The monetary transmission mechanism in Pakistan: a sectoral analysis

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Abstract

The present paper takes a first step in investigating the monetary transmission mechanism in Pakistan at a sectoral level. Using quarterly data spanning from 1973:1 to 2003:4, we examine whether monetary policy shocks have different sectoral effects. Taking note of structural transformation of the economy and the monetary and financial reforms during 1990s, we also assess whether the reform process has notable impact on the monetary transmission mechanism. We find evidence supporting sector-specific variation in the real effects of monetary policy. Our results also suggest significant changes in the transmission of monetary shock to real sector of the economy during post-reform period.

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I. Introduction

Does monetary policy have economically significant effects on the real output? Historically, economists have tended to hold markedly different views with regard to this question. In recent times, however, there seems to be increasing consensus among monetary economists and policy makers that monetary policy does have real effects, at least in the short run[1]. Consequently, focus of monetary policy analysis has recently shifted from the big question of whether money matters, to emphasizing other aspects of monetary policy and its relations to real economic activity. One aspect that has received considerable attention of late is the sectoral or regional effects of monetary policy shocks. Recent studies on the subject make it quite clear that different sectors or regions of the economy respond differently to monetary shocks. This observation has profound implications for the macroeconomic management as the central bank will have to weigh the varying consequences of its actions on different sectors or regions of the economy. For instance, the tightening of monetary policy might be considered mild from the aggregate perspective, yet it can be viewed as excessive for certain sectors. If this is true then monetary policy should have strong distributional effects within the economy. Accordingly, information on which sectors react first and are more adversely affected by monetary tightening provides valuable information to monetary authorities in designing appropriate monetary policies. Additionally, the results can contribute to our understanding of the underlying nature of transmission mechanism. And for that reason, many economists have called for a disaggregated analysis of monetary transmission mechanism [e.g., Domac (1999), Dedola and Lippi (2005), Ganley and Salmon (1997), Carlino and DeFina (1998)].

[1] For discussions regarding the emerging consensus on the real effects of monetary shocks, see Bernanke and Gertler (1995); Taylor (1995); and Solow (1997).

An early attempt to explore monetary transmission at the disaggregated level is Bernanke and Gertler (1995). They use a vector autoregressive (VAR) model to show differing impact of monetary policy on components of final expenditures. Since then numerous studies have emerged analyzing the impact of monetary policy on different sectors or regions of the economy in more detail. For instance, Raddatz and Rigobon (2003) find supportive evidence on differential effects of monetary policy for various sectors of the US economy, whereas Gertler and Gilchrist (1993) conclude that output of the smaller firms in the USA is more sensitive to monetary shocks as compared to large-sized firms. Disaggregating the Canadian economy at the level of final expenditures as well as at the level of output, Farès and Srour (2001) collect evidence of differing response of various sectors of the economy to innovations in monetary policy. Analyzing the UK data, Tena and Tremayne (2006) collect evidence of cross-sectional differences across industries and asymmetries in some sectors to a monetary policy change while Ganley and Salmon (1997) provide evidence that the construction sector is the most interest-sensitive sector, followed by the manufacturing industry, services, and agriculture. In contrast, Hayo and Uhlenbrock (1999) focus on the Germany's manufacturing sector. They conclude that heavy industries react more strongly to interest rate shocks than the production of non-durables such as clothing and food. Using disaggregated industry data from five industrialized countries, Dedola and Lippi (2005) document sizable and significant cross-industry differences in the effects of monetary policy. Ibrahim (2005) suggests sector-specific response to innovations in monetary policy for Malaysia.

For a panel of US regional data, Fratantoni, Schuh and Mae (2001) and Carlino and DeFina (1998, 1999) estimate differential effects of monetary policy shocks. Their

analyses show significant variation in the magnitude and duration of dynamic responses to monetary shocks across regions of the USA. Giacinto's (2002) results confirm that economic sensitivity to changes in monetary policy varies across US regions. Arnold and Vrugt (2002) measure the impact of monetary policy shocks on regional and sectoral output for the Netherlands. They document large regional and sectoral variation in monetary policy transmission. With concern over the viability of a common European monetary policy, the European Central Bank created in 1999 the Monetary Transmission Network (MTN) to comprehensively research the transmission of monetary policy in the newly formed euro area. It existed for about three years documenting large amount of evidence on the differences in the effects of monetary policy among the EU countries using a range of econometric techniques and a number of data sets (see, for instance, Angeloni, Kashyap and Mojon, 2003)[2].

