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Transmission Mechanism of Monetary Policy in Pakistan

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Abstract

This paper uses vector autoregressions to examine the monetary transmission mechanism in Pakistan. The results point to a transmission mechanism in which banks play an important role. A monetary tightening leads to a fall in domestic demand, primarily investment demand financed by bank lending, which translates into a gradual reduction in price pressures that eventually reduces the overall price level with a significant lag. We also find an active asset price channel. The exchange rate channel is less significant by comparison.

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1. Introduction

The transmission mechanism of monetary policy is concerned with the relationships between changes in the supply of money and the level of real income (output). There are several channels through which changes in money supply affects output. A few prominent[1] channels are the interest rate channel, credit channel, exchange rate channel, and asset price channel. The objective of this study is to disentangle and investigate the channels through which monetary policy shocks are propagated in Pakistan. Distinguishing the relative importance of various channels of monetary transmission is useful for the following reasons.

First, understanding which financial variables are impacted by policy would improve our understanding of the links between the financial and real sector of the economy. Second, a better understanding of the transmission mechanism would help policy makers interpret movements in financial variables more precisely. Finally, more information about the transmission mechanism might lead to a better choice of targets such as, if the credit channel is an important part of the transmission mechanism, bank portfolios should be the focus of more attention. On the other hand, if the interest rate channel is crucial, then the central bank may need to focus on an interest rate target.

This paper is organized as follows. Section 2 describes channels of money transmission; Section 3 discusses estimation methodology, choice of variables and data. Estimation results are discussed in section 4, followed by specification issues in section 5. Section 6 gives the conclusion.

[1] The literature on monetary policy transmission mechanism has also identified other channels, such as monetarist channel [Meltzer (1995)], but we believe the above four channels should be able to explain significant part of the effects of a monetary policy shock on output and prices for Pakistan.

2. Channels of Money Transmission

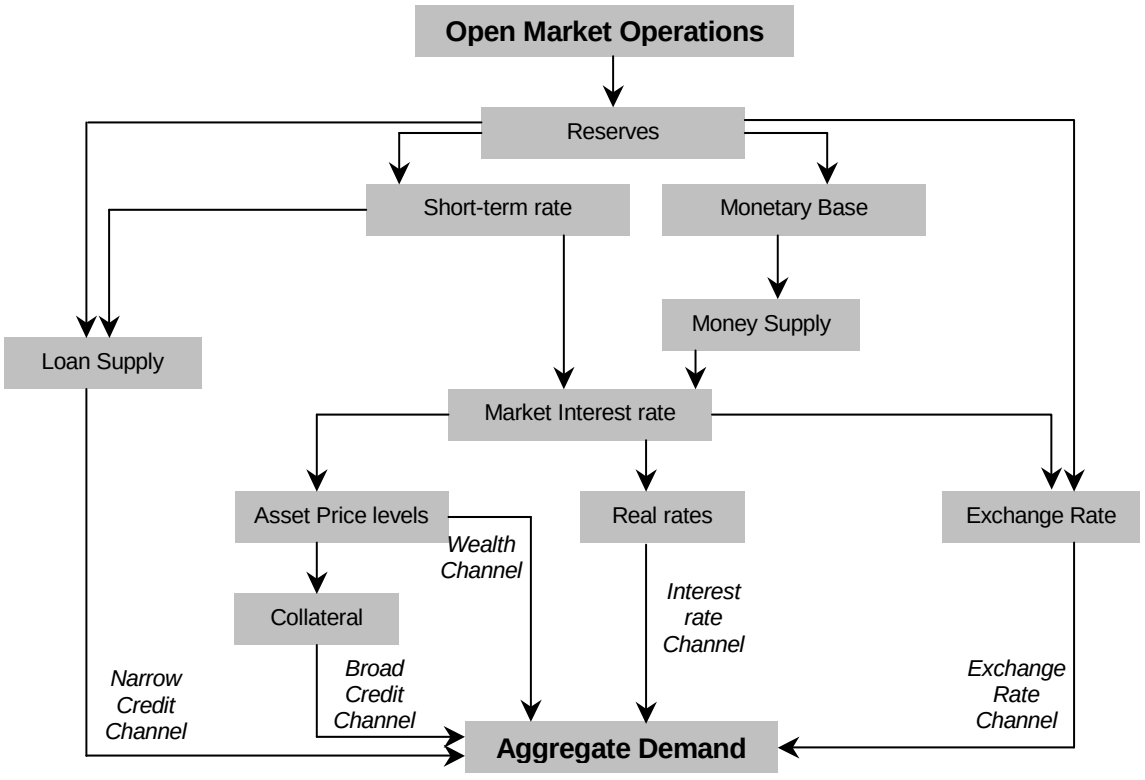
Monetary transmission, due to its complexity, has often been referred to as 'black box' because there are not one, but many channels through which monetary policy simultaneously operates. The relative strength of these channels varies from country to country depending on the state of its financial markets. The process begins with the transmission of Open Market Operations (OMOs) to money market interest rates, through the reserves market or more broadly to market interest rates through the supply and demand for money. From there, transmission may proceed through any of these channels. The interest rate channel, also referred to as the traditional channel, is the primary mechanism at work in conventional macroeconomic models. Assuming some degree of price stickiness, an increase in nominal interest rates, for example, translates into an increase in the real rate of interest and the user cost of capital. These changes in interest rates may lead to a postponement in consumption or a reduction in investment spending.

Another channel is the credit channel which works through two separate mechanisms, namely the narrow credit or bank lending channel and the broad credit channel. The bank lending channel relies on credit market frictions in which banks play a more central role. The basic idea is that because banks rely on reservable demand deposits as the source of funds, a contractionary monetary policy reduces the aggregate volume of bank reserves, resulting in reduction of the availability of bank loans. Since, a significant number of firms and households rely heavily on bank financing; a reduction in loan supply will depress aggregate spending.

An alternative path is the wealth channel, modeled on the life-cycle hypothesis of consumption developed by Ando and Modigliani (1963), in which households' wealth is a key determinant of consumption spending. The connection to monetary policy comes via the link between interest rates and asset prices: a policy-induced interest rate increase reduces the value of long-lived assets (stocks, bonds, and real estate), shrinking households' resources and leading to a fall in consumption.

Asset values also play an important role in the broad credit channel developed by Bernanke and Gertler (1989), but in a manner different from that of the wealth channel. In the broad credit channel, asset prices are especially important as they determine the value of the collateral that firms and consumers may present when obtaining a loan. In the presence of information or intermediary costs, declining collateral values will increase the premium that the borrowers must pay for external finance, which in turn will reduce consumption and investment. Thus, the impact of policy-induced changes in interest rates may influence aggregate demand.

Figure 1: Monetary Policy Transmission



The exchange rate channel is an important element in conventional open-economy macroeconomic models. The chain of transmission here runs from interest rates to the exchange rate via the uncovered interest rate parity condition, relating interest rate differentials to expected exchange rate movements. Thus, an increase in the domestic interest rate, relative to foreign interest rates, would lead to a stronger currency and a reduction both in net exports and in the overall level of aggregate demand.

These channels are not mutually exclusive: the economy's overall response to a monetary policy shock will incorporate the impact of a combination of these channels.

