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PURCHASING POWER PARITY AND THE SENSITIVITY OF EXCHANGE RATES TO RELATIVE INFLATION RATES

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ABSTRACT

This paper examines the theory and evidence on Purchasing Power Parity and identifies biases and weaknesses in previous work. The empirical validity of the theory is examined using several price indices and base years and also on a quarter-to-quarter basis. Although evidence in support of the theory is weak, the patterns observed in both short- and long-run tests suggest an underlying assymmetry in the response of exchange rates to relative inflation rates when countries are segmented into groups whose currencies were significantly overvalued or significantly undervalued prior to 1971.

The general theory that the exchange rate between two currencies should be related to the domestic value of money in each country can be traced back to the writings of Adam Smith and David Ricardo. But not until 1916, when it was more specifically developed by Gustav Cassel, was this idea actually tested [9]. More recently, the purchasing power parity doctrine, as Cassel named it, was invoked by Haberler [26] as a basis for setting exchange rate parities at the end of World War II and by Houthakker [32] and during the international monetary crises of the early sixties respectively.

If the purchasing power parity between currencies is, in fact, an accurate and unbiased estimate of their true value, the importance and usefulness of the theory is clear. While balance of payments disequilibria can indicate the direction of exchange rate disparity (ie. over- or undervaluation), they cannot give a measure of the exact amount of disparity. Under the system of fixed or "pegged" exchange rates à la Bretton Woods, market forces are not free to determine the equilibrium rate; when revaluations or devaluations are necessary, an objective estimate of this rate would assist governments in determining the extent of change needed.

Before it can be justified as a basis for such important policy decisions, however, purchasing power parity (PPP) must be validated and its assumptions and limitations made explicit. Two major studies of the theory's validity were published during the period of currency devaluations and revaluations of the late fifties and early sixties. Yeager [56] found support for the theory, but his work was methodologically weak and thus cannot be considered a definitive validation.

Balassa [5] concluded that the parities indicated by the theory were so disparate from existing exchange rates that they could not be considered as equilibriums. But this study, also, contained methodological flaws. In particular, the model it tested bore little resemblance to the one actually proposed by Cassel, and the study therefore cannot be considered an invalidation of the theory.

Since the dollar devaluations of 1971 and 1973, most major currencies have been allowed to float. Although these floats are "managed" (ie., subject to government intervention), exchange rates have fluctuated widely and have been subject to the forces of the market. The theory is more readily testable now than at any other time in recent history; floating exchange rates represent the equilibrium sustainable by the market and thus are the best indication possible of true currency values. If purchasing power parities closely predict actual exchange rates during the period, then the theory is valid and its use as a tool in determining exchange rate policy merits further exploration and consideration.

PPP: A MACROECONOMIC OVERVIEW

The line which divides supporters of PPP from its nonsupporters follows closely the line which separates monetarists from Keynesians. The theory rests upon the assumption that disequilibrium in a country's internal balance (planned expenditure=planned income) caused by disequilibrium in its external balance (the foreign exchange market) under conditions of fixed exchange rates will manifest itself through changes in the money supply and thus changes in the general price level.

In the pre-World War I era the major countries of the world were on a domestic gold standard and currencies were exchanged at gold parity. An increase in foreign exchange holdings (gold) due to excess demand for a country's currency in the foreign exchange market led to a concomitant increase in its money supply and, following the quantity theory of money, to an increase in the general price level. (Flows of non-trade-associated liquid short-term capital were small.) At the time of its conception, then, PPP had a sound economic basis. The question of the economic soundness of the theory today centers on the debate between the monetarists and the Keynesians over the importance of money in the internal balance mechanism and the degree to which wage and price rigidities affect its operation.

The theory

The substance of the theory is that the rate of exchange between two currencies is primarily determined by the domestic purchasing power of the money of each country against goods [10], subject to the conditions:

1. There is a free movement of merchandise in and out of each country.
2. There exists a somewhat comprehensive trade between the two countries.

If the domestic purchasing power of money, or price level, should change in one country, there are only two basic methods of restoring external balance: similar price level changes in other countries or a change in the exchange rate. These changes may be mitigated somewhat in the short run by balance of payments disequilibria.

There are several concepts of equilibrium in the balance of pay-

ments. The most elementary is the "official settlements balance," the net change in a country's official foreign exchange holdings and equivalents. But this concept overlooks short-term, non-trade-associated capital flows which have much the same effect as official reserve changes. The "net liquidity balance" and "basic balance" take these flows into account, measuring not only actual changes in official reserves (as does the official settlements balance), but also potential changes due to liquid short-term and all short term claims on the country's currency.

In terms of the PPP theory, capital flows carry with them transfers of purchasing power; capital exports decrease aggregate demand and tend to hold the price level down while capital imports increase aggregate demand and tend to drive the price level up.

Models of the theory

The first model of the theory was constructed by Cassel to see if the floating exchange rates during World War I corresponded to their purchasing power parities. Using pre-war exchange rates as a base, he formulated his model as

(1) $PPP=(XR_{1913}) \times (P_i/P_j)$ where XR= exchange rate (i/j)
P= price level index (1913 base).

