21-41

THE INFLATIONARY EFFECT OF LDC EXCHANGE RATE CHANGES UNDER GENERALIZED CURRENCY FLOATING

*Romeo M. Bautista**

1. Introduction

A major reason for the widespread reluctance of policymakers in less developed countries (LDCs) to undertake exchange rate adjustments, despite the recognition of domestic currency overvaluation, is the anxiety about induced general price increases which may "rapidly undercut the improved competitiveness that the devaluation is designed to achieve" (Cooper, 1971, p. 21). There is a pervasive belief that devaluation is inflationary, not only in the sense of a once-and-for-all price increase but also through some cost-push mechanism (e.g., a wage price spiral) which make a higher *rate* of inflation inevitable. While the nature and empirical significance of such mechanisms have been debated in the literature for some time, the evidence from cross-country studies based on LDC experience under the Bretton Woods system seems to indicate that the worst fears concerning the inflationary effect of devaluation are unfounded.

In a study of 24 devaluation episodes involving 19 countries, most of them developing, during the period 1959-1966, Cooper

*The University of the Philippines School of Economics and Philippine Institute for Development Studies. This paper is part of a larger study on the comparative experience of developing countries under generalized currency floating done by the author as consultant to the Economic Analysis and Projections Department of the World Bank during 1979-80. The author is indebted to James Riedel for helpful discussions and to William Shaw for data collection and computational assistance. Views expressed in the paper are personal and should not be attributed to the World Bank.

(1971) finds that increases in wholesale and consumer prices have been far less than devaluation – on average, by 32 percent and 42 percent, respectively, of the devaluation. Connolly and Taylor (1976) have likewise observed that eight devaluations in five LDCs during 1962-1970 resulted in faster increases in wholesale and consumer prices in the year following devaluation but at much lower rates than export and import prices; over two years "the devaluation would have added 13 and 14 1/2 percent to the export and import price indices" (p. 857). Finally, in a regression analysis of the inflationary impact of devaluation in ten developing countries (included in the recently completed NBER project on foreign exchange regimes and economic development) using data through 1972, Krueger (1978) concludes that, after taking account of monetary behavior, the net effect of other influences on the rate of price increase in each of the four quarters following devaluation has not been statistically significant.

The devaluations examined in the abovementioned studies took place under the Bretton Woods system of adjustable par values, involving large once-and-for-all exchange rate changes. Similar cross-country studies on LDC experience with small, gradual exchange rate adjustments under generalized currency floating, which has been in effect since March 1973, are not yet available.[1] The "crawling peg" system (frequently involving relatively large sustained currency depreciation in nominal terms), which has gained legitimacy in the post-Bretton Woods period, represents still another form of exchange rate adjustment whose inflationary effect has yet to be compared with the other exchange rate regimes on an intercountry basis.

For several reasons the response of domestic prices to exchange rate changes may be quantitatively different under different exchange rate regimes. One possibility is that producers, in their pricing decisions, may react less significantly to smaller changes over a given period in the exchange rate, in view of the transactions cost of changing prices in imperfectly competitive markets. Moreover, the publicity attending policy decisions involving large, discrete exchange rate changes may lead to greater domestic price repercussions. Some producers may even take the opportunity to raise prices of certain

1. Published research on selected developed countries (cf. Goldstein, 1977) appears to indicate mixed results concerning differences in estimated price equations using time series data including and excluding the years 1971 to 1973 which are transition periods of exchange rate regimes.

products which was difficult to do before the exchange rate adjustment "for reasons of law, custom, fear of public opprobrium or simply inertia" (Cooper, 1971, p. 27);[2] the large, once-and-for-all devaluation serves as an excuse for producers to raise prices even for unrelated reasons. On the other hand, continuous exchange rate adjustments, whether large or small, may generate expectations of sustained movements in the same direction, which add to inflationary pressure. The so-called "ratchet effect", due to a possible asymmetry in the effects of positive versus negative cost changes induced by fluctuating exchange rates on domestic prices, also needs to be considered. With increased variability in an LDC's effective exchange rate under generalized floating, downward rigidity of domestic prices could result in a cumulative rise in the general price level. While each of the above hypotheses is intuitively plausible, their practical significance remains an open question.

In this paper, we attempt to relate observed movements in the effective exchange rate, measured as a trade-weighted average of the domestic currency's exchange rates with foreign currencies, to changes in the general price level in a sample of 22 developing countries during 1973-1979. This is done with due consideration of other possible influences on the inflation rate based on previous contributions to the empirical literature. Section 2 describes various inflation models which have appeared prominently in the literature, specifying the variables that may contribute to the explanation of observed differences in intercountry inflation rates. Certain aspects of exchange rate changes are also discussed, laying the groundwork for the subsequent estimation of their influence on the domestic price level.

