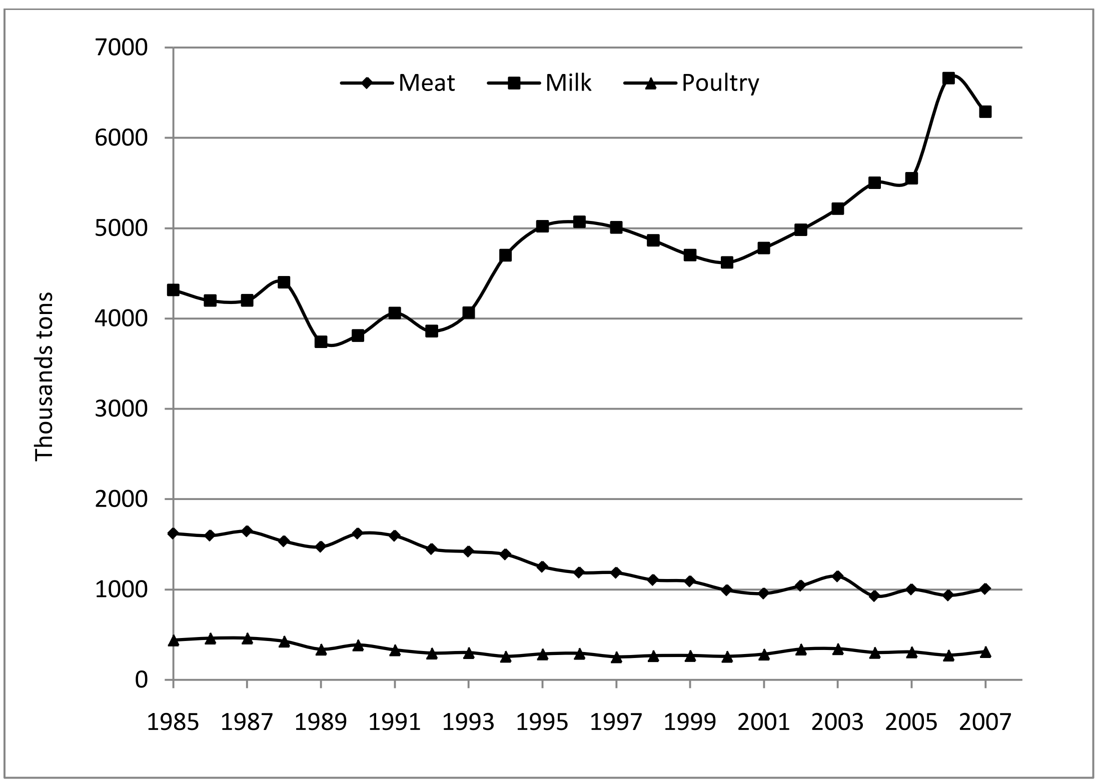
Unlike the Polish economy, the long-run relationship between the industrial and agricultural sectors was negative for the Romanian economy. This means that as the industrial sector grows, on average, the growth of the agricultural sector will diminish, holding all other variables that affect the agricultural sector constant. This contradiction might be explained by a number of factors. First, in 1990, both Poland and Romania had their first free elections. The anticommunist Solidarity Party in Poland won the elections, and the new government adopted a shock therapy to make a speedy transition. However, Romania chose the successor of the communist party leader, Ion Iliescu, and he stayed in power together with his party until 1996.

During this period, Romania followed a gradual transition path, and such a transition process failed to provide the appropriate environment for the small-scale private sector to take off. For instance, Boeri and Terrel (2002) found that, in 1996, the employment share in firms fewer than 100 employees was 16 percent in Romania compared to 50.3 percent in Poland. Furthermore, hyper inflation, higher black market premiums for foreign exchange, and limited trade dependencies hindered entrepreneurs in Romania. Second, the agricultural sector in Poland was practically private from the beginning and it was never collectivized as in Romania. The privatization of agricultural land in Romania was started in 1991, and it was based on the restitution of 9.5 million hectares, which represents 66 percent of total agricultural land. About 5.7 million people received up to 10 hectares of land. The average land size distributed was 1.8 hectares per owner, which is detrimental to modern agriculture. Third, the newly elected, former communist government was much more powerful, and spent resources to maintain its power base through the large loss-making state owned enterprises in Romania. All these factors contributed to the negative relationship between the agricultural and industrial sectors.

These effects substantiate the fact that during the first eight years of liberalization, agricultural employment in Romania increased by 10 percent (Swinnen et al, 2005). Therefore, we may conclude that the Romanian transition process failed to overcome the early labor movements (industry to agriculture) because the second part of the labor movements (agriculture to industry) could not dominate the former, resulting in a negative relationship between the industrial and agricultural sectors.

Output from food processing industries (Figure 5.10) shows that while meat and poultry industries are continually decreasing, the milk processing industries show an upward trend. This trend contradicts the pattern of Poland's food processing industries. Processed milk output increased by 68 percent during the transition period in Romania. However, both meat and poultry output decreased by substantial amounts -- 32 and 8 percent, respectively. The decrease in meat and poultry outputs may have resulted from an increase in food imports from the rest of the world as well as higher income elasticity of these products. The reduction of such products also could have contributed to the negative linkage between the agricultural and the industrial sectors.

Figure 5.10: Processed Livestock Output - Romania



Source: FAOSTAT, 2009

5.4.2.2 Impact of Service on Agriculture - Romania

The empirical analysis shows that the service sector in the Romanian economy has positively contributed to the agricultural sector. Figure 5.3 confirms that the agricultural sector grew 30 percent and the service sector grew 51 percent since the transition began. The results shows that on average, a one percent increase in the service outputs resulted in 6 percent growth in the agricultural output in the long-run, holding all other factors that affect the agricultural sector constant. This means that the agricultural sector has benefitted from the fast growing service sector. For instance, improvements in transportation, marketing and finance facilities would have created a positive backward linkage to the agricultural sector.

Since the beginning of transition, the agricultural land use in Romania decreased only by 4 percent (Figure A5.1). This means, despite the large agricultural sector, the resource transfer from the agriculture to other sectors is somewhat limited. This is because large amounts of resources were released from the industrial sector. The direction of resource transfer confirms that the Romanian economy has not fully utilized its resources, and this implies that the Romanian economy is still at a progressing stage. At this level of development, demand for the service sector is, in general, not high enough to transfer a significant amount of resources from the other sectors. Thus, the agricultural sector still plays an important role in the Romanian economy compared to many other transition countries in the region.

5.4.3 Long-Run Relationship - Bulgaria

Similar to Poland, the Bulgarian economy has established three long-run relationships, and the estimates for long-run equilibrium and the adjustment coefficients were estimated (Table 5.15) and normalized to the agricultural sector (Table 5.16).

Table 5.15: Estimated Long-Run Estimates and Speed of Adjustment - Bulgaria

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 0.0323 & 0.0060 & -0.0624 \\ Indus & 0.0131 & 0.0228 & 0.2543 \\ Serv & 0.1772 & -0.0089 & -0.0195 \\ Trad & 0.1343 & 0.1455 & 0.0176 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -1.0128 & 6.1771 & 14.1757 \\ Indus & -1.7024 & 5.8409 & -2.2617 \\ Serv & -6.5954 & 2.9001 & -0.8561 \\ Trad & -1.5938 & -13.6509 & -2.4145 \end{bmatrix}$$

Table 5.16: Normalized Long-Run Estimates and Speed of Adjustment Coefficients - Bulgaria

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 1.00 & 1.00 & 1.00 \\ Indus & -35.95 & -2.10 & -0.67 \\ Serv & 37.86 & 9.64 & 3.48 \\ Trad & 47.13 & 0.39 & 5.19 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & 0.03 & 0.02 & -0.28 \\ Indus & 0.01 & 0.06 & -0.08 \\ Serv & -0.02 & -0.13 & 0.07 \\ Trad & -0.01 & -0.11 & -0.28 \end{bmatrix}$$

The stable long-run equilibriums of Bulgaria, presented in Table 5.16, can be written as:

$$Agric = 35.95\,Indus - 37.86\,Serv - 47.13\,Trade \tag{5.12}$$

$$Agric = 2.10\,Indus - 9.64\,Serv - 0.39\,Trade \tag{5.13}$$

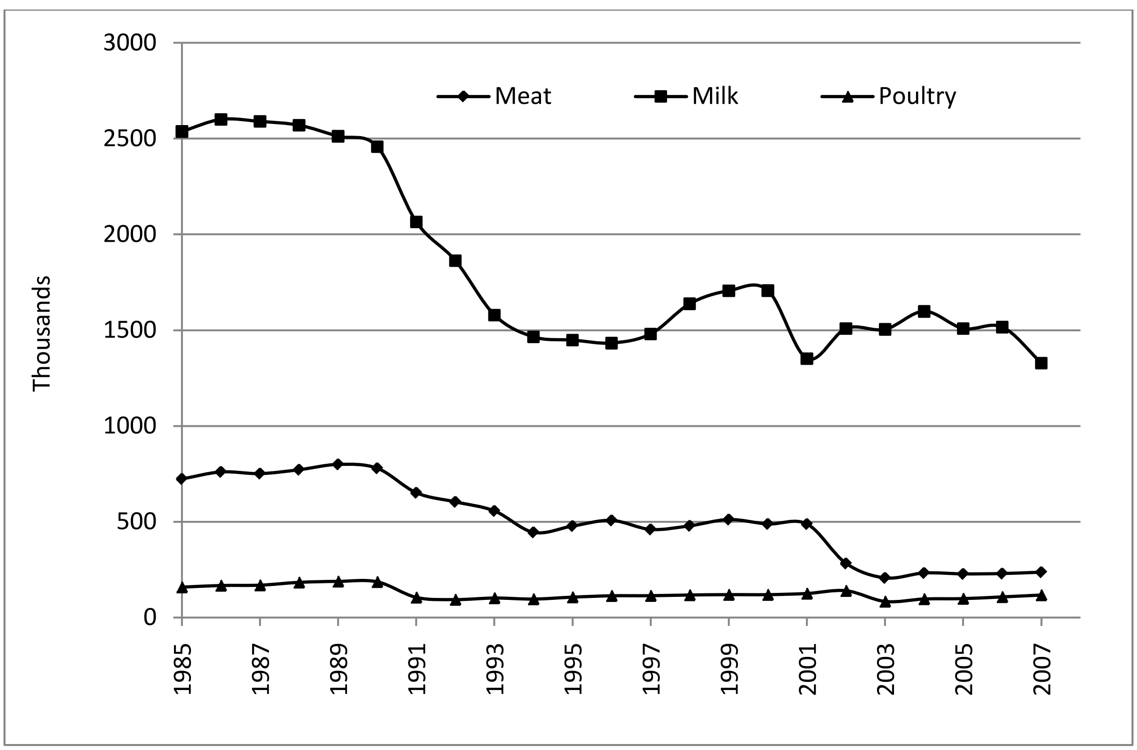
$$Agric = 0.67\,Indus - 3.48\,Serv - 5.19\,Trade. \tag{5.14}$$

5.4.3.1 Impact of Industry on Agriculture - Bulgaria

Even though the Bulgarian and Polish economies established the same number of cointegrating vectors, the Bulgarian economy differs from the Polish economy in a number of ways. First, the effects of the industrial sector on the agricultural sector appear to be similar, i.e., all three long-run relationships have positive signs, and the results indicate, on average that an increase in industrial output will lead to an increase in agricultural growth. However, these effects hold in the opposite direction too. Since the industrial sector continually decreased for a ten years period (Figure 5.1), the agricultural sector followed a similar pattern. Figure 5.1 further implies that since 2000, the industrial sector output shows an upward trend in while the agricultural sector output shows a downward trend. Consequently, a negative sign on the industrial sector is expected; however, the negative effect seems to be outweighed by the strong positive effects.

Second, the lack of productivity increases in the agricultural sector reiterates the fact that there are no strong backward linkages from the industrial to the agricultural sector. The number of tractors used in Bulgarian agriculture (Figure A5.2) decreased by 39 percent in the period between 1990 and 2002. Another noticeable characteristic of Bulgarian agriculture is a 66 percent drop in the fertilizer use during the same time period (Figure A2.5). It is interesting to notice that during the same period, Polish agriculture increased tractor use by 15 percent and fertilizer use by 24 percent. These results indicate that not only the industrial sector is depleted during the transition, but also the agricultural sector is abandoned from investments.

Figure 5.11: Processed Livestock Output - Bulgaria



Source: FAOSTAT, 2009

Third, since the agricultural sector is ignored, the food processing industry cannot take off as in other countries. Consequently, the agricultural sector could neither make any strong forward linkage to the industrial sector nor did the industrial sector establish a backward linkage to the agricultural sector. The burden on the total economy was significant as the impacts were negative in all three sectors (impact on service sector will be discussed in the following section). Figure 5.11 shows that milk, meat and poultry output is consistent with our estimation that all three food items decreased over time and this is reflected in the production, productivity and investments in the agricultural sector.

5.4.3.2 Impact of Service on Agriculture - Bulgaria

The long-run effects of the service sector on the agricultural sector are negative, which means, in the long-run, an expansion of the service sector will be detrimental to the agricultural sector. Figure 5.2 shows that the service sector has become the most dominant sector in Bulgaria, and the agricultural and industrial sectors are continually transferring their resources to the service sector. Since the food processing industries, mechanization, technological improvements and investments in the agricultural section did not improve, the growing service sector did not produce any positive impact on the agricultural sector. In other words, the agricultural sector failed to utilize the benefits of a growing service sector. Since the agricultural sector has not utilized the available service goods (banking, finance, transportation) the growth and efficiency of the service sector were not maximized.

During the period between 1989 and 2005, agricultural land in Bulgaria decreased by 15 percent whilst the service sectoral output increased by 51 percent. The growing service sector also affects the local agricultural production indirectly by increasing the supply of imported food items in the local markets. So the ultimate effect of the service sector is negative on the agricultural sector.

