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Inflation in Pakistan

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This paper examines the factors that explain and help forecast inflation in Pakistan. A simple inflation model is specified that includes standard monetary variables (money supply, credit to the private sector), an activity variable, the interest and the exchange rates, as well as the wheat support price as a supply-side factor. The model is estimated for the period January 1998 to June 2005 on a monthly basis. The results indicate that monetary factors have played a dominant role in recent inflation, affecting inflation with a lag of about one year. Private sector credit growth and broad money growth are also good leading indicators of inflation which can be used to forecast future inflation developments.

JEL classification: E31, C22, C32

Keywords: Inflation, Pakistan, Leading Indicators, Forecasting, Monetary Policy

I. INTRODUCTION

After remaining relatively low for quite a long time, the inflation rate accelerated in Pakistan starting in late 2003. Following the 1998–99 crisis, inflation was reduced to below 5 percent by 2000 and remained stable through 2003. Tight monetary policy combined with fiscal consolidation appears to have contributed to this low-inflation environment.¹ Figure 1 shows that inflation follows broad money growth and private sector credit growth closely with a lag of about 12 months. With monetary growth picking up, inflation followed and increased sharply in late 2003, peaking at 11 percent year-on-year in April 2005. Average annual inflation stabilised around 8 to 9 percent by September 2005, and has receded somewhat since then.

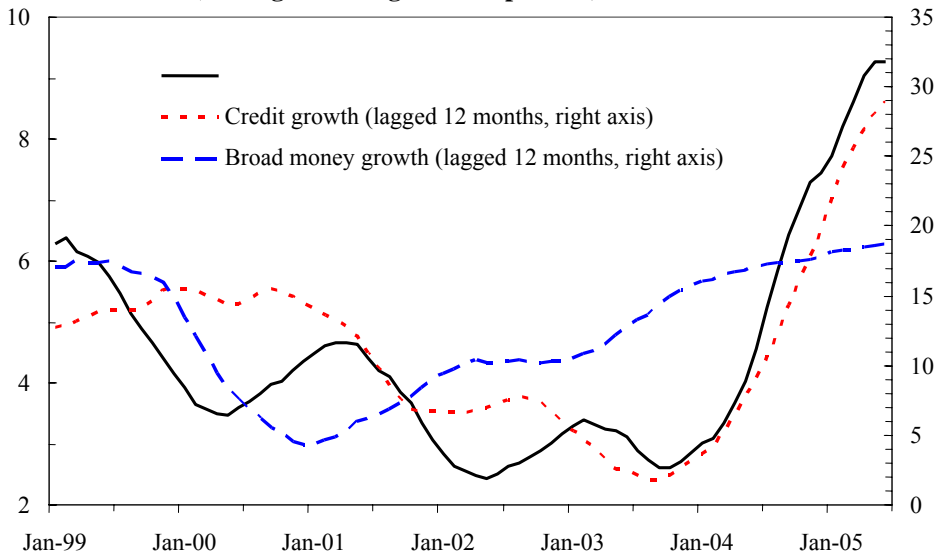
Controlling inflation is a high priority for policy-makers. High and persistent inflation is a regressive tax and adversely impacts the poor and economic development. The poor have little options to protect themselves against inflation. They hold few real assets or equity, and their savings are typically in the form of cash or low-interest bearing deposits. Thus, this group is most vulnerable to inflation as it erodes its savings. Moreover, high and volatile inflation has been found to be detrimental to growth [e.g.,

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Author's Note: The views expressed in this paper are those of the authors and do not necessarily represent those of the International Monetary Fund or its policy. This paper draws on previous work by Khan and Schimmelpfennig, "Inflation in Pakistan: Money or Wheat?", published in the State Bank of Pakistan's *Research Bulletin–Papers and Proceedings* Vol. 2, No. 1, available at http://www.sbp.org.pk/research/bulletin/2006/Inflation_in_Pakistan_Money_or_Wheat.pdf, and in Bokil and Schimmelpfennig "Three Attempts at Inflation Forecasting," available as IMF Working Paper 05/105 at <http://www.imf.org/external/pubs/ft/wp/2005/wp05105.pdf>.

¹According to the State Bank of Pakistan (SBP) a change in the methodology of deriving the house rent index may also be partly responsible for the observed slowdown in headline inflation.

Fig. 1. Pakistan: Inflation and Monetary Growth, 1999:1–2005:6
(Average annual growth in percent)



Sources: National

authorities; and IMF staff calculations.

Khan and Senhadji (2001)] and financial sector development [e.g., Khan, Senhadji, and Smith (2006)]. High inflation obscures the role of relative price changes and thus inhibits optimal resource allocation.

Understanding the factors that drive inflation is fundamental to designing monetary policy. Certainly in the long run, inflation is considered to be—as Friedman (1963) stated—always and everywhere a monetary phenomenon. Workhorse models of inflation typically include monetary variables, such as money growth, real GDP, the interest rate, and the exchange rate as explanatory variables. Some authors have also pointed to supply side developments in explaining inflation. This structuralist school of thought holds that supply constraints that drive up prices of specific goods can have wider repercussions on the overall price level. For example, in Pakistan, increases in the wheat support price have frequently been blamed for inflation.²

This paper finds that monetary factors are the main drivers of inflation in Pakistan, while other typical explanatory variables play less of a role. We specify a simple inflation model that includes standard monetary variables (money supply and credit to the private sector), the interest rate, the exchange rate, an activity variable, as well as the wheat support price as a supply-side factor. The model is estimated with monthly data for the period January 1998 to June 2005. The results indicate that monetary factors have played a dominant role in recent inflation, affecting inflation with a lag of about one year. Monetary factors are also well-suited to forecast inflation in a leading-indicator type model.