In Section 3 the collective experience of 22 sample LDCs is examined, utilizing cross-country data expressed in *average* annual levels or rates of change over the period 1973-1979. One advantage of using this type of cross-section data over time series analysis is that dynamic considerations (e.g., adjustment lags) and short-term disturbances can be ignored; averaging of values over a span of six years serves to "smooth out' fluctuations from these sources, so that comparison across countries provides a meaningful basis for estimating at least the intermediate-term response of domestic prices to

2. Prime examples are public utility companies and other firms whose products are subject to government price control.

exchange rate changes and other influences. It also affords an opportunity to discern differences in the estimated effects under different exchange rate regimes. The final section discusses certain implications of the findings for LDC policymaking and gives some concluding remarks.

2. Alternative Specifications of the Price Equation

While there exists a wide variety of empirical models explaining domestic price behavior, we are interested here only in those that have immediate relevance to LDCs and include the exchange rate (explicitly or implicitly) as an explanatory variable. Moreover, data limitations require that our model specification be kept simple; one would be ill-advised to insist on analytical sophistication given the data constraints in developing countries. It is necessary however to consider various models of inflation in open economies as basis for the empirical tests of the effect of exchange rate changes on the general price level. The objective is to reduce the possibility that the test results are peculiar to only one set of assumptions concerning the determinants of inflation in developing countries.

We start with the following variant of a fairly standard cost-push type specification of the price equation:

$$(1) \quad \dot{P} = a_o + a_1 \dot{W} + a_2 \dot{P}_m + a_3 \dot{Y}, \quad a_1, a_2 > 0, a_3 < 0$$

where

$\dot{P}$ = general price level
$\dot{W}$ = money wage rate

$\dot{P}_m$ = import price, in domestic currency
$\dot{Y}$ = real output

and the dot (.) above each variable denoting a proportionate change.

It is hypothesized in eq. (1) that the change in domestic prices bears a linear relationship to the changes in unit labor cost and import price, the latter embodying exchange rate changes. Because information on man-hours worked is generally not available, output level is used instead of labor productivity which is the usual

explanatory variable in this type of inflation model (cf. Ball and Duffy, 1972). The variable $\dot{Y}$ is expected to have a negative coefficient. This would follow from a constant mark-up assumption, since an increase in real output, other things constant, will lower unit costs. Alternatively, where the mark-up is positively related to the level of excess demand in the product market (or any other measure of market tightness), a rise in output supply for the same amount of effective demand will reduce excess demand, which is disinflationary. Imports are viewed in the above formulation "more as a factor of production than as a finished good that competes with domestically produced finished goods" (Goldstein, 1977, p. 579), which seems a realistic assumption in the context of developing countries.

It is possible that the money wage rate depends in part on the general price level, in which case, there will be a simultaneity problem in the estimation of eq. (1). Indeed, the wage-price spiral is widely assumed to provide the mechanism, or in the "structuralist" terminology (cf. Argy, 1970, p. 80), the propagating element that sustains a higher rate of inflation once a price increase, from any source, has been initiated. We hypothesize the following relationship:

$$(2)\quad \dot{W} = b_o + b_1 \dot{P} + b_2 \dot{Y} + b_3 L, \quad b_1, b_2, b_3 > 0$$

where L is a shift variable representing the level of economic development (measured by per capita GDP). Other things being equal, an increase in domestic prices or real output is assumed to result in a rise in nominal wages. This might be justified even in labor surplus LDCs on the grounds that employers will find it easier to comply with minimum wage requirements, or accede to union demands for pay increases, when product prices and volumes are rising. The coefficient b_3 is expected to be positive, on the assumption that the pressure to raise wages (or the bargaining strength of labor unions) is greater in higher income countries. If higher income LDCs have higher levels of labor productivity (which seems reasonable), then b_3 greater than zero would be consistent with Glytsos' (1977) hypothesis, apparently borne out by his empirical analysis using data for nine LDCs in the 1960s, that the "rate of change of wages depends (positively) on the level of productivity and not on the rate of change of productivity" (p. 318).

Substituting (2) into (1) yields:

$$(3)\quad \dot{P} = a_o' + a_1' \dot{P}_m + a_2' \dot{Y} + a_3' L, \quad a_1' a_3' > 0, \; a_2' \gtrless 0$$

where

$$a_o' = \frac{a_o + a_1 b_o}{1 - a_1 b_1}, \quad a_1' = \frac{a_2}{1 - a_1 b_1}, \quad a_2' = \frac{a_1 b_2 + a_3}{1 - a_1 b_1},$$

$$a_3' = \frac{a_1 b_3}{1 - a_1 b_1}.$$

The above discussion suggests two ways of estimating the price equation which could be the basis for an investigation of the inflationary effect of exchange rate changes (which are embodied in $\dot{P}m$). First, assuming exogeneity of $\dot{W}$ (i.e., it is independent of $\dot{P}$ and $\dot{Y}$), one can use eq. (1); and second, assuming that eq. (2) holds, one can use the reduced form eq. (3).

