Prices, Profit Margins, and Exchange Rates

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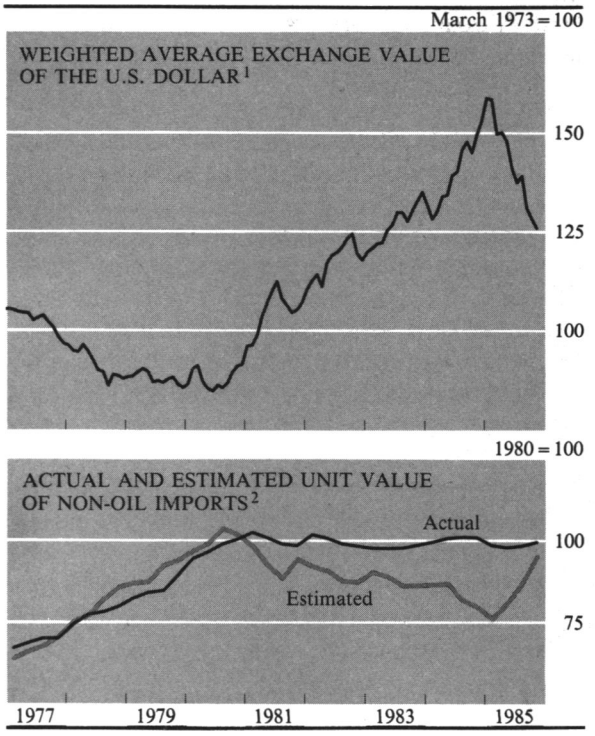
The decline in the exchange value of the dollar over the past year or so has had important implications for the outlook for the U.S. current account balance and domestic inflation. The relationship between changes in exchange rates and changes in import and export prices, known as the "pass-through" relationship, has been relatively stable historically. But recent changes in the pattern of U.S. trade, the unprecedented appreciation of the dollar during the first half of the 1980s, and the volatility of bilateral exchange rates may affect at least the speed of the pass-through of exchange rate changes to import and export prices, and possibly the long-run relationship as well. The top panel of chart 1 shows the significant movements over the last nine years of the foreign exchange value of the dollar measured in terms of a multilateral trade-weighted index of the currencies of the other Group of 10 countries.[1] The bottom panel shows the actual unit value of non-oil imports and an estimate of that unit value based on a long-run historical relationship between exchange rates and import prices. The historical relationship suggests that non-oil import prices should have risen faster during 1985 than they did. This raises several questions: Are the profit margins of foreign suppliers being squeezed in the short-run? Is the long-run pass-through relationship changing?

This article reviews both aggregate macroeconomic evidence on how changes in the value of the dollar affect overall U.S. export and import prices, and disaggregated microeconomic evidence, including the behavior of prices and profit margins, for a number of individual industries. Examining industry-specific behavior may help illuminate some of the empirical regularities of the aggregate pass-through relationship. Throughout the analysis, the period of depreciation in the dollar from 1977 through 1980 is contrasted with the period of appreciation from

1. Index of the exchange rate and actual and estimated import prices



1. Weighted average against foreign G–10 countries using total 1972–76 average trade shares.
2. Estimate based on the multilateral trade-weighted consumer price index and a contemporaneous 60 percent pass-through of exchange rate changes.

1. This index, which includes the currencies of Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, and the United Kingdom, is a convenient summary statistic for the dollar's average performance. However, movements in bilateral exchange rates may be more significant in determining trade in particular products because often only a few countries account for the bulk of the source of imports or the destination for exports. Moreover, certain key importers, such as the Asian newly industrialized countries and Brazil, more or less peg the value of their currencies to the dollar. The movements in these bilateral rates often are quite different from that of the G-10 rate.

1981 through early 1985. Comparing these two periods may reveal some consequences of the current depreciation of the dollar.

Statistical analysis of macroeconomic data suggests that the long-run relationship between the exchange rate and import and export prices was relatively stable over the two subperiods. However, the profit margins of foreign suppliers (in the aggregate) do appear to have expanded somewhat more during the period of appreciation after 1980 than earlier experience would have predicted; and profit margins of U.S. exporters appear to have risen somewhat less. Two factors may have contributed to these deviations from the historical relationship: the unusual magnitude of the dollar's rise during the early 1980s and the month-to-month volatility of the dollar over this period.

Analysis of microeconomic data from individual industries suggests that, in addition to the appreciation of the dollar, the rebound in real growth in the United States, inflation in the source country, market structure, and trade barriers influenced profit margins and the amount and speed of pass-through during the first half of the 1980s. Dollar prices on products imported from the newly industrialized countries with high inflation rates generally remained high and profit margins rose, while dollar prices of products from the countries with more moderate rates of inflation fell and profit margins were more stable. At the same time, U.S. exporters in many individual industries appear to have been relatively insensitive to exchange rate changes. Indeed, some exporters appear to have widened their profit margins even as the dollar appreciated.

The presentation is organized as follows: The next section reviews some analytical foundations for the relationship among exchange rates, prices, and profit margins. Next comes an examination of evidence on pass-through and profit margins based on the macroeconomic data, then a review of the industry-specific evidence on the behavior of prices and profit margins. A final section presents some concluding observations.

Analytical Foundations

A fundamental starting point for an analysis of the pass-through of exchange rate changes to import and export prices is the law of one price: under conditions of perfect competition in domestic and international goods markets (zero profits or no profits in excess of "normal economic" profits) the exchange rate equates the domestic currency prices of similar traded goods produced at home and abroad. This relationship, given in equation 1, says that the U.S. price (in dollars) of a product equals the foreign price (in foreign currency) times the exchange rate:

$$P_d = P_f \times E, \tag{1}$$

where

P_d = price of the product in the United States, in dollar terms
P_f = price at which the foreign supplier sells the product, in foreign currency terms
E = the exchange value of the dollar in terms of dollars per unit of foreign currency.

Under these conditions, if the exchange rate changes and foreign prices remain unchanged, the domestic price changes one for one: pass-through of the exchange rate change to domestic prices is 100 percent.

