



# Monetary and fiscal policies' effect on agricultural growth: GMM estimation and simulation analysis

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## ARTICLE INFO

### Article history:

Accepted 4 June 2012

### JEL classification:

Q1  
C5  
E6

### Keywords:

Agricultural sector  
GMM  
Simulation

## ABSTRACT

The concept of sustainable economic growth is closely linked with the agricultural growth. This is especially true in the context of under-developed countries. Pakistan is a typical under-developed country that has huge labor force employed in conventional rural economy and more than half of the population relies on agriculture for subsistence. The study examines the agricultural growth through developing a model using the data from agricultural sector of Pakistan for the period 1972–2010. The model is primarily based on input–output reduced form structural equations approach. It is then estimated by GMM, validated and used for deterministic simulation analyses. Finally the validated model is used to critically analyze the impact of fiscal, monetary and energy policies on the agricultural output. We concluded that recent fiscal and monetary policies should be continued, while the energy policy needs to be modified in order to improve the agricultural GDP and reduce the rural poverty situation in the country.

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## 1. Introduction

Growth in agricultural productivity is central to overall economic development and poverty reduction (see, for example, Fare et al., 2008; Gollin et al., 2002; Irz et al., 2001; Machethe, 2004; Matsuyama, 1992; Pauw and Thurlow, 2011; Thirtle et al., 2003; Timmer, 1988). The use of inputs such as fertilizers and better seeds has been achieved considerably during the Green Revolution in 1980s. Moreover, the growing interest in national food security especially in South Asian countries stirred by recents supply shortages and restricted international trade during short supply periods boosts the importance of domestic agricultural sectors. Production of adequate amounts of agricultural output is essential for food security, which has been a major concern since the mid-1990s spanning a spectrum from the individual to the global levels (FAO, 2010; World Hunger, 2011). Growing agricultural sector ensures the employment and sustenance of masses living in rural areas in the agrarian economies.

Although agriculture is operated entirely by private sector yet public policy plays an important role in the sectoral growth of developing countries due mainly to resource constrained farming communities. Historically, public sector influenced domestic agriculture directly through fiscal measures and setting price of output low to ensure the availability of inexpensive food for the masses as well as indirectly through monetary policy. Subsidized fertilizers were made available

to ensure optimal inputs use for increasing productivity and such subsidies were a major component of Public Sector Development Plan of Pakistan during 1980s and 1990s. Recently, the public influence on agricultural prices and fertilizers subsidy has gradually been reduced. Moreover, public expenditures on research and its dissemination also contribute to the agricultural growth in Pakistan. Many previous studies observed that both public agricultural research and extension have positive and significant impacts on productivity (for example, Eyo, 2008; Huffman and Evenson, 2006; McCarl et al., 2009). Direct monetary policy impact is limited and credit requirement of farmers are mainly met through informal setting where broker (*Arhti*) provides input on credit. However, inflationary measures taken by the State Bank of Pakistan may affect indirectly the demand of inputs and output in agricultural sector.

The discourse in literature on development economics focuses the agricultural productivity and various factors affecting its growth in developing countries (see, for example, Ahmad and Martini, 2000; Chang and Zepeda, 2001; Dayal, 1984; Fan and Pardey, 1997; Fare et al., 2008; Fernandez-Cornejo and Shumway, 1997; Huang and Rozelle, 1996; Jensen et al., 2001). Gollin et al. (2002) shows that improvements in agricultural productivity accelerate industrialization and, have large effects on relative income. Therefore, a greater understanding of the determinants of agricultural growth may be helpful in understanding the development process for underdeveloped nations.

The impact of monetary policy on agricultural sector is rarely analyzed in the context of less develop countries. Few studies check the impact of monetary policy variables on commodity prices in agricultural sector (see, for example, Frankel, 2006; Hye, 2009; Orden and

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Fackler, 1989). In a recent study, Eyo (2008) finds that the exchange rate regime has not encouraged agricultural export while, agricultural credit is insignificant in affecting agricultural output growth. In recent years, monetary authorities have been adjusting interest rate after every three months in Pakistan keeping in view the economic conditions. On the fiscal side, energy subsidies have been reduced gradually due to constraints resulting in successive increases in energy prices during the last few years.<sup>2</sup> The impact of energy policy on agricultural sector is an ignored area and we could not find any study examining this issue. This study contributes in many ways to the existing literature. We develop an econometric model of Pakistan based on input–output framework using reduced form structural approach. Later, we conduct simulation to analyze the impact of interest rate shocks and various increases in energy price index on agricultural sector. Our study extends to previous literature on policy role in agricultural sector modeling both in breadth (*i.e.* consideration sub-sectors) and analytical scope (*i.e.* model estimation through the recent econometric methodology).

