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Can a Rule-Based Monetary Policy Framework Work in a Developing Country? The Case of Yemen

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Can a Rule-Based Monetary Policy Framework Work in a Developing Country?
The Case of Yemen

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Abstract

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those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are
published to elicit comments and to further debate.

Monetary policy in Yemen is largely rudimentary and ad hoc in nature. The Central Bank of
Yemen's (CBY) approach has been based on discretionary targeting of broad money without
any clear target to anchor inflation expectations. This paper argues in favor of a new formal
monetary policy framework for Yemen emphasizing a proactive and rule-based approach
with a greater direct focus on price stability in the context of a flexible management of the
exchange rate. Although, as in many developing countries, institutional capacity is a concern,
adopting a more formal framework could impel the kind of changes that are required to
strengthen the ability of the CBY in achieving low and stable rates of inflation over the
medium term.

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I. INTRODUCTION

The conduct of monetary policy in Yemen is largely rudimentary and ad hoc in nature. Under a series of Fund-supported macroeconomic stabilization programs in the 1990s, the Central Bank of Yemen (CBY) focused on targeting broad money, using treasury bills and reserve requirements as the main policy instruments. While the efforts at stabilization were largely successful, the monetary policy framework has not evolved in any significant way since the end of the last Fund arrangement in 2001. Interest rates are relatively rigid, with the benchmark deposit rate set at 13 percent by the CBY for the past seven years. The CBY continues to informally target broad money, but this approach has had limited success in maintaining price stability or reaching desired inflation levels—casting doubt on the efficacy of the CBY's monetary policy framework.

This paper argues in favor of a new monetary policy framework for Yemen. Several factors underlie the need for a new approach. First, money demand has become increasingly unstable in Yemen—weakening the link between monetary aggregates and inflation. Second, the CBY's approach to monetary policy over the last six years has been discretionary, nontransparent and reactive—responding to inflation developments only after they occur. Third, monetary policy lacks a clear anchor for inflation expectations. The CBY does not communicate its policy intentions, nor does it disclose its targets. But even if it were to announce such targets, the informational content of monetary aggregates is relatively low—limiting their utility in shaping public expectations regarding inflation.

A formal policy framework—proactive, rule-based, and with a greater direct focus on inflation—is needed to guide the central bank in the conduct of monetary policy in the context of a more flexible exchange rate and continued free capital mobility. Institutional capacity is naturally a concern, as it is in any developing country. However, adopting a more formal framework could propel the kind of institutional change that is required, and could also create incentives for strengthening the policy making capacity of the CBY over the medium term.

The remainder of the paper is organized as follows: Section II addresses some key concerns with respect to monetary policy in Yemen; Section III lays out the basic elements of a new monetary policy strategy after testing for the stability of money demand and the degree of pass-through from exchange rate changes to inflation; Section IV discusses various inflation forecasting techniques that are needed to implement the new framework; and Section V concludes.

II. KEY CONSIDERATIONS IN DESIGNING A MONETARY POLICY FRAMEWORK FOR YEMEN

Three main elements are critical in moving from the current informal monetary policy framework—which is based essentially on informally targeting broad money—to a formal monetary policy framework that is based on a clear monetary rule and an inflation objective: (i) the apparent instability of money demand; (ii) the authorities' commitment to, and the need for, exchange rate flexibility (albeit with a focus on limiting short-term volatility); and (iii) the impact of exchange rate movements on domestic inflation.

A. Instability of Money Demand

Several studies have investigated the instability of money demand, with some work focusing on countries undergoing a process of structural or financial transformation. In situations where money demand is unstable, countries that continue to target monetary aggregates run the risk of chasing a moving target. This explains why several industrialized and emerging market countries have opted for inflation targeting regimes in recent years.

Instability of money demand in Yemen has become an increasingly important factor undermining the ability of the central bank to achieve and maintain desired inflation levels. Official data from the last several years support this view. This instability likely comes from several sources, including (i) financial deepening;[2] (ii) volatile inflation; and (iii) the high degree of dollarization in Yemen and the tendency for the public to shift to foreign currencies as a hedge during periods of economic or political uncertainty. In addition, the large variability of money supply due to substantial variations in the value of oil exports makes the relationship even more complex. Given the discretionary nature of monetary policy and the infrequent adjustment of targets and instruments, the risks of missing the inflation objective have increased. This was demonstrated most recently in the surge of inflation during the latter half of 2005 and the first half of 2006 (Figure 1), despite relatively benign rates of money growth.[3]

The anecdotal evidence noted above is strongly supported by econometric analysis on the weak link between monetary aggregates and inflation—suggesting that the central bank may consistently miss its inflation target despite meeting targets for broad money or other monetary aggregates. A money demand equation was estimated using output, inflation, and exchange rate changes as proxies for the opportunity cost of holding money (given the absence of reliable data on interest rates). Using the Chow test, it was shown clearly that money demand in Yemen is unstable (Appendix I).

However, the weak link between money demand and inflation in the short run could also be attributed to the fact that inflation appears to be affected by exogenous supply factors. Given Yemen's relatively low income, about 44 percent of the CPI is determined by food prices. Yemen's agricultural output is subject to periodic drought, and the prices of imported food products vary in line with international market prices. Even if the price of qat (which fluctuates substantially with supply and demand factors) is excluded (core CPI), the remainder of the inflation basket is subject to large fluctuations.

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[2] While Yemen's financial system is still relatively underdeveloped, there is evidence of financial deepening in recent years. Private sector deposits (demand deposits and quasi-money) have grown from 22 percent of non-oil GDP in 1995 to 30 percent in 2005. Private sector credit also doubled during this period, from 5 percent to 10 percent of non-oil GDP.

[3] Inflationary pressures in 2005 were largely the result of changes in administered prices, but similar spikes in 2006 have been almost entirely due to surges in food prices.

Figure 1. Yemen: Overall and Core Inflation, January 2000—July 2006
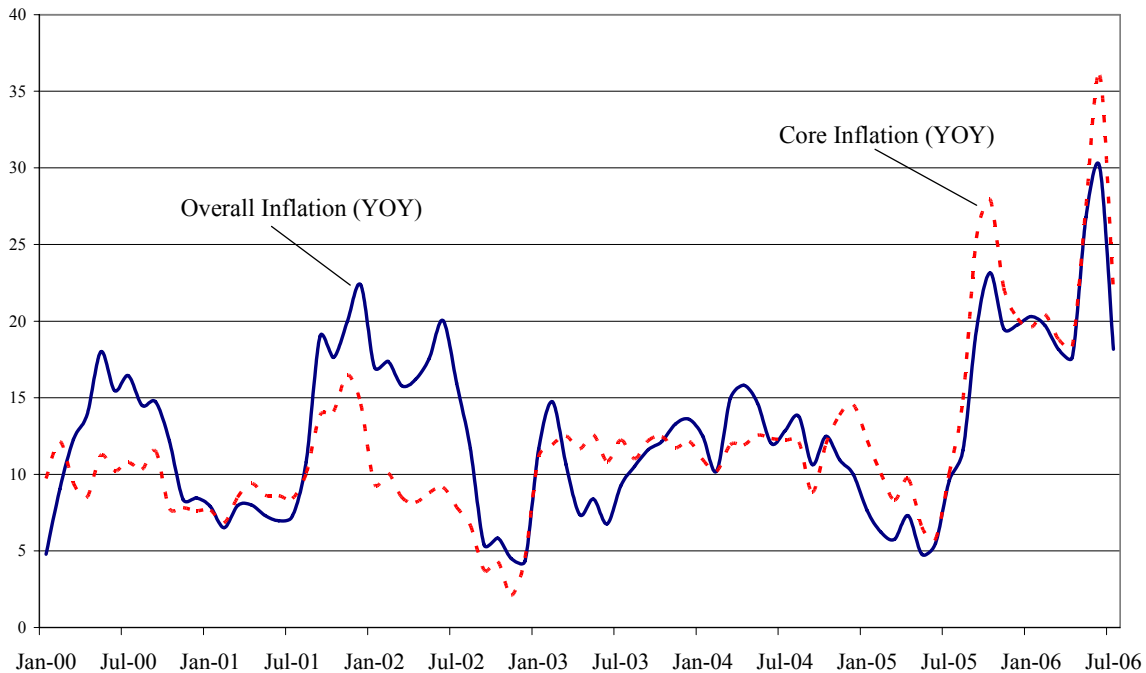
Source: Central Bank of Yemen.

