

Determinants of Services Sector Growth in Pakistan: A Time Varying Parametric Approach

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Abstract

This empirical study followed time varying parametric approach to find out relevant macroeconomic determinants of Pakistan's services sector growth. Annual data was taken from World Development Indicators (2014) during period 1976-2014. Main findings of the study are that rolling regression estimates of explanatory variables justify the use of Kalman filtering approach. The state space results indicate that Table 6.4 shows that inflation (cpi_t) has negative and significant effect on services sector output growth (y^s_t) at five percent significance level. Net foreign direct investment has positive and significant effect on services sector output growth (y^s_t). Gross national expenditures with positive effect are the relevant significant determinants of services sector output growth (y^s_t) at five percent significance level. Evidence proved that structural changes affect the static results. For effective policy making, it is necessary to employ time varying parametric approach to study the behavior of economy in real sense. Based on empirical findings, it is recommended to concerned authorities to augment gross national expenditures, foreign direct investment and control inflation to achieve long run economic growth in country. Some of the results have been changed when we apply time varying parametric approach like Kalman Filter approach instead of static approach like Auto Regressive Distributive Lag.

Keywords: Kalman Filter, rolling regression, inflation, foreign direct investment, gross national expenditures

1. Introduction

Over the time, the structure of any economy changes and the constancy of estimated coefficients or parameters is affected significantly by these structural changes. The fixed parametric approaches like ARDL, Engle Granger (1987), Phillips-Ouliaris (1988) and Johansen and Juselius (1988) don't take into account impact of structural changes on estimated constant parameters. It is compulsory to employ a time varying parameter approach to evaluate the impact of structural changes on constant estimated parameters (Gilal and Chandio, 2013). Kalman Filter is applied as a time varying parametric approach. Isaiah et al. (2015) preferred Kalman (1960, 1963) filter estimation strategy than other conventional method of estimation due to following advantages. First, Kalman Filter is an ideal approach as the impact of variables used changes with time (Slade, 1989). Second, Kalman filter is considered to be better than the least squares methods particularly when the parameters are not stable (Morisson and Pike, 1977). Third, this approach of estimation is prognostic and adaptive and it can be applied without checking the stationarity of variables. (Inglesi-Lotz, 2011).

Effect of structural changes on GDP growth in Pakistan can be explained as: during the decade of fifties, gross domestic product was very low in the beginning of decade of fifties due to political instability and unavailability of proper constitution or proper framework. Then Field Martial General Ayub Khan took over the charge of country and gross domestic product remained somewhat stable during period 1958-1969 except years 1966 and 1967 when the effects of War 1965 with India came out in shape of low output. In the beginning of decade of seventies Pakistan was broken into two parts and Bangladesh was the newly born country on the map of World. Pakistan has to face a loss in terms of production due to the undeclared War with India in 1971. During period of 1972-1977, when Zulfikar Ali Bhutto was ruling the country, gross domestic product remained stable, and then Military took over the charge of country and General Zia Ul Haq ruled for the period 1977-1988 when GDP remained stable. During the period of 1988-1999, four governments changed; two governments of Peoples Party Parliamentary (PPP) and two of PML (N); gross domestic product remained very low during this period. This downfall was continued till 2005 even when General Musharraf was ruling the country. Rule of General Musharraf prolonged for period 1999-2008. After 2003 till 2008, gross domestic product remained stable. After 2008 till 2011, pace of GDP is showing downfall and then increasing till now.

Prior to discussing Kalman filter approach, the rolling regression method is used to justify the use of time-varying parameter approach. We used annual data in order to reduce the variability and autocorrelation in the data. This allowed us to avoid having to include autoregressive terms and lagged components of the independent variable, hence keeping the model specification simpler and more interpretable. Annual data were also used in the studies of Moosa (1997) and Viren (2001).