Another approach to the empirical analysis of inflation in developing countries is via the relationship between money supply and the general price level. Justification for the use of money supply as an explanatory variable in the price equation rests on the quantity theory of money. One advantage of using this approach is that it avoids the structural representation of various influences on the general price level which, it has been argued, no simple model can adequately provide in a cross-country study (cf. Krueger, 1978, p. 180). Furthermore, it recognizes that for any cost-push type disturbance to be a source of continuing inflation, there has to be an accompanying stimulus to aggregate demand, as would be provided by an increasing money supply. While studies of cost-push inflation tend to ignore the role of money supply (e.g., Goldstein, 1977 and Kwack, 1977), it is clear that an accommodating monetary policy serves to validate the higher prices and sustain wage-price spirals. Finally, monetary theories of inflation also emphasize the tendency for government expenditures in developing countries to be financed not by higher taxes or bond sales to the public but by money creation. The increased spending thus tends to stimulate faster money supply growth which results in accelerated inflation.

Here we follow Cooper (1971) and, to some extent, Argy (1970) and Glytsos (1977), in expressing the change in the general price level as:[3]

3. Instead of changes in real output ($\dot{Y}$) and in import prices ($\dot{P}_m$), Cooper made use of variations in food production and devaluation rate, respectively, as explanatory variables in eq. (4). Argy, and Glytsos in his demand pull submodel, did not include $\dot{P}_m$ in their regression specifications.

$$(4)\quad \dot{P} = c_o + c_1 \dot{M} + c_2 \dot{Y} + c_3 \dot{P}_m\,, \quad c_1,\ c_3 > 0, \quad c_2 < 0$$

which allows for the fact that increases in money supply are not inflationary to the extent that they are absorbed by changes in real output. As shown by Aghevli and Rodriguez (1979), a price equation similar to (4) can be derived using a two-sector open economy model in which home goods prices adjust in part to the excess supply of money while the price in the import-competing sector is determined directly by the world price and current exchange rate.

As argued some time ago by Harberger (1963) in his study of Chilean inflation, autonomous wage increases could lead in the short run to price rises even in the absence of money supply expansion, adding to the explanation given by monetary movements in the rate of inflation. Of course, "if the monetary authorities always increased the money supply by enough (or more than enough) to assure full employment at the new wage level, there would be no strong reason to expect that wages would add significantly to a monetary explanation of inflation" (p. 228). It seems worthwhile in the present study to run regressions on a specification with the wage variable included in the R.H.S. of (4), i.e.,

$$(5)\quad \dot{P} = c_o' + c_1' \dot{M} + c_2' \dot{Y} + c_3' \dot{P}_m + c_4' \dot{W}.$$

Similar formulations have also been used by Diaz-Alejandro (1965) and Diz (1970) for Argentina, and Colaco (1969) for Brazil and India.

A final specification of the price equation deserving some attention concerns the use of $\dot{M} - \dot{Y}$ as a measure of excess domestic demand, which "captures the excess liquidity created by the government fiscal deficit as well as changes in the demand for money caused by income growth" (Blejer and Halevi, 1980, p. 119). Equation (5) might then be simply modified as:

$$(6)\quad \dot{P} = c_o'' + c_1'' (\dot{M} - \dot{Y}) + c_3'' \dot{P}_m + c_4'' \dot{W}.$$

Focusing now on the import price variable, several aspects of its influence on the domestic price level need to be recognized. First, the effect of changes in P_m may vary from country to country, depending on the extent of reliance on imported goods. We can make allowance for this by multiplying the observed values of $\dot{P}_m$ by the

factor $(1 + m)$ where m is the share of imports to GNP – representing a fairly standard measure of the "degree of openness". More highly open LDCs might be expected to exhibit a greater response in domestic prices to a change in import price, based on a cost-push view of inflation.[4]

Second, $\dot{P}_m$ represents the combined changes in foreign currency import prices, in tariff, indirect tax and other policies affecting the domestic price of imported goods, and under generalized currency floating in bilateral exchange rates with trade partner currencies. We do not take into account here changes in domestic policies related to the so-called "non-formal" component of the exchange rate which, given the complexity of the trade and payments regime in most developing countries, would be exceedingly difficult to make comparable across countries and over time. There is a presumption however that "formal" exchange rate changes, being more widely publicized and having a greater impact on expectations, have a much stronger and faster effect on the rate of domestic inflation (Blejer and Halevi, 1980). We need then an index of import prices in currencies at which they are set and an effective exchange rate (EER) index reflecting "what is in some sense the average change in the country's exchange rate" (Rhomberg, 1976, p. 88). Import price and EER indices which we have calculated in an earlier work (Bautista, 1980), are used here based on the "price-currency import shares" of twelve major currencies, assuming that world prices of primary agricultural products and fuels are set in U.S. dollars, metals and minerals in U.K. pounds, and other traded goods in the currencies of the developed country origin of imports.[5]

---

4. There is a competing hypothesis that views openness as a reflection of an LDC's capacity to draw from foreign sources in times of reduced domestic availability for whatever reason (e.g., poor crop harvest), which implies a negative relationship between the degree of openness and inflation rate. Additionally, more open economies are faced with a higher degree of foreign competition, and hence are less subject to inflationary pressures arising from monopolistic behavior of domestic producers. It would be appropriate therefore to include m also as an intercept dummy whose coefficient is expected to be negative.

5. See Bautista and Riedel (forthcoming) for a detailed discussion. This weighting scheme in EER calculation differs from the traditional use of bilateral trade shares which does not allow for pricing of traded goods in third-country currencies.