The remainder of the paper is organised as follows. Section II reviews the relevant literature and introduces a stylised model to structure the analysis. Section III estimates the model and assesses the roles for explaining inflation played by monetary factors and other variables. Section IV presents a leading indicators model to forecast inflation, and Section V provides some conclusions.

²The acceleration of inflation in late 2003 coincided with two increases in the wheat support price in September 2003 and in September 2004, which has re-opened the debate whether the wheat support price was driving inflation in Pakistan [Khan and Qasim (1996) and Sherani (2005)].

II. BASIC ELEMENTS OF THE MODEL

Several studies highlight the role of monetary factors for inflation in Pakistan.³ For example, Khan and Qasim (1996) find that overall inflation is only determined by money supply, import prices, and real GDP. The empirical evidence is inconclusive regarding the role of the exchange rate. Choudhri and Khan (2002) do not find evidence of exchange rate pass-through in a small VAR analysis, while Hyder and Shah (2004) find some evidence of exchange rate pass-through using a larger VAR. Some authors have emphasised structuralist factors in explaining inflation in Pakistan.⁴ Khan and Qasim (1996) find food inflation to be driven by money supply, value-added in manufacturing, and the wheat support price.⁵ Non-food inflation is determined by money supply, real GDP, import prices, and electricity prices. Sherani (2005), referring to this work, finds that increases in the wheat support price raise the CPI index (but not necessarily inflation). He also argues that the high levels of inflation in 2005 largely resulted from a monetary overhang that was built up by loose monetary conditions.

We start our stylised model from a monetarist perspective. Agents hold money for transaction purposes, as a store of value, and for speculative purposes. For a constant velocity (v), inflation (\dot{p}) results if money growth (\dot{m}) exceeds real GDP growth (\dot{y}). The opportunity cost of holding money, that is the interest rate r , reduces money demand and thus inflation. Moreover, financial deepening and innovations enable agents to use alternative monetary instruments in lieu of cash. Thus, the velocity of a particular monetary aggregate, say M2, changes if agents switch from cash or demand deposits to instruments included only in M3. In an open economy, headline inflation can also be affected by movements of the exchange rate (e).⁶ We also allow for the wheat support price (w) as a structuralist factor to drive inflation. The general open-economy monetary model (incorporating a supply-side variable) is then given by

$$\dot{p} = f(\dot{m}, \dot{y}, \dot{v}, r, \dot{e}, \dot{w}) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

where lower case letters denote the natural logarithm of a variable and a dot over a variable denotes the first derivative with respect to time.

For non-stationary time series, Equation (1) only reflects short-run relationships as the variables are in (log) first differences, and the equation does not include a cointegrating relationship. However, the aspects of the model that reflect monetarist thinking will tend to be long-run relationships, and the model can be easily be rewritten in levels and in an error correction representation to differentiate between short-run and long-run relationships.

³For a comprehensive survey of empirical studies on Pakistan [see Bokil and Schimmelpfennig (2005)].

⁴Structuralist models of inflation emphasise supply-side factors as determinants of inflation. They emerged in the 1950s as part of the structuralist theories of development promoted by Prebisch [see Bernanke (2005)]. In these models, inflation is driven by developments and bottlenecks on the real side of the economy. Food prices, administered prices, wages, and import prices are considered sources of inflation. Structuralist models assume that such factors have to be accommodated by monetary policy-makers because they are determined outside the monetary sphere. Monetary developments in themselves are given little importance as independent determinants of inflation.

⁵It is hardly surprising that changes in the wheat support price affect the food price index, given that wheat products account for 14 percent of the index. However, this does not automatically imply that headline inflation is affected by changes in the price of one particular item.

⁶Import prices could also play a role, in particular if the exchange rate is pegged. Unfortunately, import prices are not available at a monthly frequency, but since Pakistan had a flexible exchange rate regime during our sample period, import prices should be less important than in previous years.

III. EMPIRICAL RESULTS

We estimate the basic model in growth rates as well as in log levels. Since our sample extends over a crisis period and subsequent wide ranging economic reforms as well as a growth take-off, it may be difficult to discern long-run relationships from the data due to structural changes and non-constant parameters. However, we would still expect short-run relationships to reflect our proposed model structure. Therefore, as a first step, we estimate Equation (1) to gain an understanding of some basic relationships and short-run dynamics.⁷ In the second step, we estimate the model as a vector error correction model (VECM) in log-levels to investigate whether we can find a cointegrating vector that would provide information about long-run behaviour.