In the case of Pakistan, past research on monetary transmission mechanism has focused on the response of aggregate variables to monetary shocks and on measuring the effectualness of various channels of transmission mechanism[3]. The present paper takes a first step in investigating the monetary transmission mechanism in Pakistan at a sectoral level. There are two possible levels of disaggregation of an economy; one at the level of final expenditures and the other at the level of production. Due to data limitations, however, we restrict this analysis to examining the issue with disaggregated data of sectoral production. Using quarterly data spanning from 1973:1 to 2003:4, we examine effects of a monetary policy shock to aggregate output as well as real production from

[2] Much research on regional differences of the effect of monetary policy has focused on the Euro area. See, for example, Carlo and Luigi, 2005; Mihov, 2001; Ramaswamy and Slok, 1998; Guiso et al., 1999; Cecchetti, 1999; Barran et al., 1996.
[3] See, for example, Ahmed et al., (2005).

seven different sectors. These sectors are agriculture (S1), mining and quarrying (S2), manufacturing (S3), construction (S4), wholesale and retail trade (S5), finance and insurance (S6), and ownership of dwellings (S7). To this end, we adopt a standard vector autoregression (VAR) framework and generate impulse-response functions as a way to assess dynamic responses of aggregate as well as sectoral production to monetary policy shocks[4]. This paper also examines the robustness of the estimates of the responses of outputs to monetary shocks with respect to inclusion of nominal exchange rate in the VAR specification. Taking note of structural transformation of the economy and the monetary and financial reforms during 1990s, we also assess whether this has notable impact on the monetary transmission mechanism.

The organization of this paper is as follows. The next section provides some background information on monetary transmission mechanism and the framework for evaluating empirical evidence. Section III describes the data and the estimation strategy. Estimation results are discussed in section IV. Section V concludes the paper with a summary of the main findings.

II. Background Information

The monetary transmission mechanism is generally defined as the process through which monetary policy decisions affect the level of economic activity in the economy. Broadly speaking, there are two views on the transmission mechanism. The financial market price view emphasizes the impact of monetary policy on prices of and rates of return on financial assets (i.e., interest rates, exchange rate and other asset prices). The

[4] The monetary shock is of the same dimension for all the systems–a one standard deviation shock to the orthogonalized error term of the interest rate equation in the VAR. It corresponds approximately to 2.3 and 2.9 percentage point shocks to the interest rate in the full sample and sub-sample periods respectively.

other, named credit view, stresses changes in lending by banks and other financial intermediaries as an alternative to internal finance [Taylor (2000)]. Thus, in the credit view the contractionary impulses of monetary policy are transmitted to a large extent through declines in bank lending. Variations in the effects of monetary shock on different sectors can arise because of relative strength of a particular channel of transmission mechanism for some sectors and not for others. This relative strength, in turn, depends crucially on the structure, dependence on and availability of bank credit, and openness of a particular sector[5]. Hence, for example, one would expect exchange rate channel to have a significant impact of a monetary shock to a sector which is considered relatively more open than to the rest of the economy.

Since our objective in this paper is to derive an estimate of the statistical relationship between a set of variables and not to establish relative importance of the various channels of the transmission mechanism, the appropriate framework to evaluate empirical evidence consists of reduced-form VARs. The VAR approach presumes as if the economy were a black box whose working cannot be seen and hence it abstracts from spelling out the specific ways in which a monetary shock is transmitted to the economy. A VAR essentially consists of a set of equations in which each variable is treated symmetrically; i.e., each variable is determined by its own lagged values and the lags of all other variables in the system. Thus, this particular approach has the distinct advantage of allowing for the presence of feedback in the system. The VAR approach also provides an appropriate framework for making sectoral comparisons—the same reduced form equations can be used in all sectors for estimating the response of output to monetary

[5] Several studies investigate the sources of differential impact of monetary policy shock to different regions or sectors; see, for instance, Arnold and Vrugt (2002); Dedola and Lippi (2005); Dornbusch, Favero, and Giavazzi (1998); Mishkin (1996); Kashyap and Stein (1993).

shock. Additionally, the VAR approach allows the data to determine the shape of the impulse responses for different sectors when there are no clear priors about these.