B. Maintaining a Flexible Exchange Rate Regime

A flexible exchange rate regime could continue to serve Yemen well in view of its openness and potential vulnerability to external shocks. Conventional economic wisdom strongly suggests that a flexible exchange rate would be more effective than a fixed regime in insulating the economy from real shocks as it acts as an automatic stabilizer. Further, under a flexible exchange rate system, the CBY would have the option of pursuing an independent monetary policy and retain its function as the lender-of-last-resort. At the same time, a flexible exchange rate would make the country less vulnerable to currency crises.

The main argument for maintaining a flexible exchange rate in Yemen is the expected sharp fall in oil production over the medium and long term. With the projected decline in oil production and export receipts, it is expected that the real effective exchange rate would need to adjust to contribute to maintaining internal and external equilibrium. Maintaining a tightly managed float, as the authorities have been doing recently, could lead to an overvaluation of the real effective exchange rate, which would reduce competitiveness and affect the prospects of developing non-oil sectors in the medium and long term.

C. Exchange Rate Pass-through to Inflation

The choice of a monetary policy framework, policy instruments, and operating targets in an open economy depends to some extent on the impact of exchange rate changes on prices. Yemen's high degree of openness and its heavy dependence on imports—especially food and other basic commodities—suggest that domestic prices may be susceptible to exchange rate

movements. The degree of pass-through to inflation is also influenced by the existing market structure. There is strong evidence of monopolistic competition among importers who, by exploiting market power, can maintain their profit margins by fully passing on costs associated with exchange rate depreciations to domestic prices. In addition, given the large degree of dollarization of the economy (roughly 45 percent of broad money), where many goods are priced in dollars, any fall in the value of the rial relative to major currencies is likely to result in an equal increase in domestic prices.

To test the degree and speed of exchange rate pass-through to domestic inflation, we used the same model as that used by Choudhri and Khan (2002), using first differences to deal with the nonstationarity of the data.

$$\Delta P_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta P_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta e_{t-i} + \sum_{i=0}^{n} \delta_i \Delta P_{t-i}^* + \varepsilon_t$$

Where P and P^* denote the domestic and foreign price level, respectively, and e is the nominal effective exchange rate. This equation allows for measuring the short- and long-run effects of exchange rate change on domestic prices (a more detailed discussion is provided in Appendix II).

Econometric analysis suggests a strong pass-through from exchange rate movements to domestic inflation. The immediate impact of a depreciation on inflation is highly significant and is estimated at around 0.37. In other words, an unforeseen 1 percent depreciation increases inflation by 0.37 percent. The long-run impact is higher, on the order of 0.47 (Appendix II). The pass-through of exchange rate fluctuations to prices is thus an important consideration for Yemen. This strong relationship would affect the design of the proposed monetary policy framework, and would imply the need to allow for some interventions in the foreign exchange market to mitigate the impact of exchange rate changes on prices and keep inflation within the targeted range.

III. AN ALTERNATIVE MONETARY POLICY FRAMEWORK

The preceding sections highlight the weaknesses in the current approach to monetary policy in Yemen, and the key elements that would need to figure prominently in a new framework. This section attempts to lay out the general nature of the new framework, the operating targets and instruments, and the monetary rule or guideline that should inform the conduct of monetary policy. The new framework should be transparent in setting an inflation objective as its primary goal, and proactive in the sense that it reacts to developments before they affect inflation according to the transmission mechanism as specified in the monetary policy rule. Again, while this kind of approach may stretch the technical capacity of the monetary authorities in Yemen, it should in and by itself help in developing and strengthening this capacity.

A. General Considerations

The proposed framework might best be characterized as a transitional arrangement, during which time the required analytic and institutional capacity to support a fully fledged inflation targeting regime could be developed.[4] The framework should be based on a public commitment to price stability, a clear inflation objective, and a monetary policy rule. The CBY should reiterate that the primary goal of monetary policy, as specified in the CBY's mandate, is price stability.[5] In order to reach an inflation objective, the central bank should be proactive and adopt a forward looking approach to monetary policy. Rather than the reactive approach currently in use, the central bank would seek to base monetary policy decisions around an internally generated projection of short-run inflation. The introduction of a monetary policy rule would enforce discipline. However, until complementary structural reforms are complete, some flexibility in applying this rule will be required.

The success of the new monetary policy framework would also depend on supporting macroeconomic policies, and particularly fiscal policy. An expansionary fiscal policy constitutes a burden on and complicates the conduct of monetary policy, undermining the ability of the central bank to reach its inflation objective (a problem commonly referred to as fiscal dominance). While fiscal dominance is not an issue in Yemen at the present time, the expected decline in oil revenues could lead to large fiscal deficits, and pressure to finance these deficits through money creation. Ensuring coordination between the fiscal and monetary policies would be essential.

Even with supporting policies from key institutions, a range of reforms would be necessary for the new monetary framework to be effective. Particularly if interest rates are to be used as an operating target, liberalization of interest rates would be essential. The administered rate on deposits has remained fixed at 13 percent for the last seven years, and its elimination should be discontinued given the distortions that it creates, and because of the difficulty in adjusting these rates to respond to economic developments. Liberalizing interest rates should also improve the functioning of the banking sector and enhance the role of interest rates in providing market signals. Further, moving the CBY to a stronger position vis-à-vis the banking system would enhance prospects for the new framework, as the effectiveness of

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[4] This flexible approach to inflation targeting is known in the literature as "inflation targeting lite" or ITL (Stone, 2003). Countries pursuing ITL typically have low institutional credibility, a relatively weak financial position, shallow financial systems, and vulnerability to economic shocks. These countries have less market-oriented monetary policy instruments and lack transparency in the overall conduct of monetary policy.

[5] Over time, the CBY should begin to regularly (either quarterly or semiannually) announce its inflation objective, and make clear that other goals (such as growth and exchange rate stability) will be subordinate to this objective. Provided that sufficient capacity in inflation targeting and monetary policy formulation has been achieved, this move toward greater transparency should enhance the credibility of the CBY and help deflect political pressures that could undermine price stability for short-term political gains.

interest rates as a target are much typically much stronger if the central bank is a net creditor to the banking system (Carare and others, 2002).[6]

It is important to note that, even under the best of circumstances, the new policy framework would not be a "silver bullet" solution to inflation in Yemen. Exogenous shocks to inflation (from further increases in domestic fuel prices, monopolistic practices at the trader or retail level, or sudden spikes in food prices related to international commodity markets or domestic agricultural output) will likely continue to be a problem over the medium term.

B. Instruments and Operating Targets

Open market operations using government securities would continue to be the main instrument for monetary policy, supported by foreign exchange auctions. Treasury bill auctions have generally been successful in influencing monetary conditions and interest rates, and should continue to be the main instrument of monetary policy. However, recognizing the importance of minimizing large swings in the exchange rate—given its impact on inflation—auctions of foreign exchange could also be used as a secondary monetary policy tool. These interventions should smooth short-term fluctuations and minimize the impact of exchange rate pass-through on inflation.