3. Empirical estimation

3.1. Methodology

In this paper we have employed vector autoregressions (VARs) to examine the monetary transmission mechanism in Pakistan. Given the lack of consensus about the workings of the monetary transmission mechanism in Pakistan this methodology allows us to place minimal restrictions on how monetary shocks affect the economy, which is a distinct advantage. In addition, this approach recognizes explicitly the simultaneity between monetary policy and macroeconomic developments, that is, the dependence of monetary policy on other economic variables (the policy reaction function), as well as the dependence of economic variables on monetary policy. The choice of a VAR approach is also inspired by the existence of a large empirical literature using VARs to examine the monetary transmission mechanism, which focuses primarily on reduced-form relationships between monetary policy and output using a small number of variables (for a survey, see Christiano, Eichenbaum, and Evans, 1999). The closest antecedents to this paper are Bayoumi and Morsink (2001) for Japan and Disyatat and Vongsinsirikul (2003) for Thailand, which explores the working of the transmission mechanism.

As the reduced-form errors are typically correlated, this makes the impulse responses unreliable for analysis. Therefore, the VAR is identified using a Choleski decomposition, which isolates the underlying structural errors by recursive orthogonalization, with the innovation in the first equation untransformed, the innovation in the second equation taken as orthogonal to the first, and so on. The ordering determines the level of exogeneity of the variables, so current shocks to activity are assumed independent of current shocks to all the other variables in the system, while current shocks to monetary policy variable are assumed to be affected by current shocks to all other variables.

We begin our analysis with our basic model which gives us the combined impact of monetary policy on output and prices. For the assessment of effectiveness of different channels, we have estimated four separate models. In order to assess the relative strength of a particular channel of monetary transmission a common solution is to compare policy's estimated effects with its impact, with the channel in question econometrically 'turned off'. If the remaining equations are assumed to be unchanged by this intervention, then the difference between the two responses can be interpreted as a gauge of the channels' contribution. We have estimated four models (representing the four channels) by first endogenizing and afterwards exogenizing the variable of choice representing a particular channel. Therefore, by appending our basic model with a variable of interest such as, credit to private sector (Loans) for credit channel, and compare the results obtained with the Loans exogenized in the same model. The following are the models with the order of variables given:

Credit Channel:	IPI, Prices, Loans, TB6
Asset Price Channel:	IPI, Prices, KSEI, TB6
Exchange rate Channel:	IPI, Prices, REER, TB6
Interest rate Channel: (Measured as the residual output effect)	IPI, Prices, Loans, REER, KSEI, TB6

IPI: Industrial Production Index	Prices: Consumer Price Index (CPI)
Loans: Private Sector Credit	KSEI: Karachi Stock Exchange (KSE-100) Index
TB6: 6-month Treasury Bill Rates	REER: Real Effective Exchange Rate

The ordering was chosen on the basis of the speed with which the variables respond to shocks, with output assumed to be the least responsive, followed by prices, then finally interest rates. In the extended VARs, other variables are assumed to reflect contemporaneous shocks to output, prices, and monetary policy. Although we did not estimate all possible alternative orderings, the results were similar for some radical re-

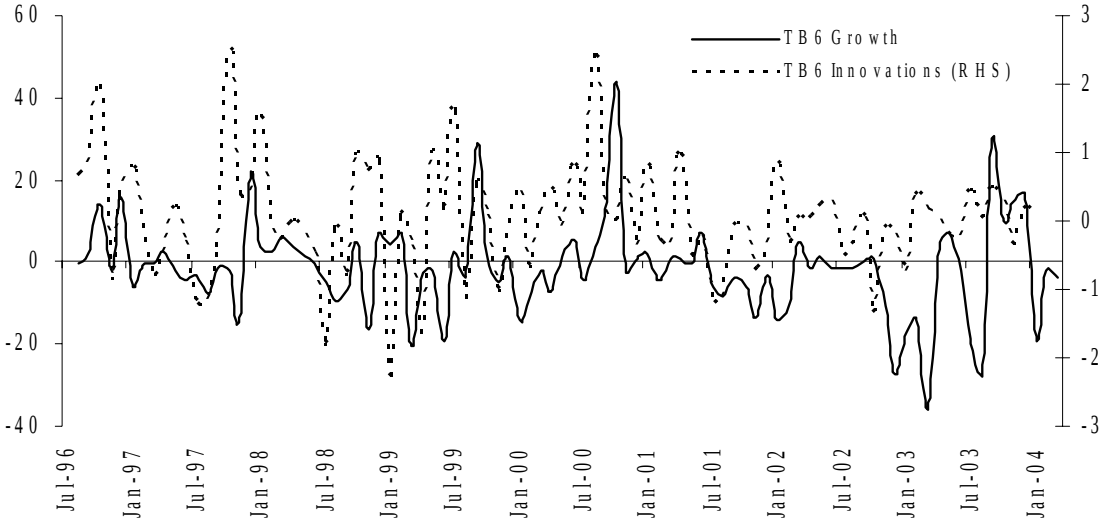
orderings (in particular, completely reversing the ordering to be interest rate, prices, and economic activity).

3.2. Data and the Choice of Variables:

The inspiration to use TB6 rate came from Bernanke and Blinder (1992) who have shown in a theoretical and empirical framework that federal fund rate is a superior indicator of monetary policy stance for the US. In addition, several authors have noted that monetary policy has consistently laid a strong emphasis on short-term interest rates. More recent work, such as, Disyatat and Vongsinsirikul (2003) have also used short-term interest rates as monetary policy stance for Thailand. Other reasons for using TB6 are, the financial sector reforms and more recently developments on the external front (heavy capital inflows after 9/11), have caused instability with in the components of reserve money (RM), and the association between RM and Monetary aggregates (M2) has also become inconsistent. Moreover, in view of increasing emphasis on maintaining orderly conditions in the financial markets TB6 emerges as the most desirable intermediate target for monetary policy operations, at least during the sample period.

Figure 2. Innovations versus Growth in TB6

(July 1996 - March 2004)



Before we estimate the models, it will be useful to examine whether the monetary policy shocks identified by our VAR seems reasonable. Figure 2 represents the recovered structural TB6 innovations against the month-on-month growth of TB6, where positive

innovations in TB6 are identified with monetary policy tightening while negative values represent episodes of loosening. The graph indeed depicts this fact that structural innovations in TB6 closely follow its growth, as one would expect.

As evident from the foregoing, our measure of the stance of monetary policy in Pakistan is the 6-month treasure bill rate (TB6), mostly reflecting the developments in financial markets. Monthly data on Private Sector Credit (Loans) and Real Effective Exchange Rate (REER) have been obtained from the State Bank while the data on Karachi Stock Exchange 100 Index (KSEI) has been obtained from Karachi Stock Exchange (KSE). The price level is given by the Consumer Price Index (CPI) which is gathered from Federal Bureau of Statistics (FBS). Since, data on GDP is not available on monthly basis; we have used Industrial Production Index (IPI) as a proxy for output. Apparently, IPI may seem a weak proxy for GDP as it covers only 20 percent of the total output. Contrary to the above observation, the manufacturing sector has a share of around 58 percent in private sector credit off take over the last several years. Moreover, it is a leading and lagging indicator of agriculture sector. The services sector is also highly correlated with the growth in the industrial output, which underscore its usefulness particularly for exploring the relationship between output growth and monetary policy stance. The estimation is done using monthly data from July-1996 to March-2004. All the variables are seasonally adjusted and have been used in log form, except TB6.

