DOES EXCHANGE RATE APPRECIATION 'DEINDUSTRIALIZE' THE OPEN ECONOMY? A CRITIQUE OF U.S. EVIDENCE

REUVEN GLICK and MICHAEL HUTCHISON*

This paper takes a critical look at the conventional view that the dollar exchange rate appreciation during the early 1980s caused a major resource shift in the U.S. economy away from tradables production, such as manufactures, toward nontradables production. We argue that the association of a dollar appreciation with relative strength or weakness in the tradable goods sector depends on the particular shock causing the appreciation, and consequently that the relation between exchange rates and the sectoral composition of output is unlikely to be stable over time. Our empirical analysis finds evidence of instability in the exchange rate—sectoral output link and of a positive association between tradables output and fiscal stimulus.

I. INTRODUCTION

The sharp appreciation of the dollar in the early 1980s, followed by its decline since 1985, has generated considerable interest in the output effects of exchange rate changes. Many academics, practitioners, and policymakers believe that the initial rise in the value of the dollar significantly depressed growth in the tradable goods sector of the U.S. economy, particularly in manufacturing output, and prevented the tradable goods sector from participating in the initial stages of the general U.S. economic expansion since 1982. The dollar's subsequent sharp decline, in turn, they hope will provide an independent stimulus to the nation's manufacturing sector.

According to this view, development within the U.S. economy was "two-tiered" through 1985: growth was robust in those parts of the economy not directly sensitive to international relative price changes, i.e. nontradables, such as services, construction, transport, public utilities, etc.; while growth languished in those parts of the economy producing either exportable or import-competing goods, i.e. tradable goods, such as manufactures, agriculture, forestry products, etc. Brinner [1985], Marris [1985], Cline [1986], Branson [1986], and Branson and Love [1986; 1987; 1988] provide empirical evidence linking depressed output in manufacturing industries to the strong

* Senior Economist, Federal Reserve Bank of San Francisco, and Assistant Professor of Economics, University of California at Santa Cruz. We thank Roz Bennett, Cindy Beltz, and Kim Luce for research assistance. Helpful comments on earlier drafts by Sven Arndt, Tom Willett, Dick Sweeney, two anonymous referees, and participants at seminars at the University of Konstanz, the University of California at Santa Cruz, and Norges Bank are greatly appreciated. Support for this research from the Ford Foundation is gratefully acknowledged.

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dollar.[1] These results have been interpreted by some as evidence that the appreciation of the dollar has caused or contributed to the "deindustrialization" of the U.S. economy [e.g., Brinner, 1985].[2]

A major shortcoming of the literature, however, is that it typically fails to distinguish between exchange rate changes that are truly exogenous and exchange rate changes that are endogenously determined with output changes by policy and other shocks. This is especially true in the "deindustrialization" debate where exchange rate shocks may be largely due to domestic macroeconomic policies.

Output levels and exchange rates in a general context are both endogenous variables, and the association between them depends on the underlying disturbances and policy reactions. Depending on the underlying disturbance, an appreciation of the exchange rate may be associated with an expansion as well as contraction of aggregate output in different sectors.

For example, a disturbance emanating from the foreign exchange market that has the effect of appreciating the dollar (e.g., an exogenous shift in international investors' portfolio preferences toward dollar assets) may be considered "exogenous" in some sense, and will likely have a depressing effect on output in the tradables sector. However, a policy-induced exchange rate appreciation arising, for example, from a fiscal expansion (in a Mundell-Fleming world with high capital mobility) or a monetary contraction has ambiguous effects on aggregate and sectoral output movements.[3] While exchange rate effects reduce output in both cases, in the case of fiscal stimulus the overall net effect on output is likely to be positive, while in the case of monetary contraction, negative. Focusing on the relation between exchange rates and output alone is analogous to attributing output movements along a supply or demand curve to price changes, rather than to the underlying factors causing the curves to shift.

