The Developing Economies, XXXIV-2 (June 1996)

THE CYCLICAL BEHAVIOR OF PRICES: EVIDENCE FROM SEVEN DEVELOPING COUNTRIES

NICHOLAS APERGIS

I. INTRODUCTION

ONE of the stylized facts that characterize an economy over the business cycle is the movement of prices with real output. In the literature on the demand and real theories of business cycles, the two main theories state that if movements of output result from demand shocks, prices are expected to be procyclical; by contrast, if shocks originate from the supply side then prices are expected to be countercyclical. Lucas provided evidence in support of a positive correlation between prices and real output [24][25]. Olson also argues that new-classical as well as Keynesian economics agree on the positive correlation between the variables in relevance [28]. The same holds in Mankiw [26]. Cooley and Ohanian confirm the price countercyclicality for the United States [11], and Backus and Kehoe confirm it for other countries [1].

By contrast, other studies have reached the opposite conclusions (Bernanke [2]). The pioneering works of Kydland and Prescott [20] and Long and Plosser [23] initiated an attempt to explain certain stylized facts of U.S. business cycle behavior. This attempt—the so-called real business cycle theory—considered that what is responsible for the presence of business cycle phenomena are exogenous technological shocks and the accompanying propagation mechanism generated by the behavior of economic agents to optimize their behavior within an environment characterized by rational expectations and market-clearing conditions. These business cycle models attempt to explain the fluctuations in macroeconomic aggregates via the technological or any other "real" channel supporting the presence of an inverse relationship between prices and output. Mankiw has criticized real business cycle models on the grounds that they show that prices are not procyclical [26].

Countercyclicality of prices connotes that prices and output are negatively correlated. Moreover, the countercyclical behavior of prices suggests that real output

I would like to thank the anonymous referee from *The Developing Economies* for the helpful comments and suggestions.

variation must be attributed to supply rather than demand (or monetary) disturbances, since real disturbances shift the aggregate supply of output along a relatively stable aggregate demand with standard negative slope. It has been accepted in the international literature that, although money is procyclical, the price level is countercyclical (Kydland and Prescott [21] and Smith [32]). This is consistent with the finding that real monetary aggregates are more procyclical than the nominal aggregates. The countercyclical behavior of the price level indicates that monetary shocks cannot be the principal disturbance that determines the behavior of the economy. What really determines such a behavior are those disturbances that force output and prices to move in opposite directions. The observed behavior of the price level depends on the strength of the procyclical pattern of money. It has been argued—in the case of the United States—that the strong procyclical pattern for M1 and M2 over the period 1880–1940, comparative to its counterpart over the period 1954–91, helps to explain why the price level changed from procyclical before World War II to countercyclical after the war (Kydland and Prescott [21] and Wolf [33]).

However, to the best of the author's knowledge, no attempt has been made to explain the origins of business cycle phenomena via the cyclical behavior of prices for the developing countries. The goal of this paper, therefore, is to provide evidence with respect to the cyclical behavior of prices for these countries. The rest of the paper is organized as follows. Section II presents the empirical analysis, while Section III provides some concluding remarks.

II. THE EMPIRICAL ANALYSIS

A. *Data*

Quarterly data for prices (consumer price index) and output (GDP or industrial production) was obtained from seven developing countries over the period 1975:1–1993:4 from the IMF *International Financial Statistics* tape. The involved countries are the Republic of Korea, Israel, India, Argentina, Brazil, Mexico, and the Philippines. While for all countries the consumer price index was employed, GDP data were obtained for Korea, Argentina, Brazil, and the Philippines. Industrial production data were used for the remaining countries. Although industrial production is considered to be a subset of GDP, for these three countries, namely, Israel, India, and Mexico, only industrial production data were available on the IMF tape.

B. *Methods of Detrending Price and Output Series*

One commonly used detrending procedure which eliminates the unit root problem is taking first differences in logs. An alternative detrending method has been proposed by Hodrick and Prescott (HP) [17]. They employed a two-sided filter

which removes the trend component of a time series. Despite certain advantages, the statistical properties of the detrended data remain in dispute. There are also various drawbacks with the way in which the HP filter is used to study business cycle stylized facts (Cogley [9], Harvey and Jaeger [15], King and Rebelo [19], Fiorito and Kollintzas [14]). For more details on the HP filter, see Cogley and Nason [10] and King and Rebelo [19].[1] Rather than stay with a particular technique for detrending output and prices, the robustness of the empirical findings across a variety of detrending methods is evaluated. Therefore, we examine the sensitivity of the empirical findings to the detrending method by employing these two alternative detrending methods.[2] Prescott, however, has stated that business cycle phenomena are not sensitive to the detrending method employed [31].