Profit margins are a key link between the exchange rate and prices of traded goods that extends the analysis based on the law of one price. Relaxing the assumptions of perfect competition allows for short-run variability in profit margins that may help explain the short-run variations in the pass-through relationship observed in the macroeconomic data. Equations 2 and 3 together show two important identities that relate the dollar price of imports, the exchange rate, and profit margins:

$$P_f = C_f + M_f \tag{2}$$

$$P_d = (C_f + M_f) \times E, \tag{3}$$

where C_f is the cost, in foreign currency terms, of producing the product in the foreign country and M_f is the margin over costs, in foreign currency terms, chosen by the foreign producers. Equation 2 says that the foreign currency price of products imported into the United States equals

the foreign cost of producing the product plus some profit margin. Equation 3 combines equations 1 and 2 and shows that the U.S. dollar price equals the sum of the foreign costs of production and profit margins, all times the exchange rate. The concept of pass-through is presented in equation 4:

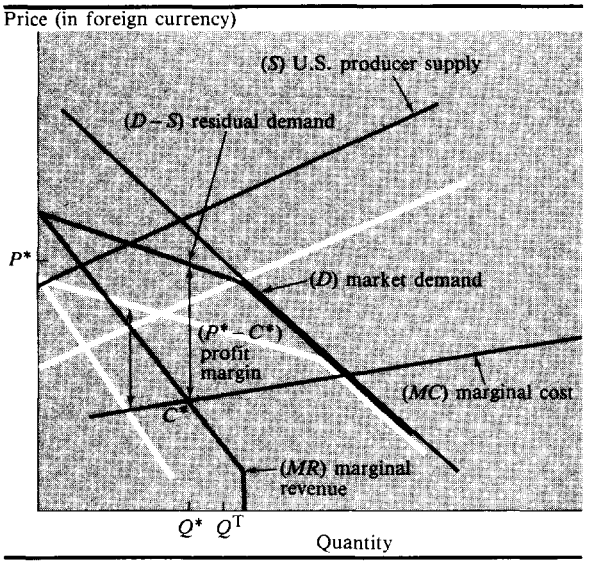
$$(4) \qquad \Delta P_d = \Delta C_f + \Delta M_f + \Delta E;$$

that is, the change in the dollar price equals the change in foreign costs plus the change in margin plus the change in the exchange rate. If foreign costs are constant, dollar import prices will change little (and pass-through will be less than 100 percent) if foreign profit margins adjust to offset some of the exchange rate changes. If foreign costs change as well, profit margins can change and buffer the ultimate effect on the dollar price.

Introducing profit margins into the aggregate equation allows more flexibility in the speed and amount of pass-through of exchange rate changes to import prices. But what factors can lead to variable profit margins? Profit margins vary in part because of the characteristics of market structure in the individual industries and in part because of overall changes in the macroeconomic environment.

A number of models of international trade analyze how prices are affected by market structures that deviate from perfect competition. Factors leading to imperfect competition include imperfect substitutability of products so that each supplier has some market power; production technology that exhibits nonconstant returns to scale so that the supply curve is sloped; a relatively small number of firms in the industry; and wage and sales contracts that may limit the speed of adjustment of prices to changes in costs or demand.[2]

2. A model of foreign suppliers' profit margins and pass-through



In addition to these microeconomic factors, macroeconomic forces such as the volatility of exchange rates and booms and recessions in demand may affect a firm's pricing strategy. The data suggest that the key factor in determining industry pricing and profit margins over the last eight years was not market structure alone, but the way market structure interacted with macroeconomic uncertainty.

2. Peter Isard, "How Far Can We Push the 'Law of One Price'?" *American Economic Review*, vol. 67 (December 1977), pp. 942–48, examines the law of one price for disaggregated industry groups. Eugene R. Flood, "Global Competition and Exchange Rate Exposure," Research Paper 837, Stanford Business School, September 1985, discusses in very general terms the way the slopes of the demand and supply curves affect the pricing decision and profitability of an international firm. Paul Krugman, "Scale Economies, Product Differentiation, and Patterns of Trade," *American Economic Review*, vol. 70 (December 1980), pp. 950–59, and Elhanan Helpman, "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlinian-Heckscher-Ohlin Approach," *Journal of International Economics*, vol. 11 (August 1981), pp. 305–40, provide a theoretical foundation for the effect of product substitutability on pricing decisions. Paul Krugman, "Increasing Returns, Monopolistic Competition, and International Trade," *Journal of International Economics*, vol. 9 (November 1979), pp. 469–79, and Rudiger Dornbusch, "Exchange Rates and Prices," October 1985, focus on production technology; Dornbusch also reflects on how the number of firms affects prices. The following papers examine how contracts affect the timing of the pass-through of exchange rate changes to prices: John E. Wilson and Wendy E. Takacs, "Expectations and the Adjustment of Trade Flows Under Floating Exchange Rates: Leads, Lags, and J-Curve," International Finance Discussion Papers 160 (Board of Governors of the Federal Reserve System, April 1980); Stephen P. Magee, "Currency Contracts, Pass-through, and Devaluation," *Brookings Papers on Economic Activity, 1:1973*, pp.303–23; and William H. Branson, "The Trade Effects of the 1971 Currency Realignments," *Brookings Papers on Economic Activity, 1:1972*, pp. 15–58.

Chart 2 depicts one way of thinking about import price determination.[3] A set of foreign firms, which are assumed to act as one, export to the United States. These firms face a market demand curve (D) that represents the potential market in the United States. This curve moves out over time as U.S. gross national product grows, but because of booms and recessions, it does not move out at a constant rate. The slope of the demand curve is determined by such aspects of market structure as the number of firms producing the good, strategic interfirm behavior, and the degree of product substitutability.

Part of the total U.S. demand is supplied by domestic U.S. producers (S). How large a share they capture depends in part on the value of the dollar, which moves over time and which is also volatile. The U.S. market price is expressed in terms of foreign currency in the diagram so that a depreciation of the dollar will shift down the U.S. supply curve. The slope and location of that curve are also determined by such characteristics of the market as trade barriers, product substitutability, and the production technology of the U.S. producers.

The marginal cost curve of the foreign firms (MC) depends on their production technology. Its slope and location depend on wages, the cost of fixed capital, costs of imported intermediate products, and other costs of production.

The foreign firms face much uncertainty as they make their pricing decision. They must guess the location of the total market demand, the supply from the U.S. producers, and the cost of their own output. To maximize profits, the firms choose a price on the residual-demand curve ($D - S$) at the point at which expected marginal revenue equals expected marginal cost. Thus the foreign firms price their product at P^*. They export Q^* to the United States, and the remainder of the output (to Q^T, which is the total output demanded) is supplied by the U.S. producers. At price P^* and output Q^*, the cost of production per unit to the foreign firm is C^*. Hence the profit margin enjoyed by the foreign producers on each additional item sold in the United States is the amount $P^* - C^*$ shown in the diagram.