5.4.4 Long-Run Relationship – Hungary

Similar to Poland and Bulgaria, the Hungarian economy established three long-run relationships, and the estimates for long-run equilibrium and the adjustment coefficients were estimated (Table 5.17) and normalized to the agricultural sector (Table 5.18).

Table 5.17 Estimated Long-Run Estimates and Speed of Adjustment - Hungary

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 0.0703 & 0.0592 & 0.1116 \\ Indus & -1.0398 & 0.5096 & 1.3523 \\ Serv & 0.4067 & -0.3591 & -0.3043 \\ Trad & -0.1711 & 0.2424 & 0.1436 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -10.9279 & -7.6178 & -3.2070 \\ Indus & 1.6556 & 1.1896 & -0.6212 \\ Serv & 1.4476 & 0.6495 & -2.5187 \\ Trad & 0.6381 & -8.4810 & 0.3581 \end{bmatrix}$$

Table 5.18 Normalized Long-Run Estimates and Speed of Adjustment Coefficients - Hungary

$$\beta \text{ matrix: } \begin{bmatrix} Agric & 1.00 & 1.00 & 1.00 \\ Indus & 2.38 & 5.04 & -1.12 \\ Serv & -3.11 & -5.74 & 0.25 \\ Trad & -0.83 & -.56 & -0.36 \end{bmatrix}$$

$$\alpha \text{ matrix: } \begin{bmatrix} Agric & -0.15 & 0.23 & -0.15 \\ Indus & -0.17 & -0.12 & 0.03 \\ Serv & -0.08 & 0.02 & 0.01 \\ Trad & -0.01 & -0.09 & 0.14 \end{bmatrix}$$

The stable long-run equilibriums of Hungary, presented in Table 5.18, can be written as:

$$Agric = -2.38\ Indus + 3.11\ Serv + 0.83\ Trade \tag{5.15}$$

$$Agric = -5.04\ Indus + 5.74\ Serv + 0.56\ Trade \tag{5.16}$$

$$Agric = 1.12\ Indus - 0.25\ Serv + 0.36 Trade. \tag{5.17}$$

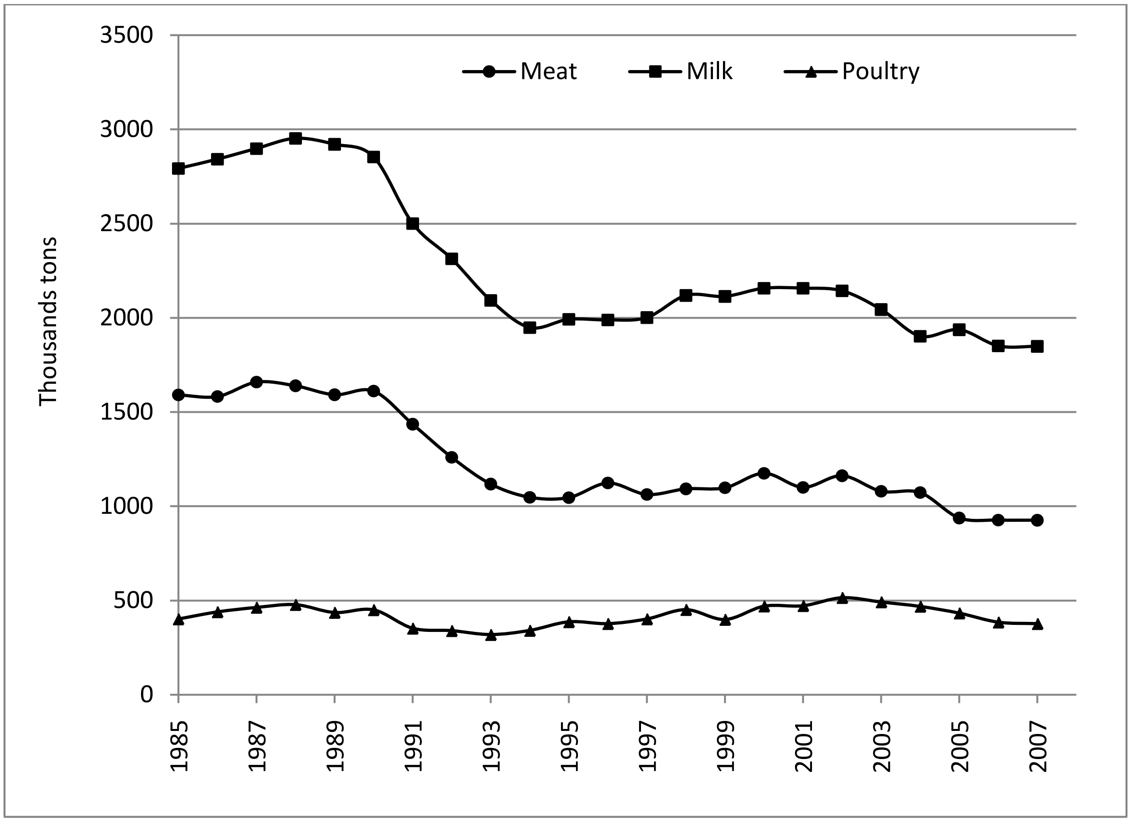
5.4.4.1 Impact of Industry on Agriculture - Hungary

Impacts of the industrial sector on the agricultural sector are somewhat different in Hungary compared to the other three countries. The industrial sector has positive impacts on agriculture in Poland and Bulgaria, and a negative impact in Romania, the Hungarian economy shows both positive and negative effects on the agricultural sector. One positive and two negative relationships to the agricultural sector prove that the Hungarian economy is well diversified. Figures 5.7 and 5.8 show that the industrial sector is the second largest sector in contributing to the national GDP (after the service sector), and this position is maintained during the whole transition period.

Similar to other countries, agricultural land in Hungary decreased by10 percent since 1989; however, agricultural output increased by 9 percent during the same period. This confirms that productivity of the agricultural sector has improved significantly. Better technologies and efficient use of inputs caused productivity to increase. For instance, use of agricultural tractors increased by 130 percent, and fertilizer use increased by 147 percent within the period between 1992 and 2002. These results show that while the agricultural sector transfers its resources to the other sectors, the sector increases its productivity by using both the industrial and service sectors efficiently. This means the agricultural sector enjoys the benefits of the backward relationships, which were not observed in the Bulgarian economy.

Figure 5.12 shows how meat, milk and poultry output evolved during the transition period. There is a decreasing trend in milk and meat production, while poultry production oscillates around 420,000 tons. This suggests that livestock production in Hungary has not contributed to the output increase, but growth is a result of an increase in crop production.

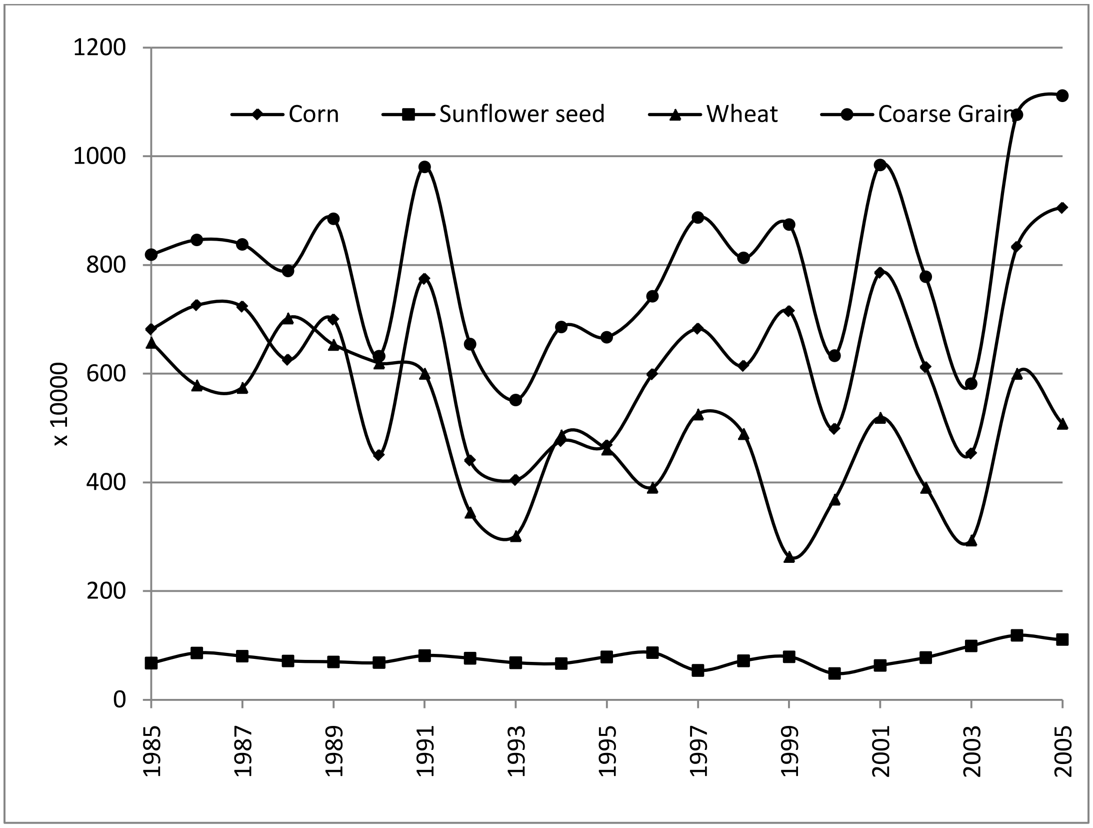
Figure 5.12: Livestock Processed Output - Hungary



Source: FAOSTAT, 2009

Figure 5.13 confirms that the output of major crops increased during the transition period, and this suggests that Hungarian agriculture is moving away from meat and milk, and toward crop production. It is also interesting to note that Hungarian farmers are changing their production system from a stable and less risky livestock production to a high yield-fluctuating crop production system. This suggests that the Hungarian farmers are willing to take higher risk in their revenues, and this may be another indication that the Hungarian economy has established a reputable service sector, in which the insurance system plays a major role.

Figure 5.13: Agricultural crops in Hungary



Source: FAOSTAT, 2009

5.4.4.2 Impact of Service on Agriculture - Hungary

Service is the largest economic sector in Hungary and its contribution to the economy is about 52% in 2007. Similar to the industrial sector, the service sector affects the agricultural sector both in positive and negative directions. Higher productivity in the agricultural sector indicates that the sector is utilizing the service sector very efficiently, particularly, facilities such as education, marketing, finance, insurance, and transportation. Therefore, a strong positive relationship between the agricultural and service sectors is expected. However, the agricultural sector competes for resources (land, skilled labor and capital) with higher income elasticity service products, and such competition for resources establishes a negative relationship as well.

5.5 Short-Run Growth

By incorporating the results of cointegration analysis in the previous section, we can isolate the short-run effects from the long-run. Therefore, the long-run relationship information is included as explanatory components of the model to understand the short-run relationship. The resulting model is a short-run error correction model, and the results are presented in Tables 5.19-5.22 for Poland, Romania, Bulgaria and Hungary, respectively. Column 3 ($\Delta Agric_t$) represents the short-run estimates for the growth of the agricultural sector. Columns 4, 5 and 6 represent the estimates for the growth of the industrial, service and trade sectors, respectively.

5.5.1 Short-Run Effects - Poland

Table 5.19 shows the short run estimates (standard errors in parenthesis) for the Polish economy. The estimates in the first row ($\Delta Agric_{t-1}$) show that the short-run impacts of the agricultural sector on the growth of the other sectors in the economy. For instance, the agricultural impact on the industrial sector is -0.29. On average, a 1 percent increase in the agricultural growth leads to a 0.29 percent decrease in the industrial growth, holding all other variables constant. Similarly, the industrial impact on the agricultural sector is -0.50. On average, a 1 percent increase in industrial output leads to a 0.50 percent decrease in the agricultural sector, holding all other variables constant.

Table 5.19 Short-Run Inter-Sectoral Linkages - Poland

		Dependent variables			
		$\Delta Agric_t$	$\Delta Indus_t$	$\Delta Serv_t$	$\Delta Trade_t$
Explanatory variable	$\Delta Agric_{t-1}$	-0.11 (0.22)	-0.29 (0.42)	0.04 (0.16)	0.17 (0.22)
	$\Delta Indus_{t-1}$	-0.50 ** (0.15)	-0.94** (0.29)	-0.68 *** (0.11)	0.54 *** (0.15)
	$\Delta Serv_{t-1}$	2.34 *** (0.42)	3.05 *** (0.82)	1.70 *** (0.32)	1.37 ** (0.42)
	$\Delta Trad_{t-1}$	0.68 *** (0.14)	-0.07 (0.27)	0.23* (0.10)	-0.68 *** (0.14)

*, ** and *** denote the estimates are significant at 10%, 5% and 1%, respectively. Standard errors are in parenthesis.

The model also estimates how sectoral growth is affected by the past values of the same sector. The results show that the growth of industrial and trade sectors were negatively and the service sector was positively affected by their own growths. For example, a one percent increase in the last year's industrial growth leads to 0.94 percent decrease in the current period growth, holding all other variables constant.

The short-run impacts of the agricultural sector on the other sectors are not significant in the Polish economy. This is not surprising since the relative size of the agricultural sector is small compared with the industrial and service sectors. Furthermore, the agricultural sector does not change significantly in its input-output choices in the short-run, and therefore, impacts on the other sectors will be minimal.

The importance of the service sector is proved again in the Polish economy. The results suggest that a 1 percent increase in growth of the service sector leads to a more than 2 percent growth in the agricultural and industrial sectors, holding all other variables constant (row 3). The positive effects of the service sector reiterate the fact that its expansion increases the demand and supply for the agricultural and industrial sectoral outputs in the short-run. However, as noted earlier, in the long-run the service sector could produce negative effects on the other sectors, as more and more resources are transferred from the agricultural and industrial sectors as the economy grows.

In contrast to the service sector, the industrial sector provides negative impacts on the agricultural and service sectors. These results imply that the Polish economy has binding resources constraints, and the fast-growing industrial sector attracts more input factors from the other sectors.