The operating target for monetary policy could, under normal circumstances, be either a liquidity indicator, such as the aggregate bank balances held at the central bank for liquidity management, or a price indicator such as the short-term interest rate. In most countries that pursue an inflation target, short-term interest rates are used as the intermediate objective (Stone, 2003). Short-term interest rates would have several advantages over a liquidity indicator as an operating guide for monetary policy in Yemen. First, the authorities attach considerable weight to the stability of interest rates, which could fluctuate more than desirable if the focus were on a liquidity indicator. Second, interest rates are more visible and communicate better the stance of monetary policy to the general public. Third, anecdotal evidence suggests that an interest rate change would have a greater impact on the exchange rate than a change in a liquidity target—and hence on inflation given the high degree of pass-through. Given this high pass-through, however, smoothing the exchange rate path could also be considered as a guidepost for monetary operations—at least in the early stages, and until interest rate liberalization and other key reforms are completed.

The effectiveness of interest rates as an operating guide may, however, be affected in Yemen given the existing structural liquidity in the banking sector and the weak transmission mechanism linking interest rates and inflation. In addition, the noncompetitive structure of the banking system, the absence of a credit culture, screening procedures, a collateral system,

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[6] At present, the CBY is a net borrower from banks through the issuance of certificates of deposit and thus has less influence over the interest rate. The existence of a structural liquidity surplus in Yemen arises principally from oil export proceeds, which could not be fully sterilized. To enhance the efficacy of interest rates as a monetary policy tool, the central bank should withdraw liquidity from the banking sector, either by issuing more CDs or, preferably, by coordinating with the ministry of finance to issue a larger amount of treasury bills. If these two actions combined prove insufficient, then raising the reserve requirement could also be considered.

and risk assessment capacity may weaken (but not eliminate) the relationship between interest rates and credit (the credit channel) and, thus, between interest rates and inflation.

C. Monetary Policy Rule

In order to instill some discipline in the conduct of monetary policy and reduce the central bank's discretion, a monetary policy rule or some kind of guideline is necessary. The design of a monetary policy rule depends on the objective of the monetary authorities. While in principle the primary objective of the central bank is price stability, in practice, other objectives may enter into its objective function. These include promoting growth and employment, smoothing business cycles, and minimizing the variability of the exchange and interest rates. Policymakers have a tendency to focus on short-term goals, sometimes in response to political pressures, at the expense of an inflation objective. This problem has come out clearly in discussions with the monetary policy authorities in Yemen.[7] A well defined policy rule should help limit these tendencies and reduce any inflationary bias. A formal rule should also help create incentives for reforming the institutional structure of the central bank and strengthening its capacity and credibility.

Monetary policy rules, even in most developed countries, are at best "guideposts" to help central banks, and should not be seen as so inflexible as to eliminate discretion (Greenspan, 1997). In developing countries, more flexibility should be allowed in the application of monetary policy rules (dubbed as constrained discretion by Fischer (2001)). In the context of the proposed approach, which could be considered as a transition to a more formal inflation targeting framework, a larger margin for discretion should be allowed. Initially, and to protect the credibility of the central bank, the inflation objective should be specified within a relatively wide range with a short forecasting horizon to minimize the chances of failure. The inflation objective could be specified in terms of bands and the forecasting horizon could be short first but not shorter then the transmission lag otherwise the central bank may be setting itself for failure. Over time, as the authorities' capacity and experience deepens, the margin for discretion would narrow, as would the inflation band, while the forecasting horizon would lengthen.

This "constrained discretion" approach could potentially help strike a stable balance between a rigid monetary rule and a completely discretionary approach to monetary policy by the central bank (Bernanke, 2003). Constrained discretion could also serve as an educational tool and create incentives for the technical and policy-level staff at the CBY to develop their understanding of how monetary policy works by providing a coherent framework for public policy making.

An interest rate rule would likely be the best choice for Yemen, once complementary reforms on interest rate liberalization are complete. Traditionally, there are two types of rules: (i) a monetary growth rule, and (ii) an interest rate rule. The first allows for reactions to correct

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[7] Another way of describing this idea is to say that "policymakers unconstrained by rules have an incentive to 'cheat' the private sector to spur an output gain" (Khan, 2003).

mistakes or shifts in money demand, and the second responds to macroeconomic variables other than inflation rates, including exchange rates and output (Khan, 2003). Given the likely multiple objectives of the Central Bank of Yemen, including the stability of the exchange rate, as well as the advantages offered by using the short-term interest rate as an operating target, an interest rate-based rule seems more appropriate.

Under an interest rate rule, the central bank adjusts its short-term interest rate in response to deviations of the variables in its objective function from their desired values. While this could fall under the heading of a Taylor rule, such a rule varies in sophistication from country to country. For countries following a strict inflation targeting, the interest rate adjusts only in response to deviations of inflation or projected inflation from its target. However, in most cases, and certainly in developing countries where the central bank may be pursuing multiple objectives, this relationship would be more complicated—linking changes in interest rates to deviations of the inflation rate from its target, and output from its full employment level. For Yemen, the function would also need to take into account the desirability of sudden or unwarranted volatility in the value of the rial relative to major trading currencies. In addition, the inclusion of an interest rate term (on the right hand side of the equation) measures the degree of interest rate persistence and reflects the central bank's preference to smooth interest rate fluctuations.

In this light, following Taylor (1999), Kollmann (2002), as well as Lubik and Schorfheide (2004), among many others, a more realistic formulation of an interest rate rule, is expressed in the following relationship:

$$i_t = \rho i_{t-1} + \gamma_\pi \pi_t + \gamma_y y_t + \eta_0 e_t + \eta_1 e_{t-1} + \gamma_0$$

Where i_t, π_t, y_t, e_t, and γ_0 denote the short-term interest rate, the inflation rate, the output gap, the exchange rate, and a constant term.[8] As long as more (largest) weight is attributed to inflation relative to the other objectives, the framework would remain viable.

As long as the monetary authorities are fully committed and attach the highest priority to price stability, exchange rate arrangements with less than full flexibility (managed float or crawling pegs) could coexist with the new framework. The inclusion of the exchange rate term in the monetary policy rule is justified especially when the pass-through from the exchange rate to inflation is very high and with relatively short lags, as is the case in Yemen. Foreign exchange interventions should be limited to smooth the effects of temporary shocks on inflation. Minimizing fluctuations in the exchange rate enhances also the credibility of the central bank and affects inflationary expectations.[9] Ball (1999) also finds that adding the

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[8] Depending on the exact specification, the interpretation of the variables and the constant term will change. For example, Ball (1999) uses the real exchange rate, whereas Kollmann (2002) as well as Lubik and Schorfheide (2004) use the nominal exchange rate in their rules.

[9] Calvo and Reinhart (2000) argue that in many developing countries although policymakers pursue (de jure) a flexible exchange rate, they tend to intervene aggressively in the exchange market for "fear of floating."

exchange rate to the policy rule could improve macroeconomic performance in a small open economy model.[10]

Given the expected decline in oil production and its likely impact on the exchange rate (see Chami and others, 2006), setting an inflation objective will need to reflect the likely depreciation of the rial. Therefore, the inflation target to be set by the monetary authorities will need to take into account this reality and thus it may not be possible to target a very low inflation rate given the high degree of pass through. In other words, even with very restrictive fiscal and monetary policies, reducing inflation to a very low level will not be possible given the expected decline in foreign proceeds on account of oil. In this context, the monetary authorities may have to accept a partial inflationary offset of the depreciation and may not be able to target a very low inflation rate. But even under these circumstance, having a formal framework for conducting monetary policy and reaching an inflation objective remains a preferable option.

While the output gap may not be as important in Yemen, given high levels of excess capacity in the economy, government spending could be used as a proxy for aggregate demand. Again, monetary policy should respond to a widening of the output gap only to the extent that it affects inflation (or inflationary expectations) and not because it has a large (political) weight in the government's objective function. If the output gap is given a higher weight, then it will take more time to reach the inflation objective following a supply shock (Khan, 2003).