(a) Data and Sample

Our database covers the period January 1998 to June 2005 on a monthly basis. The choice of sample reflects a trade-off between having sufficient observations and avoiding structural breaks that would complicate the empirical analysis. Banking sector reforms were initiated in 1997 and pursued vigorously after 1999, leading to increased intermediation. Financial deepening also occurred as confidence returned in the aftermath of the 1998-99 crisis and with the new government restoring macroeconomic stability. Taken together, this implies that the monetary transmission mechanism has evolved and money demand has possibly shifted over the sample period which may lead to nonconstant parameters, in particular with respect to long-run parameters.

The definitions of the data utilised are:

- *CPI*: overall consumer price index—the percentage change of which is also termed “headline inflation”.
- *Monetary variables*: Broad money; private sector credit; and the 6-month treasury bill (T-bill) rate (the SBP’s key policy rate).
- *Activity variables*: interpolated real and nominal GDP (12-month moving average of the fiscal year GDP data);⁸ and the large scale manufacturing index (LSM).
- *Exchange rate*: nominal effective exchange rate (NEER).
- *Wheat support price*: guaranteed minimum government purchase price.

The basic correlations between the variables are shown in Table 1.

The log levels of all variables are non-stationary. Most variables are integrated of order one (Table 2). However, somewhat surprisingly, our interpolated real and nominal GDP series are integrated of order two. This would suggest that our GDP series cannot be part of a long-run cointegrating relationship with other variables that are only integrated of order one. Alternatively, the LSM may be a meaningful proxy for the activity variable.⁹

Data for Pakistan is subject to overlapping seasonality stemming from Gregorian calendar effects (including agricultural seasonality) and Islamic calendar effects. Riazuddin and Khan (2005) construct variables to address Islamic seasonality. For regressions based on growth rates, we control for seasonality by using 12-month moving averages. In Bokil and Schimmelpfennig (2005), we show that this is sufficient to take account of both sources of seasonality. The approach has the advantage of requiring no additional

⁷Note that this model may be mis-specified if we have non-stationary data and there exists a cointegrating vector.

⁸GDP data is available only at annual frequency.

⁹The correlation coefficient between the annual LSM index and annual real GDP is 0.97 which suggests that a 12-month moving average of the LSM index is probably a reasonable proxy for monthly real GDP.

regressors. However, for regressions based on log levels, we include monthly dummies and the Islamic calendar control variables used in Riazuddin and Khan (2005).¹⁰

(b) CPI Inflation

We first analyse the impact of changes in the explanatory variables on headline inflation. We estimate two variants of our stylised model using either broad money or private sector credit to capture the impact of monetary policy. The models are estimated using the *PcGets* routine in *PcGive* which automatically tests down a general model.¹¹ In our case, we include 12 lags of all variables in the general model. In principle, the resulting specific model can then include individual lags of the variables from the general model, or exclude variables altogether.

We focus on summary coefficients that give the direction of influence of a particular regressor after all dynamics have played out. The estimated specification is an autoregressive distributed lag model (ADL) that can be written as:

$$A(L)\dot{p}_t = B(L)\dot{x}_t + u_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

where x is the vector of independent variables. $A(L)$ and $B(L)$ are lag polynomials that take the form:

$$A(L)\dot{p}_t = 1 - \sum_{i=1}^{12} A_i \dot{p}_{t-i} \quad \text{and} \quad B(L)\dot{x}_t = \sum_{j=0}^{12} B_j \dot{x}_{t-j} .$$

The ADL can be re-written as:

$$\dot{p}_t = \frac{B(L)}{A(L)}\dot{x}_t + \varepsilon_t . \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

¹⁰We thank R. Riazuddin and M. Khan for kindly providing their data to us. In some specifications, the control variables for calendar effects can be dropped.

¹¹The routine is described and illustrated in Hendry and Krolzig (2004).

Table 1

*Pakistan: Correlation between Main Variables in Log Levels
(Sample: January 1998 to June 2005)*

| | CPI | Broad Money | Private Sector Credit | Real GDP | LSM Index | 6-month <i>t</i> -bill | NEER | Wheat Support Price |
|------------------------|-------|----------------|-----------------------------|-------------|--------------|---------------------------|-------|---------------------------|
| CPI | 1.00 | 0.98 | 0.97 | 0.99 | 0.96 | -0.67 | -0.95 | 0.94 |
| Broad Money | 0.98 | 1.00 | 0.97 | 0.99 | 0.98 | -0.76 | -0.91 | 0.89 |
| Private Sector Credit | 0.97 | 0.97 | 1.00 | 0.98 | 0.98 | -0.65 | -0.91 | 0.92 |
| Real GDP | 0.99 | 0.99 | 0.98 | 1.00 | 0.98 | -0.73 | -0.94 | 0.93 |
| LSM Index | 0.96 | 0.98 | 0.98 | 0.98 | 1.00 | -0.67 | -0.90 | 0.89 |
| 6-month <i>t</i> -bill | -0.67 | -0.76 | -0.65 | -0.73 | -0.67 | 1.00 | 0.67 | -0.60 |
| NEER | -0.95 | -0.91 | -0.91 | -0.94 | -0.90 | 0.67 | 1.00 | -0.88 |
| Wheat Support Price | 0.94 | 0.89 | 0.92 | 0.93 | 0.89 | -0.60 | -0.88 | 1.00 |

Source: National authorities, IMF staff calculations.

