WP/01/198

IMF Working Paper

Sources of Inflation in Developing Countries

Prakash Loungani and Phillip Swagel

INTERNATIONAL MONETARY FUND

 WP/01/198

IMF Working Paper

External Relations Department and Western Hemisphere Department

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Prepared by Prakash Loungani and Phillip Swagel

Authorized for distribution by Steven Dunaway and Graham Hacche

December 2001

Abstract

This paper develops stylized facts about the inflation process in developing countries, focusing particularly on the relationship between the exchange rate regime and the sources of inflation. Using annual data from 1964 to 1998 for 53 developing countries, we find that money growth and exchange rate changes—factors typically related to fiscal influences—are far more important in countries with floating exchange rate regimes than in those with fixed exchange rates. Instead, inertial factors dominate the inflation process in developing countries with fixed exchange rate regimes.

JEL Classification Numbers: E31, E42

Keywords: Inflation, developing countries, exchange rate regimes

Author's E-Mail Address: ploungani@imf.org, pswagel@imf.org

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[1] This paper was prepared for presentation at the conference on "Economic Policy in the International Economy," held at Tel Aviv University on March 25–26, 2001, to honor Assaf Razin's sixtieth birthday. We thank our discussant, Eran Yashiv, an anonymous referee, and other seminar participants for their helpful comments.

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I. Introduction

This paper develops stylized facts about the inflationary process in developing countries, focusing particularly on the relationship between the exchange rate regime and the sources of inflation. To this end, we examine the influences on inflation in annual data from 1964 to 1998 for 53 developing countries grouped both by region—Africa, Asia, the Mediterranean, and South America—and by exchange rate regime—fixed or floating. This broad-brush approach of pooling together countries is intended to complement the many previous analyses of inflation in developing countries that have typically focused on the experience of individual countries or small groups of them.[2]

We group sources of inflation into four categories. First, as discussed by Montiel (1989), inflation in developing countries is often linked to underlying fiscal imbalances. Such imbalances can lead to an increase in inflation either by triggering higher money growth, as in Sargent and Wallace (1981), or by triggering a balance of payments crisis and forcing an exchange rate depreciation, as in Liviatan and Piterman (1986). The interaction between inflation and the government budget constraint is also stressed in Razin and Sadka (1987) and Bruno and Fischer (1990).

Another possibility, examined by Coe and McDermott (1997) for 13 Asia economies, is that—as in the industrial countries—inflation in developing countries indicates an overheating economy and is influenced by an activity variable such as the output gap. A third source of inflation, examined by Ball and Mankiw (1995), is supply-side "cost shocks"—movements in the prices of particular goods, such as oil, that lead to persistent changes in the aggregate price level. Finally, as discussed by Chopra (1985), inflation may have a substantial inertial component arising from the sluggish adjustment of inflationary expectations or the existence of staggered wage contracts.

To provide evidence on the relative importance of these four sources for inflation, we include in our analysis the following variables:

1. money growth and exchange rates, variables suggested by the fiscal view;
2. the output gap and a measure of the world business cycle;
3. changes in the prices of oil and non-oil commodities, to capture cost shocks;
4. past realizations of inflation, to reflect the inertial component of inflation.

In examining the sources of inflation, we do not explore the underlying political and institutional features in each country which either lead to high inflation rates or provide an

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[2] For example, Moser (1995) provides evidence on the dominant factors influencing inflation in Nigeria, while Montiel (1989) examines inflation in Argentina, Brazil, and Israel.

atmosphere conducive to achieving price stability.[3] Instead, we focus on the "proximate" sources of inflation suggested by the four views discussed above.

We find that the sources of inflation are quite diverse in African and Asian countries, which tend to have low to moderate rates of average inflation. In these countries, the most important of the four sources is the inertial component. The other three sources matter as well, but their quantitative importance is much smaller. In contrast, in economies with higher rates of average inflation, such as many in South America, the fiscal variables of money growth and exchange rate changes are predominant, with inertial inflation playing a much smaller role. We show that these differences in the relative importance of sources of inflation across regions correspond to differences in the exchange rate regime. The contribution of the fiscal component of inflation—money growth and exchange rate changes—is far more important in countries with floating exchange rate regimes than in those with fixed exchange rates, where inertial factors dominate the inflationary process.

The remainder of the paper is organized as follows. The next section presents our econometric method, after which section three discusses data. Section four provides results, first for developing countries taken as a whole, and then for various groups of countries distinguished by their region and their exchange rate regime. Section five concludes.

II. Econometric Method

We estimate vector autoregressions (VAR's) with at least the following six variables: oil price growth, non-oil commodity price growth, the output gap, money growth, inflation, and exchange rate changes. The approach is similar to that of Montiel (1989), with the exception that we pool together data across the various countries instead of estimating separate VAR's for each country. We also discuss results in which we add measures of fiscal deficits and the world business cycle to this base specification.

For our cross-country panel of data, let t denote time, and i index countries. We pool the data across countries and estimate VAR's of the form:

$$Z_{it} = A(L)\, Z_{it-1} + \theta_i + \varepsilon_{it}$$

where $A(L)$ is a one-sided polynomial in the lag operator (L), θ_i denotes a set of country-specific fixed effects and ε_{it} is a vector of normally distributed errors.[4] By pooling across

[3] Examples of these institutional features, along with recent studies, include: central bank independence, Alesina and Summers (1993); openness to trade, Romer (1993); and country size and development, Campillo and Miron (1996).

[4] It is well known that least squares estimates are biased in the presence of both fixed effects and lagged endogenous variables. However, as discussed by Nickell (1981) ahd Hsiao (1989,

(continued)

countries, we impose the restriction that the estimated coefficients in each equation are the same across each country in the VAR. The fixed effects are intended to capture country-specific influences on inflation due to differences in institutional factors such as unionization rates, wage bargaining structures, or concentration ratios, all of which potentially explain the behavior of prices, but for which country- or industry-specific data are not available. In Section 4 below, we split the countries into several groups to examine the sources of inflation across regions and other groups of countries.