Rolling regression parameter estimates were obtained by employing OLS within the rolling regression

framework for the period 1976–2014. K^l was set to 12. The first observation is then dropped and another one added and re-estimated. This process continues until the last observation is used in the analysis. This is in line with the duration of almost one business cycle² and is in agreement with the choice of Moosa (1997) and Gilal(2013)

The Kalman filter (1960) is employed recursively by time to find forecasts and variance of forecast. Each next after other forecast is constructed through the updation of previous forecast. Weighted averages of the previous observation and the previous forecast error are used for each forecast. The fascinating character of the Kalman filter is that the weights in the update criterion are taken to ensure that the forecast variances are minimized. These weights, referred to jointly as the Kalman gain. The Kalman filter is crucial because it may be employed in real time. That is, as each value of the annual data is noticed the forecast for the next observation can be calculated (Hyndman and Snyder, 2001)

Organization of study is as the first section is about introduction, section two includes methodology: data, model and estimation technique. Section three discusses results, fourth section concludes the study and section five is about references.

2. Methodology:

2.1. Data

Annualized data from 1976 to 2014 is used. The data is taken from World Bank World Development Indicators. The choice of sample is based on two factors (a) disintegration of the country in December, 1971 and (b) data on most of the variables is available after 1975. Since data on most of the variables shows strong trend therefore, it is used in log form. Log transformation linearizes exponential function because log function and exponential are inversely related with each other (Astierou and Price, 2007). Finally, log transformation allows us to interpret estimated parameters in terms of elasticities.

2.2. Model

General model to find out the determinants of services sector growth is as under:

$$y_t^s = \alpha + \varphi_1 cpi_t + \varphi_2 fd_t + \varphi_3 fdi_t + \varphi_4 gne_t + \varphi_5 k_t + \varphi_6 rem_t + \varphi_7 to_t + \varepsilon_t \dots \dots \dots (04)$$

Equation (4) is services sector's output growth and its determinants. The relevant determinants of services sector contribution (y_t^s) to overall economic growth are: Inflation (cpi_t), domestic credit to private sector (fd_t), foreign direct investment (fdi_t), government national expenditures (gne_t), gross fixed capital formation (k_t), personal remittance (rem_t) and trade openness (to_t).

$$y_t^s = SV_{1t} cpi_t + SV_{2t} fd_t + SV_{3t} fdi_t + SV_{4t} gne_t + SV_{5t} k_t + SV_{6t} rem_t + SV_{7t} to_t + [\text{var} = \exp(c(1))] \dots \dots \dots 4.1$$

$$SV_1 = SV_1(-1) \dots \dots \dots 4.2$$

$$SV_2 = SV_2(-1) \dots \dots \dots 4.3$$

$$SV_3 = SV_3(-1) \dots \dots \dots 4.4$$

$$SV_4 = SV_4(-1) \dots \dots \dots 4.5$$

$$SV_5 = SV_5(-1) \dots \dots \dots 4.6$$

$$SV_6 = SV_6(-1) \dots \dots \dots 4.7$$

$$SV_7 = SV_7(-1) \dots \dots \dots 4.8$$

Where

SV_{1t} , SV_{2t} , SV_{3t} , SV_{4t} , SV_{5t} , SV_{6t} and SV_{7t} are coefficients of inflation, domestic credit to private sector, foreign direct investment, Gross national expenditures, gross fixed capital formation, remittances and trade openness. $[\text{var} = \exp(c(1))]$ is used to show the impact of other factors including structural changes on services sector growth.

¹ K is used for window size i.e. number of observations in rolling regression

² The cycles are of the types :1- the Kitchin inventory cycle having duration of 3 to 5 years , 2- the Juglar fixed investment cycle of duration: 7 to 11 years , 4- the Kuznets infrastructural investment cycle having duration of 5 to 25 years and 5- the Kondratieff wave or long technological cycle with duration of 45 to 60 years (Isaiah:2015).

3. Results:

3.1. Rolling Regression: Determinants of Services Sector Growth

Rolling regression parameter estimates were obtained by employing OLS within the rolling regression framework for the period 1976–2014. K was¹ set to 12. The first observation then dropped and another one added and re-estimated. This process continues until the last observation is used in the analysis. This is in line with the duration of almost one business cycle² and is in agreement with the choice of Moosa (1997) and Gilal (2013).³