Table 2

*Pakistan: Test for Non-stationarity of Variables of Log-levels
(Sample: January 1998 to June 2005)*

| | Log Level | First Difference | Second Difference | Critical Value 1/ |
|--|--------------|---------------------|----------------------|----------------------|
| Phillips Perron Test 2/ | | | | |
| CPI | 1.03 | -8.00 | | -2.89 |
| Broad Money | 5.95 | -9.21 | | -2.89 |
| Private Sector Credit | 1.96 | -6.26 | | -2.89 |
| 6-month <i>t</i> -bill | -1.43 | -6.32 | | -2.89 |
| Real GDP | 5.45 | -0.84 | -9.49 | -2.89 |
| LSM Index | 4.63 | -5.49 | | -2.89 |
| NEER | -1.57 | -7.56 | | -2.89 |
| Wheat Support Price | -0.61 | -9.59 | | -2.89 |
| Augmented Dickey-Fuller Test /2 | | | | |
| CPI | 1.13 | -7.98 | | -2.89 |
| Non-food | | | | |
| Broad Money | 2.90 | -1.84 | -8.40 | -2.89 |
| Private Sector Credit | 1.51 | -6.25 | | -2.89 |
| 6-month <i>t</i> -bill | -1.90 | -2.83 | -12.12 | -2.89 |
| Real GDP | 1.56 | -0.85 | -9.49 | -2.89 |
| LSM Index | 2.87 | -5.47 | | -2.89 |
| NEER | -1.53 | -7.58 | | -2.89 |
| Wheat Support Price | -0.64 | -9.59 | | -2.89 |

Source: National authorities, IMF staff calculations.

1/Critical value at the 5 percent level based on MacKinnon (1996).

2/Model includes intercept.

The coefficient β that describes the impact of changes in the independent variables on inflation after all dynamics have played out is then given by:

$$\beta = \frac{B(1)}{A(1)}. \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

The empirical results are broadly consistent with our stylised model. Models M1 and M2 in Table 3 are based on the general specification in Equation (1). In M1, we use broad money, and in M2, we use private sector credit to measure monetary policy. In both cases, no regressor is completely dropped from the model. *PcGets* only eliminates some individual lags. However, in M1, the T-bill rate, and in M2, the NEER, the T-bill rate, and the wheat support price carry the wrong sign. We therefore drop these regressors (except for the wheat support price) to arrive at our two preferred specifications M3 and M4. M3 explains CPI inflation as a function of broad money growth, real GDP growth, NEER appreciation, and the average annual wheat support price change. M4 explains CPI inflation as a function of private sector credit growth, real GDP growth, and the average annual wheat support price change. These results illustrate that monetary factors are

Table 3

Pakistan: Inflation Determinants—General-to-specific Modeling^{1/}
 (Dependent Variable: Average Annual CPI Inflation in Percent;
 Sample January 1998 to June 2005)

| | M1 | M2 | M3 | M4 |
|---------------------------|-------|-------|-------|-------|
| Broad Money 2/ | 3.87 | | 1.46 | |
| Private Sector Credit 2/ | | 0.65 | | 0.28 |
| Real GDP 2/ | -4.52 | -1.15 | -2.32 | -1.67 |
| NEER 2/ | -1.81 | 0.54 | -0.50 | |
| 6-month <i>t</i> -bill 3/ | 0.06 | 0.01 | | |
| Wheat Support Price 2/ | 0.69 | -0.17 | 0.21 | 0.26 |
| Adjusted R ² | 0.999 | 1.000 | 0.999 | 0.999 |
| Degree of Freedom | 60 | 35 | 54 | 58 |
| Observations | 78 | 78 | 78 | 78 |
| Regressors | 18 | 43 | 24 | 20 |

Source: Pakistani authorities and IMF data; own calculations.

1/General-to-specific modeling based on the *PcGets* algorithm. Columns show the coefficient β that describes the joint impact of all lags of the respective regressor: the individual lags are not shown, but are mostly significant at the 5 percent level.

2/ Average annual change in percent.

3/ Absolute change over the last 12 months in basis points.

determinants of inflation, at least in the short run. Likewise, real GDP growth and the wheat support price matter, and to some extent, there is an impact from NEER appreciation. Monetary growth affects inflation with a lag of around 12 months.¹²

(c) A Vector-Error Correction Model

Based on the above results, we specify a VECM to identify long-run relationships between our variables. To limit the size of the VECM, we start with the preferred specifications M3 for a VECM including broad money and M4 for a VECM including private sector credit. We find that a meaningful cointegrating relationships exists only in the case of a VECM including private sector credit.

CPI, Private Sector Credit, and Wheat Support Price VECM

The preferred VECM contains the CPI, private sector credit, and the wheat support price. We estimate the system with monthly dummies and Islamic calendar effect controls used in Riazuddin and Khan (2005).¹³ Based on the stylised model and the results for the inflation equation above, we initially estimate a system including the CPI (*cpi*), private sector credit (*credit*), real GDP, and the wheat support price (*wheat*). However, no meaningful cointegrating relationship is found in this system, and we

¹²M3 includes a 7 and a 11 month lag of broad money growth. M4 includes a 1, 3, 5, 10, and 12 month lag for private sector credit growth.