Since the residual-demand curve is a function of both domestic supply and U.S. demand, it incorporates both exchange rate uncertainty and aggregate demand uncertainty. The foreign firms cannot perfectly forecast either the exchange rate or GNP, so their profit margins are exposed to both exchange rate and demand shocks. For example, if the dollar depreciates, the U.S. supply curve will shift down, causing the residual-demand curve to shift down as well (see chart 2). The foreign firms reduce their price, and their profit margins fall. Because the foreign currency price falls somewhat, the decline in the value of the dollar is not fully passed through to the U.S. dollar price of the product. If, at the same time, there are other macroeconomic shocks, such as a demand boom in the United States, the foreign suppliers' price and profit margins may not change as much as they would in the face of a depreciation in the dollar taken by itself: pass-through would appear to be even lower.[4] Therefore, while microeconomic market structure generates profit margins, macroeconomic uncertainty alters profit margins and affects pass-through.

Aggregate Macroeconomic Evidence on Profit Margins and Pass-Through

Aggregate regression equations for the price of U.S. non-oil imports often take the form of a logarithmic transformation of equation 1. Various reseachers using similar regression equations

3. The model presented here is adapted from the limit-pricing models in industrial organization theory. Daniel Gros, "The Determinants of Competitiveness and Profitability," International Monetary Fund, Research Department DM/86/21, March 20, 1986, presents a somewhat different model, which examines competitiveness and profitability when aggregate demand changes in a small open economy that is not perfectly competitive.

4. Consider a depreciation in the dollar and a simultaneous demand boom. The depreciation shifts down the U.S. supply curve causing the residual-demand curve to shift down. A boom shifts out the total market demand curve causing the residual-demand curve to shift up. The decline in prices and profit margins of foreign suppliers will not be as large as if the dollar depreciated by itself. (In fact, prices and profit margins could increase if the demand boom is large enough.) Since pass-through is defined for changes in import prices resulting from changes in exchange rates, pass-through would appear to be smaller in the multiple-shock scenario.

have estimated pass-through of a change in the exchange rate to import prices ranging from 50 percent to 80 percent, depending on the time period of estimation, the particular measure of the exchange rate used, the import price considered, and the other variables in the regression equation.[5] Despite these different estimates of pass-through, statistical tests have shown the relationship to be fairly stable over different time periods of estimation, implying that the variations in the estimates derive more from differences in the variables used than from changing characteristics of the macroeconomic environment.[6]

Some modelers have employed a distributed lag on the exchange rate, making the regression specification functionally equivalent to equation 3. Although a profit margin is not explicitly specified in this form of the regression equation, the lag on the exchange rate means that changes in the exchange rate do not have their full effect on import prices immediately. During the adjustment period (until the exchange rate change completes its effect on import prices), foreign profit margins on products imported into the United States must be changing. The long-run pass-through effect from these equations, measured by the sum of the coefficients, is quite similar to pass-through estimated without the lag. But additional information about how profit margins may be changing over the adjustment period is revealed by examining the lag structure.

Finally, even though stability tests fail to uncover any statistically significant structural breaks in the parameters of the relationship between external prices and the dollar, an examination of the residuals over different time periods of estimation may reveal some information about whether the behavior of profit margins and pass-through differs between periods of appreciation and depreciation of the dollar.

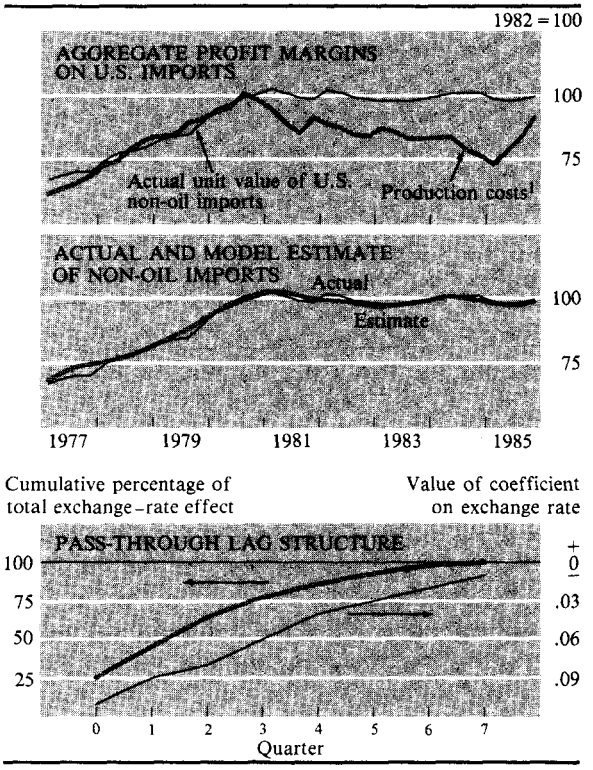
Imports

The top panel of chart 3 is a rough empirical representation of equation 1 without using a regression equation. It shows the unit value of non-oil imports in dollars and an estimate of aggregate foreign costs in dollar terms (using foreign consumer prices). If dollar import prices

5. These studies include a comprehensive analysis by Peter B. Clark, "The Effects of Recent Exchange Rate Changes on the U.S. Trade Balance," in P.B. Clark, D.E. Logue, and R.J. Sweeney, eds., *The Effects of Exchange Rate Adjustments* (U.S. Treasury, OASIA Research Department, 1974). Peter Isard, "The Price Effects of Exchange Rate Changes," in Clark and others, eds., *Effects of Exchange Rate Adjustments*, focuses on how different degrees of industry aggregation in the import data affect pass-through. Eugene R. Flood, "An Empirical Analysis of the Effect of Exchange Rate Changes on Commodity Prices," revised, September 1984, compares pass-through for different commodity and manufacturing groups. Robert M. Dunn, Jr., "Flexible Exchange Rates and Oligopoly Pricing: A Study of Canadian Markets," *Journal of Political Economy*, vol. 78 (January–February, 1970), pp. 140–51, examines data for Canada. Lawrence Schwartz and Lorenzo Perez, "Survey Evidence on the Pass-Through of Smithsonian Revaluations," in Clark and others, eds. *Effects of Exchange Rate Adjustments*, focuses on different industries and countries, as do Irving B. Kravis and Robert E. Lipsey, "Price Behavior in the Light of Balance of Payments Theories," *Journal of International Economics*, vol. 8 (May 1978), pp. 193–246, and John E. Wilson and Wendy E. Takacs, "Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries," *Review of Economics and Statistics*, vol. 61 (May 1979), pp. 267–79. Charles Schotta and Joseph Trojanowski, "The Impact of the Smithsonian Exchange Rate Realignments on U.S. Retail and Import Prices of Japanese Photographic Equipment," in Clark and others, eds., *Effects of Exchange Rate Adjustments*, examines both retailers' and wholesalers' profit margins and pass-through for Japanese cameras and lenses. Eliot R.J. Kalter, "The Effect of Exchange Rate Changes Upon International Price Discrimination," International Finance Discussion Papers 122 (Board of Governors of the Federal Reserve System, August 1978), examines pass-through for a highly disaggregated group of industrial exports, assuming a model of imperfect competition. Jacques R. Artus, "The Behavior of Export Prices for Manufactures," in Clark and others, eds., *Effects of Exchange Rate Adjustments*, examines exporters' price behavior for several countries. Two other papers examine exporters' behavior in a macroeconomic framework: Helen B. Junz and Rudolf R. Rhomberg, "Price Competitiveness in Export Trade Among Industrial Countries," *American Economic Review*, vol. 63 (May 1972, Papers and Proceedings), pp. 412–18, and Irving B. Kravis and Robert E. Lipsey, "Export Prices and Transmission of Inflation," *American Economic Review*, vol. 67 (February 1977), pp. 155–63.