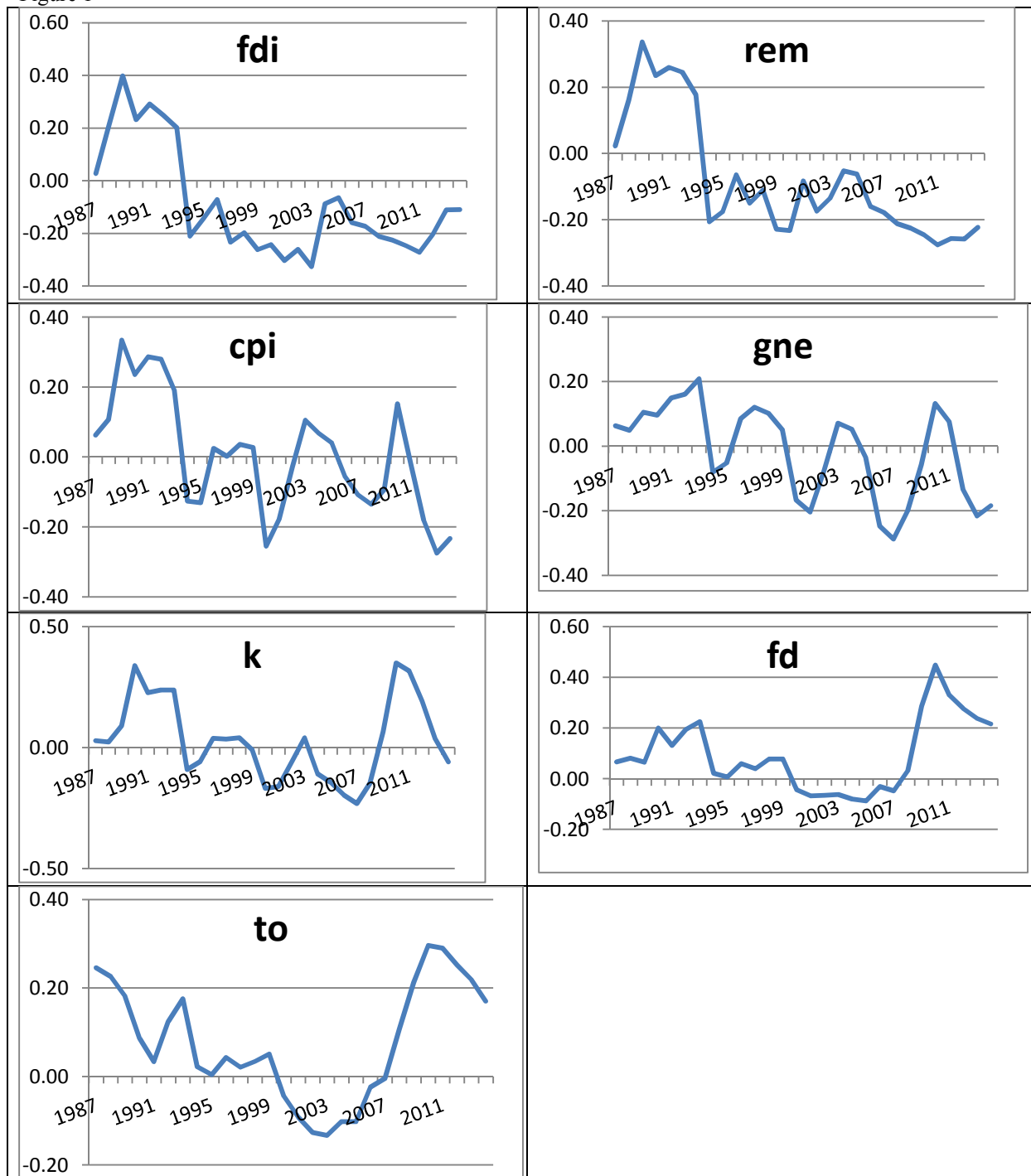
Figure 1 shows that the rolling regression estimates foreign direct investment (fdi_t), remittances (rem_t), inflation (cpi_t), gross national expenditures (gne_t), gross fixed capital formation (k_t), domestic credit to private sector (fd_t) and trade openness (to_t) with Services Sector growth (y^s_t) as dependent variable show some fluctuation thus justifying the use of Kalman filtering approach.

¹ K is used for window size i.e. number of observations in rolling regression.

