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INFLATION, EXCHANGE RATES AND STABILIZATION

Rudiger Dornbusch

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ABSTRACT

The essay is an extended version of the Frank D. Graham Lecture presented at Princeton University in May 1985. It discusses the interaction of inflation and exchange rate policy in a variety of contexts. Four different settings are used to highlight that role: the experiments with exchange rate overvaluation in the Southern Cone; the place of exchange depreciation in the transition from high to even higher inflation discussed in the context of Brazil; exchange rate fixing and real appreciation during stabilization in the 1920s; and finally the U.S. real appreciation of 1980-85. The common thread of the argument is that exchange rate policy can make an important contribution to stabilization, but that it can also be lead to persistent deviations from PPP, with devastatingly adverse effects.The essay investigates through what channels these PPP deviatiins arise and how they influence inflation, trade and capital flight.

Rudiger Dornbusch
E52-357
Massachusetts Institute of Technology
Cambridge, MA 02139

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Rudiger Dornbusch
Massachusetts Institute of Technology

Frank Graham's interest in the relationship between the monetary standard, exchange rates and prices spanned his entire professional career. From his 1920 Harvard dissertation on "International Trade Under Depreciated Paper" to the "Cause and Cure of the Dollar Shortage" in 1949 his work constantly touched on the implications of alternative monetary arrangements and the interpretation of actual developments. His most outstanding writing in this area is no doubt Exchange Rates, Prices and Production in Hyperinflation Germany, a book which is required reading for anyone who wants to understand the characteristics of extreme monetary experience. Of course international monetary issues were only one of Graham's interests: his work on protection and on general equilibrium can claim as much importance. But even so his favorite must have been the issue of exchange rates and prices to which he returned so frequently. It is appropriate to honor his memory with further discussion of this topic.

This essay considers the role which exchange rates play in the context of inflation stabilization. Four different settings are used to highlight that role: the experiments with exchange rate overvaluation in the Southern Cone to which Carlos Diaz Alejandro first drew attention; the place of exchange depreciation in the transition from high to even higher inflation discussed in the context of Brazil; exchange rate fixing and real appreciation during stabilization in the 1920s; and finally the U.S. real appreciation of 1980-85. The common thread of the argument is that exchange rate policy can make an important contribution to stabilization, but that it

can also be malpracticed leading to persistent deviations from PPP, with devastatingly adverse effects.

The various applications are chosen to highlight quite different issues. In the first section dealing with Latin America attention focusses on the trade and capital account effects of exchange rate overvaluation: even though exchange rate policy can help stop inflation, at least for a while, the resulting overvaluation can become very costly as capital flight and import spending become large in anticipation of a collapse of the program. Section 2 focusses on the synchronisation of wages, prices and the exchange rate in two contexts. In a system of wage indexation and PPP-based exchange depreciation we discuss the problem of budget and trade correction. Stopping hyperinflation via exchange rate fixing is another application of the same set of ideas and the German and Argentinian cases are given as examples. Finally in section 3 dealing with the U.S. disinflation we pay attention to the impact of the exchange rate on commodity prices and the prices of manufactures, analysing the microeconomic channels through which exchange rate movements affect relative prices and the inflation process. The essay concludes with quantitative estimates of the contribution of dollar appreciation to U.S. disinflation and the likely inflation cost that must be borne when the dollar comes down again.

1. THE LATIN AMERICAN EXPERIMENTS

In the late 1970s the authorities in Chile and in Argentina used exchange rate overvaluation to try to bring down inflation. In Chile's case the exchange rate was fixed outright even though the prevailing rate of

inflation was still 30 percent. In Argentina's case a timetable for prefixed disinflation --the tablita-- was adopted. In both countries inflation was indeed brought down, but at a cost of destructive overvaluation. The experiments were encouraged by the belief that in part inflation is the result of a vicious cycle: inflation requires for external balance depreciation which in turn causes cost inflation both directly and indirectly (via increases in wages), and therefore requires renewed depreciation and so on. The only means to escape from the inflation trap is to cut the recurrent feedback of currency depreciation.[1]

Chile: In March 1979, having achieved a balanced budget, the Pinochet Regime decided to round out their classical stabilization by putting the country on a fixed dollar exchange. Even though the rate of inflation was still 25 percent the currency was pegged to the dollar at 39 Pesos forever after, or so the government announced.

Exchange rate pegging was thought to help bring inflation under control through at least two channels: first, international prices would exert an immediate, tight discipline on domestic price increases, perhaps not literally by the operation of the law of one price, but still in a very effective manner. This would be all the more true because extensive trade liberalization had been under way, clearing the road for international competition to play its role. The second channel through which exchange rate pegging would enhance inflation stabilization was through expectations. The expectation of a fixed exchange rate would influence those sectors which are

[1]On the Southern Cone experiment see Corbo and de Mello (1985), Diaz Alejandro (1981), Dornbusch (1985a), Edwards (1985),and Harberger (1983,1985).

price setters rather than price takers. The recognition that exchange rates would be fixed forever after would shift expectations from an inflationary setting to a new regime of price stability.

The disinflation strategy was almost successful: inflation fell over the next two years from more than 20 percent to zero. But the disequilibria accumulated in the process led to a complete failure of the experiment. Today the standard of living in Chile is even below the levels of 1970, mostly as a result of the policy blunders. The problem arose from the fact that wages were indexed backward: each year's wage increases would be determined by the preceeding year's rate of consumer price inflation. The real wage policy was one of the tools which the military dictatorship used to sustain its support. In fact, in 1979-80 the policy led to a rising real wage, since wage increases exceeded the current rate of inflation that was already being held down by the fixed exchange rate. As a result the purchasing power of wages in terms of traded goods increased sharply. The gain in real wages was all the more significant in that complete trade liberalization had contributed to reducing the rate of import price inflation.

The mechanics of overvaluation can be described in a model of cost-determined price inflation. Let p, w and e be the rates of CPI inflation, wage inflation and exchange depreciation. For simplicity we assume zero productivity growth. The given world rate of inflation (in dollars) is denoted by p^*. The home rate of inflation of the CPI is a weighted average of wage inflation and international inflation measured in pesos:

(1) $$p_t = aw_t + (1-a)[e_t + p^*]$$

where a is the share of labor in costs. Next we use the indexing rule $w_t = p_{t-1}$ to substitute in (1) together with the exchange rate rule e=0 to obtain:

(2) $$p_t = ap_{t-1} + (1-a)p^*$$

Equation (2) shows that the wage and exchange rate policy combine to yield a gradually declining rate of inflation which ultimately converges on the world rate of inflation, p*. The convergence is more rapid the smaller the weight of wages and the larger the weight of international prices in determining the home inflation rate. Equation (2) thus bears out the view that exchange rate policy can be used for disinflation and that the openness of the economy speeds up and reinforces such a disinflation strategy.

But the problem with this strategy is brought out in (3) where we show the rate of growth of the real wage, $w_t - p_t$:

(3) $$w_t - p_t = p_{t-1} - p_t = (1-a)[p_{t-1} - p^*]$$

Equation (3) shows that as long as lagged inflation exceeds the rate of international inflation the real wage is rising. As home inflation gradually comes down (without overshooting) the real wage steadily increases

without there being at any stage a correction for the cumulative overvaluation. Thus, even as the war on inflation is being won there is a developing serious overvaluation problem. The model of the inflation process is, of course, highly simplified and leaves out potentially important channels, (in particular demand). But even so it does capture the basic contradiction of the wage and exchange rate policy. [2]

The disequilibrium implied by fixing too many variables did become a problem in Chile. In the period from the third quarter of 1979 to the second quarter of 1982 the real exchange rate appreciated by more than 70 percent. It is worth recording that in every instance of gross overvaluation there will always been an attempt to rationalize the overvaluation, commonsense notwithstanding, as a change in equilibrium relative prices. In the Chilean case three arguments were advanced: first that trade liberalization and extremely high productivity growth had changed the equilibrium price structure; second that the basket of Chilean tradeables was very special compared to the basket represented by world inflation; and third, that the real appreciation was merely a response of equilibrium relative prices to a sharp increase in the rate of capital inflow. It is a surprising fact that overvaluation tends to bring out more readily a rationalization rather than appeal to historical precedents in the same country or elsewhere that overvaluation is merely the result of poor exchange rate policy, soon to be followed by collapse.