In this paper we take a critical look at the arguments and empirical evidence offered in support of the hypothesis that exchange rate appreciation

1. Cline [1986, p. 452], for example, states that "What the strong dollar is doing is signaling that resources should go to the production of nontradable goods: haircuts, housing, subways, and that resources should come out of tradable goods: automobiles, steel, computers and agriculture. It is beginning to show up very painfully in the composition of this recovery." Similarly, Brinner [1985, p. 18] states that "the present agony of many American manufacturing firms is an evolutionary mutation engendered by the extraordinary value of the U.S. dollar. "

2. Note the similarities between this line of reasoning and that of the so-called "Dutch disease."

3. The predominant view in the profession is that fiscal expansion was primarily responsible for the real appreciation of the dollar in the first half of the 1980s. See, for example, Hutchison and Pigott [1984], Hutchison and Throop [1985], Dornbusch [1983], and Feldstein [1985]. However, Darby et al. [1987] and others have argued that a shift in investment habitat preferences towards the U.S., perhaps associated with falling U.S. tax rates, was primarily responsible for the dollar appreciation. Others (e.g., Evans, 1986) argue that no robust empirical relation between tax changes and exchange rates exists, perhaps due to Ricardian equivalence between tax and debt finance.

has been an independent cause of decline in the U.S. manufacturing sector. In section II we discuss several methodological problems in estimating and interpreting the relation between output and exchange rates. In particular, we show how the overall association of exchange rate changes with output depends on the source of the exchange rate change, i.e., whether it may be considered exogenous or policy induced.

In section III we present an empirical analysis of the relation between the exchange rate and sectoral production of output in the United States. We first show that there is no evidence for any secular decline in U.S. manufacturing output when measured properly. We also reproduce the basic results offered in support of the hypothesis that the appreciation of the dollar has negatively affected U.S. manufacturing output using quasi-reduced form regressions. However, we demonstrate that this result does not hold generally. In particular, we show that real exchange rate effects on output are unstable over different sample periods.

Finally, we investigate empirically the reduced-form linkage between the sectoral output growth and the underlying exogenous shock to which the real appreciation of the dollar between 1980–1985 has most commonly been attributed—an expansionary fiscal policy. Our results indicate that on balance, an expansionary fiscal policy—represented by a rise in the real structural Federal budget imbalance—is stimulatory in its effect on manufactures output growth and has not contributed to any "deindustrialization" of the U.S. economy as is popularly believed. Section V presents conclusions.

II. METHODOLOGICAL ISSUES

The empirical relation between exchange rates and output depends on the nature of underlying disturbances and policy developments as well as the channels of interaction. For illustrative purposes, consider the Mundell-Fleming (M-F) single-good framework with flexible exchange rates and high (but not perfect) capital mobility. Both a fiscal expansion and contractionary monetary policy initially appreciate the exchange rate under fairly general conditions in this model.[4] In the case of fiscal stimulus, the domestic currency would generally appreciate in real terms because of the resulting relative increase in demand for the country's goods. With a monetary contraction, the likely appreciation results from the inflow of foreign capital attracted by higher domestic interest rates. While exchange rate effects crowd out output in both cases, in the former case the net effect on output is likely to be positive, while in the latter, negative. Consequently, the M-F model predicts that simple measurements of the correlation between the exchange rate and output changes are likely to indicate a negative association over periods in

4. This is generally the case even when a rational expectations framework is employed; see Marston [1985].

which monetary policy movements dominate and a positive association over periods when fiscal policy movements dominate.[5]

Consider, in contrast, a full employment two-sector (tradable and nontradable goods) framework. In this model an increase in fiscal spending may indeed lead to a decline in manufacturing (tradables) output through an appreciation of the real value of the domestic currency if the composition of the spending rise is such that aggregate demand is shifted toward nontradable goods. In this case, domestic production is shifted from the tradable sector, consisting primarily of manufactures, to the nontradable sector, generating the "two-tiered" economy result. However, if the fiscal shift has the effect of shifting aggregate demand towards tradable goods, a relative exchange rate depreciation and a resource shift towards tradable goods occurs.[6]

Also in the context of the two-sector framework, an exogenous increase in foreign demand for domestically-produced tradable goods raises the relative price of domestic tradables and expands production of tradables. If exportable and importable goods are imperfect substitutes, a rise in the terms of trade, i.e., a real appreciation, also occurs. In this case a real appreciation is associated with a manufacturing sector expansion to accommodate the foreign demand shift.

