

# The Exchange Rate and Domestic Inflation

The value of the American dollar, measured as a weighted average against the currencies of our major trading partners, fell 12 percent between the first quarter of 1977 and the last quarter of 1978. During the same span, the rate of change in consumer prices—measured by the percentage change in the consumption deflator from four quarters earlier—rose unevenly from just over 5 percent to over 8 percent per annum. The coincident fall of the dollar and surge of prices in the United States raise several important questions. How much has the depreciation contributed to the acceleration of domestic inflation? What has been the timing of the inflationary impact of the depreciation? What are the principal channels through which the depreciation has raised American prices?

The relationship between the exchange rate and domestic prices is influenced by a variety of factors, including economic conditions here and abroad, the response of policymakers to fluctuations in the exchange value of the dollar, and expectations of future economic and political events. These considerations greatly complicate efforts to measure the inflationary impact of a depreciation. For example, it is difficult to

This article summarizes a recently completed study of the inflationary impacts of fluctuations in the exchange rate. The complete work is available from the author upon request. For an excellent survey of research done on this topic, see Peter Hooper and Barbara Lowrey, "Impact of the Dollar Depreciation on the U.S. Price Level: An Analytical Survey of Empirical Estimates", Board of Governors of the Federal Reserve System, International Finance Discussion Papers, No. 103 (April 1979). The author would like to thank Hooper and Lowrey for helpful comments made during the preparation of this article.

estimate how much members of the Organization of Petroleum Exporting Countries (OPEC) raise prices in response to a depreciation, or to separate the inflationary impact of a depreciation from the depressing influence that expectations of United States inflation can have on the exchange rate. Statistical techniques, however, are useful in obtaining estimates of the approximate measurable contribution of the rise in domestic prices made by the decline of the dollar that occurred in 1977 and 1978. These estimates suggest that the 12 percent depreciation ultimately will raise consumer prices in the United States by about 2½ percent. Roughly two thirds of this increase had occurred by the second quarter of this year.

**The dollar and domestic inflation during the recovery**  
Fluctuations of the dollar on the foreign exchange markets can be summarized in a composite index, representing a weighted average of the dollar's rate of exchange against selected major foreign currencies. The weight assigned the currency of any country typically reflects the relative importance of that country in international transactions.<sup>1</sup> The measure used here is a geometrically weighted average of indexes of the value of the dollar against the currencies of ten major industrial countries. The weights reflect each country's share of the total volume of bilateral capital

<sup>1</sup> Such summary measures can vary both in coverage and in weighting procedures, depending on the use for which the index is intended. A good discussion of these issues is presented by Peter Hooper and John Morton, "Summary Measures of the Dollar's Foreign Exchange Value", *Federal Reserve Bulletin* (October 1978), pages 783-89.

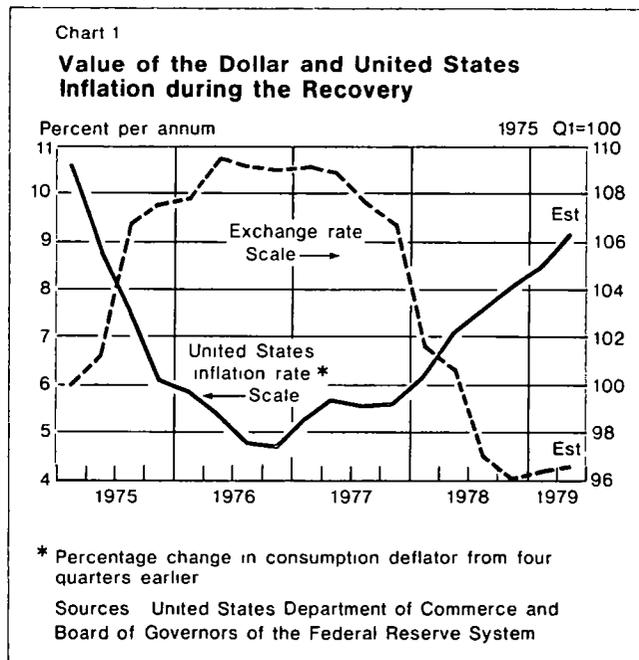
and trade flows between the ten countries and the United States<sup>2</sup>