A third consideration, particularly warranted in the assessment of the inflationary effect of exchange rate changes, is the possible nonlinearity of the domestic price response. As indicated above, large EER changes may or may not have a more significant impact on domestic prices than small-step exchange rate adjustments, in part depending on what expectations on future exchange rates and costs are generated as well as on the relative cost of frequent price adjustments. This can be dealt with by including the square of the effective exchange rate change (EER^2) as an additional explanatory variable in the regressions. Bruno and Sussman (1978), for example, have reported a positive coefficient for this variable, "although of not very high degree of significance" (p. 23), in an examination of inflation and devaluation in Israel based on quarterly data for the period 1967-75.

Fourth, one would also want to test the ratchet effect associated with exchange rate fluctuations under generalized floating which, as pointed out earlier, generates an inflationary bias due to domestic price inflexibility in the downward direction.[6] An extension of this hypothesis would be that upward and downward deviations of the effective exchange rate from expected or trend values have asymmetrical effects on the domestic price level, so that countries faced with greater EER variability around the trend would tend to be more inflationary, other things the same. The explanatory variable used here to capture the ratchet effect of EER variability consists of the standard error of estimate in the logarithmic trend regression of monthly import-weighted EER values for each sample LDC over the period March 1973 to December 1979.

A final consideration concerns the differences among sample LDCs in the type of exchange rate adjustment adopted during the observation period. Some of the characteristics of exchange rate regimes would have been captured already in the other explanatory variables mentioned earlier. For instance, if the crisis atmosphere in which large, discrete devaluations take place makes it easier for the national authorities to adopt contractionary monetary policy and to rally labor groups behind a more restrained wage increase than would be the case with small, gradual exchange rate changes, the

6. Inconclusive results have been obtained in a recent systematic investigation of the practical significance of ratchet effects, which however pertain only to some selected major industrial countries (Goldstein, 1977).

estimated coefficients for the money supply and wage rate variables will already reflect the corresponding effects on the domestic price level. In introducing dummy variables for particular exchange rate regimes in the regression equation, one is representing other aspects of exchange rate adjustment and attendant policy measures having a separate influence on the inflation rate. Thus, if the adoption of a crawling peg meant, in an *ex post* sense, the relaxation of import restrictions to a greater extent than what accompanied other exchange rate regimes, the dummy coefficients allowing the intercept of the price equation to shift might turn out significant. It is of course hazardous to speculate on the various relevant aspects of economic policy, which may have offsetting influences on the domestic price level, accompanying exchange rate adjustments and to assess their separate inflationary effects in the sample countries. However, we can attempt to generalize from the collective experience of the sample LDCs by examining the significance of the dummy variables that would reflect the net effect on the domestic price level of other policy measures attributable, at least indirectly, to the type of exchange rate regime being adopted. Additionally, it is instructive to run regressions excluding the crawling peg countries (Argentina, Brazil, Colombia and Uruguay) and to compare the estimated coefficients with the corresponding results of the regressions based on the entire sample.

3. Empirical Results

The results of cross-country regressions testing for the foreign inflation rate ($\dot{P}_f$), wage rate changes and level of economic development as determinants of domestic inflation are presented in Tables 1 and 2 for sample LDCs including and excluding the crawling peg countries, respectively.[7] Other explanatory variables appearing in the various specifications are changes in money supply, real GDP and effective exchange rate ($\dot{E}$).[8]

---

7. Indonesia and Thailand, which are part of our sample of 22 countries, do not have available wage series and hence have not been included in these regressions.

8. See Appendix A for a further description of the variables (and sources of data) appearing in these and other regression results reported in this paper. Appendix B gives data observations not drawn from published sources.

Table 1 – Regression Results A

(Dependent variable: P; 20 observations)

Equation Number	Const.	$\dot{M} - \dot{Y}$	$\dot{M}$	$\dot{Y}$	$\dot{E}$	$\dot{P}_f$	W	L	$\bar{R}^2$	s.e.e.
I	17.94	.281	–	–	.912**	−1.160	.013	−.067	.9944	3.09
	(1.32)	(1.55)			(5.05)	(−.90)	(.10)	(−.66)		
II	15.90	.310	–	–	.918**	−1.091	−.033	–	.9946	3.03
	(1.27)	(1.79)			(5.19)	(−.86)	(−.28)			
III	5.282**	.360*	–	–	.848**	–	–	–	.9950	2.92
	(2.98)	(2.39)			(5.83)					
IV	28.15	–	.256	−.728	.928**	−1.963	.003	−.132	.9946	3.01
	(1.86)		(1.44)	(1.90)	(5.26)	(−1.40)	(.02)	(−1.19)		
V	21.91	–	.311	−.589	.931**	−1.524	−.066	–	.9945	3.06
	(1.52)		(1.78)	(1.59)	(5.20)	(−1.11)	(−.53)			
VI	6.088*	–	.367*	−.507	.836**	–	–	–	.9947	2.98
	(2.47)		(2.38)	(−1.49)	(5.56)					
VII	37.30 *	–	–	−.528	1.137**	−2.664	.047	−.173	.9942	3.12
	(2.61)			(−1.42)	(10.93)	(−1.96)	(.34)	(−1.56)		
VIII	31.29 *	–	–	−.274	1.204**	−2.259	−.037	–	.9937	3.27
	(2.11)			(−.78)	(12.14)	(−1.61)	(−.28)			
IX	9.668**	–	–	−.082	1.190**	–	–	–	.9933	3.36
	(4.38)			(−.25)	(46.88)					

*Significant at 5 percent level.
**Significant at 1 percent level.
Numbers in parentheses underneath the coefficient estimates are t-values.