4. Estimation Results

4.1. Basic Model

The basic model estimates the overall impact of monetary policy on IPI (output) and CPI (Price). The idea is to estimate the basic model, then compare the results obtained from including other channels one-by-one. The estimation is done using seasonally adjusted monthly data from July-1996 to March-2004 with six lags. The various criteria[2] for

[2] Including Akaike, Schwarz, and Hannan-Quinn both modified and non-modified. Generally speaking, lag length criteria are not without shortcomings and should be used as a guide rather than hard and fast rules. Ramaswamy and Sloek (1997) also use two quarters in their cross-country comparison of monetary transmission in the EU, as did

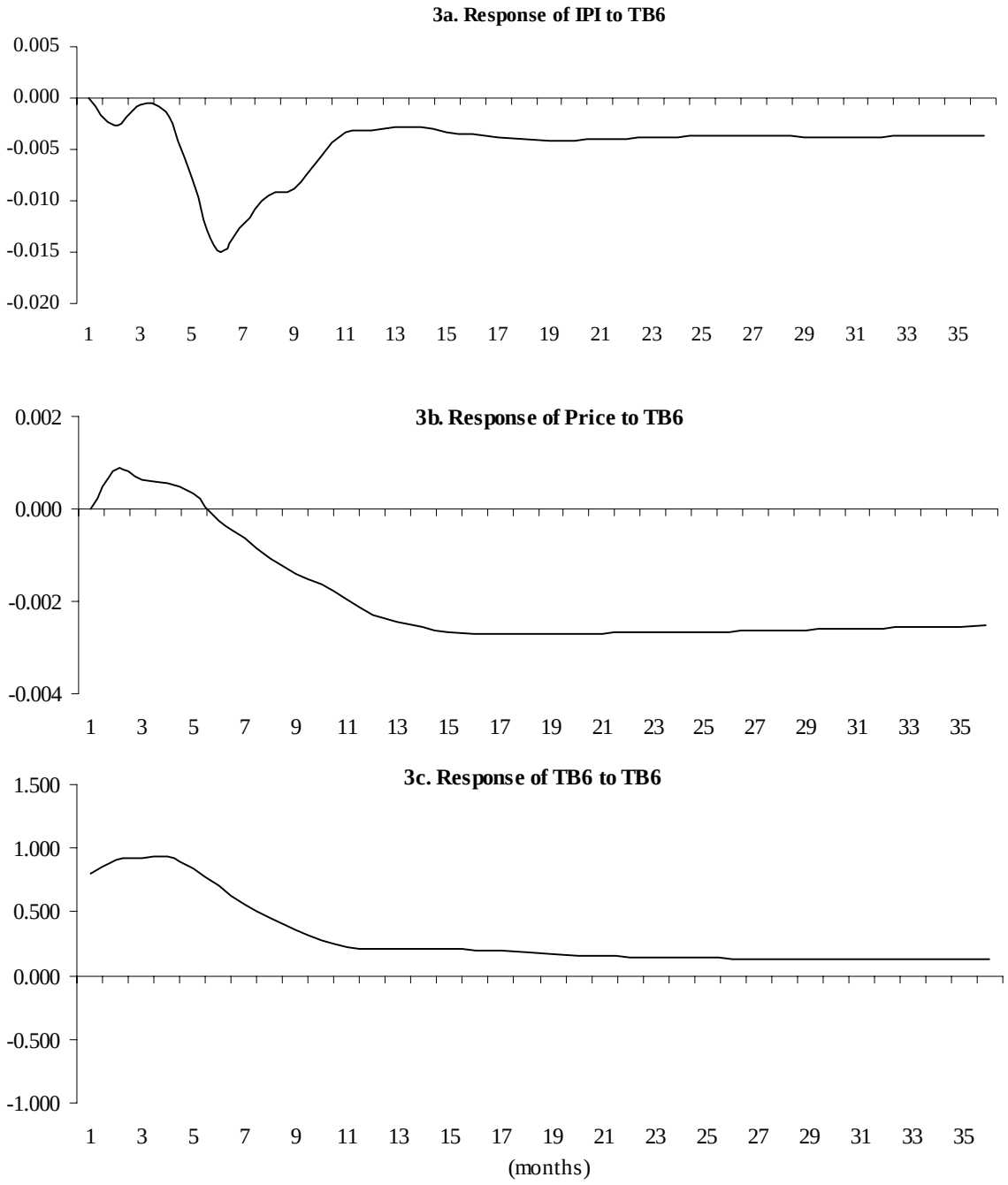
optimal lag length selection gives 3 months as optimal lag; however, keeping in view the nature of our analysis it appears too short to capture the underlying dynamics of the system. Therefore, we use 6 months as the optimal lag length in all of the VAR systems. At the same time including more lags were causing degrees of freedom problem. For this reason the results are quite parsimonious with the set of variables kept relatively small and lag length set to 6 months only. This approach has been used by Disyatat and Vongsinsirikul (2003) for Thailand.

The above listed VAR models were identified using 'recursive' Choleski decomposition. The ordering is based on the assumptions about the dynamic structure of the economy and is in part guided by the observation that the movements in TB6 tend to lead changes in IPI. In particular, the conjecture is that IPI is not affected contemporaneously by shocks in other variables in the system while TB6 responds to innovations in IPI and Price within the same period. Nonetheless, the results are robust to alternative ordering, including some radical ones such as completely reversing the order.

The impulse response functions from our basic model are presented in Figure 3. They allow us to see the monetary transmission mechanism unfolding by illustrating the response of the system to a shock in our measure of monetary policy. A 0.8 percent rise in TB6 gives rise to a V-shaped output response bottoming out after 6 months, with the effect fully dissipating in one year. Prices do not begin to decline until about six months, and although the fall itself is quite small, it seems quite persistent. Finally, the interest rate shock is also quite persistent after getting close to the baseline in one year.

Bayoumi and Morsink (2001) in their analysis of Japan and likewise Disyatat and Vongsinsirikul (2003) for their analysis of Thailand

Figure 3. Impulse Response: Basic Model



In the literature, the initial positive response of prices to a contractionary monetary policy shock is referred to as the 'price puzzle' and is attributed to lacking in the specification of the model. It is due to the fact that policy makers observe variables that contain useful information about future inflation, if those variables are left out of the model then positive innovations in interest rates may be associated with higher prices because they partly reflect systematic policy responses to information indicating that inflation is on the way.

Table 1: Variance Decomposition - Basic VAR Model

Variance Decomposition of IPI				
Months	S.E	IPI	Price	TB6
3	0.068	96.45	3.38	0.17
6	0.072	90.49	3.89	5.61
9	0.074	85.11	3.84	11.05
12	0.075	83.97	4.35	11.69
18	0.077	82.16	5.45	12.39
24	0.078	80.22	6.30	13.48
30	0.080	78.55	7.08	14.37
36	0.081	77.03	7.76	15.21
Variance Decomposition of Price				
3	0.007	0.72	96.71	2.57
6	0.009	1.06	96.95	1.99
9	0.011	6.61	88.96	4.43
12	0.013	10.35	78.76	10.89
18	0.017	15.35	61.31	23.34
24	0.020	18.98	52.08	28.94
30	0.022	21.12	46.97	31.90
36	0.024	22.51	43.86	33.63
Variance Decomposition of TB6				
3	1.553	2.01	1.32	96.66
6	2.130	1.18	1.31	97.50
9	2.303	3.20	1.16	95.64
12	2.384	6.12	1.52	92.36
18	2.480	8.30	2.48	89.22
24	2.544	9.53	3.55	86.92
30	2.597	10.39	4.59	85.02
36	2.646	11.09	5.50	83.41

Cholesky Ordering: IPI Price TB6

Table 1 presents variance decompositions for each variable at forecast horizons of one through three years, which gives an idea of the share of the fluctuations in a given variable that are caused by different shocks. The columns give the percentage of the variance due to each shock, with each row adding up to 100 percent. The results indicate

that, after three years, the interest rate shock account for around 15.2 percent of the fluctuations in output, with its own shock accounting for most of the rest. This indicates that interest rate innovations are relatively weak determinant of fluctuations in economic activity.

