REGIONAL IMPACTS OF EXCHANGE RATE MOVEMENTS

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Introduction

The combination of a tight anti-inflationary U.S. monetary policy, a rapidly expanding federal budget deficit, and an improved outlook for investment in the U.S. led an unprecedented appreciation of the dollar in the early 1980s. Between 1980 and mid-1985, the real value of the dollar appreciated by over 45 percent on a trade-weighted basis. This appreciation translated into a severe reduction in the competitiveness of many U.S. export- and import-competing industries. During this period, nominal exports decreased by nearly 4 percent while imports grew 35 percent, producing a $100 billion deterioration in the U.S. merchandise trade balance. The dollar reversed its course in mid-1985 and depreciated by 20 percent on a real trade-weighted basis over the next 18 months. This depreciation has contributed to the recovery of many U.S. export- and import-competing industries in the second half of the decade.

The volatility of the dollar during the 1980s has raised questions about the impact of exchange rate movements on a region's economy. As many industries tend to be concentrated geographically because of nearness to markets and gravitation to inputs, industrial mixes vary widely across regions of the country. This variety suggests that regions may respond differentially to a given change in the value of the dollar. Branson and Love [1, 2] find substantial differences in the effects of exchange rate movements on employment and output across U.S. manufacturing industries. Their work provides an introduction to a broader assessment of the impact of exchange rate movements on regional economic activity.

As the papers in this volume by Coughlin *et al.*, Kahley, and Giese show, much research has been undertaken into the regional impacts of foreign direct investment. At present, no research investigates the effect of exchange rate movements on regional economic growth. This lack of attention largely has been due to the absence of regional data on domestic export activity or even aggregate output. Although the *Census of Manufacturers* publishes data on exports for manufacturing

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firms, these data are not suited to analyzing international trade and regional growth. In particular, little is known about the international export activity of industries other than manufacturing, such as financial services, and the effects of import substitution on an area's output. Data on total international exports by state are available for 1987 and 1988, but they are not available for other years. In addition, Smith [9] raises a number of important objections regarding the state export data. Moreover, there are important indirect effects on a state's output due to subcontracting on export orders received by other states (auto firms in Michigan hire Madison Avenue advertising firms to help boost sales of their autos abroad).

This lack of data has led researchers to take alternative approaches to estimating the responsiveness of production in a region's tradable goods sector. Cox and Hill [4] calculate the dollar depreciation between March 1985 and June 1987 for each two digit manufacturing industry. This measure is combined with an estimate of the sensitivity of industrial production to changes in exchange rates to form an estimate by industry of the effects of the lower dollar on U.S. manufacturing output. When weighted to reflect a state's industrial mix, these individual industry responses provide Cox and Hill with an estimate of the effects of a lower dollar on manufacturing output at the state level.

Rather than inferring the individual state effects of exchange rate movements as in Cox and Hill [4] or focusing narrowly on manufacturing as Branson and Love [1, 2], researchers now use recent data on real Gross State Product (GSP) to estimate state specific exchange rate effects directly. This paper estimates the impact of exchange rate changes on aggregate output at the state level for the period 1972-1986. After controlling for productivity differentials, the findings indicate real exchange rate movements (nominal exchange rate changes adjusted for shifts in relative final goods prices between the U.S. and its major trading partners) have lasting effects on economic growth in 11 states. Although 11 appears to be a relatively small number of states, the magnitude of exchange rate movements on the growth rate of GSP in these states is relatively large. The results for states that are adversely affected by a dollar appreciation indicate that, on average, a 10 percentage point acceleration in the rate of appreciation of the dollar is associated with roughly a 4 percentage point deceleration in the rate of GSP growth. In addition, the findings indicate that 21 states predominantly located in the industrial belt experienced large and permanent changes in their growth rates of GSP as a result of changes in relative productivity growth between the U.S. and its major trading partners.

The Empirical Model

The main objective of this paper is to analyze the effects of changes in real exchange rates on real economic growth at the state level. To capture the full exchange rate effects, this study focuses upon production in the entire tradable goods sector, as proxied by real gross state product (GSP). This paper employs a simple supply and demand model for tradable goods developed by Branson and Love [1, 2]. This model suggests that the domestic production of tradable goods will be inversely related to the real exchange rate and positively related to domestic and foreign real income.