6. In "The Strong Dollar and U.S. Inflation," Federal Reserve Bank of New York, *Quarterly Review* (Spring 1984), pp. 23–29, Charles Pigott and Vincent Reinhart report their findings of a statistical break in 1982. However, it appears that they may not, in fact, have tested for statistical stability of the parameters. A Chow test of whether the two subperiods examined here were statistically different from the period 1965:1 through 1984:2 confirmed parameter stability. However, because the variables are highly collinear, the power of the test was likely quite low. In fact, there is some reason to question the parameter estimates.

3. Aggregate and model estimate of profit margins on U.S. imports



1. Multilateral trade-weighted foreign CPI of G-10 countries, dollar terms.

depended on the exchange rate and foreign prices alone, the dollar price of U.S. imports probably would have fallen more in line with the gray line during the 1980s. Therefore, the panel suggests that profit margins of foreign suppliers in the aggregate rose substantially in recent years.

A more systematic analysis of the relationship between exchange rates and import unit values is given in the middle panel. The gray line shows the prediction for non-oil import prices using a regression equation based on equation 3 that relates the import price to foreign consumer prices, commodity prices, and the exchange rate.[7] The equation suggests that on average a 10 percent change in the value of the dollar on a multilateral trade-weighted basis leads gradually (over a period of about two years) to a 6 percent change in the dollar price of non-oil imports.[8] The presence of a two-year lag suggests that foreign profit margins tend to fall below their normal levels for a time as the dollar depreciates and tend to rise above their normal levels as it appreciates. When the model's prediction deviates from the actual non-oil import unit value,

$$\log(PM_t) = a + \sum_{i=0}^{7} b_i \times \log(XR_{t-i}) + \sum_{i=0}^{3} c_i \times \log(PC_{t-i})$$

$$+ d \times \log(CPI^*_t) + e_t,$$

where

PM = index of non-oil import unit value
XR = multilateral trade-weighted exchange rate, estimated with an eight-quarter, second-degree, polynomial distributed lag (with a tail constraint)
PC = commodity price index, estimated with a three-quarter, second-degree, polynomial distributed lag (with a tail constraint), from *International Financial Statistics*
CPI^* = foreign consumer price index weighted by the multilateral trade weights
e = random error.

The period of estimation is 1965:1–1982:4.

Consumer prices are a poor proxy for the costs of production in the import price equation because they include nontraded goods. However, two other proxies, unit labor costs and producer price indexes, are not available with either the frequency or the reliability of the consumer price index.

8. The result that import prices, even in the long run, change by significantly less than 100 percent of the exchange rate change can be explained by several factors. One is that the particular measure of the dollar's exchange rate used in this estimate is an average against 10 currencies weighted by each country's share in world trade. U.S. import prices are a function of a much wider set of bilateral exchange rates. More broadly based import-weighted indexes tend to move less than the Federal Reserve Board's 10-currency index because many of the excluded currencies are tied fairly closely to the dollar. Hence the 10-currency index tends to overstate the implications for U.S. import prices of any given episode of exchange rate changes. Schemes with alternative weighting, such as GNP weights or bilateral trade weights, give somewhat different results. Experiments using a more broadly based exchange rate measure and bilateral trade weights including some of the trading partners that are among the larger newly industrialized countries yielded a long-run pass-through estimate close to 90 percent. Moreover, just as U.S. prices rise with a fall in the dollar, foreign costs and prices tend to fall, for analogous reasons. The decline in foreign prices, if passed through to prices of traded goods, will offset part of the effect of the exchange rate change on U.S. import prices.

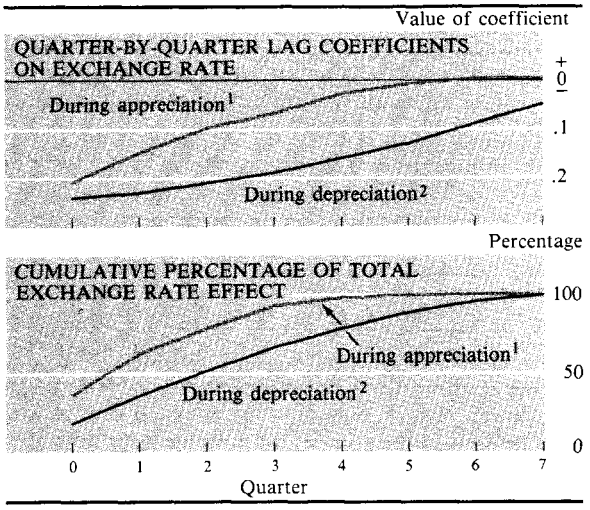
7. The equation specification used here is part of a larger model of the U.S. balance of payments. For additional information on the model specification, see William L. Helkie, "A Forecasting Model for the U.S. Merchandise Trade Balance," paper presented at the Fifth International Symposium on Forecasting, Montreal, Canada, June 9–12, 1985. The specification for the non-oil import price equation is

profit margins are changing more than the average as predicted by the equation. The panel therefore implies that foreign profit margins in the aggregate decreased slightly more during 1977 through 1981 and increased somewhat more during 1982 through early 1985 than would have been predicted on the basis of experience.

The bottom panel of chart 3 shows the quarter-by-quarter structure of the relationship between non-oil import prices and the exchange rate. The gray curve shows, for each quarter, the cumulative percentage of the total long-run pass-through that had taken place through that quarter. About 50 percent of the effect on import prices of a change in the exchange rate is felt within two quarters, and almost 70 percent in a year.