This model yielded purchasing power parities which were within ±2 percent of the actual average monthly exchange rates in 1916 for the currencies of Sweden, England, Germany, France, and Russia on the Stockholm Exchange, although these rates fluctuated as much as 40 percent from their pre-war par values. The price level index used was a measure of general price level computed from increases in each country's money supply with allowances made for changes in productivity.

Using basically the same model, Yeager computed 1957 PPPs for three dozen countries. His model used a 1937 base year and either wholesale or consumer price indexes, depending on what was available for a particular country. The results were rather ambiguous; only one third of the computed PPPs were within ±10 percent of the actual exchange rates and only three quarters were within ±25 percent. In addition to the inconclusiveness of its results, two major points of the study may be criticized. First, 1937 is a poor base year; most of the world was still recovering form the Depression, trade barriers were extremely high, and world trade was minimal. Second, the study covered such a long period that many structural changes in world trade took place during the time it covered. By 1957 tariffs and other trade barriers were markedly different from their 1937 character, as was the composition of world trade. In 1937, manufactures and raw materials represented 39.5 percent and 38.1 percent of world trade respectively; in 1957, these proportions were 54.3 percent and 24.9 percent. The theory requires circumstances of relatively free and comprehensive trade, and these requirements were not met in this study.

In a second test of the theory, Yeager developed a somewhat different model. He found a coefficient of correlation of +.64 between quarter-to-quarter Canadian exchange rates and quarter-to-quarter ratios of U.S. to Canadian inflation rates during the period 1950-1957, when the Canadian dollar was allowed to float (inflation measured by wholsale price indexes). This model can be expressed as

$$\frac{XR_t}{XR_{t-1}} = \frac{P_{it}/P_{it-1}}{P_{jt}/P_{jt-1}} \qquad t = \text{time, in quarters.} \tag{2}$$

Although the correlation was significant, no indication was given as to the actual equality between the exchange rate ratio and the inflation rate ratio. If, on average, it was equal to unity, then there is strong support for PPP. On the other hand, if it was significantly different from one, it would provide strong evidence that the theory, at least in this form, is invalid. The same model, with inflation rates measured in terms of consumer prices, showed insignificant (+.14) correlation. The differences in correlation between the WPI- and CPI-based inflation rate ratios can be attributed to both the smaller range within which the CPIs fluctuated and the fact that the WPI is heavily weighted with internationally traded goods.

The issue over what price index to use in PPP calculations has been heavily debated. The use of an index heavily weighted with traded goods, like the WPI, will tend to understate any differences which exist between the actual exchange rate and the PPP, because traded goods will tend towards price equality in all countries, allowing for transport cost differentials and tariffs. The CPI overcomes this drawback, but the CPI "market basket" may be substantially different between countries. Another potential drawback of the CPI is that it includes services whose costs are closely related to wage costs in industry but whose productivity increases may not be as great as those in industry [5]. Because many services which are included in the CPI do not affect the exchange rate, the use of CPIs may tend to overstate discrepancies between PPP and actual exchange rates.

Balassa, in his work, attempted to surmount the price index problem by constructing an index of consumer prices which used the

geometric mean of the market basket quantities in each country. Not only is it difficult to estimate the cost of a market basket of goods of one country in the currency of another, but the resulting price index has no meaningful economic interpretation and its use tends to overstate differences between PPP and actual exchange rates even more than does the use of the CPI of each individual country.

In addition to using a bastardized price index, Balassa created and tested a new formulation of PPP, which he dubbed the "absolute" version of the theory (as opposed to the older forms which he called the "relative" version). The absolute version seems a much stricter interpretation of PPP than the relative one. Not only must changes in exchange rates (from some base period) be equal to the relative changes in price levels, but the exchange rates themselves must be equal to the ratio of prices of some common market basket of goods. For example, if a particular market basket of goods would cost $260.00 or £100.00, then the exchange rate between dollars and pounds must equal $2.60/£. This model may be shown as

$$(3) \qquad PPP = \frac{P_i Q_{ij}}{P_j Q_{ij}}$$

where P_i = domestic prices of country i for the goods in basket Q_{ij}

Q_{ij} = common market basket of goods determined by the geometric mean of quantity weightings in domestic CPIs.

This model yielded PPPs which indicated the U.S. dollar was overvalued by 8 percent at least (with respect to the Canadian dollar) to as much as 40 percent (with respect to the Japanese yen) in 1960. While the dollar may very well have been somewhat overvalued at that time, it is difficult to believe that the degree of overvaluation was on the order

of 20-25 percent, which was the average overvaluation indicated by the computed PPPs. While these results appear to refute the validity of the absolute version of PPP, it does not seem wise to refute the validity of the PPP theory in general, as Balassa has done, on the basis of a straw man which is not representative of the theory as a whole.