Because a consistent real exchange rate series (adjusted for relative wages) is not available for the entire sample period, the empirical model separates the effects of relative labor costs and the real exchange rate. Specifically, the model enters the trade-weighted value of the dollar adjusted for final goods prices and relative U.S. and foreign productivity as separate explanatory variables. The trade-weighted value of the dollar and relative productivity variables are interacted with a dummy variable for each state to capture their state-specific effects.

The model to be estimated is a pooled cross-sectional time-series for 48 contiguous states covering the period 1972-1986 and is summarized by the general form:

$$(1) \qquad \Delta g_{jt} = \alpha_0 + \alpha_1 \Delta y_t^* + \alpha_2 \Delta y_t + \sum_{j=1}^{48} \beta_{j,0} S_j \Delta e_t + \sum_{j=1}^{48} \beta_{j,1} S_j \Delta e_{t-1} + \sum_{j=1}^{48} \gamma_{j,0} S_j (\Delta \omega_t^* - \Delta \omega_t) + \sum_{j=1}^{48} \gamma_{j,1} S_j (\Delta \omega_{t-1}^* - \Delta \omega_{t-1}) + \mu_t$$

where:

g_{jt} = (log) GSP in the jth state in year t;
y_t^* = (log) foreign gross domestic product in year t;
y_t = (log) U.S. gross domestic product in year t;
e_t = (log) real trade-weighted exchange rate in year t adjusted for relative prices of finished manufactured goods;
ω_t^* = (log) output per man-hour in foreign manufacturing in year t;
ω_t = (log) output per man-hour in U.S. manufacturing in year t;
S_j = dummy variable for the jth state;

μ_t = random error term;
ΔX_t = $X_t - X_{t-1}$.

As all variables are in logs, taking first differences implies that the regression is estimated in terms of the **growth rates** of the respective variables.

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' largest trading partners. The manufacturing productivity variables, which are measured for the national economy, are taken from Hooper and Larin [5].

The sample begins in 1972, the first full year after the breakdown of the Bretton Woods system of fixed exchange rates, and ends in 1986 with the last available observation for GSP. The Δy_t^* variable in equation (1) proxies growth in foreign real income. The coefficient on this term, α_1, is expected to be positive because an increase in foreign income growth, *ceteris paribus*, should stimulate U.S. exports and thus increase real GSP growth. The growth in domestic (U.S.) income is captured by Δy_t. An increase in the growth of aggregate income should stimulate demand for domestically (as well as foreign) produced tradable goods, implying a positive value for α_2.

The rate of appreciation of the real exchange rate, Δe_t, is interacted with the state dummy variables, S_j, to capture the state-specific effects of exchange rate changes. An appreciation of the real value of the dollar, $\Delta e_t > 0$, indicates a loss of U.S. competitiveness on world goods markets and should be associated with slower GSP growth.

This exchange rate effect is, however, a long-run result; that is, the full impact of exchange rates on trade flows generally are not felt within a short period, such as one year. The short-run trade effects of changes in the exchange rate are ambiguous. If trade flows respond gradually to an appreciation of the dollar, a J-curve pattern may be observed.[1] Specifically, a depreciation of the dollar that raises the prices of foreign goods relative to domestic goods eventually should cause U.S. net exports to increase. In the short run, however, the increase in import prices relative to export prices can cause the measured net exports to decrease. There are also production and delivery lags that lengthen the actual response of trade flows and

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[1] For an accessible survey of research on the J-curve, see Meade [8].

production to exchange rate changes. To account for a possible J-curve effect, the current and one period lagged values of the appreciation of the dollar are interacted with the state-specific dummies. Although the expected sign on $\beta_{j,0}$ is ambiguous, the anticipated sign on $\beta_{j,1}$ is negative. The long-run effect $(\beta_{j,0} + \beta_{j,1})$ should be negative.