The lag structure reveals some variability over time in the dynamic relationship between exchange rates and prices. The panels in chart 4 show estimates of the lag structure and cumulative percentage of pass-through as obtained for the two subperiods during 1977 through early 1985. Although the short period of estimation prevents them from being statistically significant, these results suggest that exchange rate changes were passed through to non-oil import prices more fully, but more slowly (as calculated in terms of the cumulative percentage effect), when the dollar depreciated than when it appreciated. This result is at least consistent with both the evidence presented in equations 1 through 4 and anecdotal accounts of how, during the early 1980s, foreign suppliers absorbed the dollar appreciation into wider profit margins instead of passing it through to lower dollar import prices. If the foreign suppliers widened their short-run profit margins as much as these results suggest, one implication is that they probably had ample room to squeeze their margins as the dollar fell after early 1985.

4. Pass-through lag structure

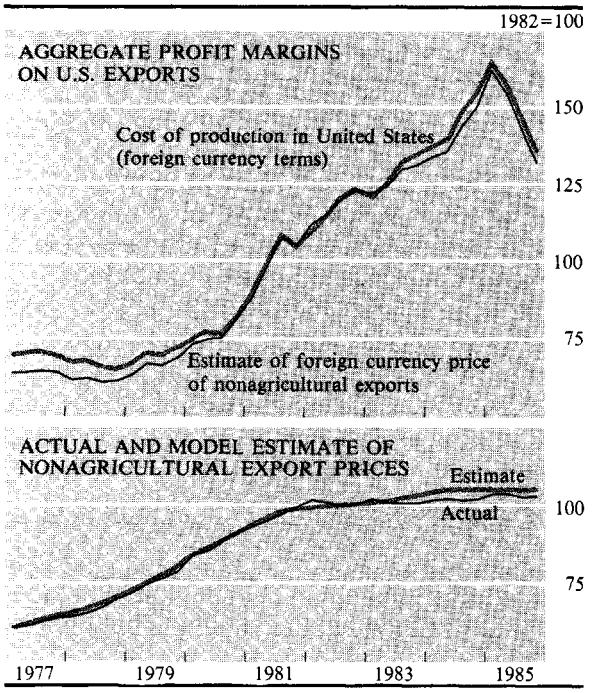


1. Estimation period: 1981:1–1985:2.
2. Estimation period: 1977:1–1980:4.

Exports

Chart 5 illustrates analogous pass-through and profit-margin relationships for U.S. exports and the price competitiveness of U.S. exports in international markets. The top panel presents an estimated foreign currency price of nonagricultural exports and an estimated foreign currency value of U.S. costs of production, as measured by producer prices. This aggregate evidence suggests that profit margins for U.S. exporters do not change much with a change in the exchange rate: pass-through for exports is close to 100 percent. As the dollar appreciated, the foreign currency price of exports rose almost one for one with the exchange rate, causing a significant

5. Aggregate and model estimate of profit margins on U.S. exports



decline in the price competitiveness of U.S. exports in international markets.

The bottom panel shows the unit value of nonagricultural exports and a prediction of the price of nonagricultural exports derived from an estimated equation that relates that unit value to U.S. producer prices, foreign consumer price indexes, and the multilateral trade-weighted exchange value of the dollar.[9] The equation predicts that on average a 10 percent change in the value of the dollar should lead directly to a 0.75 percent change in export prices. Of course, a change in the exchange rate will affect domestic and export prices indirectly through its effect on import prices and on the prices of internationally traded commodities. The gap between the lines suggests that, in the aggregate, U.S. producers limited price increases on their exports somewhat more as the dollar appreciated than the historical evidence suggested that they would. Therefore, the sustained appreciation of the dollar may have induced U.S. exporters to price somewhat more competitively on international markets than they had done in the past.

Industry Evidence on Profit Margins and Pass-Through

Disaggregated industry data provide further evidence on changes in profit margins and the stability of the long-run pass-through relationship. Industries examined in this study produce the following imported products and the following exported products; all are disaggregated to the four-digit SIC level.

SIC number	
	Imports
2311.....	Men's and boys' suits and coats
2621.....	Paper mill products
2221.....	Weaving mill, synthetics, and silks
2033.....	Canned fruits and vegetables
314.....	Men's and women's leather footwear (3143 + 3144)
33.....	Rolling mill and electrometalurgical steels (3312 + 3313)
3531.....	Construction machinery
	Exports
2611.....	Pulp mill products
2011.....	Meat packing and preparation
3494.....	Valves and pipe fittings
3519.....	Internal combustion engines
3523.....	Farm machinery and equipment
3533.....	Oilfield and gasfield equipment
3546.....	Power-driven hand tools
3555.....	Printing trades machinery
3674.....	Semiconductor devices

The four-digit Standard Industrial Classification (SIC) disaggregation was used because the Bureau of Labor Statistics recently began to publish export and import price indexes on this basis; heretofore, only unit value indexes were available.[10] When working with disaggregated industry data, a careful match of the industry categories for prices and costs is important; many other data for the United States are available disaggregated on an SIC basis.

Only nine export price indexes and seven import price indexes had an historical record long enough for this project. The export categories accounted for 6 percent of total trade in 1980 and the import catagories for about 7 percent. For such a small set of industries, there is variety, and as a group these industries represent the kinds of products that dominate U.S. nonagricultural exports and U.S. non-oil imports.

An index of profit margins on U.S. exports of each category was calculated in dollar terms as the ratio of each product's export price index to

9. See Helkie, "A Forecasting Model" for further details. The equation is

$$\log(PX_t) = a + \sum_{i=0}^{2} b_i \times \log(WPI_{t-i}) + c \times \log(CPI^*_t/XR_t) + e_t,$$

where

PX = unit value of nonagricultural exports
WPI = an index of U.S. export-weighted producer prices (estimated with a three-quarter, second-degree, polynomial lag with nose and tail constraint)
XR = multilateral trade-weighted exchange rate
CPI^* = foreign consumer price index
e = random error.

The period of estimation is 1969:1–1982:4.

10. Only rarely is an external *price* series available. These data are based on a survey (done once each quarter, in the last month of the quarter) of actual transactions prices of exporters and importers (as opposed to customs valuation). Unit value indexes have often been the only available proxies for external prices. Unit value indexes are prone to problems of shifting composition of goods within the aggregate and often are poor at capturing quality changes. See Irving B. Kravis and Robert E. Lipsey, *Price Competitiveness in World Trade* (National Bureau of Economic Research, 1971), for a full discussion of the problems associated with using unit value indexes as proxies for prices.

its producer price index.[11] The U.S. producer price index is a proxy for U.S. costs of production. Nothing can be inferred from the level of this index because the choice of base year is arbitrary.

