THE WORLD BANK ECONOMIC REVIEW, VOL. 14, NO. 2: 251-85

Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts

Pierre-Richard Agénor, C. John McDermott, and Eswar S. Prasad

This article documents the main stylized features of macroeconomic fluctuations for 12 developing countries. It presents cross-correlations between domestic industrial output and a large group of macroeconomic variables, including fiscal variables, wages, inflation, money, credit, trade, and exchange rates. Also analyzed are the effects of economic conditions in industrial countries on output fluctuations in the sample developing countries. The results point to many similarities between macroeconomic fluctuations in developing and industrial countries (procyclical real wages, countercyclical variation in government expenditures) and some important differences (countercyclical variation in the velocity of monetary aggregates). Their robustness is examined using different detrending procedures.

Understanding and distinguishing among the factors that affect the short- and long-run behavior of macroeconomic time series have been among the main areas of recent research in quantitative macroeconomic analysis. Using a variety of econometric techniques, a substantial body of literature has documented a wide range of empirical regularities in macroeconomic fluctuations and business cycles across countries. These stylized facts have often been used as an empirical basis for formulating theoretical models of the business cycle and as a way to discriminate among alternative classes of models.

Most of the new research in this area has focused on industrial countries, paying less attention to developing countries.[1] At least two factors may account for this. First, limitations on the quality and frequency of data may be constraining factors. For instance, quarterly data on national accounts are available for only a handful of developing countries, and even where they are available, they are considered to be of significantly lower quality than annual estimates. Second, developing countries tend to be prone to sudden crises and marked gyrations in

1. For an overview of the literature on industrial countries, see, for example, Backus and Kehoe (1992), Fiorito and Kollintzas (1994), and van Els (1995).

Pierre-Richard Agénor is lead economist and director of the Macroeconomic and Financial Management Program at the World Bank, C. John McDermott is an advisor at the Reserve Bank of New Zealand, and Eswar Prasad is a senior economist at the International Monetary Fund. Their e-mail addresses are *pagenor@worldbank.org*, *mcdermottj@rbnz.govt.nz*, and *eprasad@imf.org*. The authors would like to thank Nadeem Haque, Alexander Hoffmaister, Philip Lane, James Nason, and Julio Santaella for helpful discussions and comments; Marianne Baxter for the computer code for the band-pass filter; Brooks Calvo for excellent research assistance; and three anonymous referees for their comments.

macroeconomic variables, often making it difficult to discern any type of cycle or economic regularity.

At the same time documenting the stylized facts on macroeconomic fluctuations in developing countries could be useful for a number of reasons. Such an exercise could be valuable for analyzing whether similar empirical regularities are observed across countries with different income levels. Differences in the types of reduced-form relationships observed in industrial countries could provide an empirical basis for constructing analytical models of short-run fluctuations that incorporate features particularly important to developing countries. In addition, as argued, for instance, by Agénor and Montiel (1996), these findings may have important policy implications. They may, for example, be crucial for designing stabilization and adjustment programs.

A burgeoning literature has begun to document these stylized facts for developing countries. Some of the studies focus on specific stylized facts and construct theoretical models that can replicate those facts. Mendoza (1995), for instance, documents a strong positive correlation between terms-of-trade and output fluctuations in developing countries. Other studies in this genre include Kouparitsas (1997) and Kose and Riezman (1998), although these articles focus on one or two specific sets of bivariate correlations. Another set of articles documents a broader set of cross-correlations, but typically only for one country. Further, most use only one detrending procedure. Representative papers include Kydland and Zarazaga's (1997) work on Argentina and Rodríguez-Mata's (1997) analysis of fluctuations in Costa Rica. This article builds on the existing literature by systematically documenting a wide range of regularities in macroeconomic fluctuations for a large group of developing countries.

We chose the countries in our sample on the basis of several considerations. The first was the desire to select a group of countries for which we could assemble data of reasonable quality, thereby addressing the criticism that such exercises have limited validity because of data inaccuracies. The second consideration was the need to include different geographic areas and a wide range of macroeconomic experiences, at the same time selecting countries that did not suffer substantial economic turmoil (in the form of, say, sustained episodes of hyperinflation) over the relevant sample period. With this criterion we avoid crisis-prone countries and the difficulties associated with data interpretation in such cases. Moreover, by looking for a consistent set of relationships among macroeconomic variables in a relatively large group of countries that have had diverse experiences with structural change, we provide a set of stylized macroeconomic facts that are unlikely to reflect country-specific episodes.

Our study of business cycle regularities is based on quarterly data for a group of 12 middle-income countries: Chile, Colombia, India, the Republic of Korea, Malaysia, Mexico, Morocco, Nigeria, the Philippines, Tunisia, Turkey, and Uruguay. On the one hand, the decision to use quarterly, rather than annual, data imposes an additional constraint on the size of our sample, because relatively few developing countries produce quarterly output indicators. On the other hand, quarterly data provide us with sufficiently long time series for reliable statistical inference.[2]

The data cover a wide range of macroeconomic variables and include industrial output, prices, wages, monetary aggregates, domestic private sector credit, fiscal variables, exchange rates, and trade variables. (See the appendix for a description of the data and sources.) Thus we are able to examine macroeconomic fluctuations in various dimensions, in contrast to earlier studies. In addition, we examine the relationship between economic fluctuations in these countries and two key indicators that proxy for economic activity in industrial countries—an index of industrial-country output and a measure of the world real interest rate.

Two methodological aspects of this article are worth highlighting at the outset. First, in line with the recent literature on business cycles for industrial countries, many of the results discussed in the article are based on unconditional correlations between different variables. We naturally recognize that such correlations do not imply causal relationships and, in some cases, attempt to complement our correlation results by examining bivariate exogeneity tests. We also recognize that reduced-form relationships between certain variables depend crucially on the sources of macroeconomic shocks. Nevertheless, our results are useful in that they indicate the types of shocks that could be important for different countries and set the stage for more formal structural models of business cycle fluctuations.

Second, many of the macroeconomic series used in this article have distinct trends over time and, hence, need to be rendered stationary prior to empirical analysis. Empirical results could, of course, be sensitive to the choice of econometric procedure used to remove long-term trends from the data and derive cyclical components. This article makes an additional methodological contribution by examining the sensitivity of correlations and other stylized facts to the detrending procedure used. We use two detrending techniques: a modified version of the Hodrick-Prescott (1997; HP) filter developed by McDermott (1997) and the band-pass (BP) filter proposed by Baxter and King (1995).[3]

Thus this article's main contribution is to document a comprehensive set of stylized facts that are comparable across countries and to examine their sensitivity to different detrending techniques. Consistent with the work of other authors (such as Mendoza 1995), we find that output volatility is greater in developing countries than in industrial countries, terms-of-trade and output fluctuations are strongly positively correlated, and there is no consistent relationship between the

2. There are two additional considerations in choosing quarterly rather than annual data. First, some of the series we use have been readily available (and comparable across countries) for only a limited time. For instance, our data on effective exchange rates have been published by the International Monetary Fund only since 1978. Second, establishing large enough samples on an annual basis would imply going back to the early 1960s. It is likely that the quality of the data, where available, was substantially lower in those earlier years.

3. In Agénor, McDermott, and Prasad (1998) we provide robustness checks for our results using two other detrending techniques—first differences and a nonparametric technique.

trade balance and fluctuations in domestic output. As in Kouparitsas (1996), we find some evidence that output fluctuations in developing countries are positively correlated with business cycles in industrial countries and negatively correlated with real interest rates in industrial countries. We also find evidence of procyclical variation in monetary aggregates and real wages and countercyclical variation in government expenditures.

The remainder of the article is organized as follows. Section I briefly describes the detrending procedures used. Section II describes a number of economic features of the countries included in the data set and presents summary statistics for the behavior of output. Section III provides a more rigorous characterization of macroeconomic fluctuations in these countries and contrasts the results with available stylized facts of business cycles in industrial and developing countries. Section IV summarizes the main results of the article. Section V offers some final remarks and suggestions for further empirical and theoretical analysis.

I. Univariate Detrending Techniques

As indicated earlier, the objective of our article is to examine economic fluctuations at business cycle frequencies rather than to study longer-term growth.[4] To do so, it is necessary to decompose all of our macroeconomic series into nonstationary (trend) and stationary (cyclical) components, because certain empirical characterizations of the data, including cross-correlations, are valid only if the data are stationary.

For a given series, in finite samples, stationary components obtained using different filters can often display very different time-series properties (see Canova 1998). In this article we take an agnostic approach and report results obtained using the two filters mentioned above. The variant of the HP filter we use here chooses the smoothing parameter optimally for each series rather than imposing the same exogenous smoothing parameter for all series (see McDermott 1997).[5]

II. Key Characteristics of Sample Countries

In this section we describe a number of important economic features of the developing countries in our sample that are relevant for our analysis. In addition, we present summary statistics for output and inflation and provide a preliminary characterization of business cycle fluctuations in our group of countries. We also compare the properties of business cycles in these countries with those observed in industrial countries. The sample period for most of the data series used in this study runs from the first quarter of 1978 to the fourth quarter of 1995. The data sources are described in detail in the appendix.

4. The real business cycle literature makes no clear distinction between trend and cycles since both short- and long-term fluctuations are regarded as being driven by the same stochastic process.

5. A detailed discussion of the detrending techniques and the algorithms for these filters, along with a discussion of their properties, can be found in Agénor, McDermott, and Prasad (1988).

Most of the countries in our sample could be reasonably characterized as middle-income countries. Although India and Nigeria have relatively low per capita incomes, we include them in the sample because they are among the largest market economies in Asia and Africa (figure 1a). The urbanization rate and the proportion of agricultural output as a share of gross domestic product (GDP) indicate that agriculture is an important, but not dominant, sector in most of the sample (figures 1b and 1c).

Because we were unable to obtain reliable quarterly GDP data for all of the countries in our sample, we use indexes of industrial output to construct measures of the aggregate business cycle. The manufacturing sector accounts for a significant fraction of total GDP (figure 1d). Except for Nigeria, this share is more than 15 percent for all countries in our sample, compared with an average share of 25 to 30 percent for most industrial countries. In addition, because output in the industrial sector roughly corresponds to output in the traded goods sector (excluding primary commodities) and is most closely related to what are traditionally thought of as business cycle shocks, either exogenous or policy-determined, we argue that this variable is a reasonable proxy for measuring the aggregate cycle.[6]

For all countries except Nigeria, export growth is an important contributor to overall GDP growth (figure 1h). Standard measures of openness to international trade—as indicated by the average openness ratio (the ratio of the sum of imports and exports to GDP)—illustrate the importance of foreign trade transactions in our sample (figure 1i). Hence an important part of our analysis focuses on the relationship between the domestic business cycle and the prices and quantities related to international trade.