[2] The contradiction is worth highlighting since Chicago graduate student, including the Chilean policy makers, had been brought up on Harberger's classic "The Case of the Three Numeraires" which made the point that separate exchange rate and wage targets were incompatible. See,too, Mundell (1968, chapter 8) and Swan (1960).

The tendency to rationalize overvaluation may stem from the fact that overvaluation is very popular at least in the initial stages. Carlos Diaz Alejandro (1963) and Krugman and Taylor (1978) have emphasized that devaluation can be deflationary as it cuts the purchasing power of wages in terms of tradeables. The same effect is at work in the opposite direction in periods of overvaluation. The first impact is to raise the purchasing power of wages and thus create a period of prosperity, usually called "the miracle". Of course the miracle can only last as long as the central bank can afford to put foreign exchange on sale. But even before the bank's reserves are depleted the income effect of real wage increases come to be dominated by the classical effects of substitution away from overpriced domestic labor.

The substitution effects on the demand and supply side lead to bankruptcy and unemployment which is always stage II of an overvaluation experiment. Stage III involves paying the bill: the central bank no longer has reserves, but the external debt incurred to finance the overvaluation needs servicing. The only way to do so is to run a trade surplus generated by austerity and sharp real depreciation. The excessive standard of living of the initial overvaluation period now is paid for by a long period of deprivation. The matter is often worsened by a differential impact of the policy on rich and poor, because of their differential ability to take advantage of the overvaluation. The workers will almost always pay, in the end, by a cut in their real wage. The real wage cut is necessary to generate the gain in competitiveness required to service the foreign debt, but they may not always fully benefit in the stage I where shifting into foreign assets or durables is the name of the game.

The adverse substitution effects are reinforced by real interest rate effects. The expectation of depreciation raises nominal interest rates on peso loans. But because the government does not in fact depreciate the currency the realized real interest rates keep being high. Thus result financial difficulties for all those firms that are already unprofitable and whose debts grow relative to assets and earning potential.

In Chile the overvaluation played itself out through the trade balance. The combined effects of overvaluation and trade liberalisation cheapened imports in real terms to an unprecedented extent. There was growing doubt that the overvaluation was sustainable and the public came to believe that ultimately, access to cheap imports would again disappear via devaluation, tariffs or quotas. As a result the level of imports in 1980-81 exploded. This was particularly the case for durables. Automobile imports doubled, imports of electro-domestic equipment increased nearly 60 percent and imports of breeding stock more than tripled.

Needless to say, devaluation did take place in the end, inflation is back to around 20 percent, the tariffs and quotas are back, the budget has deteriorated, the debt crisis is on and unemployment stands for a few years already at record levels. In retrospect the exchange rate experiment, has proved a terrible mistake because of the neglect of the effects of wage indexation. The mistake was enhanced by the arrogant stupidity of policy makers who watched growing overvaluation without recognizing early on the fatal flaw or later the inevitable collapse.

Argentina: The stabilization attempt using the tablita was implemented by Economics Minister Martinez de Hoz, starting in December 1978. The initial inflation rate was 120 percent and thus an outright fixing of the exchange rate seemed implausible. Instead the government committed itself to a pre-set, declining rate of exchange depreciation. The time table for the exchange rate was seen as an important element in stabilizing expectations around a declining inflation trend.

In Argentina, just as in Chile, domestic inflation did not come down as rapidly as the rate of depreciation though for reasons that remain as yet unsettled. The fact that the economy is very closed, via protection, and the persistently large budget deficit must certainly be important elements of any explanation. Figure 1 shows the real exchange rate measured by the ratio of import prices to domestic prices. The Figure brings out the huge real appreciation that took place between 1978 and 1980. Once again disinflation was almost successful: the inflation rate fell from 120 percent in 1978 to only 60 in early 1981, but the system broke down in early 1981 leading to a rapid escalation of inflation ultimately reaching hyperinflation levels in 1985.

The important difference between the Chilean and the Argentine case is the channel through which exchange speculation took place. In Chile's case trade had been utterly liberalized and hence flight into importables was the rule. In Argentina's case, the capital account had been completely opened and hence flight into foreign assets rather than into goods was the rule.

Figure 1
ARGENTINA'S REAL EXCHANGE RATE
(Index 1978-83 =100)

Estimates of the magnitude of capital flight are available from a variety of sources. They can be built up from balance of payments statistics and increases in gross external debt, or alternatively from recorded asset holdings. Table 1 shows estimates of the capital flight from several countries in 1979-82 and the increase in holdings with U.S. banks by nationals of these countries in the form of deposits or securities.

Table 1 Capital Flight and Increases in Holdings With U.S. Banks (Billion $ U.S.)

	Total Capital Flight	Increased Holdings With U.S. Banks
Argentina	19.2	1.9
Mexico	26.5	5.3
Venezuela	22.0	4.6

Source: World Development Report,1985 p.64 and Treasury Bulletin, various issues.

Estimates of the amount of capital flight in Argentina in 1978-82 vary, but $20-25 billion is certainly a conservative estimate.[3] Argentinian residents, fully aware that the real exchange rate overvaluation ultimately had to come to an end fled into dollar assets, real estate in Brazil, Uruguay and the U.S., and into U.S. currency. The capital flight was financed by the central bank's borrowing from abroad and using the proceeds to sustain the tablita against domestic speculation.

The lesson from both the Chilean and the Argentine case is this: if exchange rates are used for disinflation, success requires at least three conditions: first that the monetary and fiscal fundamentals be consistent

[3] See World Bank (1985) p.63-65 and Dornbusch (1985a).

with the exchange rate target. Second, that rather than relying passively on the influence of the exchange rate on inflation, a maximum effort at exchange rate-consistent incomes policy should be undertaken. Third, that the government should actively stand in the way of exchange losses occasioned by speculation in durables or foreign assets. Transitory taxes on durables can separate an open trading system and speculation; free capital mobility, as in the Argentine case, should certainly not be a feature of a stabilization plan. There is not much of a case to be made for free capital outflows from an LDC at the best of times. During stabilization it definitely is not a priority.

Other Experiences

We have singled out the experience of Argentina and Chile because they are particularly clear-cut. But in fact in the period 1978-83 there were quite a few instances of exactly the same policy approach. Mexico allowed her exchange rate to become overvalued in 1980-82 and thus provoked massive imports and capital flight as already shown in Table 1 above. Venezuela and Peru pursued an overvaluation policy with ultimate collapse and so did Israel. In every case the exchange rate was held to decelerate inflation and reap political benefits.

Without exception the policy has ultimately involved fantastic costs because of the large increases in external indebtedness and the massive devaluations that were ultimately required.

2.EXCHANGE RATES AND HIGH INFLATION

In this section we take up the role of exchange rates in experiences of extremely high inflation. Two points are made. First, in a setting of institutional wage setting, accelerating inflation ultimately leads to a shift from backward looking price setting to exchange rate-based price setting. Second, in the stabilization of extreme inflation, fixing the exchange rate may be a strategic measure that establishes immediate support for a drastic program.

The Pazos-Simonsen Mechanism

Institutional wage setting mechanisms often rely on fixed contract length with wage adjustments occurring at specified intervals. The adjustments will be based on the accumulated increase in prices since the last adjustment. A good example is the Brazilian wage mechanism: wage earners receive full compensation for past actual price increases at regular intervals: until 1980 yearly, and since then at 6 month intervals. The interesting question is what happens when the frequency of adjustments increases. This point has been developed especially by Simonsen(1984) and Pazos(1972). It is of interest here because it highlights the characteristics of an accelerating inflation mechanism and the place of exchange depreciation in that context.

