

# Should States Fear the Effects of a Changing Dollar?

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**S**ince the introduction of flexible exchange rates in August 1971, economists have sought to measure the effects of a changing dollar on the national economy. Recently, they have given some attention also to the effects a changing dollar has on the economic activity of states and regions.

Movements in exchange rates can have different effects across states for several reasons. Some states specialize in the production of certain goods. Some make goods that are more exportable than others. And some are better

positioned geographically for foreign trade. According to recent studies, movements in the exchange rate appear to have their largest effects on states in the East North Central, West North Central, and Mountain regions.

Policymakers at the state and local levels cannot affect exchange rates directly. They can, however, influence other things that affect a state's international competitiveness. One is the productivity of a state's workers. A recent study has shown that the effect of changes in U.S. productivity relative to foreign productivity has been quite large for many states.

States often have focused attention on attracting foreign investment, promoting exports, and lobbying for protection from international

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competition. This new study suggests that state governments can also improve their foreign competitiveness by adopting policies that increase the productivity of their firms.

### HOW EXCHANGE RATE MOVEMENTS AFFECT A COUNTRY'S NET EXPORTS

The nominal exchange rate is one currency's price in terms of another—for example, 1.5 German marks per U.S. dollar.<sup>1</sup> When the dollar appreciates in value—rising to, say, 2.0 marks—people need fewer dollars to buy a given number of marks. In the U.S., German goods become relatively less expensive than comparable goods made in the United States, and imports from Germany rise. Meanwhile, in Germany, U.S. goods become relatively more expensive than German goods, and imports from the U.S. fall.<sup>2</sup>

The reverse happens when the dollar depreciates in value against the mark. People need more dollars to buy marks. In the U.S., German goods become relatively more expensive than comparable U.S. goods, and imports from Germany decline. Meanwhile, in Germany, U.S. goods become relatively cheaper than German goods, and imports from the U.S. increase.

By itself, however, the nominal exchange rate does not necessarily indicate how much more (or less) expensive U.S. goods will be relative to foreign goods. If the dollar is appreciating at a time when inflation rates are higher in foreign countries than in the U.S., then some of the dollar's appreciation will merely be compensating for the higher inflation abroad.

Economists have developed the notion of the *real* exchange rate to measure a country's

competitiveness in world trade. The real exchange rate is the nominal exchange rate adjusted for the price level across countries.<sup>3</sup>

**Productivity Differences Matter.** Among other things, relative inflation rates can be influenced by changes in productivity levels across countries. When U.S. productivity increases, U.S. firms can produce more units of output with the same number of worker-hours, and the average cost of production falls, or at least rises less than it would have if productivity had not increased. The higher productivity leads to an increased supply of U.S. goods and thus to a lower price (or at least a smaller increase in price) both at home and abroad.

If productivity levels in other countries remain the same, or increase at a slower rate than in the U.S., then the prices of U.S. goods compared to foreign goods will fall at home and abroad. The relatively lower prices of U.S. goods abroad lead to higher U.S. exports to foreign countries. And in the U.S., the relatively lower prices of domestic goods lead to what is called *import substitution*, the substituting of domestic goods for imported goods. With fewer foreign goods being imported and more U.S. goods being exported, net exports increase.<sup>4</sup>

<sup>3</sup>In the long run, any change in relative prices may be offset by changes in the nominal exchange rate that keep the real exchange rate constant. According to the purchasing-power-parity (PPP) doctrine, a country's exchange rate is linked closely to the ratio of domestic prices to foreign prices. If domestic prices rise more than foreign prices, the home nation's currency should depreciate proportionally. There is some debate about whether deviations from PPP are in fact temporary. The evidence suggests, however, that if PPP holds, it is a long-run proposition. See J.A. Whitt, "Purchasing-Power Parity and Exchange Rates in the Long Run," Federal Reserve Bank of Atlanta *Economic Review* (July/August 1989) pp. 18-32.

<sup>4</sup>For an extended discussion of the effects of changes in productivity on the market for foreign trade, see J.A. Tatom, "The Link Between the Value of the Dollar, U.S. Trade and Manufacturing Output: Some Recent Evidence," Federal Reserve Bank of St. Louis *Review* (November/December 1988) pp. 24-37.

<sup>1</sup>Except for the dollar/pound exchange rate, most exchange rates are expressed as units of foreign currency per dollar.

<sup>2</sup>This assumes that the home-currency prices of U.S.-produced goods relative to foreign-produced goods remain unchanged.

