Abstract:

This paper analyses the monetary transmission mechanism in India and Pakistan. It tries to answer to the question: Which channel is important in the transmission of monetary shocks to real sector? It discusses different channels of monetary transmission and their relevance with emerging countries. Finally, it uses the vector autoregression approach in order to analyse the monetary transmission mechanism in India and Pakistan. In order to ameliorate the problem of price-puzzle, a vector of exogenous variables is introduced in the empirical estimations. Our results indicate the significance of bank lending channel in India and Pakistan. In case of Pakistan we also found the importance of exchange rate channel.

JEL classification: E40, E52, E58, E60

Key words: Monetary policy, transmission mechanism, impulse response function, Vector Autoregression

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1. **INTRODUCTION:**

There is a general agreement on the effects of monetary policy actions on the real sector. The question that arises now is how the monetary policy actions are transmitted to the real sector. Monetary policy affects the real sector through its influence on financial variables. The monetary policy decisions are transmitted to real sector through different channels. In industrialised countries, different ways are employed in order analyse a specific channel of monetary transmission. The mechanism of transmission of monetary shocks is often called as “black box”, as different views exist about transmission channels of monetary policy in an economy during the same time period.

While monetary transmission mechanism is considered as the black box, nevertheless the analysis of relative importance of the channels of monetary transmission is important for an effective monetary policy. Knowledge of the transmission mechanism of monetary policy will help the monetary authorities to interpret more accurately the variations in the financial variables. The policy makers having the knowledge about monetary transmission mechanism can choose better targets for monetary policy. Finally, it ameliorates the understanding to the relationship between the financial and the real sector of an economy.

The paper is organised in the following way: In the second section, given the importance of analysis of the functioning of monetary policy, we sketch an outline of monetary policies in India and Pakistan in order to better understand the relevance of the channels of monetary transmission in respective countries. In the third section, we discuss different channels of the transmission of monetary policy. Here, we discuss the relevance of these channels with both the two economies. In section four, we employ the vector autoregression approach in order to analyse empirically the pertinence of the channels of transmission of monetary policy in these countries. More specifically, we answer to the question: Which channel is importance in the transmission of monetary shocks to real sector? Finally, we conclude in section five.

2. **An overview of monetary policy in India and Pakistan:**

Since the mid of 1980s, the Reserve Bank of India (RBI) used the monetary aggregate M3 as an intermediate target of the monetary policy in order to control the variations of inflation and to promote the growth. In 1998, RBI introduced the approach of multiple indicators.

During 1980s, M3 was correlated with the evolution of inflation. Therefore, in 1985 the Chakravarty committee proposed the approach of monetary targeting, with M3 as an intermediate target. During the period of 1985-1997/98, M3 remained the intermediate target of the monetary policy. Thus, the monetary policy framework during the period 1985/86 – 1997/98 can be considered as monetary targeting framework\(^2\). RBI used to fix a target of M3 each year corresponding to the tolerable inflation rate and the targetted GDP growth rate.

In the second half of the 1990s, the RBI found that following the financial liberalisation in the country, the money demand was no more dominated by the real income\(^3\). These economic changes resulted in the transition of the functioning of monetary policy from targeting the M3 towards the multiple indicators approach. Therefore, in 1998, the RBI formally adopted the multiple indicators approach. In the multiple indicators approach, the RBI used the interest

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\(^2\) Pandit & al. (2006)

\(^3\) Report on money and finance RBI, 2001-02
rate, fiscal position, trade, capital flows, rate of inflation, exchange rate, refinancing and the foreign exchange transactions. However, in this approach the growth rate of M3 remained an important indicator.

Since 1950s, the RBI used different instrument of monetary policy. Among these instruments, the open market operations and the inter-bank interest rate are the important instruments in the context of Indian monetary policy (Table 1).

**Table 1: India: The instruments of Indian monetary policy**

<table>
<thead>
<tr>
<th>Instruments/Years</th>
<th>1950s</th>
<th>1960s</th>
<th>1970s</th>
<th>1980s</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash reserve ratio</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use until 1997-98</td>
<td></td>
</tr>
<tr>
<td>Standing facilities(^4)</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use of the particular refinancing to sectors was stopped</td>
</tr>
<tr>
<td>Credit control</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>Used was finished</td>
</tr>
<tr>
<td>Open market operations</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>Was put again in Active use 1992-93</td>
</tr>
<tr>
<td>Inter-bank interest rate</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>In Active use</td>
<td>Was put again in Active use 1997-98</td>
</tr>
</tbody>
</table>

Source: Report on money and finance 2001-02; Annual report 2001-02, RBI.

RBI started to use the instruments of the open market operations (OPOs) in 1991-92. The RBI performed the OPOs by using:

(i) The immediate purchase and sale of government securities.

(ii) The operations of repo and reverse repo\(^5\) (recently via the liquidity adjustment facility) for liquidity management in the short run.

In Pakistan, the broad money M2 is used as the intermediate target by the State Bank of Pakistan (SBP). It is composed of M1, the time deposits, and the resident foreign currency deposits. The M1 consists of the currency in circulation, the demand deposits and other deposits with the SBP.

**Table 2: Pakistan: Major changes in monetary policy instruments during 1990s**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Major changes in the monetary policy instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 1992</td>
<td>The prescription of credit ceiling was abolished.</td>
</tr>
<tr>
<td>Jan. 1995</td>
<td>Introduction of Open market operations (OPOs)</td>
</tr>
<tr>
<td>Mar. 1995</td>
<td>Removal of the cap on lending rate of banks and non-bank financial institutions (NBFIs) other than applicable to special financing schemes.</td>
</tr>
<tr>
<td>Oct. 1995</td>
<td>Credit / Deposit ratio was liberalised.</td>
</tr>
<tr>
<td>Oct. 1997</td>
<td>Use of bi-directional intervention introduced for liquidity management.</td>
</tr>
<tr>
<td>1998</td>
<td>Restrictions on deposit rate were removed.</td>
</tr>
</tbody>
</table>

\(^4\) Standing facilities are the facilities of the central bank for commercial banks. The central bank activates these facilities on the discretion of commercial banks. Standing facilities put the limits in order to control de movements of interest rate.