For imports, the study examines foreign currency profit margins on the assumption that a foreign firm maximizes profits measured in its own currency. Therefore, each product's import price index must be converted to foreign currency units. An index of nominal exchange rates weighted by import shares was created for each product.[12] Multiplying this index by the index of dollar import prices yields an index of foreign currency import prices. Multiplying the import-share weights by each country's proxy for the product's production costs creates an index of foreign currency costs of production for each imported good. Since there is no comparable SIC breakdown for foreign costs of production, the analysis relied on the nearest equivalent producer price index from national sources.[13] The ratio of the indexes of foreign currency import prices and of foreign currency costs of production forms an index of foreign currency profit margins for each import.

Imports

The relation of dollar import prices to domestic U.S. prices in part determines the competitiveness of domestic import-competing products and, moreover, influences domestic inflation. The panels in chart 6 show dollar import prices and the calculated estimates of foreign currency values of foreign profit margins of selected U.S. imports. Dollar prices increased fairly sharply for all of these imports during the depreciation of 1977–80. During the appreciation of 1981–85, however, behavior was mixed: dollar prices for some products, such as footwear, textiles, and apparel, remained rather stable; for other products, such as certain steels and construction machinery, dollar prices fell.

Foreign currency profit margins behaved rather similarly over the eight years, showing a direct association with movements in the dollar. Profit margins generally declined slightly during the period 1977–80, when the dollar depreciated, and increased during the more recent period, when the dollar appreciated. For some products, such as footwear, textiles, paper products, and

11. Producer price indexes include a profit margin at the wholesale level because they are constructed from prices observed in the first commercial transaction involving the item. However, the index of export profit margins calculated here captures at least the extent to which profit margins can differ between exporting versus selling the same product in the United States.

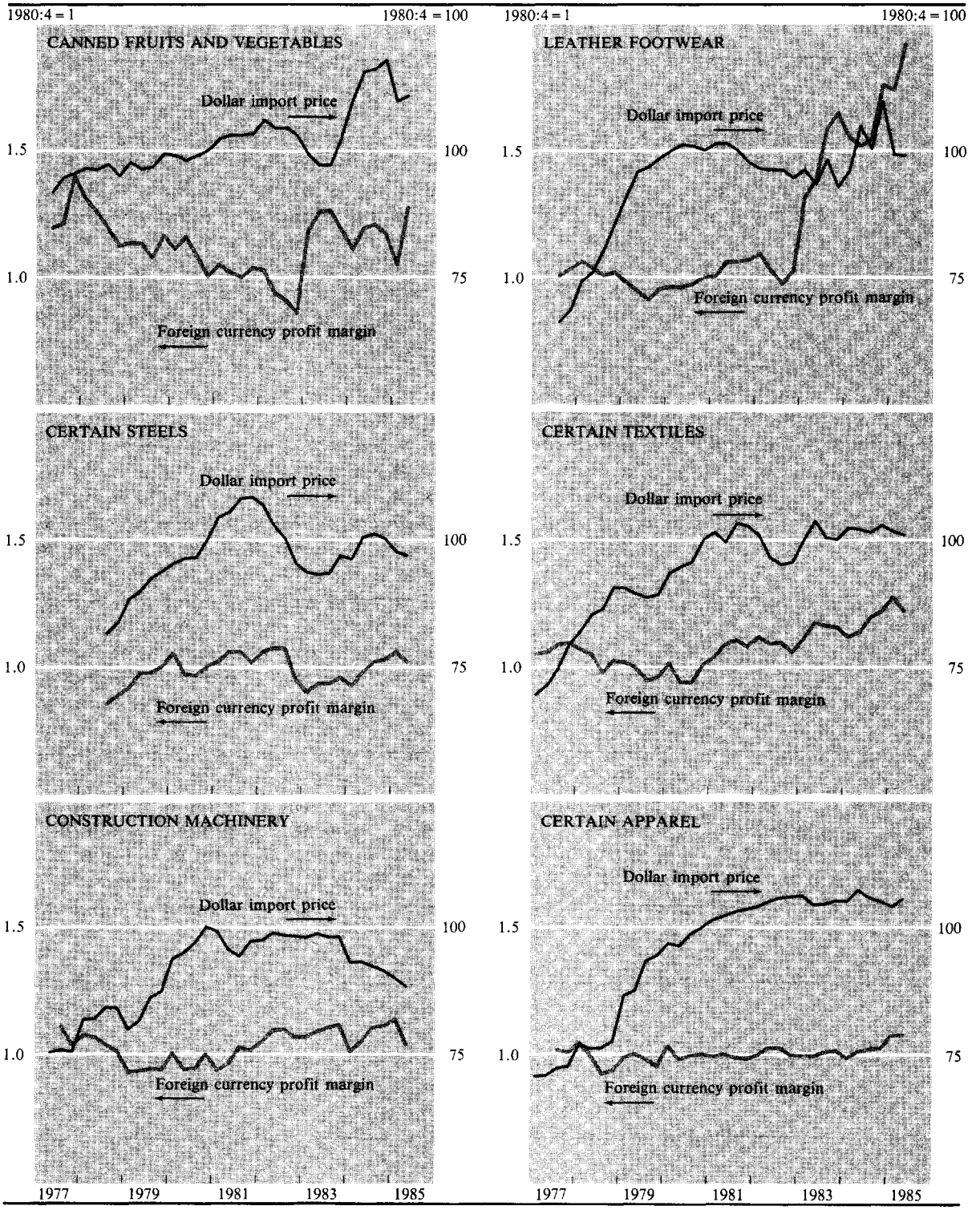
12. In concept, the import share weights are the share each foreign country has in the total imports into the United States of a particular four-digit SIC category of product. However, trade data are available on a Schedule A disaggregated basis only by individual country. Therefore, the import share weights are based on Schedule A, and a concordance between Schedule A and the SIC was used to determine which Schedule A categories to aggregate to get the four-digit SIC category. The share weights were calculated for the top three to five supplying countries for 1980 and 1984, interpolating for the intervening years. This technique accounted for an average of 80 percent of the imports of each four-digit SIC category, ranging from a low of 66 percent for steel to a high of 89 percent for footwear. The average values of the exchange rate index and the cost of production indexes were used for the fraction not allocated to any particular country.

While this method has many pitfalls, a very different import weighting calculation revealed virtually the same pattern of behavior of profit margins and exchange rates. In this alternative technique, the import share weights were calculated for each year using selected aggregate Schedule A groupings containing products similar to those in the four-digit SIC categories. These data are available for the regions of the world and a few countries. For each region, a representative country's costs of production and nominal exchange rate were chosen. For example, Brazil "represented" Latin American imports to the United States.