An important consideration in choosing our sample was to exclude countries that had suffered sustained episodes of hyperinflation during the period under study. Although some of the countries in the sample (such as Mexico, Turkey, and Uruguay) had high levels of inflation over the past two decades, none suffered sustained episodes of hyperinflation (figure 1k). This is also apparent from the average annual rates of consumer price inflation and the volatility of inflation, as measured by the standard deviation of annual inflation rates (last two columns of table 1).

A key issue concerning business cycle fluctuations in developing countries is whether aggregate fluctuations are characterized by basic time-series properties, such as volatility and persistence, that are similar to those observed in industrial countries. A simple way of approaching this issue is by examining summary statistics for the stationary components of industrial output (table 1). The first two columns of table 1 report means and standard deviations of output growth rates as well as standard deviations of the cyclical components of output derived using

6. In general, the use of GDP data for measuring business cycle activity in a developing country can be problematic. Agriculture, which still accounts for a large share of aggregate output in many developing countries (including several in our sample) is influenced more by weather conditions than by cyclical factors. Poor measurement of services and informal sector activities may also impart significant biases.

Figure 1. *Economic Indicators in Selected Developing Countries* (data are for 1993, unless otherwise indicated)

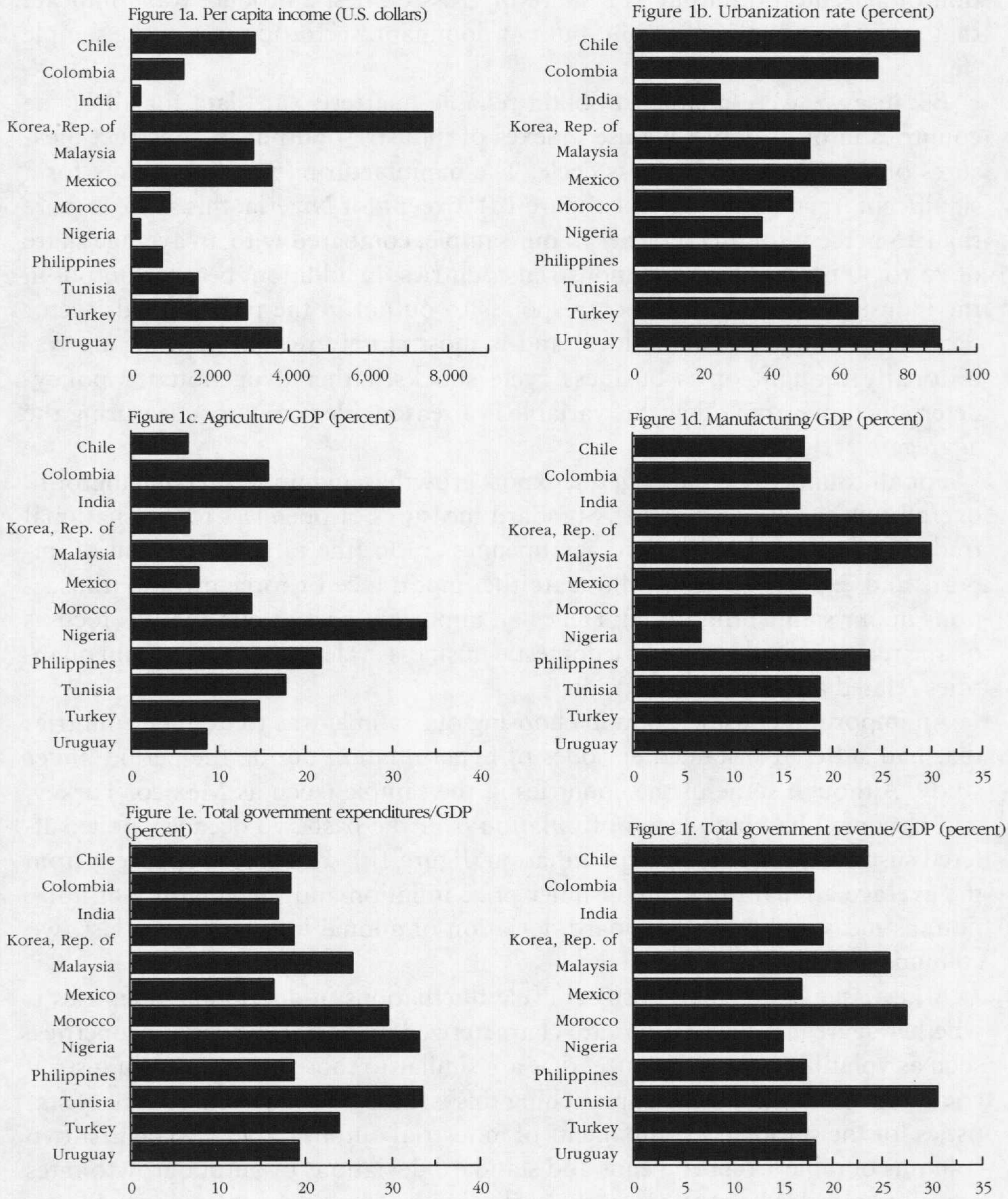
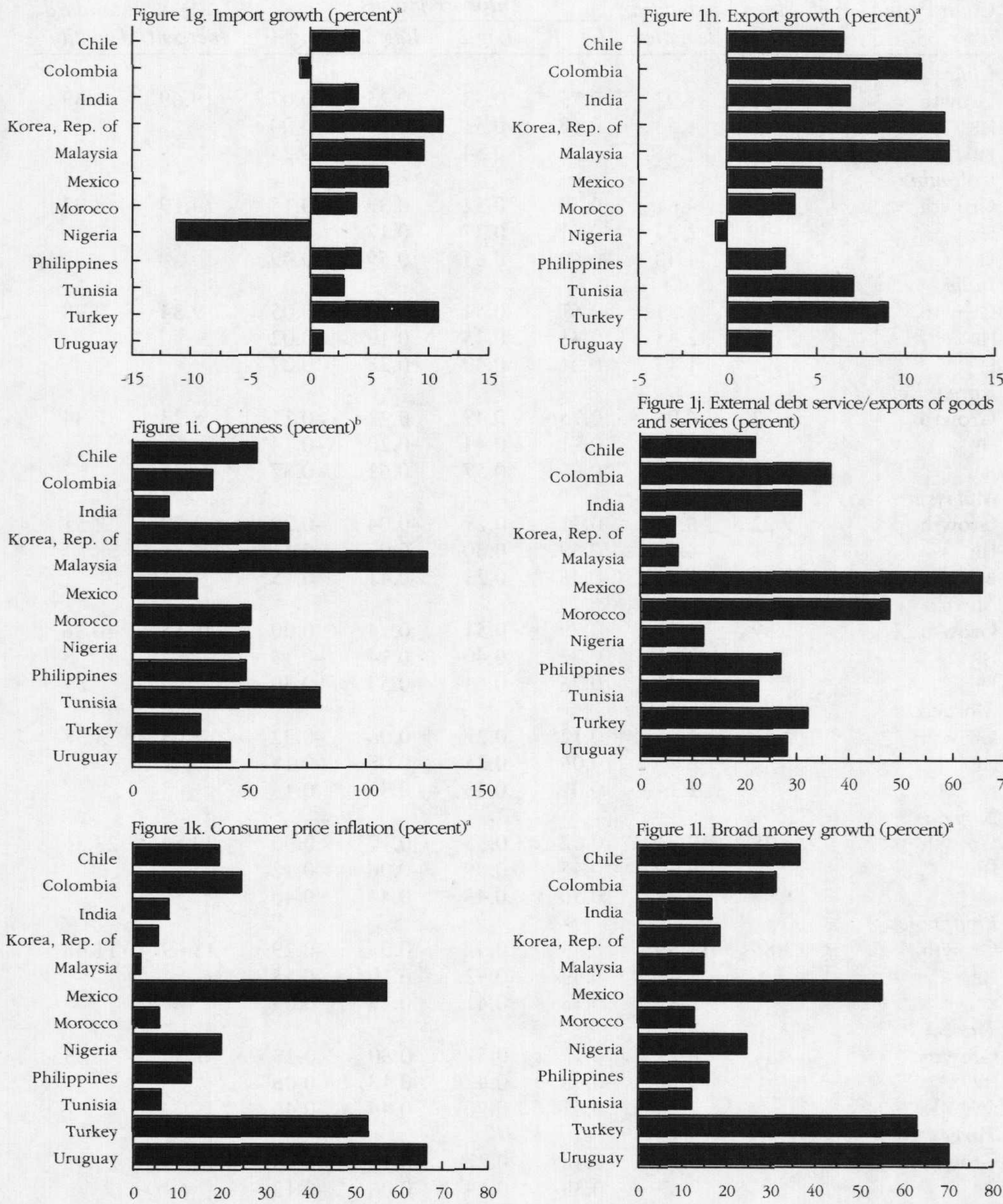


Figure 1. *(continued)*



a. Average annual growth rate, 1980–93.
b. Average annual ratio of sum of exports and imports to GDP, in percent, 1980–93.
Source: International Monetary Fund and World Bank.