Table 2 – Regression Results B

(Dependent Variable: $\dot{P}$; 16 observations)

Equation Number	Const.	$\dot{M} - \dot{Y}$	$\dot{M}$	$\dot{Y}$	$\dot{E}$	$\dot{P}_f$	$\dot{W}$	L	$\bar{R}^2$	s.e.e.
I	11.80	.320	–	–	.919**	−.707	.035	−.056	.7986	3.28
	(.82)	(1.24)			(3.98)	(−.48)	(.18)	(−.48)		
II	11.39	.367	–	–	.926**	−.708	−.020	–	.8126	3.16
	(.82)	(1.59)			(4.16)	(−.50)	(−.13)			
III	4.529	.395*	–	–	.898**	–	–	–	.8377	2.94
	(1.93)	(2.18)			(4.67)					
IV	27.10	–	.327	−.818	.859**	−1.912	−.017	−.110	.7962	3.30
	(1.24)		(1.26)	(−1.38)	(3.56)	(−.98)	(−.08)	(−.840)		
V	20.40	–	.398	−.695	.893**	−1.444	−.083	–	.8022	3.25
	(1.02)		(1.65)	(−1.23)	(3.81)	(−.782)	(−.46)			
VI	4.965	–	.401	−.475	.879**	–	–	–	.8251	3.05
	(1.58)		(2.11)	(−1.18)	(4.04)					
VII	31.78	–	–	−.474	.983**	−2.132	.112	−.164	.7843	3.39
	(1.42)			(−.88)	(4.33)	(−1.06)	(.63)	(−1.29)		
VIII	22.29	–	–	−.145	1.084**	−1.433	.047	–	.7714	3.49
	(1.03)			(−.30)	(4.95)	(−.72)	(.27)			
IX	9.016**	–	–	.022	1.195**	–	–	–	.7787	3.43
	(3.23)			(.06)	(6.73)					

*Significant at 5 percent level.
**Significant at 1 percent level.
Numbers in parentheses underneath the coefficient estimates are t-values.

Given the consistently low t-values and sometimes perverse signs of the estimated coefficients for $\dot{P}_f$, $\dot{W}$ and L in the relevant specifications, these variables were not included in subsequent regressions. The lack of significance of the foreign price variable was not entirely surprising in view of the observed similarity in P_f trends among the sample LDCs having the same principal trade partners. In the case of the wage variable, the statistical insignificance of the estimated coefficient might have been due in part to the poor quality and low degree of comparability of wage data among developing countries. Note however that dropping $\dot{W}$ is consistent with equation (2) above, which postulates simultaneity in the determination of $\dot{P}$ and $\dot{W}$. Moreover, to the extent that wage increases had been accommodated by monetary expansion, there would be no additional explanation of domestic inflation that is provided by $\dot{W}$.

The regression results in Tables 1 and 2 also indicate that $\dot{Y}$ appearing in the various specifications without $\dot{M}$ yields insignificant coefficient estimates. Furthermore, use of $\dot{M} - \dot{Y}$ is clearly superior, based on the comparative values of the t-statistics, to having $\dot{M}$ and $\dot{Y}$ as separate explanatory variables. Another striking observation from Tables 1 and 2 is the consistently significant coefficient estimates for the exchange rate variable in either set of regressions. Based on the specification having only $\dot{M} - \dot{Y}$ and $\dot{E}$ as explanatory variables, the estimated elasticity of the domestic price level with respect to the exchange rate is .848 for the sample of 20 LDCs and .898 excluding the crawling peg countries which, using the t-test, are not significantly different at the 5 percent level.

Table 3 contains the results of regressions including the degree of openness as an additional explanatory variable, based on the entire sample of 22 LDCs and on a smaller sample excluding the four crawling peg countries. The coefficient estimates for $m\dot{E}$, which show contrasting signs in the two sets of regressions, are found to be no significantly different from zero. The coefficient of the intercept dummy, while having the expected sign, is also seen to be insignificant in every specification. The estimated elasticity of the domestic price level with respect to the exchange rate is .776 for the entire sample and .846 for the subsample without the crawling peg countries. Again, the difference between these coefficient estimates is not statistically significant.