\(^5\) Repo and reverse repo are the sale and repurchase contracts. It’s the sale of securities with a contract of repurchase of these securities on a future date and on a specific price. The repo and reverse respo operations make possible the provision of short run funds.
The SBP used both the direct and the indirect instruments of monetary policy in order to achieve its goals. However, since 1990/91 several policy measures have been adopted for a transition from the use of direct instruments to indirect instruments and market based monetary management (Table 2).

Now, the indirect instruments the main instruments employed by the SBP and these instruments consist of the 3-day repo rate, Treasury bills auction rate, Open market operations in government securities and other suitable assets, the statutory reserve requirement and statutory liquidity ratio. The direct instruments consist of credit ceilings, credit / deposit ratio, fix margin requirements and the control of the rate of return. Following, we provide a brief discussion of these instruments.

3. TRANSMISSION MECHANISM OF MONETARY POLICY:

The transmission of monetary policy is the process by which the central bank transmits the decisions of the monetary policy to the variations of the inflation and the GDP.

3.1 Channels of the transmission of monetary policy:

Monetary policy affects the real sector via its influence on the aggregate demand in order to achieve the objectives. There are often various channels of the transmission of monetary policy stance which work simultaneously. That is why the process of monetary transmission is often referred as the “black box”. The relative importance of each channel changes from one country to another depending upon the nature of financial markets.

In developed countries, the short run interest rate is a monetary policy instrument. During 1990s, we found a financial globalisation in the emerging market economies. The process of financial globalisation has increased the importance of interest rate in the functioning of the monetary policy. However, we found the importance of other channels of monetary transmission especially the narrow credit channel.

It is important to note that the effectiveness of the transmission mechanism of monetary policy is influenced by the way the bank credit is distributed. In different developing countries, a large percentage of bank credit is allotted to the priority sectors. In case of India, the report of the committee on financial system proposed 38% of non food credit to priority sector. This percentage increased to 42.5% in 2002/03. Thus, a distribution of credit to priority sector according to the policy rules, does not respond to either market signals or changes in monetary policy. As a consequence, the influence of the transmission of monetary policy shocks is restricted. In the following sections, we discuss different channels of the transmission of monetary policy.
3.1.1 Interest rate channel:

The interest rate channel is considered as the most important channel of the monetary policy in conventional macroeconomic models especially in the *Neo Keynesian* context.

An open market purchase reduces the short run interest rate. A decline in the short run interest rate leads to an increase in the market interest rates. The short run price rigidity implies for a decrease the short run real interest rate. According to the expectations hypothesis of the term structure, the long run real interest rate is an average of expected future short run real interest rates. Thus, a decline in the short run real interest rates leads to a decrease in the long run real interest rate. The user cost of capital decreases. On one side, the consumption and investment increase and on the other side, the exchange rate depreciates. An increase in the consumption and investment leads to an increase in inflation.

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*Schematic diagram (a): Mechanisms of the transmission of monetary policy*

Open market operations

→ Policy rates

→ Market interest rates

→ Price expectations

→ Asset prices

→ Exchange rate

→ Real interest rate

→ Bank loans

→ Asset price

Channel

→ Interest rate

Channel

→ Exchange rate

Channel

→ Bank lending

Channel (Narrow credit Channel)

→ Consumption and investment

→ Inflation

6 Modified schematic diagram by the author, originally taken from Mishkin F. (2006)
In India the interest rate was administered until the end of 1990s and the interest rate channel was not important. During 1990s, the functioning of monetary policy underwent by different structural reforms (liberalisation and deregulation). The Indian financial markets were progressed rapidly. Since 1997-98 the inter-bank interest rate was deregularised and the interest rate channel became more important. The pass through of inter-bank interest rate to the lender rate and deposit rate was estimated at 60% and 42% respectively (RBI 2003). The effect of interest rate shock on prices and production appears in the period of six months. The importance of inter-bank interest rate was increased after the introduction of the liquidity adjustment facility (LAF) in 2000.

In India, the monetary policy signals are transferred by the modifications of the inter-bank interest rate and the repo rate (through open market operations). According to an empirical study the response of production to a monetary shock via the interest rate channel was more important than the response of production to a monetary shock via the credit channel (IMF 2003).

The monetization of the economy in Pakistan, shown by the ratio of M3 to GDP (Table 4), increased since 1999. This increase is mainly due to the increase in foreign remittances. This increase remained concerned in order to control the inflationary pressures in the economy. The higher monetary growth since that period and the low inflation, showed an increase in the financial sector intermediation of economic activities.

### 3.1.2 Bank lending channel:

This channel relies on the hypothesis of the asymmetry of information. The asymmetry of information creates the gap between the cost of funds created externally and the opportunity cost. This gap is called as the external financing premium. The external financing premium shows the associated costs (for example, the asymmetry of information and the anticipated cost of evaluation). The experts of financial institutions, i.e., the banks, lend to the firms that can not get the loan in the financial markets. In the credit channel, a monetary shock affects not only the interest rates but also the external financing premium.