Use of a VAR allows us to look at the effect of different assumptions as to the contemporaneous interactions of the variables, notably the interactions of money growth, inflation, and exchange rates, without imposing any constraints on the particular channels through which the factors interact.[5] We present variance decompositions for inflation, as well as results on the effect of innovations ("shocks") in each of the variables on inflation. As usual, an innovation is defined as the component of each variable which is orthogonal to lags of all variables as well as contemporaneous values of variables ordered before it in the VAR. While this provides an economically meaningful definition of shocks, a pitfall of the non-structural VAR methodology is that certain results may be sensitive to the ordering of the variables in the system. This is discussed extensively in Section 4.

III. Data

We use annual data on 53 developing countries for the years 1964 to 1998. Table 1 presents summary statistics, along with a list of the individual countries. Major oil-producing countries are excluded from the sample.[6] Data on money growth, inflation and nominal exchange rates come from the IMF *International Financial Statistics*. Money growth is the difference of the log of M2 (line 35l, which is line 34 plus line 35), though using base money instead (line 14) does not affect our results. Inflation is the difference of the log of the CPI (line 64), while the nominal exchange rate is measured as the difference of the log of the bilateral nominal exchange rate with the U.S. dollar (line rf). The exchange rate is specified as units of domestic currency per dollar, so that an increase in the exchange rate represents a depreciation of the currency. It would be preferable to use an exchange rate which takes into

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pp. 73–76), the bias is inversely proportional to the time dimension (T) of the panel; in our data set T is between 20 and 30, so that the size of the bias is likely to be small. Note that the dynamic panel data model of Holtz-Eakin, Newey, and rosen (1988) is not appropriate for our case, since the asymptotics rely on the width of the panel (number of countries) going to infinity.

[5] See Clarida and Gali (1996) for a related structural model.

[6] Removing the oil-producing nation of Gabon from the sample does not change our results.

account bilateral exchange rates with each country's major trading partners (such as the nominal effective exchange rate, lines nec and neu in IFS), but such a measure is not available for many of the countries in our sample. We use nominal rather than a measure of the real exchange rate; this is because real exchange rates already take into account the inflation rates we seek to explain.

Data on fiscal deficits are from the IMF's World Economic Outlook database. These are measured as the central government balance as a share of GDP, so that a negative sign indicates a deficit. A measure of the general government deficit rather than the central government deficit is available for a limited subset of countries and years; the correlation between the overlapping observations of the two measures is in excess of 0.9.

The output gap is constructed as the log of potential output minus the log of actual output, so that an increase in the output gap reflects a slowdown in economic activity relative to potential. Of course, this could also indicate an increase in potential with no change in actual output. Actual output is per capita real GDP (RGDPCH) from version 5.6 of the Summers-Heston database, while potential GDP is constructed by using the filter from Coe and McDermott (1997) to smooth the log of per capita real GDP. The McDermott filter is similar to the Hodrick-Prescott filter, but with the smoothing parameter chosen by the data.[7] A measure of labor market slack such as the unemployment rate would be an obvious alternative to the output gap as a measure of real activity; unfortunately, this is not available on a consistent basis for the broad range of developing countries. We also examine the impact on inflation of the "world business cycle," measured here as the GDP-weighted growth rates of the seven largest industrial countries.

We construct a measure of non-oil commodity prices by matching disaggregated data on the value of imports for each country from the UN commodity trade database to commodity-specific prices of 23 commodities from IFS.[8] The prices for the 23 individual commodities are aggregated together using each country's import weights to create a country-specific measure of non-oil commodity prices. As a result, movements in the price of a particular commodity will have the largest effect on inflation in countries that most heavily import that item. The measure of oil prices is the average oil price from IFS in dollars; this is a global price and thus the same for each country. Energy prices of course vary by country due to

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[7] Note, however, that developing countries may experience particularly large positive supply shocks by importing new technologies from the industrial countries. These large increases in potential output would tend to be averaged over by our use of a smoothing filter to construct potential output.

[8] The commodities are: cereals, vegetable oil, beef, lamb, sugar, bananas, coffee, cocoa, tea, timber cotton, wool, rubber, tobacco, hides, copper, aluminum, iron ore, tin, nickel, zinc, lead, and fertilizer.

country-specific tariffs, excise taxes, and differences in the productivity of the electrical generating and heating industries. Unfortunately, country-specific measures of energy prices are not available for our wide range of developing countries.

Table 1 provides a summary of the data, in total, by region, and for individual countries, with the countries sorted by average rates of inflation within each region. Average rates of inflation vary widely across regions, with moderate to low rates generally found in Africa and Asia, but quite high average rates in most South American and Mediterranean countries. Using median rather than mean rates of inflation gives similar results.

The long run relationship implied by the quantity equation is evident in the strong correlation between money growth and inflation in the whole sample, though the strength of the relationship varies across country groupings. Most notably, there is a strong correlation between money and inflation in countries with high inflation (average inflation above 10 percent), but a much weaker relationship in low inflation countries (average inflation below 10 percent). This is true for the individual regions and countries as well.

Surprisingly, there is only weak evidence of a negative correlation between the fiscal balance and either money growth or inflation in the sample as a whole. However, the correlation is strongest (that is, most negative) in countries with high average rates of inflation, particularly in the Mediterranean region. In Africa, inflation and money growth appear to decrease with a fiscal deficit, though of course these raw correlations do not control for other factors and do not imply anything about causality. Further, 7 of the 16 African countries in the sample are members of the CFA Franc Zone (Cameroon, Congo, Gabon, Ivory Coast, Niger, Senegal, and Togo), and thus do not pursue independent monetary policies. Positive output growth in these countries likely leads to both fiscal surplus and to capital inflows. These inflows would be expected to expand the money supply, which is endogenous with the fixed exchange rate regime, thus providing for the positive correlations between fiscal balance, money growth, and inflation.

We next turn to results from the VAR's, which allows an examination of conditional correlations between variables, issues of causality, and effects of various shocks to inflation.

