Preliminary

INTERNATIONAL RELATIVE PRICES UNDER FIXED AND FLEXIBLE EXCHANGE RATE SYSTEMS

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Deviations from purchasing power parity became greater and more widespread in the early 1970's, particularly with the adoption of floating exchange rates by many industrial countries around 1973. While the floating exchange rate system is commonly held responsible for these increased deviations, evidence presented in this paper suggests that they would have increased in the 1970's even if a pegged exchange rate system had been maintained.

A change in the exchange rate adjusted ratio of the price indexes of two countries, i.e., a deviation from purchasing power parity, occurs only when there is a change in the relative price of at least one pair of goods contained in the indexes and these goods receive different weights in the two price indexes. Non-traded goods, for example, receive (by definition) a zero weight in the foreign price index. The ratio of the domestic price index to the foreign price index times the exchange rate, p/ep^*, therefore changes when relative prices change. These relative price changes may involve either traded or nontraded goods.

One can imagine (perhaps) a world in which money is superneutral and in which prices adjust immediately to changes in relative supply and demand curves. Neither monetary policy nor the exchange rate system would affect relative prices in this hypothetical world.[1] Therefore, neither monetary policies nor the exchange rate system would affect deviations from purchasing power parity. Even in this hypothetical world, however, there might be a relation between the exchange rate system and measured deviations from purchasing power parity. This could

occur for (at least) two reasons. First, measured prices may differ from actual transactions prices, e.g., if measured prices are obtained from published price lists. Under a fixed exchange rate system, any change in the relative price of American and German beer, p_A/ep_G (where p_A is the dollar price of American beer, p_G is the mark price of German beer, and e is the dollar price of marks), must occur through a change in p_A or p_G. Under a flexible exchange rate system, changes in relative prices generally occur partly through a change in the exchange rate, e (Stockman, 1978a). If the measured exchange rate is close to the actual transactions exchange rate while measured p_A and p_G are smooth relative to the transactions p_A and p_G, then there will appear to be more variability in p_A/ep_G under flexible exchange rates than under fixed exchange rates. Second, countries with greater variability of relative prices might be the countries that choose flexible exchange rate systems. There are two possible reasons for this. A country that experiences greater shifts or more unpredictability of its terms of trade may experience greater shifts or more unpredictability of its balance of trade, and this circumstance may lead to the adoption of floating. The other reason has to do with the relation between inflation and relative prices. Barro (1976) has shown using a Lucas-type supply function, that a greater variance in the unanticipated component (actually, the currently unperceived component) of inflation induces greater variability in relative prices. Parks (1978) derives a positive relationship between a measure of the variance of relative price changes and the level of currently unperceived inflation, and presents evidence of this relationship for a twelve-commodity breakdown of the U.S. GNP deflator from 1929 to 1975.

If countries with greater unanticipated inflation are the same countries as those who choose flexible exchange rates, then the greater variability in relative prices experienced by these countries may show up in greater deviations from purchasing power parity. Heller (1978) has recently examined the choice of an exchange rate system and concluded that countries with greater inflation rates choose to float.

Another explanation for the greater deviations from purchasing power parity under flexible exchange rates is due to Dornbusch (1976a, 1976b), who showed that if prices do not immediately adjust to clear goods markets but the exchange rate is flexible and can adjust rapidly relative to prices in goods markets, then the exchange rate will overshoot its long-run equilibrium position following a monetary shock. This leads to greater variability of p/ep^* under flexible than under fixed exchange rates.

Because of these reasons for expecting greater deviations from purchasing power parity under flexible exchange rates, there has been a tendency to assume that the increased deviations from purchasing power parity since 1973 can be attributed to the flexible exchange rate system. The next section presents evidence on this issue: while there appears to be a strong relationship between the variability of deviations from purchasing power parity and the exchange rate system, factors <u>other</u> than the exchange rate system appear to account for somewhere between one-third and one-half of the increase in the variance of purchasing power parity from 1957-72 to 1973-77.

II. The procedure applied in this paper was to extract country-specific and year-specific means from a measure of the variability of the exchange-rate-adjusted ratio of price indexes over the twelve months within each year. Specifically, monthly observations on $p_i/e_i p_{US}$ were calculated for a number of countries from 1957-1977 (using consumer price indexes). Then a relative price-level variability measure, V_{it}, was calculated for each country i for each year t by

$$V_{it} \equiv \frac{1}{12} \Sigma [\ln(p_{is}/e_{is}p_{USs}) - \frac{1}{12} \Sigma \ln(p_{is}/e_{is}p_{USs})]^2$$