The bank lending channel relies on two conditions. Firstly, the central bank controls the bank lending through its monetary policy instrument. The banks depend on reservable demand deposits as a source of funds. Secondly, there is no alternative of the bank lending at least for
some sectors of borrowers. When there exists an asymmetry of information, the banks perform an important role in the intermediation of lending in the financial markets. A monetary policy shock affects the banking lending through variations in reserves and through the market interest rates. An open market purchase will lead to an increase in the bank reserves. The availability of bank loans will increase. An open market purchase increases also the liquidity in the system. The market interest rates decrease the availability of bank deposits. As the firms and households depend mostly on bank lending, an increase in bank lending will increase the aggregate spending and inflation.

Table 5: Indicators of the of bank lending

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>134.9</td>
<td>157.9</td>
<td>172.0</td>
<td>213.3</td>
<td>193.9</td>
<td>225.1</td>
<td>192.4</td>
</tr>
<tr>
<td>Japan</td>
<td>245.3</td>
<td>200.9</td>
<td>190.8</td>
<td>197.3</td>
<td>151.8</td>
<td>187.1</td>
<td>151.7</td>
</tr>
<tr>
<td>Malasia</td>
<td>117.9</td>
<td>104.5</td>
<td>167.1</td>
<td>149.6</td>
<td>161.0</td>
<td>149.2</td>
<td>159.5</td>
</tr>
<tr>
<td>Middle income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Countries</td>
<td>54.7</td>
<td>47.5</td>
<td>60.4</td>
<td>52.5</td>
<td>64.6</td>
<td>54.2</td>
<td>68.3</td>
</tr>
<tr>
<td>India</td>
<td>48.6</td>
<td>24.1</td>
<td>48.2</td>
<td>25.3</td>
<td>54.6</td>
<td>29.0</td>
<td>59.0</td>
</tr>
<tr>
<td>Philippines</td>
<td>44.4</td>
<td>31.9</td>
<td>74.0</td>
<td>52.2</td>
<td>63.3</td>
<td>40.2</td>
<td>61.4</td>
</tr>
<tr>
<td>Pakistan</td>
<td>52.9</td>
<td>23.7</td>
<td>49.8</td>
<td>24.5</td>
<td>38.2</td>
<td>22.0</td>
<td>21.9</td>
</tr>
<tr>
<td>Indonesia</td>
<td>49.0</td>
<td>49.2</td>
<td>59.8</td>
<td>42.0</td>
<td>53.9</td>
<td>18.1</td>
<td>51.4</td>
</tr>
</tbody>
</table>


{1} Domestic credit provided by banking sector (% of GDP)
{2} Domestic credit to private sector (% of GDP)

Since 1950, the bank lending channel was the principal channel of the transmission of monetary policy in India. During this period the sectoral allocation of credit and the required reserves ratios were the dominant instruments of the monetary policy. According to an empirical study, the correlation between the bank lending and the production was important in nineteen cities in a sample of twenty five cities in India during the period of 1981-2000 (RBI 2003).

Graph 1: Currency to deposit ratio

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7 Barran F. et al. 1996.
8 For India (left axis), we used the following formula in order to calculate the currency to deposit ratio.
Currency to deposit ratio = currency in circulation / (Demand deposits with banks + Time deposits with banks)
For Pakistan (right axis), we used the following formula in order to calculate the currency to deposit ratio.
Currency to deposit ratio = Currency in circulation / (Scheduled Banks’ demand deposits + Scheduled banks’
time deposits + Resident foreign currency deposits)
The balance sheets of banks and the production were correlated during the period 1982-2002 (Virmani V. 2005). The control of bank credit remained the principal instrument of the monetary policy. During the 1990s, the Indian economy passed through the structural reforms. However, the bank lending channel remained important in the transmission of monetary policy.

In Pakistan, the commercial banks are very important in the financial system, having about 90% of deposits and providing two third of total financing. Since the fiscal year 2001, the cash to deposit ratio gradually decreased, which shows the increasing intermediation of the banking system. The cash to deposit ratio decreased firstly because of an increase in the deposit growth due to the increasing remittances and secondly due to the increased financial innovations. Furthermore, an increased availability in the consumer credit led to a higher intermediation of the banking system. In the year 2004, this ratio was lowest at 0.30 since 1999. In India, the cash to deposit ratio also showed a declining trend since 2000, which explains an increase in the importance of commercial banks in the economic activity.

3.1.3 Price expectations and the monetary transmission mechanism:

The central bank announces that it is concerned over an increase in inflation and therefore the economy requires a monetary tightening. If the central bank’s policies are credible, i.e., the central bank is firm to keep its monetary policy in accordance to its announcement, then this announcement will create the expectations among the economic agents that in future the inflation will go down. Therefore, they will adjust the wages and salaries. The firms will take this increase in inflation as temporary increase in their costs. The price level will not change.

Given the forward looking nature of financial markets, the credibility of the central bank’s policies performs the central role. If the central bank’s policies are credible, the economic agents will accept its announcements. If the central bank’s policies are not credible, economic agents do not fully take into account the changes in the policy variables. The effect of change in policy variable is not fully transmitted to long term real interest rate (schematic diagram a). As a consequence, the monetary transmission mechanism weakens.

3.1.4 Exchange rate channel:

The exchange rate channel is more important in a more open economy. A decrease in the real interest rate due to an open market purchase, as discussed above, decreases the value of deposits dominated in the domestic currency and increase the value of deposits dominated in the foreign currencies. Consequently, the exchange rate depreciates. A decrease in the value of domestic currency increase the net exports (indirect effect of exchange rate depreciation) and increases the import prices (direct effect of exchange rate depreciation). An increase in net exports increases the aggregate output. Finally, domestic prices increase. On the other side an increase in import prices is transferred to the domestic inflation according to the level of the pass-through of the import price inflation to domestic inflation.