With periodic wage adjustments the real wage follows a saw-tooth pattern as shown in Figure 2 below. On the adjustment date the real wage is increased by the cumulated inflation since the preceding adjustment, say 50%. Then, over the adjustment interval it declines as the constant nominal

payments steadily lose purchasing power as a result of the ongoing inflation. As a result, at the end of the adjustment interval, real wages have declined below their period average. The higher the rate of inflation, given the interval of adjustment, the lower the average real wage.

In a system of periodic full, though lagged, indexation the real wage can be cut only by moving to a higher rate of inflation. A once and for all depreciation of the currency immediately raises the rate of inflation and thus erodes existing contracts at a more rapid rate. But the catchup ensures that inflation must be pushed to a higher rate so that there is always some group that is still lagging on the price increases. The same principle applies to removals of subsidies that are undertaken for correcting the budget. Measures undertaken to correct competitiveness or the budget can only be efffective if they achieve a cut in the real wage, but that cut because of full indexation can only take place if inflation is allowed to run at a higher rate. That mechanism often sets the stage for inflation explosions.

Consider a country that requires adjustments in the budget and external competitiveness. Suppose, too, that the government does not have the political force to suspend full indexation. Then the removal of subsidies or exchange depreciation will speed up the inflation rate. Workers who are in the middle of their contracts or three quarters toward the next adjustment find that their real wage falls below what they consider a minimum standard of living. They cannot borrow in perfect capital markets. Hence they will call for a shorter interval between wage adjustments in order to recover the real wage losses imposed by inflation. They will ask

for an advance of what they think they are due. If the economy in fact shifts from say 6 monthly to 3 monthly indexation intervals, as is likely in the case of Brazil today, the inflation rate will simply double.[4] But once the inflation rate has moved to a three month scheme two facts are clear: first, it is exceptionally unlikely that indexation will return spontaneously to a longer interval, even if shocks are favorable. Second, there is nothing that makes the 3 month interval more stable than the 6-month one that was just abandoned. Renewed shocks will shift the economy to even more frequent adjustments and hence to correspondingly higher rates of inflation. At this stage the exchange rate becomes critical.

Pazos (1978,p.92-3) in his seminal study of the inflation process in Latin America has described the dynamics as follows:

> "When the rate of inflation approaches the limit of tolerance, a growing number of trade unions ask for raises before their contracts become due. And management grants them. These wage increases give an additional push to inflation and bring about a further reduction of the adjustment interval. Probably the interval is initially shortened to six months, and then, successively. to three months, one month, one week, and one day. At first the readjustment is based on the cost-of-living index; but since there is a delay of one or two months or more in the publication of this index, it must soon be replaced by another. The best-known and more up-to-date of the possible indicators in Latin America is the quotation of a foreign currency, generally the U.S. dollar"

This description of the inflation process makes one point very clear: the dramatic escalation of inflation, seemingly out of proportion with the disturbances, arises from the endogeneity of the adjustment interval. This is due not so much to the direct impact on inflation of corrective exchange rate or price policies. It rather occurrs because minor

[4]See the discussion in Simonsen (1983) on this point.

increases in inflation, though highly visible as would be a 10% devaluation over and above a PPP rule or a removal of bread subsidies, are the straws that break the camel's back. They lead to an increase in the fequency of wage adjustments, and with that a much higher inflation rate. The endogeneity of adjustment intervals is the mechanism that connects small inflation disturbances with the shift from 50 to 100 inflation, as was the case for example in Brazil in 1980.

Figure 2 shows the real wage in Brazil in 1977-81 as well as the 12-month rate of inflation. Until 1979 readjustments occurred annually, in May. In November 1979 the new Planning Minister, Delfim Neto, increased the frequency of indexation to a semi-annual pace and, at the same time devalued the currency. A very rapid increase in the inflation to well over 100 percent followed without much delay.

The exact modality of the shift to increased frequency will differ from one experience to another: the government may cave in under the impact of a strike, business may find it is easier to give an "advance" on the real wage adjustment rather than risk labor unrest in the middle of a recovery or boom, or a planning minister may want the popularity that comes from a wage policy apparently favoring labor. One way or the other the frequency will increase and once it happens in a large part of the economy it cannot fail to become generalized.[5]

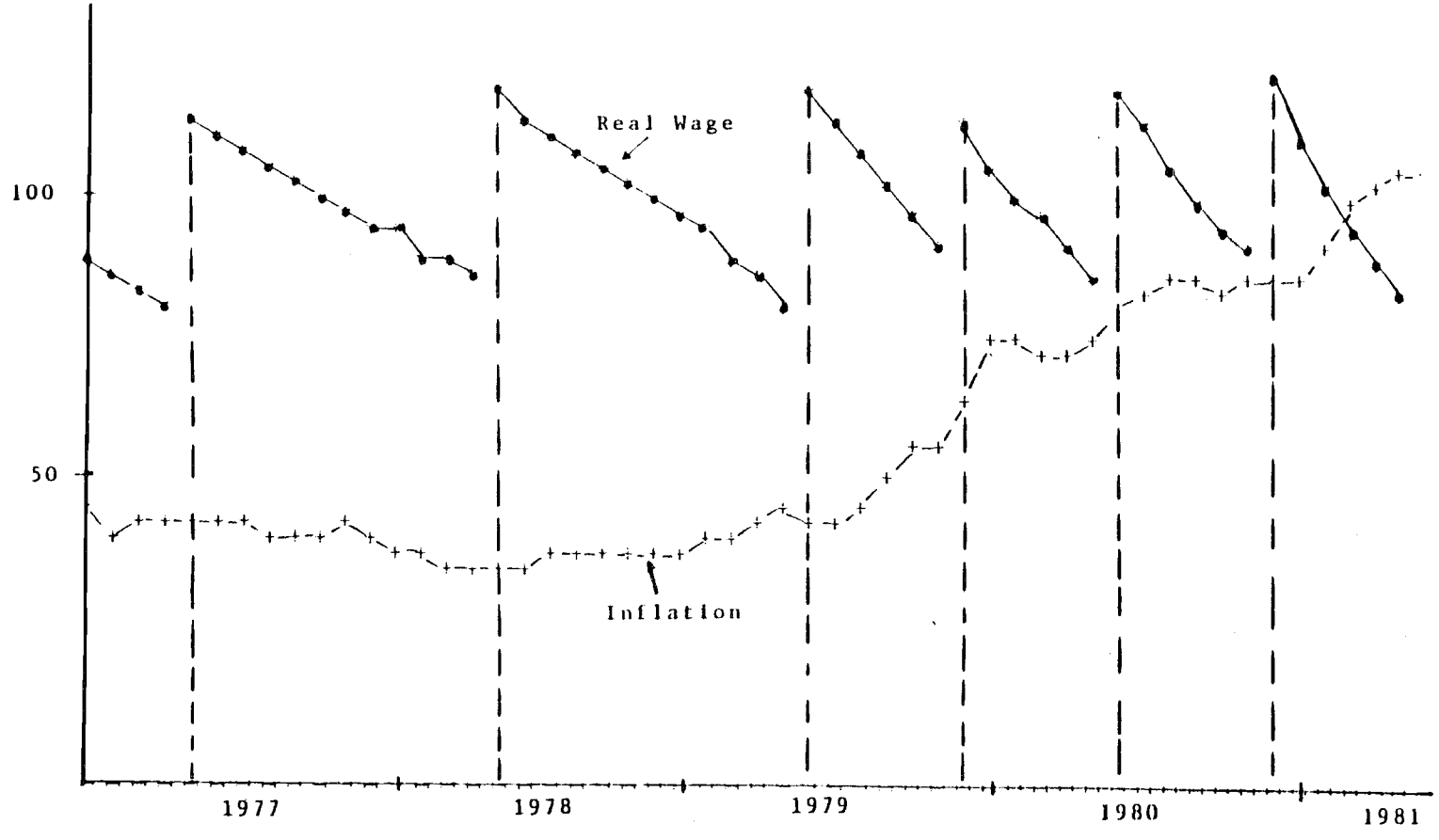
It is immediately clear from the Pazos-Simonsen mechanism that the optimal incomes policy in this context is a policy that monitors above all

[5]It is interesting to note that the dynamics of transition between intervals have in fact not been modelled. Perhaps Schelling's (1978,chapter 3) analysis of group choices placed in a macroeconomic setting might be a start.