Finally, $(\Delta\omega_t^* - \Delta\omega_t)$ represents the growth in productivity abroad relative to growth in U.S. productivity. As with the exchange rate variable, the current and one period lagged values of the relative productivity variable are interacted with the state-specific dummy variables. These variables are designed to capture the effects on GSP growth of output-per-hour differences between the U.S. and its trading partners. Over time, it is expected that an increase in the growth rate of foreign productivity relative to that of the U.S. will cause U.S. goods to become less competitive on the world market, depressing GSP growth, i.e., $\gamma_{j,0}$, $\gamma_{j,1}$ and $(\gamma_{j,0} + \gamma_{j,1}) < 0$. Tatom [10] suggests that in a reduced form specification such as equation (1), the relative productivity term captures supply side effects.

Findings

The results of the pooled cross-sectional time-series estimation of equation (1) are summarized below (the estimated coefficients for the exchange rate and productivity variables are given separately in Table 2):

$$(2)\quad \Delta g_{jt} = \underset{(-0.058)}{-0.0002} + \underset{(2.477)}{0.2751}\Delta y_t^* + \underset{(15.19)}{0.8853}\Delta y_t$$

$$+ \sum_{j=1}^{48} \hat{\beta}_{j,0} S_j \Delta e_t + \sum_{j=1}^{48} \hat{\beta}_{j,1} S_j \Delta e_{t-1}$$

$$+ \sum_{j=1}^{48} \hat{\gamma}_{j,0} S_j (\Delta\omega_t^* - \Delta\omega_t) + \sum_{j=1}^{48} \hat{\gamma}_{j,1} S_j (\Delta\omega_{t-1}^* - \Delta\omega_{t-1})$$

$R^2 = .7640$, $F = 7.96$, 671 observations, t-statistics in parentheses.

The income variables are positive and significant, as expected; faster growth both at home and abroad is associated with an acceleration in the growth rate of GSP. The estimates indicate that a 1 percentage point acceleration in foreign growth produces a statistically and economically significant 0.27 percentage point acceleration in GSP growth. The effect of domestic growth is roughly three times the magnitude of the foreign effect, with a 1 percentage point acceleration in domestic growth leading to a 0.89 percentage point acceleration in GSP growth.[2]

A number of specification tests were conducted to determine the significance of the state-specific effects; that is, various forms of the null hypothesis that the β_js, as well as the γ_js, should be restricted to be equal across states were tested. Table 1 presents convincing evidence of significant differences across states in terms of the response of real GSP growth to both real exchange rate movements and changes in relative productivity growth rates.

Turning to Table 2, the column headed $\hat{\beta}_{j,0}$ ($\hat{\beta}_{j,1}$) lists the estimated coefficients for the exchange rate variable in the current (lagged) period. The column headed $\hat{\beta}_{j,0} + \hat{\beta}_{j,1}$, the sum of the coefficients, gives the estimated long-run effect. Similarly, the column headed $\hat{\gamma}_{j,0}$ ($\hat{\gamma}_{j,1}$) lists the estimated coefficients for the productivity variable in the current (lagged) period. The column headed $\hat{\gamma}_{j,0} + \hat{\gamma}_{j,1}$ gives the estimate of the permanent effect of changes in relative productivity.

The $\hat{\beta}_{j,0}$ coefficient is statistically significant for 11 states. It is negative and significant for five states and positive and significant for six states. The empirical results suggest that the major impacts of exchange rate fluctuations occur after one year. The coefficient on $\hat{\beta}_{j,1}$ is significant for 17 states; more importantly, it is negative (as expected) and significant for 13 of these states. The results also provide some evidence of a J-curve effect for six states (Louisiana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming). In each of these states, an acceleration in the rate of appreciation of the dollar initially caused a significant increase in GSP growth ($\hat{\beta}_{j,0} > 0$) that was offset by a significant slowing in the following year ($\beta_{j,1} < 0$). Five of these six states are major energy-producing states. Future research will attempt to determine what role production bias plays in this result.