Fluctuations in the exchange rate also affect the balance sheet of the firms and consumers that possess significant shares of foreign currency dominated debt. Since the liabilities are dominated in foreign currency, a depreciation of the nominal exchange rate leads to an increase in the debt burden of these firms. On the other side, there is no increase in their asset because the assets are dominated in the domestic currency. As a result the net worth of these
firms decrease. The moral hazard that some firms will not be able to pay back the debt increases.

**Exchange rate depreciation and balance sheet of firms:**

The exchange rate depreciation affects the inflation also via the effect of balance sheet. If the banks and enterprises are indebted heavily in a foreign currency, for example the US dollar, exchange rate depreciation will increase the debt. As, the assets of these banks and enterprises are dominated in the domestic currency, thus exchange rate depreciation will deteriorate the balance sheet of these banks and firms by increasing the liabilities and decreasing the value of their assets. Net value of banks and firms will decrease and the investment will decline. Consequently, the production and the inflation will also go down. The adverse balance sheet effect of exchange rate depreciation is significant in the economies dominated by the banks and firms strongly indebted in a foreign currency.

### 3.1.5 Asset price Channels:

Monetary policy shocks are also transmitted through asset prices such as the stocks prices, bonds and the real estate. A change in the asset prices affects consequently the production and the inflation. Following are two types of the transmission mechanism of monetary policy through asset prices.

![Schematic diagram (b): Mechanism of monetary policy transmission via asset prices](image)

(i) **Investment effect and the theory of Tobin’s q:**

The theory of Tobin’s q explains the effect of a monetary shock on inflation by the evaluation of bonds. According to the Tobin’s q theory, q is the ratio of market value of firms and the replacement cost of capital.

An open market purchase results into a decline in market interest rates. The demand for stocks increases. The prices of stocks increase. Higher stock prices lead to an increase in the Tobin’s q. A higher value of q means that the price of firms is more than the replacement cost of capital.

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9 Modified schematic diagram by the author, originally taken from Mishkin F. (2006)
capital. The firms will buy new investment goods with only a small issue of stock. An increase in the investment spending will lead to an increase in the production and the prices. The lending to these firms for investment spending will decrease. As a result the production and prices will also decrease.

(ii) Financial wealth effects:

According to the life cycle hypothesis developed by Ando and Modigliani (1971), the life time sources of the consumers determine the spending and the financial wealth is an important source of consumer’s lifetime income.

Table 4: Market capitalisation of listed companies (% of GDP), US dollars

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>76,7</td>
<td>147,3</td>
<td>137,5</td>
<td>106,4</td>
<td>130,3</td>
<td>139,4</td>
<td>136,5</td>
</tr>
<tr>
<td>Japan</td>
<td>73,8</td>
<td>69,9</td>
<td>54,1</td>
<td>53,5</td>
<td>70,9</td>
<td>79,6</td>
<td>105,1</td>
</tr>
<tr>
<td>Malaysia</td>
<td>225,0</td>
<td>169,6</td>
<td>136,4</td>
<td>130,0</td>
<td>162,0</td>
<td>160,6</td>
<td>139,3</td>
</tr>
<tr>
<td>India</td>
<td>31,2</td>
<td>32,3</td>
<td>23,1</td>
<td>25,9</td>
<td>46,5</td>
<td>55,8</td>
<td>70,4</td>
</tr>
<tr>
<td>Middle income Countries</td>
<td>27,3</td>
<td>33,6</td>
<td>34,1</td>
<td>31,3</td>
<td>40,8</td>
<td>43,4</td>
<td>49,6</td>
</tr>
<tr>
<td>Phillipines</td>
<td>59,2</td>
<td>55,9</td>
<td>27,8</td>
<td>24,3</td>
<td>29,3</td>
<td>32,1</td>
<td>40,8</td>
</tr>
<tr>
<td>Pakistan</td>
<td>18,8</td>
<td>12,6</td>
<td>6,9</td>
<td>14,3</td>
<td>20,1</td>
<td>30,2</td>
<td>41,5</td>
</tr>
<tr>
<td>Indonesia</td>
<td>18,9</td>
<td>27,7</td>
<td>14,0</td>
<td>15,0</td>
<td>23,0</td>
<td>28,8</td>
<td>28,4</td>
</tr>
</tbody>
</table>


An open market purchase leading to an increase in asset prices, i.e., the prices of stocks, bond and the real estate, leads to an increase in the financial wealth of the consumers. Consumption and investment increase. Finally the production and inflation increase.

(ii) Balance sheet channel:

Balance sheet channel also called the broad credit channel emerges in the presence of the problem of asymmetry of information in the credit markets. The balance sheet effect relies on the hypothesis that the external financing premium depends on the financial situation of the borrowers. In the balance sheet channel, asset prices perform an important role in determining the value of the net worth of the firms and consumers during the process of obtaining the loan. A low value of net worth of the firms and consumers means that they have low collateral for their loans. Thus, the adverse selection and the moral hazard problem of lending to these firms and consumer is high. The lending to finance the investment spending will decrease.

An open market purchase leads to a decrease of market interest rates. The asset prices increase resulting in an increase of the net worth of firms and consumers. These firms and consumers have more collateral in order to get the loans. An increase in the loan for financing the investment spending will increase investment and thus the production. Finally the inflation also increases.
3.2 Importance of structural features in the transmission mechanism of monetary policy:

There are particular structural characteristics in an economy that influence the relative importance of various transmission mechanisms. We discussed earlier that the policy rate affects the market rates and market prices through different channels. The market rates and market prices ultimately affect the spending by firms and households.

