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The Dollar and U.S. Manufacturing

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U.S. manufacturing industries are becoming increasingly sensitive to changes in the international value of the dollar. A look at recent studies of exchange rate effects on industry performance suggests that the 1997-98 rise in the dollar may significantly reduce U.S. producers' profits and compel firms to scale back their investment in new plants and equipment.

In 1997 and throughout most of 1998, the U.S. dollar increased in value relative to the currencies of its trading partners. This rise came more than a decade after the sharp run-up in the dollar in 1985 and followed a long period of declining or relatively flat exchange rates. Although the recent appreciation has been mild in comparison with the dollar's 1985 rise, evidence suggests that it is having a significantly stronger impact on the U.S. manufacturing sector.

The increased sensitivity of manufacturing firms to movements in the U.S. dollar exchange rate is largely attributable to the growing reliance of this sector on international trade. Firms now export a greater share of their products than in the past and make more extensive use of foreign parts and materials in the production of their goods.

In this edition of *Current Issues*, we examine the mechanisms through which dollar movements affect U.S. manufacturers. Using a new measure of industry exposure to exchange rate shifts—a measure termed net external orientation—we also assess the changes in the exchange rate sensitivity of U.S. manufacturing since the mid-1980s and identify the industries that are most likely to be hurt by a dollar appreciation.[1]

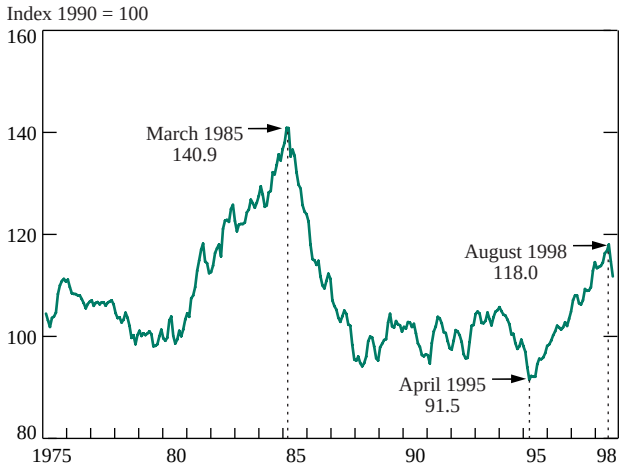
In addition, we review some recent studies exploring the effects of a stronger dollar on select areas of industry performance: profitability, investment spending, wages, and employment patterns. We find that, in particular, producer profits and investment spending are likely to suffer when the real value of the dollar rises. These effects are most pronounced in industries with high net external orientation and low price-over-cost markups.

The Rise in the U.S. Dollar

The value of the dollar has climbed steadily over much of the past two years (Chart 1). The dollar's rise through August 1998 represents more than a 20 percent appreciation over its average value in the 1991-95 period and more than a 30 percent strengthening relative to its unusually weak performance in April 1995. This large appreciation is reminiscent of the appreciation observed in 1985. At that time, the dollar rose 25 percent above the 1980-84 period average and approximately 50 percent above the dollar's trough in mid-1978.

Although the dollar today is only about as strong as it was in the early 1980s, its relatively steep ascent in recent years raises questions about the ability of U.S. manufacturers to maintain their profitability and to compete with foreign producers of the same goods. In the next section, we explore this relationship between the changing valuation of the dollar and the performance of U.S. manufacturing.

Chart 1
Real Trade-Weighted Dollar Exchange Rate
January 1975–October 1998



Source: Federal Reserve Bank of New York staff calculations.

Note: The chart shows the path of the real dollar relative to a trade-weighted basket of currencies.