In terms of the first procedure, Dickey-Fuller unit root tests—developed by Dickey and Fuller [13]—and Phillips-Perron tests—developed by Phillips [29] and Phillips and Perron [30]—indicate the presence of a unit root in the levels of output and price series in all countries, but not in their first differences. The issue of nonstationarity is important, since it determines how the trend component of output could be removed and its cyclical component derived. The results are reported in Table I.

C. *Correlations between Prices and Output*

Part A of Table II reports the correlations between HP-filtered prices and output. Correlations for Korea, India, Mexico, and the Philippines are negative. For the remaining countries most of the correlations (including the contemporaneous ones) are positive. Therefore, for Korea, India, Mexico, and the Philippines price and output movements are negatively correlated, which in turn connotes that there are real disturbances that primarily explain business cycle characteristics. In fact, technological changes in the Korean economy (as in Bhalla [3]), oil shocks and terms of trade changes in Mexico (as in Bhalla [3]), and terms of trade disturbances in India and the Philippines help to identify their economies as driven by real innovations (Cline [7]). By contrast, in economies such as that of Israel and Argentina, demand (or monetary) disturbances seem to determine their behavior. Leiderman

[1] The Hodrick-Prescott filter solves the following minimization problem:

$$\min\ (1/T)\sum_{t=1}^{T}(x_t - q_t)^2 + (\lambda/T)\sum_{t=2}^{T-1}[(q_{t+1} - q_t) - (q_t - q_{t-1})]^2,$$

with x the involved series, q the trend or growth component, and $x_t - q_t$ is the residual used as a proxy for the cyclical component. Lambda (λ) is set equal to 1,600 for quarterly data (Prescott [31]).

[2] One additional technique has been suggested for detrending various macroeconomic variables which makes use of a deterministic linear trend. This technique, however, is not employed here because Campbell and Mankiw have argued that output series may not be trend stationary but difference stationary [6].

TABLE I

UNIT ROOT TESTS

Var. (X)	ADF in Levels	ADF in 1st Differences	PP in Levels ($Z\tau_\mu$)	PP in 1st Differences ($Z\tau_\mu$)	PP in Levels ($Z\tau_\tau$)	PP in 1st Differences ($Z\tau_\tau$)
Korea:						
P	–2.20	–4.41*	–2.27	–4.73*	–1.65	–5.31*
Y	–1.26	–4.83*	–0.07	–20.47*	–1.66	–20.39*
Israel:						
P	–1.64	–4.07*	–1.39	–4.29*	–0.06	–4.61*
Y	–2.10	–4.08*	–0.69	–11.37*	–2.02	–11.37*
India:						
P	–2.46	–4.81*	–1.66	–5.85*	–1.20	–6.15*
Y	–2.58	–4.04*	–1.07	–20.87*	–1.39	–21.00*
Argentina:						
P	–2.23	–4.54*	–0.24	–5.99*	–1.69	–5.77*
Y	–2.08	–3.45*	–1.06	–9.68*	–2.02	–9.58*
Brazil:						
P	–0.90	–4.58*	–2.09	–5.85*	–1.06	–7.68*
Y	–1.24	–3.60*	–1.39	–9.63*	–1.12	–11.07*
Mexico:						
P	–1.99	–4.63*	–0.37	–16.16*	–1.70	–15.53*
Y	–2.58	–4.19*	–1.15	–10.21*	–1.95	–10.45*
Philippines:						
P	–1.77	–4.51*	–0.43	–6.01*	–2.03	–6.12*
Y	–2.16	–4.10*	–2.39	–10.23*	–2.06	–10.31*

Notes: 1. ADF = the augmented Dickey-Fuller tests with a constant and a time variable. The regression involved is

$$\Delta X_t = a_1 + a_2\ TIME + a_3\ X_{t-1} + \sum_{i=1}^{m} b_i\ \Delta X_{t-i} + u_t,$$

with *TIME* being a time variable, Δ denoting first differences, and u_t a random term.