5.5.2 Short-Run Effects-Romania

The short-run inter-sectoral linkages of the Romanian economy are presented in Table 5.20, and the results suggest that the agricultural sector has a positive impact on the industrial sector. On average, a 1 percent increase in the agricultural growth leads to a 0.15 percent increase in the industrial growth, holding all other variables constant. This positive relationship is unexpected when an economy is steadily progressing toward industrialization. However, the Romanian sectoral composition (industry 37 percent and agriculture 20 percent in 2004) does not support the view that the Romanian economy is accomplishing a successful industrialization process. The positive linkage (the effect of agriculture on industry) also reiterates that the Romanian economy is still at the progressing stage and the agricultural sector plays an important role both in the long-and short-run. The negative relationship (-0.39) to its own (past) growth indicates that the agricultural sector is sensitive to its own growth.

The impacts of industrial and service sectors on the agricultural sector are not significant. This implies that the short-run inter-sectoral relationships in Romania are not as strong as in Poland. Resource transfer from one sector to another or movements of inputs or outputs from one sector to another are not significant. A possible explanation for such a sectoral interdependency is that the country might have underutilized its resources, and therefore, a sector can increase its output without affecting the other sector negatively.

Table 5.20 Short-Run Inter-Sectoral Linkages - Romania

		Dependent variables			
		$\Delta Agric_t$	$\Delta Indus_t$	$\Delta Serv_t$	$\Delta Trade_t$
Explanatory variable	$\Delta Agric_{t-1}$	-0.39 ** (0.15)	0.15 ** (0.05)	0.06 (0.08)	-0.07 (0.10)
	$\Delta Indus_{t-1}$	1.06* (0.52)	0.02 (0.19)	-0.15 (0.26)	0.85* (0.36)
	$\Delta Serv_{t-1}$	-1.21 (0.93)	0.18 (0.34)	0.60 (0.47)	-1.16 (0.64)
	$\Delta Trad_{t-1}$	-0.84 * (0.37)	0.09 (0.14)	0.38 * (0.19)	-0.23 (0.26)

*, ** and *** denote the estimates are significant at 10%, 5% and 1%, respectively. Standard errors are in parenthesis.

5.5.3 Short-Run Effects - Bulgaria

The short-run inter-sectoral linkages of the Bulgarian economy are presented in Table 5.21, and the results show that none of the sectors have influenced the agricultural growth significantly. However, the agricultural sector affects the industrial and service sectors positively. This means both the industrial and service sectors benefit by the agricultural sector, however, the agricultural sector failed to benefit from these two sectors. This reiterates the fact that the agricultural sector has not made productivity gains and has not invested in modern technologies.

The impact of the service sector on the industrial sector is positive and this is consistent with the Polish economy. This means, on average, a 1 percent increase in the service sector leads to a 0.44 percent increase in the industrial sector, holding all other variables constant. Similarly, the impact of the industrial sector on the service sector is also positive. Therefore, the inter-relationships between the industrial and service and service to industrial sectors are bidirectional.

Table 5.21 Short-Run Inter-Sectoral Linkages - Bulgaria

		Dependent variables			
		$\Delta Agric_t$	$\Delta Indus_t$	$\Delta Serv_t$	$\Delta Trade_t$
Explanatory variable	$\Delta Agric_{t-1}$	0.01 (0.13)	0.18 *** (0.05)	0.35 *** (0.03)	-0.24*** (0.06)
	$\Delta Indus_{t-1}$	0.15 (0.31)	-0.42 ** (0.13)	0.17* (0.08)	-0.66*** (0.14)
	$\Delta Serv_{t-1}$	0.14 (0.29)	0.44** (0.13)	0.49 *** (0.08)	-0.31** (0.13)
	$\Delta Trad_{t-1}$	0.01 (0.37)	0.36 * (0.16)	0.06 (0.10)	0.11 (0.17)

*, ** and *** denote the estimates are significant at 10%, 5% and 1%, respectively. Standard errors are in parenthesis.

Both industrial and service sectoral growths are sensitive to their own past growth. This is consistent with Polish short-run linkages. The signs for these sectors are dictated by the structure, technology, and conditions in the sector, including fluctuations in the demand, product cycles, expansion and contraction adjustment speeds, time to build, planning, inventory management, technological progress and other shocks peculiar to the sector.

5.5.4 Short-Run Effects - Hungary

The short-run inter-sectoral linkages of the Hungarian economy are presented in Table 5.22. Agricultural growth is positively related to the short-run industrial growth and negatively related to the service growth. Furthermore, the agricultural impacts on the industrial and service sectoral growths are positive. This means there are strong short-run inter-sectoral linkages among the agricultural, service and industrial sectors. The role of agriculture in the Hungarian economy is different from the Polish economy, where the industry was detrimental to agriculture and the role of agriculture on the other sectors was not significant.

Table 5.22 Short-Run Inter-Sectoral Linkages - Hungary

		Dependent variables			
		$\Delta Agric_t$	$\Delta Indus_t$	$\Delta Serv_t$	$\Delta Trade_t$
Explanatory variable	$\Delta Agric_{t-1}$	-0.29 (0.20)	0.18 ** (0.06)	0.07* (0.03)	0.10 (0.14)
	$\Delta Indus_{t-1}$	1.52* (0.77)	0.17 (0.17)	0.29** (0.11)	-0.02 (0.53)
	$\Delta Serv_{t-1}$	-3.80* (1.82)	0.27 (0.41)	-0.63** (0.26)	2.71* (1.25)
	$\Delta Trad_{t-1}$	-0.84** (0.30)	-0.04 (0.09)	-0.16 ** (0.06)	0.43 (0.27)

* and ** denote the estimates are significant at 10% and 5%, respectively. Standard errors are in parenthesis.

The service sectoral growth in the Hungarian economy is negatively related to its own past growth. This means, a one percent increase in the past year's service growth caused a 0.63 percent decrease in the current period service growth, holding all other variables constant. This negative relationship contradicts the growth of the service sectors in Poland, Romania and Bulgaria. More interestingly, only the service sector showed the sensitiveness to its own past growth in Hungary. These results suggest that the service sector is not only the biggest sector in Hungary, but it has also propensity or tendency to fluctuate at a particular frequency like any other sectors in an economy.

5.5.5 Summary

One of the most notable observations in this section is how the linkages vary between the short-run and long-run. A sector can have a negative linkage to other sectors in the short-run; however, that does not mean that the linkage will be negative in the long-run, or vice versa. For instance, the industrial sector in Poland affects the agricultural sector positively in the long-run; however, the short-run impact is negative. It is plausible since increases in the industrial sector lead to greater competition for resources among the other sectors. Labor in the agricultural sector will move toward high paying industrial jobs, and farming lands could be used for non-agricultural purposes in the short-run. Higher competition for capital could lead financial institutions to choose a sector which produces higher returns and fewer risks or the firms that could payback a greater portion of the loan at the beginning of the loan period. All these activities will lead to a negative relationship between the industrial and agricultural sectors in the short-run. In the long-run, as noted earlier, growing industrial sectors lead to a greater demand for agricultural goods and greater productivity in the use of resources. This leads to a positive relationship in the long-run. Therefore, policymakers should pay greater attention to how different sectors are inter-related both in the short-and long-run.

In contrast, the industry-agriculture relationships in Romania are negative in both the short and long-runs. The negative short-run relationship is not surprising, as both sectors compete for the same resources. However, the negative relationship in the long-run suggests that the agricultural sector is struggling to increase its productivity. The reasons for the negative long-run relationship could be a combination of several factors. First, the economy could miss a strong backward linkage from the industrial to agricultural sectors. The industrial sector is not promoting technological improvements to the agricultural sector or the agricultural sector is unable to utilize the development of the industrial sector. The distribution of farm sizes in Romania (Vidican, 2008) shows that the majority of farms are less than three hectares of land. The smaller farm size in Romania suggests that mechanization of agriculture is limited since the use of expensive agricultural machinery will not be profitable for small farms. Therefore, increasing farm size should be one of the priorities to develop a highly mechanized agriculture, which might be positively linked to the industrial sector in the long-run.

Secondly, the relationship between the shares of agricultural GDP and the industrial GDP could play an important role in productivity change in agriculture. For instance, the share of agricultural GDP in Poland is much smaller and therefore, the cost of transferring a unit of resource from agriculture will be greater compared to transferring a unit of resource from the Romanian agriculture, assuming increasing marginal cost of resource transfer. Romanian agriculture could easily transfer a significant number of resources to the industrial sector, and this could lead to a negative relationship between the agricultural and industrial sectors.

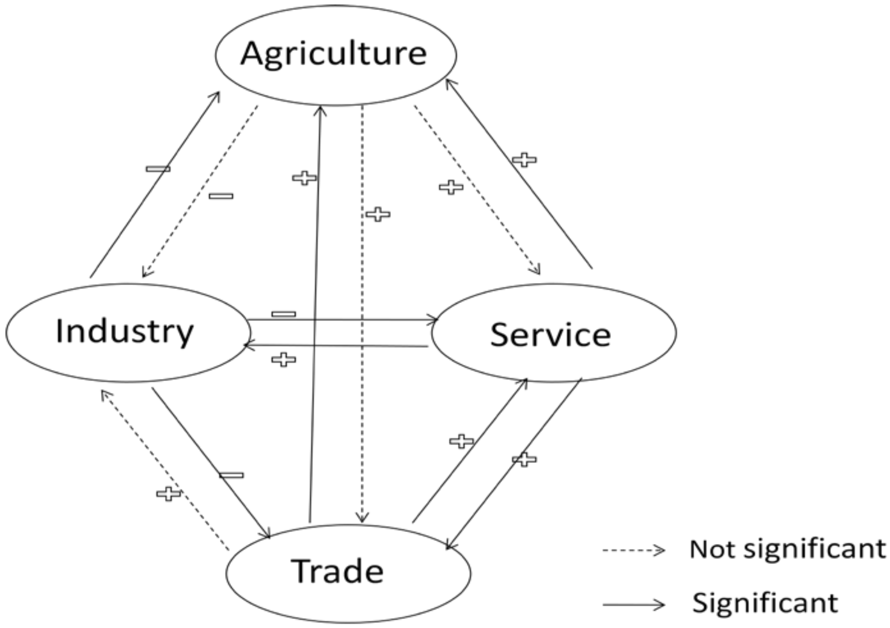
5.6 Impulse Response Functions

Impulse response functions are constructed to determine how a system reacts to a shock in one of the endogenous variables in a model. This section focuses on how a shock in the agricultural sector will be absorbed by the other sectors in the economy, and how a shock in the other sectors will be absorbed by the agricultural sector, in all four countries. The responses to the shock depend on how the variables are inter-related within a country, and how the shocks are transferred through different linkages over a long period of time. For instance, suppose a model predicts a positive linkage between two variables, agriculture and industry. This does not mean that there will be an increase in the industrial output, regardless of an increase in the growth of the agricultural sector. The ultimate effect depends on the other sectors in the economy, and how these sectors are linked together in the economy.

5.6.1 Impulse Response Function - Poland

Figure 5.14 presents an inter-sectoral linkage chart based on Table 5.19 showing that the agricultural sector affects the industrial sector negatively and service sector positively, however the estimates are not significant.

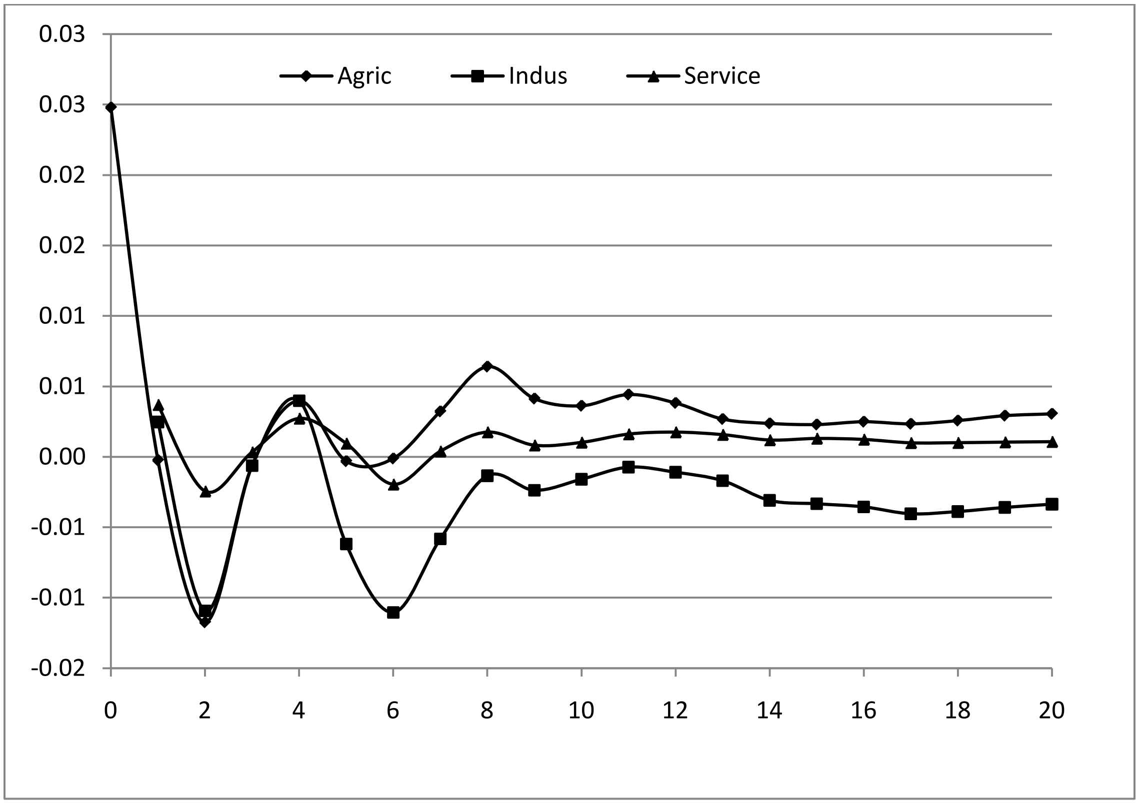
Figure 5.14: Short-run Inter-Sectoral Linkages: Directions and Significances-Poland



To understand how a positive shock in the agricultural sector will affect the other sectors in the model, a series of impulse response functions (IRF) are constructed. One standard deviation shock is imposed in the agricultural sector, and the responses in the agricultural, industrial and service sectors are measured (Figure 5.15). The initial impacts on all the sectors are negative. The sectors first suffer negative growth, and reach its most negative growth at the end of the second year. The sectors grow for another two years and the shock has its largest positive growth in the industrial and agricultural sectors at end of the fourth year. So, the agricultural shock induces cycles in the industrial growth, which dampened slowly for eight years after the shock.