Table 3 – Regression Results C
(Dependent variable: $\dot{P}$)

Equation No.	Const.	$\dot{M} - \dot{Y}$	$\dot{E}$	$m\dot{E}$	m	$\bar{R}^2$	s.e.e.
22 Observations							
I	5.670*	.432**	.804**	−.390	−.019	.9939	3.08
	(2.89)	(2.96)	(5.72)	(−.55)	(−.77)		
II	4.911**	.439**	.786**	−.275	–	.9940	3.04
	(2.89)	(2.99)	(5.74)	(−.40)			
III	5.441**	.417**	.787**	–	−.016	.9941	3.02
	(2.89)	(2.99)	(5.85)		(−.68)		
IV	4.828**	.432**	.776**	–	–	.9943	2.97
	(2.96)	(3.18)	(5.89)				
18 observations (excluding crawling peg countries)							
V	4.541	.54*	.818*	.132	−.010	.8147	3.18
	(1.71)	(2.66)	(2.76)	(1.38)	(−.38)		
VI	3.941	.472**	.815*	.95	–	.8260	3.08
	(1.90)	(2.98)	(2.84)	(.15)			
VII	4.578	.453*	.839**	–	−.011	.8278	3.06
	(1.80)	(2.77)	(4.37)		(−.41)		
VIII	3.969	.471**	.846**	–	–	.8373	2.98
	(1.99)	(3.08)	(4.55)				

*Significant at 5 percent level.
**Significant at 1 percent level.
Numbers in parentheses underneath the coefficient estimates are t-values.

In Table 4 regression results, testing for the significance of exchange rate variability and nonlinear price effects, are presented. Consistently low values of the t-statistic are shown for the estimated coefficients of V in the various specifications, indicating that exchange rate variability does not add to the explanation of intercountry differences in inflation rates. In the case of $\dot{E}^2$, insignificant coefficient estimates are also observed in the regression equations having $\dot{E}$ as another explanatory variable; however, where $\dot{E}$ is not included in the specification (equations III and V for the entire sample, VIII and X for the subsample excluding the crawling peg countries), there is apparently a significant influence of $\dot{E}^2$. Even so, having $\dot{E}$ instead of $\dot{E}^2$ seems superior, judging by the usual statistical criteria (higher t-statistic and $\bar{R}^2$, and lower s.e.e.). No conclusive evidence is therefore provided with respect to the differential effects of large versus small exchange rate changes on the domestic price level.

Table 4 – Regression Results D
(Dependent variable: $\dot{P}$)

Equation No.	Const.	$\dot{M}$-$\dot{Y}$	$\dot{E}$	$.01\dot{E}^2$	V	$\bar{R}^2$	s.e.e.
33 observations							
I	5.046*	.434**	.728**	.030	.814	.9937	3.12
	(2.60)	(3.05)	(4.39)	(.57)	(.05)		
II	5.085**	.434**	.730**	.030	–	.9941	3.03
	(2.96)	(3.14)	(4.69)	(.58)			
III	–.310	.954**	–	.146*	20.33	.9874	4.42
	(–.15)	(8.55)		(2.21)	(.88)		
IV	4.797*	.432**	.774**	–	.651	.9940	3.06
	(2.59)	(3.10)	(5.47)		(.04)		
V	.306	.993**	–	.154*	–	.9875	4.39
	(.15)	(9.74)		(2.37)			
18 observations (excluding crawling peg countries).							
VI	4.355	.438*	1.826	–2.301	–15.66	.8217	3.12
	(2.03)	(2.43)	(1.93)	(–.63)	(–.66)		
VII	4.060	.431*	1.142	–1.775	–	.8288	3.05
	(1.97)	(2.45)	(1.85)	(–.51)			
VIII	3.288	.624**	–	4.330**	2.797	.7871	3.40
	(1.45)	(3.76)		(3.08)	(.12)		
IX	4.182	.486**	.922**	–	12.45	.8294	3.05
	(2.01)	(3.06)	(3.91)		(–.55)		
X	3.320	.631**	–	4.414**	–	.8011	3.29
	(1.53)	(4.22)		(3.76)			

*Significant at 5 percent level.
**Significant at 1 percent level.
Numbers in parentheses underneath the coefficient estimates are t-values.

The coefficient estimates for $\dot{M} - \dot{Y}$ and $\dot{E}$ are significant at the 5 percent level, but not those for the exchange rate regime dummy variables. Thus, one may accept the hypothesis that the method of exchange rate adjustment adopted in the sample countries does not shift the price equation in the sense indicated above.[9] It is also worth noting that the estimated coefficient for $\dot{E}$ (.795) is within the range of the corresponding estimates presented earlier. Given the limited sample size and data imperfections, the relationship between the exchange rate and domestic price level as represented in the above regression results appears quite robust. Moreover, the high values of the coefficient of determination are suggestive of the general validity of the hypotheses tested.

The implication from the above results, that on average, the general price level rises by about 80 percent of the rate of currency depreciation, is at variance with the findings in earlier studies cited above. While such magnitude of the inflationary effect does not completely nullify the improvement in international competitiveness that a devaluation is designed to confer on the country's products, it represents a much more severe repercussion on domestic prices than indicated in past empirical investigations. Part of the reason would be that longer term price effects are captured in the present study by using *average* levels and rates of change over a six-year period. The results from other empirical studies using cross-country data pertaining to a shorter time span would reflect to some extent dynamic adjustments and short-run disturbances which render more difficult the taking into account of the cumulative effect of exchange rate changes on the domestic price level. Hence, the long-run inflationary effect might tend to be underestimated if one relied simply on estimates based on cross-country data over one, two or three years.