where the summations are over s=Jan, year t to s=Dec., year t. If $\ln (p_{is}/e_{is}p_{USs})$ is a stationary random process then V_{it} is just its sample variance within year t. V_{it} is nonzero because of changes in the relative prices of goods making up the consumption baskets used to calculations, V_{it} and V_{jt} are presumably related. Similarly, V_{it} and $V_{it'}$, $(t \neq t')$ are presumably related. A simple way of allowing for these similarities across countries within each year and for similarities across years within each country is to extract yearly and country-specific means. A simple way of introducing the possible effect of the exchange rate system on V_{it} is to let the exchange rate system shift its mean. Therefore, the following model was estimated:

$$V_{it} = \beta_i + \gamma_t + \partial \text{ esystem} + \varepsilon_{it} \qquad (1)$$

where β_i is a country-specific dummy, γ_t is a year-specific dummy, and esystem is a dummy variable taking the value zero for year-country pairs characterized by fixed exchange rates and one for pairs characterized by flexible exchange rates. The equation was estimated with ordinary least

squares, so the disturbance ε_{it} was assumed to be classical.

The sample of countries was chosen on the basis of the availability of monthly consumer price index and exchange rate data from the IMF's International Financial Statistics and on the basis of (my) judgments about the quality of the available data. The countries chosen are listed in Table I. Some countries with available data, such as Peru and Korea, were eliminated from the sample because the data is simply not credible. Other countries, such as Turkey, Iran, and Israel, devalued or revalued too many times to be included. All country-year pairs in which there was a devaluation or a change in the exchange rate system were excluded from the sample (see "excluded years" in Table I, which also includes years excluded due to unavailable data). That is why the "float years" in Table I begin in 1974 for the countries that began floating in 1973: if the change in the exchange rate system occurred in 1973, that data point was excluded.[2] Several other countries, marked with asterisks in Table I, were determined a priori to be countries with questionable data quality, so the equation was estimated both with and without these countries included in the sample. One of these countries, Ghana, was an extreme outlier in the fitted equation, and, since the data was of uncertain quality anyway, was dropped from the sample. (Adding Ghana to the sample increases the "p" in the first column of Table II, discussed below, to over 50%.) These "questionable" countries had, in the sample period, systems of extensive controls over international trade and payments, functioning black markets in their currencies at exchange rates substantially different from the par rate, or both. (Black market rates for many of these countries are reported in Pick's Currency Yearbook.)

Table II presents four sets of estimates of equation (1) for four different choices of the sample of country-year pairs. Column (1) displays results when the sample includes all countries in Table I (with only the "excluded years" listed in that table excluded from the sample). Column (3) shows the results when the questionable countries (those with an asterisk in Table I) are also excluded from the sample. Columns (2) and (4) are the same as (1) and (3) except that three major outliers have been omitted from (2) and (4): Japan 1977, Switzerland 1977, and Malaysia 1975. These three data points are discussed further below. Table II shows the estimates, for each sample choice, of γ_t and ∂. The level of each γ_t is arbitrary so the levels have been normalized to sum to zero. Only differences between the γ_t's have any meaning. The same is true of the β_i's. The estimates of β_i from column (1) are displayed in Table I. Table II also shows the proportion of the increase in V_{it}, from 1957-72 to 1973-77 for a country that switched to flexible exchange rates in 1973, that can be attributed to the year effects rather than to flexible exchange rates, i.e.,

$$p \equiv \frac{\Delta}{\Delta + \partial}$$

where

$$\Delta \equiv \frac{1}{16} \sum_{t=1957}^{1972} \gamma_t - \frac{1}{5} \sum_{t=1973}^{1977} \gamma_t$$

The results in Table II indicate that too much emphasis has been placed on the experience of a handful of industrial countries that began floating their currencies against the dollar around 1973; when a larger sample of countries is examined, one finds that substantial increases in

relative price variability (deviations from purchasing power parity) occurred in the 1970's even in countries that continued to peg their currencies to the dollar. At least 1/3 to 1/2 of the increase in international relative price variability, between the period 1957-72 and 1973-77 for a country that floated in the latter period, appears to be unrelated to the exchange rate system.[3] Countries that maintained a peg against the dollar for the entire period experienced, on average, an increase in variability equal to between 1/3 and 1/2 that experienced by countries that floated in the latter period.

Comments:

(1) One might think that by including 1972 as a year of fixed exchange rates for the set of "European industrial countries," I am biasing downward the coefficient on esystem because the allowable fluctuation limits around the official par rates were substantially larger following the Smithsonian agreement of December, 1971. That is not so. While the argument that a peg with, say, 4.5% fluctuation limits may be more analoguous to a floating system in which governments intervene in an attempt to limit fluctuations than to a pegged rate system with fluctuation limits of 1% or less, has some a priori plausibility, one can examine its importance by simply treating 1972 as a year in which the international monetary system was a hybrid of earlier systems and of times yet to come. If 1972 is simply deleted from the sample, the coefficient on esystem in (1) remains at 1.11 with a standard error of .16, the γ's remain virtually unchanged, and the proportion p rises to 44.0%. So the conclusions are unaffected by the decision to treat

the European pegs of 1972 as pegged exchange rates. This is consistent with the evidence presented by Frenkel (1978): a switching regression that allows a single structural change in the demand for international reserves indicates that the international monetary system in 1972 was closer to the pegged rate system of earlier years than the system of later years.