The estimated coefficient ($\hat{\beta}_{j,0} + \hat{\beta}_{j,1}$) provides an indication of the permanent effects of exchange rate changes on the growth rate of real GSP. These estimates reveal that real exchange rate changes have long-run effects on GSP in 11 states. Seven states experience permanent reductions in the growth rate of real GSP in response to more rapid appreciation of the real exchange rate. As Figure 1 shows, these states are located in the Midwest and Northwest states (Iowa, North and South Dakota, Montana, Oregon, Washington, and Wyoming). On

[2]An alternative specification also included state dummies interacted with domestic and foreign income growth to allow for differential effects of these variables on GSP growth. This specification, however, was rejected at the 5 percent level.

average, a 10 percent acceleration in the rate of appreciation of the real exchange rate is associated, *ceteris paribus*, with a 4 percent deceleration in the rate of growth of real GSP in these states. Contrary to the predictions of the theory, four states (Georgia, Massachusetts, Vermont, and New Hampshire) benefit from an appreciation of the real exchange rate. Little [6] also finds faster growth of the New England economy during the period of the dollar's appreciation. She argues that the strong dollar induced a shift in resources from unskilled to skilled manufacturing industries (such as high tech industries) that benefitted the New England region.

Although 11 states appears to be a small number, this result reflects the fact that the authors controlled for productivity differences between the U.S. and abroad and, therefore, the exchange rate reflects pure price effects. The results reported in Table 2 indicate that productivity differentials play a crucial role in understanding geographic differences in the sensitivity of GSP growth. Twelve states have significant responses to changes in relative productivity during the current period, with ten states experiencing an expected slowdown in real growth when domestic productivity growth increases more slowly than productivity growth abroad. Twelve states have significant responses to relative changes in the growth of foreign productivity one period after the change occurs; seven states have negative and significant coefficients as expected. A comparison of the results in the $\hat{\gamma}_{j,1}$ column with those in the $\hat{\gamma}_{j,0}$ column shows that the 12 states that are affected one period after a change in the relative growth in productivity are not necessarily the same 12 states that are affected during the period in which the change in relative productivity occurred.

The permanent effects of a change in the relative growth of foreign productivity are given in the column headed $\hat{\gamma}_{j,0} + \hat{\gamma}_{j,1}$. Long-run effects from changes in the growth of foreign productivity are found for 21 states. As Figure 2 shows, 15 states located in the manufacturing belt are found to be affected negatively by a widening of the productivity growth differential between foreign and domestic producers. On average, an acceleration of 1 percentage point in the relative growth rate of foreign productivity produces a permanent .86 percentage point slowdown in the growth rate of GSP in these states.

Conclusion

This paper employs a simple model of the demand and supply of tradable goods to analyze the effects of exchange rate movements and changes in relative productivity on aggregate output at the state level. The findings indicate that changes in the real trade-weighted value of the dollar have permanent effects in 11 states. While a long-run exchange rate effect is found in relatively few states, this result reflects the fact that the estimation controls for productivity differentials. A widening of the productivity growth differential between foreign and domestic producers permanently affects the growth rate of GSP in 21 states, only three of which experience sustained real exchange rate effects.

These results suggest a broader policy role for state governments than currently pursued. In particular, state governments historically have limited their foreign sector efforts to attracting foreign direct investment, promoting exports, and lobbying the federal government for protection from foreign competition. The research by Zech [11], Coughlin and Cartwright [3], and Manrique [7] shows that export promotions have increased industrial growth in some states. The increased importance of the foreign sector suggests, however, that states need to take a more active policy role. There is little that a state government can do to offset an appreciating dollar that reduces its international competitiveness. This paper has shown, however, that increases in a state's growth rate of productivity relative to abroad can improve the growth rate of aggregate output irrespective of changes in the relative prices of final goods.

In light of these findings, state governments should consider policies designed specifically to improve the productivity of their economies. One way a state government could increase the productivity of its firms is through spending to improve its infrastructure. Increased spending to modernize a state's port facilities, highways, and bridges are obvious examples. Another avenue is for state governments to make larger investment in their human capital stock through increased spending on educational programs. Finally, state governments could develop programs that promote technical progress by providing incentives to firms to modernize plant and equipment.