How Dollar Movements Affect U.S. Producers

A dollar appreciation can affect U.S. manufacturers' revenues in two ways. First, a stronger dollar pushes up the price of U.S. goods in export markets, making those goods much less attractive to foreign buyers and ultimately resulting in reduced export sales for U.S. producers.[2] Second, a stronger dollar can jeopardize the domestic sales of U.S. manufacturers by giving the foreign producers that have penetrated U.S. markets a competitive edge in pricing. For example, if the dollar appreciates against the yen, then Japanese producers selling to U.S. markets will find that their dollar revenues translate into more yen than in the past. This increase in their "local-currency profit" enables the Japanese producers to reduce the prices they charge in U.S. markets and thus to draw customers away from rival U.S. producers.

The revenue effects we have described are central to most discussions of the impact of dollar shifts on U.S. manufacturers. Less widely acknowledged, however, are the effects of dollar movements on manufacturers' *costs*. U.S. firms are increasingly relying on foreign equipment and components in producing their goods. When the dollar rises, the cost of such imported inputs falls. The resulting savings can at least partly offset the revenue losses associated with a dollar appreciation and thereby help to stabilize industries' profits. Indeed, for some industries, the cost benefits of the appreciation may outweigh the adverse revenue effects.

Constructing an Indicator of Industry Exposure to Exchange Rate Shifts

To capture both the revenue and the cost sides of an industry's exposure to dollar movements, we use a measure called net external orientation.[3] This measure is computed as the share of an industry's total revenues that is derived from exports less the share of its total spending that is attributable to imported inputs.[4] An industry has positive net external orientation when its reliance on exports on the revenue side of its balance sheet exceeds its reliance on imported inputs on the cost side. An industry has negative net external orientation when its imported input costs exceed export revenues. Although a fairly rough measure, net external orientation is a useful indicator of the direction and relative importance of exchange rate effects for specific U.S. manufacturing industries.[5]

The importance of using a net measure to assess the vulnerability of U.S. manufacturers becomes clearer if we compare the external orientation of different manufacturing industries (see table).[6] In many industries, exports represent a large fraction of total revenues: Chemicals, industrial machinery, electronic equipment, transportation equipment, and instruments generate more than 15 percent of their revenues through exports. This shared focus on exports would seem to suggest that the profitability of all these industries would suffer significantly under a dollar appreciation. But once we take into account the offsetting effects of imported input use, we find that these industries would not, in fact, all fare alike with a rise in the dollar.

In the electronic equipment industry, exports account for 24.2 percent of revenues, while imported inputs account for a much smaller share of costs—11.6 percent. Subtracting the imported input share from the export share yields a relatively high net external orientation of 12.6 percent. By contrast, in the transportation equipment industry, the share of total revenues attributable to exports is a sizable 17.8 percent, but spending on imported inputs—15.7 percent of total spending—largely offsets the high export share, producing a net external orientation of only about 2 percent. The contrasting net figures for the two industries indicate that a strong dollar is likely to have significant adverse effects on the profitability of U.S. electronic equipment manufacturers, while the profitability of the transportation equipment industry should be more insulated from exchange rate effects.

The Net External Orientation of U.S. Manufacturing

As our industry comparison suggests, the net external orientation measure gives us a better understanding of the relative significance of a strong dollar for different manufacturing industries. To identify the industries that are especially sensitive to a dollar rise, we divide U.S.

Trade Orientation of U.S. Manufacturing Industries in 1995

Percent

Industry	Export Share[a]	Imported Input Share[b]	Net External Orientation
Food and kindred products	5.9	4.2	1.7
Tobacco products	14.0	2.1	11.9
Textile mill products	7.6	7.3	0.3
Apparel and other fabric products	7.4	3.2	4.2
Lumber and wood products	7.6	4.3	3.3
Furniture and fixtures	5.5	5.7	-0.2
Paper and allied products	9.0	6.3	2.7
Printing and publishing	2.4	3.5	-1.1
Chemicals and allied products	15.8	6.3	9.5
Petroleum refining	3.9	5.3	-1.4
Rubber and miscellaneous plastics products	9.2	5.3	3.9
Leather and leather products	14.4	20.5	-6.1
Stone, clay, glass, and concrete products	5.6	4.7	0.9
Primary metal products	11.2	10.6	0.6
Fabricated metal products	7.9	8.7	-0.8
Industrial machinery and equipment	25.8	11.0	14.8
Electronic and other electrical equipment	24.2	11.6	12.6
Transportation equipment	17.8	15.7	2.1
Instruments and related products	21.3	6.3	15.0
Miscellaneous manufacturing	13.5	9.9	3.6
Total manufacturing	13.4	8.2	5.2

Source: Campa and Goldberg (1997).