IV. Specifications and Results

Our method is to first find an empirical specification which best characterizes the entire sample, and then examine separate results for groupings of countries. Our base specification is a six equation recursive VAR with the following variables:

1. Oil price growth
2. Non-oil commodity price growth
3. Output gap (as share of potential GDP)

4. Money growth
5. Exchange rate growth
6. Inflation

As discussed below, we consider two base specifications, with the difference between the two being a switch in the positions of money and exchange rate growth in the VAR. Measures of fiscal balance and the world business cycle are considered in section 4.5, though it turns out that these variables do not affect our main results. Four lags used in the VAR's; the results do not change much if we use two, three, or five lags instead of four.

The ordering of the variables is discussed in section 4.1, followed by variance decompositions showing the importance of each variable in accounting for inflation movements in section 4.2, and impulse response functions showing the response of inflation to various shocks in section 4.3. Sensitivity analysis follows in section 4.4.

A. Ordering of the Variables

Table 2 provides two sets of results that are helpful in discussing the ordering of variables in the VAR. The top part of the table shows the significance level for the F-test of the null hypothesis that the four lags of the variable in a particular row can be excluded from the regression for the variable at the top of each of the six columns without loss of explanatory power. A small significance level (corresponding to a large F-statistic, not shown) indicates a rejection of the null and means instead that the variable in a given row does forecast the variable listed at the top of the column. The bottom part of the table shows the correlations between the errors of the six equations. A high correlation indicates that the ordering of the two equations in question might (but does not necessarily) matter for the results of the variance decompositions and impulse response functions. We use these results as a guide to make several assumptions as to the ordering of the base specification.

We first assume that price movements in oil and non-oil commodities are driven by exogenous developments that are not affected in the same year by the other factors. For oil prices, of course, the biggest developments in prices have resulted from OPEC-related supply disturbances. Oil and non-oil price movements are closely related, with a correlation coefficient of the errors from the two equations just over 0.4. In all specifications, however, we find that it makes little difference which of the two is ordered first. We also experimented with a single variable which combines oil and non-oil commodity prices, again with import values as weights. While this does not affect results for the other four variables, the fit of this one equation is substantially worse than the fit of either of the two separate regressions.

The other large correlations are those between money growth, inflation, and exchange rates. We assume that the contemporaneous correlation between innovations in money growth and inflation innovations reflects causation from money growth to inflation, though there is clearly some feedback from inflation to monetary aggregates within the year. A similar assumption is made with respect to the correlation between exchange rate growth and inflation, with innovations in exchange rates assumed to lead to inflation within the year.[9] While a structural model and higher frequency data are needed to disentangle the underlying relationship, the ordering of exchanges rates and inflation does not change the result that the relative importance of fiscal vs. inertial factors corresponds closely to the grouping of floating and fixed exchange rate regimes. This leaves the issue of the direction of causation between exchange rate innovations and money growth innovations; in this case, we consider both orderings.

Finally, we place the output gap before the three nominal variables (money, exchange rates, and inflation). This is because even though Table 2 shows that lags of money growth forecast the output gap but not vice-versa, the correlation between the errors of these two equations is quite small. And it turns out that the ordering of money growth and the output gap does not matter for our results. We thus place the output gap after oil and Non-Oil prices and before M2 growth in order to pair money and inflation and most cleanly isolate their interaction.

B. Importance of the Six Factors as Influences on Inflation

Table 3 shows the results from variance decompositions for the two specifications discussed above (exchange rates before money growth and vice-versa), estimated over the entire sample (with country fixed effects). Three key findings emerge:

- Inflation is mainly a fiscal phenomenon, represented in our framework by money growth and exchange rate movements. With money (and inflation) ordered before inflation, money growth accounts for over two-thirds of the variance of inflation at both short and long term horizons; under the second ordering, this role is assumed by exchange rate movements. And this finding of the combined importance of money growth and inflation is not affected by putting inflation before exchange rates.

- Past realizations of inflation account for between ten and twenty percent of inflation movements. This suggests an important role for inflationary expectations and institutional features such as indexation schemes, both of which allow past inflation to influence current wages and price-setting.

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[9] The F-statistics in Table 2 indicate that lags of inflation provide information on exchange rate movements, while we cannot reject the null hypothesis that lags of exchange rates do not forecast inflation. However, block exogeneity tests indicate that inflation and exchange rates Granger cause each other, though we much more decisively reject the null that inflation has no affect on exchange rates (χ^2 statistic of 208.4) than we do the null that exchange rates have no affect on inflation (χ^2 statistic of 34.7).

- Cost shocks and the output gap play a relatively minor role in accounting for inflation. It is possible, of course, that these influences matter more for short-term inflation movements not evident in annual data.

The next four tables split the data into four regional groups. For African countries (Table 4), past realizations of inflation play a predominant role, accounting for two-thirds to three-fourths of the variance of inflation—this is especially remarkable since inflation is ordered last in the VAR. The role of fiscal influences—money growth and exchange rate changes—is correspondingly lower than is the case for the entire sample. One important additional result here is that the uncertainty about the relative importance of money shocks and exchange rate shocks is reduced as well. For instance, at a ten year horizon, money shocks account for between 6 and 10 percent of the variance of inflation, whereas exchange rates account for between 14 and 18 percent. In both cases, the choice of ordering does not really alter the qualitative results. Commodity shocks are somewhat more important in African countries than for developing countries as a whole, corresponding to the importance of primary commodities in these countries' economies. Even so, they are far less important influences on inflation than inertial dynamics and fiscal factors.

Results for Asian economies (Table 5) are broadly similar to those for Africa. The predominant factor in accounting for inflation is again past realizations of inflation, though cost shocks eclipse fiscal factors for Asia. Note that the uncertainty about the respective roles of money and exchange rate shocks is again quite small; at a ten year horizon, money shocks account for between 8 and 9 percent of inflation movements, while exchange rate shocks account for between 7 and 8 percent.

The results for South America present a sharp contrast (Table 6). Inflation displays little persistence. Instead, most of the explanatory power comes from the fiscal variables, although of course our non-structural approach does not delineate between the roles of money and exchange rate shocks. The results for the fourth group, the Mediterranean countries (Table 7), fall in between those for Asia and Africa, on the one hand, and South America on the other.

