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The Fiscal Reaction Function and the Transmission Mechanism for Pakistan

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1. INTRODUCTION

Modern macroeconomics literature emphasises both the short run and long run objectives of fiscal policy [Romer (2006)]. In the short run it can be used to counter output cyclicalities and/or stabilise volatility in macro variables, which is descriptively same as of effects of the short run monetary policy. Further for the long-run, fiscal policy can also affect both the demand and supply side of the economy. But in most traditional analyses it is assumed that fiscal policy would adjust to ensure the inter-temporal budget constraint to be satisfied, while monetary policy is free to adjust its instruments [‘Ricardian Regime’ by Sargent (1982)] such as stock of money supply or the nominal interest rate [Walsh (2003)]. The debt financing methods, expenditure and tax powers of fiscal authorities i.e. the fiscal policy has also been seen as to affect both the supply and demand side of the economy. As noted by Baxter and King (1993), the initial Real Business Cycle models had only the supply side effects of the fiscal policy, where these were transmitted through the wealth effect and labour-leisure choices of the household. Recently also New-Keynesian type models with micro-foundations and sticky prices argue that still through the supply side fiscal policy management could be accorded for stabilisation [Linnemann and Schabert (2003)]. The demand side effects of the fiscal policy could also be found only with more imperfections such as ‘Rule of Thumb’ consumers or those with liquidity constraints, which lead to exclusion of Ricardian equivalence [Gali, *et al.* (2005)]. But all that depends on the structure of the economy, as Blanchard and Perotti (2002) stated:

“The evidence from large-scale econometric models has been largely dismissed on the grounds that, because of their Keynesian structure, these models assume rather than document a positive effect of positive fiscal expansion on output”.

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In order to gauge the effects of shocks in fiscal policy or its responsiveness to various macro variables (i.e. the automatic stabilisers property of fiscal instruments) one has to see the stance by composition of budget from both the share of components and their classifications. Normally macroeconomics 'fiscal stance' is assessed by looking at the consolidated scale of public deficit. But the dynamic effects of the shocks in government spending, taxes and the consolidated budget deficit (thereby implying the composition of inter-temporal budget constraint) can be altogether different in magnitude and lags in implementation. For example, Blanchard and Perotti (2002) noted, there is persistent affect of government spending on private consumption, which is consistent with the Keynesian models but opposite in the neoclassical approach. Further, there is new literature on the theory of 'expansionary fiscal contraction', in which the reduction in provision of those public goods which are in the utility function of households (by virtue of reduction in government expenditures) leads to increased spending by households to meet that gap and thus components of aggregate demand increases.

On the other hand, government expenditures (GE) can be of permanent and transitory nature. Both have different direct multiplier (Keynesian) affects towards aggregate demand (AD) components, e.g. C & I. For instance it could lead to increased AD directly in a standard IS-LM framework, hence activating the idle production factors in the economy and creating more employment and output growth. Moreover in recessionary phases, when economy is in a liquidity trap (e.g. Japan), where private investment demand becomes inelastic, fiscal policy (FP) can provide the necessary stimulus to the economy for coming out of that trap.¹ Further, in developing economies, GE also plays a complimentary role for private investment.

On the financing side of GE such as tax, or inflation-seigniorage (money printing) have different implications. Where as creating a debt against the same would have yet another set of dynamic affects on the macroeconomic variables. In case of money printing (fiscal dominance) there are changes in price levels, hence controlling them by monetary policy (MP) alone could be miss-targeted. If the increased GE is supported by deficit which is financed by issuing bonds through banking system, then it could lead to a crowding out of private investment if the interest rate rises in the loan able funds market. Where as in presence of a loose MP (passive FP) the interest rate would decrease and output increase. So domestic debt raising cost would decline, but if this is done through increase in Money supply (MS), exchange rate would appreciate and there could be indirect impact on the foreign debt servicing of the country.

On the other hand a Fiscal Policy (FP) stance through the tax structure can affect the supply side of the economy by affecting the household labour supply decisions or the firm's business financing decisions etc. Direct and Indirect tax levels have different transmission mechanism on economic agent's decision makings. For instance as taxes would change the disposable incomes of household hence affecting the household's consumption, investment, labour supply and savings decisions. Further, by taxing the interest earnings, the same would also change at dynamic levels as well.