## REGIONS ARE AFFECTED BY CHANGES IN REAL EXCHANGE RATES

Many studies have looked at the effects of real exchange rates on the national economy, but far less is known about their effects on U.S. states and regions. The few regional studies that have been conducted find that the effects of a changing dollar are uneven across states and regions. Two factors that matter are a state's location and its industry mix.

**Geographic Proximity.** States that are geographically close to a major U.S. trading partner may have a relatively larger share of their total trade with this particular country. International evidence shows that a country first establishes trade relations with bordering countries. Not only are transportation costs lower, but more information is generally available about these countries, and the historical and cultural ties are closer.<sup>5</sup> In many instances, this may also be true for regions within a country. A region will tend to have relatively more information and closer ties—and hence a relatively larger share of total trade—with the foreign country closest to it.

If there are transportation costs associated with the shipping of goods between U.S. and foreign markets, goods may become more expensive for the states furthest from foreign markets. This is particularly true for goods, such as wheat, that have a low value per pound. For these goods, transport costs will be a larger portion of the delivered price than will be the case when a high-value-per-pound good, such as computer chips, is shipped the same distance.

In a study conducted at the Kansas City Fed, Tim Smith finds that regional export relationships are determined largely by geographic

proximity to trading partners. Smith looked at nine U.S. regions' shares of manufactured exports to the nation's top 10 export destinations in 1987. The regions were chosen by grouping states with similar manufacturing activity and, where possible, by grouping states according to proximity to major ports. He found that the Great Lakes states ship around 50 percent of their manufacturing exports to Canada, while the average for the U.S. as a whole is just over 23 percent. To Mexico go about 28 percent of the Southwest states' share of manufactured exports, compared with just 6.2 percent for the nation. The Rocky Mountain states ship 20 percent, and Western states about 21 percent, of their manufacturing exports to Japan, compared with about 10 percent for the nation.<sup>6</sup>

Since the states differ in their amount of trade with particular countries, some have been much more affected by real exchange rate declines than others. For example, in recent years the dollar has fallen more against the Deutsche mark, the British pound, and the Japanese yen than it has against the Canadian dollar. According to Smith's findings, other things equal, states that export mainly to Europe or Japan would have been affected more by changing exchange rates than have those states that export mainly to Canada.

**Industry Mix.** Some sectors, such as agriculture and manufacturing, are more exposed to exchange rate swings than others, either because their industries export more of their output to other countries or because their products are easily substituted for foreign prod-

<sup>5</sup>See Irving B. Kravis and Robert E. Lipsey, "The Location of Overseas Production and Production for Export by U.S. Multinational Firms," *Journal of International Economics* 12 (1982) pp. 201-23.

<sup>6</sup>See T.R. Smith, "Regional Exports of Manufactured Products," Federal Reserve Bank of Kansas City *Economic Review* (January 1989) pp. 21-31. Smith also finds evidence that manufactured exports make varying contributions to personal income across regions. Manufactured exports as a percentage of personal income ranged from highs of 6.2 percent in the Southwest and 5.9 percent in the West to a low of 2.7 percent in the Rocky Mountain states. Thus, location may be a factor in the foreign sector's total effect on a region's economy.



ucts. And even within these sectors, some industries are more exposed than others. Among manufacturing industries, for example, producers of durable goods are more export-oriented than producers of nondurable goods.

Looking at exchange rate effects by industry, Dallas Fed researchers Michael Cox and John Hill calculated the effects of dollar depreciation between March 1985 and June 1987 for various U.S. manufacturing industries.<sup>7</sup> They found that individual industries were affected far differently by the dollar's fall. When weighted to reflect a state's industrial mix, the industry responses indicated the degree to which a lower dollar affects a state's manufacturing output. The results showed manufacturing production gains in much of the Northeast, the upper Midwest, and the West exceeding the national average. Below-average production gains were found for most of the South Atlantic, the South Central, and the Northern Plains states.

### CAN THE EFFECTS ON STATES BE ESTIMATED DIRECTLY?

As much as the two Fed studies reveal about the state and regional effects of exchange rate movements, they provide no direct estimates of how much a state's output or employment will change as a result. Only recently have economists attempted to estimate these effects directly.