What accounts for these differences across regions in the sources of inflation? While a complete investigation of this issue is not conducted in this paper, we suggest that the differences can be connected to differences in exchange rate regimes. To see this, we segment the sample into countries with exchange rate regimes that, on average over the sample period, are close to a fixed exchange rate regime and those with regimes close to a floating exchange rate regime. This segmentation relies on the work of Ghosh, Gulde, Ostry and Wolf (1995), who classify the exchange rate regimes of a large sample of countries over the period 1960–1990 into nine regimes, ranging from single currency pegs at the fixed end to floating regimes with no intervention at the floating. Using the average value for each country's exchange rate regime over 1964 to 1990, we collapse the scheme of nine regimes into two categories, those that are relatively fixed and those that are closer to a floating exchange rate regime.

The average exchange rate regime differs substantially across regions, but there is a good deal of similarly within each region. In Africa, for example, 16 of the 19 countries in our sample countries have pegged systems and two others are close to fixed. The eleven Asian countries have regimes that are between pegged and floating regimes, but most are closer to a fixed regime than to floating. In South America, on the other hand, few countries have fixed systems, with the vast majority—14 of the 19 countries in our sample—characterized as floating over the sample period.

Given this close relationship between regions and exchange rate regimes, it is no surprise that the results for the variance decomposition of inflation by exchange rate regime are broadly similar to those by region (Tables 8 and 9). The results for the fixed exchange rate group are quite similar to those for the African and Asian regions: inflation has a substantial inertial component, the two fiscal variables are together the next most important influences on inflation, the range of uncertainty about the relative importance of money growth and exchange rate changes is narrow, and cost shocks and the output gap play a modest role. For the floating exchange rate group (Table 9), the results resemble those for South America: fiscal variables are the predominant influence on inflation rather than inflationary inertia, while cost shocks and the output gap are relatively minor influences on inflation.

C. Response of Inflation to Shocks

We next assess the response of inflation to shocks to a one standard deviation shock to each of the six influences considered above (including inflation itself). The focus here is only on the response of inflation; the complete set of impulse responses—the response of all six variables to all six shocks—is available from the authors. The impulse responses for inflation are shown in Figure 1 for the sample of all countries for the two orderings of the VAR. In addition to the point estimates (the solid lines), the Figures show error bands two standard deviations wide (the dashed lines).[10]

Regardless of the ordering chosen, the following conclusions hold. First, expansionary policies, whether reflected in faster money growth or exchange rate depreciation, lead to higher inflation and the impact is statistically significant. The response of inflation to money innovations is hump-shaped, with the largest impact coming a year after the monetary impulse. Second, positive oil and non-oil innovations raise inflation by only a modest amount and the impact is borderline statistically significant. Third, an increase in the output gap—that is, a weakening of the economy—leads to a statistically significant decline in

[10] The standard errors of the impulse responses are computed by the Monte Carlo method described in the manual for RATS version 4, using 1,000 draws from the estimated asymptotic distribution of the VAR coefficients and the covariance matrix of the innovations. The point estimate and standard errors are the mean and standard deviation across draws of the simulated impulse responses.

inflation, though with a lag of one to two years and after an initial movement in the other direction. But the magnitude of the inflation response to real activity is generally small, so that our results provide limited support for the "gap model" of inflation in developing countries. One explanation for the perverse initial response of inflation to a slowdown of output is that it may reflect governments' initial reliance on inflation-causing fiscal deficits in the face of falling revenues. Fourth, an exogenous increase in inflation has a persistent effect, with a statistically significant increase in inflation for two to three years following the initial impulse.

The close relationship between the variance decomposition of inflation for regions and the decomposition for exchange rate regimes holds for the impulse responses as well. The responses for Asia and Africa resemble those for pooling together economies with fixed exchange rate regimes, while those for South America are similar to those for countries with floating exchange rate regimes. In the interest of brevity, we report the impulse responses for inflation only by exchange rate regime and not by region; these are shown in Figure 2 for fixed exchange rates and Figure 3 for floating exchange rates. For fixed exchange rate regimes (Figure 2), both oil and non-oil innovations have strong and statistically significant impacts on inflation. Even though together these account for only about 10 percent of the variance of inflation (as seen in Table 8), they matter when they happen (the impulse response is statistically significant). The response of inflation to money innovations is muted though statistically significant in countries with fixed exchange rate regimes. For floating exchange rate regimes (Figure 3), oil and non-oil innovations have only small effect on inflation, while money innovations and exchange rate shocks have substantial impacts (for the latter, particularly when ordered ahead of money growth in the VAR system). This again points to the importance of fiscal factors in economies with flexible exchange rate regimes.

D. Sensitivity Analysis

We examined several alternative specifications beyond changes in the orderings of the variables.[11] Using base money rather than M2 as our measure of money growth hardly affects the results. Similarly, adding the "world business cycle" (the GDP-weighted growth rates of the G7 countries) as an additional variable in the VAR has little effect on the results; this turns out to explain less than one percent of the variance of inflation in the whole sample, and no more than four percent in any of the groupings of countries.

We also examined the impact of shocks to the fiscal balance on inflation, money growth, and exchange rates by adding the fiscal balance to the system before money growth. This is to make fiscal effects explicit rather than implicit in the variables of money and exchange rates.

[11] June Flanders suggested that another useful sensitivity test would be to see if the estimates are stable over time, particularly comparing the pre- and post-1973 periods. We intend to do this in future work.

The effect of a fiscal impulse on inflation depends on whether the ratio of fiscal balance to GDP exceeds a threshold value. For countries in which the average deficit is smaller than 5 percent of GDP, the ratio of the fiscal balance to GDP accounts for little of the variance of inflation, and a one standard deviation innovation in the deficit to GDP ratio has essentially no effect on inflation. In these "small deficit" countries, the fiscal balance explains less than 1 percent of the variation in money growth and less than 2 percent of exchange rate movements. Deficits matter much more, however, when they are large; for example, when the average fiscal deficit exceeds 5 percent of GDP. In these "large deficit" countries, the fiscal balance accounts for 7 percent of inflation movements, and an increase in the deficit leads to a statistically significant increase in inflation. Similarly, the fiscal balance accounts for over 5 percent of the variance of money growth and over 4 percent of exchange rate movements in these countries.

We also checked whether the results were sensitive to the inclusion of Argentina and Brazil, whose inflation series might be I(1). Dropping these two countries from the sample did not affect the empirical results.