¹However, in the case of the RBC model, with Ricardian consumers there could be a negative impact on consumption. While there is a growing literature which identifies rule-of-thumb consumers, which mainly are Non-Ricardian and base there decisions on their current wages then the results could be standard. Similarly MP becomes ineffective in RBC supply side theories, but fiscal policy is affective through the investment demand channel and labour supply (with taxes).

Deficit levels, financing patterns and sources have altogether different implications for the macroeconomic variables. Domestic versus external borrowing, multilateral and others, banking versus non-banking and short-term versus long-term borrowing all have different dynamic affects on the economy. There has been a large of literature exploring these issues, for example Barro (1989) explored whether bonds are net wealth or not. So Ricardian Equivalence (RE) can hold or may be challenged, depending on the types of consumers and policy environments such as imperfect loans market, timing of taxes, uncertainty of incomes etc. [Barro (1989)].

Once the issue of fiscal stance is settled, yet another issue arises, i.e. the fiscal policy transmission mechanism. FP is considered to have dynamic transmission mechanism, as it carries longer policy lags for different macro variables. In this case (FP) the private agents have formed anticipations about the fiscal policy; hence it is not unexpected [Blanchard and Perotti (2002)]. Further, with interaction to different monetary policy stances considering its solvency constraint, it has different impacts on key macro variables. In a standard case MP can react to inflation and FP could to output and distribution. However MP stabilisation policies have often fallen short of results as earlier inflation biased policies, i.e. targeting potential output (Y^*) above the natural (\bar{Y}) rate were adopted.² Especially in developing economies case, where private sector lacks the capacity to keep output at the potential level and provide for all welfare maximising goods through market mechanism.³ Further new evidence show that fiscal stance can also impact the prices in an economy [e.g. see Leeper (1991) and Woodford (2001)].

Hence FP can affect the economy dynamically with different theoretical assumptions about the structure of the economy differently. It can have direct or indirect effects on levels and growth rates of demand and supply side variables such as output, prices, exchange rate, interest rate, balance of payment, debt, consumption, investment, labour supply and its (FP) own future variables.

Once the transmission mechanism is identified then we can look for the optimal reaction functions of the FP for policy consistency. As policy makers have a certain loss function (assigned to them by society, or in a public choice model the voters loss function which is dictated to the policy maker in a public-agent model setting, which is to be minimised with certain constraints). So there could be certain short-run (output gap, inflation etc) objectives and long-run goals such as debt sustainability. The constraints for a fiscal policy reaction function (FPRF) would be the debt sustainability and stance of MP. The parameter stability and symmetry in response (automatic stabilisers) for these FPRF in the presence of business cycles, solvency conditions, debt financing patterns, FP institutional regimes, society's objectives and political regimes could be different in a developed and a developing economy.⁴ Further the issue of spend-tax or tax-spend, debt to tax-revenue capacity and the inter-temporal budget constraint consideration i.e. the causality debate for long-run fiscal sustainability is yet inconclusive for developing economies.

²However now most studies take \bar{Y} to be equal to Y^* .

³As also seen by some empirical studies that private investments are complementary to the government durable spending.

⁴In developing economies, going beyond the objective functions of the society it can also be used to bridge the two gaps of saving investment and current account balance.

In the context of developing economies, such as Pakistan, it becomes more crucial to ascertain the fiscal transmission mechanism, where active fiscal policy is practiced and large seigniorage revenues exist. In this context, the present study aims at estimating fiscal policy reaction function and identifying a fiscal policy transmission mechanism. More specifically, Vector Autoregression (VAR) model containing three variables, output gap and inflation as policy objectives and fiscal deficit as percentage of GDP as fiscal instrument, has been estimated. One of the three equations specifies fiscal policy reaction function in which fiscal policy responds to state of the economy. While the other two equations represent the transmission mechanism of policy.

We find evidence of fiscal policy in Pakistan being endogenous over the period 1965 to 2006. Though the response to both of the variables is significant, we find only pro-cyclical response of fiscal policy to the business cycle fluctuations. Also the pro-cyclical response is seen more in the periods of boom. On the other hand, we could not identify transmission mechanism of fiscal policy with the help of model we have estimated. We also find the evidence of contemporaneous response of policy to state of the economy but the policy is not forward-looking at all.