From early 1975 through the end of 1976, the dollar rose roughly 9 percent (Chart 1) This overall strengthening occurred despite some well-publicized losses of the dollar in 1976 against the Japanese yen, the West German mark, and the Swiss franc These latter depreciations were more than offset by the appreciation of the dollar against the currencies of several of our other major trading partners, including Canada, the United Kingdom, France, and Italy

The year 1977 marked a turning point for the dollar. While the dollar continued to fall against the yen, mark, and Swiss franc, these depreciations were no longer countered by appreciations against other currencies With the exception of the Canadian dollar, nearly all major currencies gained against the American dollar in late 1977 and 1978 By October of last year, the dollar was down over 12 percent from its peak of 1976

On November 1, 1978, President Carter announced a major new effort, in coordination with the authorities of several other industrial countries, to correct the decline of the dollar The program featured a tightening of monetary policy and the mobilization of foreign currency resources totaling up to \$30 billion to finance the United States part in coordinated exchange market intervention The initiatives were successful in halting the dollar's slide, and in the following months the weighted exchange rate rose significantly for the first time in two years.

While the dollar gained in 1975 and 1976, the rate of change in consumer prices—measured by the percentage change in the consumption deflator from four quarters earlier—fell rapidly from over 10 percent to just under 5 percent (Chart 1) Shortly after the dollar peaked in 1976, the inflation rate began moving upward, although unevenly, approaching 6 percent in late 1977 Then, as the depreciation quickened in 1978, the rate of increase in consumer prices jumped quickly



to over 8 percent and accelerated further during the first half of 1979.

The channels by which a depreciation affects domestic prices are numerous, and their importance varies with economic conditions here and abroad as well as with expectations of future economic and political developments Therefore, before considering estimates of the inflationary impact of the depreciation, it is useful to discuss the major linkages between the exchange rate and the domestic price level

#### Depreciation raises the price of imports

As the dollar depreciates, foreign costs of production rise when measured in terms of dollars The resulting squeeze on earnings from goods sold to the United States tends to induce foreign producers to boost the dollar price of their exports. Viewed from an American perspective, the depreciation raises the price of our imports unless foreign suppliers absorb the cost of the depreciation through reduced profitability

It is likely, however, that import prices will rise by less than the full amount of the depreciation Buyers here may resist the higher priced imports by reducing their purchases of foreign products. If the American market for these products constitutes a major share of the worldwide market, the softening of demand in the United States could discourage foreign suppliers from posting proportionately higher prices. The inducement not to boost prices is heightened if foreign

<sup>2</sup> The currencies (and weights) are Belgium (055), Canada (251), France (085), Italy (068), Japan (160), the Netherlands (061), Sweden (028), Switzerland (028), the United Kingdom (104), and West Germany (160) This exchange rate, along with other data used in this study, is taken from the data base of the MIT-Pennsylvania-Social Science Research Council (MPS) quarterly econometric model of the United States economy One advantage of this data source is its consistent construction of summary indexes of foreign economic activity that are useful in estimating linkages between the exchange rate and domestic prices When evaluating the impact of a depreciation on domestic prices of goods and services, however, it may be conceptually inappropriate to use an exchange rate with weights based on trade and capital flows Nevertheless, empirical experimentation with other aggregate measures of the exchange rate suggests that the choice of index fails to alter significantly the estimated impact on domestic prices of the dollar's recent depreciation

producers already face slack demand. For example, although the United States economy expanded strongly following the last recession, other major industrial nations recovered sluggishly. The continued excess capacity abroad in 1977 and 1978 spurred foreign producers to extra efforts to supply goods at competitive prices to the American market despite the depreciation of the dollar.

Expectations of future movements in the exchange rate can also temper efforts by foreign exporters to pass through the cost of a depreciation. If the depreciation is considered temporary, foreign suppliers may prefer to hold prices constant and tolerate a period of reduced profitability rather than risk losing their market share and jeopardizing relationships with American importers by raising prices with each dip in the exchange rate. Indeed, many foreign suppliers contract with domestic firms to reduce the impacts on costs of short-term fluctuations in the dollar. An example is the contract between one American electronics corporation and its Japanese supplier. Each year, the parties set a "bench-mark" exchange rate of the dollar against the yen. If the market exchange rate fluctuates within 5 percent of the bench-mark value, the firms continue to conduct their transactions at the bench-mark rate. If fluctuations are in excess of 5 percent, the companies split losses (that otherwise would have been borne in full by one or the other) until the contract is renegotiated to reflect newly established expectations regarding the value of the dollar.<sup>3</sup> This and other similar types of arrangements delay the full response of import prices to a prolonged depreciation, thus slowing the timing of the inflationary impact of the dollar's decline.