¹³The lag length is set at 6. Table 4 shows information criteria for different specifications and lag lengths.

Table 4

*Pakistan: Information Criteria to Determine Optimal Lag Length k of VAR I/
(Endogenous Variables: CPI, Private Sector Credit, Real GDP, Wheat Support Price all in Log Levels)*

| | k = 2 | k = 3 | k = 4 | k = 5 | k = 6 | k = 7 | k = 8 | k = 9 | k = 10 | k = 11 | k = 12 |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| (Endogenous variables: CPI, private sector credit, real GDP, wheat support price all in log levels) | | | | | | | | | | | |
| Aikaiki Information Criterion | -30.358 | -30.211 | -30.238 | -30.041 | -30.113 | -30.154 | -29.995 | -30.268 | -30.675 | -31.198 | -32.411 |
| Schwarz Criterion | -27.655 | -27.036 | -26.585 | -25.903 | -25.483 | -25.024 | -24.359 | -24.119 | -24.005 | -24.000 | -24.676 |
| (Endogenous variables: CPI, private sector credit, wheat support price all in log levels) | | | | | | | | | | | |
| Aikaiki Information Criterion | -17.539 | -17.511 | -17.446 | -17.289 | -17.220 | -17.193 | -17.036 | -17.008 | -16.851 | -16.783 | -16.673 |
| Schwarz Criterion | -15.681 | -15.385 | -15.049 | -14.617 | -14.268 | -13.958 | -13.514 | -13.195 | -12.742 | -12.374 | -11.960 |
| (Endogenous variables: CPI, broad money, real GDP, NEER, wheat support price all in log levels) | | | | | | | | | | | |
| Aikaiki Information Criterion | -35.808 | -35.645 | -35.770 | -35.646 | 36.210 | -36.184 | -36.313 | -36.489 | -37.234 | -39.316 | -98.016 |
| Schwarz Criterion | -32.148 | -31.251 | -30.633 | -29.755 | -29.554 | -28.752 | -28.095 | -27.473 | -27.408 | -28.669 | -86.535 |

Source: National authorities; and IMF staff calculations.

I/VAR includes dummies to control for Islamic and Gregorian calendar effects.

estimate a reduced system without real GDP.¹⁴ This reduced system has a cointegrating rank of one (Table 5). The cointegrating vector is given by:

$$cpi = 1.733 + 0.205 * credit + 0.004 * wheat + 0.002 * trend$$

(8.472) (0.120) (8.871) ... (5)

Table 5

*Pakistan: Cointegration Test for the CPI, Private Sector Credit,
Wheat Support Price VECM 1/*

| Number of Cointegrating Vectors | Eigenvalue | Trace Test | | Maximum Eigenvalue Test | |
|---------------------------------|------------|------------|-------------------|-------------------------|-------------------|
| | | Statistic | Critical Value 2/ | Statistic | Critical Value 2/ |
| None | 0.329 | 49.901 | 42.915 | 33.128 | 25.823 |
| At Most 1 | 0.109 | 16.773 | 25.872 | 9.594 | 19.387 |
| At Most 2 | 0.083 | 7.179 | 12.518 | 7.179 | 12.518 |

Source: National authorities; and IMF staff calculations.

1/ VECM of lag length 6; include dummies for Islamic and Gregorian calendar effects.

2/ Based on MacKinnon, Haug, Michaelis (1999) at the 5 percent level.

Critical values assume no exogenous series in the VECM.

The *t*-statistics in parentheses suggest that the wheat support price is not part of the long-run relationship. We can also drop the seasonal controls, without affecting the white-noise characteristics of the residuals, which gives us additional degrees of freedom. This yields:

$$cpi = 0.994 + 0.263 * credit + 0.001 * trend$$

(9.803) (4.887) (6)

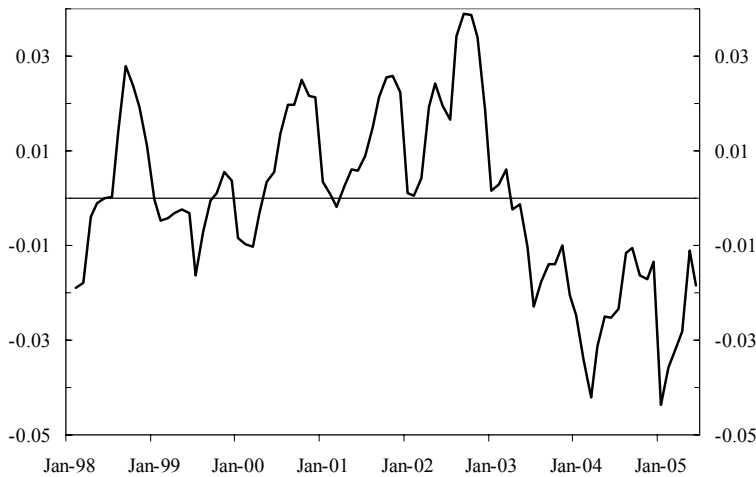
Based on these results, the CPI is affected only by private sector credit in the long-run. The estimated cointegrating vector describes recent inflation developments well. Starting in early 2003, monetary conditions were very accommodating, private sector credit growth picked up, and a disequilibrium in the CPI-private sector credit relationship emerged (Figure 2). As inflation picked up as well, the disequilibrium has been reduced, but not yet been eliminated through June 2005. The loading coefficient in the equation for the CPI indicates that 23 percent of a deviation from the long-run relationship is adjusted in the next period.