Rest of the study proceeds as follows. Section 2 deals with the estimation methodology. It provides details regarding estimating fiscal policy response function and transmission mechanism with the help of VAR and estimating fiscal reaction function with contemporaneous variables by Generalised Method of Moments (GMM). Detailed estimation results of fiscal reaction function and transmission mechanism are given in Section 3. Finally Section 4 concludes the paper.

2. ESTIMATION METHODOLOGY

We have used three equation Vector Autoregression (VAR) technique to estimate state-contingent fiscal reaction function as well as the effect of fiscal policy changes on economic indicators—output gap and inflation.⁵ To find the direction of effect of different shocks on the three variables. Further impulse response functions have also been estimated. To overcome the issue of over parameterisation in the VAR, a near-VAR model could be used. The paper also focuses on the response of fiscal authority to changes in economic indicators over the business cycle, as the government may react differently in recessions and booms. To deal with the fact that standard reduced form VAR contains only lagged values of all variables as regressors, fiscal reaction function with contemporaneous variables could be used. But in this case the problem arises that information on contemporaneous variables may not be available to policy maker at the time of decision. The problem could be solved by estimating the model by instrumental variables technique, where past information set could be used as instruments. Detailed discussion regarding estimation techniques is given below.

Consider the following three variables structural VAR,

$$BX_t = B_0 + \sum_{i=1}^p C^i X_{t-i} + \xi_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

⁵We have used VAR technique following Malik (2006). That study specifies VAR representation of Pakistan's economy to identify transmission mechanism of monetary policy.

Where X_t is a vector given by,

$$X_t = [p_t, y_t, FD_t]$$

Where FD_t is real fiscal deficit as percentage of real GDP, y_t is real GDP gap and p_t is annualised inflation calculated by GDP deflator. B is a matrix of coefficients with one on the diagonal and off diagonal terms captures the contemporaneous effects of variables on each other. B_0 is a vector of constant terms. C^i are the matrices of coefficients measuring the lagged effects of variables on each other. ξ_t is a vector of error terms that contains zero mean, constant variance and serially as well as cross uncorrelated innovations, i.e. these elements represent pure structural shocks. Equation 1 can be converted into standard reduced form VAR with only lagged variables on the right hand side.

$$X_t = A_0 + \sum_{i=1}^p A_i X_{t-i} + e_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

Where, $A_0 = B^{-1} B_0$

$$A_i = B^{-1} C^i$$

and $e_t = B^{-1} \xi_t$

Here e_t contains the elements that have zero mean, constant variance and are serially uncorrelated. However, these errors might be contemporaneously correlated, i.e.

$$E(e_{jt}) = 0,$$

$$Var(e_{jt}) = \sigma_j^2,$$

$$Cov(e_{jt}, e_{kt-1}) = 0,$$

but $Cov(e_{jt}, e_{kt})$ may or may not be equal to zero.

Now the problem is to estimate Equation 2 and then using these estimated parameters identify the structural parameters and to recover structural shocks from Equation 1 by imposing appropriate restrictions on structural parameters. Equation 2 can be estimated by OLS because right hand side variables of all equations are same. However if we allow different lag length in different equations then the system has to be estimated as seemingly unrelated (SUR) model, [Enders (2004)]. To identify the shocks a reasonable assumption is that fiscal authority responds the shocks in the economy only with one period lag but fiscal policy changes contemporaneously affect output gap that further affect inflation with a one period lag.⁶ The appropriate number of restrictions to

make model exactly identified is $\left(\frac{n^2 - n}{2}\right)$, where n is the number of variables in the

VAR, [Enders (2004)]. Here the fiscal policy shocks are estimated residuals from the first equation in the system of Equations 1.

⁶This assumption is opposite to what is taken by Bernanke and Blinder (1992); Bernanke and Mihov (1998); Giannoni and Woodford (2003); Christiano, *et al.* (2001) among others. However the assumption taken in these studies is taken for monetary policy.