2. PP = the Phillips–Perron test with a constant. The regressions involved are

$$X_t = b_0 + b_1\ (TIME - m/2) + b_2\ X_{t-1} + u_{1t} \text{ and}$$
$$X_t = d_0 + d_1\ X_{t-1} + u_{2t},$$

with u_{1t} and u_{2t} being random terms. The null hypotheses involved are

$$H_0^1: b_2 = 1 \text{ and}$$
$$H_0^2: d_1 = 1.$$

The first hypothesis is tested by means of the statistic $Z(\tau_\mu)$ and the second by means of the statistic $Z(\tau_\tau)$.

* significant at 5 per cent.

and Razin provided evidence that there has been a close link between the inflationary process and nominal variables [22]. In particular, monetary and exchange rate disturbances account mostly for the behavior of inflation. The same results have been reached by Bruno [5]. The same holds for Argentina (Helpman and Leiderman [16]) and Brazil (Cline [8]). Crockett has also showed that it is adjustments in interest rates and in the structure of the financial sector which generate

TABLE II

CROSS–CORRELATIONS OF PRICES AND OUTPUT

A. Correlations of HP-Filtered Prices and Output

Lag	Korea	Israel	India	Argentina	Brazil	Mexico	Philippines
3	–0.091	0.063	0.276	–0.088	0.166	0.017	–0.360
2	–0.099	0.143	0.152	–0.055	0.142	–0.017	–0.292
1	–0.172	0.189	–0.368	–0.011	0.116	0.087	–0.177
0	–0.162	0.151	–0.292	0.027	0.087	–0.037	–0.139
–1	–0.064	0.146	0.132	0.064	0.049	–0.070	–0.051
–2	–0.052	0.181	0.011	0.104	0.011	–0.290	–0.023
–3	–0.115	0.182	–0.432	0.147	–0.027	–0.028	0.054

B. Correlations of First Differences of Prices and Output

Lag	Korea	Israel	India	Argentina	Brazil	Mexico	Philippines
3	–0.177	–0.022	0.515	–0.254	–0.348	–0.025	–0.080
2	0.016	0.058	0.305	–0.085	–0.129	–0.100	–0.165
1	–0.050	0.016	–0.542	–0.036	–0.037	0.035	0.086
0	–0.069	–0.038	–0.304	–0.496	–0.547	–0.159	–0.123
–1	–0.126	–0.037	0.509	–0.193	0.075	–0.074	0.045
–2	0.011	–0.012	0.257	–0.134	–0.279	–0.284	–0.156
–3	–0.070	–0.039	–0.512	–0.187	–0.151	0.176	0.253

C. Correlations of Inflation and HP-Filtered Output

Lag	Korea	Israel	India	Argentina	Brazil	Mexico	Philippines
3	0.073	0.021	0.146	0.049	–0.244	0.092	–0.203
2	0.158	0.073	0.562	0.067	–0.198	0.025	–0.292
1	0.073	0.116	–0.120	0.100	0.032	0.111	–0.199
0	–0.036	0.080	–0.508	–0.114	–0.595	–0.035	–0.243
–1	0.002	0.081	0.133	–0.165	0.037	–0.097	–0.187
–2	0.094	0.107	0.485	–0.136	0.014	–0.378	–0.239
–3	0.006	0.106	–0.174	–0.184	0.055	–0.125	–0.026

Notes: 1. A positive lag denotes a lead.
2. Lag –3 indicates a correlation of the price series with the third lag of the output series.

fluctuations in the economies of Argentina, Israel, and the Philippines [12]. Furthermore, Montiel [27] argues that it is mainly fiscal deficit as well as changes in base money and in exchange rates that seem to determine the behavior of the economy in countries such as Argentina, Brazil, and Israel, which have employed specific stabilization programs designed to achieve a quick remedy in balance of payments and inflation crises via the employment of “orthodox” stabilization policies (Khan and Knight [18]). The results for India seem paradoxical, since they connote that real factors determine the price process, a piece of evidence which is in full contrast with Bhalla’s thesis [4].

Part B reports correlations between the first differences of prices and output. In this case, first differences in (logged) prices are interpreted as inflation. Therefore, part B describes correlations between inflation and the rate of growth of output. According to these results, all countries exhibit patterns suggesting that inflation moves in a countercyclical manner.