² The cycles are of the types :1- the Kitchin inventory cycle having duration of 3 to 5 years , 2- the Juglar fixed investment cycle of duration: 7 to 11 years , 4- the Kuznets infrastructural investment cycle having duration of 5 to 25 years and 5- the Kondratieff wave or long technological cycle with duration of 45 to 60 years (Isaiah:2015).

³ Moosa(1997) used 14 observations and Gilal(2013) used 13 observations.

Figure 1



3.2. Kalman Filter Results: Determinants of Services Sector Growth

Table 1 shows that inflation (cpi_t) has negative and significant effect on services sector output growth (y^s_t) at five percent significance level. This implies that increasing prices in services sector are not beneficial for services sector growth. This result does match with ARDL results where relationship was also negative. The results of inflation are in line with the study by Stockman (1981) where he developed a model that shows a negative relationship between inflation and economic growth. Stockman's model shows that an increase in the inflation rate results in a lower steady state level of output and people's welfare declines. Stockman applied a fixed parametric approach.

Net foreign direct investment has positive and significant effect on services sector output growth (y^s_t).

This result is similar to that of ARDL results where relationship was also positive. Positive impact of foreign direct investment (fdi_t) is consistent with Neoclassical and endogenous growth theories which emphasize that foreign direct investment (fdi_t) promotes economic growth through physical investment (Baro & Salai-I-Martin 1995, Grosman & Helpman 1991, Lucas 1988 & Romer 1986)

Gross national expenditures with positive effect are the relevant significant determinants of services sector output growth (y^s_t) at five percent significance level. Implications of results of gross national expenditures are that gross national expenditures may have positive effects on services sector output growth through capital accumulation, labor force growth and total factor productivity (tfp) growth.

Remaining variables included in estimation process could not show significant association with services sector output growth. Other factors including structural changes (c(1)) showed significant association with services sector output growth.

Table 1: Determinants of Services Sector Growth¹

Variables	Model :1	Model :2
	Coefficient	Coefficient
C(1)	^a	^a
cpi_t	-8.40(29.79)	-7.78(-28.53)
fd_t	-0.04(-3.05) ^a	-0.04(-2.49) ^a
fdi_t	-0.14(-2.61) ^a	
gne_t	0.07(9.06) ^a	0.07(8.55) ^a
k_t	1.05(17.56) ^a	0.86(105.00) ^a
rem_t	-0.12(-1.46)	
to_t	-0.02(-1.71) ^b	
	-0.01(-0.14)	

^a and ^b show the significance of estimated parameters at five and ten percent significance level respectively. Calculated z statistics are given in parentheses.

3.3. State Space Filtered Graph: Determinants of Services Sector Growth:

Figure 2 represents one step ahead graph of determinants of service sector growth. SV1 represents inflation, SV2 represents foreign direct investment and SV3 represents gross national expenditure.

Figure 2 shows \pm two standard error time varying parameter estimates, after recursive estimation of inflation (cpi_t), foreign direct investment (fdi_t) and gross national expenditure (gne_t) with services sector growth (y^s_t) as dependent variable. It is clear from the figure that initially, the estimated parameters show more fluctuation with increased standard errors. This is due to a small number of observations that are used for estimating additional parameter of interest. Once the information that is used for predicting $t+1$ observation increases, the estimated parameters stabilize and their corresponding errors are reduced.

If we divide the sample period in Figure 2 into two sub-periods: period from 1976 to 1990 is called before regulation period and period after 1990 is considered the period of reforms and regulations. The results depict that all variables are found to be much instable during the non reform period while the sample period after decade of 90s is found to be much stable. It is further clear from the figure 2 that estimated parameters are found to be within the range of ± 2 .

¹ Two variables domestic credit to private sector (fd_t) and remittances received (rem_t) become insignificant when estimated in model 2, so were dropped.