4.2. Channels of monetary transmission

The strength of each channel is estimated by first extending the basic model with a variable that captures the particular channel and obtaining two sets of impulse responses: one with the variable treated as endogenous and another where it is included as exogenous variable. The exogenizing effectively blocks off the responses that passes through the variable representing the channel. Comparison of two responses tells us about the importance of that particular channel acting as a conduit of monetary policy to the real economy.

It is pertinent to mention that in order to measure the true working of each channel it is imperative to go into details of intermediary variables involved in the particular channel. Given the data constraints and the limited scope of this study, this paper attempts to obtain rough indications of the relative importance of each channel. Once an idea of the relative importance of each channel is developed, further research can be conducted to systematically unearth the factors responsible for making one channel more important than the other in Pakistan.

4.2.1. Bank lending Channel

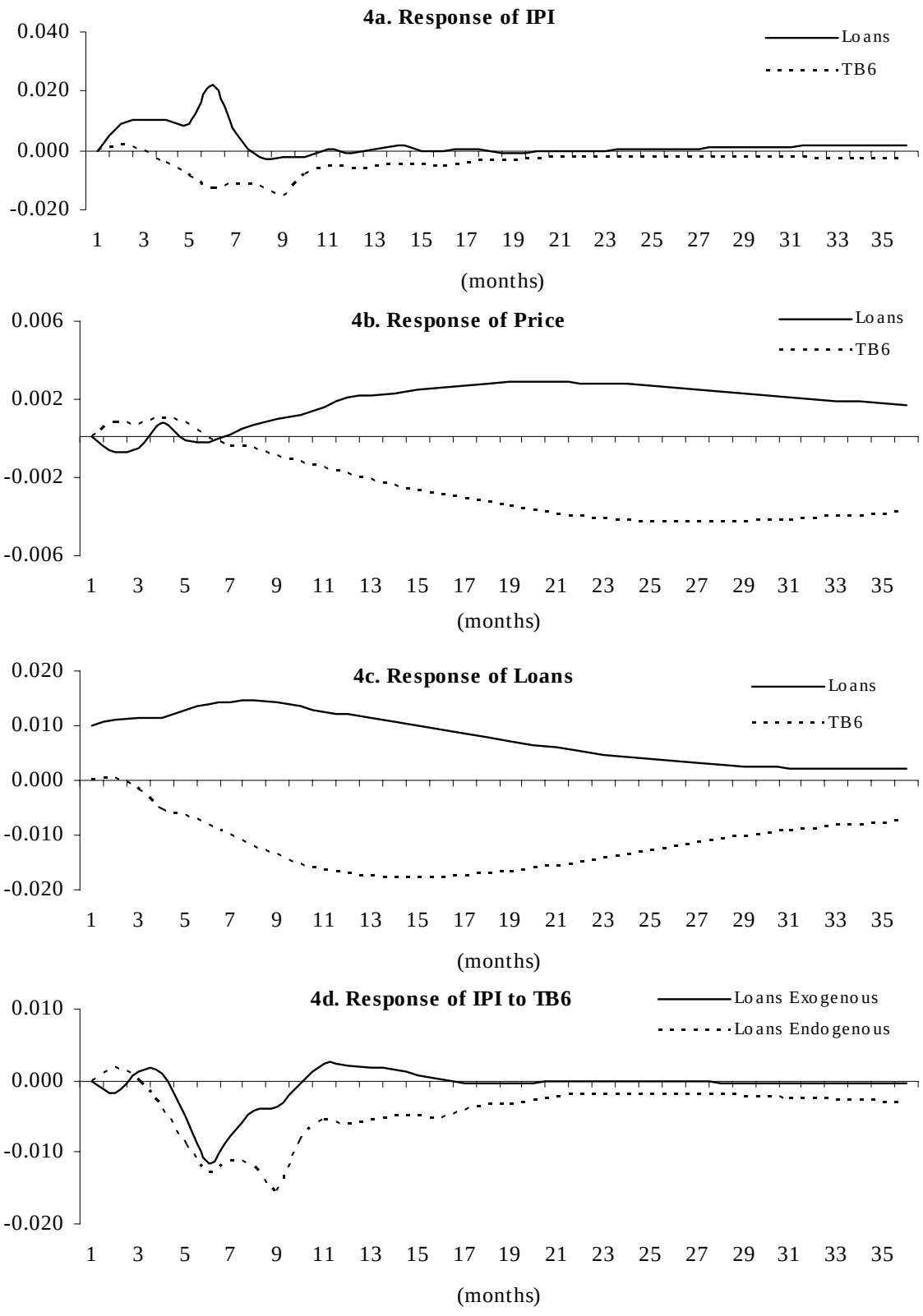
We first examine the role of bank credit. Under a contractionary monetary policy shock 'bank lending channel' operates through the fall in bank reserves, implying a reduction in supply of loanable funds by banks that can be used to finance investment and consumption. In other words, monetary policy may have amplified effects on aggregate demand by modifying the availability or the terms of new loans. The lending channel presumes that small and medium-sized firms, facing informational frictions in financial markets, rely primarily on bank loans for external finance because it is not possible for these borrowers to issue securities in the open market. The importance of this channel

thus depends on two factors: (i) the degree to which the central bank has allowed banks to extend loans; (ii) monetary policy stance, and (iii) the dependence of borrowers on bank loans. These factors are clearly influenced by the structure of the financial system and its regulation.

The bank-lending channel is an enhancement mechanism to the interest rate channel. The key point here is that the real effects of higher interest rates may be amplified through the lending channel beyond what would be predicted were policy transmitted only through the traditional interest rate channel (cost of capital). As market interest rates rise subsequent to monetary tightening, business investment falls not only because cost of capital is high but also due to supply of bank loans mostly to small and medium sized firms is reduced.

To estimate the effect of bank lending on transmission mechanism, we extend the basic VAR model with log of credit to private sector (Loans). The model thus comprises of IPI, Prices, Loans and TB6 in the given order. Figure 4 shows the impulse responses of IPI, Loans, and prices to innovations in TB6 and Loans. First, the initial response of IPI to TB6 shocks (of roughly 0.8%) is a bit suppressed compared with the basic model. After bottoming out in 10 months, the effects take longer to dissipate as compared with the basic model. Second, the 'price puzzle' is still there, prices starts to fall after six months bottoming out after 28 months. In addition, output and prices responds positively to innovations in loans, while loans immediately falls after a monetary shock, bottoming out in 15 months. Finally, a variance decomposition reveals that the share of output variance accounted for by TB6 is now larger at around 16.1% after 36 months reflecting a marginal improvement in the role of monetary policy in the augmented model.

Figure 4. Impulse Response: Credit Channel



Now, estimating the model and exogenizing bank loans in the calculation of impulse responses to gauge the importance of banks in transmitting monetary shocks to the real economy. As shown in Figure 4.d, the output responses to a TB6 shock with and without loans exogenized are quite similar for the first 6 months but the former dissipates more quickly afterwards. While the output response is dampened when the role of bank credit is blocked off, the difference is very pronounced after 6 months indicating the significance of bank-lending channel. After two years, the accumulated response of output is about 32.2 % lower when this channel is blocked off. This may not seem surprising given the importance of banks in Pakistani financial system.