The CPI increases after shocks in the private sector credit equation. We calculate an impulse response function based on generalised 1-standard deviation impulses [Pesaran and Shin (1998)]. In response to an innovation in private sector credit, the CPI initially falls (akin to the price puzzle), but after 4 months steadily increases (Figure 3).¹⁵

¹⁴This finding could reflect that real GDP may be integrated of order two while all other variables are integrated of order one. However, using the LSM instead of real GDP does not alter the result.

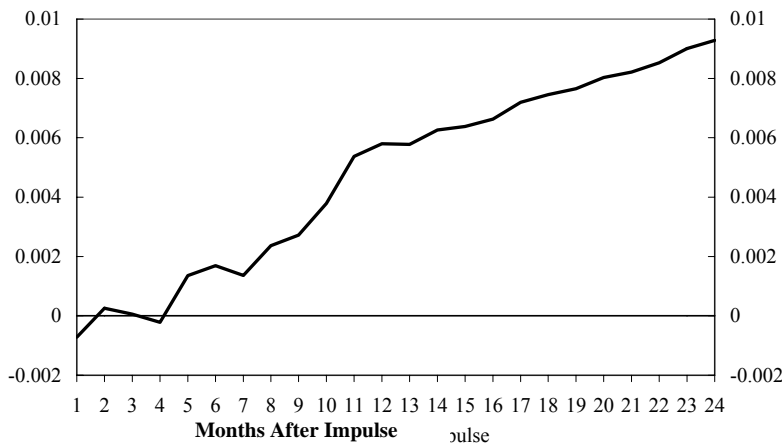
¹⁵The price puzzle is a fairly common empirical finding where an unexpected tightening of monetary policy initially leads to an increase rather than a decrease in the price level. This theoretical inconsistency can be addressed by introducing forward-looking variables [e.g., Brissimis and Magginas (2004), and Balke and Emery (1994)].

Fig. 2. Pakistan: The Cointegrating Vector—CPI and Private Sector Credit_{dit}



Source: National authorities; and IMF staff calculations.

Fig. 3. Pakistan: Impulse Response Function for CPI Based on the CPI, Private Sector Credit, Wheat Support Price VECM 1/



Source: National authorities; and Fund staff calculations.
1/ Generalised 1 standard deviation impulse.

CPI, Broad Money, and Wheat Support Price

No meaningful VECM that contains broad money could be identified in the sample. Based on the stylised model and the findings in the inflation regressions above, we started with a system including the CPI, broad money, NEER, real GDP, and the wheat support price.¹⁶ The system also included controls for Gregorian and Islamic calendar effects and in some specifications deterministic components. We set the lag length to 6 to maintain sufficient degrees of freedom; the optimum lag length for this system is 12, but our sample is not large enough to allow this number of parameters (Table 4). We experimented with different specifications for the deterministic component, and dropped or retained any of the endogenous variables.

¹⁶Alternatively, we used the LSM instead of real GDP, but this did not change the results.

Nonetheless, no cointegrating relationship emerged that would be broadly consistent with our model or would yield sensible impulse response functions.

The failure to find cointegration most likely stems from ongoing changes to fundamental relationships, in particular money demand, during the sample. As we show in Bokil and Schimmelpfennig (2005), a money demand equation for Pakistan suffers from nonconstant coefficients when estimated with either annual or monthly data. For annual data, recursive coefficient estimates diverge significantly after 1998 from the coefficient estimated in the 1978–2004 sample. With monthly data, the recursive coefficients fluctuate throughout the 1995–2004 sample, in the case of real GDP even switching signs. These findings are likely to reflect the impact of the 1998-99 debt crisis on the Pakistani economy and the reforms that followed. Macroeconomic stabilisation and financial sector reforms, can be expected to have affected estimated parameters. Moreover, De Grauwe and Polan (2005) show that standard quantity theory of money relationships are hard to identify in countries with inflation of less than 10 percent.

IV. FORECASTING INFLATIONARY TRENDS

Inflation forecasts are an important input into monetary policy formation. Given typical time lags, monetary policy needs to be concerned with future inflation. Current inflation levels, which are themselves the result of past policies, may provide only insufficient information. Inflation forecasts that link future inflation to current developments can bridge this gap. Some central banks have even adopted an inflation forecast target. However, this assumes that inflation forecasts are very reliable. Still, even in situations where structural relationships are less stable and data quality is evolving, quantitative inflation forecasts can provide useful information on future developments, though this needs to be combined with additional analysis going beyond econometric relationships. Leading indicators can be used to generate forecasts, in particular in situations where time series are short and structural relationships are not stable enough to allow for an economic model-based inflation forecast.