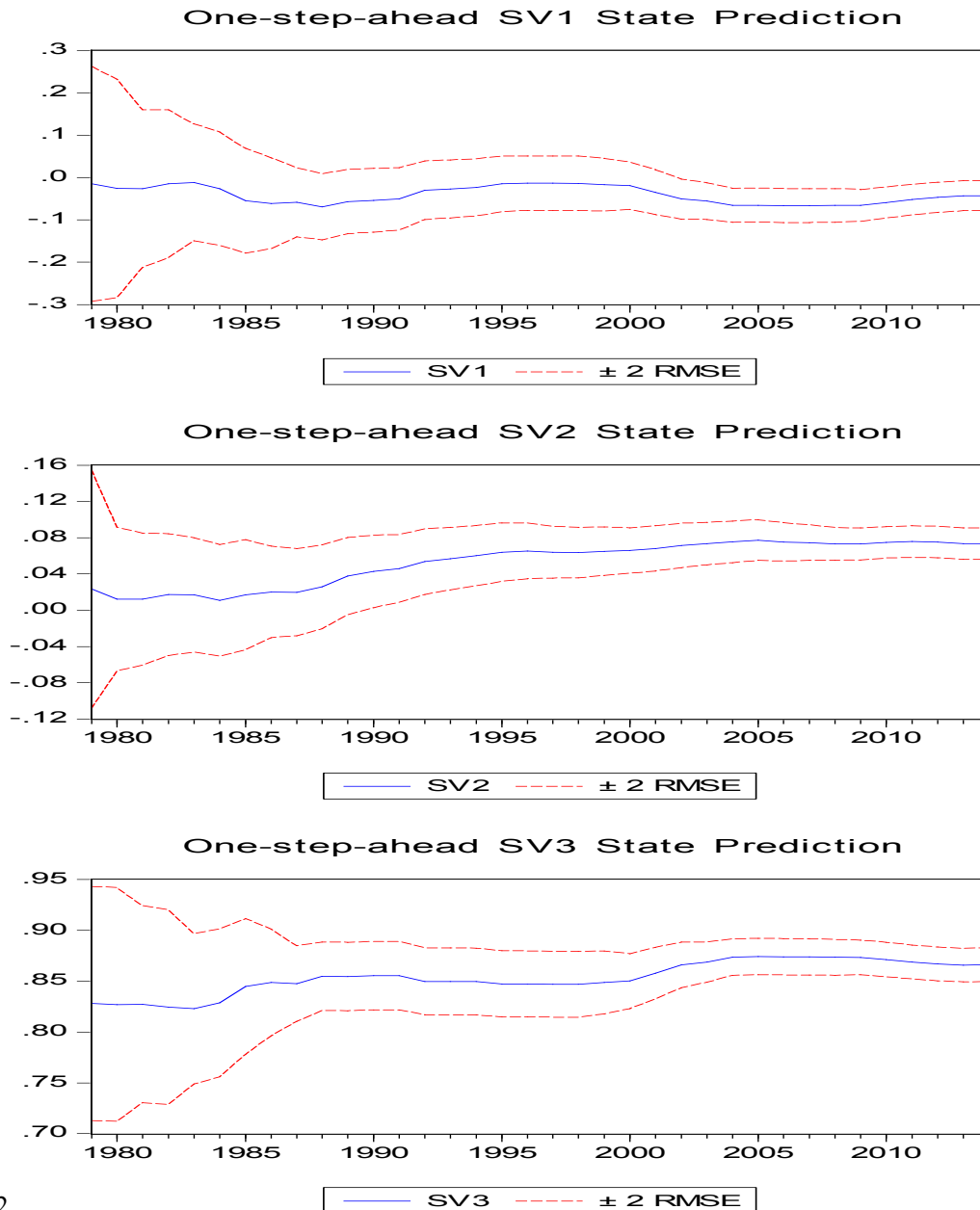


Figure 2

4. Conclusion:

Main findings of the study are that rolling regression estimates of explanatory variables justify the use of Kalman filtering approach. Table 1 shows that inflation (cpi_t) has negative and significant effect on services sector output growth (y^s_t) at five percent significance level. Net foreign direct investment has positive and significant effect on services sector output growth (y^s_t). Gross national expenditures with positive effect are the relevant significant determinants of services sector output growth (y^s_t) at five percent significance level. Evidence proved that structural changes affect the static results. For effective policy making, it is necessary to employ time varying parametric approach to study the behavior of economy in real sense. Based on empirical findings, it is recommended to concerned authorities to augment gross national expenditures, foreign direct investment and external debt to achieve long run economic growth in country.