Table 2. Variance Decomposition: Credit Channel

Variance Decomposition of IPI					
Period	**S.E.**	**IPI**	**Price**	**Loans**	**TB6**
3	0.062	91.5	3.5	4.9	0.1
6	0.072	71.3	7.1	16.7	5.0
9	0.077	64.2	7.6	15.3	12.9
12	0.080	61.9	9.6	14.3	14.1
18	0.082	59.4	11.5	13.6	15.4
24	0.083	58.4	12.8	13.3	15.6
30	0.084	57.7	13.5	13.1	15.7
36	0.085	56.9	13.9	13.1	16.1
Variance Decomposition of Prices					
3	0.007	1.1	94.6	2.7	1.6
6	0.009	1.9	93.2	2.4	2.6
9	0.010	5.6	87.7	2.9	3.9
12	0.011	7.3	75.1	7.7	9.8
18	0.016	9.5	46.8	18.0	25.8
24	0.022	10.9	33.3	19.6	36.1
30	0.027	12.1	29.1	17.6	41.2
36	0.031	13.0	28.5	15.5	42.9
Variance Decomposition of Loans					
3	0.019	2.7	0.3	96.2	0.8
6	0.032	4.5	0.8	81.0	13.7
9	0.047	5.1	2.3	66.4	26.3
12	0.061	6.5	3.9	52.5	37.0
18	0.083	9.3	7.9	36.3	46.5
24	0.098	11.0	12.0	28.5	48.5
30	0.106	12.0	15.5	24.7	47.9
36	0.111	12.6	17.9	22.7	46.9

Cholesky Ordering: IPI, Prices, Loans, TB6

Looking forward, the importance of credit channel will further improve mainly because of financial sector reforms and continued expansion of private sector credit. On the contrary, reliance on bank finance should decline as capital markets become more developed. Nevertheless, given fact that capital market development tends to take place

gradually and the increased emphasis on small and medium scale enterprises in Pakistan, the overall effect in the medium term should be an increase in the significance of the bank-lending channel.

4.2.2. Exchange Rate Channel

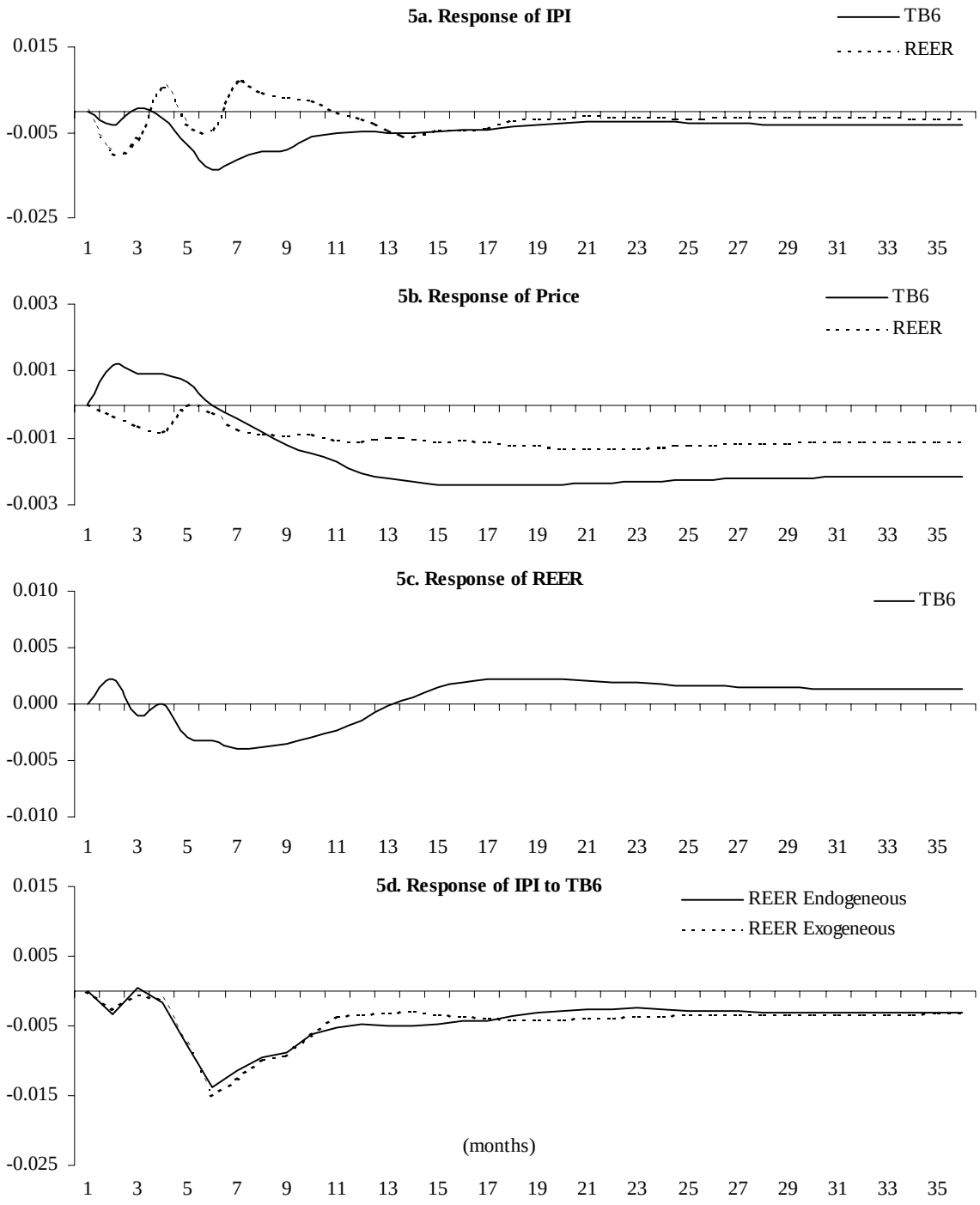
The strength of the exchange rate channel depends on the responsiveness of the exchange rate to monetary shocks, the degree of openness of the economy, and the sensitivity of net exports to exchange rate variations. In a small open economy, a nominal depreciation brought on by monetary easing, combined with sticky prices, results in a depreciation of the real exchange rate in the short-run and thus higher net exports.

To examine the effectiveness of exchange rate in Pakistan's monetary transmission mechanism, we add log of the real effective exchange rate (REER) to our basic VAR model. The response of IPI, Price and REER to a monetary policy shock is analyzed by obtaining impulse response functions. In the presence of exchange rate channel, the IPI bottoms-out in 6 months having a trough at 1.4 percent of the baseline (Figure 5a) to a 0.8 percent rise in TB6. However, the changes in the IPI adjusted after 2-years with a permanent fall of 0.3 percent.

A monetary policy shock also lead to changes in REER. Impulse response reveals that a 0.8 percent rise in TB6 leads to a marginal appreciation of 0.2 percent in REER during the first two months. Afterwards, it starts to depreciate having a trough at 7 months. However, it adjusted after 24-months having an appreciation of 0.1 percent (Figure 5c)

Figure 5d shows the response of the output to innovations in TB6 with and without REER exogenized. With the exchange rate channel blocked-off, we do not find any marked difference in response of output to the changes in monetary policy shock. The response is the same with the trough of IPI marginally higher (0.1 percent) than in the case with the REER endogenous.

Figure 5. Impulse Response: Exchange Rate Channel



Nevertheless, given the change of exchange rate regime during the sample period, these results need to be analyzed with some caution. A move from a fixed exchange rate to floating regime enhances the importance of the exchange rate channel because nominal exchange rates are not allowed to fluctuate in the former case. Real exchange rates, however, can vary under a fixed or crawling pegged regime so there is scope for monetary policy to affect real activity through this channel. Moreover, the effects are likely to be subdued given that prices adjust slowly.