Such agreements are also common in the trade of raw materials, where procurement contracts often are written at fixed prices valid over extended periods. A special example is imported oil, most of which is produced by members of the Organization of Petroleum Exporting Countries (OPEC). The price of OPEC oil is an administered price set by the cartel in dollar terms. Consequently, the price of imported oil is not subject to immediate pressure arising from fluctuations in the exchange rate. In the long haul, however, OPEC nations raise oil prices at least in part to recoup purchasing power lost to the dollar's depreciation.

These caveats notwithstanding, import prices do climb following a depreciation, raising consumer prices here through two channels. First, increases in the prices of imported consumer goods are reflected directly in

consumer prices in the United States. For example, the prices of Japanese and European automobiles climbed steadily in 1977 and 1978 as the dollar depreciated. Second, American firms that rely on imported materials will attempt to pass through to prices the rising cost of supplies. Their ability to do so is, of course, limited by resistance of consumers to higher prices. It can also be weakened by the presence of slack demand. The latter consideration was of diminishing importance during the dollar's two-year decline, since by the end of 1978 the rate of capacity utilization in the United States was not far below the peaks experienced in 1973 and 1974.

#### **Demand-induced increases in domestic prices**

An additional major impact on the price of domestically produced goods is transmitted through the demand side of the economy. Many American goods and services compete with foreign products in the world's marketplaces. When the dollar depreciates, the dollar price of foreign goods rises relative to the price of domestically produced substitutes. Our imports tend to fall as Americans switch from the now more expensive foreign goods to American products; our exports tend to rise as foreign purchasers do the same. Consequently, the demand for domestically produced items increases.

In competitive sectors of the economy where prices are determined by the forces of supply and demand, the prices of domestically produced goods and services normally will be bid up as demand shifts toward United States markets. Such price increases may occur only with a lag because buyers here and abroad do not immediately switch to the relatively less expensive American goods. Many may be bound by previous contractual agreements to purchase foreign products; others may find it impractical to interchange foreign and domestic equipment in the short term. However, in sectors where American producers exercise some power in setting prices, price hikes may occur with little delay as firms here raise prices in anticipation of the shift in demand toward domestically produced goods and services. This apparently was the case in the auto industry where, in 1977 and 1978, the prices of small domestic models rose as the dollar declined and the prices of similarly sized imported cars climbed.

In addition, the extent of demand-induced increases in domestic prices depends on the ability of domestic producers to expand supplies. In some areas of manufacturing, production can be stepped up sufficiently to meet the increased demand at unchanged prices—although it does become increasingly difficult to do so as plant and equipment are more fully utilized. In

<sup>3</sup> This example was reported in "Dollar's Long Decline Snarls Trade Patterns but Effect Isn't All Bad", *Wall Street Journal* (August 4, 1978), page 1

other industries, such as agriculture and various raw materials, supplies often cannot be increased significantly in the short term. Consequently, prices of these commodities can prove sensitive to the exchange rate and may rise rapidly following a depreciation. In some instances the problem can be exacerbated by government policies designed to alleviate other difficulties. This apparently was true in agriculture. Acreage "set-aside" programs were activated in 1978 to boost farm incomes by restricting grain output just as the depreciation provided greater incentives for United States agricultural exports

### **The effects of portfolio shifts on prices**

One characteristic that distinguishes the dollar from other currencies is its continued use throughout the world both as a unit of account and as a store of value. A sizable part of all financial assets (and liabilities) is denominated in dollars, and the bulk of international reserves is still held in dollars by private individuals and foreign officials. Given the role of the dollar as the world's major currency, changes in the value of the dollar can have substantial wealth effects. Consequently, uncertainty over the dollar's future value may cause investors to prefer holding assets other than dollars.

One possible alternative is tangible goods such as raw materials and other commodities thought to be a safe store of value. If investors switch from dollar-denominated assets to tangibles, the prices of these commodities, which typically are determined in a worldwide market, are bid upward. Therefore, the shift by investors to tangibles imparts additional inflation to the United States economy

The volume of dollar assets held by foreigners is large enough that even a small change in views on the desirability of holding dollars may have a substantial impact on commodities prices. This may have been the case in 1978. The uncertainty that characterized foreign exchange markets during the dollar's sharp depreciation increased the perceived risk of holding dollar-denominated assets. A resulting switch by investors from dollars to tangibles appears to have contributed to a new surge in the dollar price of commodities, particularly raw materials.