**Schematic diagram (c): Factors that influence the transmission of monetary policy**

1. Policy rate → Market interest rates, Market prices (Loan rate, exchange rate, Asset prices), price expectation
   - Structure of the financial system
   - Size and openness of the economy
   - Central bank’s credibility

2. Market rates, Market prices, price expectation → Spending by firms and households, Inflation
   - Financial development
   - Balance-sheet position of firms and households

If the financial markets are well diversified, the variations in the policy rate are quickly transmitted to the market interest rates and prices (Schematic diagram (c)). The consumption and investment decisions by the firms and households are more responsive to variations in the market rates and prices. Thus the depth and structure of financial system matters in the determination of the relative importance of monetary transmission mechanisms. The size and openness of economy is another factor that affects the monetary transmission mechanism. In small and more open economies the exchange rate channel is relatively important. If the domestic firms are indebted in foreign currency, exchange rate channel is more pronounced. The extent of the effects on domestic inflation depends on the degree of exchange rate pass-through to domestic prices.

4. **EMPIRICAL ESTIMATIONS:**

We use the Vector autoregressions (VAR) in order to analyse how the monetary policy shocks affect the production and inflation in India and Pakistan. The VAR approach takes into account the simultaneity between the monetary policy variables and the real sector variables. This approach makes it possible to impose minimum restrictions on the ways through which the monetary policy influence the real sector. The VAR approach is used by a large number of empirical literatures in order to examine the ways through which the monetary policy shocks...

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10 Modified diagram by the author; originally taken from Loayza & Hebbel (2002).
affect the real sector\textsuperscript{11}. Our estimation procedure is based on the methodologies proposed by Morsink & Bayoumi (2001), Peersman & Smet (2001).

In case of emerging countries, Distyatad P. & al (2003) analysed empirically the relative importance of different channel of monetary transmission in Thailand. They found that the banks act as an important conduit for monetary policy to real sector. Al mashat (2003) studies empirically the monetary policy transmission in India. He found that the impact of shock of key macroeconomic variables is larger after introducing the exchange in the model. He also found that the response of nominal interest rate in the pre-reform period is smaller than that in the post-reform period. An empirical study of monetary transmission India, performed at the Reserve bank of India (2003), found that a substantial part of output volatility is not due to monetary policy shocks. According to this study, the proportion of output variance, at 60 months ahead horizon, due to broad money and the interest rate, is around 1-2 percent\textsuperscript{12}. Pandit & al. (2006) analysed the importance of the bank lending channel in India from 1993/94 to 2002/03. They used the changes in the bank rate and the cash reserve ratio as the measures of the stance of monetary policy. Their results supported the existence of the bank lending channel in India. Ahmed et al (2005) analysed empirically the channels of monetary policy in Pakistan. They found the importance of credit channel and the interest rate channel in monetary transmission in Pakistan.

Going deeper in search of the channels of monetary policy transmission, we introduced a vector of exogenous variables in our estimations. The rationale for including the vector of exogenous variables is to solve the problem of price-puzzle. The problem of price-puzzle emerges due to an increase in price following a monetary policy tightening (a decrease in interest rates). This problem arises due the lack of specification of the model. The policy makers observe the variables that are important in the context of future inflation. If we do not take into account these variables in our model, positive innovations in the interest rate lead to an increase in prices.

4.1 Identification scheme:

Consider the following VAR model that contains the contemporaneous relationships among the variables.

\[ K Y_t = A Y_{t-1} + B X_t + \varepsilon_t \]  

(1)

Where,

\( Y_t \) is the vector of endogenous variables
\( X_t \) is the vector of exogenous variables.

In equation 1, the coefficient matrix K explains the simultaneous relationship among all the variables. The coefficient matrix A includes all the coefficients that explain the lagged relationship among the variables. The coefficient matrix B explains the relationship among the exogenous and the endogenous variables. The disturbance term \( \varepsilon_t \) includes all the


\textsuperscript{12} Report on currency and finance, (2003), Reserve Bank of India.
residuals in the VAR model. If we multiply equation 1 by $K^{-1}$, we can derive the residual form of the VAR model from as follows:

$$Y_t = K^{-1}AY_{t-1} + K^{-1}BX_t + K^{-1}\varepsilon_t \quad (2)$$

We can rewrite equation (2), as follows:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + \mu \quad (3)$$

Where,

$$A(L) = K^{-1}A, B(L) = K^{-1}B, \mu = K^{-1}\varepsilon_t$$

In the case of India, the vector of exogenous variables is a vector comprising of foreign variables. Thus, the vector of exogenous variables is given as:

$$X_t = \begin{bmatrix} \text{Compi}_\text{World} & \text{Oilprices} & i_{\text{US}} \end{bmatrix}$$

Where,

Compi$_\text{World}$ is the World commodity price index,
Oilprices are the spot oil prices (US dollars), and $i_{\text{US}}$ is the federal funds rate.

However, in case of Pakistan, we did not include the exogenous variables. The inclusion of above mentioned variables did not improve the results. Thus, our identification scheme for Pakistan is as follows:

$$Y_t = A(L)Y_{t-1} + \mu \quad (4)$$

### 4.1.1 Benchmark model:

We use the following vector of endogenous variables as the benchmark model:

$$Y_t = \begin{bmatrix} \text{GDP} & \text{Prices} & i \end{bmatrix}$$

With

GDP = the Gross domestic product.
Prices = the index of domestic prices
$i$ = the indicator of the monetary policy stance.

For India, we used the quarterly data on GDP. However, for Pakistan the data on GDP is not available in quarterly frequency. Therefore, we used the Index of industrial production as a proxy for the GDP. The manufacturing sector has a share of around 58% in the private sector credit. It is also a leading and lagging indicator of agriculture sector. Moreover, the services sector in Pakistan is highly correlated to growth in the industrial output. These observations show the significance of the index of industrial production as a good proxy for GDP.