Table 1. *Summary Statistics for Industrial Output and Inflation*

Country and filter	Output						Annual inflation	
	Mean (percent)	Standard deviation	Autocorrelations Lag 1	Lag 2	Lag 3	Lag 4	Mean (percent)	Standard deviation
Chile								
Growth	3.81	7.03	0.75	0.53	0.25	–0.07	19.69	8.69
HP		4.53	0.68	0.51	0.27	0.00		
BP		1.45	0.56	0.54	0.42	0.25		
Colombia								
Growth	2.57	4.61	0.70	0.52	0.39	0.15	24.19	4.02
HP		2.33	0.51	0.27	0.17	0.02		
BP		1.40	0.63	0.65	0.59	0.49		
India								
Growth	6.02	4.31	0.67	0.54	0.27	0.05	9.34	2.78
HP		2.45	0.48	0.35	0.10	0.02		
BP		1.13	0.24	0.49	0.28	0.27		
Korea, Rep. of								
Growth	9.22	6.06	0.75	0.49	0.22	–0.11	8.23	7.34
HP		3.47	0.71	0.44	0.20	–0.14		
BP		1.48	0.67	0.57	0.61	0.37		
Malaysia								
Growth	9.22	6.79	0.71	0.29	–0.04	–0.29	3.79	2.55
HP		4.06	0.69	0.30	0.07	–0.16		
BP		1.41	0.46	0.23	0.41	0.15		
Mexico								
Growth	2.39	6.21	0.79	0.51	0.24	0.00	48.55	40.36
HP		3.31	0.72	0.40	0.14	–0.13		
BP		1.42	0.76	0.64	0.53	0.30		
Morocco								
Growth	2.57	4.44	0.12	0.27	0.06	–0.32	7.03	3.38
HP		2.77	0.06	0.25	0.08	–0.18		
BP		1.14	0.01	0.43	0.33	0.13		
Nigeria								
Growth	3.05	12.34	0.62	0.33	0.17	0.00	29.54	23.56
HP		6.69	0.45	0.09	–0.06	–0.12		
BP		3.29	0.50	0.43	0.44	0.40		
Philippines								
Growth	13.85	11.69	0.63	0.37	0.03	–0.29	13.69	11.48
HP		7.45	0.63	0.42	0.10	–0.15		
BP		2.62	0.18	0.41	0.19	0.04		
Tunisia								
Growth	2.34	4.79	0.77	0.57	0.30	0.13	7.50	2.35
HP		2.72	0.63	0.42	0.13	0.06		
BP		1.25	0.61	0.70	0.44	0.46		
Turkey								
Growth	6.19	6.14	0.48	0.27	0.11	–0.23	61.78	25.45
HP		3.67	0.38	0.14	0.06	–0.12		
BP		1.42	–0.08	0.20	0.20	0.07		
Uruguay								
Growth	–0.94	8.55	0.72	0.55	0.34	0.04	62.04	23.93
HP		4.94	0.63	0.50	0.27	–0.01		
BP		2.37	0.62	0.75	0.63	0.53		

Note: Growth refers to the four-quarter differences of the log levels of relevant variables (as in text). HP and BP refer to the stationary components of output derived using the modified Hodrick-Prescott and band-pass filters, respectively.

Source: Authors' calculations based on IMF data.

the HP and BP filters.[7] Growth rates are measured here as four-quarter differences of the log levels of the relevant variables.

Mean annual growth rates of industrial output over the past two decades varied substantially across the countries in our sample, ranging from almost 14 percent for the Philippines to about 2.5 percent for Colombia, Mexico, Morocco, and Tunisia. Uruguay, in fact, recorded a negative mean growth rate over this period. The volatility of growth rates also varies markedly across countries. On average, volatility in our sample is much higher than the level typically observed in industrial countries.

A similar picture emerges from the standard deviations of the filtered cyclical components of industrial output.[8] Because the filters used here tend to eliminate more of the low-frequency variation than, say, a first-difference filter, these standard deviations are generally lower. However, the ordering of countries by their cyclical volatility is similar, and their volatility is generally higher than that observed for industrial countries. The volatility of the cyclical components obtained using the BP filter is generally much lower than that using the HP filter; the BP filter eliminates some of the high-frequency variation in the data, whereas the HP filter eliminates only low-frequency variation.

To examine the persistence of business cycle fluctuations, we also measure the first four autocorrelations of the filtered series (table 1). The autocorrelations are generally strongly positive, indicating considerable persistence in the cyclical components. These results suggest that it is appropriate to view the developing countries in our sample as having short-term fluctuations that could reasonably be characterized as business cycles.

III. Main Features of Macroeconomic Fluctuations

We measure the degree of comovement of a series y_t with industrial output x_t by the magnitude of the correlation coefficient $\Delta(j)$, $j \in \{0, \pm1, \pm2, \ldots\}$. These correlations are between the stationary components of y_t and x_t, with components in both derived using the same filter. In the discussion that follows, we consider the series y_t to be procyclical, acyclical, or countercyclical if the contemporaneous correlation coefficient $\Delta(0)$ is positive, zero, or negative, respectively. In addition, we deem the series y_t to be strongly contemporaneously correlated if $0.26 \le |\Delta(0)| < 1$, weakly contemporaneously correlated if $0.13 \le |\Delta(0)| < 0.26$, and contemporaneously uncorrelated with the cycle if $0 \le |\Delta(0)| < 0.13$.[9]

7. These filters, by construction, deliver stationary components that have zero means. The output series as well as all the other time series used in this article were deseasonalized using the X-11 procedure.

8. We can interpret these standard deviations as quarterly percentage standard deviations. For purposes of comparison, the standard deviation of HP-filtered postwar quarterly industrial production for the United States is about 2 percent.

9. The approximate standard error of these correlation coefficients, computed under the null hypothesis that the true correlation coefficient is zero and given the average number of observations per country in our sample, is about 0.13.

The cross-correlation coefficients $\Delta(j)$, $j \in \{0, \pm1, \pm2, ...\}$ indicate the phase-shift of y_t relative to the cycle in industrial output. We say that y_t leads the cycle by j periods if $|\Delta(j)|$ is a maximum for a positive j, is synchronous with the cycle if $|\Delta(j)|$ is a maximum for $j = 0$, and lags the cycle if $|\Delta(j)|$ is a maximum for a negative j. To conserve space, we report only contemporaneous correlations and correlations at the fourth and eighth lags and leads. Results for a larger set of lags and leads can be found in Agénor, McDermott, and Prasad (1998).

Correlations with Industrial-Country Business Cycles

Here we examine the relationship between fluctuations in domestic industrial output in our sample countries and variables that represent economic activity in the main industrial countries—a relationship that could be particularly important for developing countries that have substantial trade links with industrial countries.[10] As discussed earlier, the magnitude of the links between macroeconomic fluctuations in industrial and developing countries and the channels through which shocks propagate between these two sets of countries are of considerable interest from a number of different perspectives.

The contemporaneous correlations are positive for a majority of the sample countries, indicating that business cycle fluctuations in developing countries tend to be correlated with business cycle fluctuations in industrial countries (table 2). For many of the countries that have positive contemporaneous correlations, the correlations generally peak at or near a zero lag, suggesting that output fluctuations in industrial economies are transmitted fairly quickly.[11]

These results are generally robust across filters, barring a couple of exceptions. For instance, in the case of Mexico the BP filter yields a strong negative contemporaneous correlation, whereas the HP filter yields a positive correlation. The correlations at the four-quarter lag are, however, all strongly positive, indicating that industrial-country output has a lagged effect on Mexican output. The contemporaneous correlations are close to zero for Morocco and Nigeria and marginally negative for Turkey. For these countries there is some evidence that industrial-country output has a positive effect on domestic industrial output with a lag of about four to eight quarters.

Business cycle conditions in industrial economies also could influence fluctuations in developing economies through the world real interest rate. The world real interest rate is likely to have an important effect on economic activity in the developing world, not only because it affects domestic interest rates, but also because it reflects credit conditions in international capital markets. These capital markets may be especially important for developing countries (even those in the middle-income range) that do not have well-developed domestic capital markets. To examine this issue, we measure correlations of industrial output in our

10. The industrial-country variables used in this section are described in the appendix.

11. Business cycles in the industrial economies are, of course, not perfectly synchronized. But Lumsdaine and Prasad (1997), among others, argue that there is a substantial common component in business cycle fluctuations across the main industrial economies.

Table 2. *Cross Correlations between Domestic Output and Industrial-Country Output*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	−0.04	0.09	0.52	−0.11	−0.48
BP	0.24	0.38	0.32	−0.03	−0.28
Colombia					
HP	−0.44	−0.07	0.43	0.21	−0.12
BP	−0.37	0.02	0.49	0.55	0.35
India					
HP	0.13	0.15	0.24	−0.20	−0.11
BP	0.32	0.56	0.46	0.07	−0.15
Korea, Rep. of					
HP	0.00	−0.49	0.36	0.22	0.22
BP	0.28	0.07	0.36	0.66	0.49
Malaysia					
HP	−0.49	0.14	0.59	0.08	−0.40
BP	−0.29	0.30	0.57	0.21	−0.35
Mexico					
HP	0.08	0.38	0.19	−0.62	−0.37
BP	0.36	0.35	−0.29	−0.83	−0.70
Morocco					
HP	0.10	−0.07	−0.06	0.02	−0.03
BP	0.20	0.06	−0.05	−0.06	−0.17
Nigeria					
HP	0.22	0.26	0.03	−0.22	−0.05
BP	0.59	0.31	−0.15	−0.41	−0.38
Philippines					
HP	−0.63	−0.05	0.53	0.10	−0.48
BP	−0.32	−0.11	0.38	0.26	−0.36
Tunisia					
HP	−0.43	−0.24	0.45	0.13	−0.36
BP	0.80	−0.48	0.04	0.07	−0.27
Turkey					
HP	0.23	0.04	−0.14	−0.02	0.12
BP	0.24	−0.32	−0.36	−0.16	0.43
Uruguay					
HP	0.33	0.08	0.21	−0.30	−0.29
BP	0.66	0.49	0.18	0.01	0.17

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of industrial-country output, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

sample countries with a weighted index of real interest rates in the major industrial countries (table 3).

For most of the countries in our sample the contemporaneous correlations between HP-filtered output and the world real interest rate are positive. This could reflect the facts that the real interest rate in industrial economies tends to be procyclical and that changes in industrial-country output, through trade links,

Table 3. *Cross Correlations between Domestic Output and the World Real Interest Rate*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	0.06	–0.43	0.17	0.10	0.06
BP	–0.18	–0.42	–0.25	0.06	0.16
Colombia					
HP	–0.50	–0.33	0.22	0.32	0.33
BP	–0.55	–0.13	0.24	0.58	0.39
India					
HP	0.00	0.14	0.29	–0.28	–0.28
BP	–0.08	0.14	0.09	–0.36	–0.25
Korea, Rep. of					
HP	0.12	–0.28	0.34	–0.08	0.08
BP	–0.21	–0.08	0.05	0.16	0.06
Malaysia					
HP	–0.03	–0.18	0.18	–0.09	–0.04
BP	0.56	–0.02	–0.12	–0.24	–0.29
Mexico					
HP	–0.32	0.00	0.22	–0.03	–0.14
BP	0.11	0.11	0.09	–0.02	–0.06
Morocco					
HP	0.24	0.18	–0.16	0.00	–0.04
BP	0.32	0.23	–0.06	–0.25	–0.22
Nigeria					
HP	–0.23	0.32	–0.01	–0.05	0.22
BP	–0.04	0.01	0.08	0.05	–0.17
Philippines					
HP	–0.15	–0.08	0.26	0.06	–0.34
BP	–0.04	0.07	0.21	0.17	–0.41
Tunisia					
HP	0.26	–0.25	0.04	0.07	–0.14
BP	0.27	0.13	0.10	–0.01	–0.32
Turkey					
HP	0.13	0.02	–0.22	–0.05	0.22
BP	0.05	–0.25	–0.46	–0.04	0.44
Uruguay					
HP	–0.10	–0.32	0.19	0.13	–0.02
BP	–0.20	–0.35	–0.19	0.04	0.22

Note: The world real interest rate is proxied by a weighted index of real interest rates in the major industrial countries. HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of the world real interest rate, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

have positive spillover effects on output in these middle-income countries.[12] Morocco and Turkey are the only sample countries for which this correlation is negative using either filter. For a few countries the lagged correlations are negative. Mexico is an interesting case: the contemporaneous correlation is positive,

12. The correlation between the cyclical components of the output and real interest rate indexes for industrial countries is strongly positive for 1975–95, irrespective of the detrending procedure used.

but most of the correlations at short leads and lags are close to zero, indicating that the effects of changes in the world interest rate are transmitted quite rapidly to Mexican industrial output. This is not surprising given Mexico's physical proximity to and close trade links with the United States, which is the dominant industrial economy and therefore has a high weight in the composite index of industrial-country output and our proxy for the world real interest rate.