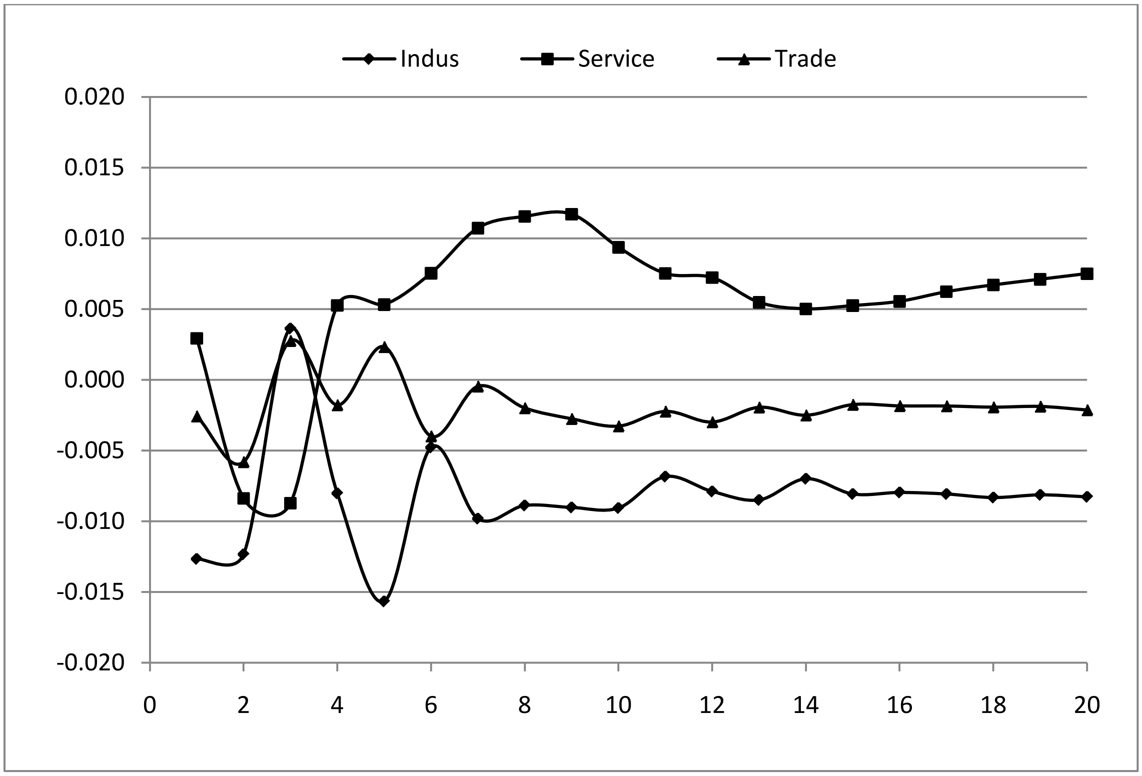
After the fourth year, the effect of the shock is negative for the industrial sector and positive for the agricultural and service sectors. These effects are consistent with Figure 5.14, i.e., the relationship between agriculture and industry is negative and the relationship between the agriculture and service sector is positive.

Figure 5.15 Impacts of a Shock in the Agricultural Sector - Poland



To understand how the agricultural sector responses to positive shocks in the other sectors, a one standard deviation shock is imposed in the industrial, service and trade sectors. The IRFs are constructed and the results are presented in Figure 5.16. The shock in the industrial sector is positive in the first three years, and thereafter, the effect turns negative. On the other hand, the impact of a service shock shows that the initial effect in the agricultural sector is negative; however, after three years, the agricultural sector grows positively and reaches its maximum effect in the ninth year. The trade shock affected the agricultural sector negatively, but the impact is small compared the effect of the industrial shock.

Figure 5.16: Responses in the Agricultural Sector to a Shock in the Other Sectors - Poland

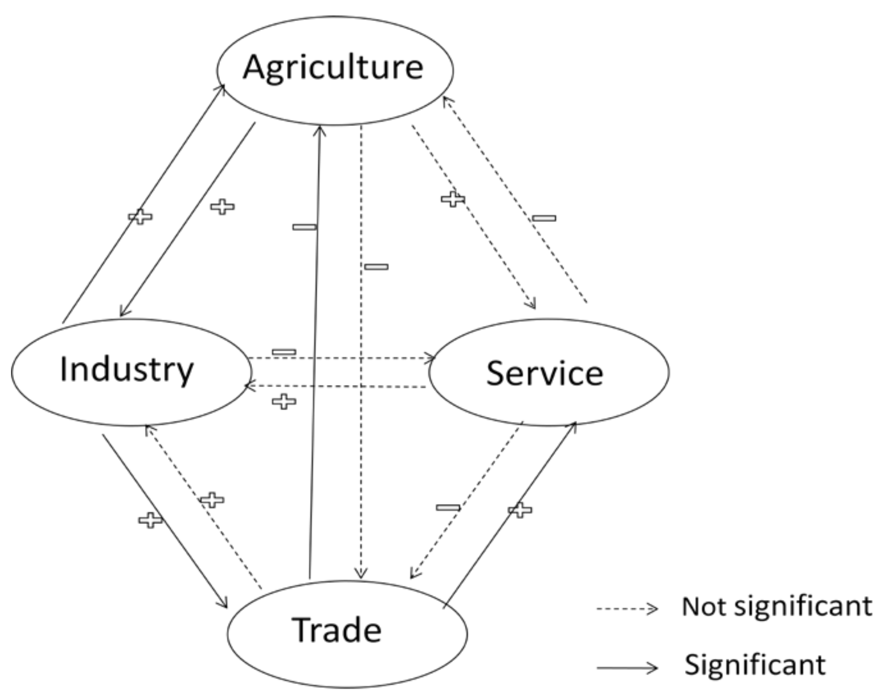


All these results suggest that in the short-run, the industrial and agricultural sectors are competing for the same resources, and therefore an increase in one sector affects the other sector negatively. We can conclude that the Polish economy is facing resource constraints. The positive impacts between the agricultural and the service sectors imply that these two sectors are not competing for the same resources and the growth of one sector is stimulating the other sector. These results are consistent with our of short-run estimates and the direction of linkages shown in Table 5.14.

5.6.2: Impulse Response Function - Romania

Figure 5.17 presents an inter-sectoral linkage chart based on Table 5.20, showing that the linkages of agriculture to industry, and industry to agriculture are positive. This does not mean that a positive shock on the agricultural sector would increase the industrial growth when all the complex linkages are considered. This is because the system shows a number of negative linkages between the sectors and these complex linkages could alter the ultimate effects and the shock. For instance, the positive shock will be transferred to the industrial sector, and this will be transferred further into the trade sector. However, the negative linkage between the trade and agricultural sectors could play a dominant role, and the latter's effect could outweigh the former. Consequently, the ultimate impact of an agricultural shock on the industrial sector is more complex.

Figure 5.17: Short-run Inter-Sectoral Linkages: Directions and Significances-Romania



To understand how a positive shock in the agricultural sector will affect the other sectors in the model, a series of IRFs are constructed. Figure 5.18 reveals that the shock in agriculture does not produce any significant impact on any of the sectors, except a small drop in the industrial sector in the first year. These results confirm that the agricultural sector already has abundant resources, and a positive shock (temporary) in the agricultural sector will not affect the other sectors significantly. The impact of the shock is observed for only three years.

Figure 5.18: Impacts of a Shock in the Agricultural Sector - Romania

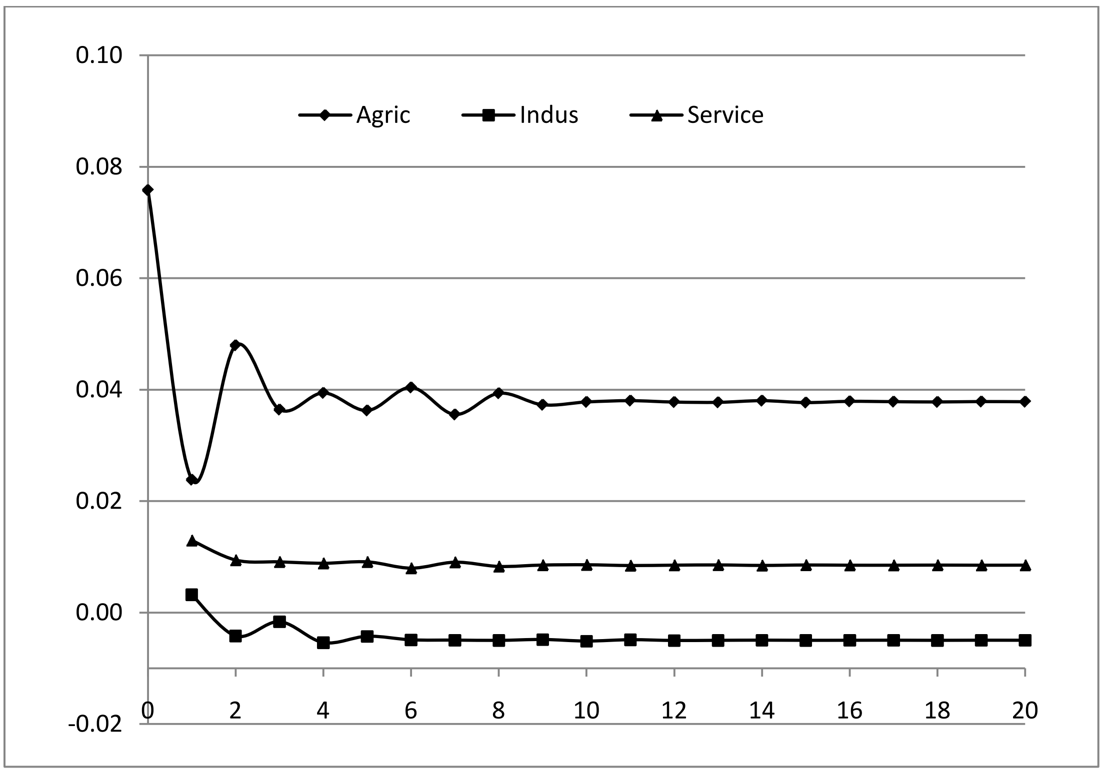
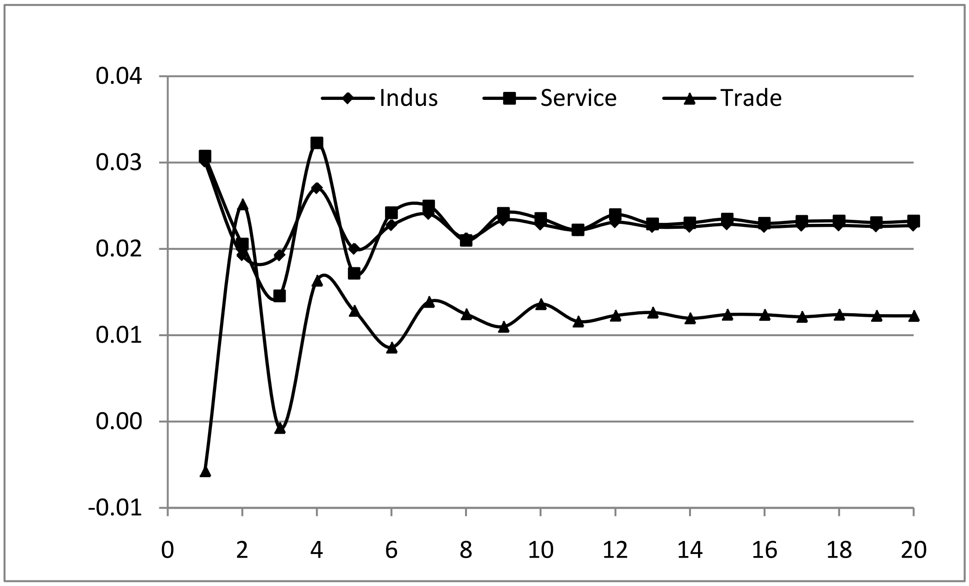


Figure 5.19 shows how the agricultural sector responds to shocks in the other sectors in the Romanian economy. The results reveal that the response to shocks in the industrial and service sectors are quite similar for agriculture. However, this is not consistent with Table 5.14 (or Figure 5.16), which shows that industry-agriculture relationship is negative and service-agriculture relationship is positive. Therefore, the dynamic relationships among the sectors play an important role in the ultimate effects in the shocks.