We used the consumer price index (CPI) for Pakistan and the wholesale price index (WPI) for India as the index of domestic prices. In India, consumer price index for industrial workers is
the most used indicator of consumer price inflation (CPI). CPI comprises an important percentage of agricultural products (about 57%). Whereas, the wholesale price index (WPI) contains a larger basket of goods than that of CPI and it contains less percentage of agricultural products than CPI. WPI comprises 62.8% of manufactured products, 22% of agricultural products and 14.2% of energy products.

We employed the bank rate for India as a measure of the stance of monetary policy. We described the shocks to inter-bank interest rate in our VAR model as shocks to monetary policy. The responses of other variables in our VAR model to a shock in inter-bank interest are termed as the structural responses of those variables to unanticipated monetary policy shock. The inter-bank interest rate is the rate by which the RBI finances the commercial banks. The inter-bank interest rate is an instrument employed by the RBI in short run. Modifications of the inter-bank interest rate by the RBI give signals to commercial banks to modify their deposit rates and also the lending rates. In 1997, all the interest rates were attached to the inter-bank interest rate in order to signal the indication of the functioning of monetary policy. The inter-bank interest rate was considered as the superior band of the short term interest rate. Since that period, the RBI uses the inter-bank interest rate as an important instrument of the monetary policy. Moreover, the interest rate and the exchange rate being exogenous in the pre-reform period have become endogenous in the post reform period (report on money and finance 2004). Numerous empirical analyses have showed the important effects of the transmission of the interest rate on prices during the post-reform period. Following an active use of the inter-bank interest as a key instrument of the monetary policy from 1997, the movements of the short term interest rate remained around the inter-bank interest rate (graph2).

Graph 2: India: Inter-bank interest rate and call money rate, 1997-2005

We used the 6-month Treasury bill rate as a measure of the stance of monetary policy for Pakistan. The 6-month Treasury bill rate is considered as the benchmark rate in the money market. A large part of the outstanding volume of the treasury bills has the maturity of six months. In addition to it, the 6-month T. bill rate has become the most desirable intermediate target in the context of stability in the financial markets.

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4.1.2 Ordering of variables:

The ordering of endogenous variables is performed by focusing on the dynamic structure of respective economies. In this way we assume that there exists simultaneity among particular variables. The ordering of the variables is based on two assumptions:

(a) What is observed by the monetary policy makers while they are making the monetary policy decisions?
(b) Which variable do not respond contemporaneously to a monetary policy shock?

Thus, the ordering of variables used in equation 3 implies that the monetary authorities take into account the current stage of output and prices. Output and prices are assumed not to react to the contemporaneous shocks in the interest rates.

We use the recursiveness assumption in order to identify the original shocks $\varepsilon_t$ from the reduced form residuals $\mu_t$. The recursiveness assumption is based on the Cholesky decomposition. In order to exactly identify the original shocks, we have to impose $(n^2-n)/2$ restrictions. Where $n$ is the number of endogenous variables. Using the recursiveness assumption, we impose the restriction that the matrix $K$ is the lower triangular matrix. Thus, the upper diagonal values are equal to zero. We assume that the monetary policy shocks have no contemporaneous impact on output and prices. Thus, we can write the identification scheme as follows:

\[
\begin{bmatrix}
1 & 0 & 0 \\
k_{21} & 1 & 0 \\
k_{31} & k_{32} & 1
\end{bmatrix}
\begin{bmatrix}
\mu_t^{GDP} \\
\mu_t^{price} \\
\mu_t^i
\end{bmatrix}
= 
\begin{bmatrix}
\varepsilon_t^{GDP} \\
\varepsilon_t^{Prices} \\
\varepsilon_t^i
\end{bmatrix}
\]  

(5)

4.2 Estimation of the benchmark model:

We used all the variables in logarithmic form and seasonally adjusted. However, the interest rates are only seasonally adjusted. Using the quarterly, seasonally adjusted data from fourth quarter of 1996 to fourth quarter of 2005, with two lags, we estimated the benchmark model for India. The optimal lag length under different criteria found to be one quarter. However, the lag length of one quarter is too short, so we used two lags in order to capture the underlying dynamics of the system. The impulse responses of industrial production, prices and interest rates following a one-time shock to interest rate innovations are explained in figure 3.
An unexpected tightening of monetary policy, corresponding approximately to a 0.36% increase in the bank rate resulted in a decline of output. Thus, the output shows a V-shaped response and it bottoms out after six quarters. The effect of contractionary monetary policy output declines continuously afterwards. Prices start declining after the second quarter. The immediate effect of a contractionary monetary policy is yet an increase in prices. However, inclusion of the vector of exogenous variables reduced significantly the so called price puzzle. The prices achieved the minimum value, at around 0.0035% below the baseline, in the fifth quarter.

We estimated also the variance decompositions for each variable. The variance decomposition enables us to analyse the share of fluctuation in a given variable that are caused by different
shocks. Table 7 presents the variance decompositions for each endogenous variable at forecast horizons of one year to four years. The sum of the variances in each row adds up to 100%. After four years, the interest rate shock accounts for around 20% fluctuations in the output. The interest rate shock accounts for around 26% fluctuations in the wholesale price index at the end of four years. The variance decomposition results are largely similar to the earlier empirical studies. The results explain that the innovations to the bank rate are important determinant of fluctuations in the economic activity.