Table 3. Variance Decomposition: Exchange Rate Channel

Variance Decomposition of IPI					
Months	**S.E**	**IPI**	**Price**	**REER**	**TB6**
3	0.069	92.93	3.78	3.06	0.23
6	0.073	86.75	4.33	3.89	5.03
9	0.077	81.25	4.09	4.89	9.78
12	0.078	80.04	4.29	4.87	10.81
18	0.081	76.89	4.76	6.33	12.02
24	0.082	75.83	5.63	6.28	12.25
30	0.083	74.67	6.42	6.27	12.64
36	0.085	73.59	7.06	6.28	13.07
Variance Decomposition of Price					
3	0.007	0.48	94.14	0.95	4.43
6	0.010	1.04	93.85	1.29	3.82
9	0.011	6.88	86.15	2.47	4.50
12	0.013	12.17	75.65	3.61	8.56
18	0.017	19.61	58.62	4.75	17.03
24	0.020	24.34	49.49	5.82	20.35
30	0.023	27.31	44.86	6.17	21.66
36	0.025	29.16	42.07	6.31	22.46
Variance Decomposition of REER					
3	0.034	0.31	0.72	98.44	0.54
6	0.038	1.13	1.85	95.23	1.78
9	0.039	2.15	4.00	89.47	4.38
12	0.041	2.92	5.62	86.30	5.16
18	0.041	3.08	6.77	84.14	6.00
24	0.042	3.84	7.11	81.86	7.19
30	0.042	4.75	7.59	79.91	7.75
36	0.043	5.60	8.14	78.12	8.13

Cholesky Ordering: IPI Price REER TB6

4.2.3. Assets Price Channel

The role asset prices may play in the transmission mechanism of monetary policy is well known theoretically, although quite difficult to characterize empirically. Monetary policy

shocks result into fluctuations in assets prices. A monetary policy easing can boost equity prices in two ways: (i) by making equity relatively more attractive to bonds (since interest rates fall) and (ii) by improvement in the earnings outlook for firms as a result of more spending by households.

Higher equity prices have dual impact of monetary impulses. First, higher equity prices increase the market value of firms relative to the replacement cost of capital, spurring investment also referred to as Tobin's q theory.[3] Secondly, increase in stock prices translates into higher financial wealth of household and therefore higher consumption[4]. In addition, to the extent that higher equity prices raises the net worth of firms and households which improves their access to funds, the effects captured would partly reflect the 'broad credit channel' of monetary policy as well.

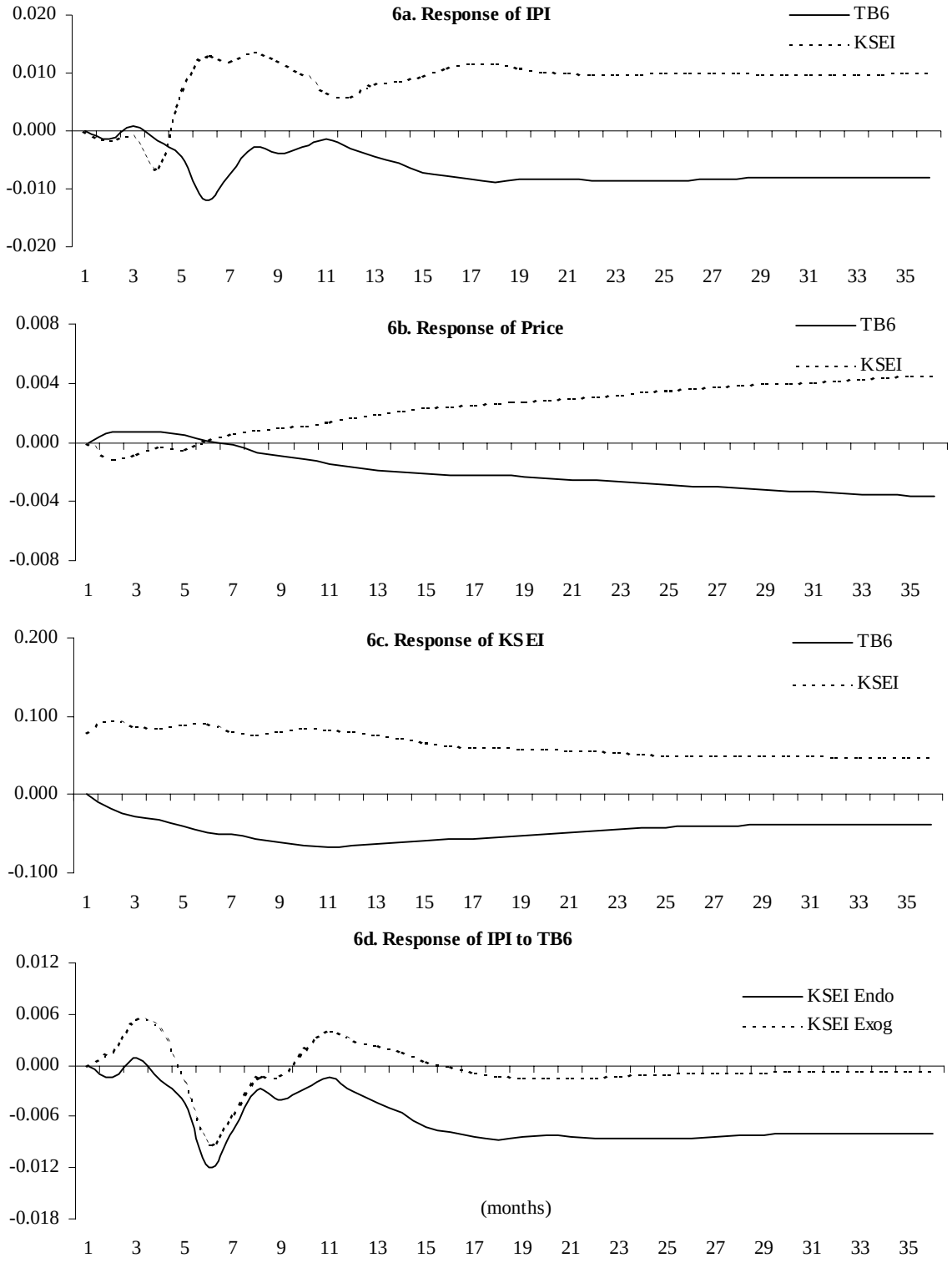
A broader range of assets e.g. real estate – commercial and residential – may be included to cover the wealth effects, however, due to data limitations, we used stock market equity, keeping in mind that these may serves as a proxy for broader range of assets as well. Typically, peaks in equity prices tend to lead those in real estate prices. However, the relationship is somewhat less clear-cut around troughs.

To examine the role of assets prices, we add a log of the KSEI to our basic VAR model. Figure 6c shows that a monetary tightening (corresponding to a rise in TB6 of 0.8 %) results in an immediate and persistent fall in equity prices, reaching to its lowest level of approximately 6.5 percent in 12 months from where equity prices starts rising and stabilize at around 4 % below the baseline after 30 months. Innovations in equity prices

[3] Tobin's *q* theory, as widely covered in the literature, provides a mechanism by means of which monetary policy affects the economy through its effects on the valuation of equities. Tobin defines *q* as the market value of firms divided by the replacement cost of capital. If *q* is high, the market price of firms is high relative to the replacement cost of capital, and new plant and equipment capital is cheaper relative to the market value of business firms. Companies can then issue equity and get a high price for it relative to the cost of the plant and equipment they are buying. Thus investment spending will rise because firms can buy a lot of new investment goods with only a small issue of equity.

[4] According to Modigliani's life-cycle model, as widely covered in the literature, consumption spending is determined by the lifetime resources of consumers, which are made up of human capital, real capital and financial wealth. A major component of financial wealth is common stock. When stock prices rise the value of financial wealth increases, thus increasing the lifetime resources of consumers, and consumption should rise. Similarly, housing and land prices are an extremely important component of wealth and a rise in these prices increase wealth, thereby increasing consumption.