These two different construction methods introduce very different biases. That the results are similar is reassuring.

13. The following sources were used: *Canada:* industry selling price indexes based on 1970 Standard Industrial Classification, Statistics Canada, *Canadian Statistical Review*; *Japan:* wholesale price indexes (by products and sectors), Bank of Japan, *Statistical Bulletin*; *Brazil:* Precos por atacado (nova classificacao) offerta global, Conjuntura Economica, *National Economic Indexes*; *United Kingdom:* index numbers of wholesale (producer) prices, price indexes of output of broad sectors of industry, Central Statistical Office, Government Statistical Service, *Monthly Digest of Statistics*; *Germany:* Preise und Preisindizes fur gewerbliche Produkte (Erzeugerpreise), W. Kohlhammer GMBH, *Statistisches Bundesamt Wiesbaden*; *Italy:* Numeri indici prezzi all ingrosso, indici por settori e branche, indici alcuri gruppi, Insitutio Centrale de Statistica, *Bollettino Mensile Da Statistica*; *South Korea:* wholesale price indexes (by commodity by subgroup), Bank of Korea, *Monthly Statistical Bulletin*; *Taiwan:* indexes of wholesale prices in Taiwan area, Executive Yuan Republic of China, Directorate-Generale of Budget Accounting and Statistics, *Monthly Statistics of the Republic of China*.

6. Prices and profit margins for U.S. imports, selected industries



canned fruits and vegetables, the change in trend is quite distinct. For others, such as steels, it is less so.

The top panel of table 1 shows how much these estimates of foreign currency profit margins changed during the two periods of dollar movement. This calculation emphasizes the general trends of narrowing profit margins during a depreciation and widening profit margins during an appreciation. It also shows the diversity of responses of individual imported products.

Both industry-specific and general macroeconomic factors contribute to the observed pricing and profit margins. In the earlier period, high rates of cost inflation abroad, which importers did not completely pass on to their sales prices, raised the dollar price of imports and narrowed foreign currency profit margins from the cost side. In addition, relatively slack aggregate demand conditions in the United States meant that producers could not exploit market power and raise prices; thus margins were capped. In the later period, as the dollar appreciated sharply, the rapid expansion of domestic demand in the United States probably was the key to keeping dollar import prices up and foreign currency profit margins wide, especially as foreign cost inflation abated. It appears that dollar import prices fell while margins remained stable on products imported primarily from the other industrial countries, where domestic disinflation was most significant. Dollar prices were maintained, as were margins, on products imported from the newly industrialized countries, where cost inflation remained high. The Multi-Fiber Arrangement probably was also important in maintaining the margins on textiles and apparel.

1. Percent change in profit margins, selected industries

Industry	1977 to 1980[1]	1980 to 1985:2[2]
Exchange value of the dollar[3]	−15.5	74.9
	Imports (foreign currency)	
Leather footwear	−4.2	87.3
Certain textiles[4]	−9.1	28.0
Construction machinery	−9.2	11.6
Paper products	−2.3	17.6
Certain apparel[5]	−4.9	4.1
Canned fruits and vegetables	−14.1	6.8
Certain steels[6]	14.6	4.1
	Exports (dollars)	
Semiconductors[7]	−5.9	−9.6
Power-driven hand tools[8]	−5.0	−6.9
Pulp mill products	4.6	−17.1
Internal combustion engines[9]	−4.5	4.2
Valves and pipe fittings[10]	−2.7	8.7
Oilfield and gasfield equipment[8]	−2.0	1.0
Printing trades machinery[10]	−3.9	5.3
Farm machinery[9]	−2.9	4.5
Meat packing and preparation[8]	−3.6	17.7

1. Percent change between the 1977 four-quarter average and the 1980 four-quarter average.
2. Percent change between the 1980 four-quarter average and the 1985 two-quarter average.
3. Based on the G-10 multilateral trade-weighted exchange rate.
4. Silk and other man-made fibers.
5. Men's and boys' suits and coats.
6. Rolled and electrometalurgical steels; 1978 four-quarter average.
7. 1979 three-quarter average.
8. 1977 three-quarter average.
9. 1978 three-quarter average.
10. 1978 two-quarter average.