[a]Export revenues relative to total revenues.

[b]Imported input spending relative to total spending.

manufacturing industries into four groups representing different levels of net external orientation—high, moderate, low, and negative (Chart 2). An industry is classified as having a high net external orientation if its export share in 1995 was at least 10 percent greater than its imported input share. Industries with net external orientation between 2.5 percent and 10 percent in that year fall in the moderate group; industries with positive net external orientation below 2.5 percent fall in the low group. The negative net external orientation group is reserved for industries whose imported input shares in 1995 were greater than their export shares.

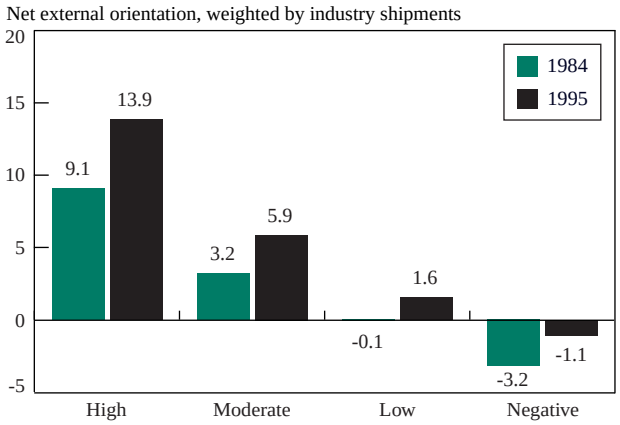
The industries most likely to be hurt by a stronger dollar are those with high net external orientation—tobacco, industrial machinery, electronic equipment, and instruments. Although fairly few in number, the industries in this group account for a substantial 23.9 percent of all U.S. manufacturing shipments. Another six industries—apparel, lumber, paper, chemicals, rubber and plastics, and miscellaneous manufacturing—had a moderate level of net external orientation. The moderate group, which represents 24.9 percent of all manufacturing shipments, is also likely to be vulnerable to a rise in the dollar.

Using the net external orientation measure, we can also track changes over time in the degree of industry exposure to dollar fluctuations. For U.S. manufacturing overall, net external orientation more than doubled between 1984 and 1995, rising from 1.9 percent to 5.2 percent. This striking increase reflects the rapid growth in the dependence of U.S. producers on sales to foreign markets. Exports accounted for 8 percent of all manufacturing shipments in 1984; in 1995, this share climbed to 13.4 percent. Although spending on imported inputs as a share of total spending has also risen, it has not kept pace with the growth in export share.

The changes over time in the net external orientation of each industry group parallel the aggregate trend. Between 1984 and 1995, all of the industry groups increased their external orientation (Chart 2). The industries in the high group experienced the greatest increase in exposure, with net external orientation rising from 9.1 percent to 13.9 percent.

Chart 2

A Breakdown of Industries by Level of Net External Orientation: 1984 and 1995



Notes: Industries with high net external orientation are tobacco; industrial machinery; electronic equipment; and instruments. Industries with moderate external orientation are apparel; lumber; paper; chemicals; rubber and plastics; and miscellaneous manufacturing. Industries with low external orientation are food; textiles; stone, clay, glass, and concrete products; primary metal products; and transportation equipment. Industries with negative external orientation are furniture and fixtures; printing and publishing; petroleum refining; leather; and fabricated metal products.

