Determinants of Sectoral Growth in Pakistan:
An Analysis of SVAR

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Abstract

In this paper, we evaluated the impulse response of agriculture, industrial and services sector growth to their own shocks and shocks to other macroeconomic indicators determining their growth. Amisano and Giannini (1997) AB model in structural vector auto regression was used for conducting the analysis. Objective was to check sustainability of shocks in relevant determinants of sectoral growth in Pakistan. Results show that agriculture sector growth impulse response to its shock and shock to gross national expenditures was positive. However, inflation and remittances shock affected agriculture sector growth negatively while effect of permanent crop land shock was both positive and negative. Industrial sector results show that external debt, industrial sector growth impulse response to rest of the variables was both positive and negative. External debt shock however, caused industrial sector growth to rise. Same kind of results are obtained for services sector growth impulse to its own shock and shocks to other relevant determinants.
Keywords: Growth, Agriculture, Industry, Services, TVP, SVAR

Introduction

Today's world is witnessing a great interest in retarded economic growth. It is one of the main macroeconomic indicators used for measuring economic performance of the country. Higher economic growth is accompanied with higher living standards and overall economic prosperity. Uncertain economic growth results in many problems such as high inflation, unemployment etc. (Montiel, 2011).

Asian countries particularly South East Asian economies are going through huge transformation and it is expected that Asian countries will change face of global economic landscape. Recent empirical literature on economic growth has recognized the potential of Asian countries as bastion of economic growth due to rise in their economic size, influence and living conditions of the people. Romer, Solow and Swan first provided theoretical model explaining economic growth.

Overall economic growth mainly consists of sectoral growth of the country. In Pakistan, overall economic growth is simply sum of growth in agriculture, industrial and services sector growth. However, each sector contribution to overall economic growth has been changing over the time. During initial years, agriculture sector contribution to overall economic growth of the country was larger than industrial and services sector. However, with the passage of time, agricultural sector contribution has decreased while contribution made by other two sectors in overall economic growth has increased. Based on sectoral contribution, we could say that structure of the economy has substantially changed. Up to 1980, Pakistan economy could be called as agro based because major contribution to overall economic growth came from agriculture sector. The situation has now changed. Services sector's contribution to economic growth is 58.8 percent, industrial sector has 20.30 percent and agricultural sector has 20.90 percent share (Economic Survey of Pakistan, 2014-15).

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Both industrial and services sector contribution adds-up to approximately 80 percent of overall GDP growth of the country.

Rural development is interlinked with agriculture sector growth while growth in industrial and services sector results in urban development of the country. Agricultural sector through its interlinkage with other sectors plays key role in determining overall economic growth of the country. The inter-sectoral linkages analysis identifies agriculture as the main economic sector that controls most economic activities in India (Singariya, 2016).

Given the importance of sectoral growth in determining overall economic growth of the country, this paper estimates impulse of sectoral growth to shocks to their determinants. The objective is to find out significance of shock and how long its effect on the sub-sector growth lasts.

Literature Review

Economic growth and its determinants have always remained a focus of both theoretical and empirical economic growth literature. However, the available empirical literature on growth has not given adequate attention to sectoral growth around the world. This paper addresses dearth of empirical literature on sectoral growth determinants.

Determinants of Agricultural Sector

Odhiambo et al. (2004) assessed the sources and determinants of agricultural growth and productivity in Kenya. Using ordinary least square method to augmented neo classical model, they found variables like rainfall, real exchange rate, primary school enrollment, government expenditures, financial development, trade openness and import penetration have relevancy for agriculture sector growth in Kenya. Using autoregressive distributed lags(ARDL) method to annual data from 1965 to 2009, Ahmed and Heng (2012) found that fertilizers, human capital and credit to private sector affected total factor productivity of agricultural sector positively and significantly. However, agricultural productivity was affected negatively by area under crops. Peter and Warr (2012) show that government expenditures, international spending on agricultural production and share of food crops affected Indonesian agriculture sector productivity positively. Agriculture extension and total rainfall retarded the growth. Khalidi and Sherazi (2013) used simple economic growth model and found that labor, capital and total productivity are main determinants of value added of agricultural sector growth in Iran because all the three variables affected positively and significantly the value-added of agricultural sector. While using ordinary least square method to Cobb-Douglas production function, Enu and Obeng (2013) concluded that labor force, real exchange rate, and real gross domestic product (GDP) per capita have significant effect on agricultural outputin Ghana.Camelia and Burja (2015) while using annual panel data from 2008 to 2012 found utilized agricultural area is the main determinant of productivity of agricultural sector in Romania. Labor input and farm capital on each hectarehave less impact on productivity of agricultural sector compared to utilized agricultural area.