Implementing the above monetary rule requires the estimation of its coefficients—a very difficult task in the absence of interest rate data, or when interest rates remain constant for an extended period. The central bank may need to rely initially on estimates from other developing countries, and then recalibrate the rule to take account of Yemen's particular characteristics. There is always a key role, even where sophisticated models exist, for judgments in the formulation of monetary policy and for periodic adjustments to the policy stance (values of the parameters) to reflect the situation on the ground. Over time, and with better data collection and analysis, more elaborate models can be developed. In addition, a prerequisite for the proposed monetary policy rule is to forecast inflation so adjustment can be made ahead of time to keep inflation within the desirable band. Given the limited technical capacity of the central bank, the next section illustrates the use of some simple forecasting techniques, which could be developed over time.

IV. Forward-Looking Approach and the Need to Forecast Inflation

Under the monetary rule proposed above, the stance of monetary policy should be adjusted whenever inflation is expected to deviate from its target over the policy time horizon. The rule could thus serve to guide the policy response to inflation developments, and is inherently

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[10] Following the parameter suggestions in Ball (1999), Taylor (1999) augments an interest rate rule with the U.S. dollar-Euro exchange rate, and conducts simulations to assess the optimality of these rules with and without the exchange rate. He finds that inclusion of the exchange rate terms can decrease the variability of inflation and output.

forward-looking. In other words, because monetary policy affects inflation with a lag, the central bank would be in a better position to anticipate future movements in inflation and act preemptively.[11] A critical input, however, would be the central bank's ability to anticipate inflation developments, for which some consideration of an inflation forecasting model is necessary.

A. Forecasting Techniques

In light of Yemen's limited institutional capacity, inflation forecasting models should be relatively simple at the beginning. A highly sophisticated and accurate model is not necessarily a prerequisite for applying the new approach to monetary policy. Rather, it is more likely that such models will be developed if the new approach is adopted.[12] In the absence of reliable data and structural economic models, there may be a need to rely first on judgments and some inflation indicators. These indicators could include monetary aggregates, exchange rate, current inflation data, and some demand and supply signals (Carare and others, 2002).

Simple techniques could initially be used to forecast inflation in Yemen. This point is illustrated with two simple time series models—univariate ARMA models, and multivariate VARs.[13] ARMA models are simple to implement and perform well in the context of short-term forecasting—one or two quarters beyond recent historical data, which is most relevant in Yemen. These models are easy to produce and allow for frequent assessment of economic conditions. VARs are particularly useful since they can potentially use the informational content of other variables to refine inflation forecasts. An assessment of these two models, followed by a discussion of more sophisticated techniques and their applicability to Yemen, is discussed in Appendix III.

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[11] In the words of former Federal Reserve Chairman William Martin (1965): "To me, the effective time to act against inflationary pressures is when they are in the development stage—before they have become full-blown and the damage has been done. Precautionary measures are more likely to be effective than remedial action: the old proverb that an ounce of prevention is worth a pound of cure applies to monetary policy as well as to anything else." This idea was reinforced by Alan Greenspan (1999): "For monetary policy to foster maximum sustainable economic growth, it is useful to preempt forces of imbalance before they threaten economic stability...When we can be preemptive, we should be, because modest preemptive actions can obviate more drastic actions at a later date that would destabilize the economy."

[12] This in line with Fischer's argument (2000) made at a conference held in the IMF on inflation targeting: "I do not believe that a very accurate model or a very sophisticated set of expectations is a prerequisite to adopting inflation targeting. Obviously, having them would be preferable. I would add as a footnote that a country is more likely to develop the models once it has an inflation targeting approach that it must implement than if it waits for it to arrive."

[13] ARMA refers to auto- regressive and moving average regressions (see Box and Jenkins, 1976) and VAR stands for vector auto- regression (see Hamilton, 1994).

V. CONCLUDING REMARKS

At present, there is no formal and clear framework that guides the conduct of monetary policy in Yemen. The central bank has generally been following a broad money target, using excess reserves of the banking system at the central bank as a trigger for open market operations to mop up or inject liquidity. Because of the growing instability of money demand, however, the relationship between broad money and inflation has become weaker. Moreover, monetary policy has been discretionary and without any forward-looking vision—reacting to developments only after they occur. As a result, the CBY has had only limited success in maintaining price stability or lowering the overall rate of inflation.

The limited capacity of the central bank to achieve its key objectives argues strongly for a reassessment of the monetary policy framework. This paper has demonstrated the need for a formal monetary policy framework that sets a clear inflation objective—within a wide band first—that anchors inflationary expectations in the context of a flexible exchange rate and a clearly defined monetary policy rule. While the technical requirements of such an approach are not insignificant, having a formal policy framework could well encourage the development of the analytical and technical capacity that is needed at the CBY to "feed the model." Indeed such capacity is unlikely to evolve in the absence of a formal framework.

Ideally, a new monetary policy framework for Yemen should rest upon the single objective of price stability. The reality, however, is that the CBY is likely to consider a hierarchy of objectives, including growth promotion and exchange rate stability. These secondary objectives are, to some extent, dictated by political pressures that may run counter to the central bank's mandate to pursue, first and foremost, price stability. As long as the CBY attaches more weight to price stability in its objective function, however, it can still succeed in reaching its inflation objective, while simultaneously smoothing the exchange rate path to moderate the pass-through from exchange rate changes to inflation.

The monetary policy framework proposed here will use open market operations with government securities as the main policy instrument and the short-term interest rate as the main operating target. But in view of the strong link between the exchange rate and inflation, an exchange rate path could also be used as an operating target. Therefore, the monetary strategy should be based on a short-term-interest rule that reacts to the deviation of inflation from its objective, smoothes exchange rate fluctuations, and responds to some aggregate demand indicators. Since this framework would require inflation forecasts, it is suggested that Yemen initially use the simplest forecasting techniques, which could be developed and refined over time.

APPENDIX I. INSTABILITY OF MONEY DEMAND IN YEMEN

To assess the stability of money demand in Yemen, a typical money demand function was estimated. The lack of timely and high-quality data in Yemen complicated this task, requiring the use of a number of proxies.

Nominal interest rates in Yemen have been subject to administrative control (the minimum rate on saving deposits, which anchors all other rates, has been constant for the last six years). Consequently, exchange rate depreciation and the rate of inflation are used as proxies for the opportunity cost of holding money.[14] More problematic is the absence of any monthly (or even quarterly) measurement of real economic activity. In view of the strong correlation between output and government expenditures, and the procyclicality of fiscal policy with oil revenue, crude oil exports are used as a proxy for output. On this basis, the following relationship was estimated:

$$\frac{M_t}{P_t} = f(y_t, \pi_t, \Delta e_t) \tag{1}$$

where, M_t/P_t denotes real money balances, y_t is the proxy for real activity, and the two proxies for the opportunity cost of holding money are the inflation rate, π_t and the depreciation rate, Δe_t, where, e_t, is the nominal exchange rate, and, Δ, is the first difference operator.

Equation (1) is estimated using different econometric specifications, the results of which are reported in Table I-1. The baseline regression is under column [1], where real money balances are regressed against a constant, as well as the proxies for real activity and the opportunity costs of holding money discussed above. Under column [2], a lag of the inflation and depreciation rates is added. Finally (under column [3]), a lagged real money balances term is added to account for any possible serial correlation and misspecification issues.[15]

Although the contemporaneous depreciation term in the first regression under column [1] has the expected sign, it is not statistically significant. However, in the second specification under column [2], the lagged depreciation rate has both the correct sign and is statistically significant. This could be attributed to the delayed impact of financial developments on money demand. A 1 percent depreciation seems to decrease the demand for real balances in the next period by approximately 2 percent. In the third regression, the inclusion of the lagged endogenous variable improves the fit of the equilibrium relationship, and highlights the persistent nature of money demand in Yemen.

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[14] This approach is also used by Celasun and Goswami (2002). However, given the limited sample, we do not (explicitly) test for any cointegrating relationships, although, in each specification it is possible to confirm the stationarity of the residuals, providing evidence against running spurious regressions. Results are available from authors upon request.

[15] In this case, the lagged inflation rate is no longer statistically significant and is dropped out.