III. Data and Estimation Strategy

In line with previous studies on the transmission of monetary policy, we estimate a VAR with three variables for the aggregate economy as well as for each sector: the level of output, the level of prices, and a monetary policy indicator[6]. The price level is represented by the consumer price index. In the context of Pakistan, there is no general consensus among policy makers or academia on whether some monetary aggregate or short term interest rate be used as a measure of monetary policy stance. Many, however, now argue for using some short term interest rate as a monetary policy indicator because the financial sector reforms have, presumably, caused instability within the components of reserve money, and the association between reserve money and monetary aggregates seems to have become inconsistent [Ahmed et al. (2005)]. Accordingly, and also due to being in line with many recent studies on the subject, we use the call money rate as our monetary policy variable. A positive shock to the call money rate signals tight monetary policy and vice versa. Additionally, we test the stability of the results obtained from above VAR analysis by performing similar VAR estimation with the inclusion of nominal exchange rate.

The data used in the present study are quarterly, spanning from 1973:1 to 2003:4. Note that the financial sector of Pakistan underwent a drastic reform process starting from early 1990. This included various measures to switch from a highly regulated to a liberalized and market-based monetary and financial system. This could and should have

[6] See Appendix for a description of the data and its sources.

fundamental implications for the monetary transmission mechanism in Pakistan[7]. For this reason, we also performed the VAR analysis on a sub-sample of the data set which excluded the pre-reform period, spanning from 1990 to 2003.

An important issue relating to the estimation strategy consists of selecting the appropriate specification of the VARs. Specification entails deciding on whether the VAR should be estimated in pure differences, in levels without imposing any restriction, or as a vector error correction model (VECM) to allow for the presence of cointegration. Statistically, the decision hinges crucially on the data temporal properties; that is, their unit root and cointegration properties. In particular, if the variables in a VAR are nonstationary and are not cointegrated then the VAR should be specified in pure differences. Sims (1980), and Sims, Stock and Watson (1990), however, recommend against differencing even if the variables contain a unit root. They argue that by way of differencing we trade loss of information for (statistical) efficiency. But since the goal of VAR analysis is to determine the interrelationships among the variables and not the parameters estimates, this trade is obviously unwarranted[8]. In contrast, if the variables are integrated of the same order and are cointegrated as well, then vector error correction is the preferred specification since it can generate efficient estimates without losing information about the long run relationships among the variables. However, many economists have argued against simply looking at the statistical properties of the data to decide on the appropriate specification. Hence, Ramaswamy and Slok (1998) contend that a VAR should be

[7] For detailed description of the reform process and its implications, see Financial Sector Assessment (various issues), State Bank of Pakistan. http://sbp.org.pk/publications/fsa.htm

[8] Ramaswamy and Slok (1998) provide an economic argument for estimating the VAR in levels rather than in first differences. They argue that the impulse response functions generated from estimating the VAR in first differences tend to imply that monetary shocks have permanent impact on the level of output, while those from the unrestricted VAR allow data to decide on whether the effects of monetary shocks are long lasting are not.

estimated using the error correction model only if cointegration exists, and the true cointegrating relationship is both known and can be given an economic interpretation. However, if the true cointegrating relationships are unknown, and furthermore, when these relationships are not the main focus of the analysis, then imposing cointegration may not be the appropriate estimation strategy. Imposing inappropriate cointegration relationships can lead to biased estimates and hence bias the impulse-responses derived from the reduced-form VARs. In cases where there is no a priori economic theory that can suggest either the number of long run relationships or how they should be interpreted, it is reasonable not to impose the cointegrating restriction on the VAR model. Consequently, we proceed by estimating an unrestricted VAR in levels[9].