Chebil et al. (2015) applied autoregressive distributed lags (ARDL) method of estimation for annual data from 1980 to 2012 concluded that government expenditures on research and development affected wheat production positively and significantly. Effect of infrastructure development in rural areas like roads etc. and irrigated area for wheat with respect to total cultivated area could not affect wheat output in a positive way in Tunisia.

Determinants of Industrial Sector

Kathuria et al. (2010) assessed the relationship between human capital and manufacturing productivity growth using data on fifteen Indian states. Results show positive and significant effect of human capital on manufacturing productivity growth. Effect of physical capital

however, appeared insignificant. Sola et al. (2013) found relevancy of imports, exports, capacity utilization and investment in determining performance of manufacturing sector in Nigeria. Otalu and Andreu (2015) also focused the determinants of industrial sector growth in Nigeria. Using Leontief input output model and co-integration and error correction technique, they found that capital, labor, exchange rate, capacity utilization, trade openness and electricity generation have positive and significant effect on industrial sector growth. Education attainment, inflation rate and trade openness however, affected negatively Nigerian industrial sector output growth. Mohsen et al. (2015) applied Johansen cointegration and Granger causality test to find out determinants of industrial sector output in Syria. Results show gross fixed capital formation, manufactured exports, population growth rate and agricultural output affected industrial output positively. Oil prices however, have negative effect on industrial output. Sertic et al. (2015) also focused the determinants of manufacturing industry exports in European Union states. Generalized method of moments (GMM) based results show relevancy of domestic demand, industrial production, real effective exchange rate labor cost and economic crisis in determining manufacturing industry exports in European Union States. Martinaitytė and Kregždaitė (2015) evaluated the factors determining the development of creative industries in Lithuania. Creative industries were defined as the area of overlap between culture, technology, science and commerce. They involve the supply of goods and services that contain a substantial element of artistic and intellectual activities associated with a vital role in social and human development.

Determinants of Services Sector

Gordon and Gupta (2003) focused the factors determining service sector growth in India. Based on ordinary least square estimates, the authors concluded that exports of services, external trade and trade liberalization significantly affected Indian services sector growth. Jain et al. (2015) also focused services sector growth determinants in India. Using annual data from 2000 to 2012 and ordinary least square method, they found relevancy of institutional investment, foreign direct investment, equity of imports exports of the services sector, debt, and institutional investment abroad in determining services sector growth. Based on vector autoregressive (VAR) estimates, Singh and Kaur (2014) recommended that GNP per capita, foreign trade and the domestic investment affected services sector growth positively. However, effect of foreign direct investment on services sector growth was negative and significant. Wu (2005) employed fixed effect and random effects techniques of estimation for finding out determinants of the services sector in India and China. Based on empirical evidence, the author concluded that per capita income, urbanization and foreign demand for services have positive and significant impact on the growth of the services sector in India and China.

Data

Appropriate determining factors of three sectors of economic growth were calculated for SVAR analysis, by employing general to specific approach in coordination with time varying parametric approach and ARDL. Inflation, consumer prices (annual %) denoted as (cpi_t), personal remittances received (% of GDP) denoted as (rem_t) gross national expenditures (% of GDP) denoted as (gne_t), gross fixed capital formation (% of GDP) denoted as (k_t), total population denoted as (pop_t) and Permanent cropland (% of land area) denoted as (pcl_t) were finally selected appropriate determinants of sectoral growth in Pakistan. All variables were converted into log form for final analysis as these were taken as it is form from WDI

(2015) for the period 1976-2014. First difference stationary variables were converted into level state.

Results

Structural vector auto regression is employed for finding out how sectoral growth responds to shocks to its determinants. Structural vector auto regression (SVAR) models provide valid and consistent results especially in case of small open economy (Cushman and Zha, 1997). Furthermore, the researcher can apply assumptions theoretically while restricting explicitly in their empirical models to build associations as an alternative of simple unrestricted VAR. SVAR can be given as:

$$
\begin{bmatrix} \varepsilon_t y_t \\ \varepsilon_t cpi_t \\ \varepsilon_t gne_t \\ \varepsilon_t k_t \\ \varepsilon_t rem_t \end{bmatrix} = B = \begin{bmatrix} 1 & b_{12} & b_{13} & b_{14} & b_{15} \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t y_t \\ e_t cpi_t \\ e_t gne_t \\ e_t k_t \\ e_t rem_t \end{bmatrix} \qquad (1)
$$

The matrix B is reflected as recursive SVAR if all its elements above or below its diagonal are equal to zero. However, based on structural features of a small open economy like Pakistan, non-recursive restrictions are imposed on contemporary parameters of SVAR model in equation (1). Ten zero restrictions are required for the model to be just identified. However, the model is over identified if total of 16 zero restrictions are imposed. Since it is not possible to observe structural shocks without identifying restrictions, so, to identify the system, certain assumptions are essential. Hence structural restrictions are put on the model for identifying sectoral growth determinants.[a] Being the most exogenous variable in the system, sectoral growth (y_t) is assumed to give response only to its own shocks in this sense.