With no clear-cut validation or invalidation of the theory since it was first introduced over fifty years ago, the need for additional testing is apparent. The absolute version is an aberrant form of the theory and has already been shown to be invalid. Therefore, the remainder of this study will be devoted to the relative versions:

$$(4) \qquad XR_t = (XR_0) \times (P_{i_t}/P_{j_t})$$

P = price level index

and the more specific form

$$(5) \qquad \frac{XR_t}{XR_{t-1}} = \frac{P_{i_j}/P_{i_{t-1}}}{P_{j_t}/P_{j_{t-1}}}.$$

TEST DESIGN

The two most important decisions in designing a test of PPP are the choices of base year and price index. The base year should be one in which the fixed exchange rates are in equilibrium; it should be far enough in the past that trade will have had an opportunity to adjust to relative price changes, and yet it should not be so distant that large changes have taken place in industrial structure or trade barriers and trade composition. The relative merits of the CPI and WPI have already been discussed briefly. The WPI appears to be the

better index for predicting exchange rates in the short run. But a strict interpretation of the theory requires that a more comprehensive index such as the CPI be used. Although the use of this index has been attacked on the basis of differences in international consumption patterns and in industrial/service sectoral productivity, these arguments now carry less weight than when they were first put forth. Consumption patterns in the major industrial countries show much greater similarity than they did ten or fifteen years ago. In addition, the productivity gap between the industrial and service sectors has narrowed markedly during that period and more services are entering international transactions [13, 23].

The base year was chosen using three criteria: (1) it had to be post-1965 so that structural and trade changes would not be too great, (2) it had to be pre-1971 so that trade would have adjusted to price level changes, and (3) within the first two constraints it had to be the year with the least general disequilibrium. The concept of general disequilibrium was measured by summing the absolute value of the balance of payments disequilibrium for each country included in the study. Thus three measures of general disequilibrium were obtained: basic balance, net liquidity balance, and official settlements balance. On the basis of rankings of each of these balances, 1967 was chosen as the base year. 1970 (the year of greatest disequilibrium) was also chosen as a base year for the purpose of seeing how much difference the equilibrium/disequilibrium base year choice made in a test of PPP. The CPI was chosen for the actual testing of the theory, but the WPI was also used to test the generally accepted dictum that, vis-à-vis the

CPI, it tends to understate differences between PPP and actual exchange rates.

Eleven countries were chosen for the test on the basis of their importance in world trade: United States, Canada, Japan, United Kingdom, Germany, Sweden, France, Netherlands, Belgium, Switzerland, and Italy. Although it would have been desirable to include the OPEC countries, there was a paucity of information available on these countries, and their exchange rates, for the most part, remained fixed during the 1971-74 period studied and were thus not amenable to the tests.

Yeager and Balassa both used the United States as the referent country for their tests of PPP, but there appears no a priori reason for doing so. If the theory is, indeed, general, it should yield the same results regardless of what country is used as a reference. As a test of the theory's generality, the United Kingdom and Germany were chosen as referent countries in addition to the United States.

The second model (equation 5, page 8) is a short-run variant of the first. It overcomes the limitation of using an equilibrium base year, because each time period is successively used as the base period for the next, but by its short-run nature it introduces limitations of its own. If exchange rate changes are equal to relative inflation rates as predicted by the model, how much of a time lag is there before the changes are effected? And if the quarter-to-quarter exchange rate changes and relative inflation rates are both very small, will a relationship between them be statistically significant, given a measurement error that may be of a magnitude equal to the fluctuations?

The first limitation can be circumvented by observing the correlations between exchange rate changes and lagged relative inflation rates. In general, correlations for concurrent variables were insignificant, but lagging the relative inflation rates one to three quarters produced significant positive correlations. Intuitively, this was expected; most orders for imported goods are placed at least several months in advance. Combined with an information time lag, it is easy to accept a lag of up to several quarters between price changes and shipments.

The second limitation is not so easily addressed. Exchange rates for the countries under study are given to four or five significant digits; CPIs to three or four. Measurement accuracy of these variables is compounded when they are transformed into the working variables for the study. In cases where the quarter-to-quarter changes in exchange rates and inflation rates are on the order of 10-15 percent, measurement limitations are of little consequence. But most changes were on the order of 5 percent or less, and many were less than 2 percent. Here the measurement problem is important.

In interpretation of the results, two caveats are in order: the accuracy of the results can be no greater than the accuracy of the inputs (and may be less), and the CPI is, at best, a rough indication of the general price level upon which the theory actually rests.

Results

The results can be summarized in one word: inconclusive. In the long-run model, significant correlation was found between actual and predicted exchange rates, but discrepancies between PPPs and actual

rates were often large and they were highly dependent upon what country was used as a reference. The choice of base year had little impact on the results; discrepancies between PPPs and actual rates were somewhat larger when there was greater disequilibrium in the base year, but the difference was insignificant. Similarly, the use of the CPI produced significantly larger discrepancies than the use of the WPI in only one-third of the cases. In the short-run model, the discrepancies between actual and predicted rates were much smaller—within ±1 percent in about half the cases. But the correlations between relative inflation rates and exchange rate changes were virtually all insignificant. As in the long-run model, the PPPs obtained depended on the referent country used.