(2) If the country-year pairs labeled "excluded years" in Table I are divided into two classes: those excluded because of devaluations or changes in the exchange rate system and those excluded due to unobtainable data, and if the former data points are included in the sample, the coefficient on esystem falls to .86, its standard error rises to 1.03, and the proportion p rises to 65.4%, indicating that (at most) only 1/3 of the increase in international relative price variability from 1957-72 to 1973-77 (for a country that adopted flexible exchange rates in the latter period) can be attributed to the exchange rate system rather than to some other factors occuring in the latter years that affected all countries, regardless of exchange rate system. The rationale for excluding devaluations (and upvaluations) and changes in the exchange rate system from the sample, as in the tables, is that these episodes are frequently associated with extraneous circumstances (such as changes in controls, speculative capital movements, etc.) with consequences that are not well understood, and that including these episodes would thereby distort the comparison that is being sought.

(3) The caveat that "at most" $1 - p$ percent of the increased variation in international relative prices is attributable to the exchange rate system is necessary for the reasons discussed in the first section of

the paper: (a) the exchange rate system may be endogenous in the sense that countries with greater variability of deviations from purchasing power parity may choose flexible exchange rates in response to the associated balance of trade problems; this biases the esystem coefficient upward, and (b) a spurious positive relationship between esystem and V_{it} may be caused by the use of price indexes that do not reflect actual transaction prices.

(4) The proportion p drops from sample (1) to sample (3). If you believe that the exchange rate data problems for the set of questionable countries are seriously influencing the result in sample (1), then you will prefer the sample (3) result, which attributes slightly less of the increased variability to the year effects and more to the exchange rate system. On the other hand, when the questionable countries are dropped from the sample, the results are based on considerably fewer countries, and, in particular, the sample tends to be dominated by a handful of industrial countries. Furthermore, it is not clear that the mere <u>existence</u> of substantial controls, rather than <u>changes</u> in the controls, should affect the interpretation of the evidence.

(5) There are three main outlying points in (1) and (3): Japan 1977, Switzerland 1977, and Malaysia 1975. The residuals corresponding to these observations are all over twice as great (in absolute value) as the (absolute value of) the next largest residuals, and they are all six to eight times the size of the mean absolute residual. The influence of these outliers in affecting the result is reported in samples (2) and (4) of Table II, which reproduce samples (1) and (3) with these three data points removed. These three observations reduce the proportion p by three to four and one half

percentage points, since each of these observations corresponds to a flexible exchange rate period and to a particularly large deviation from purchasing power parity. I am unaware of any special circumstances responsible for these outliers and hence unaware of any reason for preferring the results in (2) and (4) to those in (1) and (3).

(6) The year effect in 1977 is enormous. Also, the year effects for 1971 and 1972 are larger than those for 1957-69 but smaller than 1973-77 (except 1976), making 1971 and 1972 look like transitional years to the greater variability of international relative prices. A statistic analogous to p but based upon the change from 1957-70 to 1973-76 takes the value (in sample 1) of 33.9%. One might argue, since all relative international prices are measured relative to the United States, that particular factors in the U.S. in 1977 were responsible for a depreciation of the dollar that year and that this effect is showing up in the 1977 year coefficient. But the evidence here indicates that the variance of international relative prices (measured against the dollar) became greater in 1977 not only for countries with flexible exchange rates against the dollar but also for countries with currencies pegged to the dollar. From 1976 to 1977, the average percentage increase in V (measured by the change in the logarithm) for countries that had flexible exchange rates against the United States in both years was 1.41. The average percentage increase in V for countries that pegged their currency against the dollar in both years was 1.20. So the percentage increase was virtually independent of the exchange rate system. The absolute magnitude of the increase was over twice as much for flexible exchange rate countries as for fixed exchange rate countries, however. The depreciation of the dollar against

several currencies in 1977 is apparently not the reason for the large coefficient on the 1977 dummy.

The variability of international relative prices has increased substantially in the 1970's, particularly in 1977, both for countries that have flexible and those that maintain fixed exchange rates. What is the source of this additional variation? One possibility was suggested at the beginning of this paper: higher rates of inflation may be associated with more unanticipated inflation, and this may induce greater relative price variability. However, the magnitude of the 1977 effect still seems peculiarly large. The sources of the additional variation in relative prices, and the underlying demand and supply factors determining these relative prices, must be determined by future research.