Being the most endogenous variable in the system, sectoral growth (y_t) also responds to its determinants which include consumer prices, personal remittances received, gross national expenditures, gross fixed capital formation and other relevant variables that are not shown in (1). (b_{12}), (b_{13}), (b_{14}) and (b_{15}) represent response of sectoral growth (y_t) to shock in inflation (cpi_t), remittances received (rem_t), gross national expenditures (gne_t), and gross fixed capital formation (k_t).[b]

Phillips and Perron unit root test is employed for testing time series properties of the variables before estimating equation (1) using SVAR approach.[c] Results given in table 1 show that all variables except foreign direct investment are nonstationary in levels and stationary at first difference. Foreign direct investment on the other hand is stationary in level in both specifications at 10 and 5 percent significance level.[d]

Figure 1, 2 and 3 show impulse response of agriculture, industrial and services sector growth to their determinants. The two dashed red lines represent confidence interval while solid blue line indicates impulse response of the dependent variable. Ten-year time period having

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[a] Culha (2006) also imposed similar restriction on his model.

[b] The authors also constructed Matrix B for agricultural, industrial and services sectors growth determinants and can be obtained on request.

[c] ADF test results are not reported here due to space constraint.

[d] We followed Ibrahim and Sufian (2014); Kim and Roubini (2000) and Cushman and Zha (1997) for estimating equation (1) using SVAR approach.

thousand bootstrapped reproductions with 95% confidence intervalsas suggested by Hall (1992) is used for estimating SVAR impulse-response functions of sectoral growth in Pakistan.[a]

To shocks from all the explanatory variables, the time path of dependent variables could be produced by impulse response function (IRF) in the VAR. Any shock of the explanatory variables to dependent variable becomes zero when the impact of shock weakens, it could be seen in figures. This indicates the stability of SVAR.
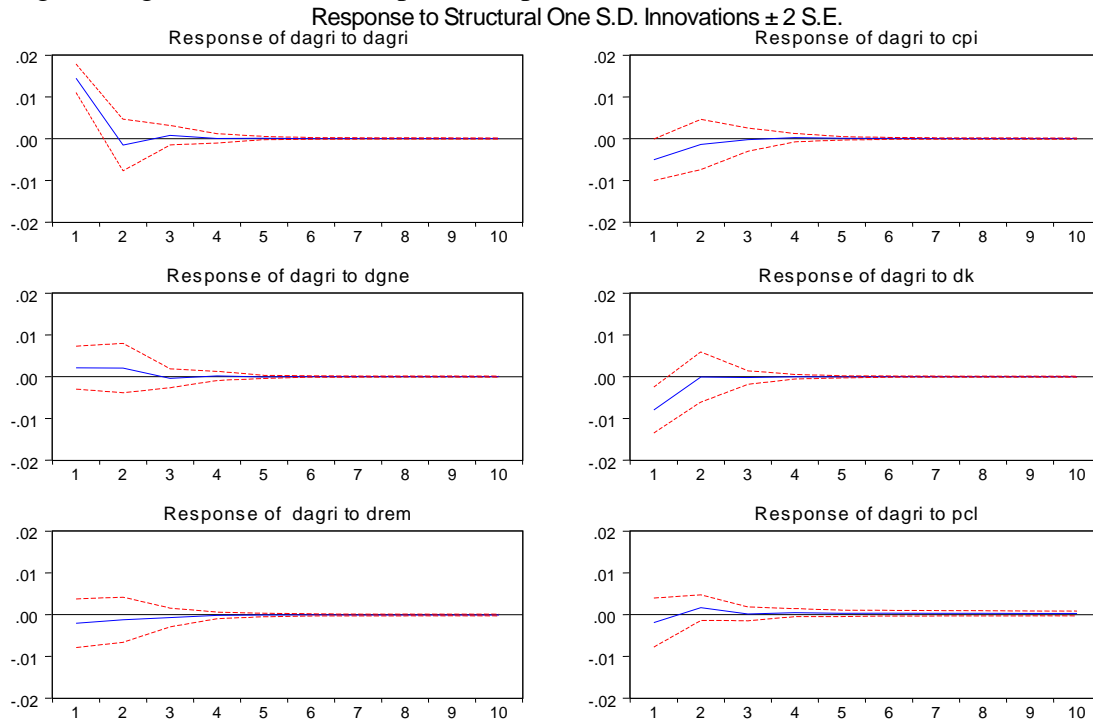
Figure 1 shows agriculture sector output growth to its own shock and shocks to its determinants. It is apparent from the figure that agriculture sector output growth responds positively to its own shock and its effect persists up to five years. Inflation shock affect agriculture sector growth negatively up to four years. Gross national expenditure shock on agriculture growth is positive. Shocks to remittances received and gross fixed capital formation