The general point is that, given an economy's structural relationships, the association between the real exchange rate and the sectoral allocation of resources depends on the nature of the disturbance moving the exchange rate. Depending on the underlying disturbance, an appreciation of the exchange rate may be associated with an expansion or contraction of the manufacturing sector. An "exogenous" exchange rate appreciation (e.g., a change emanating from a disturbance in the foreign exchange market, such as a shift in international portfolio preferences) will generally depress the growth of manufacturing output. Policy-induced or other disturbances causing appreciation could have the opposite effect.

The empirical literature has typically overlooked this point in estimating the relationship between output and exchange rates. The partial equilibrium

5. In different contexts, Pigott, Rutledge, and Willett [1985], Swamy et al. [1987], Bernheim [1987], and Oxelheim and Wihlborg [1987] also make this point. Pigott, Rutledge, and Willett demonstrate that most conventional estimates of the impact of exchange rate depreciation on domestic inflation are both biased and misleading because (i) quasi-reduced form equations are often estimated employing single-equation methodologies and interpreted as reduced-form equations, and (ii) the correlation between exchange rates and inflation is typically assumed stable irrespective of the underlying shocks in the system. Our discussion here is related to that provided in Pigott, Rutledge, and Willett [1985, p. 249–253]. Swamy et al. [1987] and Bernheim [1987] make a similar point; they argue that interest rate equations investigating the effects of endogenous federal budget deficits have no direct behavioral interpretation, being quasi-reduced forms that reflect the interplay of forces which alter the supply and demand for funds.

6. See Razin [1984]. Arndt [1987; 1988] shows how if in the short run factors such as capital or labor are immobile, relative prices may overshoot in response to particular disturbances.

effects of changes in the exchange rate on output, both of which are endogenous variables, are often confused with general equilibrium effects. In addition, it is not typically acknowledged that since the estimated relationship between output and the exchange rate over any particular period depends on the disturbances and policy reactions that have occurred, this relationship reflects the average pattern of factors producing exchange rate changes during the sample period. The estimated coefficients will remain stable for a different sample period only if there is no change in this pattern.

To illustrate, consider a simple two-equation structural model in which output (Q) and the exchange rate (S) are the only two endogenous variables (time subscripts are omitted):

$$\alpha_{11}Q + \alpha_{12}S + \alpha_{13}Z_1 = Z_3 \tag{1}$$

$$\alpha_{21}Q + \alpha_{22}S + \alpha_{23}Z_2 = Z_4 \tag{2}$$

where the α's represent the structural coefficients, Z_1 and Z_2 are exogenous variables, and Z_3 and Z_4 are random disturbances. (These equations may be interpreted as representing the equilibrium conditions for the goods and money markets for a small country facing a given world interest rate.)

The corresponding reduced-form equilibrium levels of output and the exchange rate can be expressed as

$$Q = \beta_{11}Z_1 + \beta_{12}Z_2 + \beta_{13}Z_3 + \beta_{14}Z_4 \tag{3}$$

$$S = \beta_{21}Z_1 + \beta_{22}Z_2 + \beta_{23}Z_3 + \beta_{24}Z_4 \tag{4}$$

where the β's denote reduced-form coefficients defined in terms of the α's (e.g., $\beta_{11} = -\alpha_{13}\alpha_{22} / (\alpha_{11}\alpha_{22} - \alpha_{12}\alpha_{21})$).

Estimating a structural relationship between S and Q, such as given by equation (1) or (2), provides information only about partial equilibrium effects between two endogenous variables. Thus, for example, the coefficient $-\alpha_{12}/\alpha_{11}$ represents the partial equilibrium effect of a change in the exchange rate on output in equation (1); i.e., the effect of a change in the exchange rate on output, holding all other variables constant. This effect should not be confused with that of the exogenous variables or disturbances—Z_1, Z_2, Z_3, or Z_4—underlying the changes in the exchange rate and output. If the exogenous disturbance takes the form of, say, a change in Z_1, the total effect (including both direct and indirect feedback effects) on output is given by β_{11}. This disturbance may arise from an "independent" shock to the exchange rate as well as from exogenous policy changes.