Figure 6. Impulse Response: Asset Price Channel



reduce output up to a quarter and then starts to boost the output as expected. A 0.08 percent innovation/increase in stock prices boosts output by 12.5 percent in 6 months period above the baseline. However, the output stabilizes at 10 percent above the baseline after two years (Figure 6a). This result apparently seems puzzling because of the fact that during the first four months innovations in equity prices led to a fall in output. In the later part, the high response of IPI to innovation in KSEI is because of high correlation between IPI and KSEI.

Table 4. Variance Decomposition: Assets Price Channel

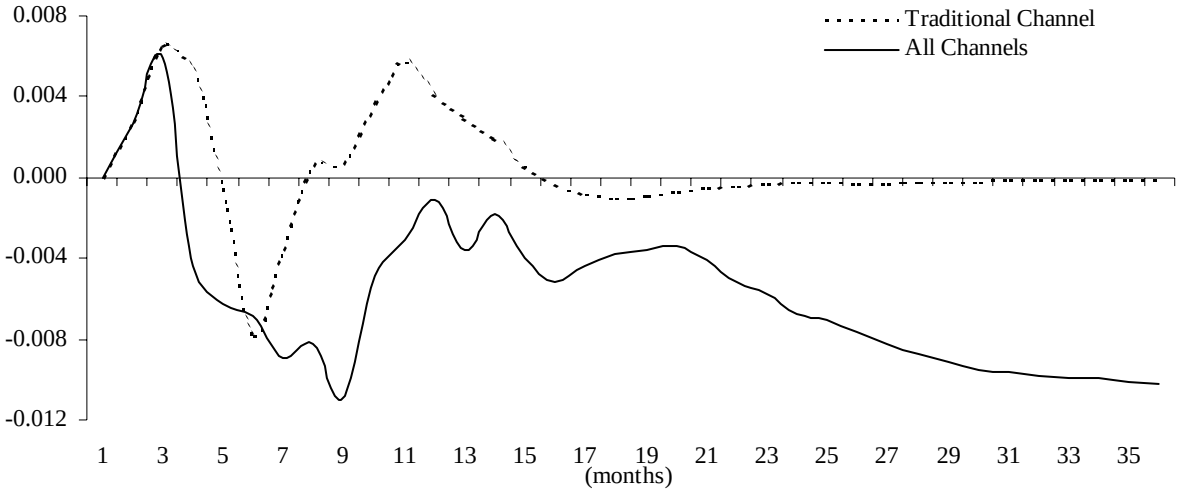
Variance Decomposition of IPI:					
Months	**S.E.**	**IPI**	**Price**	**KSEI**	**TB6**
3	0.063	98.2	1.7	0.1	0.1
6	0.068	89.2	1.6	5.6	3.7
9	0.072	79.2	1.9	14.1	4.8
12	0.075	75.6	3.1	16.4	4.8
18	0.081	64.4	3.8	23.1	8.8
24	0.089	55.7	4.1	27.2	12.9
30	0.095	49.6	4.4	30.2	15.8
36	0.101	45.0	4.7	32.5	17.8
Variance Decomposition of Price:					
3	0.007	0.4	93.7	3.9	1.9
6	0.009	0.7	94.8	2.6	1.9
9	0.011	5.5	88.5	3.5	2.5
12	0.013	8.2	79.6	6.3	5.8
18	0.016	10.0	60.7	15.8	13.4
24	0.021	11.0	47.3	23.6	18.1
30	0.025	11.1	37.4	30.0	21.6
36	0.029	10.9	30.4	34.6	24.1
Variance Decomposition of KSEI:					
3	0.156	0.3	3.2	92.3	4.2
6	0.234	3.5	1.8	83.5	11.2
9	0.290	2.8	1.4	77.1	18.7
12	0.344	2.5	1.1	72.1	24.3
18	0.411	3.7	1.0	66.1	29.2
24	0.453	4.3	1.1	63.7	31.0
30	0.482	4.7	1.3	62.5	31.4
36	0.509	5.1	1.6	61.7	31.6

Cholesky Ordering: IPI Price KSEI TB6

In order to determine the relative importance of asset price channel we blocked off this channel by exogenizing the KSE-100 Index. Not surprisingly, exogenizing the impact dampens the response of IPI as depicted in Figure 6d. Comparing the accumulated movements in equity prices account for only 19 percent of the total response on output after 2-years.

These results need to be accepted with a caution as the share ownership in not yet very common in Pakistan, and firms mostly rely on bank credit for their financing needs as against equity financing. We anticipate the role of asset prices in the transmission mechanism to increase in the future as the capital market develops.

Figure 7. Responses of IPI to TB6



4.2.4. Direct interest rate channel

The interest rate channel, also referred to as the traditional channel, is the primary mechanism at work in conventional macroeconomic models. Assuming some degree of price stickiness, an increase in nominal interest rates, for example, translates into an increase in the real rate of interest and the user cost of capital. These changes in interest rates may lead to a postponement in consumption or a reduction in investment spending. In the absence of any good indicator for cost of capital, we have measured its impact indirectly. In order to arrive at the impact of interest rate channel, we augment our basic VAR by including Loans, REER and KSEI and compare the output responses with and without these variables exogenized (Figure 7). The residual output effect left after adding these variables could be used as a measure of strength of interest rate channel. The results indicates that the traditional interest rate channel accounts for more than 40% of the output effect after two years, moreover the variation in other variables play a role in hastening the dissipation of monetary policy shock.