Overall, these results suggest that the level of economic activity in industrial countries has a significant, positive relationship with industrial output in the middle-income countries in our sample.[13] Because real interest rates are procyclical in industrial countries, their relationship to industrial output in developing countries may be muted by the opposite, indirect effect of aggregate economic activity in industrial countries. Further research is needed to separate out the quantitative importance of these different influences on business cycle propagation. An important issue in this context (which we return to later) is the inability to measure interest rates that individual countries face on world capital markets without adequate data on country-specific premiums.

Cyclical Behavior of Public Sector Variables

The relationship between fluctuations in aggregate output and the components of aggregate demand has been well documented for industrial countries. Unfortunately, we were unable to obtain consistent and sufficiently long series of quarterly data on consumption and investment for all countries in our sample. We were, however, able to obtain data on the public sector, although only for a limited set of countries. Examining the relationship between aggregate economic activity and public sector expenditures and revenue has analytical value from the perspective of business cycle modeling and is important from a policy perspective, including in the design of macroeconomic stabilization programs.

There is a robust negative relationship between government expenditures and the domestic business cycle in all four countries for which we have data—Chile, Korea, Mexico, and the Philippines (top panel of table 4). Thus there is fairly clear evidence of a countercyclical role for government expenditures. These results contrast with those obtained for industrial countries. Fiorito and Kollintzas (1994), for instance, find no clear pattern. The negative contemporaneous correlation between government consumption expenditures and industrial output is consistent with the prediction of a variety of models, such as the class of intertemporal optimizing models with imperfect capital mobility and flexible prices (see Agénor 1997). In these models an increase in public spending leads to a net increase in domestic absorption (if the degree of intertemporal substitution in consumption is not too large), a real exchange rate appreciation, and a fall in output of tradable goods on impact.

Government revenues are significantly countercyclical in Korea, the Philippines, and Uruguay (second panel of table 4).[14] This negative correlation may

13. This finding is consistent with the results of Kouparitsas (1996).

14. Rodríguez-Mata (1997) establishes a countercyclical pattern of government revenue for Costa Rica.

Table 4. *Cross Correlations between Domestic Output and Government Expenditures, Government Revenue, and the Fiscal Impulse*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Between domestic output and government expenditures					
Chile					
HP	–0.13	–0.04	–0.16	0.30	0.00
BP	–0.27	–0.01	–0.13	0.43	–0.34
Korea, Rep. of					
HP	–0.03	–0.17	–0.39	0.13	0.32
BP	–0.14	–0.33	–0.46	–0.02	0.39
Mexico					
HP	–0.10	–0.11	–0.21	0.22	0.36
BP	–0.11	–0.35	–0.10	0.21	0.27
Philippines					
HP	0.59	0.22	–0.72	0.00	0.57
BP	0.69	0.10	–0.54	–0.06	0.25
Between domestic output and government revenue					
Colombia					
HP	–0.03	0.05	–0.17	0.03	0.23
BP	0.15	0.20	–0.01	–0.03	0.14
Korea, Rep. of					
HP	–0.06	–0.17	–0.28	0.14	0.30
BP	–0.18	–0.20	–0.31	0.08	0.41
Mexico					
HP	0.07	0.21	–0.08	–0.03	0.17
BP	–0.11	0.15	0.13	0.15	0.41
Philippines					
HP	0.49	0.32	–0.69	–0.14	0.45
BP	0.35	0.22	–0.57	–0.22	0.24
Uruguay					
HP	–0.13	–0.09	–0.26	0.28	0.22
BP	–0.27	–0.26	–0.13	0.15	0.12
Between domestic output and the fiscal impulse[a]					
Korea, Rep. of					
HP	–0.03	–0.09	–0.23	0.00	0.11
BP	–0.02	–0.23	–0.27	–0.08	0.15
Mexico					
HP	–0.13	–0.25	–0.16	0.28	0.24
BP	–0.07	–0.40	–0.14	0.17	0.10
Philippines					
HP	0.32	–0.10	–0.30	0.16	0.30
BP	0.46	–0.16	–0.17	0.15	0.10

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of government expenditures, government revenue, or the fiscal impulse, with both variables detrended using the same filter. The data series and sources are described in the appendix.

a. The fiscal impulse is defined as the ratio of government expenditures to government revenue.

Source: Authors' calculations based on IMF data.

result from the negative effects of increases in tax revenues (possibly induced by increases in effective tax rates) on disposable income and aggregate demand.[15] In Mexico the relationship appears to be acyclical, although this result is sensitive to the choice of filter. To examine the net effect of government revenue and expenditures on the domestic business cycle, we construct a measure of the fiscal impulse—the ratio of government expenditures to government revenue—for the three countries for which both revenue and expenditure series were available. The fiscal impulse is negatively correlated with the business cycle, either contemporaneously or at short lags, in Korea, Mexico, and the Philippines (third panel of table 4). Thus the fiscal impulse is countercyclical and plays a role in short-run macroeconomic stabilization.

To summarize, the correlations examined in this subsection suggest that the government balance does play a significant role in dampening domestic fluctuations in Korea, Mexico, and the Philippines. However, the countercyclical behavior of government revenue in some countries highlights the need to reexamine revenue sources to ensure that they do not exacerbate domestic fluctuations. An alternative possibility is that tightening government finances could raise future output growth by, for instance, crowding in private investment or by signaling the future stability of domestic macroeconomic policy, thereby stimulating foreign investment. Based on the negative lagged correlations, there is some evidence of this effect in Korea.

Correlations with Wages and Prices

Establishing stylized facts about the cyclical behavior of wages and prices has important implications for discriminating among different classes of models (based on their predictions concerning such behavior). For instance, Keynesian models imply that real wages are countercyclical, whereas equilibrium models of the business cycle imply that real wages are procyclical (Abraham and Haltiwanger 1995). Similarly, the implications of the cyclical behavior of prices, inflation, and (as discussed later) various monetary aggregates for discriminating among different classes of business cycle models have been the subject of considerable debate in the business cycle literature recently (Chadha and Prasad 1994).

We begin by examining correlations between average nominal wages in the industrial sector and industrial output. Consistent time-series data on wages were available for only 5 of the 12 countries in our sample. The cyclical behavior of nominal wages varies markedly across the five countries (first panel of table 5). In Chile nominal wages appear to be procyclical, whereas there is some evidence that nominal wages are countercyclical in Korea, Colombia, and Mexico.

In interpreting these results, it is useful to look at the cyclical behavior of real wages, often the relevant wage variable for analyzing business cycles. We construct real wages by deflating nominal wages by the consumer price index (CPI).

15. A highly positive short-run correlation between current income and expenditures in developing countries has been well documented and has been attributed to the existence of liquidity constraints and finite horizons. See Agénor and Montiel (1996: ch. 3).

Table 5. *Cross Correlations between Domestic Output and Nominal Wages and between Domestic Output and Real Wages*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Between domestic output and nominal wages					
Chile					
HP	-0.13	-0.08	0.08	0.03	0.06
BP	-0.54	-0.29	0.38	0.53	0.08
Colombia					
HP	-0.05	0.07	-0.13	0.41	0.15
BP	-0.03	-0.35	-0.45	-0.47	0.41
Korea, Rep. of					
HP	-0.05	-0.28	-0.08	0.06	0.29
BP	-0.58	-0.56	-0.43	-0.12	0.33
Mexico					
HP	0.16	-0.07	-0.15	-0.17	0.1
BP	0.73	0.20	-0.30	-0.29	-0.18
Turkey					
HP	0.02	0.32	0.08	-0.20	-0.22
BP	0.47	0.50	0.05	-0.53	-0.36
Between domestic output and real wages					
Chile					
HP	0.06	-0.27	0.31	-0.01	0.04
BP	-0.15	-0.04	0.15	0.06	0.00
Colombia					
HP	-0.24	0.02	0.68	-0.44	-0.07
BP	0.27	0.09	0.27	-0.43	-0.46
Korea, Rep. of					
HP	-0.33	-0.21	0.38	0.21	-0.11
BP	-0.24	0.01	0.32	0.34	0.34
Mexico					
HP	-0.40	-0.26	0.64	0.15	-0.24
BP	0.15	0.28	0.47	0.14	-0.48
Turkey					
HP	0.07	0.19	0.43	-0.21	0.64
BP	0.38	0.61	0.15	-0.63	-0.64

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of nominal wages or real wages, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

Alternative theories offer different predictions of wage behavior. For instance, traditional Keynesian models of the business cycle posit short-run movement along a stable labor demand schedule and, therefore, predict that real wages are countercyclical. However, real business cycle models, as well as new Keynesian macroeconomic models with imperfect competition and countercyclical mark-ups, predict procyclical wages.[16] Finally, efficiency wage models predict no tight contemporaneous relationship between output (employment) and real wages.

16. See Rotemberg and Woodford (1991) for a discussion of macroeconomic models with imperfect competition and countercyclical markups.

More generally, as Abraham and Haltiwanger (1995:1230) note, different types of shocks can have very different implications for the cyclicality of the real wage. Technology shocks tend to produce procyclical movements of the real wage, whereas nominal shocks (such as money supply shocks) generate countercyclical movements.