Table I-1. Yemen: Estimated Money Demand Functions

Variable	[1]		[2]		[3]	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	-0.04	-0.33	-0.04	-0.38	-0.02	-0.25
y_t	0.01	0.36	0.01	0.45	0.01	0.32
π_t	-0.77	-2.69	-0.71	-2.58	-0.85	-4.60
π_{t-1}			-0.85	-3.10		
Δe_t	-0.31	-0.33	0.41	0.44	-0.26	-0.42
Δe_{t-1}			-1.79	-1.93	-1.40	-2.22
$(M/P)_{t-1}$					0.72	9.34
R^2	0.11		0.26		0.66	
Stability Test Results						
Chow breakpoint	15.25 *		35.79 *		17.11 *	
Chow forecast	73.6 *		114.68 *		82.54 *	

Note: The asterisk (*) indicates that the log-likelihood test statistic is significant at 1 percent level.
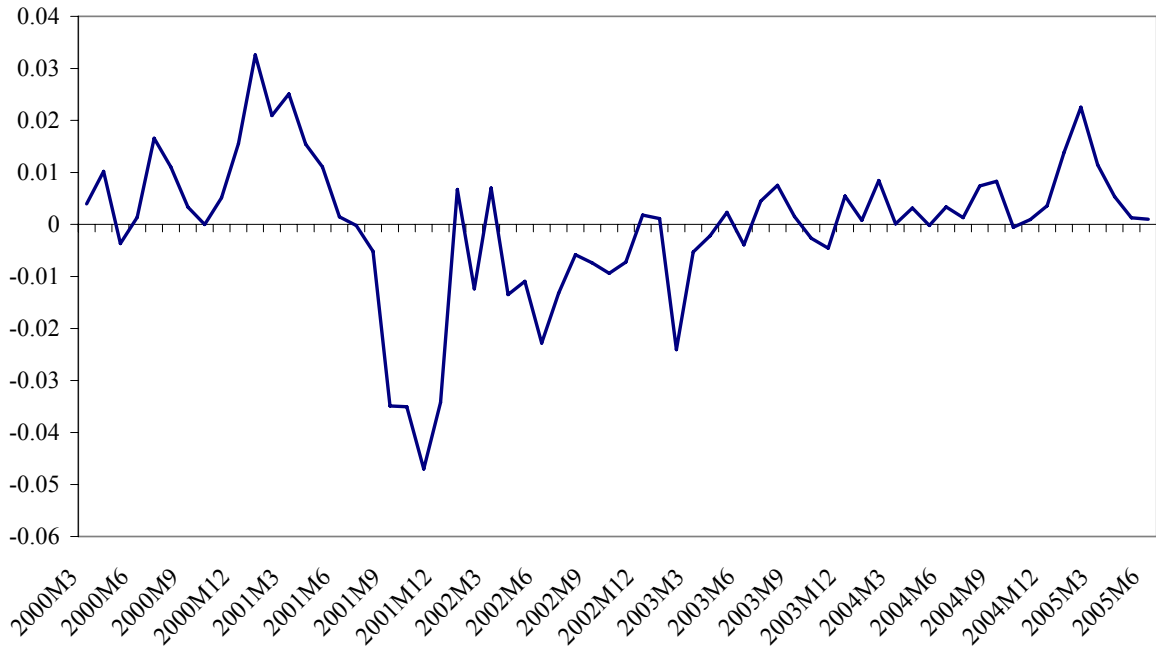Source: Fund staff estimates.

However, when an estimated money demand function derived from these regressions is plotted, as shown in Figure I-1, the stability of the relationship does not seem robust.[16] The Chow test (Chow, 1960) is then applied to gauge the stability of this relationship more rigorously for parameter stability. The Chow test posits the null hypothesis that there is no structural break in the money demand function at a given date. The results, which are also reported in the lower panel of Table I-1, overwhelmingly reject the null hypothesis, providing support for the instability of the money demand function in Yemen. In fact, for each equilibrium money demand estimation, the null hypothesis is rejected at the 1 percent level.[17] These results support the notion that the central bank may consistently miss its inflation target despite meeting targets for broad money or other monetary aggregates.[18]

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[16] Figure I-1 is based on the regression in column [3] of Table I-1. The other regressions yield very similar estimated equilibrium money demand functions, especially with the break in mid-2001.

[17] As can be confirmed from Table I-1, this is true whether the traditional Chow breakpoint or the forecast test is used.

[18] Although not reported in the text, the ineffectiveness of the current monetary framework can be reconfirmed by trying to uncover the monetary transmission mechanism in Yemen. After considering a battery of specifications based on the vector auto- regression (VAR) methodology in the literature (see, for example, Christiano, Eichenbaum, and Evans, 2005), evidence in favor of effective monetary policy could not be found. An increase in money supply does not significantly affect inflation or output over the business cycle frequencies in Yemen. These results are available from the authors upon request.

Figure I-1. Yemen: Estimated Money Demand Function

Source: Fund staff estimates.

APPENDIX II. EVIDENCE OF EXCHANGE RATE-INFLATION PASS-THROUGH IN YEMEN

To gauge the impact of exchange rate pass-through on domestic prices, the methodology used by Choudhri and Khan (2002) is used to estimate the effect of the nominal exchange rate fluctuations on the consumer price index, using a foreign price index as a control variable. Inspection of the relevant variables shown in Figure II-1 highlight the potential nonstationarity of the data.

Figure II-1. Yemen: Price Indices and Exchange Rates, 1995-2005

Log CPI

Log Foreign CPI

Log Nominal Effective Exchange Rate

Log Real Effective Exchange Rate
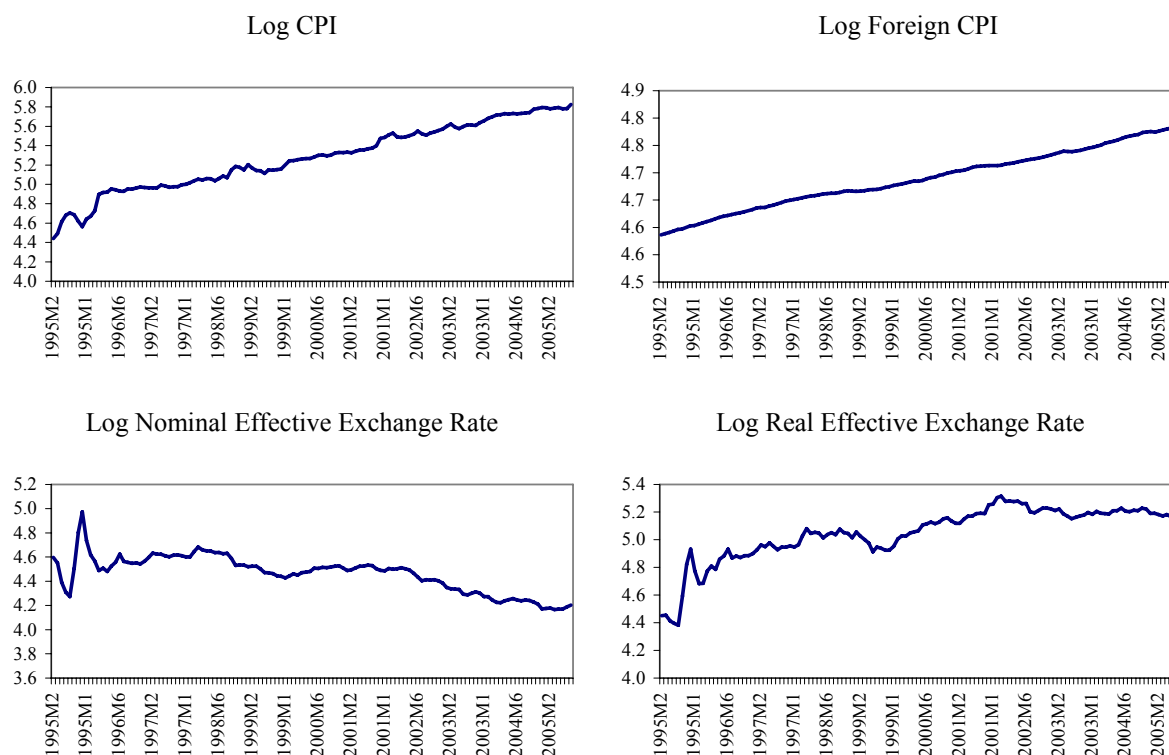
Source: Fund staff estimates.