V. Conclusions

This paper makes two principal contributions. First, the results provide a quantitative benchmark for the relative importance of various sources of inflation and traces out the dynamic response of inflation to different shocks. We find that the sources of inflation are quite diverse in African and Asian countries, the majority of which tend to have low to moderate rates of average inflation. Fiscal variables—as reflected either in money growth or in adjustments in exchange rate pegs—matter, but so too do shocks to the prices of oil and non-oil commodities and the output gap. What is most important in these countries, however, is the inertial component of inflation. This implies that anti-inflationary policy in developing countries with moderate to low inflation should focus on structural issues such as labor market rigidities and indexation schemes that affect the expectational relationship between past and future inflation. In countries with higher rates of average inflation, such as many in South America, fiscal variables are predominant, with inertial inflation playing a much smaller role.

Second, we present evidence suggesting that the differences in the relative importance of sources of inflation across regions correspond to differences in the exchange rate regime. The contribution of money growth to inflation is far less important in fixed exchange rate regimes than in floating exchange rate regimes. In recent years, many developing countries have departed, or are contemplating departing from, fixed exchange rate regimes. Our results suggest that this move can be inflationary unless the new monetary arrangement is able to assume some of the role that an exchange rate peg in moderating the impact of money shocks on inflation.

Several limitations of our analysis might usefully be addressed in future work. First, we impose a "common coefficient" restriction on the response of inflation to the various shocks.

While we present results for various regional groups, there is still considerable heterogeneity within each regional group in the inflation experience and—quite likely—in the response of inflation to different shocks. As a result, there could be some "canceling out" of the effects of explanatory variables when the data for different countries are pooled. Hence, it would be useful to test the common coefficient restriction against alternatives.

Second, while the use of country fixed effects allows for differences across countries in the average rate of inflation, there could be changes in this average over time within a country, for example from changes in institutions or other determinants of average inflation such as the degree of openness. For instance, Loungani, Razin and Yuen (2001) provide evidence on the impact changes in restrictions on capital mobility have on macroeconomic variables.

Third, our specification does not allow for non-linearities in the relationships between, for example, fiscal deficits and inflation or output and inflation, which have been found in some earlier work.

Fourth, since our data are annual, the effects of output gap and cost shocks may be understated, as these effects may operate at a higher frequency. One way to check this would be to use quarterly data.

Finally, future work might usefully be carried out in the context of a more structural model, such as the one presented in Gali and Gertler (1999).

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Table 1. Summary Statistics

Country	Obs	Inflation Average	Money Growth (M2) Average	Money Growth (M2) Corr with Inflation	Fiscal Balance/GDP Average	Fiscal Balance/GDP Corr with Inflation	Fiscal Balance/GDP Corr with M2 Growth
All countries (53 countries)	1695	16.4	22.2	0.928	-4.5	-0.019	-0.009
Inflation below 10 percent (24 countries)	924	6.6	12.8	0.371	-5.0	-0.017	0.018
Inflation above 10 percent (29 countries)	771	27.6	33.3	0.945	-3.9	-0.047	-0.039
Africa (16 countries)	494	8.8	13.0	0.481	-5.9	-0.006	0.032
Burkina Faso	15	3.5	11.6	0.455	-16.9	0.087	-0.090
Niger	35	5.4	7.5	0.419	1.9	0.200	0.383
Morocco	35	5.7	12.0	0.587	-6.0	-0.265	0.145
Ethiopia	32	6.1	11.6	0.242	-4.7	-0.220	-0.291
Gabon	34	6.2	11.6	0.574	-21.6	0.161	-0.068
Togo	31	6.4	11.2	0.419	-4.2	-0.190	0.184
Senegal	31	6.4	8.5	0.475	-1.8	-0.218	-0.009
Seychelles	27	6.8	14.7	0.280	-8.3	0.127	0.111
Cote D Ivoire	35	7.1	11.0	0.558	-6.6	0.129	0.516
Congo	33	7.1	8.7	0.272	-5.2	-0.138	0.276
Cameroon	29	7.9	10.1	0.463	-3.1	0.089	0.567
Mauritius	35	8.2	16.1	0.391	-6.0	-0.213	0.262
Kenya	29	10.6	15.7	0.325	-5.2	-0.267	-0.099
Algeria	26	11.6	16.5	-0.003	5.1	-0.407	0.239
Madagascar	34	11.7	14.1	0.302	-4.9	-0.485	-0.185
Ghana	33	27.5	27.5	0.527	-6.2	-0.218	-0.009
Asia (11 countries)	351	9.3	17.2	0.812	-3.5	-0.018	0.086
Singapore	35	3.1	13.4	0.103	3.5	-0.117	-0.149
Malaysia	34	3.6	14.0	0.336	-3.1	-0.139	0.154
Thailand	35	5.4	16.3	0.289	-1.3	0.067	0.168
Bangladesh	12	6.0	15.6	0.365	-7.9	-0.601	-0.627
Fiji	28	7.2	10.4	0.530	-3.0	0.120	0.179
India	34	8.3	14.8	-0.310	-5.8	-0.018	-0.315
Pakistan	35	8.4	14.2	-0.132	-7.3	-0.091	-0.230
Sri Lanka	35	8.7	14.2	0.317	-10.4	0.020	-0.203
Korea	35	9.9	24.1	0.228	-1.6	-0.492	-0.564
Philippines	35	10.6	16.1	0.102	-1.9	0.186	0.188
Indonesia	33	28.2	37.1	0.969	-0.4	-0.179	-0.182