Finally, part C reports correlations between inflation and HP-filtered output. At this point it must be explained that there exists a substantial distinction between the correlation of inflation and first differences in output and the correlation of inflation and the cyclical component of output measured by the HP filter. The stationary series of output through first differencing does not correspond to the cyclical component of it. The results suggest that for all cases, except that of Israel, inflation behaves in a countercyclical manner.

Overall, two important points must be emphasized from Table II. First, in part A and the HP-filter detrending, only four countries, i.e., Korea, India, Mexico, and the Philippines, report countercyclical behavior of prices. For the remaining three economies, namely Israel, Argentina, and Brazil, prices follow a procyclical pattern. Second, for the economies where the procedure of detrending does not seem to differentiate the empirical findings, countercyclicality of prices in the four countries (part A: Korea, India, Mexico, and the Philippines) or inflation—associated with the first-differenced output—in all seven countries (part B) can also be translated into countercyclicality of inflation—associated with the cyclical component of output—in six countries (part C: except Israel).

Thus, detrending through first differences is supportive of the hypothesis of countercyclical inflation behavior in all seven economies. The results appear to strongly support those found by Kydland and Prescott [21] and Cooley and Ohanian [11] for developed economies. However, the detrending procedure seems to influence the empirical findings.

III. CONCLUDING REMARKS

The objective of this study was to examine the cyclical behavior of prices in seven developing countries over the period 1975:1–1993:4. The empirical results obtained are mixed. The application of two different detrending procedures yields different conclusions; prices do not seem to demonstrate conformity in their cyclical pattern. This seems to happen only in four out of seven cases. In the cases of Korea, India, Mexico, and the Philippines, prices behave countercyclically, while inflation, correlated to the growth rate of output, reports a countercyclical pattern in all seven cases. Finally, inflation, correlated to the cyclical component of output in all but one case (i.e., Israel), also exhibits a countercyclical pattern.

The countercyclical behavior of prices is in accordance with the predictions of the real business cycle theories in which real disturbances seem to drive the

economy, while procyclicality in prices seems to suggest a demand- or monetary-driven economy. The countercyclical behavior of inflation seems to counter demand-driven models of business cycles in the developing economies concerned, contrary to some evidence in the literature that there exist economies in the sample (i.e., Brazil) that are demand-driven. However, further research—possibly via a general equilibrium model—is necessary to provide evidence that supports or corroborates these findings.

REFERENCES

1. BACKUS, D. K., and KEHOE, P. J. "International Evidence on the Historical Properties of Business Cycles," *American Economic Review*, Vol. 82, No. 4 (September 1992).
2. BERNANKE, B. S. "Alternative Explanations of the Money-Income Correlation," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 25 (Autumn 1986).
3. BHALLA, S. S. "The Transmission of Inflation into Developing Economies," in *World Inflation and the Developing Countries*, ed. W. R. Cline and Associates (Washington, D.C.: Brookings Institution, 1981).
4. ————. "India's Closed Economy and World Inflation," in *World Inflation and the Developing Countries*, ed. W. R. Cline and Associates (Washington, D.C.: Brookings Institution, 1981).
5. BRUNO, M. "External Shocks and Domestic Response: Israel's Macroeconomic Performance, 1965–1982," Working Paper No. 1298 (Cambridge, Mass.: National Bureau of Economic Research, 1984).
6. CAMPBELL, J. Y., and MANKIW, N. G. "International Evidence on the Persistence of Economic Fluctuations," *Journal of Monetary Economics*, Vol. 23, No. 2 (March 1989).
7. CLINE, W. R. "Real Economic Effects of World Inflation and Recession," in *World Inflation and the Developing Countries*, ed. W. R. Cline and Associates (Washington, D. C.: Brookings Institution, 1981).
8. ————. "Brazil's Aggressive Response to External Shocks," in *World Inflation and the Developing Countries*, ed. W. R. Cline and Associates (Washington, D.C.: Brookings Institution, 1981).
9. COGLEY, T. "Spurious Business Cycle Phenomena in HP Detrended Series," Working Paper (Seattle, Wash.: University of Washington, 1990).
10. COGLEY, T., and NASON, J. M. "Effects of the Hodrick-Prescott Filter on Integrated Time Series" (Seattle, Wash.: University of Washington, 1991).
11. COOLEY, T. F., and OHANIAN, L. E. "The Cyclical Behavior of Prices," *Journal of Monetary Economics*, Vol. 28, No. 1 (August 1991).
12. CROCKETT, A. D. "Stabilization Policies in Developing Countries: Some Policy Considerations," *IMF Staff Papers*, Vol. 28, No. 1 (March 1981).
13. DICKEY, D. A., and FULLER, W. A. "Likelihood Ratio Statistics for Autoregressive Time-Series with a Unit Root," *Econometrica*, Vol. 49, No. 4 (July 1981).
14. FIORITO, R., and KOLLINTZAS, T. "Stylized Facts of Business Cycles in the G7 from a Real Business Cycle Perspective," *European Economic Review*, Vol. 38, No. 2 (February 1994).
15. HARVEY, A. C., and JAEGER, A. "Detrending Stylized Facts and the Business Cycle,"