5. References

1. Asteriou, D. and Prices (2007) Applied Econometrics - A Modern Approach, Basingstoke: Palgrave Macmillan.

2. Ari, A., Ozcan, B. (2012) İşçi gelirleri ve ekonomik büyüme ilişkisi: Dinamik panel veri analizi, Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, no. 38, pp. 101-117.
3. Engle, R. F. and Granger, C. W.(1987) Co-integration and Error Correction: Representation, Estimation, and Testing, *Econometrica: Journal of the Econometric Society*, Vol. 55(2), pp. 251-276.
4. Gilal and Chandio(2013) Exchange Market Pressure and Intervention Index for Pakistan: Evidence from a Time-Varying Parameter Approach, *GSTF Journal on Business Review* , Vol.2(4), pp.18-24.
5. Hillier, J., The Stochastic Properties of Systematic Risk for U.S. Mutual Funds, *Department of Finance and Accounting, Glasgow Caledonian University*, 2002.
6. Hussain, I.(2012) Economic reforms in Pakistan: One Step Forward, Two Steps Backwards, A lecture at PIDE.
7. Hyndman, R., Snyder, R. (2001) Available at <http://robjhyndman.com/papers/Kalman.pdf>.
8. Ijirshar, et al.(2016) The Relationship between External Debt and Economic Growth in Nigeria, *International Journal of Economics & Management Sciences*, Vol.6(1), pp.1-5.
9. Inglesi-Lotz, R. (2011) The Evolution of Price Elasticity of Electricity Demand in South Africa: A Kalman Filter Application, *Energy Policy*, Vol. 39(6), pp. 3690-3696. www.elsevier.com/locate/enpol.
10. Isaiah, R.T. et al.(2015) Dynamics of Electricity Demand in Lesotho: A Kalman Filter Approach, *Studies in Business and Economics*, Vol.10(1), pp.1-10.
11. Javid et al. (2012) Impact of Remittances on Economic Growth and Poverty, *Academic Research International*, Vol. 2(1), pp.433-447.
12. Johansen, S. and Juselius, K.(1990) Maximum Likelihood Estimation and Inference on Cointegration- with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, Vol.52, pp. 169-210
13. Lucas, Robert E. (1988) On the Mechanics of Economic Development. *Journal of Monetary Economics*, Vol. 22, pp. 3–42.
14. Mohaddes, K, and Raissi, M.(2014) Does Inflation Slow Long-Run Growth in India?, IMF Working Paper WP/14/222 Asia and Pacific Department, pp.1-19.
15. Moosa, I. A.(1997) A cross-country comparison of Okun's coefficient, *Journal of Comparative Economics*, Vol.24, pp. 335–356.
16. Mori Kogid, Rozilee Asid, Jaratin Lily, Dullah Mulok and Nanthakumar Loganathan(2012) The Effect of Exchange Rates on Economic Growth: Empirical Testington Nominal Versus Real, *The IUP Journal of Financial Economics*, Vol. X(1), pp.
17. Morisson, G.W. and Pike, D.H. (1977) Kalman Filter Applied to Statistical Forecasting, *Journal of Management Sciences*, Vol. 23(7), pp. 768-774.
18. Phillips, P.C.B. and Perron, P. (1988) Testing for Unit Roots in Time Series Regression, *Biometrika*, Vol.75, pp. 335-346.
19. Sinha (1998) Government Expenditure and Economic Growth in Malaysia, *Journal of Economic Development*, Vol.23 (2), pp.71-80.
20. Slade, M.E. (1989) Modelling Stochastic and Cyclical Components of Technical Change: An Application of the Kalman Filter, *Journal of Econometrics*, Vol. 41(3) pp. 363-383.
21. Stock man, A.(1981) Anticipated inflation and the capital stock in a cash in-advance economy, *Journal of Monetary Economics*, Vol. 8(3), pp. 387-393.Viren,
22. M. (2001) The Okun curve is non-linear, *Economics Letters*, Vol.70, pp. 253–57.
23. Yao, J., Gao, J.(2004) Computer-Intensive Time-Varying Model Approach to the Systematic Risk of Australian Industrial Stock Returns, *Australian Journal of Management*, Vol.29, pp.121-146.