The VAR model is identified using recursive Cholesky decomposition. For each system, we use the following ordering: real output, consumer prices, and call money rate. Our contention is that a shock to interest rate has no contemporaneous effect on output. This assumption is implemented by placing real output and prices before call money rate. Technically, this involves identifying monetary policy by taking the residuals from the reduced-form interest rate equation and regressing them on the residuals from the output and price equations. From the VAR, we generate impulse response functions which trace the response of a variable through time to an unanticipated change in itself or other interrelated variables. Since our focus in this paper is on reaction of real output to a monetary shock, we only derive the impulse-response functions which trace the reaction of real output to a one standard deviation shock to the interest rate.

[9] We performed the statistical analysis of the variables' temporal properties. The ADF test indicate that all data series are integrated of order 1, except real output of finance and insurance sector which is stationary in levels; see Table A1 at the appendix.

IV. Estimation Results

IV.1 Aggregate results

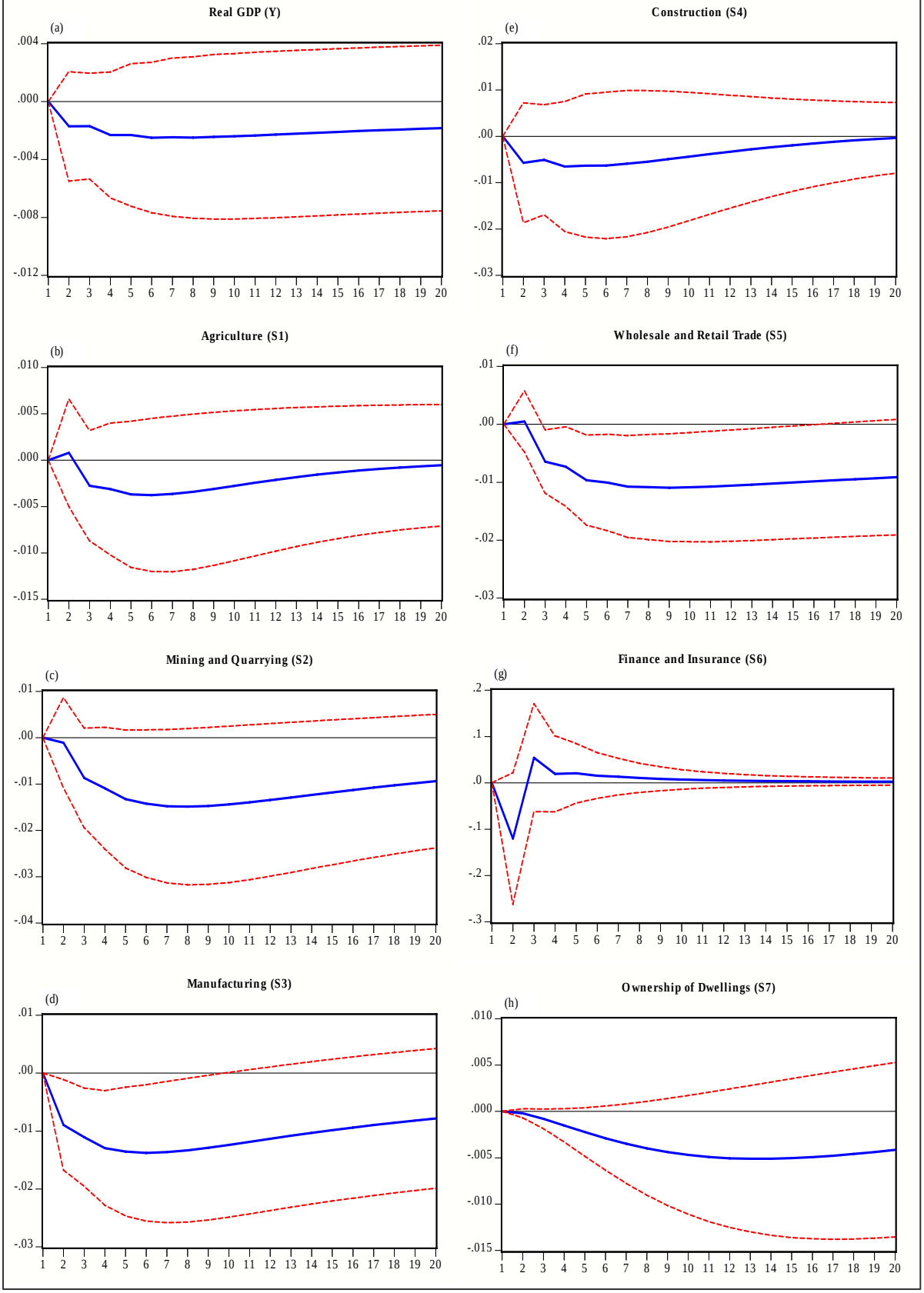
We first evaluate aggregate production response to a monetary shock in a system consisting of real output (GDP), consumer prices (CPI), and call money rate. Figure 1 (a) depicts the response of real GDP to one standard deviation shock to the interest rate. The response of real output is consistent with existing evidence on the real effect of monetary policy. In response to monetary tightening, real output declines and bottoms out at around 8 quarters, at approximately 0.25 percent below the baseline.