What does the marked upturn in the net external orientation of U.S. manufacturing industries suggest about the likely effects of a dollar appreciation? It appears that manufacturing is now much more exposed to the effects of exchange rate shifts than in earlier years. Consequently, a strong dollar could undermine the competitiveness of manufacturing industries to a greater extent than in the past.

Empirical Evidence on Dollar Effects

The heightened exposure of U.S. manufacturing to dollar movements has implications for many areas of industry performance. If the increase in net external orientation means that a strong dollar could generate larger declines in revenues than in costs, we would expect a dollar appreciation to lead to a drop in overall profitability. We would also expect manufacturing industries to respond to reduced profits by scaling back production activity and expenditures. Thus, firms might limit their investment in new plants and equipment, cut wages, and lay off workers. Finally, we would expect to see more pronounced effects in industries with the greatest exposure to dollar movements—that is, industries with high net external orientation—and in industries that are least able to absorb this exposure—those with small cushions against profit losses.

Are these expectations confirmed by the data on industry performance? In this section, we review what researchers have learned about the effects of dollar movements on industry profitability, investment spending, and wage and employment patterns.

Profitability

Two recent studies (Clarida 1997; Sheets 1992) have shown that a dollar appreciation does depress profits across U.S. manufacturing industries. Clarida, using nationally aggregated data for the 1975-93 period, finds that a permanent 1 percent real appreciation of the dollar reduces real U.S. manufacturing profits by roughly 1 percent over the long run. Sheets takes a different approach, basing his conclusion that profits fall when the dollar rises on an analysis of industry-specific, rather than aggregate, effects of dollar movements.

Interestingly, Sheets' work can be seen as supporting our view of the importance of net external orientation. The author shows that the decline in profits is sharper for those industries that rely more heavily on export markets and have more labor-intensive production. Note that industries with labor-intensive production are also more likely to have lower imported input shares—in part because they make less use of machinery and other equipment. Since industries combining large export shares and small imported input shares are, by definition, industries with a high net external orientation, Sheets' findings are consistent with our expectation that the impact of a stronger dollar on an industry's profitability will increase with the degree of the industry's external orientation.

Investment Spending

Other studies (Campa and Goldberg 1995 and forthcoming) confirm the expectation that a stronger dollar will lead industries to reduce investment spending. Such cutbacks are of concern because investment spending—defined as expenditures on goods not meant for immediate consumption, including purchases of plants and machinery—allows industries to replace outdated equipment and to expand their capacity to produce.

The Campa and Goldberg studies show that the magnitude of the dollar's effect on investment spending has varied over time and across manufacturing industries in accordance with two factors. The first is the degree of industry net external orientation: the greater the net external orientation, the larger the reduction in investment caused by the strong dollar. The second factor is industry profit structure: when the dollar rises, the most extensive cuts in investment spending occur in industries with the lowest price-over-cost markups.

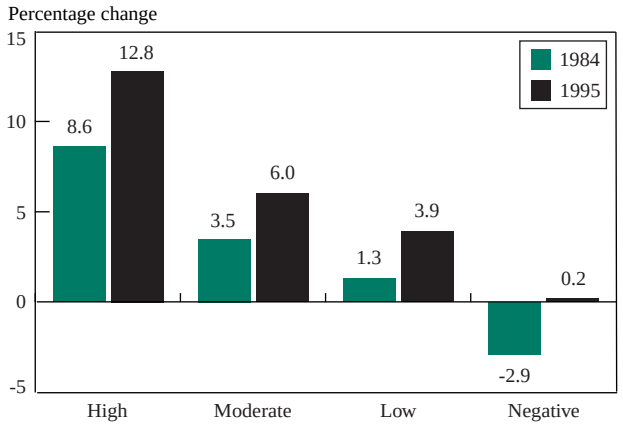
To understand the role of the first factor—net external orientation—consider how the effect of a dollar appreciation on manufacturing investment rates has changed since the mid-1980s. Regression estimates suggest that in 1984, when net external orientation for U.S. manufacturing as a whole was less than 2 percent, a 10 percent rise in the dollar produced a 2.4 percent average decline in the investment rate of manufacturing industries.[7] By 1995, when the net external orientation of U.S. manufacturing had more than doubled, the same 10 percent appreciation led to a much more dramatic 6 percent drop in investment.