Table 1. Summary Statistics

Country	Obs	Inflation Average	Money Growth (M2) Average	Money Growth (M2) Corr with Inflation	Fiscal Balance/GDP Average	Fiscal Balance/GDP Corr with Inflation	Fiscal Balance/GDP Corr with M2 Growth
South America (19 countries)	638	27.0	32.7	0.957	-2.5	-0.081	-0.064
Panama	35	3.0	11.9	0.259	-8.2	-0.558	-0.008
Barbados	32	7.4	10.9	0.276	4.9	0.443	0.235
Trinidad	34	8.4	12.4	0.420	2.3	-0.226	0.287
Honduras	35	9.0	15.7	0.437	-6.1	0.270	0.389
Guatemala	35	9.3	14.6	0.529	-2.9	0.369	0.276
El Salvador	35	10.3	13.9	0.391	-2.3	-0.403	0.111
Dominican Rep	35	11.4	17.5	0.424	-0.3	0.064	0.152
Paraguay	35	12.6	20.7	0.552	-0.9	0.671	0.620
Costa Rica	34	13.5	21.3	0.369	-4.2	0.232	0.026
Jamaica	35	15.6	19.2	0.681	-6.5	0.298	0.439
Colombia	31	18.2	23.4	0.514	-0.8	-0.336	-0.176
Ecuador	34	20.1	27.2	0.717	-1.7	0.462	0.514
Mexico	35	23.5	29.7	0.431	-4.6	-0.622	-0.268
Chile	35	36.6	46.8	0.920	4.3	0.010	0.041
Bolivia	35	41.9	49.4	0.982	-7.0	-0.682	-0.702
Uruguay	35	44.8	46.7	0.597	-2.0	0.103	0.064
Peru	35	60.4	62.3	0.990	-4.5	-0.090	-0.067
Argentina	35	78.4	81.1	0.980	-6.0	-0.082	-0.069
Brazil	18	142.2	95.1	0.944	-0.7	0.422	0.323
Mediterranean (7 countries)	212	14.7	21.6	0.846	-9.2	-0.163	-0.240
Malta	35	3.5	9.9	0.072	-1.9	0.349	0.176
Cyprus	35	4.7	12.7	0.146	-1.6	-0.571	-0.224
Jordan	28	7.5	13.5	0.521	-14.6	-0.451	-0.795
Egypt	35	10.2	16.5	0.539	-15.3	0.119	-0.075
Syria	33	10.7	17.3	0.086	-10.5	0.329	-0.271
Israel	34	31.8	40.9	0.813	-12.6	-0.236	-0.350
Turkey	12	32.9	40.6	0.881	-5.2	-0.367	-0.383

Table 2. Ordering of the Variables: Regressions with Four Lags

Significance Levels for F-Tests
All countries, 1695 observations

Influence on Inflation	Dependent Variable					
	Oil price	Non-Oil Price	Output gap	Money	Exchange Rate	Inflation
Oil	0.00	0.02	0.15	0.15	0.23	0.18
Non-oil	0.00	0.00	0.75	0.23	0.28	0.09
Output gap	0.84	0.02	0.00	0.84	0.00	0.00
Money	0.00	0.00	0.00	0.00	0.00	0.00
Inflation	0.12	0.05	0.01	0.00	0.00	0.00
Exchange rate	0.00	0.00	0.00	0.91	0.00	0.10
R^2	0.64	0.29	0.42	0.64	0.60	0.72

A low significance level (corresponding to a large F-statistic, not shown) indicates that the variable in the first columns provides predictive information on the corresponding variable in the top row.

Correlations Between Residuals of the Six Equations

	Non-Oil price	Output Gap	Money	Exchange Rate	Inflation
Oil Price	0.415	-0.098	0.081	-0.038	0.056
Non-Oil price		0.003	0.058	-0.047	0.061
Output gap			0.056	0.180	0.120
Money				0.728	0.822
Exchange rate					0.825

Table 3. Variance Decompositions for Inflation Equation: All Countries

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	0.2	0.2	1.9	66.5	11.6	19.6
1	0.2	0.5	1.2	77.8	7.9	12.5
2	0.1	0.7	1.1	80.2	6.8	11.1
3	0.1	0.7	1.6	80.2	6.7	10.7
4	0.2	0.7	2.1	79.7	6.7	10.6
5	0.2	0.7	2.2	79.7	6.6	10.6
10	0.2	0.7	2.3	79.8	6.6	10.5
			Exchange Rate Before Money Growth			
0	0.2	0.2	1.9	68.4	9.7	19.6
1	0.2	0.5	1.2	68.2	17.4	12.5
2	0.1	0.7	1.1	66.7	20.3	11.1
3	0.1	0.7	1.6	65.2	21.7	10.7
4	0.2	0.7	2.1	64.4	22.0	10.6
5	0.2	0.7	2.2	64.2	22.2	10.6
10	0.2	0.7	2.3	64.0	22.3	10.5

Table 4. Variance Decompositions for Inflation Equation: Africa

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	0.3	0.8	0.8	9.2	11.1	77.8
1	0.7	2.9	0.8	10.8	12.1	72.6
2	1.4	4.0	0.8	10.2	12.5	71.0
3	2.6	4.0	1.0	10.3	12.3	69.8
4	3.2	5.2	1.1	10.0	12.3	68.2
5	3.7	6.6	1.1	9.7	13.0	65.9
10	3.7	7.9	1.2	10.1	13.8	63.3
			Exchange Rate Before Money Growth			
0	0.3	0.8	0.8	17.1	3.2	77.8
1	0.7	2.9	0.8	19.0	3.9	72.6
2	1.4	4.0	0.8	18.8	3.9	71.0
3	2.6	4.0	1.0	18.4	4.2	69.8
4	3.2	5.2	1.1	18.1	4.2	68.2
5	3.7	6.6	1.1	18.4	4.4	65.9
10	3.7	7.9	1.2	18.2	5.7	63.3

Table 5. Variance Decompositions for Inflation Equation: Asia

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	4.8	4.7	1.1	0.1	5.3	84.1
1	9.7	21.6	0.8	3.0	7.7	57.2
2	9.8	22.1	1.2	7.4	6.8	52.6
3	9.5	21.5	1.4	8.5	6.7	52.4
4	9.4	21.1	1.6	8.6	6.9	52.5
5	9.4	20.8	1.6	9.0	6.8	52.5
10	9.4	20.7	2.9	9.1	6.7	51.2
			Exchange Rate Before Money Growth			
0	4.8	4.7	1.1	5.4	0.0	84.1
1	9.7	21.6	0.8	8.5	2.2	57.2
2	9.8	22.1	1.2	7.7	6.6	52.6
3	9.5	21.5	1.4	7.5	7.7	52.4
4	9.4	21.1	1.6	7.7	7.7	52.5
5	9.4	20.8	1.6	7.6	8.1	52.5
10	9.4	20.7	2.9	7.5	8.3	51.2