LONG RUN MODEL

For the long run model, $XR_t = (XR_0) \times (P_{it}/P_{jt})$, simple regressions were run for each country using quarterly exchange rates and price indexes for the period 1971-74. After it was ascertained that the constants were highly insignificant (at least .50 level), the remaining regressions were run forcing the model through the origin. The variables were then transformed so the regression model took the form:

(6) $\quad XRI = bRPI \qquad XRI = XR_t/XR_0$

$$RPI = P_{it}/P_{jt}.$$

Although the constants in the original regressions were insignificant, their inclusion altered the regression coefficient of RPI. This coefficient is of primary importance to the study. It represents the discrepancy between PPP and the actual exchange rates; if it is equal

to one, then, on average, the PPPs and the actual exchange rates (AXRs) are equal. If it is less than one, the currency is undervalued with respect to its PPP, and if it is greater than one, the currency is overvalued with respect to its PPP. The r^2's of regressions forced through the origin are the squared correlations between the actual and predicted exchange rates. Results of the regressions for the long-run model are given in Tables 1-3 in the Appendix.

CPI vs. WPI.

It is generally held that using the CPI will produce larger differences between PPPs and AXRs than will using the WPI. Both indexes were used to compute PPPs with 1967 and 1970 base years (U.S. reference), and the hypothesis was tested by two methods. First, we tested the hypothesis that the PPPs generated for each country by the WPI and the CPI were not significantly different. Of the twenty cases tested, only seven PPPs computed with the CPI were significantly more discrepant at the .10 level and only five at the .05 level; in all but one case, however, the CPI did produce PPPs which were somewhat more discrepant. To test whether the choice of price index produced an overall difference in PPPs an analysis of variance test was performed for each year. In 1967, the difference was not significant at the .05 level, but the difference in 1970 was significant at the .01 level. Our conclusion is that while the CPI may produce more discrepancy, the evidence is not overwhelming.

Equilibrium vs. disequilibrium

A similar analysis of variance test was used to test the difference made by using a base year with more or less general disequilibrium.

With neither the WPI or CPI computed PPPs there was a significant difference between 1967 and 1970 (.05 level).

Generality

If the theory is general, we would expect substantially the same results regardless of which country we use as a reference. It is obvious from Tables 2 and 3 that there is a significant difference in the PPPs obtained from each referent country. The U.S.-based PPPs indicate that all the other currencies are overvalued (with respect to the dollar), the U.K.-based PPPs indicate similar results (with respect to the pound) but to a lesser degree, and the Germany-based PPPs indicate that most of the currencies are undervalued (with respect to the deutschemark). A closer look, however, reveals that the relative rankings of the countries by PPP are nearly identical (see Figure 1). Futhermore, the PPP differences between referent countries is largely explained by the relative overvaluation of the deutschemark and the pound to the dollar. Even though the discrepancies between PPPs and actual rates are large, the theory does appear to be internally consistent with respect to the choice of referent country.

U.S.	Germany	U.K.
*Canada	Canada	Canada
Italy	Italy	Italy
U.K.	U.K.	
Sweden	Sweden	Sweden
France	France	*France
Belgium	Belgium	Belgium
Japan	*Netherlands	Germany
Germany		Japan
Netherlands	*Japan	Netherlands
Switzerland	*Switzerland	Switzerland

* PPP and AXR not significantly different (.01 level)

Fig. 1. Rankings by actual exchange rates as a percentage of purchasing power parity. $(\frac{AXR}{PPP})$

PPPs vs. AXRs

If exchange rates were in equilibrium in the base year and if there were no major changes in trade composition or trade barriers between the base year and the period under study, PPPs should be unbiased estimates of AXRs. The regression model was constructed in such a way that the regression coefficient was a measure of the bias of the PPP estimate. It is an average value of the AXR expressed as a ratio of PPP. As shown in Figure 1, the hypothesis that PPP is an unbiased estimate of AXR is rejected in twenty-three of the twenty-eight cases. The discrepancies ranged from as much as 20 percent undervaluation (Canada, Germany-reference, to as much as 34 percent overvaluation (Switzerland, United States-reference). Although the PPP estimates are biased, correlations between predicted and actual exchange rates were significant at the .05 level for most (23 out of 28) cases and at the .01 level or below for over half the cases.

SHORT RUN MODEL

The short run model attempts to show the relationship between quarter-to-quarter relative exchange rate changes and quarter-to-quarter relative inflation rates. More specifically, it predicts these changes will be equal. The regression model used was similar to the one used to test the long run model:

(7) $RQXR = bRQI$

RQXR = relative quarter-to-quarter exchange rate change: XR_t/XR_{t-1}

RQI = relative quarter-to-quarter inflation rate change: $\frac{P_{it}/P_{it-1}}{P_{jt}/P_{jt-1}}$

The independent variable was lagged one to three quarters to get the highest correlation with the dependent variable. When the model was tested, however, the correlations between actual and predicted RQXRs were generally insignificant. While the rankings on the basis of actual RQXR as a percentage of predicted RQXR (Figure 2) are not as consistent between referent countries as were the long run rankings, it is interesting to note the striking similarity between the long and short run rankings. As in the long run model, the discrepancies between actual and predicted values varied between referent countries. Relative exchange rates were progressively less sensitive to relative inflation rate changes with the U.S.-, U.K.-, and Germany-based referent models respectively (see Table 4 in Appendix).