IV.2 Sectoral results

We next proceed to estimating a VAR model for each sector. Using innovation accounting, we examine which sectors seem to be affected more by monetary tightening. To implement this analysis, we classify the seven sectors on two bases. First, sectors are categorized according to the magnitude of the response; that is, those with a response of less than 1 percent decline in output (relative to baseline) to a one standard deviation shock to the interest rate and those with a response of greater than 1 percent. Secondly, we also categorize these sectors according to the duration of the response; that is, those wherein the decline in output bottoms out within four quarters and those wherein the decline bottoms out after that period. Figure 1 plots impulse responses of the seven sectors considered.

In line with aggregate results, production of all seven sectors decline after a positive interest rate shock. Looking at Figure 1 (b)-(h), we observe various patterns of temporal response. Among the seven sectors, output of three seems to decline by less than

Figure 1. Impulse Responses of Real Output to Cholesky one Standard Deviation Shock to Interest Rate



1 percent below the baseline. These sectors are agriculture, construction and ownership of dwellings. The remaining four sectors show little more than 1 percent decline relative to baseline except for Finance and Insurance, wherein output declines by more than 12 percent in response to a one standard deviation shock to interest rate. Analyzing the duration of the responses, we notice that the decline in output bottoms out within a year for only two sectors; these are construction (4 quarters) and finance and insurance (2 quarters). For both agriculture and manufacturing sectors, the decline in output bottoms out at around 6 quarters whereas this happens at 4 quarters for construction and at 9 quarters for wholesale and retail trade.

From these results, we are inclined to suggest that for the period under consideration there are potential disparities in the effects of monetary shocks on sectoral output. Specifically, we find that mining and quarrying, manufacturing, and wholesale and retail trade and finance and insurance sectors are more responsive to monetary shocks. Moreover, agriculture and construction sectors seem to be weakly interrelated with interest rate.

The above results are relatively stable when estimations are carried out with the inclusion of the nominal exchange rate in the VAR. The most notable difference in the two results is that the decline in aggregate output now bottoms out at around 6 quarters compared to 8 quarters in earlier analysis (see Figure A1 at the Appendix).