The correlations between industrial output and real wages are striking (lower panel of table 5). In all five countries for which data are available, and with both filters, we find strong evidence of procyclical real wage variation. This result is consistent with the implications of real business cycle models that ascribe a dominant role to technology shocks that shift the labor demand schedule in the short run. It is also in line with the evidence on real wage rate variation in the United States (see Kydland and Prescott 1994).[17]

Next we turn to the correlations between prices and output. A substantial literature documents the countercyclical behavior of prices in industrial economies (see, for instance, Backus and Kehoe 1992, Fiorito and Kollintzas 1994, Kydland and Prescott 1994, and Cooley and Ohanian 1991). Many of these studies argue that the countercyclical behavior of price levels provides support for supply-driven models of the business cycle, including real business cycle models that depict technology shocks as predominant in driving business cycle fluctuations. However, Chadha and Prasad (1994) argue that the correlation between inflation and cyclical output is the appropriate correlation for discriminating between demand- and supply-driven models of the business cycle.[18] They show that inflation in the G-7 countries has in fact been procyclical during the postwar period. We therefore examine the cyclical behavior of both the price level and the inflation rate.

The contemporaneous correlations between industrial output and the aggregate consumer price index are generally negative for Colombia, India, Korea, Malaysia, Morocco, Nigeria, and Turkey, indicating countercyclical variation of the price level (table 6). For a few countries, including Chile and Uruguay, however, the correlations are significantly positive. Thus, unlike industrial countries, our sample countries do not show a consistent negative relationship between the stationary components of output and price levels.

The contemporaneous correlations between the level of inflation and the cyclical component of output indicate that there is little strong evidence of procyclical inflation for most countries in our sample, although the lagged correlations are positive for Chile and Uruguay (table 7).[19] The correlations at the leads do not

17. Our analysis of real wage cyclicality only considers the consumption wage in the manufacturing sector, not the producer wage. The two measures could display very different behavior over time, as Abraham and Haltiwanger (1995) illustrate for the United States.

18. Also see Judd and Trehan (1995).

19. Although we exclude from the sample countries with sustained hyperinflationary episodes, unit root tests for inflation indicate that, for about half of the countries in the sample, we cannot reject the null hypothesis of nonstationarity. Hence, for all countries we detrend inflation using the same filters that we use for output. We also examine the correlations using the raw series for inflation and filtered output. For the countries with significant correlations (reported in table 7), the choice of filtered or unfiltered inflation does not matter.

Table 6. *Cross Correlations between Domestic Output and the Price Level (Consumer Price Index)*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	-0.41	0.27	0.42	0.03	-0.14
BP	-0.03	0.28	0.51	0.15	-0.23
Colombia					
HP	0.10	-0.06	-0.43	0.14	-0.05
BP	-0.37	-0.60	-0.67	-0.46	0.11
India					
HP	-0.27	-0.21	-0.06	0.03	0.21
BP	-0.11	-0.56	-0.47	-0.12	0.09
Korea, Rep. of					
HP	0.00	0.02	-0.26	-0.22	0.27
BP	-0.37	-0.45	-0.58	-0.53	-0.18
Malaysia					
HP	0.13	-0.17	-0.05	-0.15	-0.09
BP	0.10	-0.04	-0.19	-0.34	-0.37
Mexico					
HP	0.29	0.17	0.46	-0.26	0.23
BP	0.72	0.08	-0.55	-0.50	-0.18
Morocco					
HP	-0.06	-0.05	-0.28	0.01	0.22
BP	-0.38	-0.39	-0.39	-0.10	0.21
Nigeria					
HP	0.01	0.14	-0.23	-0.05	0.16
BP	-0.01	-0.14	-0.21	-0.08	0.10
Philippines					
HP	-0.43	-0.62	0.44	0.38	-0.22
BP	-0.36	-0.56	0.00	0.47	0.50
Tunisia					
HP	0.19	0.28	-0.15	0.03	0.03
BP	0.10	0.50	0.37	0.29	-0.08
Turkey					
HP	0.26	0.24	-0.31	-0.15	0.13
BP	0.55	0.15	-0.47	-0.43	0.17
Uruguay					
HP	-0.18	0.47	0.40	-0.27	-0.48
BP	0.22	0.44	0.40	0.15	0.02

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of the price level, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

provide a clear indication of a positive relationship between output and lagged inflation, as Phillips curve–type models, for instance, would predict. Indeed, for some countries, such as Mexico and Turkey, we find negative correlations between inflation and the cyclical component of output, indicating countercyclical variations in inflation.

Table 7. *Cross Correlations between Domestic Output and Inflation*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	–0.08	0.49	0.09	–0.33	–0.14
BP	0.32	0.39	0.16	–0.20	–0.18
Colombia					
HP	–0.02	–0.17	–0.23	0.48	–0.03
BP	–0.50	–0.15	0.03	0.30	0.66
India					
HP	–0.40	–0.02	0.10	0.14	0.12
BP	–0.26	–0.42	0.04	0.36	0.34
Korea, Rep. of					
HP	–0.16	–0.01	–0.19	0.05	0.40
BP	0.19	0.17	0.27	0.43	0.56
Malaysia					
HP	–0.25	–0.23	0.10	–0.05	0.06
BP	0.14	–0.02	–0.17	–0.22	0.08
Mexico					
HP	0.23	–0.09	–0.48	0.11	0.39
BP	0.02	–0.52	–0.52	0.08	0.38
Morocco					
HP	0.07	–0.02	–0.13	0.23	0.21
BP	–0.32	–0.02	0.00	0.31	0.35
Nigeria					
HP	–0.02	0.08	–0.27	0.16	0.14
BP	0.00	–0.12	–0.08	0.10	0.04
Philippines					
HP	–0.64	–0.14	0.76	0.04	–0.40
BP	–0.49	–0.22	0.52	0.42	–0.05
Tunisia					
HP	0.23	0.12	–0.25	0.03	0.00
BP	0.58	0.42	–0.05	–0.26	–0.48
Turkey					
HP	0.25	0.00	–0.39	0.15	0.24
BP	0.23	–0.30	–0.46	–0.04	0.49
Uruguay					
HP	0.18	0.49	–0.06	–0.56	–0.28
BP	0.44	0.36	0.00	–0.44	–0.08

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of inflation, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

For countries like Mexico and Turkey the procyclical behavior of real wages and the countercyclical behavior of both the price level and the inflation rate suggest that supply shocks may have been a key determinant of domestic macroeconomic fluctuations over the past two decades. It is worth emphasizing that, for our sample of middle-income countries, the term "supply shocks" could have a different connotation than it has for large industrial economies. In particular, these developing countries could be subject to large terms-of-trade shocks rather than prototypical productivity shocks, although terms-of-trade shocks could, in principle, have both supply-side and demand-side effects.

Money and Credit

In recent years it has become increasingly evident that equilibrium business cycle models often need to incorporate monetary variables to capture important business cycle phenomena. The relationship between monetary variables and the business cycle has, therefore, become a topic of increasing interest (see, for instance, Kydland and Prescott 1994). This relationship is particularly relevant to middle-income countries, where the monetary mechanism could play an important stabilizing role.

A large literature has evolved around the question of whether monetary variables influence output in industrial countries or, in more loaded terminology, whether money causes output. From a different perspective, King and Plosser (1984) argue that the positive correlation between money and the business cycle largely reflects the endogenous response of inside money to exogenous shocks that drive business cycle fluctuations rather than a causal relationship from money to output. Given this debate and uncertainties regarding the definition of money that theoretical models use, we examine money-output correlations using several definitions of monetary aggregates.

We estimate correlations between industrial production and an index of broad money (M2). Broad money roughly corresponds to the definition for industrial economies. Although in some cases the sign (and statistical significance) of the correlations is affected by the detrending procedure, the contemporaneous correlations are broadly positive for a majority of the sample countries, including Chile, Colombia, India, Morocco, the Philippines, Tunisia, and Uruguay (table 8). Among the remaining countries, the contemporaneous correlations are often close to zero, although for Korea, Malaysia, and Mexico, there is some evidence of countercyclical variation in broad money.

Of the countries that show positive correlations between money and output, the pattern of lead-lag correlations and, in particular, the lag at which the peak positive correlation occurs could be interpreted as an indication of the speed with which innovations in monetary variables are transmitted to real activity. For these countries the peak positive correlations generally occur at very short lags, suggesting that the transmission of monetary shocks to real activity is fairly rapid. Of course, as noted earlier, this could simply reflect the endogenous response of money to output fluctuations that are driven by nonmonetary shocks. Indeed, when we run bivariate Granger-causality tests on these two variables, we find little evidence that money Granger-causes output, even in those countries where the correlations between the two variables are strongly positive.

The patterns of correlations are similar when we use two alternative monetary aggregates—reserve (or base) money and narrow money (currency in circulation

Table 8. *Cross Correlations between Output and Broad Money (M2)*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	−0.51	−0.20	0.37	0.32	0.08
BP	−0.22	−0.25	0.23	0.50	0.24
Colombia					
HP	−0.23	−0.44	0.18	0.24	0.21
BP	−0.36	−0.24	0.06	0.54	0.45
India					
HP	0.15	0.14	0.07	−0.41	−0.01
BP	0.13	0.25	0.35	−0.24	−0.10
Korea, Rep. of					
HP	−0.27	0.17	0.03	−0.15	−0.11
BP	−0.65	−0.39	−0.27	−0.34	−0.20
Malaysia					
HP	−0.10	−0.04	−0.26	0.05	0.20
BP	−0.05	−0.29	−0.32	−0.14	−0.04
Mexico					
HP	0.04	0.08	−0.09	−0.25	0.28
BP	0.32	−0.03	−0.24	0.00	0.15
Morocco					
HP	−0.29	−0.07	0.24	−0.07	0.21
BP	−0.37	0.06	0.21	0.17	0.53
Nigeria					
HP	−0.05	−0.18	−0.14	0.22	0.00
BP	−0.53	−0.38	−0.09	0.07	0.36
Philippines					
HP	−0.45	−0.21	0.48	0.25	−0.22
BP	−0.56	−0.34	0.34	0.61	0.21
Tunisia					
HP	−0.15	−0.08	0.19	0.34	−0.16
BP	−0.09	0.20	0.42	0.26	−0.45
Turkey					
HP	−0.04	−0.07	0.17	−0.39	0.00
BP	0.01	−0.03	−0.18	−0.24	0.18
Uruguay					
HP	0.03	−0.02	−0.04	0.04	0.04
BP	−0.09	0.26	0.45	0.37	0.25

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of broad money, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

plus sight deposits in the banking system).[20] The main features of the results derived from using broad money are preserved when using the other monetary aggregates. The contemporaneous correlations are positive for about half of the countries in the sample, generally statistically insignificant for many of the others, and, in the case of Nigeria, clearly negative. Overall, therefore, we find lim-

20. These results are available on request.

ited evidence in our sample of the type of procyclical behavior of monetary aggregates that has been documented for many industrial countries (see, for instance, Backus and Kehoe 1992). More important, we are unable to detect evidence of Granger causality from money to output. These results may indicate the need to develop a different analytical framework for studying the relationship between monetary policy and macroeconomic fluctuations in developing countries. We discuss this issue below.