The development of agricultural sector models and identifying interactions with other macroeconomic variables has long history. Byerlee and Halter (1974) develops a simple simulation model for Nigeria built on an input–output framework that enables interactions in the product and labor markets. The study illustrates through linkage with an agricultural simulation model and evaluate alternative agricultural policies. Roop and Zeitner (1977) also develops agricultural sector model integrated into a larger macroeconomic model in order to identify the relationship between agriculture and rest of the economy. Some studies focus on the price formation of agricultural output while examining the relationship between agricultural sector and macroeconomic environment and finds significant bilateral causal relationship between macroeconomic variables and those referring to price formation in the sector. It shows that the macroeconomic policies and decisions strongly affect the agricultural sector and price stability (see, Dritsakis, 2003; Eckstein, 1984; Hye, 2009).

In spite of long history of such econometric modeling for policy making, partial equilibrium model construction is less frequent in developing countries. The problem with scattered commodity level models is that these are poorly integrated with national or agricultural systems, severely limiting their uses in practical work. This leads to the so-called traditional paradox of “meaningful parts forming meaningless whole” in agricultural model research (Chen, 1977).

The remainder of the paper is organized as follows. In the Section 2, we provide the structure of agricultural sector in Pakistan. Section 3 presents the specification of the model and methodology and data is described in Section 4. Sections 5 and 6 put forward respectively the estimation results and validation of the model. The simulation analysis is presented at Section 7 while Section 8 concludes.

## 2. Structure of agricultural sector in Pakistan

The agricultural sector has played an important role in Pakistan's economy. It accounts for over 21% of GDP, and remains by far the largest subsistence provider sector that absorbs 45% of the country's labor force. Nearly 60% of the rural population relies directly or indirectly on agriculture for their livelihood. The sector is the primary supplier of primary goods to downstream manufacturing industry, high proportional share in exports and a market for many industrial and energy products such as fertilizer, pesticides, machinery, oil and electricity. Pakistan agricultural sector enjoys substantial growth during the Green Revolution particularly in the crops sub-sector. The decade-wise cumulative average agricultural growth rates are given in Table 1 showing the impact of Green Revolution in terms of subsequent growth achievements.

<sup>2</sup> There are two main energy regulatory bodies namely; Oil and Gas Regulatory Authority (OGRA), which regulates the natural gas, LPG and oil products in Pakistan and National Electric Power Regulatory Authority (NEPRA), which regulates the electricity in the country.

**Table 1**  
Historical decade-wise agriculture growth performance.

Period	Growth (%)
1960s	5.1
1970s	2.4
1980s	5.4
1990s	4.4
2000s	3.2

Source: Federal Bureau of Statistics, Government of Pakistan.

Agricultural sector remains a key sector in economic development despite the relatively fast growing industrial and services sectors. It is due to its ability to produce food and source of livelihood. The food security concerns are worldwide but South Asia is among the most vulnerable regions where large number of people are food insecure. World Food Programme (WFP) declared that more than 48% people in Pakistan are food insecure (Khan, 2011). The agricultural sector is a source of survival for millions of rural households and accounts for relatively huge share in national income and total employment in most agrarian economies.

The agricultural sector output especially crops has been volatile in nature. The major crops (wheat, rice, cotton, and sugarcane) contribute 1/3rd of agricultural GDP in Pakistan. The minor crops account for 11% of the value added in overall agriculture. Livestock contributes 53.2% to agricultural output—more than the combined contribution of crops while the share of fishery in total agricultural output remains 2–3%. Livestock have rather stable growth trend. Fisheries share in GDP is relatively low but it contributes substantially to the national income especially through export earnings. The fourth component of agricultural sector in Pakistan is forest that has contracted significantly in the recent past. Pakistan is among few countries where highest rates deforestation is taking place (Shahbaz et al., 2007).

To clearly appreciate the linkages between public policy and agricultural growth in Pakistan, the causal relationships are given below at Figs. 1 and 2. It shows that agricultural output at aggregate and sub-sectoral levels has causal relationships as the graphical representations show same trend in the long-run. However, public investment only remained driver of agricultural growth upto early 1990s and later private sector investment became self sustained. Therefore, the trend of public investment in agricultural sector does not match with the agricultural growth beyond 1995. Government agricultural investments prior to early 1990s was mainly focused to mechanization of the sector. During 1990s and 2000s, the public general investment keep on rising that indirectly affected agricultural growth especially through better water and energy infrastructure and access to markets. Hence fiscal policy affects agricultural growth directly as well as indirectly.

There are two important monetary policy channels affecting agricultural growth, *i.e.* interest rate channel and credit channel. Fig. 2 shows that inter-bank call money rate and weighted average rate of return on bank advances have cointegration. Graphical analysis shows poor causal relationship between agricultural output and interest rate. However, credit to agricultural sector shows causal relationship with the output. These relationships are further elaborated through an econometric model.

## 3. Specification of the model

The disposition of agricultural sector in Pakistan is carried out by constructing a simultaneous equation model in an input–output framework. It focuses on identifying the linkages of the agricultural sector with fiscal and monetary policy and a number of other interacting variables. The role of fiscal policy is limited to government investment expenditures

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