Using a statistical (multiple regression) analysis, William Branson and James Love consider what effect the dollar's 1980-85 appreciation had on state manufacturing employment. They found that 35 states responded significantly to changes in exchange rates adjusted for unit labor costs and that the dollar's rise was a major cause of job losses in the Great

Lakes states, from Ohio westward, and in the central states.<sup>8</sup>

But in addition to direct effects on manufacturing employment, there are indirect effects to consider. When manufacturing employment falls because of dollar appreciation, for instance, the incomes of manufacturing workers decline, and this has a multiplier effect on state output. Moreover, little is known about the international exports of industries other than manufacturing, such as financial services, and the effects of import substitution on a state's output. And finally, a state's output can be affected by subcontracting on export orders received by other states. For example, auto companies in Michigan could hire New York advertising firms to help boost sales abroad.

**Relating State GSP to Exchange Rates and Productivity.** An aggregate measure of state production, such as gross state product (GSP), captures both the direct and indirect effects of exchange rate movements. A Philadelphia Fed study, by Gerald Carlino, Brian Cody, and Richard Voith, looks at GSP growth to assess what effect changes in real exchange rates had on the 48 contiguous states during the period 1973-86.<sup>9</sup> The authors relate growth in GSP to changes in the real exchange rate, to growth of foreign income, to growth of U.S. income, and to relative growth in foreign productivity (in other words, growth in foreign manufacturing

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<sup>8</sup>By adjusting for unit labor costs, Branson and Love's exchange rate variable combines the effects of changes both in exchange rates and in foreign productivity relative to U.S. productivity. See W.H. Branson and J.P. Love, "The Real Exchange Rate and Employment in U.S. Manufacturing: State and Regional Results," National Bureau of Economic Research, Working Paper 2435 (November 1987).

<sup>9</sup>Unlike Branson and Love, Carlino, Cody, and Voith separate the effects on GSP growth of changes in the real exchange rate and in foreign productivity relative to domestic productivity. See G.A. Carlino, B. Cody, and R. Voith, "Regional Impacts of Exchange Rate Movements," *Regional Science Perspectives* 20 (1990) pp. 89-102.

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<sup>7</sup>See M.W. Cox and J.K. Hill, "Effects of the Lower Dollar on U.S. Manufacturing: Industry and State Comparisons," Federal Reserve Bank of Dallas *Economic Review* (March 1988) pp. 1-9.

productivity relative to growth in U.S. manufacturing productivity).<sup>10</sup>

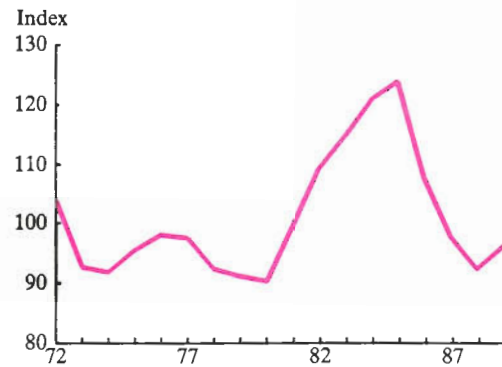
States respond differently to changes in exchange rate movements and to changes in relative growth in foreign productivity. The size of the state's response depends on its sensitivity to changes in both variables, as well as on the extent of such changes. Moreover, state growth responds to changes in exchange rates and in the relative growth of foreign productivity in the current year, as well as to changes in these variables in the *previous* year.

Over the period covered by the study, the relative growth of foreign productivity had a bigger effect on a state's economy than did the change in the dollar's value (after controlling for changes in relative productivity growth). First, GSP growth responds more to changes in the former than the latter. Second, relative foreign productivity changed more than the exchange rate during the 1972-86 period. The dollar's trade-weighted value, though subject to short-run swings, appreciated only 2.7 percent between 1972 and 1986 (Figure 1).

During the same period, however, the growth of foreign productivity greatly exceeded the growth of U.S. productivity. In 1972, foreign manufacturing workers were only 61 percent as productive as American workers, but by 1986 this ratio had increased to 76 percent—an increase of 24.5 percent, or about 1.6 percent per year. In the period 1972-84, U.S. productivity declined relative to foreign productivity. However, in the two years that followed, U.S. productivity rebounded a bit and in recent years has kept pace with the growth of foreign productivity (Figure 2).

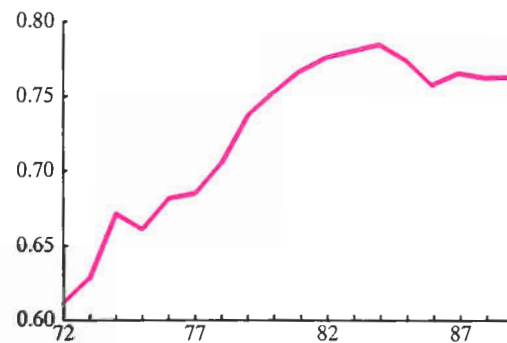
<sup>10</sup>Since the study considers the growth in aggregate GSP, the growth in *overall* foreign productivity relative to *overall* domestic productivity is the appropriate productivity measure. Since a measure of relative productivity in the service sector is not available, studies use the growth in *manufacturing* productivity at home relative to abroad as a proxy for overall productivity growth.