To assess the time series properties of the relevant variables, an augmented Dickey-Fuller test is applied. The results, which are reported in Table II-1, indicate that the exchange rate and both price indices are nonstationary, and need to be transformed to avoid running spurious regressions.[19] To this end, the first differences of the time series are used to estimate the degree of exchange rate pass-through in Yemen.[20]

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[19] It is well known that using nonstationary variables in a regression tends to give spurious results—unless of course the series are cointegrated—see below for further details.

[20] One consequence of using differenced data is the loss of relevant information, especially if the variables are cointegrated. In this context, cointegration would imply that the real effective exchange

(continued…)

Table II-1. Yemen: Tests of Stationarity of Prices and Exchange Rates

Variable	Level		First Difference	
	Lag	Test statistic	Lag	Test Statistic
P	0	-2.33	0	-8.68*
P*	1	-0.65	0	-8.20*
e	0	-1.63	0	-7.06*
REER	0	-3.33	0	-8.14*

Notes: See text for details on variables and data sources. The augmented Dickey Fuller methodology tests the null hypothesis of a unit root. The test statistic is the coefficient of the first lag of the variable in a regression of the first difference of the variable on its lags, a constant term, and a linear trend. To cross validate our results, we also perform the test on the differenced variables. The criteria for lag selection is a modified version of the Akaike information criterion, as described by Pantula, Gonzales-Farias, and Fuller (1994). The critical values of the tests are taken from MacKinnon (1994). The asterisk (*) indicates that the test statistic is significant at 1 percent level. We conclude that we cannot reject that the level of each series is nonstationary. For the analysis explained in the text, we therefore use the first difference of each series, which are stationary as can be confirmed from the table. The Phillips-Perron (1988) test is consistent with these inferences based on the augmented Dickey-Fuller test.
   Source: Fund staff estimates.

To estimate the degree of exchange rate pass-through in Yemen, the following specification is used:

$$\Delta P_t = \alpha + \sum_{i=1}^{n}\beta_i \Delta P_{t-i} + \sum_{i=0}^{n}\gamma_i \Delta e_{t-i} + \sum_{i=0}^{n}\delta_i \Delta P_{t-i}^* + \varepsilon_t \qquad (2)$$

Where P and P* denote the domestic and foreign price level, respectively, e is the nominal effective exchange rate, and ε_t is a Gaussian white noise process.[21] Lags are introduced to allow for gradual adjustment in prices possibly due to price stickiness and to correct for the serial correlation in the data.[22] This equation allows for estimates of the degree of exchange

rate (REER) is stationary, and that Purchasing Power Parity (PPP) holds for Yemen. However, Table II-2 also provides the augmented Dickey-Fuller test results for the REER which indicates that this series is nonstationary as well. Hence the PPP does not appear to hold in Yemen, and the relationship between exchange rate fluctuations and the price levels is estimated using their first differences.

[21] For details on the properties of a Gaussian white noise process, refer to Hamilton (1994).

[22] See Choudhri and Hakura (2003) for a theoretic model that would suggest such a pass-through relation.

rate pass-through over various time horizons. More specifically, γ_0, is interpreted as the short-run pass-through coefficient, which reflects the immediate impact of depreciation on the inflation rate. Further, the long-run pass-through coefficient is also defined, λ:

$$\lambda = \frac{\sum_{i=0}^{n} \gamma_i \Delta e_{t-i}}{1 - \sum_{i=1}^{n} \beta_i \Delta P_{t-i}} \tag{3}$$

where this ratio is interpreted as the long-run impact of a 1 percent depreciation on the inflation rate.

Equation (2) is estimated using different lag specifications. The results of three specifications are reported in Table II-3. In the first representation under column [1], four lags were included for each variable; in the second, the lags of ΔP_t^* that were not significant are dropped; and finally, in column [3], the Schwartz information criterion is used to determine the optimal lag for each variable. Notice that in each of the cases, the immediate impact of a depreciation on inflation is highly significant and are tightly estimated around 0.37. In other words, an unforeseen 1 percent depreciation increases inflation by 0.37 percent. The long-run impact of exchange rate fluctuations on inflation is estimated to be in the 0.43-0.47 range (lower panel of Table II-2).[23]

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[23] The results are robust to a wide range of specifications, which are available from the authors upon request. Furthermore, the use of the bilateral exchange rate vis-à-vis the U.S. dollar changes the coefficient estimates by a negligible amount.

Table II-2. Yemen: Estimates of Exchange Rate Pass-Through

Variable	[1]		[2]		[3]	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	-0.45	-0.72	-0.10	-0.24	-0.13	-0.32
ΔP_{t-1}	0.11	1.22	0.11	1.27	0.10	1.17
ΔP_{t-2}	-0.09	-0.99	-0.09	-1.01	-0.08	-0.95
ΔP_{t-3}	0.19	2.21	0.18	2.22	0.17	2.16
ΔP_{t-4}	-0.08	-0.88	-0.06	-0.71		
Δe_t	0.37	5.96	0.36	6.00	0.37	6.58
Δe_{t-1}	-0.04	-0.55	-0.03	-0.42	-0.03	-0.41
Δe_{t-2}	0.01	0.17	0.01	0.12	0.01	0.16
Δe_{t-3}	0.20	3.00	0.19	3.00	0.20	3.20
Δe_{t-4}	-0.16	-2.55	-0.16	-2.60	-0.18	-3.14
ΔP^*_t	2.53	1.13			4.95	2.29
ΔP^*_{t-1}	-2.19	-0.95				
ΔP^*_{t-2}	1.55	0.67				
ΔP^*_{t-3}	1.22	0.52				
ΔP^*_{t-4}	4.33	1.87	5.12	2.35	4.95	2.29
R^2	0.46		0.44		0.44	
Pass-Through:						
Short-Run	0.37		0.36		0.37	
Long-Run	0.44		0.43		0.47	

   Source: Fund staff estimates. Monthly data from February 1995 to July 2005 was obtained from the IMF INS database.

APPENDIX III. INFLATION FORECASTING TECHNIQUES FOR YEMEN

Table III-1. Yemen: List of Variables and their Definitions

Variable 1/	Defintion
i	Short-term interest rate
y	Logarithm of real government oil revenue
$REER$	Logarithm of the real effective exchange rate
e	Logarithm of the nominal excange rate 1/
Δe	Nominal depreciation rate 2/
M	Logarithm of broad money
μ	Growth rate of broad money (ΔM)
γ	Growth rate of credit to the private sector
P	Logarithm of the headline consumer price index
π	Headline inflation rate (ΔP)
P^*	Logarithm of the foreign price index 3/
π^*	Foreign inflation rate (ΔP^*) 4/
π^C	Core inflation rate 5/

1/ All series are of monthly frequency and span the January 2000 through June 2005 period. The real and nominal effective exchange rates are from the IMF INS database, whereas the other variables are the most recent data obtained from the authorities.

2/ Our results are robust to whether the nominal effective or U.S. dollar-Yemeni rial bilateral exchange rate are used.

3/ D denotes the first difference operator.

4/ The foreign price index represents a weighted average of the consumer prices for Yemen's trading partners expressed in U.S. dollars with weights based on Yemen's foreign trade.

5/ Core inflation is derived using the core consumer price index, which excludes the impact of qat inflation on price fluctuations.