Discussion Paper No. EM/91/230 (London: Suntory-Toyota International Center for Economics and Related Disciplines, 1991).
16. HELPMAN, E., and LEIDERMAN, L. "Slowing Down Exchange Rate Depreciation, Monetary Accommodation, and Inflation: A Comparison of Argentina, Chile, and Israel," Discussion Paper No. 4-86 (Tel Aviv: Tel-Aviv University, 1986).
17. HODRICK, R. J., and PRESCOTT, E. C. "Post-War US Business Cycles: An Empirical Investigation" (Pittsburgh, Pa.: Carnegie Melon University, 1980).
18. KHAN, M. S., and KNIGHT, M. D. "Stabilization Programs in Developing Countries: A Formal Framework," *IMF Staff Papers*, Vol. 28, No. 1 (March 1981).
19. KING, R. G., and REBELO, S. "Low Frequency Filtering and Real Business Cycles," *Journal of Economic Dynamics and Control*, Vol. 17, No. 1–2 (January–March 1993).
20. KYDLAND, F. E., and PRESCOTT, E. C. "Time to Build and Aggregate Fluctuations," *Econometrica*, Vol. 50, No. 6 (November 1982).
21. ————. "Business Cycles: Real Facts and a Monetary Myth," *Quarterly Review* (Federal Reserve Bank of Minneapolis), Spring 1990.
22. LEIDERMAN, L., and RAZIN, A. "Propagation of Shocks in a High-Inflation Economy: Israel, 1980–85," Working Paper No. 2003 (Cambridge, Mass.: National Bureau of Economic Research, 1986).
23. LONG, J. B., and PLOSSER, C. I. "Real Business Cycles," *Journal of Political Economy*, Vol. 91, No. 1 (February 1983).
24. LUCAS, R. E., Jr. "Expectations and the Neutrality of Money," *Journal of Economic Theory*, Vol. 4, No. 2 (April 1972).
25. ————. "Econometric Policy Evaluation: A Critique," in *The Philips Curve and Labor Markets*, ed. K. Brunner and A. Meltzer (Amsterdam: North-Holland, 1976).
26. MANKIW, G. N. "Real Business Cycles: A New Keynesian Perspective," *Journal of Economic Perspectives*, Vol. 3, No. 3 (Summer 1989).
27. MONTIEL, P. J. "Empirical Analysis of High-Inflation Episodes in Argentina, Brazil, and Israel," *IMF Staff Papers*, Vol. 36, No. 3 (September 1989).
28. OLSON, M. "A Microeconomic Approach to Macroeconomic Policy," *American Economic Review*, Vol. 79, No. 2 (May 1989).
29. PHILLIPS, P. C. B. "Time Series Regression with a Unit Root," *Econometrica*, Vol. 55, No. 2 (March 1987).
30. PHILLIPS, P. C. B., and PERRON, P. "Testing for a Unit Root in Time Series Regression," *Biometrika*, Vol. 75 (1988).
31. PRESCOTT, E. C. "Theory ahead of Business Cycle Measurement," *Quarterly Review* (Federal Reserve Bank of Minneapolis), Fall 1986.
32. SMITH, R. T. "The Cyclical Behavior of Prices," *Journal of Money, Credit, and Banking*, Vol. 24, No. 4 (November 1992).
33. WOLF, H. "Procyclical Prices: A Demi-Myth," *Quarterly Review* (Federal Reserve Bank of Minneapolis), Spring 1991.