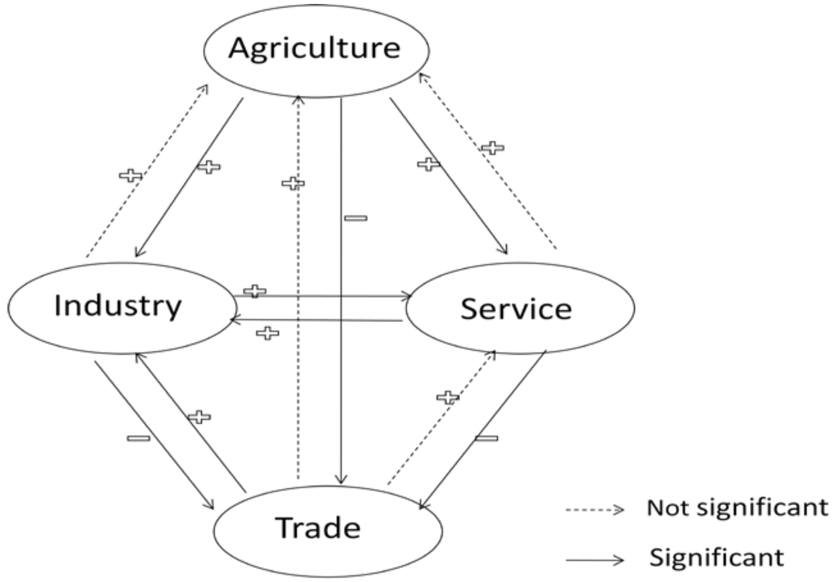
Figure 5.19: Responses in the Agricultural Sector to a Shock in the Other Sectors-Romania



5.6.3 Impulse Response Function - Bulgaria

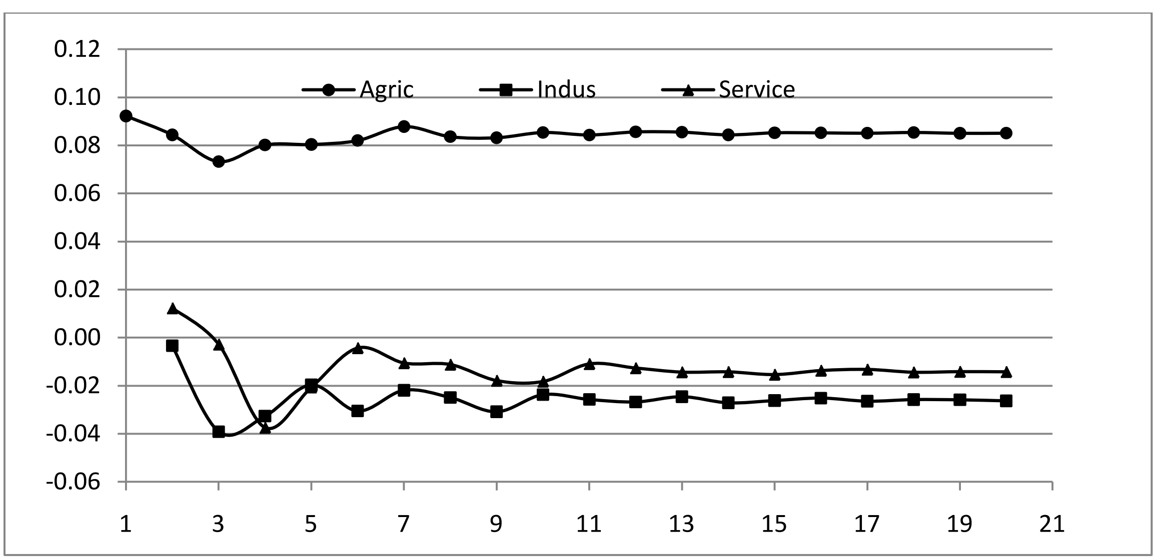
Figure 5.20 presents an inter-sectoral linkage chart based on Table 5.21, showing that the agricultural sector is positively linked to the industrial and service sectors; however, the contributions of the industrial and service sectors to the agricultural sector are not significant. A positive shock in the agricultural sector should stimulate the growth of the industrial and service sectors if the dynamic inter-sectoral linkages are not significant. Therefore, the IRFs could provide information on whether the dynamic inter-sectoral linkages play a significant role in the Bulgarian economy.

Figure 5.20: Short-run Inter-Sectoral Linkages: Directions and Significances - Bulgaria



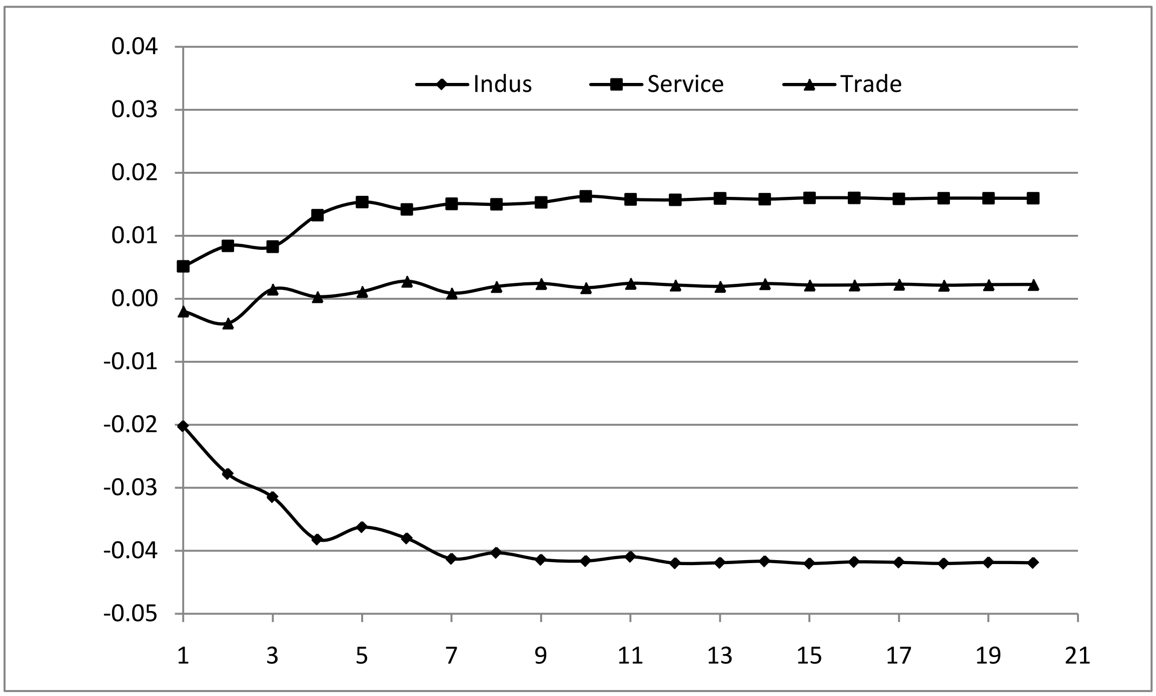
To understand how a shock in the agricultural sector could affect the industrial and service sectors, a series of IRFs are constructed (Figure 5.21). The results show that an agricultural shock has a negative impact on both the industrial and the service sectors. These results contradict the direction of the linkages shown in Figure 5.20. This means the dynamic linkages play a significant role in determining the impact of agriculture on the other sectors in the Bulgarian economy.

Figure 5.21: Impacts of a Shock in the Agricultural Sector - Bulgaria



The responses in the agricultural sector to shocks in the other sectors are determined and the results are presented in Figure 5.22. It shows that the affect of industrial shock is negative and the service sector is positive. The industrial shock affects the agricultural sector for seven years while the impact of the service sector lasts for five years. According to Table 5.21 (or Figure 5.20), the industry-agriculture linkage is positive, but not statistically significant. Figure 5.21 reveals that the dynamic linkages play a significant role in the ultimate impact on the agricultural sector. The direction of the service- agricultural linkage is consistent with our earlier estimation.

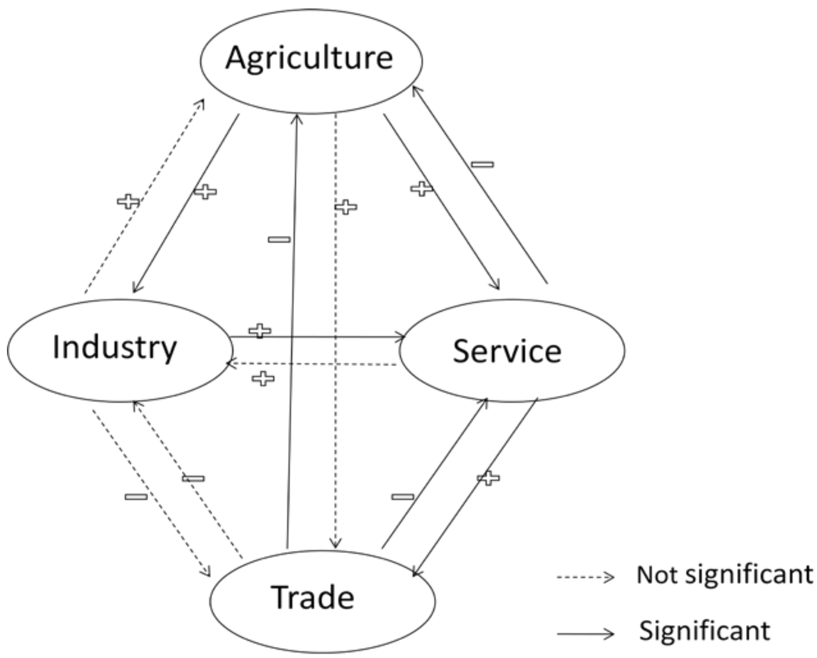
Figure 5.22: Responses in the Agricultural Sector to a Shock in the Other Sectors - Bulgaria



5.6.4 Impulse Response Function - Hungary

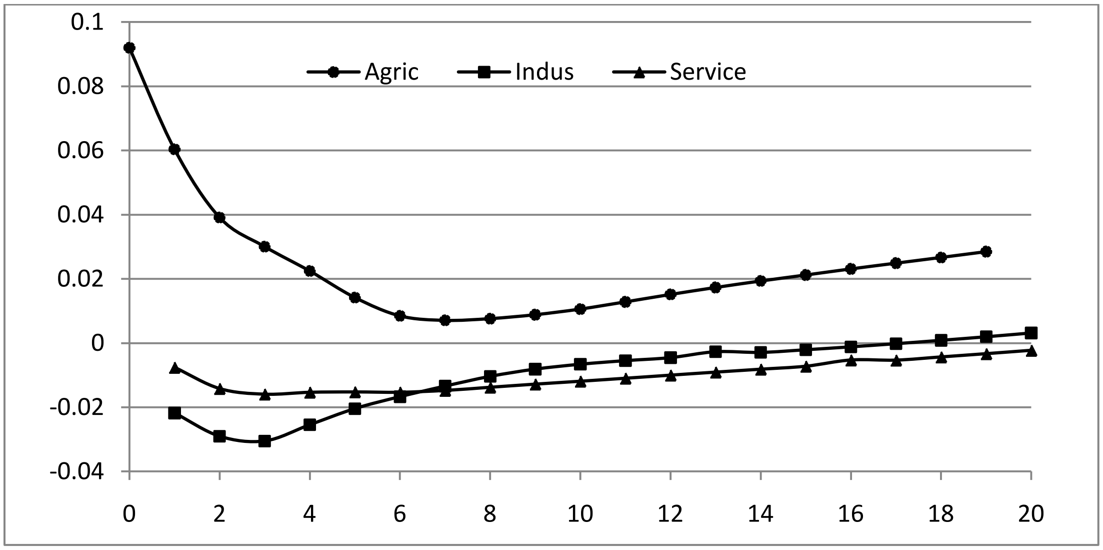
Figure 5.23 presents an inter-sectoral linkage chart based on Table 5.22, showing that the agricultural sector is positively linked to the industrial and service sectors. At the same time, the linkage of the industry-agriculture is positive and the service-agriculture is negative. These results suggest that a positive shock in the agricultural sector will positive impact on the industrial as service sectors. However, the interactions with trade and the other sectors are negative, and these negative effects could reduce the total impact of a shock. IRFs can be used to identify the total impact of one sector on the other.

Figure 5.23: Short-run Inter-Sectoral Linkages: Directions and Significances - Hungary



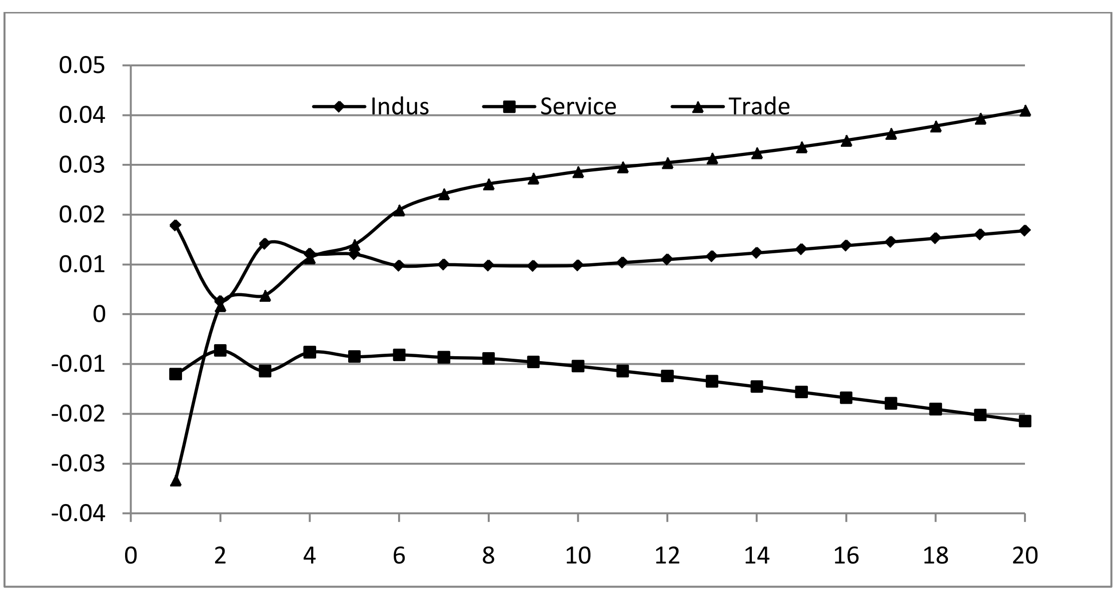
A one standard deviation shock to the agricultural sector is used to understand the impact on the other sectors in the Hungarian economy. The results are presented in Figure 5.23. The figure reveals that both the industrial and service sectors experienced small negative growth in the beginning and the initial trends are consistent with other countries in this study. The negative impact lasts for three years in the industrial sector and two years in the service sector. A significant difference between the industrial and service sectors is the shapes of the growth rates curves. The industrial sector took off at a faster rate at the beginning, while the service sector grows at a constant rate most of the time. These results suggest that a shock in the Hungarian agricultural sector produces a greater positive impact on the other sectors compared to the other three countries.