References

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Table 1
Specification Tests

Null Hypothesis	F-Value	Marginal Significance
$\hat{\beta}_{1,0} = \hat{\beta}_{2,0} = \ldots = \hat{\beta}_{48,0}$	2.3515	.0001
$\hat{\beta}_{1,1} = \hat{\beta}_{2,1} = \ldots = \hat{\beta}_{48,1}$	4.9310	.0001
$\hat{\beta}_{1,0} + \hat{\beta}_{1,1} = \hat{\beta}_{2,0} + \hat{\beta}_{2,1} = \ldots = \hat{\beta}_{48,0} + \hat{\beta}_{48,1}$	2.7944	.0001
$\hat{\gamma}_{1,0} = \hat{\gamma}_{2,0} = \ldots = \hat{\gamma}_{48,0} = 0$	1.9754	.0002
$\hat{\gamma}_{1,1} = \hat{\gamma}_{2,1} = \ldots = \hat{\gamma}_{48,1} = 0$	1.9677	.0002
$\hat{\gamma}_{1,0} = \hat{\gamma}_{2,0} = \ldots = \hat{\gamma}_{48,0}$	1.9704	.0002
$\hat{\gamma}_{1,1} = \hat{\gamma}_{2,1} = \ldots = \hat{\gamma}_{48,1}$	1.9944	.0002
$\hat{\gamma}_{1,0} + \hat{\gamma}_{1,1} = \hat{\gamma}_{2,0} + \hat{\gamma}_{2,1} = \ldots = \hat{\gamma}_{48,0} + \hat{\gamma}_{48,1}$	3.7971	.0001

Table 2

Estimated Coefficients on Exchange Rate and Productivity Variables

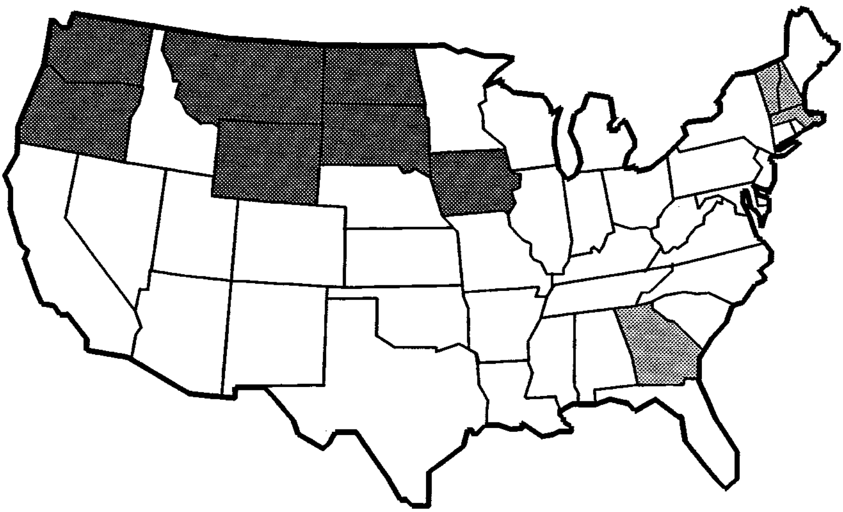
	$\hat{\beta}_{j,0}$	$\hat{\beta}_{j,1}$	$\hat{\beta}_{j,0} + \hat{\beta}_{j,1}$	$\hat{\gamma}_{j,0}$	$\hat{\gamma}_{j,1}$	$\hat{\gamma}_{j,0} + \hat{\gamma}_{j,1}$
Alabama	-.005	.017	.012	.061	-.044	.017
Arizona	-.248**	.234*	-.014	.558**	.232	.790***
Arkansas	.018	-.022	-.004	.206	-.126	.080
California	-.039	.057	.018	-.077	.289	.212
Colorado	-.040	.003	-.037	.199	.448*	.647**
Connecticut	-.023	.187	.164	.084	-.195	-.111
Delaware	-.032	.205	.173	-.625**	-.062	-.687**
Florida	-.172*	.172	.000	.355	.404*	.759***
Georgia	-.099	.344***	.245**	.348	.046	.394
Idaho	.109	-.283**	-.174	.131	-.063	.068
Illinois	.077	-.227*	-.150	-.481*	-.463**	-.944***
Indiana	-.039	-.073	-.112	-.241	-.636***	-.877***
Iowa	.085	-.531***	-.446***	-.760**	.024	-.736**
Kansas	.143	-.241*	-.098	-.346	-.178	-.524*
Kentucky	.118	-.186	-.068	-.084	-.364	-.448
Louisiana	.488***	-.546***	-.058	-.441*	-.574**	-1.015***
Maine	-.020	.203	.183	.336	-.270	.066
Maryland	.009	.006	.015	-.308	-.078	-.386
Massachusetts	.018	.193	.211*	-.177	-.105	-.282
Michigan	-.144	.140	-.004	-.266	-.810***	-1.076***
Minnesota	-.039	-.005	-.044	-.134	.101	-.033
Mississippi	.127	-.098	.029	-.018	-.186	-.204
Missouri	.070	.022	.092	-.233	-.313	-.546*
Montana	-.022	-.464***	-.466***	-.297	-.048	-.345
Nebraska	.256**	-.428***	-.172	-.761***	.122	-.639**
Nevada	-.222**	.057	-.165	.375	.629***	1.004***
New Hampshire	-.242**	.647***	.405***	.733***	.283	1.016***