**FIGURE 1**  
**Real Trade-Weighted Value of the Dollar**



Source: Morgan Guaranty

**FIGURE 2**  
**Foreign Productivity Grew Faster\***



\* The ratio of foreign manufacturing productivity relative to domestic manufacturing productivity

Source: Peter Hooper and Kathryn A. Larin, "International Comparisons of Labor Costs in Manufacturing," Board of Governors of the Federal Reserve System, International Finance Discussion Paper 330 (August 1988).

**The Effects of Productivity Changes.** According to the Philadelphia Fed study, 21 states are significantly affected by changes in relative foreign productivity. The results show that the average annual growth in GSP for these 21 states was 1.2 percentage points lower than what it would have been if foreign productivity had not grown faster than domestic productivity between 1972 and 1986 (Table 1). Fifteen states were affected negatively by the higher growth of foreign productivity. Eight of those states are located in the manufacturing belt (Figure 3).

Michigan was hit hardest by the increase in relative productivity, which reduced growth of Michigan's GSP by 2.0 percentage points per year between 1973 and 1986. This substantial reduction resulted in an actual growth rate of only 1.3 percent. During this period, eight other states experienced average annual reductions in their GSP growth rates of at least 1.5 percentage points because of relatively faster foreign productivity growth: Illinois, Indiana, Louisiana, New York, Ohio, Pennsylvania, Rhode Island, and West Virginia. Six other states—Delaware, Iowa, Kansas, Missouri, Nebraska, and South Dakota—were also affected negatively, though to a lesser extent.

The results show that the increase in relative productivity was associated with faster GSP growth rates in six states: Arizona, Colorado, Florida, Nevada, New Hampshire, and Utah. Average annual GSP growth rates in these states increased at least 0.9 percentage point during the period. Interestingly, many of these states are located in the Sunbelt (the Southwest and Florida). While these states are not major manufacturing states, all have seen their manufacturing share of GSP increase over time.<sup>11</sup>

<sup>11</sup>See G.A. Carlino, "What Can Output Measures Tell Us About Deindustrialization in the Nation and its Regions?" this *Business Review* (January/February 1989) pp. 15-27.

**TABLE 1**  
**Relative Growth of**  
**Foreign & U.S. Productivity**  
**Affects GSP Growth**  
**in the Long Run**  
**1973 - 1986**

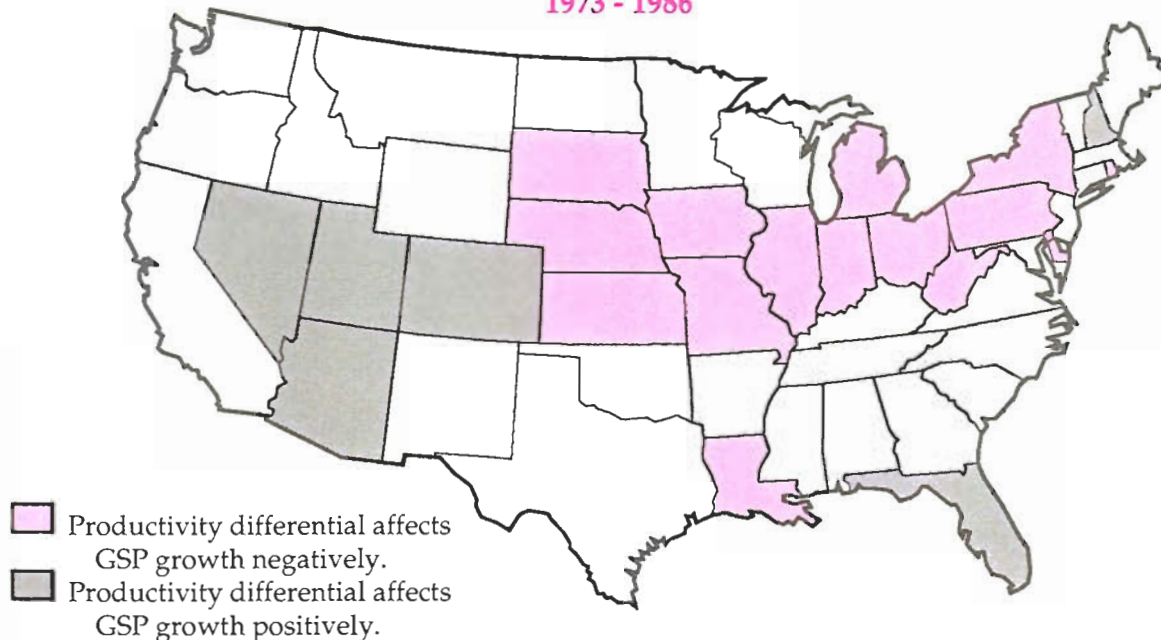
	Average annual change in real GSP	Average annual change in real GSP due to the relative increase in productivity*
Arizona	5.0%	1.3%
Colorado	4.1	1.2
Delaware	1.8	-1.1
Florida	4.6	1.3
Illinois	1.3	-1.6
Indiana	1.5	-1.6
Iowa	1.9	-1.1
Kansas	2.1	-0.9
Louisiana	0.1	-1.8
Michigan	1.3	-2.0
Missouri	2.1	-1.0
Nebraska	2.2	-1.0
Nevada	5.0	1.8
New Hampshire	6.0	1.7
New York	1.5	-1.5
Ohio	1.4	-1.5
Pennsylvania	1.2	-1.6
Rhode Island	1.8	-1.5
South Dakota	2.2	-0.6
Utah	4.1	0.9
West Virginia	0.8	-1.6
21-STATE AVERAGE**	1.8	-1.2