U.S.	Germany	U.K.
Canada	Italy	Italy
U.K.	U.K.	Canada
Italy	*Canada	
*France	Sweden	Japan
Sweden	Belgium	France
*Japan	France	Sweden
Belgium	*Japan	Belgium
Germany		Germany
Netherlands	Netherlands	Netherlands
Switzerland	Switzerland	Switzerland

* correlation between actual and predicted RQXR significant at the .05 level.

Fig. 2. Rankings by actual RQXR as a percentage of predicted RQXR, $(\frac{A.RXQR}{P.RXQR})$

Discussion

While the empirical tests, as designed, were unable to validate or invalidate the PPP theory, they do yield some interesting and useful results. The significant correlations between relative price-level

changes and exchange rates in the long-run model indicate that a relationship does exist between the two (while both are correlated somewhat with time, the correlations with each other are much higher). The discrepancies between PPPs and AXRs are probably the result of several factors. We know, for example, that the U.S. dollar was overvalued in both base periods, which would explain the apparent overvaluation of other currencies in the test period. Similarly, we know that the deutschemark was undervalued in 1970 (with respect to the dollar and most other currencies) which would explain the apparent undervaluation of most currencies in the test period using the Germany-based model. In addition, a closer inspection of Tables 1-2 (Appendix) reveals smaller discrepancies between PPPs and AXRs for Canada and Germany in the 1970-based model than in the 1967-based one and a larger discrepancy for France. In the intervening period both Canada and Germany revalued, decreasing their undervaluation with respect to the dollar; and France devalued, increasing its undervaluation with repect to the dollar. Besides the base period disequilibrium, which affected all the currencies in all the quarters of the test period in the same manner, there exist the disequilibrating effects of the oil crisis. If foreign exchange is traded in an efficient market and the PPP theory is valid,[1] the apparent disequilibrium in the market caused by the oil crisis can be explained as the equating of exchange rates with expected relative inflation rates rather than with concurrent relative inflation rates. In periods of relatively constant inflation rates, expected relative inflation rates will equal current relative inflation rates in the absence of new information

(such as provided by an exogenous shock like the oil crisis).

Any conclusions drawn from the short-run model must necessarily be tenuous because of both the problems with precision of measurement and the weak associations found between exchange rates and relative inflation rates. Given the relationship $X = bI$, where X is the relative quarter-to-quarter exchange rate change and I is the relative inflation rate, b represents the sensitivity of the exchange rate to the relative inflation rate. This sensitivity is a function of both the specific country tested and the referent country used. For example, we saw in Figure 2 that Canada, Italy, and the U.K. tend to be less sensitive and Switzerland, Germany, and the Netherlands tend to be more sensitive, regardless of which country is used as a reference. While the rankings according to relative sensitivity are substantially the same regardless of referent country, the levels of sensitivity are not. Table 4 reveals that exchange rates become progressively more sensitive to relative inflation rates when Germany, the U.K., and the United States are used as referent countries respectively. This finding is consistent with the rankings. Analysis of variance shows both referent country and specific country differences to be significant at the .01 level; interaction effects are not significant at the .10 level.

Note the similarity between the rankings of the long-run model (Figure 1) and the short-run model (Figure 2). The rankings of the

[1]Subsequent to the completion of the empirical work here I have been told that Alan Shapiro, of the Multinational Enterprise Unit at Wharton, has completer a validation of the theory.

of the long-run model are largely explained by the relative over- and undervaluations of the currencies in the base year; those of the short-run model by relative sensitivities of exchange rates to relative inflation rates. Since the short-run model has no base period valuation effect, the similarity is all the more striking; there appears to be no a priori reason for the similarity in the rankings.

These similarities seem to suggest a causal relationship between the exchange rate/inflation rate sensitivity and relative over- and undervaluations prior to 1971, but the direction of causality is not clear. If the underlying causes of the sensitivity have existed for some time, they may explain why certain currencies became undervalued and were able to remain that way for so long; if, on the other hand, these sensitivities are specific to the test period, they may be a result of the relative undervaluations which existed prior to 1971. Ideally, we would like to see what sensitivities existed throughout the 1960s. But with the fixed rate exchange system which existed at that time, the underlying causes would not have manifested themselves in exchange rate fluctuations and we cannot measure them as we did for the test period. We can, however, look at the effects of the fixed exchange rate system on the domestic economies and some of the underlying causes for economic events of the past few years.

EFFECTS OF FIXED EXCHANGE RATES ON RESOURCE ALLOCATION

It has generally been held that the reason the U.S. dollar was

allowed to remain overvalued for so long was its role in providing international liquidity. While this is undoubtedly one reason, there are other, more fundamental, reasons. The United States was satisfied with the situation because overvaluation of the dollar produced favorable terms of trade, allowed greater current consumption, and kept long-term interest rates relatively low. Countries whose currencies were relatively undervalued with respect to the dollar were content because increased export demand kept profits high and led to increases in investment and industrial capacity. In addition, overvaluation of the dollar increased foreign direct investment (FDI) by U.S. firms, particularly into Europe. Overvaluation of the dollar reduced the size of both domestic and foreign markets for U.S. traded-goods industries. These industries, expecially export-oriented ones, were generally technology intensive and desirable for FDI in the eyes of many European governments. With reduced export markets, some of the highly specialized capital of these industries (eg., technology and managerial expertise) became redundant and was more easily transferred across national boundaries than across industries. Twenty years of deficits, aided by U.S. control of over half of the world's international reserves at the end of World War II and abetted by the growth of the Eurodollar market as U.S. reserves dwidled, have led to significant distortions in both domestic and international investment. In surplus countries, particularly where restrictive fiscal and monetary policies have helped keep down wages and domestic prices, the relatively higher prices and profits in traded goods industries led to a greater allocation of resources to these industries relative to