### **Wage effects**

An additional impact of the depreciation occurs when the initial round of higher prices induces workers to attempt to recoup their lost purchasing power by demanding higher wages. In unionized sectors these forces are often institutionalized by the provision in labor agreements of cost-of-living escalators (COLAs) or "reopener" clauses.

Additional pressure on wages is also created in industries that compete with foreign producers. Following a depreciation, as our exports rise and our imports fall, domestic firms experiencing increased demand for their goods need additional manpower to expand production. If the unemployment rate is low and there is not a ready supply of qualified workers, employers in the expanding sectors may have to offer wage increases in excess of the general rise in prices to attract the requisite number of extra workers.

The response of wages to prices is not immediate. It may take considerable time for employers and employees to realize the full extent of the rise in prices following a depreciation. Many COLAs are subject only to annual reviews, and most do not compensate workers entirely for an increase in consumer prices. In these cases, full adjustment might not be completed until the existing contract expires and another can be negotiated to reflect the newly established price level.

These upward wage adjustments put additional upward pressure on prices as businesses attempt to recoup the rising costs of production by raising prices. Therefore, the depreciation can trigger several rounds of price increases that continue long after the exchange rate stabilizes. Furthermore, the series of wage and price increases may generate expectations of continued inflation that, by undermining confidence in the future value of dollar-denominated assets, can depress the exchange rate further and thereby augment the inflationary effects of the initial depreciation.

### **Factors offsetting the inflationary impact of the depreciation<sup>4</sup>**

Several factors tend to offset the inflationary effects of a depreciation. For example, the magnitude of inflationary effects generated by a falling dollar also depends importantly on the response of the monetary authorities to the depreciation. As domestic prices rise following the dollar's decline, the demand for money increases since more balances are required to conduct transactions at the higher price level. If the Federal Reserve does not permit the money stock to grow rapidly enough to meet fully the additional demand, interest rates in the United States will rise. This tightening of monetary policy works to check the increase in aggregate demand for domestic goods that stems from the depreciation and, consequently, eases pressure on United States prices. Furthermore, if interest rates in the United States rise following the depreciation, investors are induced to reduce their holdings of assets denominated in foreign currencies and to in-

<sup>4</sup> The following discussion draws heavily from Hooper and Lowrey, *loc cit*

crease their holdings of dollar-denominated claims. The resulting flow of capital toward the United States bids up the exchange rate and, through the channels outlined above, partly offsets the inflationary impact of the initial depreciation.

The dollar's decline has precisely the opposite effects abroad that it does in the United States. As American products become more competitive worldwide, demand for foreign products slackens and our exports become cheaper in terms of foreign currencies. As a result, foreign prices decline (or rise more slowly). This moderation in foreign prices affects domestic prices as would an appreciation of the dollar, and therefore can counter the inflationary impact of the initial depreciation. This offset depends, however, on the response of foreign governments to the appreciation of their currencies. If governments abroad attempt to insulate their economies from the retarding effects of the dollar's depreciation by pursuing expansionary policies, foreign prices may continue rising.

#### **Limitations of the statistical analysis**

Statistical techniques can be used to uncover the historical relationship between the exchange rate and domestic prices. However, the difficulty of capturing in a statistical model the entire complex of factors discussed above mandates several simplifying assumptions that, while rendering the following empirical analysis tractable, also subject estimates of the inflationary impact of the depreciation to a degree of uncertainty. For example, current techniques preclude accurate measurement of the response of producers and purchasers to uncertainty in the foreign exchange market. It is difficult to capture adequately the effects that changing expectations can have on commodities prices through shifts in the composition of investors' portfolios.

In addition, the statistical analysis abstracts from the moderating influence that the depreciation might have on foreign prices. This simplification tends to result in overestimates of the inflationary impact of the depreciation. On the other hand, the relatively short period of time over which OPEC nations have administered their oil prices makes it difficult statistically to relate OPEC pricing decisions to the exchange value of the dollar. Therefore, it was initially assumed that oil imports do not rise in price following a decline of the dollar. This simplification tends to result in underestimates of the inflationary impact of the depreciation, the extent of which is discussed below.