TABLE I

	Float Years	$\beta_i(1)$	Excluded Years
U.K.	73-77	-.21	67, 71, 72
Austria	74-77	-.13	71, 73
Belgium	74-77	-.19	71, 73
Denmark	74-77	.06	57-67, 71, 73
France	74-77	-.37	57, 58, 60, 69, 71, 73
Germany	74-77	-.21	61, 69, 71, 73
Italy	74-77	-.39	71, 73
Netherlands	74-77	-.15	62, 71, 73
Norway	74-77	-.46	71, 73
Sweden	74-77	-.45	71, 73
Switzerland	74-77	.06	71, 73
Canada	57-61, 71-77	-1.20	62, 70
Japan	74-77	-.19	71, 73
Finland	74-77	-.56	57, 67, 71, 73
Greece	76-77	-.24	57-66, 73, 75
* S. Africa		-.30	62, 71-75
* Iraq		-.04	71, 73
* Venezuala		-.33	64, 71, 73
* Costa Rica		-.39	57-61, 73, 74
* Dominican Rep.		-.06	none
* Ecuador		-.17	61, 70
El Salvador		-.20	none
* Guatemala		-.00	none
Haiti		.11	57-68
Honduras		-.25	none
Mexico		-.37	57, 76, 77
Paraguay		-.27	57, 59, 60, 62, 63
* Egypt		-.43	62, 73
* Syria		1.37	62, 73, 74, 76, 77
* China (Taiwan)		-.13	57-61, 63, 73
Malaysia	74-77	-.14	71-73

TABLE I (cont'd.)

	Float Years	$\beta_1(1)$	Excluded Years
* Phillipines		.09	62, 70, 72, 74, 75
Thailand		-.33	57-62, 66, 67, 69, 73
* Ethiopia		1.04	57-65, 71, 73
Liberia		-.29	57-67
* Somalia		.52	57-63, 71-73
* Sudan		1.52	77
* Tunisia	74-77	.00	57, 64, 71-73

TABLE II

	(1)	(2)	(3)	(4)
1957	-.30 (.29)	-.28 (.26)	-.18 (.31)	-.15 (.23)
1958	-.21 (.27)	-.20 (.25)	-.19 (.30)	-.16 (.22)
1959	-.28 (.27)	-.27 (.24)	-.22 (.30)	-.20 (.22)
1960	-.33 (.27)	-.31 (.25)	-.21 (.30)	-.19 (.23)
1961	-.11 (.27)	-.09 (.25)	-.07 (.30)	-.05 (.22)
1962	-.31 (.28)	-.30 (.25)	-.19 (.30)	-.17 (.23)
1963	-.29 (.27)	-.28 (.24)	-.17 (.30)	-.17 (.22)
1964	.00 (.27)	.01 (.25)	-.14 (.29)	-.13 (.22)
1965	-.25 (.26)	-.25 (.24)	-.15 (.29)	-.15 (.22)
1966	-.34 (.26)	-.34 (.24)	-.18 (.30)	-.18 (.22)
1967	-.14 (.27)	-.14 (.24)	-.16 (.30)	-.15 (.23)
1968	-.24 (.26)	-.25 (.23)	-.08 (.28)	-.09 (.21)
1969	-.21 (.26)	-.21 (.24)	-.12 (.28)	-.12 (.21)
1970	-.23 (.26)	-.23 (.24)	-.20 (.28)	-.20 (.21)
1971	.00 (.31)	.01 (.28)	-.16 (.32)	-.16 (.24)
1972	-.01 (.27)	-.01 (.25)	-.14 (.28)	-.15 (.21)
1973	.75 (.34)	.77 (.30)	.03 (.33)	.06 (.25)
1974	.21 (.28)	.31 (.25)	.09 (.27)	.22 (.21)
1975	.53 (.28)	.49 (.25)	.75 (.28)	.67 (.21)
1976	-.12 (.28)	-.01 (.25)	-.36 (.28)	-.20 (.21)
1977	1.89 (.28)	1.67 (.25)	2.04 (.28)	1.67 (.21)
esystem	1.11 (.16)	.88 (.15)	1.23 (.18)	1.02 (.13)
p	43.4%	49.0%	35.3%	38.1%
R^2	.61	.62	.70	.75

FOOTNOTES

1. This ignores two possible effects. (i) Under pegged exchange rates, an increase in the domestic component of the nominal money supply ("domestic credit") can have a temporary effect on the relative prices of traded and nontraded goods because the country, in essentially spending international reserves for goods, moves along supply curves for both goods, and presumably faces a less elastic supply curve of nontraded than of traded goods. See Dornbusch (1973). (ii) There are redistribution effects of a change in the money supply that will generally differ under pegged and flexible exchange rates.

2. Including the "excluded years" in the sample produces a number of outliers that substantially reduce the coefficient on the esystem variable. See comment (2) below.

3. The caveat "at least" in this sentence is discussed in comment (3) below.

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