Figure 2

THE REAL MINIMUM WAGE IN BRAZIL AND INFLATION

(Real Wage Index 1977-78=100, Inflation in % p.a.)



the frequency of adjustments. An entirely different view emerges with respect to exchange rate and budget policy: even seemingly small corrections, as long as indexation remains full, are a dramatic threat to inflation stability and hence may not be worth undertaking.

Stopping Hyperinflation

Once frequencies have shortened to a weekly or daily interval we are under conditions of hyper-inflation such as was experienced in Central Europe in the 1920s and again in the immediate post-war II period, and more recently in Argentina, Bolivia and Israel. Now the exchange rate comes to play an important role in stabilization.

The case of Germany is perhaps the clearest. In the final month of the hyperinflation, October-November 1923, the inflation rate reached 30,000 percent per month. Prices were adjusted more than once a day to the official exchange rate which in turn was moving more than once a day. In the move to hyperinflation the dollar quotation moved from the financial pages to the front page. It became the central front page feature for the same synchronization reasons as the New York Times displays the the shift from summer to winter time.

But if everyone watches the exchange rate as the signal for setting wages and prices it becomes natural to exploit that signal to synchronize the end of inflation. Fixing the exchange rate outright at 4.2 trillion Reichs Mark to the dollar or 0.8 Australes per dollar becomes a critical first move in bringing inflation to a screeching halt. Of course, exchange rate fixing cannot make up for the need for budget correction. But with

budgets corrected, reliance on credibility of the policy by itself, without further aid, may be taking a needless gamble on the perfect functioning of markets. This is all the more true in that no policy is truly exogeneous: budget corrections work if they turn out to be successful in terms of inflation and not exceptionally costly. If a lack of credibility raises the costs of the disinflationary policy may well go under even if with more favorable performance it could have survived.

The use of exchange rate fixing (and wage-price controls) is therefore a helpful and problably indispensable complement to fiercely orthodox budget correction. Those who argue that the latter is essential and the former redundant or even counterproductive owe evidence for that contention. For the time being they can only claim the properties of equilibrium/perfect information rational expectations models in their support where government policies are modelled as fully exogeneous. The jump from there to policy recommendations is straight off the cliff. It is interesting to note that a commission of experts advising the German government in 1922, prior to stabilization, favored the policy of starting with a fixed exchange rate. The commission included Cassel and Keynes.[6]

There is an important immediate benefit that stems from exchange rate fixing and simultaneous wage-price controls: during high and accelerating inflation, tax indexation and collection can never catch up with the inflationary erosion of government revenue. While high inflation clearly has as its source fiscal problems, it in turn gives rise to fiscal problems via the collapse of the real value of tax collection. Price

[6]See the discussion in Dornbusch (1985a).

stabilization therefore yields an immediate increase in the real value of tax collection and makes an outright contribution to budget balancing even before any new tax laws are even passed. The magnitude of that effect may be on the order of 2 to 3 percent of GDP or even more.

Using a fixed exchange rate as the tool for stabilization of course involves risks. We saw above that exactly this kind of policy led to overvaluation and ultimate instability in Chile or Argentina in 1978-82. Why then recommend it for the stabilization of hyperinflations? One reason why exchange rate pegging may be appropriate is because the fact that the real rate will have depreciated in the period of accelerating inflation. It is not unusual for high-inflation countries to show trade surplusses and corresponding capital exports. The stabilization of the exchange rate, even when domestic inflation still shows a few points, thus can count on this real depreciation as a cushion. But care must clearly be taken not to let the real exchange rate get out of line beyond a narrow margin of something like 10 percent. A safe way to do this is to depreciate at the outset of the program and not allow corrective inflation for a while.

In the German case stabilization was accompanied by a sustained real appreciation and gains in real wages in excess of 30 percent. It is difficult to determine whether the real exchange rate would have been sustainable without the Dawes loans that started a year after stabilization. Real appreciation was similarly a feature in the stabilization of the Austrian Crown and in the Poincare stabilization of 1926. In the Argentinian stabilization of June 1985 a 30 percent depreciation was undertaken as part of the program before the rate was fixed. The low rates of inflation in the

post-stabilization period -- 6.2% for July, 3.1% for August and ??% for September-- are still eroding the initial gain in competitiveness though up to this point a danger threshold has surely not been reached.

3. THE U.S DISINFLATION: 1980-85

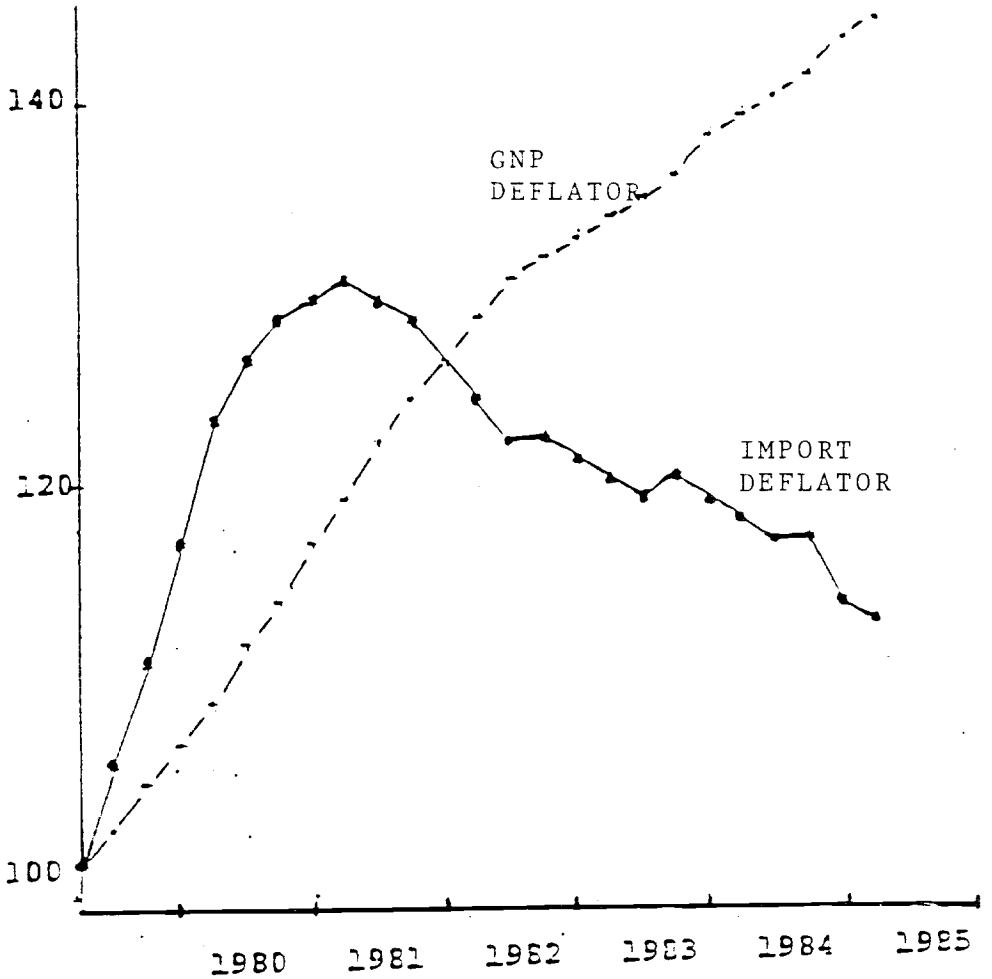
The typical pattern for U.S. inflation is that in a period of recovery inflation comes to exceed the average of the preceding recovery. Measuring the business cycle from peak to peak we find that in each successive cycle the average inflation rate exceeds that of the preceding cycle. This ratcheting upward of inflation, in combination with unfavorable supply shocks, pushed inflation in the 1970s into the double digit range. Since then inflation has declined to a comfortably low level and has remained there even three years into the recovery. The argument to be brought here is that the sharp dollar appreciation has played an important role in the disinflation.