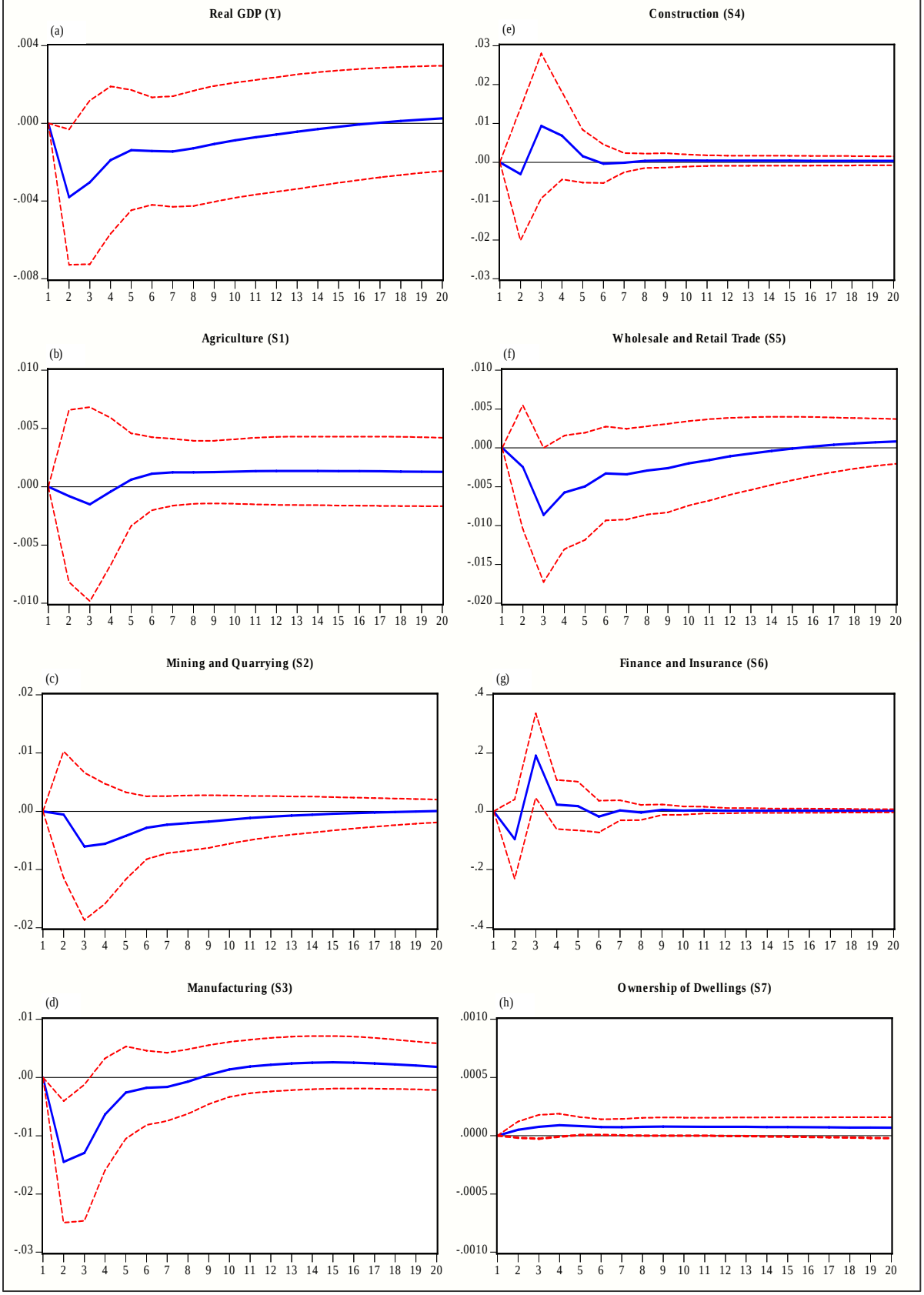
IV.3 Sub-sample results

This subsection performs further analysis on aggregate and sectoral effects of monetary policy by focusing on whether these effects have undergone any changes with

the monetary and financial system reforms undertaken since early 1990. With the liberalization and transformation of the financial sector into a market-based system, one would conjecture that the transmission mechanism might have experienced significant changes. To check this we redo the above analysis on a sub-sample of the data set containing observation over the period 1990 to 2003. The responses of aggregate as well as sectoral outputs to a monetary shock are depicted in Figure 2.