Table 6. Variance Decompositions for Inflation Equation: South America

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	0.2	0.1	4.4	76.9	8.5	9.9
1	0.1	0.3	2.8	87.0	4.8	4.9
2	0.1	0.6	2.5	88.6	4.1	4.1
3	0.2	0.6	4.1	87.3	3.9	3.9
4	0.3	1.2	5.9	84.7	3.8	4.1
5	0.3	1.5	6.5	83.8	3.8	4.1
10	0.4	1.6	6.6	83.6	3.8	4.1
			Exchange Rate Before Money Growth			
0	0.2	0.1	4.4	78.5	6.9	9.9
1	0.1	0.3	2.8	77.5	14.3	4.9
2	0.1	0.6	2.5	76.2	16.5	4.1
3	0.2	0.6	4.1	74.2	17.0	3.9
4	0.3	1.2	5.9	71.9	16.7	4.1
5	0.3	1.5	6.5	71.1	16.4	4.1
10	0.4	1.6	6.6	71.0	16.3	4.1

Table 7. Variance Decompositions for Inflation Equation: Mediterranean

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	2.8	0.0	3.3	27.3	12.4	54.2
1	4.9	0.7	1.5	41.0	6.5	45.6
2	4.8	0.9	1.4	43.7	5.4	43.9
3	4.4	0.8	1.1	51.7	5.8	36.2
4	4.9	0.7	1.0	55.7	5.4	32.2
5	6.3	0.7	1.0	55.3	5.1	31.5
10	7.4	1.2	1.2	54.7	5.0	30.5
			Exchange Rate Before Money Growth			
0	2.8	0.0	3.3	27.3	12.3	54.2
1	4.9	0.7	1.5	21.2	26.2	45.6
2	4.8	0.9	1.4	19.4	29.7	43.9
3	4.4	0.8	1.1	16.1	41.3	36.2
4	4.9	0.7	1.0	14.6	46.5	32.2
5	6.3	0.7	1.0	14.0	46.5	31.5
10	7.4	1.2	1.2	13.8	45.9	30.5

Table 8. Variance Decompositions for Inflation Equation:
Fixed Exchange Rate Regime Countries

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	0.2	0.9	1.8	5.1	20.6	71.4
1	2.2	5.3	1.6	7.2	22.4	61.2
2	2.7	6.6	1.6	8.1	21.3	59.7
3	3.1	6.5	1.6	9.1	21.4	58.4
4	3.2	6.5	1.6	9.7	21.1	57.8
5	3.5	6.5	1.8	10.0	21.0	57.3
10	3.7	7.0	2.2	10.4	20.6	56.1
			Exchange Rate Before Money Growth			
0	0.2	0.9	1.8	24.3	1.4	71.4
1	2.2	5.3	1.6	27.2	2.4	61.2
2	2.7	6.6	1.6	26.0	3.4	59.7
3	3.1	6.5	1.6	26.4	4.1	58.4
4	3.2	6.5	1.6	26.1	4.7	57.8
5	3.5	6.5	1.8	25.9	5.1	57.3
10	3.7	7.0	2.2	25.4	5.6	56.1

Table 9. Variance Decompositions for Inflation Equation:
Flexible Exchange Rate Regime Countries

Horizon	Oil price	Non-Oil Price	Output Gap	Money	Exchange Rate	Inflation
			Money Growth Before Exchange Rate			
0	0.3	0.1	5.6	71.5	8.7	13.7
1	0.2	0.3	3.7	83.3	5.1	7.5
2	0.2	0.4	3.2	85.5	4.3	6.3
3	0.2	0.5	4.9	84.2	4.2	6.0
4	0.2	0.8	7.0	81.8	4.1	6.0
5	0.2	0.9	7.7	81.1	4.1	6.0
10	0.3	0.9	7.9	80.9	4.0	6.0
			Exchange Rate Before Money Growth			
0	0.3	0.1	5.6	73.2	7.1	13.7
1	0.2	0.3	3.7	73.2	15.2	7.5
2	0.2	0.4	3.2	72.3	17.6	6.3
3	0.2	0.5	4.9	69.8	18.6	6.0
4	0.2	0.8	7.0	67.5	18.5	6.0
5	0.2	0.9	7.7	66.8	18.4	6.0
10	0.3	0.9	7.9	66.6	18.3	6.0