We also examine the cyclical behavior of measures of velocity corresponding to the alternative definitions of monetary aggregates discussed above. Again, to conserve space, we present only the results for the measure of velocity based on broad money.[21] These correlations are striking (table 9). For 11 of the 12 countries in our sample (Mexico being the exception) and with both filters, the contemporaneous correlations between the velocity of broad money and industrial output are strongly negative. From a quantity theory perspective, of course, the countercyclical behavior of velocity is be expected, given the procyclical behavior of broad money and countercyclical variation in the aggregate price level in a majority of the sample countries. This result stands in sharp contrast to the weakly procyclical behavior of velocity in the G-7 countries, as documented by Fiorito and Kollintzas (1994).

Finally, we consider another monetary variable that could have a significant influence on economic activity—domestic private sector credit. This variable is especially relevant for middle-income countries, where equity markets tend to be weakly capitalized relative to industrial-country markets and private sector credit typically plays an important role in determining investment and the financing of working capital needs—and thus overall economic activity, especially in the industrial sector.[22] Note that changes in credit could partly reflect the derived demand for credit, which in turn could be affected by exogenous shocks that influence the level of industrial activity. Nevertheless, even in these circumstances changes in the availability of credit could dampen the effects of these shocks on industrial output. Thus the pattern of these correlations is still of considerable analytical value.

A number of countries, including Colombia, India, Mexico, and Turkey, show a positive contemporaneous association between domestic credit and industrial output (table 10). Chile and Uruguay, in contrast, show a negative correlation. In the countries where the association is positive, the correlations peak at or close to a zero lag, indicating that the availability of domestic credit affects activity in the industrial sector fairly rapidly. However, this could simply reflect cyclical fluc-

21. Measures of velocity corresponding to the reserve-money and narrow-money aggregates yield velocity-output correlations that are broadly similar to the results discussed in this paragraph. These results are available on request.

22. Although the role of private sector credit in many developing countries is well documented, few studies have quantitatively assessed the relative importance of money and credit in the transmission of monetary policy. We intend to pursue this issue in future work.

Table 9. *Cross Correlations between Domestic Output and M2 Velocity*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	0.26	–0.26	–0.76	0.34	0.56
BP	–0.26	–0.62	–0.70	–0.08	0.38
Colombia					
HP	–0.04	–0.42	–0.27	0.16	0.39
BP	–0.06	–0.34	–0.38	0.28	0.35
India					
HP	0.48	0.11	–0.73	–0.22	0.21
BP	0.25	0.13	–0.68	–0.34	0.01
Korea, Rep. of					
HP	0.13	0.25	–0.69	0.13	0.07
BP	–0.08	–0.29	–0.65	–0.24	0.03
Malaysia					
HP	0.09	0.13	–0.82	0.19	0.30
BP	0.18	–0.32	–0.80	–0.09	0.33
Mexico					
HP	–0.14	0.01	0.05	–0.02	0.28
BP	–0.52	–0.21	0.17	0.42	0.32
Morocco					
HP	–0.13	0.22	–0.48	0.22	0.18
BP	–0.02	0.21	–0.44	0.14	0.43
Nigeria					
HP	0.15	–0.10	–0.48	0.21	–0.02
BP	–0.23	–0.38	–0.53	–0.19	0.02
Philippines					
HP	0.43	0.43	–0.71	0.07	0.46
BP	0.19	0.16	–0.60	0.18	0.31
Tunisia					
HP	0.21	–0.18	–0.62	0.20	0.19
BP	0.04	–0.38	–0.61	–0.26	–0.25
Turkey					
HP	–0.11	–0.17	–0.10	–0.12	0.05
BP	–0.09	–0.16	–0.43	0.05	0.33
Uruguay					
HP	0.14	–0.24	–0.59	0.39	0.47
BP	–0.37	–0.50	–0.51	0.04	0.51

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of M2 velocity, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

tuations in the demand for private sector credit, where the demand for loans is determined primarily by other factors.

To test this hypothesis, we run bivariate Granger-causality tests between the stationary components of private sector credit and industrial output. For some of the countries with positive correlations between these two variables, we do find that private sector credit has predictive power for industrial output in the Granger-

Table 10. *Cross Correlations between Domestic Output and Private Sector Credit*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	0.05	−0.43	−0.26	0.32	0.18
BP	−0.54	−0.66	−0.50	−0.35	−0.32
Colombia					
HP	−0.45	−0.31	0.28	0.37	0.18
BP	−0.62	−0.11	0.36	0.64	0.34
India					
HP	0.17	0.29	0.21	−0.17	−0.19
BP	0.01	0.55	0.47	−0.07	−0.27
Korea, Rep. of					
HP	−0.24	−0.01	0.12	0.12	−0.19
BP	0.02	0.03	0.12	0.04	0.19
Malaysia					
HP	0.07	0.08	−0.04	0.00	0.08
BP	−0.46	−0.32	0.13	0.41	0.10
Mexico					
HP	−0.39	−0.15	0.65	0.09	−0.31
BP	−0.45	0.38	0.84	0.48	−0.11
Morocco					
HP	−0.34	−0.09	0.09	0.02	0.31
BP	−0.38	−0.22	0.04	0.27	0.54
Nigeria					
HP	−0.13	−0.07	0.14	0.06	−0.01
BP	−0.17	−0.05	0.10	0.02	−0.29
Philippines					
HP	0.05	0.56	0.00	−0.20	−0.07
BP	−0.35	0.32	0.55	0.12	−0.38
Tunisia					
HP	0.14	−0.03	−0.10	0.25	0.18
BP	−0.10	0.23	0.53	0.69	0.29
Turkey					
HP	−0.32	−0.25	0.44	0.05	−0.28
BP	−0.52	0.01	0.52	0.37	−0.37
Uruguay					
HP	0.08	−0.07	−0.27	0.18	0.39
BP	−0.14	−0.38	−0.34	−0.04	0.18

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of private sector credit, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

causal sense. However, for some of these countries there is also evidence of reverse causation from output to credit. Thus we do not find robust evidence of a unidirectional causal relationship from credit to economic activity. Nevertheless, the strong positive association between private sector credit and the domestic business cycle in some of the sample countries has important implications for the design of stabilization programs. Ignoring this link may exacerbate the output cost of a restrictive monetary policy aimed at lowering inflation.

Foreign Trade and the Business Cycle

In this subsection we explore the relationship between domestic business cycle fluctuations and fluctuations in price and quantity variables that are relevant to international trade. In particular, we examine correlations of output fluctuations with fluctuations in merchandise trade and measures of both nominal and real effective exchange rates.

An adequate measure of foreign trade transactions is the trade balance, constructed as the difference between real exports and real imports and divided by real GDP in order to control for scale effects. In the absence of reliable data on price deflators for exports and imports, many authors use the ratio of the sum of nominal exports and imports to output. Unfortunately, we are even more constrained because we have only real industrial output data for most of the countries in our sample. Hence we use the ratio of exports to imports at current prices as a rough measure of the trade balance. Because changes in the terms of trade could be large and important for these countries, we return to that issue later.

For Chile, Mexico, Turkey, and Uruguay, the contemporaneous correlations between our proxy for trade balance movements and industrial output are negative irrespective of the filter used (table 11). This pattern is similar to that found for industrial countries, as reported by several authors—see Fiorito and Kollintzas (1994), Prasad and Gable (1998), and the references therein. However, for certain countries—including Morocco and Nigeria—the contemporaneous correlations are strongly positive. This result may reflect a strong link between changes in industrial output and exports of manufactures, or it may reflect the fact that merchandise imports are not highly sensitive to fluctuations in domestic demand. In addition, where we do find significant correlations between the trade ratio and domestic output, these correlations peak at (or near) lag zero. We interpret this as indicative of the close relationship between international trade and industrial output in these middle-income economies, with industrial output being a good proxy for output in the traded goods sector (other than primary commodities).

We were able to obtain unit values of imports and exports and to construct a quarterly index of the terms of trade for only three of the countries in our sample—Colombia, Korea, and Mexico. These three countries show a strong positive correlation between the cyclical components of industrial production and the terms-of-trade index (table 12). For Colombia and Korea the BP-filtered data yield the strongest correlations. This suggests that the positive relationship between output and the terms of trade might be obscured when using the HP filter because of the large amount of high-frequency variation in the terms-of-trade data.

Because these middle-income countries are unlikely to affect the world price of any industrial commodity, the positive correlations could be seen as consistent with demand shifts that lead to simultaneous increases in world prices and in the export demand for the industrial sector output of these countries. For the three

Table 11. *Cross Correlations between Domestic Output and the Trade Balance*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	0.23	0.54	–0.54	–0.49	0.28
BP	0.46	0.32	–0.48	–0.48	0.18
Colombia					
HP	0.30	0.05	–0.20	–0.16	0.25
BP	0.23	0.02	–0.08	–0.15	0.05
India					
HP	0.10	–0.05	–0.10	0.08	–0.03
BP	0.18	0.19	–0.10	0.10	0.24
Korea, Rep. of					
HP	0.00	0.40	0.04	–0.09	–0.15
BP	0.13	0.43	0.39	–0.03	–0.34
Malaysia					
HP	–0.15	0.17	0.16	–0.02	–0.19
BP	–0.15	0.04	0.15	0.10	0.16
Mexico					
HP	0.42	–0.09	–0.71	0.08	0.53
BP	0.24	–0.49	–0.60	0.17	0.75
Morocco					
HP	0.04	–0.28	0.31	–0.16	–0.30
BP	0.15	–0.12	0.23	–0.14	–0.22
Nigeria					
HP	0.00	–0.02	0.46	–0.19	–0.32
BP	–0.03	0.20	0.20	–0.47	–0.18
Philippines					
HP	–0.34	–0.27	0.24	0.05	0.12
BP	–0.23	–0.35	–0.09	0.02	0.62
Tunisia					
HP	0.07	–0.06	0.00	0.04	0.04
BP	0.08	–0.03	–0.08	0.10	0.04
Turkey					
HP	–0.06	0.09	–0.49	0.28	0.22
BP	–0.33	–0.18	–0.18	0.37	0.52
Uruguay					
HP	–0.12	–0.15	–0.30	–0.11	0.46
BP	–0.25	–0.35	–0.36	–0.11	0.28

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of the trade balance, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

countries for which we have terms-of-trade data, the strong positive correlations between lagged values of the terms-of-trade index and contemporaneous output provide further support for this interpretation. Overall, our results are consistent with those of Rodríguez-Mata (1997) for Costa Rica, Kose and Riezman (1998) for Sub-Saharan Africa, and Mendoza (1995), who suggest that almost half of the output fluctuations in developing countries can be explained by terms-of-

Table 12. *Cross Correlations between Domestic Output and Terms of Trade*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Colombia					
HP	0.18	0.15	0.10	0.15	0.08
BP	0.57	0.42	0.34	0.06	–0.29
Korea, Rep. of					
HP	0.08	0.08	0.41	–0.17	–0.14
BP	0.00	0.38	0.62	0.50	0.26
Mexico					
HP	–0.28	0.13	0.46	–0.30	–0.24
BP	–0.10	0.49	0.46	0.14	0.32

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of terms of trade, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

trade disturbances. Our results are also consistent with those of Deaton and Miller (1995), who find evidence that export price shocks have had substantial contemporaneous effects on output in Sub-Saharan Africa.