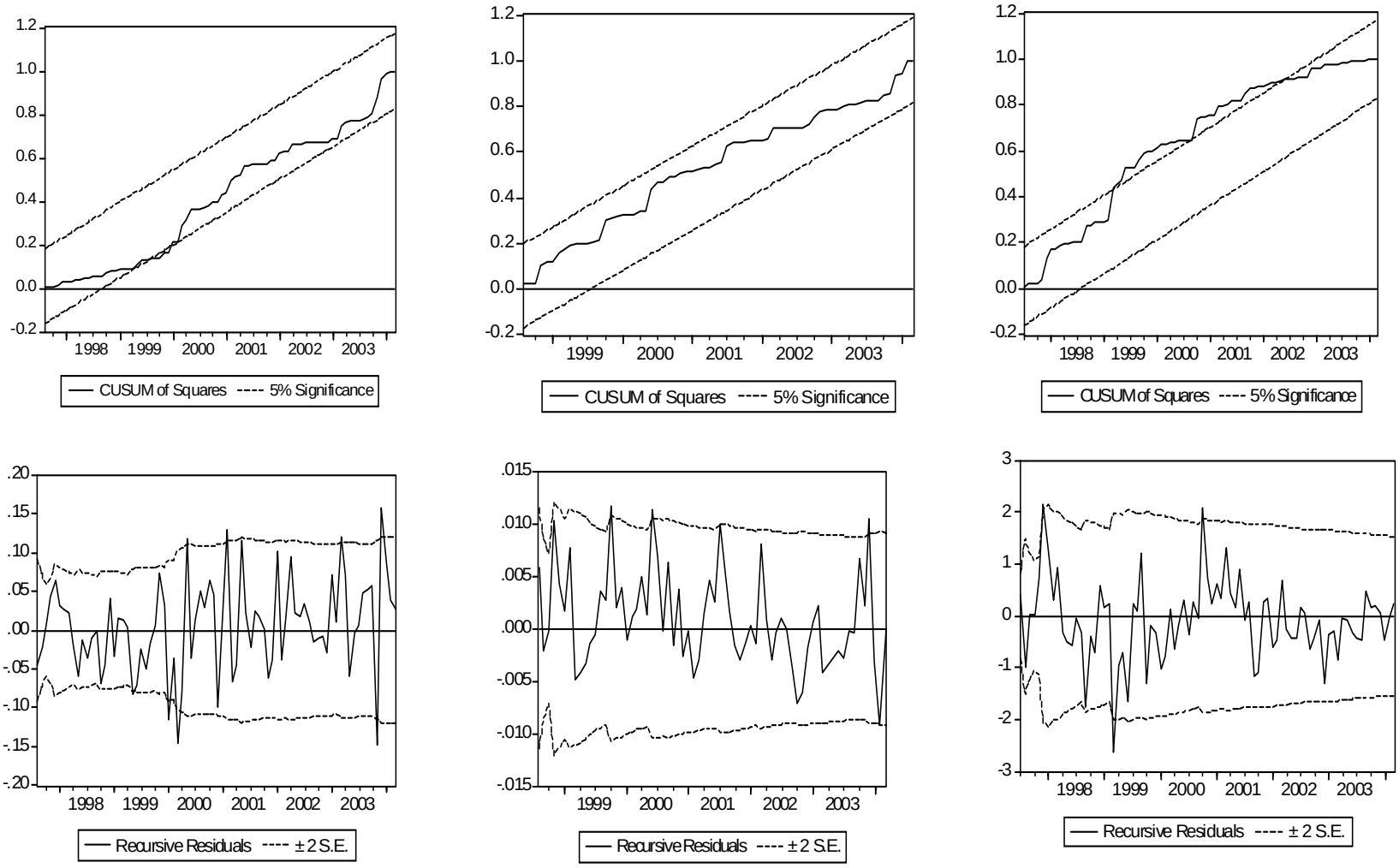
5. Specification issues and robustness

Since our main focus was to understand the latest transmission mechanism of monetary policy in Pakistan, our sample period is not very long. Nevertheless, it is important to check our results for robustness and also look for evidence of structural breaks and other misspecification problems in the VAR.

The cumulative sum of squares (CUSUM) tests for parameters stability as well as the recursive residuals for each equation of the VAR in the basic model is given in Figure 8. The results indicate some minor episodes of instability; however, the residual variance of each equation is generally stable i.e., the test statistics remain within the 5 % critical band.

We have estimated VARs in levels; however, some of the variables in the model are likely to be non-stationary. We have done so because; most of the empirical literature on VAR has tended to estimate VARs in levels. Nevertheless, there is a trade-off between estimating the VAR in levels (loss of efficiency) versus in first differences (loss of information about long-run relationships). Economic theory is mostly based on relationship between variables in levels; however, a VAR in first difference fails to capture such information. Moreover, while estimation in levels may incur some efficiency loss, this comes at no cost in terms of consistency of estimators as indicated by the stability tests.

Figure 8. Stability Test



6. Conclusions

This paper is an attempt to disentangle the various channels of monetary transmission mechanism in Pakistan. In view of non-availability of data, changes in policy regimes and the limited number of studies on the empirical estimation in Pakistan, we began with a simple objective. Given the theoretical relationships, we have attempted to quantify the lags associated with monetary policy shocks and investigated the relative strength of channels through which these shocks are propagated. A set of key findings summarized by stylized facts about the response of the economy to a tightening of monetary policy are as follows:

Stylized fact 1: The aggregate price level initially responds very little during the first 6 months, but significantly and persistently declines afterwards.
Stylized fact 2: Output follows a V-shaped response, bottoming out after about 7 months and dissipating after approximately 12 months.
Stylized fact 3: Banks play an important role through lending to private sector which affects aggregate spending.

These findings are generally consistent with findings in other countries, using similar methodology; however, given the lack of developed financial system the effects of monetary policy take relatively shorter time to completely dissipate through the economy. The above finding also highlights the fact that the linkage of monetary policy with the real sector is direct i.e., through the bank lending channel.
In addition to the traditional interest rate and bank lending channel, we have also found an active asset price channel which may be mainly due to strong correlation between our measure of output (IPI) and the variable of choice representing the asset price channel (KSEI). The exchange rate channel has been found less significant by comparison.

Overall, the monetary tightening leads first to a fall in domestic demand, financed by bank lending, which translates into a gradual reduction in price pressures that eventually reduces the overall price level with a lag. In view of the above, credit to private sector emerges as a superior intermediately variable in terms of monetary policy implementation framework.

In Pakistan, the role of bank lending is prominent because of lack of non-bank sources of finance. Other factors that my have enhanced bank's role includes, financial reforms, market-based credit allocation and crowding-in of private sector credit due to decline in fiscal dominance. Looking forward, improvement in the banking system on account of financial reforms and effective use of leveraging by corporate sector as a result of market based credit policies are essential steps for unclogging the wheels of the transmission mechanism and improving the mechanism of monetary policy.

References

Bayoumi, T. and J. Morsink (2001). *A Peek Inside the Black Box: The Monetary Transmission Mechanism in Japan.* IMF Staff Papers, Vol. 48, No.1.

Bernanke, B.S. and A.S. Blinder (1992). "The Federal Fund Rate and the Channels of Monetary Transmission." *The American Economic Review*, Vol. 82, No. 4.

Bernanke, B.S. and A.S. Blinder (1995). "Inside the Black Box: The Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives*, Vol. 9, No.4.

Christiano, L. J., M. Eichenbaum, and C.L. Evans (1998). *Monetary Policy Shocks: What Have We Learned and to What End?* NBER Working Paper 6400.

Disyatat, P. and P. Vongsinsirikul (2003). "Monetary Policy and the Transmission Mechanism in Thailand." *Journal of Asian Economics*, Vol.14, No.4.

Meltzer, A. H. (1995). "Monetary, Credit and (Other) Transmission Processes: A Monetarist Perspective." *Journal of Economic Perspectives, American Economic Association*, Vol. 9(4).

Mishkin, F.S. (1995). "Symposium on the Monetary Transmission Mechanism." *Journal of Economic Perspectives*, Vol. 9, No.4.

Mishkin, F.S. (1996). *The Channels of Monetary Transmission: Lesson for Monetary Policy*. NBER Working Paper 5464.

Ramaswamy, R. and T. Sloek (1997). *The Real Effects of Monetary Policy in the European Union: What are the Differences?* IMF Working Paper No.WP/97/160. Washington, D.C.: IMF.

Taylor, B. J. (1995). "The Monetary Transmission Mechanism: An Empirical Framework." *Journal of Economic Perspectives,* Vol. 9, No.4.

Appendix: Exogenizing a Variable

Consider the three-variable VAR:

$$
\begin{aligned}
X_t &= \alpha_1 X_{t-1} + \beta_1 Y_{t-1} + Y_1 Z_{t-1} \\
Y_t &= \alpha_2 X_{t-1} + \beta_2 Y_{t-1} + Y_2 Z_{t-1} \\
Z_t &= \alpha_3 X_{t-1} + \beta_3 Y_{t-1} + Y_3 Z_{t-1}
\end{aligned}
$$

We exogenize the variable *z* by running a two-variable VAR with *z* as an exogenous variable:

$$
\begin{aligned}
X_t &= \alpha_1 X_{t-1} + \beta_1 Y_{t-1} + Y_1 Z_{t-1} \\
Y_t &= \alpha_2 X_{t-1} + \beta_2 Y_{t-1} + Y_2 Z_{t-1}
\end{aligned}
$$

This procedure generates a VAR in which the first two equations are identical to the original VAR. However, the impulse response functions will be different because any interaction between these variables that passes through Z will be blocked (because it is exogenous). Hence, comparisons of the two sets of impulse response functions provide a measure of the importance of the variable Z in the transmission mechanism.