Figure 5.24: Impacts of a Shock in the Agricultural Sector - Hungary



To determine how shocks in the other sectors affect the agricultural sector, a one standard deviation shock in each sector was induced, and the responses in the agricultural sector are estimated. The results are presented in Figure 5.25. The results reveal that shock in the service sector affects agriculture negatively, and the shock in the industrial sector affects the agricultural sector is positively. These results are consistent with Table 5.22 (or Figure 5.23). Therefore, the dynamic linkages have not influenced the direction of the linkages.

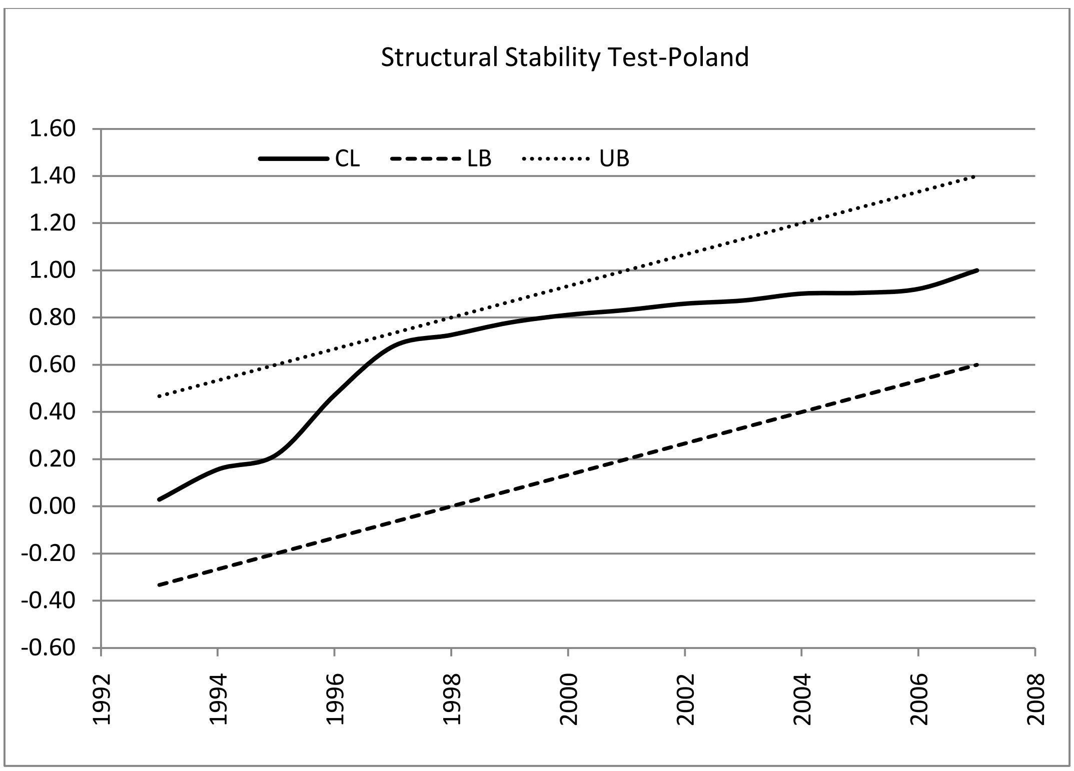
Figure 5.25: Responses in the Agricultural Sector to a Shock in the Other Sectors - Hungary



5.7 Structural Stability Test

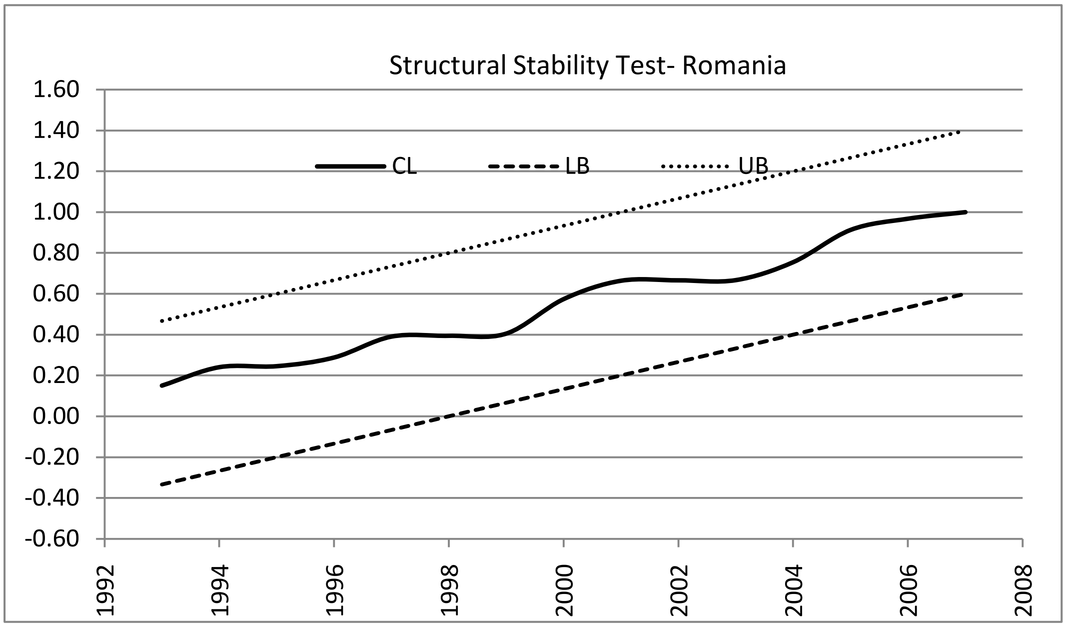
In order to test the structural stability of these models, CUSUM tests were conducted and the results are presented in Figures 5.26- 5.29 for Poland, Romania, Bulgaria and Hungary, respectively. The null hypothesis of the CUSUM test is that no structural break exists, which means the estimated squares of error do not exceed the 95 percent confidence interval. No structural break means if the estimated residuals cross the upper or lower bound lines on the figure, the null hypothesis is rejected, and it is concluded that there is a structural break.

Figure 5.26: CUSUSM square test results for Poland



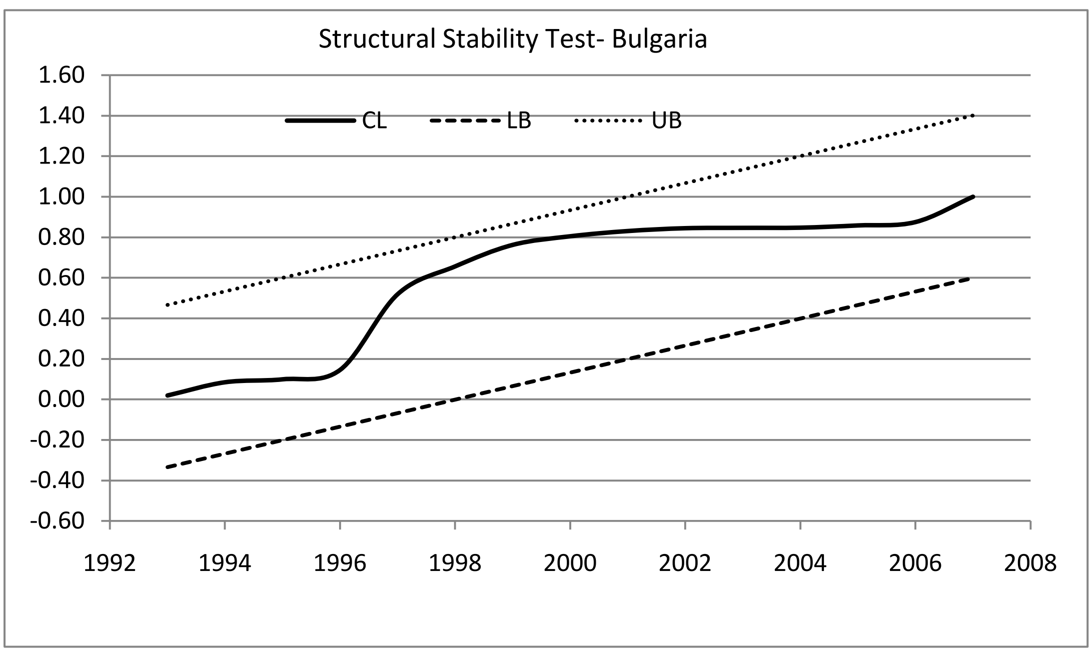
Where CL=CUSUM square line; LB= Lower-bound line; and UB= Upper-bound line

Figure 5.27: CUSUSM square test results for Romania



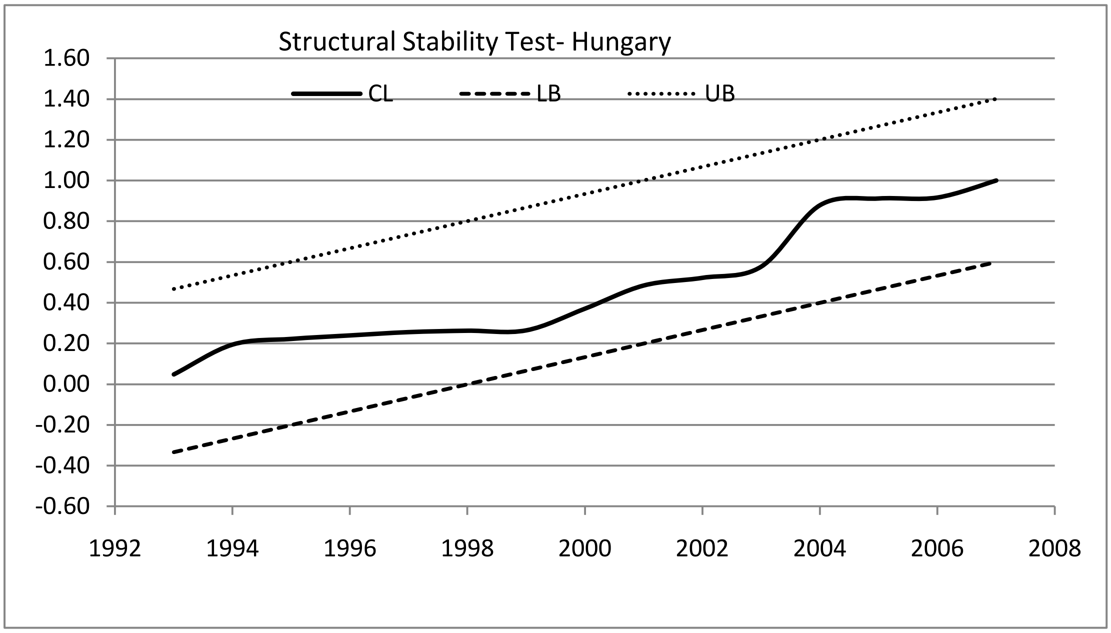
Where CL=CUSUM square line; LB= Lower-bound line; and UB= Upper-bound line

Figure 5.28: CUSUSM square test results for Bulgaria



Where CL=CUSUM square line; LB= Lower-bound line; and UB= Upper-bound line

Figure 5.29: CUSUSM square test results for Hungary



Where CL=CUSUM square line; LB= Lower-bound line; and UB= Upper-bound line

The figures show that the models do not suffer from structural breaks, since the estimated square residuals are within the range of the upper and lower bounds. These figures conclude that the estimated models for Polish, Romanian, Bulgarian and Hungarian economies are statistically valid.

Chapter 6 : Summary and Conclusions

This study mainly focused on the impacts of transition on the agricultural sector and how the agricultural sector affects other sectors in former communist countries, Poland, Romania, Bulgaria and Hungary. This study employed an endogenous growth model to identify the pattern of inter-sectoral linkages among the sectors. A vector error correction model was constructed for each country to estimate the directions and magnitudes of the linkages among the sectors (agriculture, manufacturing, and service). The procedure estimates the long-and short-run relationships among the sectors for each country. To understand the dynamic nature of short-run relationships, a series of impulse response functions were constructed to determine the impacts of an agricultural shock on other sectors, and how shocks in the other sectors would affect the agricultural sector.

6.1 Summary of Findings:

The empirical findings from the analysis confirm that the different sectors in the 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 the tendency to return to the long-run equilibrium. The results showed the number of stable long-run equilibria were three for Poland, Bulgaria and Hungary, and one for Romania.

The long-run relationship of the agricultural sector to other sectors in Poland showed that the industrial sector played a positive role on the agricultural sector. It also revealed that there exist strong forward and backward linkages between the industrial and agricultural sectors. However, the growing service sector was detrimental to the growth of the agricultural sector. This was an indication for that Poland's economy is progressing at a higher level of economic development and facing resource constraints.

On the other hand, the Romanian agriculture is negatively affected by the rising industries and positively affected by the growing service sector. Despite the large agricultural sector, resource transfer from the agriculture to other sectors in Romania is somewhat limited. This is because large amounts of resources were released from the industrial sector.

The long-run relationship of the agricultural sector to other sectors in Bulgaria indicates that the agricultural sector suffered from a lack of forward and backward linkages between the agricultural and industrial sectors. The negative relationship between the service and agricultural sector reveals that investment in the agricultural sector was neglected and, consequently, productivity of agriculture significantly decreased.

The Hungarian long-run relationships showed that the Hungarian economy is well diversified and the contribution of the industrial and service sectors to the agricultural sector are well-balanced.

The short-run analysis suggests that the impacts of the agricultural sector on the other sectors were positive for all four countries. This means short-run growth in the agricultural sector is not a detriment to the other sectors. However, growth of the other sectors affected the agricultural sector significantly. For instance, the industrial sector affected the agricultural sector negatively in Poland, and positively in Romania and Hungary. On the other hand, the service sector affected the agricultural sector positively in Poland and negatively in Hungary. The estimates were not significant for Romania and Bulgaria. Impacts of service sector on other sectors were significant and contributed positively to all other sectors in the Polish economy. This implies that the service sector played an important role in overall economic growth in Poland.