non-traded goods industries than would have been the case if exchange rates had been at a market-determined equilibrium. Because the exchange rate disequilibrium lasted for such a long period, it led to distortions not only in investment flows, but also in investment (capital) stocks. With powerful vested interests in the traded-goods industries who would find themselves with excess capacity following a revaluation and with growing government orientations towards policies aimed at maintaining high employment levels throughout the 1960s, there was a great disincentive among surplus countries for exchange rate realignment.

Internal inflationary pressures

During the 1960s and early 1970s real per capita income was growing at an increasing rate throughout the industrial countries. These rising incomes and expectations of continuous increases in the standard of living tended to pull resources into current consumption and at the same time stimulated investment in the consumer goods industries. Not only have incomes been rising, but also there has been a shift in income distribution away from profits and toward wage earners, aided by increasing government transfers. The decrease in the proportion of real net fixed business investment to real GNP, particularly in heavy industry, has weakened the ability of many industrial countries to continue rapid growth without inflationary pressures. Increases in productivity have not generally been commensurate with increases in wages; with increasingly more wage contractors containing escalator clauses, the result has been a spiraling cost-push inflation.

The widespread social and political committment to high levels of employment, even at the cost of inflation, and the general tendency of governments to underestimate the strength of underlying demand forces have led to more frequent budget deficits in most of the industrial countries in the past decade. Furthermore, large swings in monetary policy in many countries have not been conducive to the long-run investment climate.

Conclusion

Although we have looked at only two areas: the effects of fixed exchange rates on domestic resource allocation and internal inflationary pressures, there does seem to be reason to hypothesize that the causality runs from the currency valuations prior to 1971 to the exchange rate/relative inflation rate sensitivities observed in the test period. Our line of reasoning is as follows.

For countries with formerly undervalued currency (FUC), the greater the degree of undervaluation, the greater the distortion of the allocation of resources into import-substitute and export industries relative to home goods industries, and the greater the buildup of industrial capacity. The greater the industrial capacity, the easier it is to maintain high levels of employment without inflationary pressures, ceteris paribus. Conversely, for countries with formerly overvalued currency (FOC), the greater the degree of overvaluation, the greater the distortion of the allocation of resources into home goods industries relative to traded-goods industries and the slower the buildup of industrial capacity.

Before 1971 resources moved towards their most efficient alloca-

tion, given the exchange rate structure which then existed. But following the dollar devaluation, these resources were inefficiently allocated; there was relatively too much productive capacity in FUC countries and relatively too little in FOC countries. Further, the resource allocation within countries was also inefficient as described above. The general trend in the industrial countries of a declining real net fixed investment in heavy industry as a proportion of real GNP became an asset to FUC countries. But the shortage of capacity in the capital goods industries was painfully apparent in the FOC countries, where traded-goods industries were trying to expand. Long-term investment flows became more volitile. Flows into FUC countries tended to decrease or reverse themselves altogether and vice-versa for FOC countries, but the pattern was not symmetric.

We shall argue that long-term disinvestment in FUC countries was more susceptible to exchange rate changes than was long-term investment in FOC countries. As domestic desired investment increased in the FOC countries, capital goods and industrial materials began showing signs of supply shortages and rapid price increases; delivery times on capital goods increased. While foreign direct investment is a function of many things, two of its primary determinants are the present exchange rate, which partly determines present costs, and the expected course of future exchange rates, which helps to determine both expected future revenues (particularly for investments in traded goods industries) and the home currency value of future earnings. In general, we expect that, ceteris paribus , a depreciation will lead to FDI inflows and an appreciation to FDI outflows. Now if desired

investment in FOC countries is greater than actual investment and is being constrained by, for example, the capital goods sector, then an increase in favorability for FDI (eg. an exchange rate depreciation) can lead to only a comparatively small increase in actual investment. But under these conditions, even a small increase in investment demand causes a comparatively large increase in inflationary pressure. Similarly, a decrease in favorability for FDI (eg. an exchange rate appreciation) will not lead to much decrease in investment so long as desired investment exceeds actual investment, but even a small decrease in investment will greatly reduce inflationary pressure. Assuming prices are somewhat sticky downward, an outflow of capital from an FUC country will not cause a commensurate decrease in prices, and an inflow of capital will not cause as great an inflationary pressure as in FOC countries, because the capital goods sector is not constraining investment.