Table 2 (continued)

	$\hat{\beta}_{j,0}$	$\hat{\beta}_{j,1}$	$\hat{\beta}_{j,0} + \hat{\beta}_{j,1}$	$\hat{\gamma}_{j,0}$	$\hat{\gamma}_{j,1}$	$\hat{\gamma}_{j,0} + \hat{\gamma}_{j,1}$
New Jersey	.004	.177	.181	-.083	-.248	-.331
New Mexico	.226**	-.344***	-.118	-.051	.337	.286
New York	.134	-.043	.91	-.609**	-.266	-.875***
North Carolina	-.032	.143	.111	.084	-.037	.047
North Dakota	.110	-.672***	-.562***	-.528**	.397*	-.131
Ohio	.004	-.113	-.109	-.178	-.648***	-.826***
Oklahoma	.320***	-.389***	-.069	-.229	.007	-.222
Oregon	-.129	-.160	-.289**	.068	-.224	-.156
Pennsylvania	.067	-.210	-.143	-.479*	-.429*	-.908***
Rhode Island	.063	.106	.169	-.363	-.484**	-.847***
South Carolina	-.045	.120	.075	.413	-.040	.373
South Dakota	-.004	-.359***	-.363***	-.957***	.463**	-.494*
Tennessee	-.079	.155	.076	.193	-.155	.038
Texas	.239**	-.223*	.016	-.000	.304	.304
Utah	.048	-.010	.038	.228	.308	.536*
Vermont	-.059	.265**	.206*	.114	-.050	.064
Virginia	-.067	.101	.034	.012	.195	.207
Washington	-.183*	-.068	-.251**	.132	.229	.361
West Virginia	.153	-.314	-.161	-.599**	-.328	-.927***
Wisconsin	-.019	-.025	-.044	-.089	-.155	-.244
Wyoming	.432**	-.973***	-.541***	.067	.285	.352

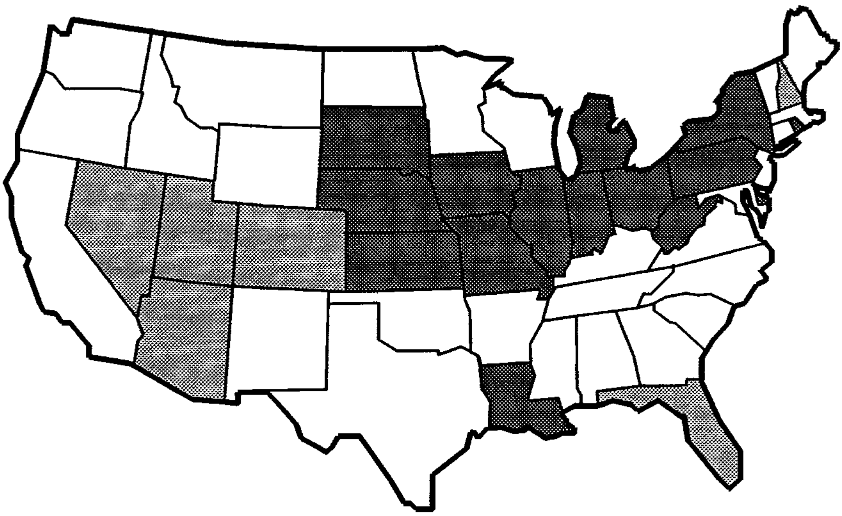
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Figure 1
Pure Exchange Rate Effects by State
1972-1986



Exchange rate effect is negative and significant.
Exchange rate effect is positive and significant.

Figure 2
Productivity Differentials by State
1972-1986



▩ Productivity differential is negative and significant.
▨ Productivity differential is positive and significant.