Another notable observation of this study was that a large number of interrelationships among the sectors were not significant in the Romanian economy (compared to Poland). This revealed that short-run inter-sectoral relationships in Romania were not as strong as in Poland. A possible explanation for such weak sectoral interdependencies is that Romania might have underutilized its resources.

Impulse response functions reveal how a shock in one sector will be transferred to other sectors through the dynamic nature of the model. A shock in the agricultural sector negatively affected the industrial sector in all countries except Hungary. The impacts lasted for a short period in Romania and Bulgaria. This implies that the short-run linkages between the agricultural and other sectors in these two countries are relatively weak. In contrast, the impact on the Polish industrial sector lasted a relatively long time. This indicates that the Polish industrial sector is more sensitive to agricultural shocks. Impacts on the service sector were relatively small and positive in Poland, Romania and Hungary but negative in Bulgaria. The agricultural sector responded negatively to a shock in the industrial sector in all countries except Romania. Conversely, the responses for a shock in the service sector were positive in all four countries. These results are consistent with the traditional economic growth theory.

This study revealed the existence of inter-sectoral linkages, and their significance in overall economic growth. The results and methodology could benefit other countries in order to adopt better economic policies. However, it is important to note that during the communist era, all four countries were economically and socially similar. Hence, the differences in the inter-sectoral linkages should reflect available resources and the adopted transition policies of each country. Therefore, countries with similar resources and economic system may use the results of this study to identify better economic policies if the country does not have resources to conduct its own analysis.

6.2 Policy Implications

This study shows that interrelationships between the sectors can be divided into two groups: long-run relationships and short-run relationships. One of the major conclusions we can make from this study is that a sector can have a negative linkage to another sector in the short run; however, that does not mean that the linkage between the same sectors should be negative in the long-run as well. Therefore, policy makers should pay greater attention on time horizon when they prescribe policy prescriptions.

Many countries support policies which encourage agricultural production for a number of reasons-- food security, multifunctional agriculture, rural employment to name a few. These policies may cause the agricultural sector to absorb a large amount of resources even if the agricultural sector suffered from comparative disadvantages. The dynamic short-run results revealed that supporting agricultural enhancing policies are detrimental to the industrial sector in Poland, but such policies do not make any significant positive multiplier effects in Bulgaria and Romania. Therefore, policymakers should scrutinize the directions and magnitudes of the inter-sectoral linkages before they prescribe a policy.

It is important to have an economic sector that is linked to other sectors in multidimensional directions. For instance, Poland had only positive linkage to the agricultural sector in the long-run. If the government has to impose a policy, say an environmental tax on industrial output, the policy will affect the industrial sector negatively. Since the agricultural and industrial sectors are linked positively the tax on the industrial output will affect the agricultural sector negatively as well. Conversely, Hungary had established both positive and negative (long-run) linkages between the agricultural and industrial sectors. The opposing directions would reduce the negative impact of the tax, and therefore policy makers will have greater flexibilities in adopting new policies in Hungary compared to Poland. Therefore, new long-term policy prescriptions should be directed toward establishing multidimensional linkages. An analysis with disaggregated data could provide more information on what policies a country need to establish such multidimensional linkages. Adopting such policies can be considered as a risk mitigating strategy.

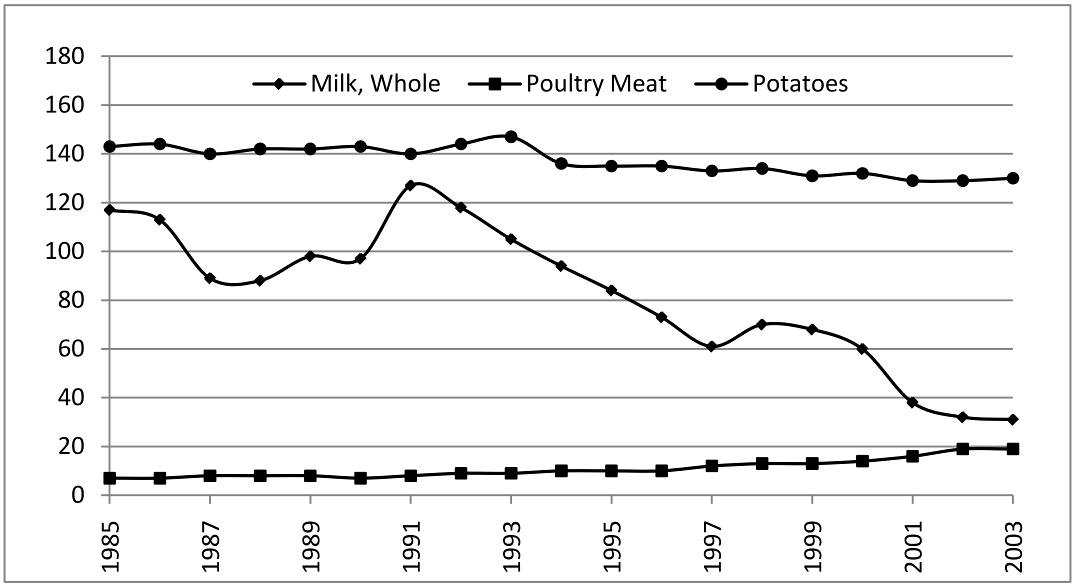
6.3 Recommendations for Future Studies

This study employed aggregate data, and the results may not expose explicitly how different sectoral linkages were formed or developed. To understand how the inter-sectoral linkages were established, one needs to use disaggregated data. Using disaggregated data provides a number of advantages. For instance, if an industry (e.g., food processing) within a sector is profitable, but the production of inputs (agricultural outputs) absorb too many resources from other sectors, then the net benefits of food processing industry may not be sustainable. Therefore, it is important to identify the net effects for any policy prescription. So, using disaggregated data will assist economists and policymakers to determine whether the net effects of the food processing industry are economically sustainable.

Aggregated data will not consider the differences between the geographic regions within a country. Each country might have different geographic characteristics and the inter-sectoral linkages between the sectors may vary among the regions. Therefore, conducting this study for regions with similar characteristics may provide more useful information for policymakers.

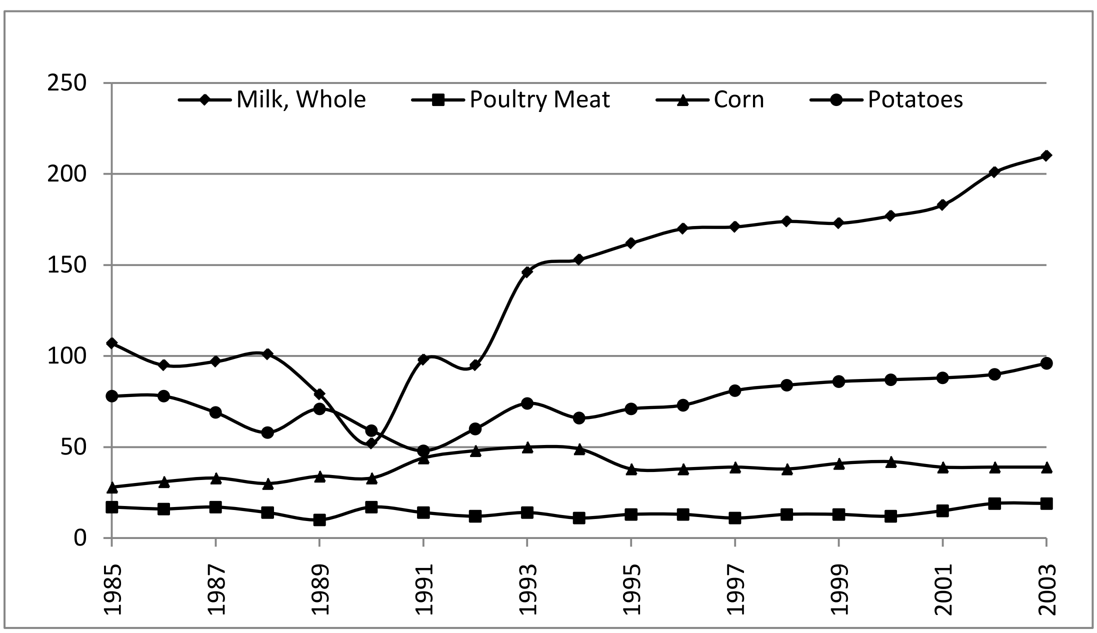
Appendix

Figure A2.1 Consumption Pattern – Poland (Kg/capita/year)



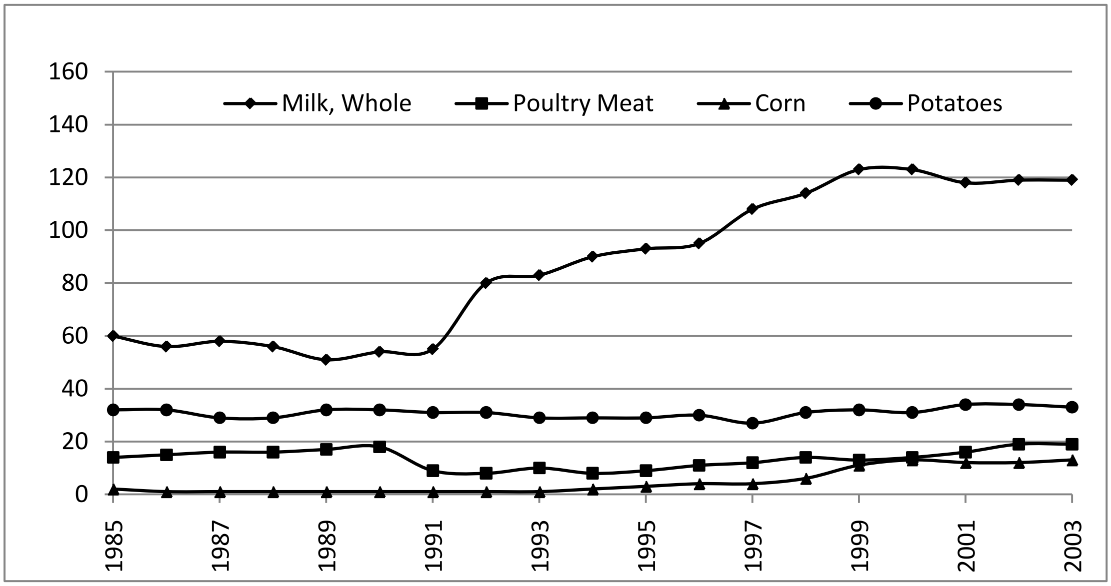
Source: FAOSTAT, 2009

Figure A2.2 Consumption Pattern – Romania (Kg/capita/year)



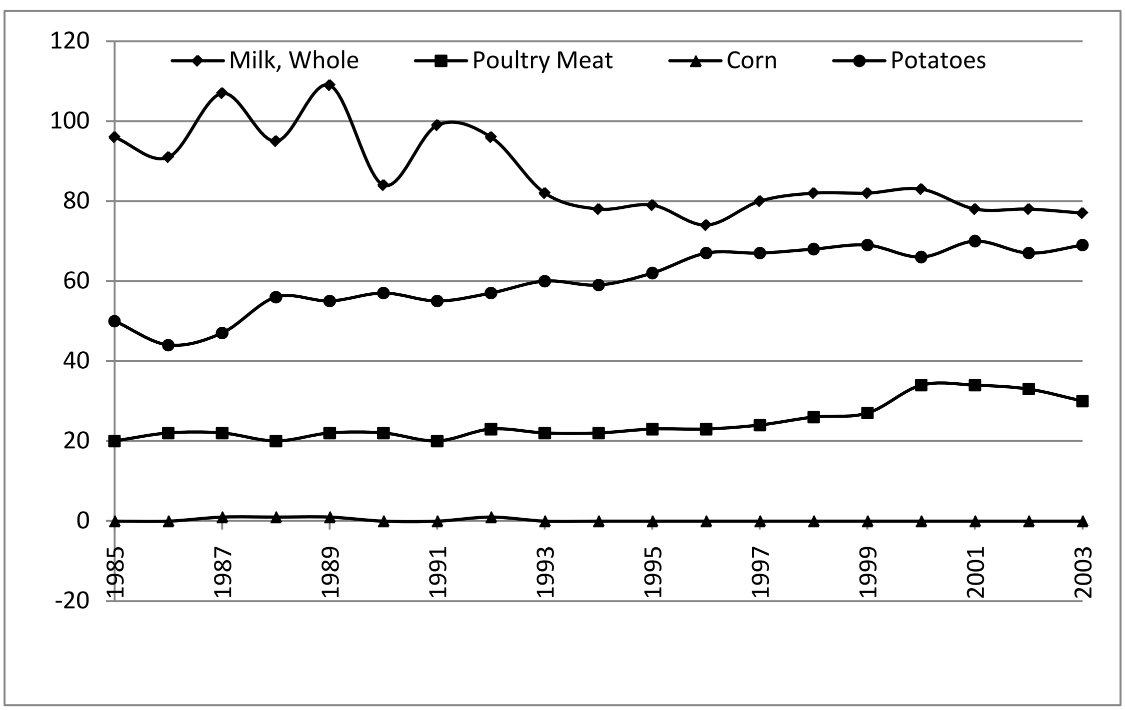
Source: FAOSTAT, 2009

Figure A2.3 Consumption Pattern – Bulgaria (Kg/capita/year)