It is note worthy that VAR model deals with estimating fiscal reaction function only with lagged variables as economic indicators. But this may not be the case, however in reality. Fiscal authority may respond to contemporaneous values of economic indicators, provided that, the authority has the information on the state of the economy without any lag. If this is not the case, the reaction function could be estimated by GMM, i.e. an instrumental variable technique. Now, the fiscal reaction function with contemporaneous variables can be written as

$$FD_t = \alpha + \beta Gap_t + \gamma Inf_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

This can be written as an orthogonality condition;

$$[(FD_t - \alpha - \beta Gap_t - \gamma Inf_t)Z_{t-1}] = 0 \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

Where Z_{t-1} contains information set available to the policy maker at time period t . The above orthogonality condition provides the basis for estimating reaction function with GMM.

3. DATA AND ESTIMATION RESULTS

We have estimated a fiscal reaction function and fiscal transmission mechanism for Pakistan over the period 1965–2006. All the data are taken from International Financial Statistics of International Monetary Fund. Output gap has been estimated as percentage deviation of real GDP from its quadratic trend values.⁷ Three different instruments of fiscal policy; government expenditure, government revenues and fiscal deficit, are taken, in real terms, as percentage of real GDP. Where as the inflation is taken as growth rate of GDP deflator.

To model the three variables, VAR in levels has been used. OLS gives efficient parameter estimates as long as the right hand side variables are same in all equations. At the same time over parameterisation in VAR can be avoided by allowing different lags in different equations. But in that case the so called Near-VAR is estimated as a SUR model. In the present study we have focused on estimating the transmission mechanism by VAR. however to get efficient results in a model without over parameterisation, the Near-VAR technique has also been used, in which only significant lagged variables are included.

We start with estimating fiscal reaction function and fiscal transmission mechanism, using the Fiscal deficit as the fiscal policy instrument. The lags in the VAR are selected on the basis of Akaike Information Criteria as well as the LM test for serial correlation. Two lags were found to be appropriate on both these criteria. There are some strong conclusions coming out from these results. The results are given in Table 1 and Figure 1.

First the Fiscal policy stance taken from the fiscal deficit perspective is not exogenous. Our results show that the policy changes can be predicted by economic indicators, here output gap and inflation.

⁷Estimating output gap as percentage deviation from the quadratic trend for Pakistan is consistent with Malik (2006).

Secondly the results in table below show pro-cyclical response of Fiscal authority to the state of the economy. Both output gap and inflation predict positive changes in fiscal deficit in one period ahead. This shows that in setting the Fiscal Deficit as a fiscal policy instrument the fiscal authority is taking leverage from the fiscal space generated by the boom of the economy. But this is only for one period and does not take into account further lags.

Table 1

Relationship between Fiscal Deficit, Output Gap, and Inflation

	Fiscal Deficit	Output Gap	Inflation
Fiscal Deficit (-1)	0.336 [2.009]	0.115 [0.342]	0.032 [0.052]
Fiscal Deficit (-2)	0.105 [0.673]	-0.106 [-0.336]	-0.055 [-0.094]
Output Gap (-1)	0.157 [1.889]	1.079 [6.427]	0.0672 [0.215]
Output Gap (-2)	-0.097 [-1.241]	-0.224 [-1.417]	-0.227 [-0.775]
Inflation (-1)	0.0898 [1.936]	0.101 [1.078]	0.626 [3.607]
Inflation (-2)	0.062 [1.184]	-0.162 [-1.530]	-0.135 [-0.689]
Constant	1.827 [1.923]	0.346 [0.181]	4.526 [1.272]
Adjusted R-square	0.425	0.781	0.270