The leading indicators approach searches for variables that co-move with the variable to be forecasted without imposing a model structure. Leading indicators do not necessarily need to be causal factors of the target variable as part of an economic model, though this would presumably strengthen one's confidence in a forecasting model [e.g., Marcellino (2004) and Stock and Watson (1989, 1999)]. We again use the general-to-specific algorithm in *PcGets* to narrow down the set of possible leading indicators from our full dataset. In addition, we look at information criteria, root mean square error and similar statistics to optimise the forecast accuracy and arrive at a final specification. We require indicators to lead inflation by at least 6 months and allow for leads of up to 12 months.

Private sector credit growth and broad money growth are leading indicators of inflation (Table 6). We extend the list of possible variables beyond that of our stylised model above to also include variables which have proven to be good leading indicators in

Table 6
Pakistan: Leading Indicators Model Regression Results

| | M5 | | M6 | | M7 | | M8 | |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Observations | 73 | | 72 | | 72 | | 76 | |
| Adjusted R-squared | 0.995 | | 0.996 | | 0.996 | | 0.996 | |
| F-statistic | 2,555.1 | | 881.6 | | 3,560.4 | | 3,412.3 | |
| Akaike Information Criterion | -1.935 | | -1.967 | | -2.136 | | -1.913 | |
| Schwarz Information Criterion | -1.716 | | -1.303 | | -1.947 | | -1.729 | |
| Root Mean Squared Error | 0.397 | | 0.358 | | 0.388 | | 1.409 | |
| Mean Absolute Error | 0.350 | | 0.280 | | 0.358 | | 1.259 | |
| Mean Absolute Percentage Error | 5.662 | | 4.300 | | 5.834 | | 18.941 | |
| | Coefficient | t-statistic | Coefficient | t-statistic | Coefficient | t-statistic | Coefficient | t-statistic |
| Constant | 0.111 | 2.813 | -0.069 | -0.585 | -0.182 | -2.638 | 0.086 | 2.082 |
| Inflation | | | | | | | | |
| Lagged 1 Month | 1.772 | 14.949 | 1.680 | 10.272 | 1.508 | 16.025 | 1.910 | 37.363 |
| Lagged 2 Months | -0.760 | -4.629 | -0.843 | -2.876 | -0.651 | -8.471 | -0.935 | -18.128 |
| Lagged 3 Months | | | 0.111 | 0.346 | | | | |
| Lagged 4 Months | | | -0.231 | -0.710 | | | | |
| Lagged 5 Months | -0.194 | -1.189 | 0.126 | 0.429 | | | | |
| Lagged 6 Months | 0.144 | 1.266 | 0.024 | 0.182 | | | | |
| Private Sector Credit Growth | | | | | | | | |
| Lagged 6 Months | | | 0.086 | 1.623 | | | | |
| Lagged 7 Months | | | -0.176 | -1.507 | | | | |

Continued—

Table 6

Table 6—(Continued)

| | | | | | | | |
|------------------------------|--------|--------|--------|--------|--------|--------|---------------|
| Lagged 8 Months | | | 0.087 | 0.689 | | | |
| Lagged 9 Months | | | 0.052 | 0.412 | | | |
| Lagged 10 Months | | | -0.068 | -0.532 | | | |
| Lagged 11 Months | 0.042 | 2.711 | 0.020 | 0.162 | | | |
| Lagged 12 Months | -0.038 | -2.444 | 0.036 | 0.547 | 0.041 | 4.991 | |
| Broad Money Growth | | | | | | | |
| Lagged 6 Months | | | -0.157 | -2.169 | | | -0.114 -2.270 |
| Lagged 7 Months | | | 0.407 | 3.164 | 0.145 | 3.775 | 0.210 2.211 |
| Lagged 8 Months | | | -0.262 | -1.847 | -0.116 | -3.392 | -0.094 -1.949 |
| Lagged 9 Months | | | 0.028 | 0.188 | | | |
| Lagged 10 Months | | | 0.074 | 0.522 | | | |
| Lagged 11 Months | | | -0.072 | -0.558 | | | |
| Lagged 12 Months | | | 0.001 | 0.017 | | | |
| Long-run Coefficient 1/ | | | | | | | |
| Private Sector Credit Growth | 10.00 | | 3.53 | | 3.47 | | |
| Broad Money Growth | | | 7.12 | | 4.85 | | 13.99 |

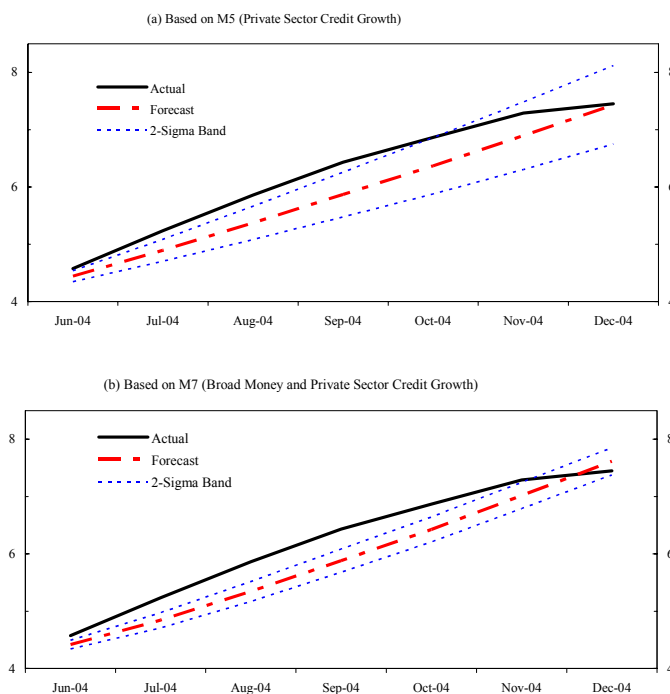
Source: Pakistani authorities; and own calculations.