Another important problem is caused by the fact that, not only does a depreciation raise domestic prices, but domestic inflation—or, more properly, expectations of domestic inflation—can depress the exchange rate. Consider, for example, a jump in the expected rate

of inflation in the United States. To protect themselves from the anticipated decline in the purchasing power of dollar-denominated assets, investors will increase their holdings of assets denominated in foreign currencies and reduce their holdings of dollar-denominated claims. Therefore, the expected worsening of domestic inflation is reflected quickly in a decline of the dollar. If, however, inflation in the United States subsequently does increase as anticipated, the surge in domestic prices might mistakenly be attributed entirely to the earlier depreciation when in fact the causality runs in both directions. This type of error leads to an overestimate of the inflationary impact of a depreciation. Attempts were made to correct for this relationship, but such efforts are hindered by the inability to measure accurately inflationary expectations.

#### **Estimated impacts of a once-and-for-all 12 percent depreciation**

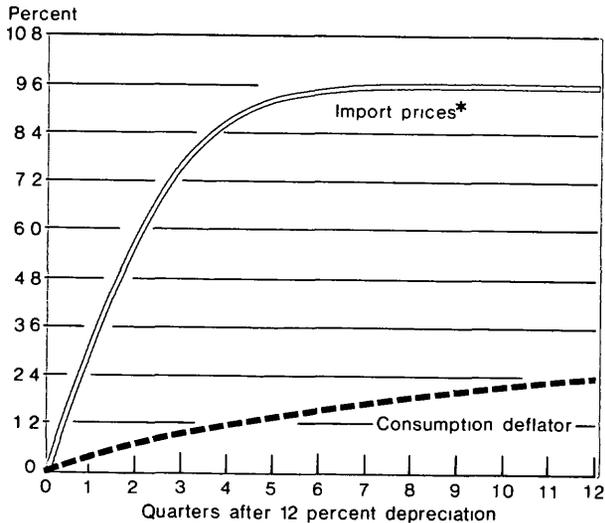
Despite their limitations, statistical techniques can be useful in estimating the importance of many of the linkages between the exchange rate and domestic prices. These estimates can then be used to investigate the approximate magnitude and timing of the impact on domestic prices of a dollar depreciation. Consider, for example, the estimated effects of a once-and-for-all 12 percent depreciation—a decline of the same magnitude actually undergone by the weighted exchange rate in 1977 and 1978. The findings, depicted graphically in Chart 2, assume that the response of domestic policymakers to the induced increase in the demand for money following the depreciation is typical of those in the past. That is, the Federal Reserve does not permit the money stock to grow rapidly enough to accommodate fully the heightened demand for money balances at existing interest rates. Hence, yields rise, choking off part of the increase in aggregate demand and easing upward pressure on prices.

Immediately following the 12 percent depreciation, the price of nonfuel imports starts rising and in just more than one year stabilizes at a level roughly 9½ percent higher than otherwise would have obtained. The less than proportionate increase is attributable mainly to the variety of moderating influences on import prices suggested in the earlier discussion.<sup>5</sup>

<sup>5</sup> An additional technical reason is that the price index for imports covers imports not just from the countries included in the weighted exchange rate. Therefore, if currencies of some of our lesser trading partners do not appreciate against the dollar along with the major currencies, not all import prices are subject to upward pressure. Consequently, the aggregate index of import prices may rise by less than the dollar's decline even if the price of goods and services imported from our major trading partners do rise proportionately.

Chart 2

Following a 12 percent depreciation, import prices rise quickly by roughly 9.5 percent while consumer prices rise more slowly by about 2.4 percent.



\* Excludes petroleum imports

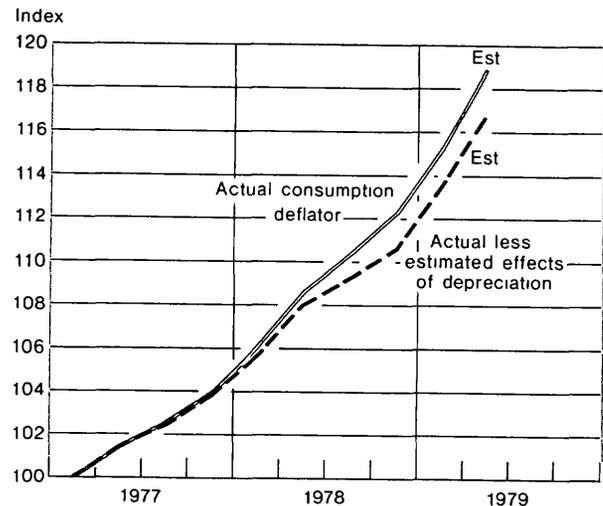
Rapidly rising import prices help push the consumption deflator up by roughly 1.2 percent in the year following the depreciation. After import prices stabilize at higher levels, consumer prices keep climbing but at a slower pace because only the shift in demand toward American products and rising wages continue to exert upward pressure on domestic prices. In two years the cumulative impact on consumer prices reaches 1.7 percent; in three years it approaches 2.4 percent.