Inside the parentheses are *t*-values

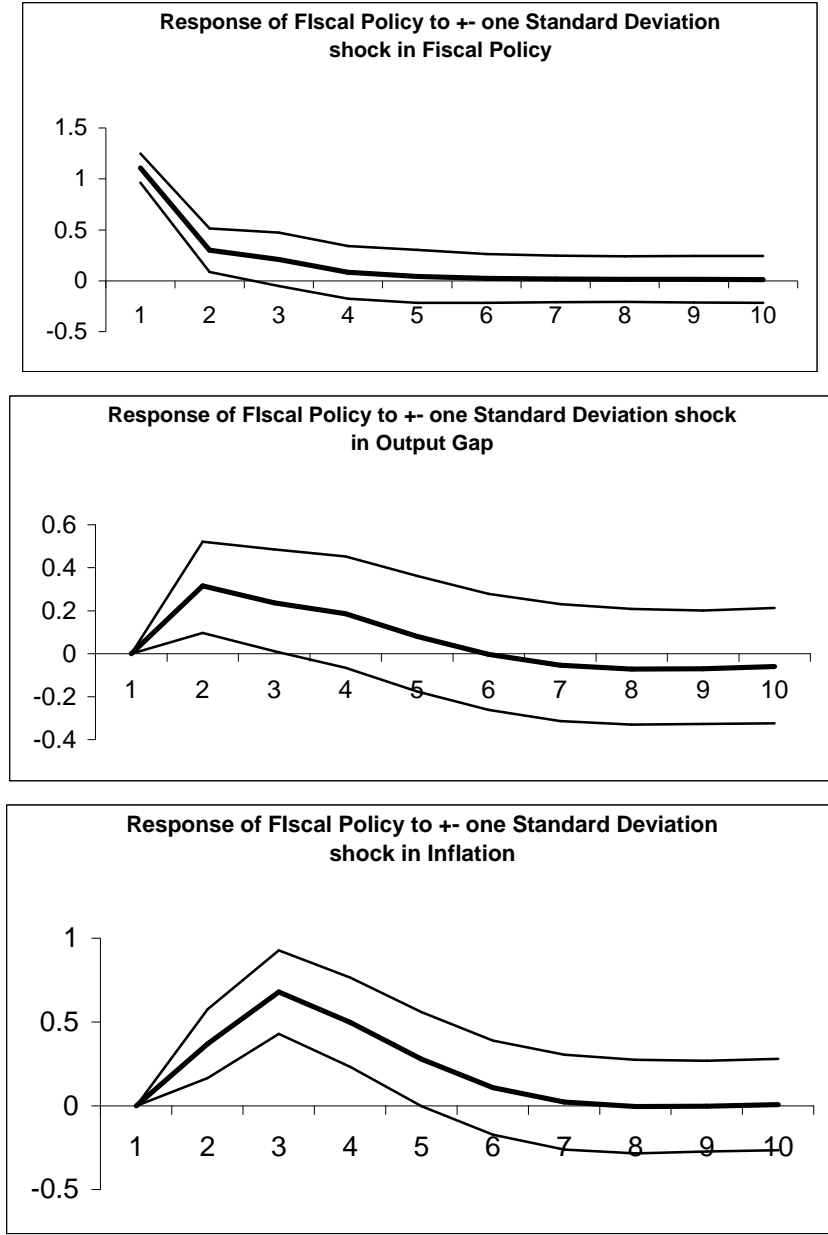
Thirdly the pro-cyclical response of fiscal policy shows that on average the stabilisation objective is not considered while conducting the policy. Therefore the automatic-stabilisation role of the fiscal instruments does not seem to hold for Pakistan. This defies the Keynesian stance of fiscal policy where Fiscal authority would expand in those time when private agents are not willing to invest (Liquidity Trap) and government being a non-profit oriented entity would increase its expenditures. As interest rate channel does not work in Liquidity Trap hence monetary policy is ineffective, and increased government expenditure could positively affect the Aggregate demand, thereby pull the economy out of recession.

Fourthly there seems to be a policy coordination problem between Monetary and Fiscal authorities. As claimed by the recent monetary policy statement by Central Bank [State Bank of Pakistan (2008)] that due to increasing and persistent inflation the monetary authority would focus on the inflation targeting only, leaving aside the output targeting.⁸ So without clear cut objectives of stabilisation with Fiscal authorities and over borrowing to meet pro-cyclical fiscal expansion would directly affect the inflation and

⁸“Widening of fiscal and external current account imbalances beyond targeted levels reflect high demand pressures in the economy, and are aggravating pressure on already high inflation. In the backdrop of domestic political noise and global developments, it seems unlikely that these deficits and their financing requirements will come close to the targets set at the beginning of current fiscal year.” Monetary policy statement for January-June 2008.

thereby monetary authority has to take contractionary stance for keeping inflation at limits.⁹ Which would increase the cost of doing business and thus create uncertainty for private investors in the economy.