The dollar appreciation which is due primarily to our monetary fiscal mix (or even to bubbles and fads) has helped disinflation through two separate channels: first, it has reduced the nominal prices of commodities and and the real price in terms of the U.S. deflator. Second, the large nominal appreciation of the dollar has reduced foreign firms' costs in dollars and therefore has reduced import prices, and to some extent domestic prices of competing products.

The combined effect of these two channels is quite apparent in Figure 3 which shows the U.S. GNP deflator as well as the deflator for imports. In the period 1979-81 the preceding depreciation of the dollar is

Figure 3

U.S. GNP DEFLATOR AND IMPORT DEFLATOR
(Index 1979:I=100)



still reflected in import price increases that outpace the GNP deflator. But from 1980 on the sharp appreciation of the dollar causes import prices to fall absolutely while domestic prices keep rising. By early 1985 while domestic prices had increased 45 percent import prices were only 13 percent above their 1979 level. In the period 1981:4 to 1985:1, after the dollar appreciation had set in, import prices declined more than 10 percent while domestic prices increased more than 14 percent.

While the magnitude of the disinflation effect is quite apparent, what needs to be spelled out is why movements in the nominal dollar exchange rate should bring about these effects. A strict adherence to PPP would lead us to believe that movements in the nominal exchange rate reflect primarily divergent trends in price levels which in turn are a reflection of divergent trends of monetary expansion.[7] But the vast size of the change in relative prices or of relative unit labor costs of the U.S. and other countries leave no doubt about the fact of a large real appreciation. In what follows we take as given that change in the real exchange rate or in relative unit labor costs and explore its implications.

We first look at the impact of dollar appreciation on the prices of homogeneous commodities. Then we turmn to the question whether dollar appreciation lowers absolutely and relatively the prices of imported manufactures. We also ask to what extent domestic producers reduce their price in response to increased import competion. The section concludes with a discussion of aggregate estimates of the impact of the dollar on inflation in the U.S.

[7]See Dornbusch (1985b) for a review of PPP theory and evidence.

Real Commodity Prices

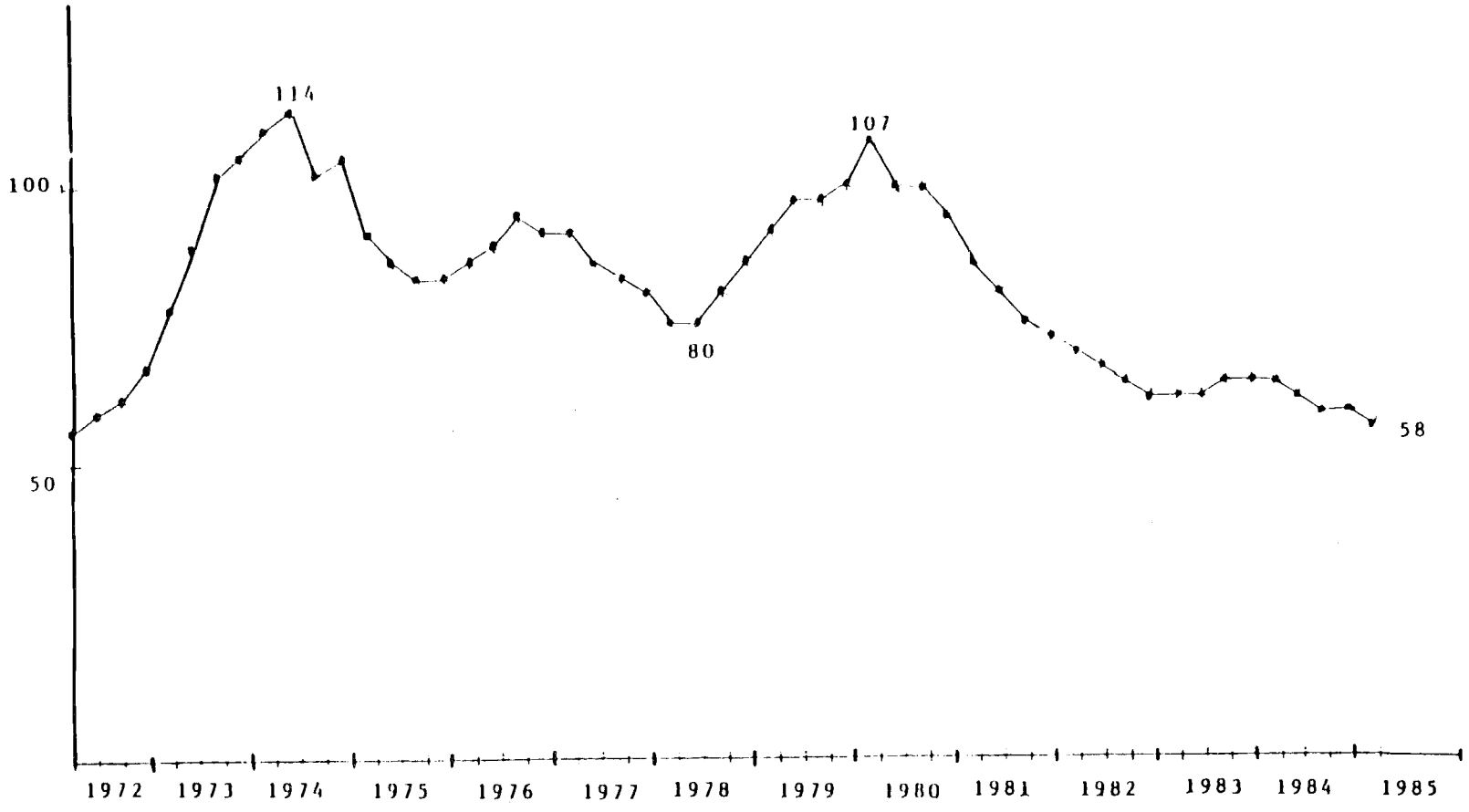
Figure 4 shows the real price of commodities. The real price is measured by the Economist index of non-oil commodity prices deflated by the U.S. GNP deflator. The striking fact is the magnitude of decline in the real commodity price since 1980--46 percent !

Much of the decline in real commodity prices can, in fact, be explained by the behavior of the U.S. real exchange rate. The critical ingredient in the argument is that for commodities, as opposed to manufactures, the law of one price holds strictly. Let q and q* be commodity prices in dollars and in foreign currency. The law of one price then requires that $q=Eq^*$. But the law of one price does not apply to goods in general and hence with P and P* the national price levels measured say by the GNP deflators the real exchange rate $R= P/EP^*$ can change. The question then is what are the links between the recorded change in the U.S. real exchange rate and the decline in the real price of commodities in the U.S.

Consider briefly the argument: suppose the price level (GNP deflator) is given both in the U.S. and abroad. As the dollar appreciates, at unchanged dollar prices of commodities, the price in foreign currencies, say DM, is up in the same proportion as the exchange rate. Since the foreign general price level is given, the real price of commodities abroad has increased and hence foreign demand and thus world demand for commodities is reduced. The equilibrium dollar price, and hence the real price to U.S. users, must decline to restore commodity market equilibrium.

Figure 4

The Real Price Of Commodities
In Terms of the U.S. GNP Deflator
(Index 1980=100)



The argument is readily formalized in terms of the equilibrium condition in the world commodity market. With S the supply and D and D* the U.S. and foreign demands we have:

$$(4) \qquad S = D(q/P,Y) + D^*(q^*/P^*,Y^*)$$

In each country demand depends on the real price and on activity (Y,Y*). Substititing the law of one price, q=Eq*, and the definition of the real exchange rate R=P/EP*, we can solve for the equilibrium U.S. real commodity price:

$$(5) \qquad q/P = J(R,Y,Y^*)$$

From (5) an increase in activity in either of the regions will raise the real price of commodities. This is the well-known cyclical effect on commodity prices. But the real exchange rate of the dollar also appears as a determinant of commodity prices. A real appreciation of the dollar must reduce the real price of commodities. The extent of reduction is a fraction of the real appreciation. The fraction is larger the smaller is the U.S. share in total commodity demand. The exact magnitude depends on the elasticities of demand, but will be a decreasing function of the real exchange rate.