Table 7: India: Variance decompositions

<table>
<thead>
<tr>
<th>Variance Decomposition of GDP:</th>
<th>Period (Quarters)</th>
<th>GDP</th>
<th>PRICES</th>
<th>Bank rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>72.75</td>
<td>21.12</td>
<td>6.13</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>50.81</td>
<td>33.96</td>
<td>15.23</td>
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<td></td>
<td>12</td>
<td>45.08</td>
<td>36.30</td>
<td>18.62</td>
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<td></td>
<td>16</td>
<td>43.08</td>
<td>37.13</td>
<td>19.79</td>
</tr>
<tr>
<td>Variance Decomposition of PRICES:</td>
<td>4</td>
<td>0.12</td>
<td>89.46</td>
<td>10.43</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.10</td>
<td>77.81</td>
<td>22.10</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.13</td>
<td>74.86</td>
<td>25.01</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>0.14</td>
<td>73.87</td>
<td>25.99</td>
</tr>
<tr>
<td>Variance Decomposition of Bank rate:</td>
<td>4</td>
<td>5.30</td>
<td>5.33</td>
<td>89.37</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>5.09</td>
<td>8.06</td>
<td>86.85</td>
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<tr>
<td></td>
<td>12</td>
<td>4.98</td>
<td>9.18</td>
<td>85.85</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>4.93</td>
<td>9.62</td>
<td>85.45</td>
</tr>
</tbody>
</table>

Cholesky Ordering: GDP PRICES Bank rate

Using the quarterly data from 1996Q2 2005Q2, we estimated the benchmark model for Pakistan. We used two lags, according to Hannan-Quin criterion and sequential modified LR test statistic. As discussed above, we did not include the vector of exogenous variable in the analysis of channels of monetary transmission in Pakistan, as the inclusion of it did not improve our results.

The impulse responses of industrial production, prices and interest rates following a one-time shock to interest rate innovations are explained in figure 4.
An unexpected tightening of monetary policy, corresponding approximately to a 1.2% increase in the 6-month Treasury bill rate, resulted in a decline in industrial production. It bottoms out in the seventh quarter, at 0.017% below the baseline. The prices start declining after one year. The prices bottom out in the eleventh month, at around 0.008% below the baseline.

Table 8 presents the variance decompositions for Pakistan, for each endogenous variable, at forecast horizons of one year to four years. After two years the interest rate shock accounts for around 24% fluctuations in the output. The interest rate shock accounts for around 42% fluctuations in the consumer price index at the end of four years. The results explain that the innovations to the 6-month Treasury bill rate are an important determinant of fluctuations in the economic activity in Pakistan.
Table 8: Pakistan: Variance decompositions

<table>
<thead>
<tr>
<th>Variance Decomposition of OUTPUT:</th>
<th>Period (Quarters)</th>
<th>OUTPUT</th>
<th>PRICES</th>
<th>T. Bill rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>97.29</td>
<td>0.58</td>
<td>2.13</td>
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<td></td>
<td>8</td>
<td>84.54</td>
<td>1.15</td>
<td>14.32</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>77.81</td>
<td>1.08</td>
<td>21.11</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>75.10</td>
<td>1.12</td>
<td>23.77</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Decomposition of PRICES:</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Decomposition of T. Bill rate:</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Cholesky Ordering: OUTPUT PRICES T. Bill rate

4.4 Channels of the monetary transmission:

We extended the benchmark model to three different models, representing three channels of monetary transmission, by including a variable corresponding to the respective channel of monetary transmission, into the benchmark model. The new variables representing the respective channels are assumed to reflect the contemporaneous shocks to GDP, prices and interest rates. We first endogenized and then exogenized the variable of choice. We exogenised the variable of choice by treating its lagged values as exogenous variables in the benchmark model. Then, we compared the response of output in each case, i.e., when the variable of choice was endogenized and when it was exogenized. By exogenizing an endogenous variable, we blocked all the interactions between the other endogenous variables and the variable exogenized. We checked for the importance of each channel by comparing the two impulse responses of GDP to the innovations in the interest rate.

Model 1: Bank lending channel:

A monetary policy shock affects the banking lending through variations in reserves and through the market interest rates. An open market purchase will lead to an increase in the bank reserves. The availability of bank loans will increase. Thus, the monetary policy influences significantly the aggregate demand by altering the supply of bank loans. In the bank lending channel, our focus is to analyse the magnification in the effects of higher interest rates through the bank lending channel.

The matrix of endogenous variables is as follows.

\[ Y_i = [\text{GDP} \quad \text{Prices} \quad \text{i} \quad \text{Loans}] \]

With,
LOANS = Credit to private sector.
For India, we used the bank credit to commercial sector. For Pakistan, we used the credit to private sector (commercial banks and the specialized banks).

Figure 6 shows the impulse responses of GDP and prices to innovations in the bank rate and the bank credit to commercial sector in India. The initial response of GDP to innovations in bank rate is suppressed as compared to the benchmark model. The GDP bottoms out after third quarter, at around 0.0024% from the baseline. Prices start to fall after second quarter. GDP and price responds positively to innovations in the bank credit to commercial sector.

In order to calibrate the relative importance of bank lending channel in the transmission of monetary shocks, we estimated the extended model by exogenizing the bank credit to commercial sector. Second figure in the second column of figure 6 shows the response of GDP to innovations in the bank rate with and without the bank credit to commercial sector exogenized, in case of India. Initial responses of GDP to innovations in bank rate are same. After the second quarter, however the two responses start diverging. This difference is very pronounced at the end of fifteenth quarter. This difference indicates the existence of a bank lending channel in India. These results are in conformity to the earlier empirical research on the channels of monetary transmission in India.