Fig. 1. Response of Fiscal Policy to Shocks

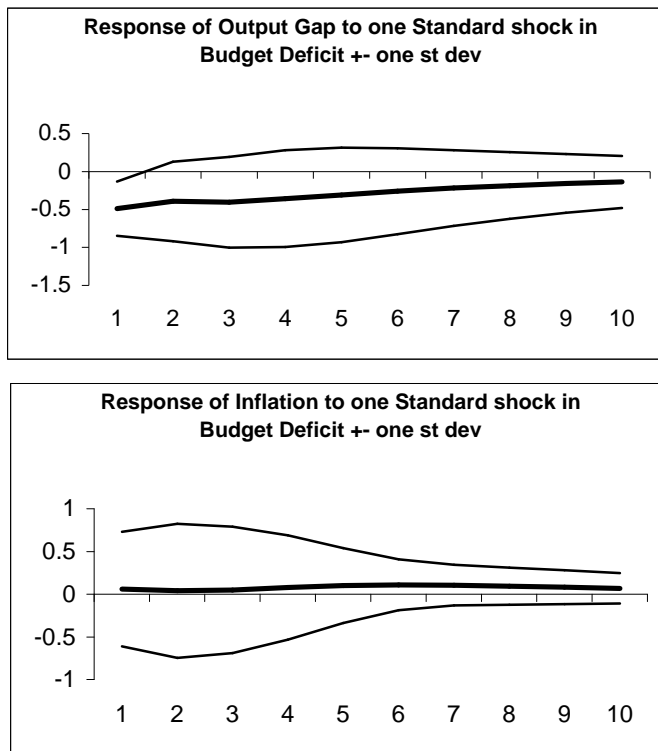


⁹“The main message that emerges from all this discussion is: risks to inflation outweigh the risks to growth in the near future. To address these risks and confront the emerging challenges, the SBP has decided to tighten its monetary policy further.” Monetary policy statement for January-June 2008.

Impact of inertia for Fiscal policy is only for one period, however for shocks in output gap and inflation have long lasting effects on the fiscal deficit. Fiscal deficit responds to output gap shocks after one period and reaches the peak in the same and dies out to zero after 4th year. Response to inflation shock is the same except that it reaches the peak in 2nd year and dies out after five years.

Second and third column of Table 1 shows the transmission mechanism for fiscal policy. Our results show that there is no significant impact of fiscal policy changes on the economy. As coefficients of fiscal deficit are insignificant in both the equations of output gap and inflation. This raises two potential issues; one policy is ineffective in changing the state of the economy, this could be attributed to the policy non-coordination (monetary policy is offsetting the possible impacts of fiscal expansion on out put and inflation thereby raising the interest rates). Secondly this simple model might be incapable of capturing the true dynamics of output gap and inflation observed in the data and we need to specify an elaborate model for identifying the fiscal transmission mechanism. So before concluding one has to see the intermediate channels for different macro variables such as consumption, investment, interest rates, reserve money, modes of debt financing etc. For instance debt financing from the banking channel might crowd out private investment through interest rate increase. But on the other hand if deficit is financed from central bank borrowing that would lead to reduce interest rate thereby boost economic activity.

Fig. 2. Response of Output Gap and Inflation to Fiscal Shocks



We estimated the impulse response functions for the output gap and inflation with fiscal shocks. But the results were estimated with larger standard errors therefore these are insignificant hence fiscal policy is ineffective as described above as well.

To estimate the response of the fiscal authority over the business cycle, we estimated the fiscal reaction function with boom and recession dummies. Our results in Equation 5 suggest that the pro-cyclical response is significant only in boom periods and the response is insignificant in recessionary periods. Then we decomposed the fiscal instruments in tax revenue and Government expenditures as percentage of GDP.¹⁰ Interestingly both instruments of fiscal policy showed quite different response. Response of Government expenditures is the opposite as that of the fiscal deficit, i.e. fiscal authority does take expansionary a cyclical position in recessions but remains insignificant in boom periods. Contrarily the tax policy is pro-cyclical in both boom and recession which is quite opposite to the tax smoothing principle and automatic stabilisation objective of the fiscal policy.

$$FD = 4.026 + 0.183 \text{ GAP } (-1)*D1 - 0.002 \text{ GAP } (-1)*D2 + 0.145 \text{ INF } (-1) \dots \quad (5)^{11}$$

(8.607) (2.747) (-0.029) (3.298)