\*See Appendix for details on calculations.

\*\*Represents a weighted average (based on a state's GSP share in 1972) of the individual states' average annual growth rates.



**FIGURE 3**  
**Increases in Relative Productivity Affect Gross State Product**  
**1973 - 1986**



Source: Carlino, Cody, and Voith (1990)

### The Effects of Exchange Rate Changes.

The Philadelphia Fed study, after controlling for changes in relative productivity growth, finds that fewer states—11 in all—were affected significantly by changes in the dollar's trade-weighted value (Table 2, p. 10). The results indicate that the average annual growth of GSP for these 11 states would have been only 0.05 percentage point greater if the dollar had not changed in the years from 1972 to 1986. This effect is much smaller than that found for relative productivity. Growth rates decreased in seven states, which tended to be grouped in the Midwest and Northwest—Iowa, Montana, Wyoming, North Dakota, South Dakota, Oregon, and Washington (Figure 4, p. 10). Wyoming was hit hardest by the dollar's fluctuations. On an average annual basis, Wyoming's GSP grew 0.8 percentage point more slowly than it otherwise would have.

Not all states were hurt by the changing dollar, however. For example, Massachusetts, New Hampshire, and Vermont experienced faster GSP growth during the 1973-86 period. A Boston Fed study by Jane Little argues that, within the manufacturing industries, the rising dollar caused a shift from unskilled labor-intensive industries to skilled labor-intensive industries, such as the high-tech firms employing scientists and engineers.<sup>12</sup> Since the New England region has a relatively large concentration of high-tech firms, it is not surprising that many of its states experienced faster GSP growth, despite the dollar's appreciation.

<sup>12</sup>See J.S. Little, "The Dollar, Structural Change, and the New England Miracle," Federal Reserve Bank of Boston *New England Economic Review* (September/October 1989) pp. 47-57. Georgia's GSP growth rate also responds positively to dollar appreciation.





## CONCLUSION

All the recent studies on the regional effects of exchange rate movements tend to find the largest impact in the states of the East North Central region: Ohio, Indiana, Michigan, and Wisconsin. Similarly, large effects are generally found for states in the West North Central and the Mountain regions.

Some differences across studies do emerge. The studies from the Dallas Fed and the Philadelphia Fed find that many of the New England states respond strongly to exchange rate movements, while the other studies find little or no response. Moreover, the Philadelphia Fed study finds that two of the three Mid-Atlantic states (Pennsylvania and New York, but not New Jersey) respond strongly to relative productivity changes, while the other studies looking only at changes in exchange rates find little or no response.

The findings in this article suggest that, in the long run, states have more to fear from slow productivity growth than from fluctuations in the dollar. Relative productivity constant, exchange rate changes have had small effects on most states' GSP growth. More important, however, have been changes in the relative growth of foreign productivity. In the past,

state governments have focused their foreign-sector efforts on attracting foreign direct investment, promoting exports, and lobbying the federal government for protection from foreign competition. However, the importance of changes in relative productivity suggests that state governments may want to put more emphasis on policies designed specifically to improve productivity.