If our assumptions are valid, we can explain the observed exchange rate/relative inflation rate sensitivities by way of an example. If the currency of an FUC country (eg., Germany) appreciates relative to that of an FOC country (eg., the United States), capital will flow from Germany to the United States, decreasing inflationary pressure in Germany very little but increasing inflationary pressure in the United States a great deal. Thus the relative inflationary rate of Germany with respect to the United States will decrease, reinforcing the appreciation of the deutschemark. If on the other hand, we start with the deutschemark depreciating with respect to the dollar, capital will tend to flow from the United States to Germany, decreasing inflationary

pressure in the United States a great deal but increasing inflationary pressure in Germany very little. Thus the inflation rate of Germany in relation to the United States will increase, reinforcing the depreciation.

Our conclusion is that the disequilibrium which existed under the fixed exchange rate system prior to 1971 brought about distortions in investment flows and resource allocations both between countries and within countries. After the dollar devaluations of 1971 and 1973 the attempts to reallocate resources efficiently under the new exchange rate system, combined with government employment policies and the trend towards declining real net fixed investment as a proportion of real GNP, led to an asymmetry in exchange rate/investment flows and investment/inflation relationships between countries whose currencies were overvalued prior to 1971 and those whose currencies were undervalued during that period. These asymmetries, in turn, tend to make the exchange rates of the former countries more sensitive to relative inflation rates than those of the latter countries.

While the assumptions we have made seem tenable, there is need for a more rigorous examination of them. There are probably other factors which have led to this phenomenon, and they too need to be explored. Finally, we point out once again that the basic assumption of the existence of the sensitivity differences rests on statistical relationships which were, themselves, tenuous.

APPENDIX

Table 1. 1967 base year, U.S. reference Long Run Model

	WPI				CPI			
Country	b	SE_b	r^2	sig.	b	SE_b	r^2	sig.
Canada	1.0976	.018	.36	.05	1.0519	.006	.29	.05
Germany	1.2789	.031	.79	.01	1.3007	.045	.01	
Japan	1.1350	.031	.00		1.3392	.046	.24	.05
U.K.	1.0980	.011	.01		1.1264	.011	.22	.10
France	1.0792	.031	.02		1.0518	.029	.40	.01
Netherlands	1.1278	.030	.35	.05	1.2851	.045	.53	.01
Belgium	1.1331	.027	.24	.05	1.1582	.035	.66	.01
Sweden	1.1476	.023	.03		1.1273	.024	.42	.01
Switzerland	1.2037	.039	.73	.01	1.2570	.054	.45	.01
Italy	1.0947	.015	.54	.01	1.0232	.013	.18	

Table 2. 1970 base year, U.S. reference Long Run Model

	WPI				CPI			
Country	b	SE_b	r^2	sig.	b	SE_b	r^2	sig.
Canada	1.0498	.018	.36	.05	1.0187	.006	.29	.05
Germany	1.2143	.029	.79	.01	1.2887	.045	.01	
Japan	1.1599	.032	.00		1.2879	.044	.24	.05
U.K.	1.0587	.011	.01		1.1218	.011	.22	.10
France	1.1411	.033	.02		1.1705	.032	.40	.01
Netherlands	1.1580	.031	.35	.05	1.2944	.046	.53	.01
Belgium	1.1357	.027	.24	.05	1.2173	.036	.66	.01
Sweden	1.1284	.023	.03		1.1677	.024	.42	.01
Switzerland	1.2370	.041	.73	.01	1.3419	.058	.45	.01
Italy	1.0787	.015	.54	.01	1.0883	.014	.18	