How do these results compare with the conclusions of other studies? In a recent study, Peter Hooper and Barbara Lowrey compared the findings of a large number of researchers.<sup>6</sup> Standardizing the results of earlier papers where possible, they concluded that a 12 percent depreciation ultimately raises domestic consumer prices by 1.8 to 2.4 percent in two to three years. Therefore, the results presented here appear representative of findings generated both within the Federal Reserve System and elsewhere

<sup>6</sup> Hooper and Lowrey, *loc cit*

Chart 3

The dollar's slide in 1977 and 1978 has added roughly 1.7 percent to the level of consumer prices since the first quarter of 1977.



Source Actual figures are from the United States Department of Commerce

### Inflationary impacts of the dollar's depreciation of 1977 and 1978

The dollar's 12 percent depreciation was actually distributed over two years. Nonetheless, the same statistical model employed to generate the results discussed above can be used to estimate the impact on consumer prices of the dollar's depreciation in 1977 and 1978. This is done by comparing the actual course of the consumption deflator after 1976 with an estimate of the path consumer prices would have followed had the weighted exchange rate remained at the level attained in the first quarter of 1977 (Chart 3). As expected, the level of consumer prices is higher than would have been the case in the absence of depreciation. By mid-1979, the dollar's cumulative 12 percent decline had raised the consumption deflator by 1.7 percent. However, since the depreciation was spread over two years, delayed inflationary effects could push domestic prices up another 7/10 percentage points over the next two years.

The estimated impact of the depreciation on the level of consumer prices may seem relatively unimportant, particularly because it is distributed over several

years. However, when presented in terms of the rate of change in consumer prices, the results are more striking. The above estimates suggest that in the last half of 1978, following the dollar's sharp losses against a broad spectrum of foreign countries, the impact of the cumulative depreciation on the annual rate of increase in the consumption deflator reached 1.4 percentage points. This differential began narrowing in 1979 as the dollar rebounded.

As noted earlier, these results are based on the assumption that any increases in OPEC oil prices after 1976 have not been in response to the dollar's depreciation. An alternative assumption is that OPEC matches the depreciation with a proportionate price increase. That is, part of past and scheduled rises in the price of OPEC oil reflects a 12 percent hike in response to the dollar's decline. Estimates suggest that a once-and-for-all 12 percent increase in the price of OPEC oil initially raises the consumption deflator by roughly  $\frac{1}{4}$  percentage point. Subsequently induced wage increases put further upward pressure on consumer prices, bringing the total impact of the OPEC response to about  $\frac{4}{10}$  percentage point. Under these assumptions, the estimated impact on domestic consumer prices of the dollar's 12 percent depreciation reaches 2.8 percent.

### **The outlook**

What does the analysis tell us about the prospects for the coming year? One important result is that the inflationary impact of a depreciation is spread over several years. Thus, we will continue to feel in 1979 additional inflationary pressure generated by the prolonged slide in the dollar that occurred in 1977 and 1978. This delayed response, attributable in part to the continued shift in demand toward American goods, could boost consumer prices an additional  $\frac{3}{4}$  percent this year, or even more if increases in OPEC prices are interpreted as a response to the depreciation.

On the other hand, since November 1978 the weighted exchange rate has climbed, mainly on the dollar's strength against the yen. This appreciation, by rendering foreign goods relatively less expensive, should diminish incentives to switch to American products and therefore, after a period of adjustment, contribute to the easing of demand pressures in the United States economy. Furthermore, although the appreciation may not lead to an outright decline in import prices, it should help forestall further increases by reducing the dollar costs of foreign exporters. Thus, the recent appreciation should help offset the lingering inflationary impact of the dollar's weak performance in 1977 and 1978.

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