Another explanation for the higher price response coefficient estimated in this study would be that the exposure of developing countries, or at least those included in our sample, to the international economy had presumably become stronger over the years. The actual extent of such exposure is not measurable simply by the weight of imports in the final expenditure basket – our "degree of openness" variable, whose coefficient did not prove

9. Blejer and Halevi (1980) have found that the inflationary effects of exchange rate changes in Israel during the period 1968-1976 are not sensitive to the change in exchange rate regime, using also intercept and slope dummy variables to distinguish the crawling peg subperiod beginning mid-1975.

significant in the above regressions – but "of the relevant group of *tradables,* that is, including close domestically produced import substitutes" (Bruno, 1978, p. 379).

A final consideration is that the dramatic developments in the world economy during the 1970s might have altered the economic structure underlying the price equation that prevailed under the Bretton Woods regime. Price expectations, whose influence on domestic price behavior has been virtually left out of account in the present study as well as in most other empirical investigations of the determinants of LDC inflation rates, would likely have reinforced the inflationary effect of exchange rate changes in the recent period compared to the calmer decades of the 1950s and 1960s. The adoption of generalized currency floating among developed countries would have contributed to the widespread breakdown of money illusion, particularly "exchange rate illusion," in developing countries in view of the greater attention now being given to the real international value of an LDC's currency.

Interpreting the $\dot{E}$ coefficient in the above regressions as a long-run elasticity measure, the resulting estimates of around .80 would not seem unreasonable. They are evidently much higher than the findings of empirical studies pertaining to postwar LDC experience through the early 1970s, which however are not comparable in many ways. It is worth noting that, in a recent investigation of the influence of exchange rate changes on prices in eighteen developed countries, "the main conclusion . . . is that parity changes have a larger and a quicker effect on the rate of inflation than they used to have" (Robinson *et. al.,* 1979, p. 48). A related finding is obtained in an analysis of inflation rates during 1972-76 in sixteen developed countries, "pointing to a very marked direct role of import costs in the inflationary process in these countries"; moreover, "even for a country as 'closed' as the United States empirical studies point to a large and significant effect of import prices in recent years" (Bruno, 1978, p. 389).

4. Conclusion

The findings of this empirical study indicate that changes in the effective exchange rate and excess domestic demand can explain to a very large extent inter-LDC differences in inflation rates for the period 1973-1979. The sensitivity of the domestic price level to exchange

rate movements is seen not to differ significantly among countries adopting different methods of exchange rate adjustment. Tests of the significance of the inflationary effects of the "degree of openness", level of economic development and exchange rate variability, and of nonlinear price effects, have also yielded inconclusive results.

The observed robustness of the coefficient estimates for the effective exchange rate suggests the stability of the exchange rate-domestic price level relationship. In contrast to the findings of earlier studies on the price effects of devaluations in the 1950s and 1960s, it would appear that the price response to exchange rate adjustment in the post-Bretton Woods period is of a very high order of practical importance to LDC policymakers, since about 80 per cent of exchange rate changes is estimated to have been added to the domestic price level. This would seem to provide justification for the caution with which governments in developing countries tend to view currency depreciation, at least under the conditions prevailing in the 1970s.

The implication for LDC policymaking seems clear. The cost of achieving a given "real" devaluation, in terms of a higher domestic inflation rate, is now greater than what it used to be, reducing the attractiveness of exchange rate adjustment as a means of improving international competitiveness (and hence allocative efficiency, external balance and real income, given the high degree of market distortion in most developing countries). What other policy options are available to LDC policymakers and how would they affect the various objectives of development policy? This and other related policy issues deserve careful study in the context of individual LDCs.

Appendix A

Definition of Variables and Data Sources

P	=	wholesale price index or, if complete series is not available (Malaysia, Morocco and Singapore), consumer price index
M	=	money supply
Y	=	gross domestic product (at 1975 prices)
m	=	ratio of imports to gross national product
W	=	non-agricultural (industrial, manufacturing) wage rate
E	=	import-weighted effective exchange rate index
P_f	=	import-weighted index of foreign wholesale prices

V = standard error of estimate in the logarithmic trend regression of monthly E values from March 1973 to December 1979

DC = dummy variable: 1 for crawling peg countries, 0 for other sample countries

DS = dummy variable: 1 for countries with small, gradual exchange rate changes, 0 for other sample countries

L = per capita gross domestic product, (in hundred U.S. dollars, 1975 prices)

Data for P, M, Y and m were drawn entirely from the IFS computer file of the IMF. The ILO *Yearbook of Labor Statistics* provided most of the wage data, which were supplemented by published materials from individual countries. The average annual percentage change in E for each sample LDC was calculated as $\{(1+\dot{E}^*)^{12} - 11\} \times 100$, where $\dot{E}^*$ is the coefficient estimate in the logarithmic trend regression of monthly values of E drawn from an earlier work of the author (cf. Bautista, 1980). A similar transformation was done on the monthly rates of change in P_f, defined as

$$P_f = \frac{\prod_i w_{xi} R_i P_i / P}{\prod_i w_{xi} R_i / P}$$

where w_{xi} is the "price currency export share" of developed country i, R_i is bilateral exchange rate and P_i is the wholesale price index in country i. As indicated in the text, the measure of EER variability V is represented by the standard error of estimate in the logarithmic trend regression of monthly E values from March 1973 to December 1979.