Table 3. 1970 base year, CPI Long Run Model

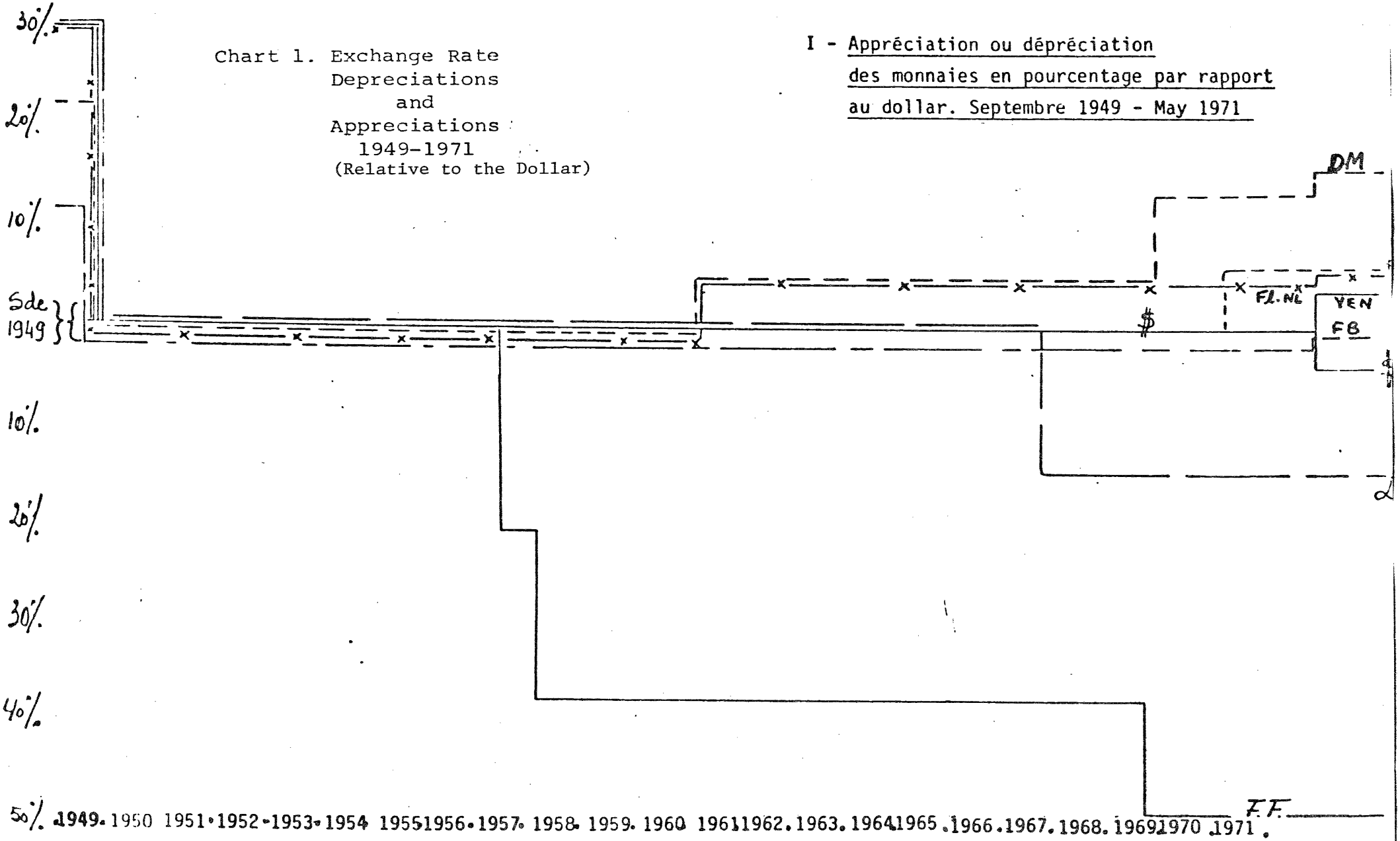
	Germany				U.K.			
Country	b	SE_b	r^2	sig.	b	SE_b	r^2	sig.
Canada	.8052	.025	.27	.05	.9073	.007	.42	.01
Germany					1.1521	.033	.63	.01
Japan	1.0132	.010	.78	.01	1.1550	.032	.10	
U.K.	.8910	.026	.64	.01				
France	.9246	.012	.59	.01	1.0479	.022	.54	.01
Netherlands	1.0091	.006	.24	.05	1.1596	.033	.55	.01
Belgium	.9499	.010	.15		1.0888	.025	.83	.01
Sweden	.9230	.016	.29	.05	1.0442	.015	.57	.01
Switzerland	1.0413	.016	.45	.01	1.2045	.047	.66	.01
Italy	.8704	.023	.72	.01	.9733	.010	.11	

Table 4. Ratio of Actual to Predicted Relative Quarterly Exchange Rate Changes

	U.S.			Germany			U.K.		
Country	b	SE_b	r^2	b	SE_b	r^2	b	SE_b	r^2
Canada	1.0054	.003	.19	.9856	.020	.41	1.0015	.012	.00
Germany	1.0277	.019	.09				1.0266	.015	.05
Japan	1.0225	.012	.31	1.0016	.011	.34	1.0152	.011	.15
U.K.	1.0066	.012	.02	.9850	.013	.02			
France	1.0175	.015	.31	.9954	.011	.16	1.0172	.013	.08
Netherlands	1.0298	.016	.01	1.0043	.006	.01	1.0267	.013	.01
Belgium	1.0253	.018	.21	.9935	.007	.00	1.0195	.013	.01
Sweden	1.o178	.013	.01	.9927	.009	.00	1.0188	.011	.23
Switzerland	1.0393	.019	.14	1.0133	.009	.12	1.0477	.017	.08
Italy	1.0079	.008	.00	.9837	.015	.00	1.0015	.013	.00

Chart 1. Exchange Rate Depreciations and Appreciations 1949-1971 (Relative to the Dollar)

I - Appréciation ou dépréciation des monnaies en pourcentage par rapport au dollar. Septembre 1949 - May 1971



Source: Michaud, [42]

Table 6. Government Transfers as a Percentage of GNP

Selected Industrial Countries: Government Transfers to Households as a Percentage of Personal Consumption Expenditures

(Per cent, based on data in current prices and local currencies)

	1955	1960	1965	1970	1972	Per cent Change in Share 1955-72
Belgium	14	17	21	25	27	93
France	20	21	27	29	30	50
Germany	20	24	25	26	28	40
Italy	15	18	22	23	27	80
Netherlands	13	18	25	35	40	208
Sweden	12	15	18	24	28	133
United Kingdom	9	10	12	15	16	78
Canada	10	13	11	15	17	70
Japan	7	7	8	9	9	29
United States	7	9	9	13	14	100

Source: OECD, National Accounts, various issues; U.S., Department of Commerce, Survey of Current Business, various issues.

Source: June, [33]

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