Numerous studies have documented the contribution of public infrastructure in increasing a state's aggregate productivity.<sup>13</sup> Under this category, states can adopt policies designed to improve their roads, highways, and bridges. In the long run, they can enhance the productivity of their workers by making a greater investment in education to improve their skills. Manpower-retraining programs may also be an effective way to increase worker productivity in the short run. And finally, states can develop programs to promote the technical progress of their firms.

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<sup>13</sup>See, for example, K.T. Duffy-Deno and R.W. Eberts, "Public Infrastructure and Regional Economic Development: A Simultaneous Equation Approach," Federal Reserve Bank of Cleveland, Working Paper 8909 (1989).

## APPENDIX

This Appendix describes the method used to calculate the estimated effects of changes in relative productivity and exchange rates on state GSP growth rates reported in Tables 1 and 2. The basic empirical model, pooled cross-sectional time series for 48 contiguous states, covers the period 1973-86 and is summarized by the general form:<sup>a</sup>

$$\begin{aligned} \dot{g}_{jt} = & \alpha_0 + \alpha_1 \dot{y}_t^* + \alpha_2 \dot{y}_t + \sum_{j=1}^{48} \beta_{j,0} S_j \dot{e}_t + \sum_{j=1}^{48} \beta_{j,1} S_j \dot{e}_{t-1} \\ & + \sum_{j=1}^{48} \gamma_{j,0} S_j (\dot{\omega}_t^* - \dot{\omega}_t) + \sum_{j=1}^{48} \gamma_{j,1} S_j (\dot{\omega}_{t-1}^* - \dot{\omega}_{t-1}) + \mu_t \end{aligned}$$

where:

- $\dot{g}_{jt}$  = GSP growth rate in the jth state in year t
- $\dot{y}_t^*$  = the growth rate of foreign gross domestic product in year t
- $\dot{y}_t$  = the growth rate of U.S. gross domestic product in year t
- $\dot{e}_t$  = the growth rate of the trade-weighted exchange rate in year t, adjusted for relative prices of finished manufactured goods
- $S_j$  = dummy variable for the jth state
- $\dot{\omega}_t^*$  = the growth rate of output per man-hour in foreign manufacturing in year t
- $\dot{\omega}_t$  = the growth rate of output per man-hour in U.S. manufacturing in year t
- $\mu_t$  = random error term

**Data.** Real GSP data for the 48 contiguous states are obtained from the Bureau of Economic Analysis, U.S. Department of Commerce. Foreign (OECD countries excluding the U.S.) and U.S. gross domestic product variables are obtained from the OECD's *Main Economic Indicators*. The real exchange rate is Morgan Guaranty's trade-weighted index of the value of the dollar, adjusted for final goods prices, against the United States' 24 largest trading partners. The manufacturing productivity variables, measured for the national economy, are taken from a study by Hooper and Larin.<sup>b</sup>

The estimated parameters from this model can be used to calculate what effect the changing dollar, for example, had on the average annual GSP growth rates for each of the 11 significantly affected states during the 1973-86 period. The effect on GSP growth from a changing dollar in year t can be computed as  $(\hat{\beta}_{i,0} \dot{e}_t + \hat{\beta}_{i,1} \dot{e}_{t-1})$ , where  $\hat{\beta}_{i,0}$  and  $\hat{\beta}_{i,1}$  are the estimated parameters on the exchange rate variable for the significantly affected states. The effect on GSP growth over the entire 14-year period is given by:

$$\Pi_{i,t=1973}^{1986} [1 + (\hat{\beta}_{i,0} \dot{e}_t + \hat{\beta}_{i,1} \dot{e}_{t-1})]$$

From this expression, the changing dollar's effect on the compound average annual growth rate of real GSP is calculated and reported in column 2 of Table 2.

A similar procedure is followed to arrive at the estimated effects of changes in relative foreign productivity on the 21 significantly affected states that are reported in column 2 of Table 1.

<sup>a</sup>The model was estimated using log differences. For more details, see G.A. Carlino, B. Cody, and R. Voith, "Regional Impacts of Exchange Rate Movements," *Regional Science Perspectives* 20 (1990) pp. 89-102.

<sup>b</sup>Peter Hooper and Kathryn A. Larin, "International Comparisons of Labor Costs in Manufacturing," Board of Governors of the Federal Reserve System, International Finance Discussion Paper 330 (August 1988).