The importance of external orientation for investment spending is also borne out by comparisons across industries. Although a stronger dollar prompts industries in all of our net external orientation groups to reduce investment spending, the investment decline is magnified as we move from the low to the high group (Chart 3). For industries in the low group, the cutback in the investment rate from a 10 percent dollar appreciation was 1.3 percent in the mid-1980s and about 4 percent in the mid-1990s. By contrast, the decline in the investment rate for industries in the high group was 8.6 percent in the mid-1980s and 12.8 percent in the mid-1990s.

Comparisons across industries also clarify the role of profit structure, the second factor influencing the magnitude of dollar effects on investment spending. Regression estimates reveal how two industries—one that prices its goods modestly above cost and one that marks up its prices more

Chart 3

Reduction in Investment Rate following a 10 Percent Dollar Appreciation, by Orientation Group



Notes: Each bar represents the weighted average of the response elasticities of industry investment rates in an orientation group. The average elasticities are weighted by the level of shipments attributable to each industry in the group.

Source: Campa and Goldberg (forthcoming).

heavily—adjust their investment spending in response to a dollar appreciation. If the two industries have the same net external orientation—an export share of 15 percent and an imported input share of 8 percent—then a 10 percent rise in the dollar leads the low-markup industry to cut its investment rate 10 percent, while the high-markup industry reduces its investment rate by less than 1 percent.[8]

What is the logic behind these differing responses? Industries that maintain lower price-over-cost markups are less able to absorb exchange rate shifts because they typically have more limited funds at their disposal. If a dollar appreciation further erodes their profits, then these industries have little to spend on investment.

Labor Market Outcomes

The expectation that industries hurt by a dollar appreciation will cut employee wages or rely on lower paid staff is partly supported by empirical evidence. A stronger dollar does restrain wage growth, although not in all industries. Statistical tests show that dollar movements can explain a significant portion of wage variability in half of the twenty U.S. manufacturing industries (Campa and Goldberg 1998). Indeed, for seven of these industries, dollar fluctuations explain more than 20 percent of the fluctuations in industry wage growth between 1971 and 1995. In addition, since 1995, dollar appreciation appears to have led to considerable restraint on wage growth in four industries—chemicals, industrial machinery, electronic equipment, and instruments.

In contrast to wage movements, overall employment in the twenty manufacturing industries—measured as the total number of workers in each industry or the total hours worked—is largely unresponsive to dollar movements. This finding seems to contradict anecdotal evidence that revenue losses stemming from the dollar's rise have forced industries to lay off workers. One possible interpretation of this surprising result is that a dollar appreciation has created "churning" within industries—a phenomenon in which large numbers of workers lose their jobs but go on to find new jobs—rather than permanent job losses.[9] Workers who find new employment within the same industry will not be counted as job losers in the nationally aggregated data for individual industries.

Some support for this interpretation is provided by a study of dollar effects on state-level industry employment. Goldberg and Tracy (forthcoming) show that a stronger dollar is correlated with job losses in some states. These job losses might be masked in the national data if the workers who were laid off were able to find new jobs within the same industry by crossing state lines.

The hypothesis about churning may also shed light on the finding that a dollar appreciation precipitates a wage decline in some industries. If a stronger dollar creates an environment in which workers are fired and subsequently hired elsewhere, then it is possible that these workers are taking a pay cut when they enter their new jobs.[10]

Conclusion

U.S. manufacturers are now more reliant on export markets and on imported inputs than at any time in recent history. As a consequence, both industry revenues and production costs are influenced by the international value of the dollar. Although these effects run counter to each other, our calculations indicate that for most manufacturing industries, revenue losses will exceed any cost savings when the dollar rises.