Table 1: Phillips and Perron Unit Root Test

Variables	Level		1st Difference	
	Intercept	Intercept&Trend	Intercept	Intercept&Trend
y_t^a	-1.77	-1.69	$-5.97^{\,a}$	$-6.16^{\,a}$
y_t^i	-2.57	-2.81	$-7.02^{\,a}$	$-7.04^{\,a}$
y_t^s	-1.50	-3.05	$-4.19^{\,a}$	$-4.27^{\,a}$
cpi_t	$-2.86^{\,b}$	-2.76	$-7.44^{\,a}$	$-7.36^{\,a}$
ed_t	-0.76	-1.16	$-4.83^{\,a}$	$-4.81^{\,a}$
fdi_t	$-2.79^{\,b}$	$-5.30^{\,a}$	$-5.40^{\,a}$	$-4.47^{\,a}$
k_t	-1.47	-2.39	$-5.92^{\,a}$	$-5.83^{\,a}$
gne_t	-1.80	-1.92	$-6.78^{\,a}$	$-6.72^{\,a}$
rem_t	-1.44	-1.58	$-5.77^{\,a}$	$-5.71^{\,a}$
fd_t	-0.86	-1.25	$-5.29^{\,a}$	$-5.57^{\,a}$
pcl_t	-2.40	-1.21	$-5.30^{\,a}$	$-5.76^{\,a}$
10 % critical values	-2.60	-3.19	-2.61	-3.20
1% critical values	-3.61	-4.21	-3.62	-4.22

Note y_t^a, y_t^i, y_t^s, cpi_t, ed_t, fd_t, rem_t, fdi_t, pcl_t gne_t, k_t represent agricultural, industrial and services sector output growth, inflation, external debt, domestic credit to private sector, personal remittances, net foreign direct investment, permanent crop land, gross national expenditures and gross fixed capital formation.

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Figure 1Agriculture Sector Impulse Response

retard agriculture sector growth while effect of shock to permanent crop land is both positive and negative.