1/Calculated as $(1 - \text{sum of coefficients on inflation}) / (\text{sum of coefficients on regressor})$.

other countries. The general model, thus, contains the following variables that could be leading indicators for inflation: wholesale-price index inflation, time-varying intercept, and slope coefficient for the yield curve, the spread between 12-month and 3-month T-bill rates, large-scale manufacturing index growth, broad money growth, reserve money growth, private sector credit growth, change in the nominal effective exchange rate, tax revenue growth, and the 6-month T-bill rate. Of these, only private sector credit growth and lags of inflation remain in the reduced specification (M5).¹⁷ We also show specifications that include broad money growth as one might expect a relationship between broad money growth and inflation. The best specification here is M7 which includes lags of broad money growth and private sector credit growth in addition to lags of inflation. Both specifications are consistent with a monetary transmission mechanism that works through the credit channel, and also reflect the findings for our stylised model.

The LIMs exhibits a good ex-post forecast quality. Re-estimating the LIMs through May 2004 and forecasting the remainder of 2004 allows a comparison of the models' forecast with actual developments (Figure 4). The ex-post forecast based on M5 (private sector credit growth) seems a bit closer to actual developments than the ex-post forecast based on M7 (private sector credit growth and broad money growth). However, the ex-post forecast based on M7 has a lower standard error.

Fig. 4. Pakistan: Leading Indicator Models—Ex-post Forecasts, Jun.–Dec. 2004 1/



Source: Pakistani authorities; and own calculations.

1/ Forecast based on model for reduced sample through May 2004.

The LIMs yield a fairly accurate forecast, and are consistent with our stylised model. By construction, the approach picks leading indicators that yield a high forecast accuracy at the current juncture. And, higher broad money growth and higher private sector credit growth being associated with higher inflation seems

¹⁷Detailed results are available from the authors upon request.

plausible from an economic point of view. However, the choice of leading indicators may change over time, so that the forecasting model may not be stable. As such, periodic re-specification and re-estimating will be required.

V. SUMMARY AND CONCLUSIONS

The empirical results presented in this paper show that monetary factors determine inflation in Pakistan, and are good leading indicators for future inflation. Broad money growth and private sector credit growth are the key variables that explain inflation developments with a lag of around 12 months. A long-run relationship exists between the CPI and private sector credit.

Pakistan's growth record since the 1970s underscores that high and persistent inflation is harmful to growth. Periods of high inflation have coincided with low growth spells, while high growth episodes tend to be associated with a low inflation environment. Between 1978 and 1991, inflation was 8 percent on average and real per capita growth averaged 3 percent. Between 1992 and 1997, inflation increased on average to 11 percent, while real per capita growth fell substantially and averaged only 1 percent. Finally, between 1998 and 2003, inflation was reduced again to an average of 5 percent, and real per capita growth displayed a dramatic recovery. Of course, there are other factors that determine growth in the short run and in the long run [e.g., van Rooden (2005)]. Nonetheless, in light of Pakistan's growth performance and the empirical thresholds beyond which inflation harms growth and financial development, an appropriate inflation target for Pakistan is 5 percent. The SBP's inflation target of 5 percent is, therefore, appropriate.¹⁸

The overarching objective of the SBP should be price stability. We believe the SBP should first and foremost focus its attention and policies to keep inflation close to its target of 5 percent. In principle, the SBP could also target an exchange rate level as a nominal anchor to achieve macroeconomic stability. However, this implies adopting the anchor country's monetary policy and may yield a suboptimal rate of inflation. In addition, the exchange rate would no longer be available to offset the impact of external shocks on the domestic economy. The SBP is fully capable of implementing its own independent monetary policy consistent with the needs of the domestic economy. Maintaining price stability will ultimately be the best policy contribution to sustained growth that the SBP can make. While there may not be a trade-off between inflation and growth in the short run, it certainly exists in the medium- and long-run.

Price stability can be approximated by different metrics. While headline inflation is better understood by the public, it is often argued that monetary policy should be more concerned with core inflation. Given the volatility of some components of the CPI, in particular food prices and energy prices, core inflation (approximated as non-food, non-energy or the SBP's trimmed mean definition) is a better measure of underlying inflation trends than headline inflation. Nonetheless, headline inflation is better understood by the public and affects households immediately. Taken together, core inflation is the right target for monetary policy, in particular over the medium term, but the SBP also needs to keep a watchful eye on headline inflation.

Finally, monetary policy has to be forward-looking to achieve its inflation target. Current monetary conditions impact inflation with a lag of around 12 months in Pakistan. There seems to be a fairly stable relationship between private sector credit growth and inflation 12 months from now. In addition, there is also a relationship between broad money growth and inflation 12 months from now. Therefore, the SBP should set monetary policy today with a view to meeting its inflation target around one year from now.

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