Several observations are notable from these results. First, at the aggregate level, the effects of monetary policy seem stronger and are transmitted to the real activity more rapidly. Specifically, aggregate output declines and bottoms out at around 2nd quarter, with 0.38 percent below the baseline. This result, therefore, suggests that effect of monetary policy becomes more potent for the aggregate real activity. Second, at the sectoral level, Figure 2 asserts that monetary shocks have almost insignificant impact on the output of agriculture, mining and quarrying, construction and ownership of dwelling sectors. In particular, output of these sectors declines by less than 0.6 percent in response to a one-standard deviation shock to interest rate. In contrast, real activity in manufacturing and wholesale and retail trade sectors declines by about 1.4 and 1 percent respectively in response to the same interest rate shock. Activity in finance and insurance sector seems to be hit the most by the monetary shock— a decline of almost 9.5 percent. Last, but not the least, Figure 2 also reveals that though the effects of monetary policy are still realized with some lags, the time required for the reaction of real activity to bottom out in response to interest rate shock is now significantly reduced.

Figure 2. Impulse Responses of Real Output to Cholesky one Standard Deviation Shock to Interest Rate (Sub-sample)



V. Conclusion

The present paper analyzes the relations between sectoral output and the call money rate in a multivariate setting to answer an important question: whether monetary policy shocks have different sectoral effects. The analysis considers seven different sectors of the economy and estimates a VAR for each sector as well as for the aggregate production. The analysis is conducted for the whole sample period as well as for a sub-sample. From the estimated VAR, we generate impulse response functions to estimate the effects of monetary shocks on real activity.

In line with many studies on money-income causal nexus, we find evidence supporting the real effects of monetary policy. Results from the subsample estimation indicate major changes in the transmission of monetary shock to variation in real activity. In particular, following monetary tightening, aggregate output declines and bottoms out after 2 quarters. Analyzing sectoral output responses to monetary shocks, we find evidence that some sectors are more affected by monetary tightening. The manufacturing, whoesale and retail trade, and finance and insurance sectors seem to decline more in response to the interest rate shocks. It seems that these three sectors are the driving force behind the aggregate fluctuations. In contrast, we observe the insensitivities of agriculture, mining and quarrying, construction, and ownership of dwellings to interest rate changes.

The differential responses of various sectors to monetary shocks are important from a policy point of view. Historically, monetary authorities in Pakistan have been actively involved in stabilization policies, promoting output growth during periods of economic slowdown and containing inflation during periods of expansion. However, the benefits of these policies need to be fully assessed in terms of potential unequal distribution of income

across sectors. In other words, the potential sectoral effects of monetary shocks need to be taken into consideration for future designs of monetary stabilization policies.

These results also raise a very important question regarding the reasons underlying differential responses of various sectors. We contend that the credit view explanation seems very likely, as the sectors that are affected most by monetary tightening are those sectors that are heavily dependent on bank loans and that are interest rate sensitive. This explanation, however, does not rule out other potential channels for monetary mechanisms. And thus a concrete answer to this question is an important avenue for future monetary research in the context of Pakistan.