The model of course also yields the nominal price of commodities in dollars by simply writing (5) in the form:

(5a) $q = PJ(R,Y,Y^*)$

In this form it is apparent that commodity prices in dollars follow the U.S. price level trend as measured by the deflator, but with an adjustment for activity and for the real exchange rate. For a given U.S. price level a real appreciation will reduce the price of commodities in dollars.

This very simple model of the determination of real commodity prices performs well in empirical tests.[8] The cyclical effect is strongly present. A one percent increase in world industrial production raises real commodity prices by 2 percent. But an uncomfortable finding emerges with regard to the real exchange rate. The coefficient is, indeed, negative as the model predicts. But it is much too large, being on the order of -1.5 rather than say -0.5. Moreover the estimate is quite precise so that one can reject the hypothesis that the coefficient is a fraction as the model would predict. This oversized impact of the real exchange rate on real commodity prices remains a puzzle. It must be due to an omitted variable or possibly a failure to specify the supply side. But even supposing that the problem were remedied the important finding of a very sizeable impact of the real exchange rate on real commodity prices will stand.

The argument so far has dealt with non-oil commodity prices. But it is clear that exactly the same forces work on petroleum prices even if they are administered. The dollar appreciation has raised the real price to the non-US world and therefore reduced demand. Hence the pressure for the real

[8]See Dornbusch (1985c) for a development and empirical test of this model

price to decline in response to over-supply. This, of course, has been happening in the past few years.

The decline in commodity prices has a favorable effect on domestic inflation. Lower commodity prices reduce costs to firms and hence are reflected in reduced rates of price inflation. They also affect directly inflation via food prices. The index of U.S. crop prices today is at about the 1980 level. While agricultural programs introduce discrepancies between U.S. prices and prices abroad for many commodities, the impact of sharply lower food prices in the world market also weighs on the U.S. price. The reduced rate of food price inflation in turn dampens wage demands and hence contributes to disinflation.

The impact of reduced real prices of commodities, whether food or copper, leaves U.S. producers of these commodities in the same position as LDCs. Relative to prices paid U.S. by farmers crop prices have declined more than 15 percent. The financial difficulties stemming from high interest rates and low real commodity prices for agriculture and agricultural financial institutions are a domestic reflection of the same adverse impact that the strong dollar has in commodity producing LDCs.

Imperfect Competition in Manufactures

The effects of dollar appreciation are particularly interesting in the field of manufactures. Here is where we have to explain why the relative prices of manufactures of the U.S. and her trading partners can move by nearly 40 percent. From the PPP perspective the law of one price would preclude any movement in the relative price except as a result of real

disturbances that call for changes in the equilibrium terms of trade. But even in that perspective the relative prices of close substitutes or even identical goods would not be expected to move appreciably, contrary to what appears to have happened.

Table 2 shows measures of the U.S. loss in competitiveness at a trade-weighted, aggregate level. The two measures are the relative prices of U.S. manufactures and U.S. relative to foreign cyclically adjusted unit labor costs. The two measures tell very much the same story of a massive loss in competitiveness in the period since 1980, much more than offsetting the gains of the preceding period of real dollar depreciation. The magnitude of the change in relative prices and costs reflects the fact that superior foreign wage and productivity performance was reinforced, perversely, by a strengthening of the dollar.

Table 2 U.S. Relative Price and Relative Unit Labor Costs
(Cumulative Percentage Change)

	1976-80	1980-85:1
Relative Value Added Deflator in Manufacturing	-14.7	49.3
Relative Unit Labor Cost	-12.6	59.8

Source: IMF

We can try to make some headway in understanding the impact of changes in relative labor costs on relative prices by assuming a very simple framework: labor is the only factor of production and there are constant returns and firms here and abroad have given unit labor costs in their

respective currencies equal to W and W* respectively. Relative unit labor costs in a common currency are then given by W/EW* and the second row in Table 2 shows how this ratio has moved. We assume markets are geographically separated and for concreteness think of the U.S. market. Competition is imperfect so that each firm is a price setter. But each competes with other firms in the same market. The only thing that sets domestic and foreign firms apart is the fact that the former has unit costs fixed in dollars while the latter has costs that are fixed foreign currency, and hence decline in dollars in proportion to the dollar appreciation. We want to see now what different market structures imply about the adjustment of prices to cost disturbances.

Industrial organization offers a variety of models to approach that question. Two critical dimensions of the problem are the degree of competition and the extent of product homogeneity or substitutablility. The flavor of the analysis is conveyed by two examples: the Dixit-Stiglitz model and the Cournot model. The Dixit-Stiglitz model assumes that there are many firms in an industry, each producing a differentiated product (brands of toothpaste or tires for example). Each firm faces a demand curve for "its" particular brand. Quantity demanded depends negatively on the relative price of the particular variant relative to the average price of the industry. Given the assumption of constant marginal costs and a constant elasticity of demand each firm will set a price that is a constant mark-up over cost. The same applies to foreign firms. Hence the dollar prices set by the typical home and foreign producer are:

(5) $P = kW \quad , \quad P^* = kEW^*$

It is immediately clear from (5) that a change in the exchange rate will leave the price set by home firms unchanged. But dollar appreciation will reduce the price charged by foreign firms in proportion to the dollar appreciation. This model accordingly predicts that dollar appreciation reduces the absolute and relative price of foreign goods in proportion to the movement in unit labor costs.

While domestic firms do not change their price, their relative price does change because prices of all import models come down. Thus home firms experience a leftward shift of their demand curves which leads at unchanged prices to a decline in home output. The same occurs on the export side. Dollar export prices remain constant, but in foreign currencies that means increased prices, an increase in relative prices and hence a loss in competitiveness and sales.

The Cournot model considers a group of oligopolists who share a market for a homogeneous product without colluding. The strategic assumption is that each firm believes assumes the other firms are not reacting to its policy but maintain their sales volume. In equilibrium each firm charges the same price and the market is divided between firms in a manner that depends on their relative costs. Figure 5 shows the impact of a dollar appreciation on the typical foreign firm. The initial equilibrium is at output level Q_o with price P_o. The dollar appreciation reduces marginal cost and hence leads this firm to move to point A', lowering price and raising output. This is