Univariate models

In the illustrative models considered below, the focus is on the annual rate of change of the core consumer price index, denoted π_t^C, in order to abstract from transitory seasonal fluctuations that affect qat prices in Yemen. In order to conduct forecast comparisons, the model is estimated up to December 2004 along with forecasts generated for the remaining six months of the sample. The general formulation of an auto-regressive process with p lags AR(p) is as follows (definitions of variables are provided in Table III-1):

$$\pi_t^C = \varphi_0 + \varphi_1 \pi_{t-1}^C + \varphi_2 \pi_{t-2}^C + \ldots + \varphi_p \pi_{t-p}^C + \xi_t \tag{4}$$

The first model considers an auto-regression with twelve lags (AR(12)) to account for the use of monthly data. Although more parsimonious lags are considered, only the AR (12) model is presented, as it summarizes the data more accurately and generates more precise forecasts when compared to other specifications. The actual core inflation time series, along with the forecast and 95 percent confidence bands from the AR(12) model is shown in Figure III-1.

Figure III-1. Yemen: Annual Core Inflation Forecast, January 2000–March 2004
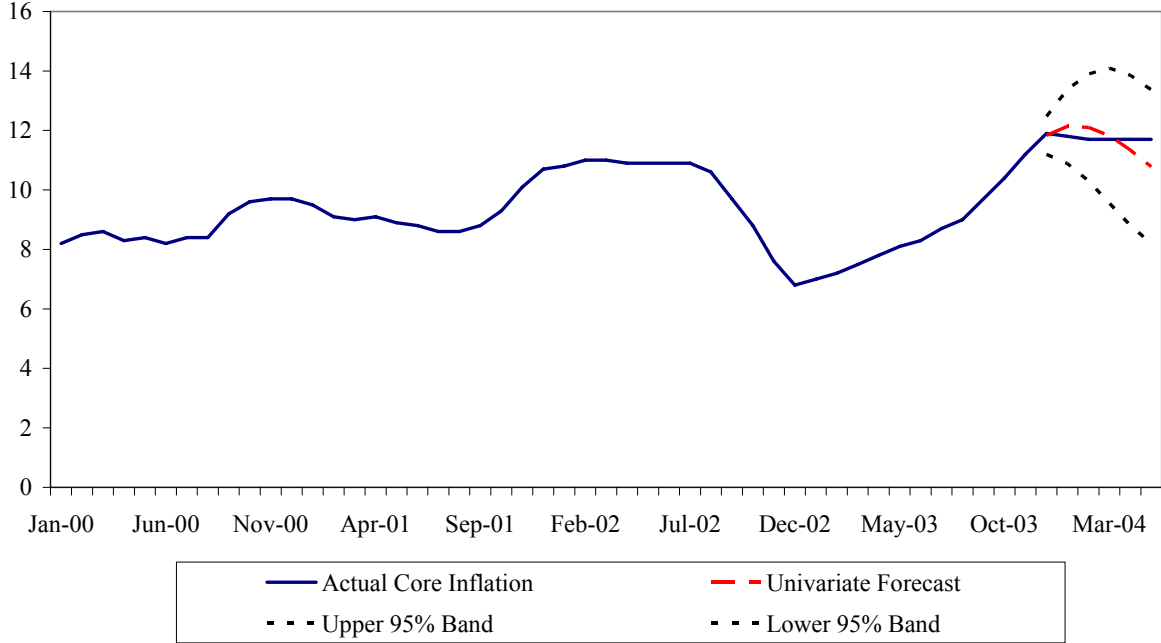
Source: Fund staff estimates.

Before discussing the results, it may be useful to consider another expository time series specification. To enhance the information content and refine the forecasts, the previous model can be extended by including additional explanatory variables. A set of monetary aggregates is considered to assess which of them could improve forecast performance. These aggregates have the potential to improve forecast accuracy by providing additional information about the future prospects of inflation. After some preliminary tests, the growth rate of broad money seems to be the most informative indicator of future inflation.[24] In its most general form, the addition of an explanatory variable would imply that equation (5) would now be recast as:

$$\pi_t^C = \varphi_0 + \varphi_1 \pi_{t-1}^C + \varphi_2 \pi_{t-2}^C + ... + \varphi_p \pi_{t-p}^C + \beta_1 \mu_{t-1} + ... + \beta_p \mu_{t-p} + \xi_t \qquad (5)$$

where μ_t denotes the growth rate of broad money.

Based on information criteria and forecast accuracy, a specification for equation (5) that uses twelve lags of core inflation and one lag of broad money growth was chosen. The estimation results are depicted in Table III-2, under the column denoted ARX (the abbreviation for this model). Figure III-2 shows the actual and forecasted core inflation series along with the 95 percent confidence bands.

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[24] Granger causality tests were conducted using all of the money and credit aggregates for Yemen.

Table III-2. Yemen: Forecasting Equations For Core Inflation

Variable	AR(12)		ARX	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	5.2073	3.2227	9.399757	4.837804
π^C_{t-1}	0.7136	5.5049	0.632053	5.197078
π^C_{t-2}	0.1365	0.8595	0.062419	0.435825
π^C_{t-3}	-0.0985	-0.6744	-0.080127	-0.589848
π^C_{t-4}	-0.2178	-1.4607	-0.115431	-0.850217
π^C_{t-5}	-0.0475	-0.3244	-0.062134	-0.472206
π^C_{t-6}	0.2580	1.7757	0.212941	1.63227
π^C_{t-7}	0.0214	0.1487	-5.37E-05	-0.000408
π^C_{t-8}	-0.0264	-0.1869	0.007687	0.059131
π^C_{t-9}	-0.1802	-1.3119	-0.122958	-0.976741
π^C_{t-10}	0.0171	0.1230	-0.035084	-0.270488
π^C_{t-11}	0.0269	0.1951	-0.007629	-0.059069
π^C_{t-12}	-0.1195	-1.0747	-0.211298	-1.934694
μ_{t-1}			-0.416154	-2.839895
R^2	0.65		0.68	
$RMSE$	2.25		2.00	

Source: Fund staff estimates.

Figure III-2. Yemen: Forecasting Core Inflation, January 1998–January 2005
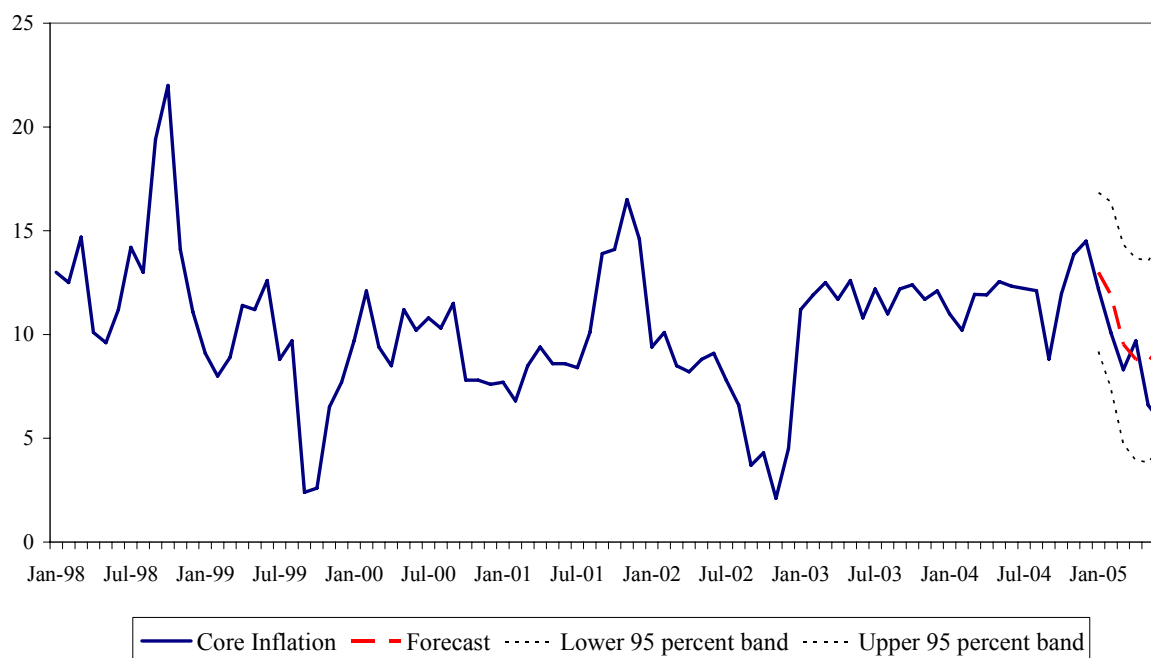
Source: Fund staff estimates.