Empirical analysis of industry performance since the mid-1970s provides concrete evidence of the negative consequences of a stronger dollar for U.S. manufacturing. Recent studies have confirmed expectations that a dollar appreciation will significantly reduce producer profits and restrain investment spending. The extent of these effects varies across industries, however, and can depend strongly on industry characteristics such as net external orientation and profit structure. Moreover, although studies do not show that industries reduce overall employment or cut workers' hours in response to exchange rate shifts, there is evidence that a strong dollar depresses wage growth and may create churning in many industries.

Notes

1. Because the dollar has followed a predominantly upward path in the past two years, our investigation is framed as an inquiry into the consequences of a dollar appreciation. If, instead, we wanted to consider the effects of a dollar depreciation, we would find these effects to be qualitatively similar but opposite in direction.

2. Of course, U.S. manufacturers may choose to avert a loss in foreign sales by keeping foreign market prices and export quantities stable. Such a strategy means, however, that the manufacturers' profits will absorb the full brunt of the dollar appreciation.

3. The concept of net external orientation was introduced in Campa and Goldberg (1997).

4. The imported input shares generally exclude raw material imports but include all processed inputs.

5. This measure is rough because it neglects producer exposure through import competition. In addition, it treats revenue and cost considerations as offsets to each other in all producer decision making.

6. We use the U.S. Department of Commerce's breakdown of manufacturing into twenty broad industries. These industries are identified by two-digit codes in the Department's Standard Industrial Classification system.

7. The estimation procedure used in Campa and Goldberg (forthcoming) treats investment responses as surfacing in the data one year after the dollar movement. All of the numerical examples in the investment spending section draw on regression results in this study.

8. Campa and Goldberg (forthcoming) generate these results by dividing the twenty manufacturing industries into a high-markup group and a low-markup group and estimating the sensitivity of investment to exchange rates for each group. The low-markup group consisted of food, textiles, apparel, lumber, furniture and fixtures, paper, petroleum refining, leather, primary metal products, fabricated metal products, and transportation equipment.

9. Davis and Haltiwanger (1997) document that churning occurs within industries in response to oil price shocks.

10. Kletzer (forthcoming) examines these wage dynamics.

References

Campa, José, and Linda S. Goldberg. 1995. "Investment in Manufacturing, Exchange Rates and External Exposure." *Journal of International Economics* 38 (May 1995): 297-320.

——. 1997. "The Evolving External Orientation of Manufacturing: A Profile of Four Countries." Federal Reserve Bank of New York *Economic Policy Review* 3, no. 2 (July): 53-82.

——.1998. "Employment versus Wages and the U.S. Dollar." NBER Working Paper no. 6749, October.

——. Forthcoming. "Investment, Pass-Through, and Exchange Rates: A Cross-Country Comparison." *International Economic Review*.

Clarida, Richard H. 1997. "The Real Exchange Rate and U.S. Manufacturing Profits: A Theoretical Framework with Some Empirical Support." *International Journal of Finance and Economics* 2, no. 3 (July): 177-88.

Davis, Steven J., and John Haltiwanger. 1997. "Sectoral Job Creation and Destruction Responses to Oil Price Changes and Other Shocks." Working paper, University of Chicago.

Goldberg, Linda, and Joseph S. Tracy. Forthcoming. "Exchange Rates and Local Labor Markets." In Robert Feenstra, ed., *The Impact of International Trade on Wages*. NBER.

Kletzer, Lori. Forthcoming. "Trade and Job Loss in U.S. Manufacturing, 1979-94." In Robert Feenstra, ed., *The Impact of International Trade on Wages*. NBER.

Sheets, Nathan. 1992. "The Exchange Rate and Profit in Developed Economies: An Intersectoral Analysis." Working paper, Board of Governors of the Federal Reserve System.

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