Appendix

Data Sources

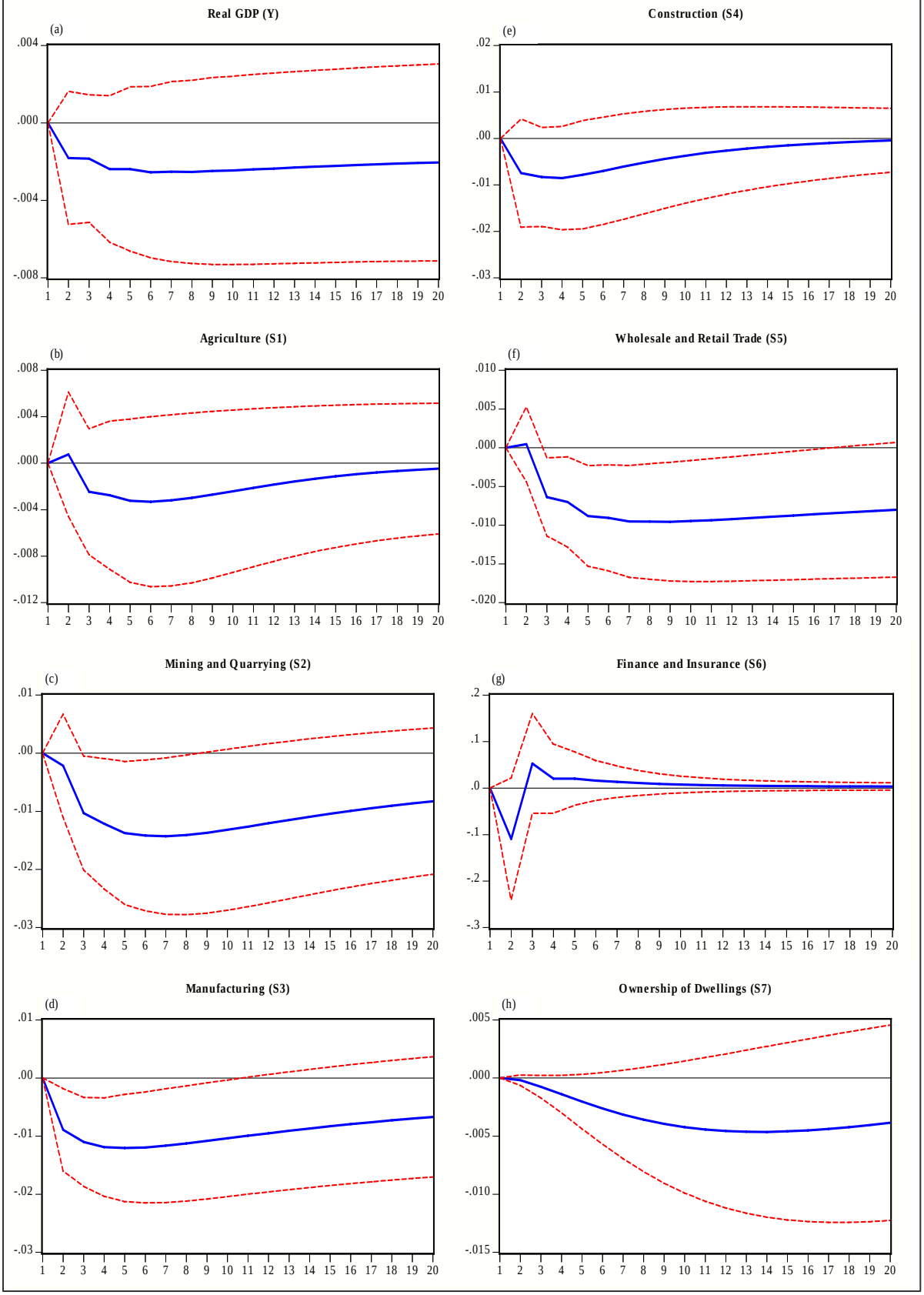
Data on quarterly GDP and sectoral outputs are obtained from Kemal and Arby (2004). Data on nominal exchange rate, CPI, and call money rate are obtained from IMF's International Financial Statistics. Output and CPI are in logs. Data on all variables is checked for seasonality and adjusted accordingly.

Table A1. Unit Root Analysis

Variables	Definition	Augmented Dickey-Fuller		
		Model	t-stat	lags
y	Real GDP	c	-2.343881	[8]
s1	Agriculture	c,t	-2.941458	[9]
s2	Mining and quarrying	c,t	-1.609281	[11]
s3	Manufacturing	c	-2.318332	[11]
s4	Construction	c,t	-2.594169	[4]
s5	Wholesale and retail trade	c	-1.64194	[1]
s6	Finance and insurance	c,t	-10.37842	[0]
S7	Ownership of dwelling	c,t	-1.810605	[12]
r	Call money rate	c,t	-1.800983	[3]
p	Consumer price index	c	-2.093273	[5]
e	Nominal exchange rate	c,t	-1.622351	[0]

Critical values of ADF test for model with 'c,t' are (-3.96, -3.41, -3.13) respectively for 1%, 5% and 10%; Mackinnon (1991).
Critical values of ADF test for model with 'c' are (-3.43, -2.86, -2.57) respectively for 1%, 5% and 10%; Mackinnon (1991).

Figure A.1. Impulse Responses of Real Output to Cholesky one Standard Deviation Shock to Interest Rate (Exchange Rate Included)



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