Figure 1. Response of Inflation to Shocks: All Countries

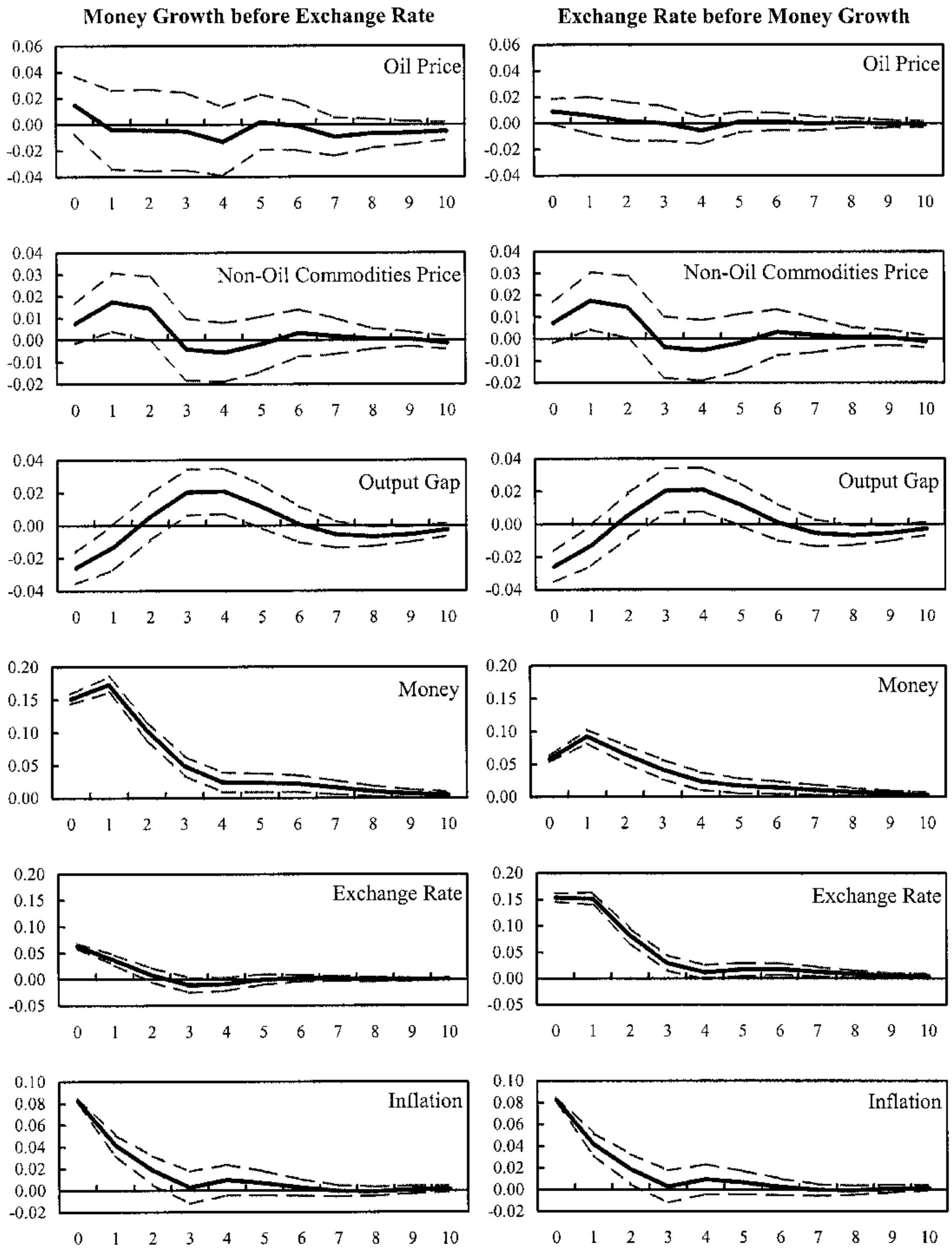

Figure 2. Response of Inflation: Fixed Exchange Rate Regimes

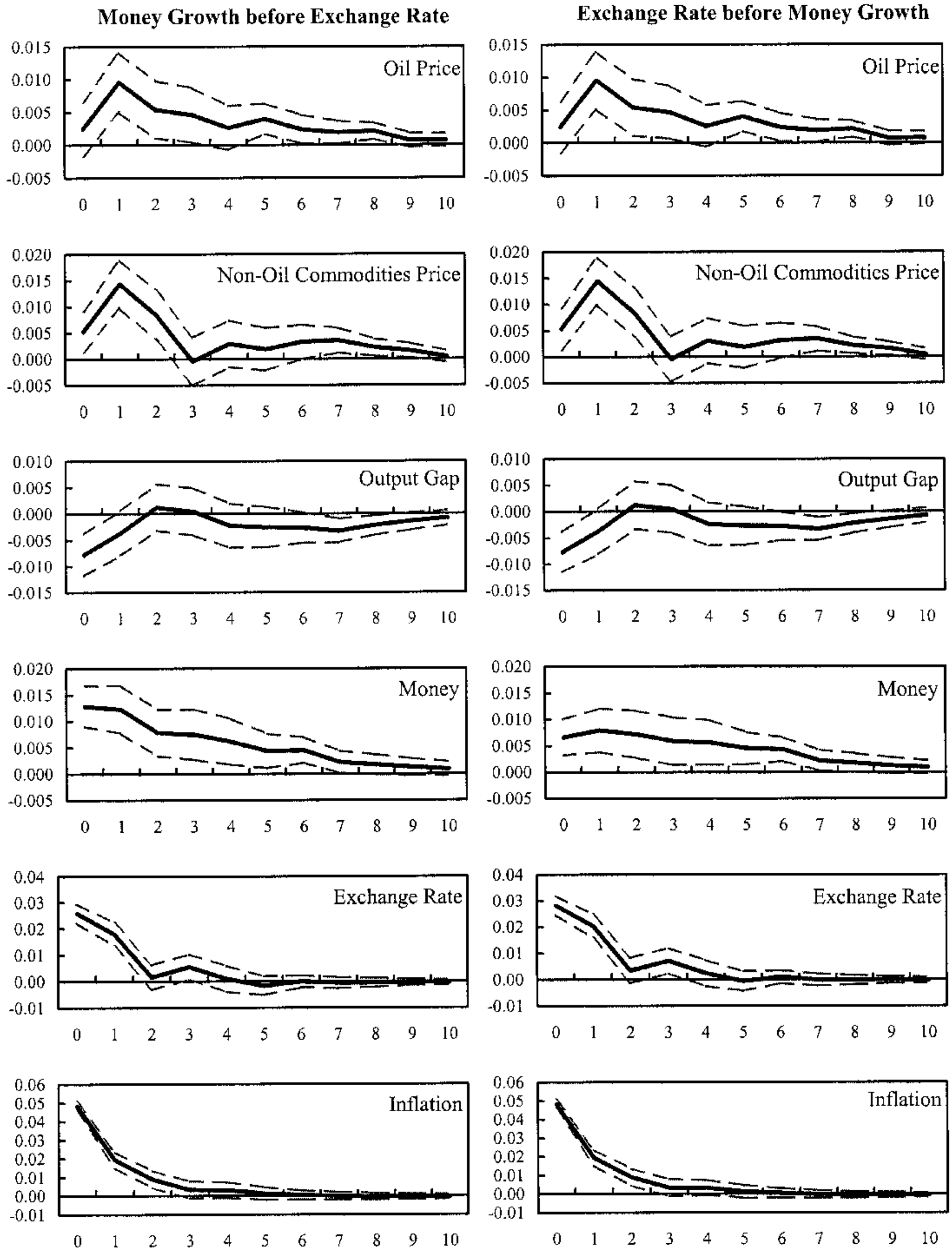

Figure 3. Response of Inflation: Flexible Exchange Rate Regimes