Cyclical Behavior of Exchange Rates

The interpretation of the unconditional correlations between industrial output and measures of nominal and real effective exchange rates is complicated by the fact that their short-run relationship depends crucially on the sources of macroeconomic fluctuations.[23] Nonetheless, it is useful to look at unconditional correlations for two reasons. First, the sign and magnitude of these correlations could indicate the types of shocks that have dominated fluctuations over a period of time. Second, these correlations could help in interpreting the correlations between output and trade variables.

In India, Morocco, Tunisia, and Turkey, there is some evidence of a positive relationship between nominal effective exchange rates and industrial output, while the correlations are generally negative for Chile, Nigeria, and Uruguay (table 13). The correlations between output and real effective exchange rates show a similar pattern, but with a few important differences (table 14). The contemporaneous correlations for Mexico and Uruguay are positive, while the correlations for Morocco and the Philippines are close to zero. However, many of the contemporaneous correlations are not significantly different from zero. The absence

23. There are, of course, important differences in the exchange rate arrangements of the sample countries. However, since we use trade-weighted measures of both real and nominal effective exchange rates, the fact that certain bilateral exchange rates could be fixed does not, in principle, affect the interpretation of our results. We also define the effective exchange rates such that an increase in the exchange rate implies an appreciation of the currency (in real or nominal terms, as the case may be). Thus a positive correlation indicates that the exchange rate tends to appreciate when the cyclical component of output rises.

Table 13. *Cross Correlations between Domestic Output and the Nominal Effective Exchange Rate*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	0.13	–0.57	–0.05	0.32	–0.11
BP	–0.04	–0.40	–0.36	–0.13	0.00
Colombia					
HP	–0.29	–0.21	0.19	0.13	–0.23
BP	–0.14	–0.40	–0.40	–0.27	–0.08
India					
HP	0.03	0.45	0.25	–0.19	–0.32
BP	–0.26	0.21	0.18	–0.37	–0.48
Korea, Rep. of					
HP	0.11	–0.43	–0.02	0.45	0.06
BP	–0.39	–0.55	–0.09	0.45	0.56
Malaysia					
HP	–0.03	0.17	0.10	0.12	–0.51
BP	–0.25	0.14	0.19	–0.06	–0.34
Mexico					
HP	0.02	0.69	–0.05	–0.41	–0.10
BP	–0.05	0.52	0.38	0.10	0.36
Morocco					
HP	0.04	0.06	0.17	0.04	–0.12
BP	–0.05	0.18	0.33	0.29	–0.02
Nigeria					
HP	0.06	–0.13	–0.04	–0.13	–0.14
BP	–0.41	–0.47	–0.39	–0.25	0.10
Philippines					
HP	0.48	–0.01	–0.38	0.26	0.02
BP	–0.06	0.29	0.25	–0.02	–0.46
Tunisia					
HP	–0.32	–0.31	0.33	0.49	0.05
BP	–0.21	0.14	0.67	0.79	0.31
Turkey					
HP	0.02	–0.26	0.36	–0.09	–0.22
BP	0.28	0.34	0.09	–0.15	–0.32
Uruguay					
HP	0.22	–0.22	–0.27	0.03	0.16
BP	–0.18	–0.41	–0.57	–0.31	0.24

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of the nominal effective exchange rate, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

of a systematic relationship between real exchange rates and the business cycle is consistent with the notion that this relationship is affected by an amalgam of supply, real demand, and nominal shocks, each of which could affect this correlation in different ways.

One interesting aspect of these results is that, for many countries, the correlations are quite similar using either nominal or real measures of effective exchange

Table 14. *Cross Correlations between Domestic Output and the Real Effective Exchange Rate*

Country and filter	*Eight-quarter lag*	*Four-quarter lag*	*Zero lag*	*Four-quarter lead*	*Eight-quarter lead*
Chile					
HP	–0.23	–0.55	0.26	0.36	–0.24
BP	–0.32	–0.54	–0.41	–0.33	–0.31
Colombia					
HP	–0.12	–0.03	0.06	0.01	–0.30
BP	0.01	–0.19	–0.36	–0.44	–0.46
India					
HP	0.02	0.47	0.19	–0.23	–0.30
BP	–0.10	0.16	0.09	–0.45	–0.61
Korea, Rep. of					
HP	0.12	–0.47	0.10	0.27	0.06
BP	–0.52	–0.62	–0.14	0.41	0.56
Malaysia					
HP	0.06	0.18	0.10	0.04	–0.49
BP	–0.19	0.17	0.19	–0.14	–0.38
Mexico					
HP	–0.47	0.24	0.59	–0.36	–0.39
BP	–0.09	0.48	0.47	–0.12	0.01
Morocco					
HP	–0.06	0.08	–0.01	0.01	–0.23
BP	–0.10	–0.06	–0.01	0.09	–0.23
Nigeria					
HP	0.08	–0.06	–0.09	–0.19	–0.12
BP	–0.32	–0.46	–0.45	–0.34	0.00
Philippines					
HP	0.07	–0.56	0.03	0.63	–0.19
BP	–0.48	–0.46	0.21	0.61	0.06
Tunisia					
HP	–0.31	–0.17	0.30	0.44	0.02
BP	–0.27	0.11	0.67	0.76	0.22
Turkey					
HP	0.19	–0.13	0.30	–0.23	–0.22
BP	0.44	0.33	–0.15	–0.35	–0.21
Uruguay					
HP	–0.17	–0.16	0.22	0.47	–0.05
BP	–0.53	–0.25	0.16	0.31	–0.02

Note: HP and BP refer to the stationary components derived using the modifed Hodrick-Prescott and band-pass filters, respectively. The correlations reported are between the contemporaneous values of domestic output and the *j*th lag or lead of the real effective exchange rate, with both variables detrended using the same filter. The data series and sources are described in the appendix.

Source: Authors' calculations based on IMF data.

rates. This finding is in line with a substantial body of research showing that, for industrial countries, nominal and real exchange rates are strongly positively correlated at business cycle frequencies (see, for instance, Mussa 1986 and Taylor 1995). Indeed, we find that the contemporaneous correlations between real and nominal effective exchange rates are strongly positive for all countries in our sample, irrespective of the filter used.

IV. Summary of the Findings

In this section we summarize the main findings of the paper. As noted in the discussion thus far, some of these results have previously been reported by other authors, using different data sets.

- Output volatility, as measured by the standard deviations of the filtered cyclical components of industrial production, varies substantially across developing countries. However, on average, it is much higher than the level typically observed in industrial countries. Developing countries also show considerable persistence in output fluctuations.
- Activity in industrial countries has a significantly positive influence on output in most developing countries. Real interest rates in industrial countries tend to be positively associated with output fluctuations in our sample of middle-income countries.
- Government expenditures are countercyclical. Government revenue is acyclical in some countries and significantly countercyclical in others—a phenomenon that is difficult to explain. The fiscal impulse (defined as the ratio of government spending to government revenue) is negatively correlated with the business cycle.
- The cyclical behavior of nominal wages varies markedly across countries and is not robust across filters. In contrast, the evidence strongly supports the assumption of procyclical real wages.
- There is no consistent relationship between the stationary components of the levels of output and prices and the levels of output and inflation. Variations in the price level and inflation are countercyclical in some countries and procyclical in a few.
- Contemporaneous correlations between money (measured by various monetary aggregates) and output are broadly positive, but not very strong—in contrast to the evidence for many industrial countries.
- The contemporaneous correlations between the velocity of broad money and industrial output are strongly negative for almost all the countries in our sample. This result is in contrast to the weakly procyclical behavior of velocity observed in most industrial countries.
- Domestic credit and industrial output are positively associated in some countries. However, the strength of the relationship is not always robust to the choice of detrending procedure. Some countries show a negative correlation between these two variables.
- There is no robust correlation between merchandise trade movements (as measured by the ratio of exports to imports) and output. For some countries the contemporaneous correlations are negative (irrespective of the filter used), whereas for others the contemporaneous correlations are strongly positive. The positive relationship may indicate that fluctuations in industrial output

are driven by export demand and that merchandise imports are not as sensitive to domestic demand fluctuations as they are in industrial countries.

- Cyclical movements in the terms of trade are strongly positively correlated with output fluctuations.
- There are no systematic patterns in the contemporaneous correlations between nominal effective exchange rates and industrial output; the results are similar for real effective exchange rates. Fluctuations in real and nominal effective exchange rates are strongly positively correlated for the developing countries in our sample.

V. Concluding Remarks

In this article we studied the cyclical properties of a large number of (seasonally adjusted) macroeconomic time series for a group of 12 (mostly middle-income) developing countries, using two univariate detrending methods. We discussed the cross-correlation patterns between output and the macroeconomic time series and attempted to identify a set of relatively robust regularities that can be used as a benchmark to guide theoretical research in development macroeconomics. We also highlighted similarities and differences between our results and other studies on business cycle fluctuations in industrial and developing countries.

We can make several remarks on the methodological and analytical implications of our analysis. First, our results suggest that, although the correlations derived from different filters were often very similar, several quantitative (as well as qualitative) features of the data are not robust across detrending methods. This result is similar to that of Blackburn and Ravn (1991) and Canova (1998), among other authors. Because generally we cannot know ex ante when results will vary across filters, considering systematically an array of detrending methods remains an important test of robustness in empirical research on business cycle regularities.