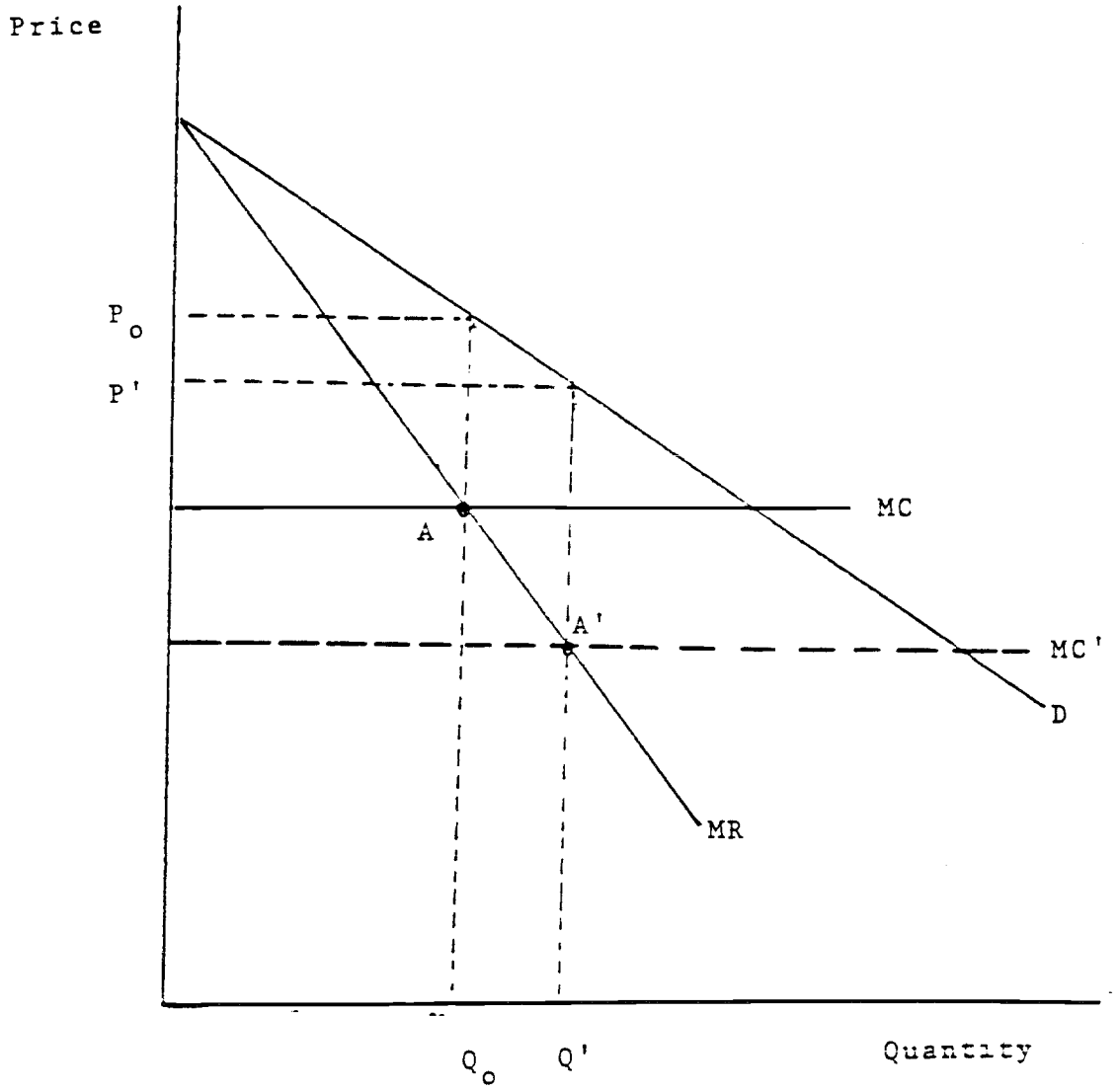


Figure 5

The Response to Cost Reduction

not the end of the story since all other firms will react. Domestic firms at their given output levels now find profits reduced, because of the decline in price and they will cut back production to raise price; foreign firms react in turn.

The equilibrium that results will show a decline in the industry price that is proportional to the appreciation. The factor of proportionality is the product of two fractions: the relative number of foreign to domestic firms and the cost-price ratio in the initial equilibrium, which itself is a measure of the degree of departure from perfect competition. The larger the number of foreign forms relative to the total number of firms and the more competetive the industry (i.e. the larger the total number of firms) the more nearly the exchange rate appreciation translates 1:1 into a fall in dollar prices. But when the market is very uncompetitive or foreign firms are few relative to the total number then the pass through may be only 20 or 30 percent. For example if one of four firms is foreign and the cost-price ratio is 70 percent then a 50 percent dollar appreciation will lower the industry price by only 8.75 percent.[9]

The same model can be applied to the dollar export prices of U.S. firms. For these firms dollar appreciation shifts the marginal revenue curves downward and therefore causes cuts in production and price. With prices of exports and prices in the home market both declining there is no presumption about the change in relative export/import price.

[9]See Dornbusch (1985d) for a development of alternative industrial organisation models in explaining the impact of exchange rates on manufactures prices.

The industrial organization models are highly suggestive of patterns that should be traceable in the data. After all, the U.S. exchange rate experience in 1976-85 has been so extreme as to swamp many of the factors that normally cloud a clear view of industrial structure. Unfortunately there are as yet no good data available to make comparisons of export, import and domestic prices of narrowly defined product groups. But Figure 6 gives an idea of the pattern that is found in looking at the available evidence. Two features are worth noting: First, almost invariably export prices move more nearly in line with domestic prices than with the prices of imports. Second, while home and export prices increase import prices decline absolutely.

These two findings suggest that the Dixit-Stiglitz model captures well the behavior of export prices. The model is also suggestive for imports although here the extent of decline is often quite small. Perhaps the Dixit-Stiglitz model's differentiated products must be put together with more strategic interaction between firms in the manner of the Cournot model to obtain more limited price cuts.

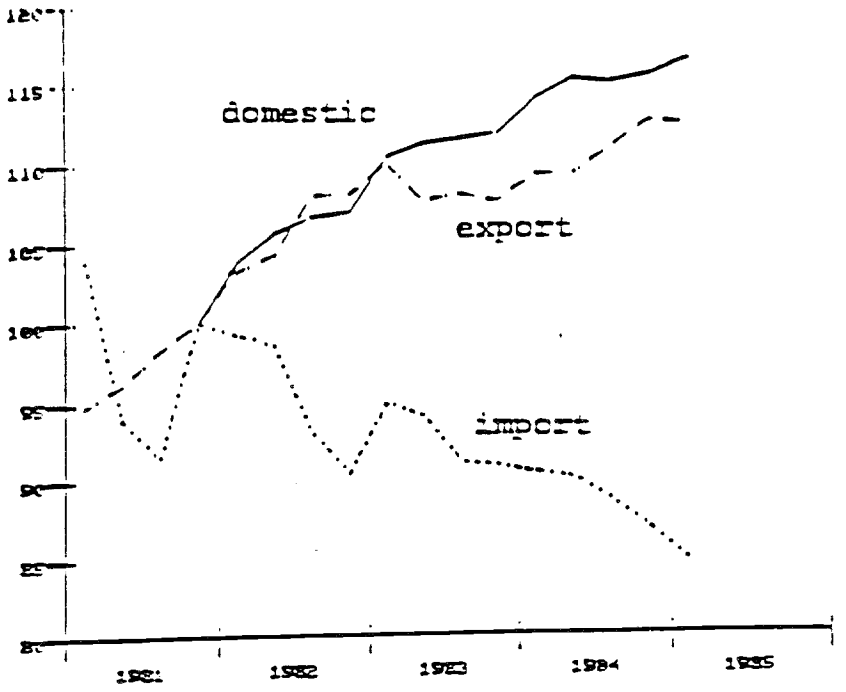
Aggregate Effects

The preceding discussion has spelled out the potential impact of dollar appreciation via commodity prices and via the prices of manufactures. In this concluding section we look at empirical evidence on the inflation impact at the aggregate level.

The recognition of exchange rate effects on inflation in the U.S. context is certainly not new. There is abundant discussion in the literature during the 1950s and again during the 1960s. But with the advent of flexible

Figure 6

Comparative Prices
(Current-Carrying Wiring Devices)



and fluctuating exchange rates the issue became of course more important. The oil price shock highlighted the role of supply disturbances of which the exchange rate is perhaps the most important. As a result macroeconometric models of the U.S. economy include in their inflation equations a place for the exchange rate or at least import prices.

The rule of thumb is that a ten percent dollar depreciation, caused by an exogeneous portfolio shift rather than a policy disturbances, will increase the price level by a full percentage point. The extent of further feedback via wages will depend crucially on the extent to which monetary policy is accommodating. The more accommodating is monetary policy, say via an interest rate rather than a monetary aggregate target, the stronger the additional feedback to inflation from higher wage demands.