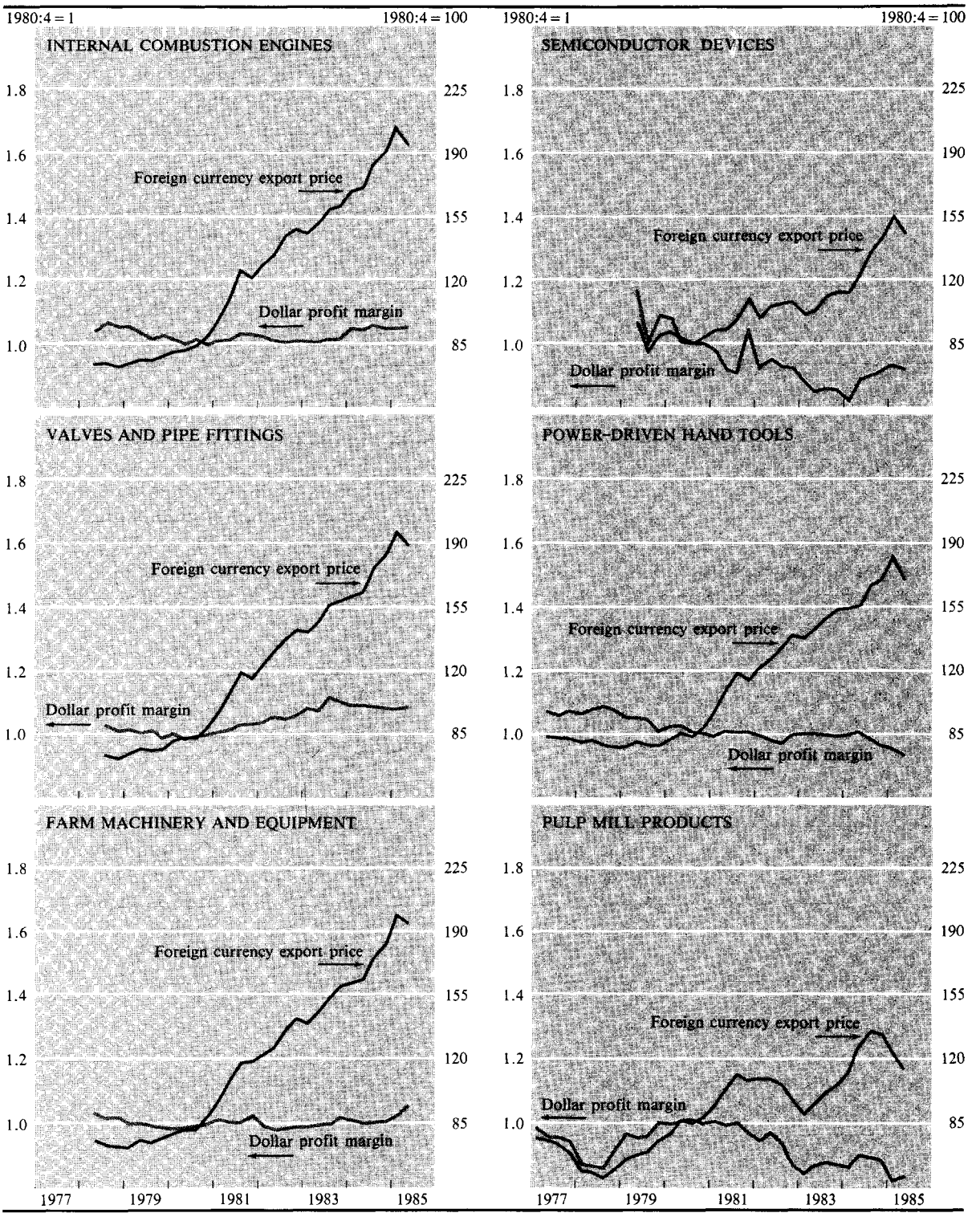
Exports

The behavior of prices and profit margins on products exported from the United States is shown in chart 7. Most U.S. exporters appear to have made relatively small adjustments to profit margins. As a consequence, as the dollar rose, U.S. exporters suffered a significant decline in price competitiveness, as implied by the rise in their prices in terms of foreign currency. Producers of semiconductors, power-driven hand tools, and pulp mill products cut margins in an effort to remain competitive on international markets, and their prices in foreign currency did not rise so much. Anecdotes support these statistical results.

All the machinery products have similar behavioral characteristics. Perhaps these products are so differentiated that foreign demand is quite inelastic. The share of exports in total output may be so small that they are a residual element in domestic marketing and pricing strategy. Import-competing products may be in such small supply that they do not affect domestic prices.

The bottom panel of table 1 shows the change in profit margins for U.S. exporters over the two periods of change in the exchange rate. Confirming the graphical evidence, those industries that responded to the appreciation in the dollar (semiconductors, power-driven hand tools, and pulp mill products) did cut profit margins. However, even these industries responded proportionately less to the change than did foreign importers when the dollar depreciated (table 2). Not only

7. Prices and profit margins for U.S. exports, selected industries



2. Comparison of changes in profit margins, selected periods[1]

Industry	1977 to 1980	1980 to 1985:2
	Imports	
Leather footwear	.27	1.17
Certain textiles	.59	.37
Construction machinery	.59	.15
Paper products	.15	.23
Certain apparel	.32	.05
Fruits and vegetables	.91	.09
Certain steels	−.94	.05
	Exports	
Semiconductors	.38	−.13
Power-driven hand tools	.32	−.09
Pulp mill products	−.30	−.22
Internal combustion engines	.29	.06
Valves and pipe fittings	.17	.12
Oilfield and gasfield equipment	.13	.01
Printing trades machinery	.25	.07
Farm machinery	.19	.06
Meat packing	.23	.23

1. These figures are the ratio of the percent change in the profit margins to the percent change in the exchange rate for the two subperiods using the data in table 1. A positive number indicates that the profit margin fell during the depreciation and rose during the appreciation.

are U.S. exporters in the aggregate relatively insensitive to the exchange rate, but also the disaggregated evidence indicates that some U.S. exporters in fact increased profit margins even as the dollar appreciated. This evidence, combined with the narrowing in margins in the earlier period, suggests that aggregate demand in the United States may dominate the exporter's pricing strategy.

Several inferences can be drawn from these disaggregated industry data. Historically, foreign producers seem to have responded to a dollar depreciation by squeezing profit margins; preserving market share in the United States may be the key to their behavior. But other factors besides exchange rate changes affect the pricing decisions and profit margins for individual imported products: inflation in the source country, relative growth in demand, and factors specific to individual industries such as market structure and trade barriers. The profit margins and pricing behavior of U.S. exporters seem even less affected by exchange rate changes.

CONCLUSIONS

A review of both aggregate data on U.S. import prices and industry-specific evidence suggests that over the past decade exchange rate changes have been absorbed into the profit margins of foreign suppliers to a considerable extent and for relatively long periods—as much as two years or more. This behavior is consistent with the prediction of theoretical models in which imported goods are produced and sold under conditions of imperfect competition and macroeconomic uncertainty. Apparently, this behavior is being repeated as dollar import prices are rising more slowly in response to the dollar depreciation than would have been expected in light of the historical record.

The empirical evidence also suggests, at least weakly, that the long-run relationship between the exchange rate and import prices may be changing. A trend toward buying worldwide by U.S. and foreign multinationals, newly established distributor networks in the United States, and a greater ability to hedge foreign currency exposure in international credit markets could imply a smaller long-run pass-through of exchange rate changes to import and export prices. In addition, stiffened competition for the U.S. market between established suppliers and newly industrialized countries may lead to permanently lower profit margins on some imports and a prolonged delay in the pass-through of the exchange rate depreciation to some import prices. U.S. producers are slowly becoming more aware of the advantages of trade. Competition for markets overseas may induce them to use exchange rate changes to price more strategically in the foreign market.

In any event, the wide profit margins that had been attained by the end of the dollar appreciation in early 1985 gave foreign suppliers ample room to squeeze profits. Improvements in the domestic price competitiveness of import-competing goods and increases in domestic inflation may be slower in coming than experience suggests. Moreover, other macroeconomic phenomena, such as aggregate demand shocks and domestic cost inflation, clearly affect pricing strategy and therefore profit margins and pass-through.

With respect to exports, in contrast, U.S. producers appear to be relatively insensitive to exchange rate changes. Both U.S. export prices in dollar terms and the profit margins of U.S.

exporting industries fluctuated much less over the past eight years than did the profit margins of foreign suppliers, suggesting that exchange rate changes were largely passed through to changes in the foreign currency prices of U.S. exports facing foreign competition. Therefore, if U.S. producers follow their historical behavior and do not broaden their profit margins on their exports too much, improvements in export performance should be forthcoming. □