Second, the unconditional correlations between different variables (such as exchange rates or prices) and domestic output may be small because they average the effects of different types of shocks. It is, therefore, important to develop and estimate structural models, along the lines, for instance, of Ahmed and Park (1994), Rogers and Wang (1995), Hoffmaister and Roldós (1997), and Prasad (1999), that attempt to separate out the effects of different types of macroeconomic shocks on variables such as prices, output, foreign trade, and exchange rates in developing countries. However, existing methods remain controversial; we do not yet have models that convincingly isolate different types of shocks.

Third, the analysis in this article ignores the possible effects of measurement errors in the raw data. This is a potentially serious problem. For instance, in our analysis of the correlations between domestic output and foreign interest rate shocks, we do not account for the risk premium that borrowers from developing countries typically face on world capital markets. However, there is considerable evidence that such premiums can be large on average (particularly for countries with a high ratio of external debt to output) and could change unpredictably in the short run as a result of sudden shifts in market sentiment. This measurement problem, which has not been adequately addressed in other studies, suggests that we should exercise caution in judging the strength and direction of correlations between domestic output and a measure of world interest rates that does not capture movements in country-specific risk premiums.

Finally, at the analytical level, a natural step forward is to build stochastic general equilibrium simulation models of small, open developing economies in order to assess if such models (properly calibrated) can reproduce the stylized facts highlighted here. Some of the correlations established (such as the countercyclical behavior of government spending) can indeed be explained within existing theoretical constructs. Building more general quantitative models that are capable of accounting for the other types of business cycle regularities highlighted here could prove important for the design of stabilization policies and macroeconomic management in developing countries.

Appendix: Data Sources and Unit Root Tests

The primary sources of data used in this study are the International Monetary Fund's *International Financial Statistics* (IFS) and Information Notice System, supplemented by other sources. This appendix describes the series, together with their IFS codes. All data are available on request.

- Real output is the industrial production index (series 66) for Mexico, Korea, India, Malaysia, and Tunisia and the manufacturing production index (series 66ey) for Chile, Morocco, Nigeria, the Philippines, and Uruguay. We obtained the industrial production index from the International Monetary Fund (IMF) desk economist for Colombia and from the Organisation for Economic Co-operation and Development (OECD) database for Turkey. IMF desk economists also provided partial information for Turkey, Tunisia, and Uruguay.
- The CPI is series 64 for all countries. The IMF desk economist for Tunisia filled in the data (for that country) missing from the IFS.
- The nominal wage index is series 65 for Mexico, Chile, and the Philippines and series 65ey for Korea. We obtained data for Colombia from the IMF desk economist. We obtained data for Turkey from the OECD database and the IMF desk economist. We calculate the real wage index by deflating the nominal wage series by the CPI.
- The monetary base (or reserve money) is series 14 for all countries. Narrow money is series 34, and broad money is the sum of series 34 and 35, again for all countries. We calculate velocity for each monetary indicator by first transforming the monetary aggregate into an index and then dividing by

the product of the CPI and the real output index, which is used as a proxy for nominal output.

- Private sector credit is series 32d for all countries. We calculate the real credit variable by deflating the nominal aggregate by the CPI. The IMF desk economist for Tunisia filled in the data (for that country) missing from IFS.
- Government expenditures in nominal terms is series 82 for Mexico, Korea, and the Philippines. We obtained data for Chile from Chile's Ministry of Finance. We derive the expenditure index by first transforming the nominal series into an index and then dividing by the same proxy for nominal output used to derive velocity indicators.
- Government revenue in nominal terms is series 81. We derive the revenue index in the same way as the expenditure index.
- We derive the fiscal impulse measure by dividing series 82 by series 81.
- The trade ratio is the ratio of merchandise exports at current prices (series 70) to merchandise imports at current prices (series 71), with both variables measured in U.S. dollar terms.
- We obtain trade-weighted measures of nominal and real effective exchange rates from the IMF's Information Notice System.
- The terms of trade are the ratio of export unit values (series 74) to import unit values (series 75) for Colombia and Korea. For Mexico we obtain export and import price indexes from the OECD database.
- World output is proxied by the industrial production index for industrial countries (series 66, code 110). The world real interest rate is proxied by the difference between the nominal euro-dollar rate in London (series 60d, country code 112) and the rate of inflation in consumer prices in industrial countries (series 64, code 110).

We performed a set of standard unit root tests, including augmented Dickey-Fuller tests and Phillips-Perron tests, on our raw data series (all of which were converted into logarithms for the empirical work, except for the world real interest rate). These tests indicated that virtually all of the series were nonstationary in levels over the relevant sample period and that, therefore, computing correlations using the raw data would not be appropriate. We also used similar unit root tests to confirm that the cyclical components obtained with the filters employed in this article were indeed stationary. In addition, we found that the inflation rate (measured as the four-quarter change in the price level) did not appear to be stationary in levels for several countries in our sample. To conserve space, the results of these unit root tests are not reported here but are available on request.

References

The word "processed" describes informally reproduced works that may not be commonly available through library systems.

Abraham, Katharine G., and John C. Haltiwanger. 1995. "Real Wages and the Business Cycle." *Journal of Economic Literature* 33(September):1215–64.

Agénor, Pierre-Richard. 1997. "Capital-Market Imperfections and the Macroeconomic Dynamics of Small Indebted Economies." Princeton Studies in International Finance 82. Princeton University, Princeton, N.J. Processed.

Agénor, Pierre-Richard, C. John McDermott, and Eswar S. Prasad. 1998. "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts." Economic Development Institute, World Bank, Washington, D.C. Processed. Online at http://www.worldbank.org/html/edi/ediwp.htm.

Agénor, Pierre-Richard, and Peter J. Montiel. 1996. *Development Macroeconomics.* Princeton, N.J.: Princeton University Press.

Ahmed, Shaghil, and Kae H. Park. 1994. "Sources of Macroeconomic Fluctuations in Small Open Economies." *Journal of Macroeconomics* 16(Spring):1–36.

Backus, David K., and Patrick J. Kehoe. 1992. "International Evidence on the Historical Properties of Business Cycles." *American Economic Review* 82(September):864–88.

Baxter, Marianne, and Robert G. King. 1995. "Approximate Band-Pass Filters for Economic Time Series." NBER Working Paper 5022. National Bureau of Economic Research, Cambridge, Mass. Processed.

Blackburn, Keith, and Morten O. Ravn. 1991. "Univariate Detrending of Macroeconomic Time Series." Working Paper 22. Department of Economics, Aarhus University, Aarhus, Denmark. Processed.

Canova, Fabio. 1998. "Detrending and Business Cycle Facts." *Journal of Monetary Economics* 41(June):475–512.

Chadha, Bankim, and Eswar Prasad. 1994. "Are Prices Countercyclical? Evidence from the G7." *Journal of Monetary Economics* 34(October):239–57.

Cooley, Thomas F., and Lee E. Ohanian. 1991. "The Cyclical Behavior of Prices." *Journal of Monetary Economics* 28(August):25–60.

Deaton, Angus S., and Ronald I. Miller. 1995. "International Commodity Prices, Macroeconomic Performance, and Politics in Sub-Saharan Africa." Princeton Essays in International Finance 79. Princeton University, Princeton, N.J. Processed.

Fiorito, Riccardo, and Tryphon Kollintzas. 1994. "Stylized Facts of Business Cycles in the G7 from a Real Business Cycles Perspective." *European Economic Review* 38(February):235–69.

Hodrick, Robert J., and Edward C. Prescott. 1997. "Postwar U.S. Business Cycles: An Empirical Investigation." *Journal of Money, Credit, and Banking* 29(February):1–16.

Hoffmaister, Alexander W., and Jorge E. Roldós. 1997. "Are Business Cycles Different in Asia and Latin America?" Working Paper 97/9. International Monetary Fund, Washington, D.C. Processed.

Judd, John P., and Bharat Trehan. 1995. "The Cyclical Behavior of Prices: Interpreting the Evidence." *Journal of Money, Credit, and Banking* 27(August):789–97.

King, Robert G., and Charles I. Plosser. 1984. "Money, Credit, and Prices in a Real Business Cycle." *American Economic Review* 74(June):363–80.

Kose, M. Ayhan, and Raymond Riezman. 1998. "Trade Shocks and Macroeconomic Fluctuations in Africa." Department of Economics, Brandeis University, Waltham, Mass. Processed.

Kouparitsas, Michael A. 1996. "North-South Business Cycles." Working Paper 96-9. Federal Reserve Bank of Chicago. Processed.

———. 1997. "North-South Terms of Trade: An Empirical Investigation." Working Paper 97-5. Federal Reserve Bank of Chicago. Processed.

Kydland, Finn E., and Edward C. Prescott. 1994. "Business Cycles: Real Facts and a Monetary Myth." In Preston J. Miller, ed., *The Rational Expectations Revolution: Readings from the Front Line*. Cambridge, Mass.: MIT Press.

Kydland, Finn E., and Carlos Zarazaga. 1997. "Is the Business Cycle of Argentina Different?" *Federal Reserve Bank of Dallas Economic Review* (4th quarter):21–36.

Lumsdaine, Robin L., and Eswar S. Prasad. 1997. "Identifying the Common Component in International Economic Fluctuations." NBER Working Paper 5984. National Bureau of Economic Research, Cambridge, Mass. Processed.

McDermott, C. John. 1997. "An Automatic Method for Choosing the Smoothing Parameter in the HP Filter." International Monetary Fund, Washington, D.C. Processed.

Mendoza, Enrique. 1995. "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations." *International Economic Review* 36(February):101–37.

Mussa, Michael. 1986. "Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications." *Carnegie-Rochester Conference on Public Policy* 25(Autumn):117–213.

Prasad, Eswar S. 1999. "International Trade and the Business Cycle." *Economic Journal* 109(October):588–606.

Prasad, Eswar S., and Jeffery A. Gable. 1998. "International Evidence on the Determinants of Trade Dynamics." *IMF Staff Papers* 45(September):401–39.

Rodríguez-Mata, Margarita. 1997. "Cyclical Patterns of the Costa Rican Economy." Central Bank of Costa Rica. Processed.

Rogers, John H., and Ping Wang. 1995. "Output, Inflation, and Stabilization in a Small Open Economy: Evidence from Mexico." *Journal of Development Economics* 46(April):271–93.

Rotemberg, Julio J., and Michael Woodford. 1991. "Markups and the Business Cycle." In Olivier J. Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual: 1991*. Cambridge, Mass.: MIT Press.

Taylor, Mark P. 1995. "The Economics of Exchange Rates." *Journal of Economic Literature* 33(March):13–47.

van Els, Peter J. 1995. "Real Business Cycle Models and Money: A Survey of Theories and Stylized Facts." *Weltwirtschafliches Archiv* 131(June):223–64.