We show in figure 7, in case of Pakistan, the impulse responses of industrial production, prices and the bank credit to private sector, to the innovations in 6-month Treasury bill rate and bank credit to private sector. We found that the effects of an increase in the 6-month
Treasury bill rate on industrial production is more pronounced in the bank lending channel than in the benchmark model. The GDP bottoms out after sixth quarter, at around 0.024% from the baseline. Prices start to fall after third quarter. GDP and price responds positively to innovations in the bank credit to commercial sector. Again, in order to gauge the importance of bank lending channel in the transmission of monetary shocks in Pakistan, we estimated the extended model by exogenizing the bank credit to commercial sector. The initial response of industrial production to innovations in 6-Month Treasury bill rate is same. After second quarter, the two impulse responses start diverging. This difference is very pronounced at the end of fifteenth quarter. This difference in impulse responses indicates the existence of a bank lending channel in Pakistan.

Figure 7: Pakistan: The bank lending channel

Model 2: Asset price channel:

The variable of endogenous variables is as follows.

\[
Y_t' = [\text{GDP} \hspace{0.5cm} \text{Prices} \hspace{0.5cm} i \hspace{0.5cm} \text{SEI}]
\]

SEI = stock exchange index;
We used the sensitive index, SENSEX-30 (Sensitive price index; the index of Bombay stock exchange) for India. SENSEX-30 is widely reported in both domestic and international markets. For Pakistan, we used the KSE-100 (the index of the Karachi stock exchange). In the Karachi Stock exchange, KSE-100 is a benchmark used to compare prices over a period of time, companies with the highest market capitalization are selected.

Figure 8 shows that the innovations in bank rate resulted in a decrease in GDP in India. The GDP bottomed out after six quarter at around 0.003% below the baseline. GDP responded positively to an increase in SENSEX-30. Prices bottom out to innovations in bank rate after five months at around 0.003% below the baseline. When we exogenized the SENSEX-30, the response of industrial production to the innovations in the bank rate was dampened. We found a significant difference of the responses of industrial production to the innovations in the bank rate after exogenizing the SENSEX-30. This difference converged in the fifth quarter and then diverged again. This difference is very pronounced at the end of fifteenth quarter. Thus, our results show the importance of the asset price channel in India.

Figure 9 shows that the positive innovations (increase) in the KSE-100 resulted in a growth in the industrial production. Industrial production increased to around 0.018% in the third quarter above the baseline. The industrial production declined after second quarter following the innovations in 6-Month Treasury bill rate. This decline continued till the end of fifteenth quarter.
When we exogenized the KSE-100, the response of industrial production to the innovations in the bank rate was dampened. The industrial production started increasing in the second quarter. We found a significant difference of the responses of industrial production to the innovations in the bank rate after exogenizing the KSE-100. Thus, our results show the importance of the asset price channel in Pakistan.

As the equity markets are not developed in India and Pakistan and firms depend on bank credit, so these results need to be accepted with a caution.

**Model 3: Exchange rate channel:**

The variable of endogenous variables is as follows.

\[ Y'_i = [\text{GDP} \quad \text{Prices} \quad i \quad \text{REER}] \]

Where,

REER = The real effective exchange rate\(^{14}\).

---

\(^{14}\) For India, we use real effective exchange rate (weights based on exports to 36 countries) for India Source: Database on Indian economy. For Pakistan, we used the real effective exchange rate. Source: International financial statistics, IMF
Here, we assume that the interest rate has an immediate effect on the real effective exchange rate. We further assume that the interest rate does not respond contemporaneously to changes in the real effective exchange rate.

Figure 10 shows the responses of GDP and prices to innovation in the bank rate and real effective exchange rate (REER) in India. Second figure in the second column of figure 10 shows the response of GDP to innovation in bank rate with and without the real effective exchange rate exogenized. When we blocked off the interaction of real effective exchange rate, the response of industrial production was dampened after fifth quarter. However, this difference of impulse responses of GDP to shocks in the bank rate is not significant indicating an absence of exchange rate channel in India.

Figure 11 shows the responses of industrial production to innovation in the 6-Month Treasury bill rate in Pakistan with and without the real effective exchange rate exogenized. When we blocked off the interaction of real effective exchange rate, the response of industrial production was much pronounced, especially between sixth and ninth quarter. The difference between two impulse responses converges after ninth quarter. Therefore, our results indicate the significance of the exchange rate channel in Pakistan.
5. Conclusion:

This paper analyses the monetary transmission mechanism in India and Pakistan. It tries to answer to the question: Which channel is importance in the transmission of monetary shocks to real sector? We try to quantify the lags associated with monetary policy. It discusses different channels of monetary transmission and their relevance with emerging countries. Finally, it uses the vector autoregression approach in order to analyse the monetary transmission mechanism in India and Pakistan. This approach makes it possible to impose minimum restrictions on the ways through which the monetary policy influence the real sector. In order to ameliorate the problem of price-puzzle, a vector of exogenous variables is introduced in the empirical estimations. We considered a benchmark model consisting of output, prices and interest. In order to analyse relative importance of difference channels, we extended the benchmark model to three different models, representing three channels of monetary transmission, by including a variables corresponding to the respective channel of monetary transmission, into the benchmark model. We first endogenized and then exogenized the variable of choice. Then, we compared the response of output in each case. We checked for the importance of each channel by comparing the two impulse responses of GDP to the innovations in the interest rate. Our results indicate the significance of bank lending channel in India and Pakistan. In case of Pakistan we also found the importance of exchange rate channel.
References:

Ahmed N. & al. (2005) “Transmission mechanism of monetary policy in Pakistan”, SBP working papers No. 9, State bank of Pakistan


Christiano J. Lawrence & al. (1998) “Monetary policy shocks: What have we learned and to what end?” NBER working paper No. 6400.


RBI, “Annual reports”, 1998-2005


Virmani V. (2004), “Examination of the credit channel of monetary policy in India: Results from response of commercial banks’ balance sheet to a monetary policy shock”, Indian institute of management, Ahmedabad