As expected, the model that includes the lagged growth rate of broad money generates more accurate forecasts. The model with the additional regressor fits the data slightly better as indicated by a higher adjusted R^2, but more important, has a lower root mean squared error (*RMSE*) indicating superior forecast accuracy when compared to the AR(12) specification.[25]

A vector auto-regression

A multivariate Vector Auto-Regression (VAR) could improve the forecast performance of the univariate specifications since it endogenizes all the variables under consideration. This implies that imposing fewer cross-equation restrictions and also permits feedback within the framework, allowing the model to capture a much richer array of dynamics. Further, with the addition of other indicators of inflation, a VAR could potentially increase the accuracy of inflation forecasts further.[26] To this end, the following VAR is estimated:

$$
\begin{bmatrix} \pi_t^C \\ \mu_t \\ \gamma_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} \pi_{t-1}^C \\ \mu_{t-1} \\ \gamma_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} \pi_{t-2}^C \\ \mu_{t-2} \\ \gamma_{t-2} \end{bmatrix} + A_3 \begin{bmatrix} \pi_{t-3}^C \\ \mu_{t-3} \\ \gamma_{t-3} \end{bmatrix} + A_4 \begin{bmatrix} \pi_{t-4}^C \\ \mu_{t-4} \\ \gamma_{t-4} \end{bmatrix} + \Psi_t \tag{6}
$$

Where, π_t^C, μ_t, and γ_t denote core inflation, broad money growth, and credit growth respectively.[27] Four lags of each variable were included based on the Akaike information criterion.[28] The inflation forecasts and 95 percent confidence bands generated by the VAR are compared to actual inflation rates in Figure III-3, and the estimation output is shown in Table III-3.

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[25] The root mean square error (*RMSE*) compares actual values with forecasted values. A lower *RMSE* is an indication of a more accurate forecast.

[26] See Hamilton (1994) for further details on VARs.

[27] A_0, A_1, A_2, A_3, and A_4 are the constant and coefficient matrices respectively, whereas Ψ is the matrix of errors terms.

[28] The growth rate of credit to the private sector was the second best indicator of inflation, which is also consistent with conclusions in related studies (see, for example, Bokil and Schimmelpfennig, 2005).

Figure III-3. Yemen: Forecasting Core Inflation, January 1998–January 2005
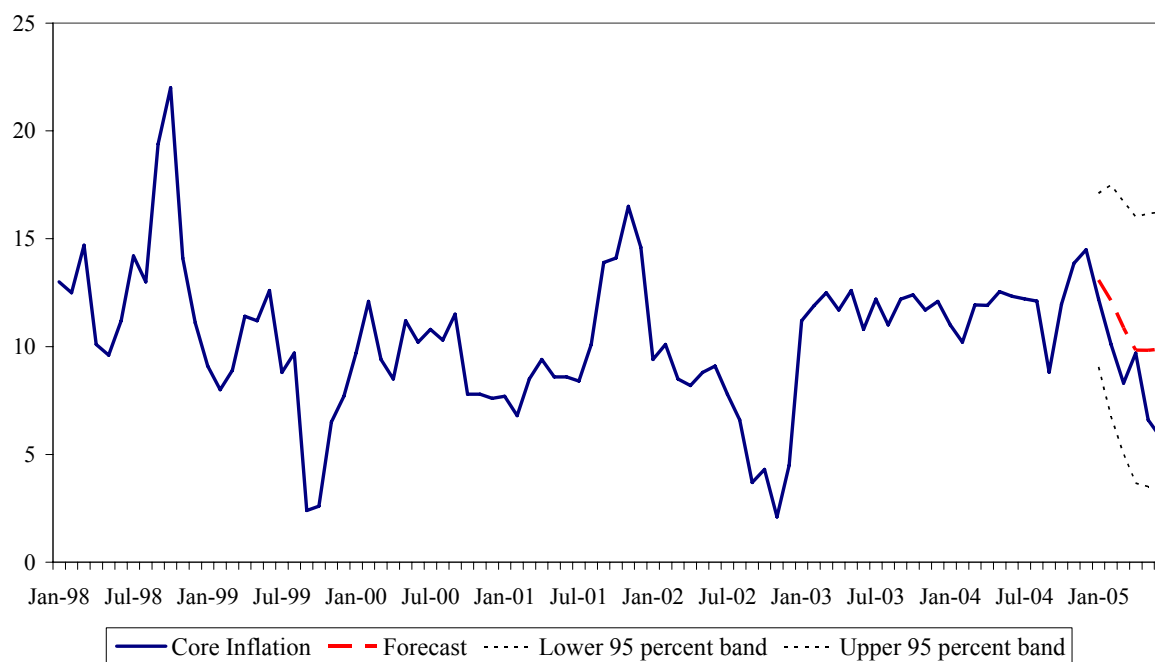
Source: Fund staff estimates.

Table III-3. Yemen: Forecasting Using a VAR

Variable	π^C_t		γ_t		μ_t	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	3.66	1.76	3.72	2.28	2.22	1.82
π^C_{t-1}	0.79	6.51	0.14	1.45	-0.07	-0.93
π^C_{t-2}	-0.16	-1.03	-0.24	-1.98	0.05	0.53
π^C_{t-3}	-0.01	-0.05	0.02	0.19	0.17	1.91
π^C_{t-4}	-0.05	-0.43	0.14	1.44	-0.04	-0.48
μ_{t-1}	0.10	0.65	0.64	5.29	0.06	0.63
μ_{t-2}	0.33	1.82	0.04	0.25	-0.09	-0.88
μ_{t-3}	-0.18	-1.00	-0.06	-0.38	-0.06	-0.52
μ_{t-4}	-0.10	-0.70	0.05	0.40	-0.06	-0.71
γ_{t-1}	-0.28	-1.44	-0.36	-2.36	0.35	3.07
γ_{t-2}	0.16	0.76	0.12	0.74	0.52	4.20
γ_{t-3}	0.08	0.39	0.09	0.52	0.00	0.02
γ_{t-4}	-0.10	-0.52	-0.06	-0.41	-0.23	-2.08
R^2	0.64		0.69		0.70	
RMSE			2.53			

Source: Fund staff estimates.

Although the VAR incorporates potentially useful leading indicators for inflation, the information content in these extra variables tend to be limited. Even though the growth of credit to the private sector is the second best indicator of inflation among all monetary aggregates, in the case of this VAR, it skews the forecasts upward, decreasing accuracy. In a break from the past, as we approach the forecast sample, core inflation begins to trend downward in contrast to credit to the private sector which begins to accelerate, thereby tilting the inflation forecasts upward. This is underscored by the fact that the VAR has a higher *RMSE* of 2.53, as compared to the *RMSE* of 2.00 associated with the ARX model.

In one sense, the limited information content of additional variables is further evidence that the relationship between monetary aggregates and inflation is unstable in Yemen. The instability of money demand and the associated weak evidence of a robust monetary transmission mechanism tend to undermine the usefulness of macroeconomic indicators in predicting future inflationary developments under the current regime.

Although these simple inflation forecasting models are highly stylized, they can be implemented and expanded upon by the CBY, in an attempt to assess future inflationary developments. The forecasts generated from such models, along with the expertise of the CBY, could serve as guidelines that would help formulate a forward-looking rule-based monetary policy regime in Yemen.

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