Adjusted R-Square = 0.297 S.E. of regression = 1.249 D.W. stat = 1.242

Here *FD* is the real value of fiscal deficit as a percentage of real GDP, *GAP* is the output gap from potential level of output, *D1* is the dummy for boom and *D2* is the dummy for recessionary periods. Finally *INF* is the inflation rate measured as the growth rate of GDP deflator.¹²

As policy has responded to lagged variables, there are two other possibilities of policy reactions, i.e. fiscal authority could respond to contemporaneous variables or it could be forward looking. Therefore we have used the GMM estimation technique and the results are reported in Equation 6 below.¹³

$$FD = 3.316 + 0.151 \text{ GAP} + 0.278 \text{ INF} \quad \dots \quad \dots \quad \dots \quad \dots \quad (6)$$

(3.389) (2.119) (2.770)

The fiscal policy does respond to the contemporaneous variables but it certainly does not have any forward looking policy setting behaviour.¹⁴

Finally to complete our discussion, we estimated a near VAR model, in which different lag length is allowed indifferent equations and variables with significant effects are included. Estimating the system of equations as a SUR model we find the same results as already noted above for fiscal deficit as a fiscal policy instrument.

¹⁰Detailed results with the other two instruments are given in Appendix Tables 3 and 4.

¹¹*t*-values are in parenthesis.

¹²We have also estimated the response function with Autoregressive terms to remove the autocorrelation from the residual term but the results did not change significantly.

¹³*t*-values are in parenthesis.

¹⁴We also estimated a forward looking fiscal reaction function, but its results were not significant and not reported in this paper.

Table 2

Results of Near VAR Model

	Fiscal Deficit	Output Gap	Inflation
Fiscal Deficit (-1)	0.718 [9.958]		
Fiscal Deficit (-2)			
Output Gap (-1)	0.084 [2.228]	1.121 [8.129]	
Output Gap (-2)		-0.264 [-2.178]	
Inflation (-1)	0.164 [3.765]	0.113 [1.515]	0.909 [13.358]
Inflation (-2)		-0.131 [-1.74]	
Adjusted R-square	0.215	0.799	0.170

Inside the parentheses are *t*-values.

Fiscal policy is found to be endogenous and pro-cyclical, where as changes in the policy does not affect any of the targeted variables. Inflation turns out to be exogenous in the system, as there might be a need to identify intermediate channels in the fiscal transmission mechanism.

4. CONCLUSION

Structural developments in public finance leads to effect both the demand and supply side of the economy in a dynamic manner. Modern Macroeconomics literature identifies both the short-run (demand management) and long-run (supply management) objectives of fiscal policy [Romer (2006)].

We have estimated the fiscal transmission mechanism for Pakistan for three leading indicators of Fiscal policy i.e. the budget deficit, government expenditures and tax revenues. We also calculated the fiscal policy reaction functions and analysed for its endogeneity and contemporaneous responses from other macro variables.

Fiscal policy is identified to be endogenous and pro-cyclical in boom if fiscal deficit is taken as the fiscal instrument, but it is insignificant in recessionary phase of the economy. However for government expenditures, these are anti-cyclical in the recessionary periods but have insignificant response in booms. Where as the Tax policy is pro-cyclical for both boom and recessions. In our smaller macro model for fiscal policy analysis, we could not identify any transmission mechanism of the fiscal policy for output gap and inflation. Further Fiscal policy is backward looking and contemporaneous but not forward looking at all.

However there is a need to see the dynamic effects of shocks in budgetary components to macro variable while adjusting for the discretionary and cyclical responses of these components for gauging the actual transmission mechanism.

APPENDIX

Table 3

Fiscal Reaction Function with Revenues as Instrument

	Dependent Variable	t-values
C	14.98170	34.14221
GAP*D1	-0.139616	-2.144649
GAP*D2	0.361815	4.691610
INF_GDPD	-0.058858	-1.496095
Adjusted R-square	0.412722	
S.E. of Regression	1.124334	

Table 4

Fiscal Reaction Function with Expenditures as Instrument

	Dependent Variable	t-values
C	9.803441	17.38278
GAP*D1	-0.043591	-0.520989
GAP*D2	0.207516	2.093614
INF_GDPD	0.037023	0.732197
Adjusted R-square	0.046175	
S.E. of Regression	1.445058	

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