Appendix B

Values of $\dot{E}$, V and $\dot{P}_f$

Country	$\dot{E}$	V	$\dot{P}_f$
Argentina	153.25	.4251	8.405
Brazil	29.31	.1022	9.413
Colombia	10.86	.0269	8.649
Costa Rica	4.14	.0647	8.462
Egypt	4.93	.1620	8.091
Greece	5.59	.0297	8.534
India	1.43	.0239	10.086
Indonesia	6.56	.1390	8.445
Malaysia	−0.22	.0267	10.069
Mexico	14.72	.1447	9.332
Morocco	0.36	.0206	9.278
Pakistan	0.70	.0330	8.888
Philippines	3.04	.0268	9.544
Portugal	14.8	.0891	8.723
Singapore	−0.44	.0235	8.618
South Korea	5.16	.0472	7.711
Spain	4.42	.0644	8.578
Taiwan	1.06	.0335	8.198
Thailand	1.69	.0492	8.722
Tunisia	−0.90	.0255	8.131
Turkey	15.12	.1500	8.280
Uruguay	45.87	.1131	8.291

Source: Basic data drawn from Bautista (1980).

REFERENCES

Aghevli, B. B. and Rodriguez, C. A., (1979), "Trade, Prices and Output in Japan: A Simple Monetary Model," *IMF Staff Papers,* 26: 38-54.

Argy, V., (1970), "Structural Inflation in Developing Countries," *Oxford Economic Papers,* 22: 73-85.

Ball, R. J. and Duffy, M., (1972), "Price Formation in European Countries," in *The Econometrics of Price Determination,* ed. O Eckstein, Washington D. C., pp. 347-368.

Bautista, R. M. (1980), "Exchange Rate Adjustment Under Generalized Currency Floating: Comparative Analysis Among Developing Countries," World Bank Staff Working Paper No. 436, Washington, D.C.

Bautista, R. M. and Riedel, J. (forthcoming), "Major Currency Realignments and the Terms of Trade in Developing Countries," *Journal of Development Economics.*

Bhatt, M. I. and Halevi, N. (1980), "Effective Devaluation and Domestic Rate of Inflation," *Journal of Development Economics*, 7: 117-122.

Bruno, M., (1978), 'Exchange Rates, Import Costs and Wage-Price Dynamics," *Journal of Political Economy*, 86: 379-403.

Bruno, M. and Sussman, Z. (1978) "Exchange Rate Flexibility, Inflation and Structural Change: Israel Under Alternative Regimes," paper presented at the Ford Foundation/Central Bank of Barbados seminar on Developing Countries and the International Financial System, January 12-14.

Fidaco, F. X., (1969), "Harberger's Inflation Model: A Critique and Test using Data for Brazil and India," *Indian Economic Journal*, 16: 434-444.

Connolly, M. and Taylor, D. (1976), "Testing the Monetary Approach to Devaluation in Developing Countries," *Journal of Political Economy*, 84: 849-859.

Cooper, R. N., (1971), "An Assessment of Currency Devaluation in Developing Countries," in *Government and Economic Development*, ed. G. Ranis, New Haven: Yale University Press, pp. 472-515.

Diaz-Alejandro, C. F. (1965), *Exchange-Rate Devaluation in a Semi-Industrial Country: The Experience of Argentina 1955-1961*, Cambridge: The MIT Press.

Fie, A. C. (1970), "Money and Prices in Argentina, 1935-1962," in *Varieties of Monetary Experience*, ed. D. Meiselman, Chicago: University of Chicago Press, pp. 111-122.

Gylfason, N. P. (1977), "Determinants of Wage and Price Changes in Less Developed Countries," *Journal of Development Economics*, 4: 315-342.

Goldstein, M. (1977), "Downward Price Inflexibility, Ratchet Effects, and the Inflationary Impact of Import Price Changes: Some Empirical Tests," *IMF Staff Papers*, 24: 569-612.

Harberger, A. (1963), "The Dynamics of Inflation in Chile," in *Measurement in Economics*, ed. C. F. Christ, Stanford: Stanford University Press, pp. 219-254.

Krueger, A. O. (1978), *Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences*, New York: Columbia University Press.

Kwack, S. Y. (1977), "The Effect of Foreign Inflation on Domestic Prices and the Relative Price Advantage of Exchange Rate Changes," in *The Effects of Exchange Rate Adjustments*, ed. P. B. Clark, D. E. Logue and R. J. Sweeney, Washington, D.C.: U.S. Department of the Treasury, pp. 387-398.

Rhomberg, R. R., (1976), "Indices of Effective Exchange Rates," *IMF Staff Papers*, 23: 88-112.

Robinson, W., Webb, T. R., and Townsend, M. A., (1978), "The Influence of Exchange Rate Changes on Prices: A Study of 18 Industrial Countries," *Economica*, 26: 27-50.