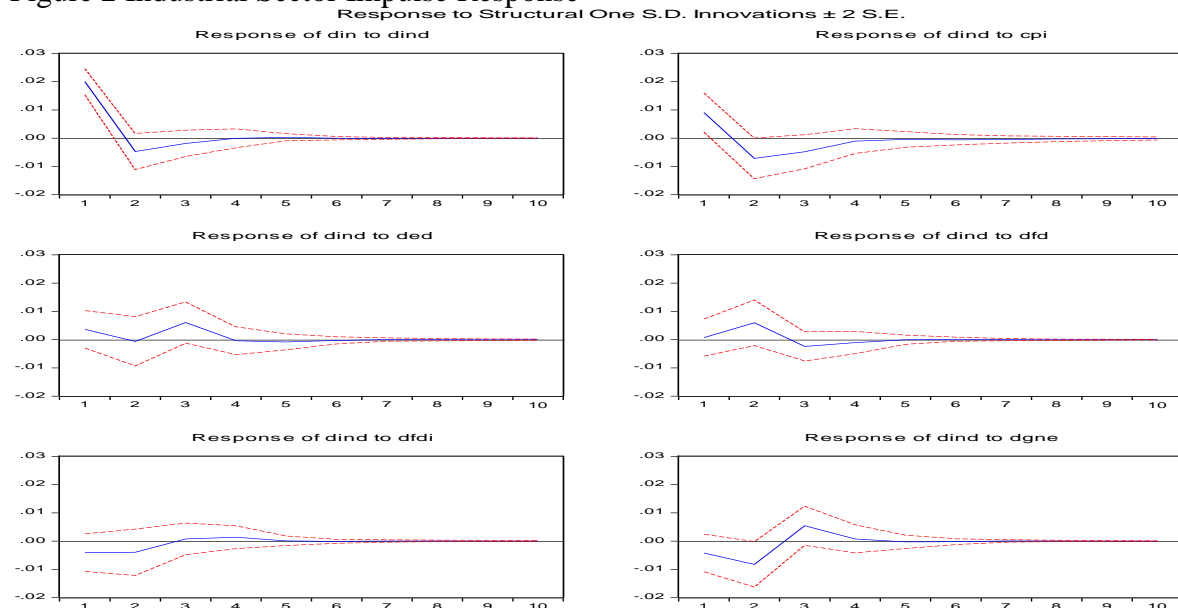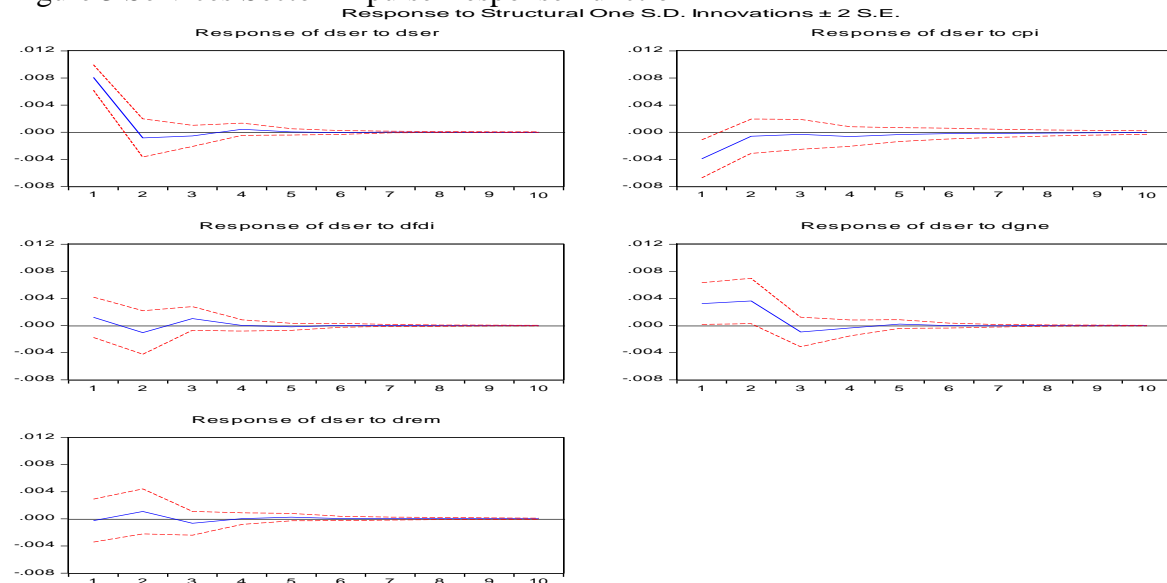Figure 2 Industrial Sector Impulse Response

Figure 2 shows impulse response of industrial sector output growth to its own shock and shocks to other determinants determining it. It is apparent from the figure that industrial sector output growth response to its shock and shock to other factors determining it is both positive and negative and it persist up to 4 to 5 years.

Figure 3 represents response of services sector growth to its own shock and shocks to relevant determinants. Services sector growth responds positively to its own shock initially. However, after two years' response of services sector growth to its own shock is negative.

Foreign direct investment, remittances received and gross national expenditures shocks affect services sector growth both positively and negatively. However, impulse response of services sector growth to inflation is negative. This implies that any shock to inflation affects services sector growth negatively.

Figure 3 Services Sector Impulse Response Function

Response to Structural One S.D. Innovations ± 2 S.E.

Conclusion

This paper focused on impulse response of agriculture, industrial and services sector growth to shocks to their determinants. Annual time series data from 1976 to 2014 was used. Impulse response function was generated from structural vector auto regression. Results show that agriculture sector output growth responded positively to its own shock and shock to gross national expenditures and negatively to remittances received, inflation and capital formation shocks. Effect of shock to permanent crop land on agriculture growth is both positive and negative. Except external debt, impulse response of industrial sector growth to its own shock and shocks to foreign direct investment, inflation, domestic credit and gross national expenditures is both positive and negative. Services sector growth impulse to its own shock and shocks to other relevant determinants is both positive and negative.

Policy Implications

Policy makers should focus on controlling inflation to boost up the growth of three major sectors of GDP. Gross national expenditures should be increased to increase the growth in agricultural sector. Industrial sector growth should be augmented through external debt as it has positive impact apparently. Determinants of services sector growth having much positive impact should be focused.

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