More recent work by Dornbusch and Fischer (1984), Woo (1984) and Sachs(1985) has once more assessed the evidence. The important question is whether the exchange rate works only via the direct effect of import prices on domestic prices or whether there are additional effects to reckon with. Any additional effects could of course significantly raise the impact of exchange rate movements on inflation. Woo concluded that there was no evidence of exchange rate effects outside the direct impact on import prices. Specifically he concluded that in manufactures foreign firms price to the U.S. market thus even diminishing the full direct impact on import prices. Most of the action in his view occurs via the reduction in oil and food prices that come about when the dollar appreciates.

Other research finds, on the contrary, important effects that go beyond the earlier estimates. In Dornbusch and Fischer(1984) the exchange rate affects directly the rate of inflation of the consumption deflator but it also affects wage settlements and, via that channel enters the Phillips curve. Table 3 shows the impact of a 10% real appreciation of the dollar indicating the channels and lags.

Table 3 The Impact of a 10% Dollar Appreciation on Wages and the Consumption Deflator

	Direct Effect on Prices	Effect on Wages	Total Effect on Prices
Magnitute (% Change)	-1.25	-1.26	-2.09
Mean Lag (Quarters)	4.03	2.87	n.a.

Source: Dornbusch and Fischer (1984)

The interesting point of Table 3 is that exchange rates appear to affect wage settlements even as of a given rate of unemployment. The argument must be that firms exposed via overvaluation to foreign competition are in a better position to exert wage discipline. Conversely following an episode of real depreciation the need for wage discipline is less plausible. The presence of this wage effect of course increases significantly the size of the exchange rate impact since wages have large coefficients in the price equation. Note that these estimates do not include the third round effects of increased price inflation feeding back to wages which would yet further raise the esimates.[10]

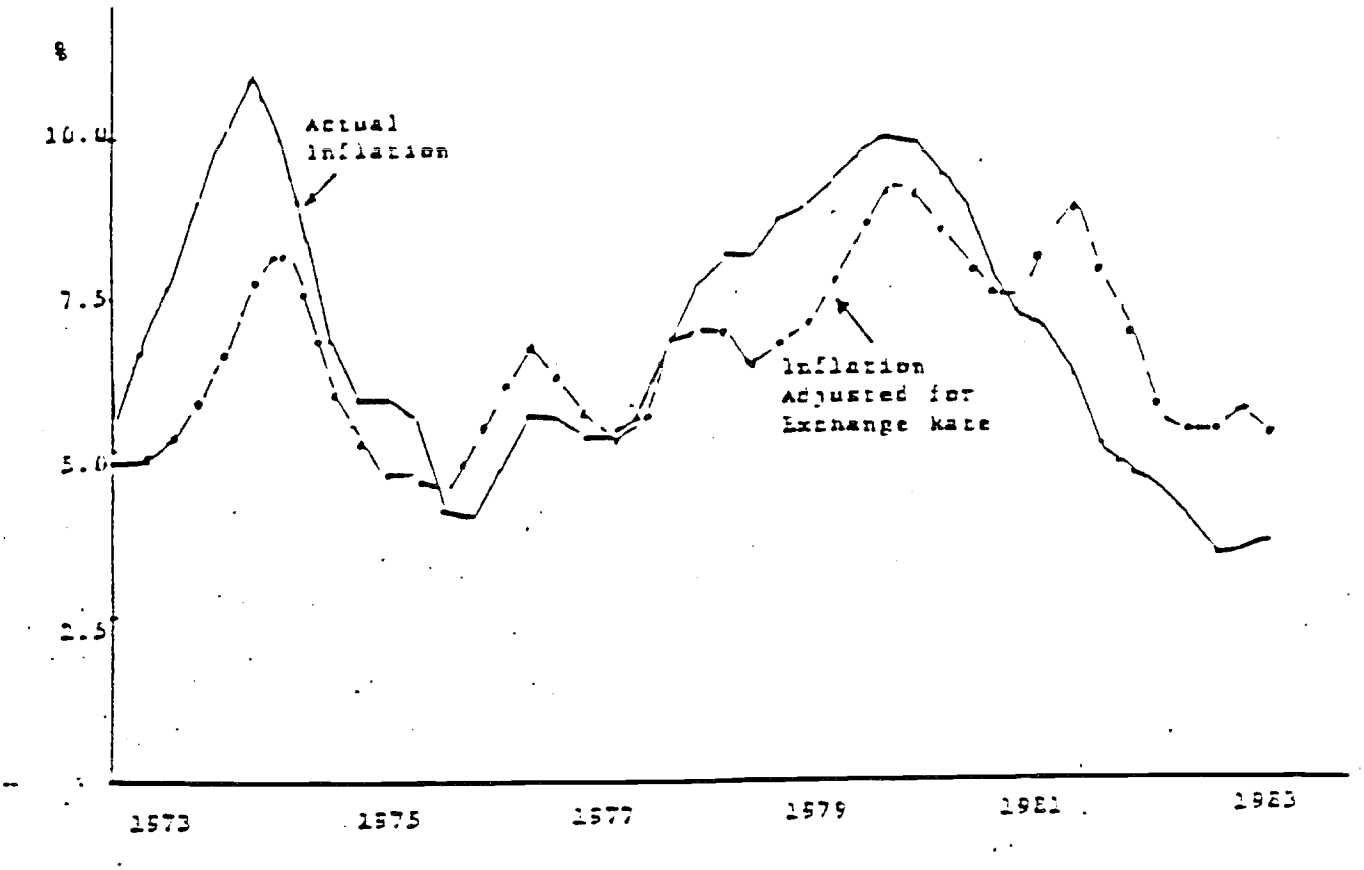
[10]Sachs (1985) considers these effects and finds that in the total cumulative slowdown of inflation in 1981-84 of 6.2 percent the exchange rate accounts for between 1.9 and 2.8 percent.

There are very few periods of major change in the exchange rate, and these episodes coincide with large changes in commodity prices and oil prices, in part by accident, but in part for the systematic reasons already explored. At the same time the U.S. wage-price process has been changing by a weakening of unions. The combination of these circumstances makes it exceptionally difficult to decide what exactly the inflationary impact of dollar appreciation and depreciation is. The divergence in estimates from different approaches reflects the fact that the data cannot be made to reveal a simple, sturdy message. But even so it is worthwhile looking at Figure 7, which shows an estimate of the inflationary impact of exchange rate movements in the U.S. economy using the estimates reported in Table 3.

It is apparent from Figure 7 that the three episodes of large movements in the dollar 1970-73, 1976-80 and 1980-83 are identified with a significant dollar effect in raising inflation in the first two and reducing it in the last one. The Figure of course immediately draws attention to the fact that if our disinflation is "borrowed" by overvaluation then it must be paid back in the course of real depreciation which now has set in. Accordingly wage and price inflation should be expected to speed up at each level of unemployment.

The uncertainty about the quantitative effect of exchange rates in influencing prices extends to the question of the impact of the depreciation now under way on U.S. inflation. Specifically, is it likely that inflation will be driven back up to near 10 percent as was the case in the large depreciation of 1976-80? There are several reasons why this is unlikely, though not impossible. The first is that one should not expect as strong a

Figure 7
The Impact of Exchange Rates
on U.S. Inflation



decline in the dollar. The 1980 level was an all-time low and a decline to that level would certainly interfere in a major way with our inflation objectives and Europe's concern with unemployment. The second reason is that both in the labor market and in commodity markets conditions are more favorable. Not all of the decline in real commodity prices is due to the strong dollar (remember, we noted an oversized effect in the estimates above) and hence need be paid back. Furthermore, the sharply reduced role of unions rules out a major wage offensive in the wake of a depreciation. These factors lead to the judgment that the impact on inflation of the dollar depreciation to say the 1982 level is on the order of 2-2.5 percent. This moderate effect is in large measure conditioned on a limited, gradual decline of the dollar. For a large dollar collapse, although the data cannot support the judgment, a really sizeable inflation bout is certainly likely.

But even though the inflation impact is judged to be minor there will, of course, be significant changes in relative prices and in the terms of trade. The real appreciation has raised the standard of living via strongly improved terms of trade and much of that must be given up. The terms of trade will improve for agriculture and business will improve for manufactures. The loser will be services.

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