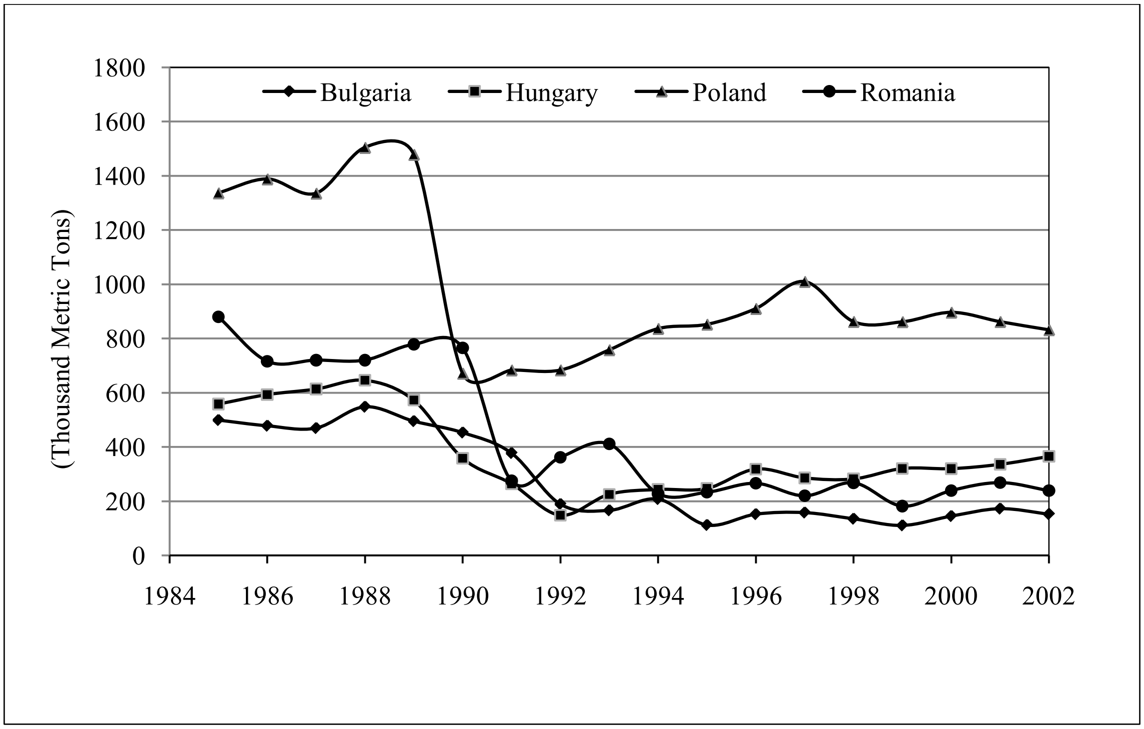
Source: FAOSTAT, 2009

Figure A2.4 Consumption Pattern – Hungary (Kg/capita/year)



Source: FAOSTAT, 2009

Figure A2.5: Fertilizer Use during the Transition



Source: FAOSTAT, 2009

Appendix 4.1

A number of previous studies show that countries which follow a speedy transition and greater openness to the rest of the world are more successful than the countries which follow a gradual transition. As noted in the earlier chapters, the transition countries have gone through a number of difficulties because the production structure of a planned economy does not conform to the demand structure of market economy. A great number of old institutions which functioned in the command economic system do not work in the market economy. Therefore, establishing new economic infrastructures and institutions are necessary steps toward a successful transition.

When the borders for these transition countries were open to the rest of the world, they needed to integrate into world trade. Many times the existing plants were exposed to stiff competition and the firms that are inherited higher costs from the planned period need to be substituted by new and modern industries. Prices needed to be adapted to marginal costs and wages to the marginal product of labor. All these transition processes lead to new sectoral linkages and the formation of these linkages are directly linked to the speed of transition and the openness of the economy. In addition, there are a number of other factors such as institutional setting, legislation, and internal and external shocks affect the growth of the agricultural, industrial and service sectors and its inter-sectoral linkages. Therefore, this study applies export-share as a proxy variable to represent the compound effects of these factors.

Figure 4.1 shows the pattern of export share for Poland, Romania, Bulgaria and Hungary. The figure reveals that export shares of Romania and Bulgaria were affected negatively in the early stages in the transition period, and this is consistent with the gradual transition policies. On the other hand, the Polish and Hungarian export shares show that the effects of transition were not negative as in other two countries, and this reflects the speedy transition policies these countries conducted in the early stages of transition.

Figure A4.1 Export-Shares to GDP (in natural log)

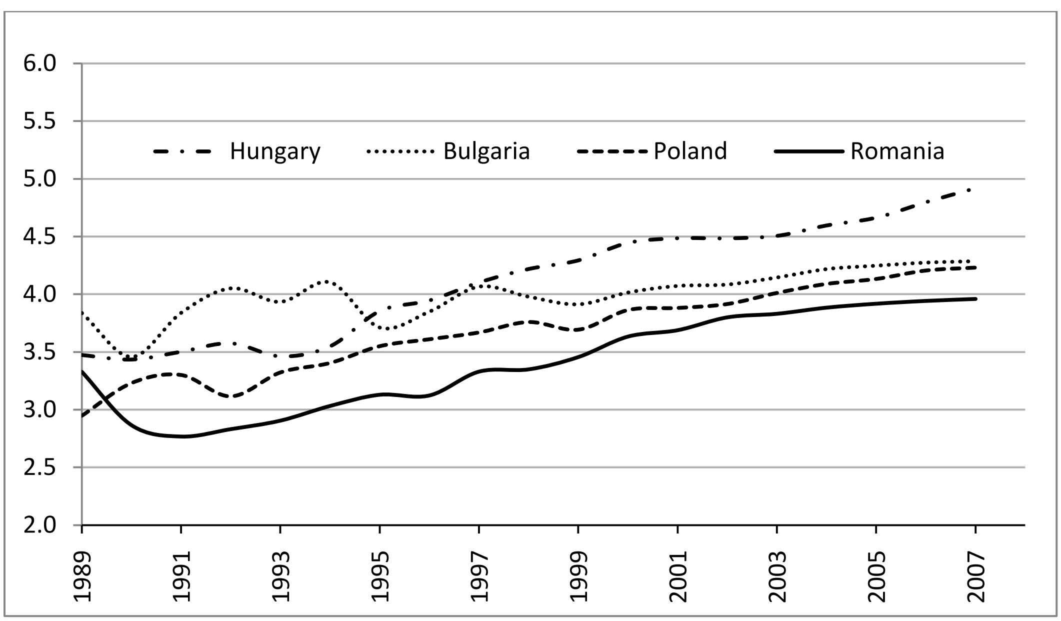
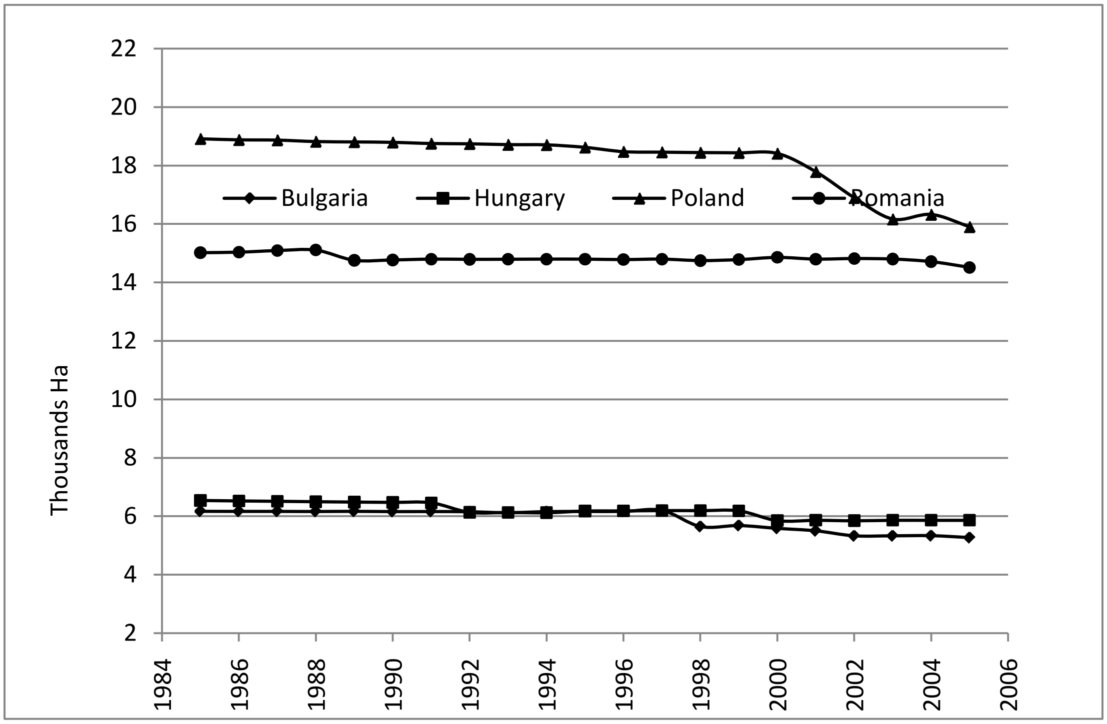


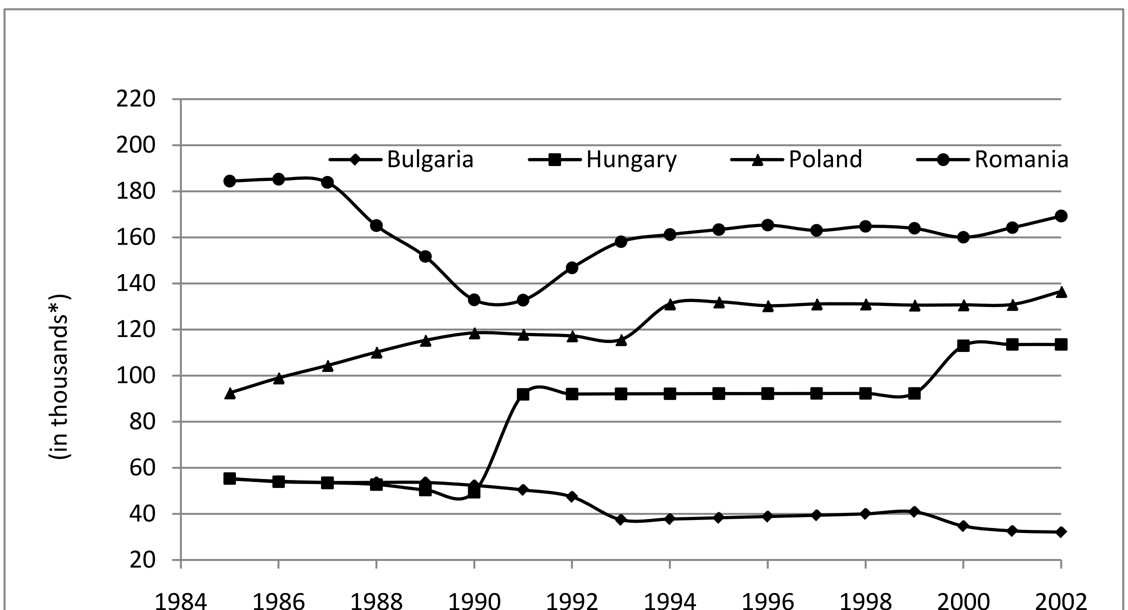
Table A4.2: A descriptive statistics of data

Country	Sector	1989-1992	1993-1996	1997-2000	2001-2004	2005-2007
Poland	Agriculture	7,022	8,634	8,939	9,643	10,920
	Industry	3,5947	54,856	71,256	80,742	101,385
	Service	30,083	35,898	44,166	51,651	59,952
	Trade	24.74	32.45	42.49	53.38	66.03
Romania	Agriculture	7,025	7,486	6,595	7,295	7,482
	Industry	14,853	13,141	12,179	14,079	16,765
	Service	9,899	10,677	10,323	12,175	15,267
	Trade	19.52	21.14	31.49	44.88	51.53
Bulgaria	Agriculture	2,326	1,278	2,047	1,998	1,651
	Industry	8,303	4,318	3,591	4,162	4,852
	Service	7,011	7,811	8,263	10,080	12,424
	Trade	45.86	49.90	54.33	62.29	71.51
Hungary	Agriculture	3,310	2,295	2,226	3,006	3,872
	Industry	8,858	8,350	11,140	13,019	15,009
	Service	16,182	16,058	17,783	20,681	23,858
	Trade	33.08	41.47	71.83	91.88	121.53

Appendix A5.1 Agricultural Land Use in Transition Countries



Appendix A5.2 Agricultural Tractor Use in Transition Countries



* Number of tractors in Poland is in ten-thousands

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Vita

PERSONAL DATA

Name: Vijayaratnam Subramaniam

Date of Birth: July 28, 1964

Place of Birth: Jaffna, Sri-Lanka

EDUCATION

1996: M.S. in Plant and Soil Sciences specialized in Soil and Water Sciences, Agricultural University of Norway. Aas, Norway.

2001: M.S. in Agricultural Economics Specialized in Production Economics at the University of Kentucky, Lexington, Kentucky, USA.

PROFESSIONAL HONORS

First Place Poster Award by Southern Agricultural Economics Association, Little Rock, AR on February 7, 2005

PROFESSIONAL POSITIONS

Spring 2010 - Current: Visiting assistant professor: Centre College, Danville Kentucky, U.S.A.

Fall 2006-Spring 2008: Adjunct Faculty: Kentucky Community and Technical College System at Cooper Campus, Lexington, Kentucky, U.S.A.

Spring 2008: Teaching Assistant: Advanced Quantitative Methods in Agricultural economics at the University of Kentucky, Lexington, Kentucky, U.S.A.

Spring 2005-Fall 2010: Research Assistant: Department of Agricultural Economics, University of Kentucky, Lexington, Kentucky, U.S.A.

Fall 2001-Fall 2004: Research Coordinator II: Department of Agricultural and Applied economics, University of Georgia, Tifton, Georgia, U.S.A.

Spring 2000-Fall 2001: Research Assistant: Department of Agricultural Economics, University of Kentucky, , Lexington, Kentucky, U.S.A.

PROFESSIONAL PUBLICATIONS

Babool, A., M. Reed, S. Saghaian, and V. Subramaniam (2009) "Food Safety Standards and Export Competitiveness in the Processed Food Industries of Asia-Pacific Countries" Journal of International Agricultural Trade and Development 5(1): 1-10

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