Since S and Q are both endogenous, the estimated correlation of exchange rate changes and output from an ordinary least square regression will depend on the pattern of behavior of the exogenous variables, $Z_1 \ldots Z_4$, as measured

by their correlations and standard deviations, as well as upon the reduced-form β coefficients. More precisely, the linear projection (regression) of Q on S (B_{qs}) can be written as

$$B_{qs} = \sum_{j=1}^{4} \sum_{i=1}^{4} \beta_{1j}\beta_{2i}\rho_{ij}\sigma_i\sigma_j \Big/ \left(\sum_{j=1}^{4} \sum_{i=1}^{4} \beta_{2j}\beta_{2i}\rho_{ij}\sigma_i\sigma_j \right) \tag{5}$$

where ρ_{ij} represents the correlation between Z_i and Z_j, and σ_i is the standard deviation of Z_i. The numerator represents the covariance of Q and S; the denominator represents the variance of S.

Equation (5) illustrates how estimates of the statistical relation between Q and S may vary when calculated over different time periods—even if the structural parameters (α's) and therefore the reduced-form parameters (β's) do not change—because the pattern of changes in the exogenous variables (as reflected in the ρ_{ij}, σ_i) is unstable.

Of course, in more rigorous empirical analysis other variables normally will be considered in calculating the impact of the exchange rate on output. In addition, the impact of exchange rate changes will depend on the extent to which output is disaggregated into sectors that are differentially exposed to international competition. Those considerations complicate the calculations underlying the arguments above without altering the basic implications. In particular, the full impact of exchange rate changes on output will still reflect the pattern of behavior of the exogenous variables.

III. REAL EXCHANGE RATES AND OUTPUT COMPOSITION: EMPIRICAL EVIDENCE

We explore three basic empirical issues in the following two sections: (1) How much evidence is there that the U.S. economy has "deindustrialized"? (2) What evidence exists that real exchange rate appreciation slowed the growth of U.S. industry in the 1980s? (3) In light of the methodological issues posed above, how robust is this evidence?

Trends in Output Composition

Evidence in support of the conventional wisdom regarding the "deindustrialization" of the U.S. economy is usually presented on the basis of Commerce Department data indicating a declining share of manufactures in total nominal GNP. As a percent of U.S. nominal GNP, manufactures fell from 29 percent in 1947 to 20 percent in 1986. Correspondingly, the share of services (retail and wholesale trade, real estate, insurance, financial services, and so on) rose from 38 percent to almost 50 percent. Transportation, public utilities, and construction—another nontradable goods sector—has been remarkably stable over the last three decades in nominal terms. On the other hand, ag-

riculture, mining, fishing, and forest industries—representing another category of tradable goods—fell as a share of nominal GNP from 13 percent in 1948 to 4.6 percent in 1971, rebounded to 8 percent by 1981, and has since declined to around 5 percent of GNP.

These figures present an incomplete picture of the sectoral composition of output, however, because they combine real output shares and relative price movements between sectors. Output shares of each sector in constant dollar terms (1982 base year) present a substantially different picture. Although an upward trend in the share of services in GNP in real terms is evident, real manufactures has been remarkably stable at roughly 21 percent of GNP over the past thirty years. This discrepancy between nominal and real shares is attributable to the secular decline in the relative price of manufactures, as shown in Figure 1. With a base of 1.00 in 1947, the relative price of manufactures had declined to .67 by 1986. In contrast, the real output share of agriculture, mining, fishing, and forestry products has shown a marked secular decline. The share of transportation, public utilities, and construction in real GNP has shown a small secular decline.

These data do not suggest a decline in the share of manufactures in real aggregate U.S. output, but rather a marked relative price decline over a three-decade long period. Lawrence [1983; 1984], Solomon [1985], and Ott [1987] also note these long-term trends and argue that high productivity growth in manufactures and agriculture have precipitated the shift toward services. Thus, it is not obvious that the U.S. manufacturing industry has experienced a secular decline as conventional wisdom suggests.[7]

Exchange Rate Effects on Output Composition

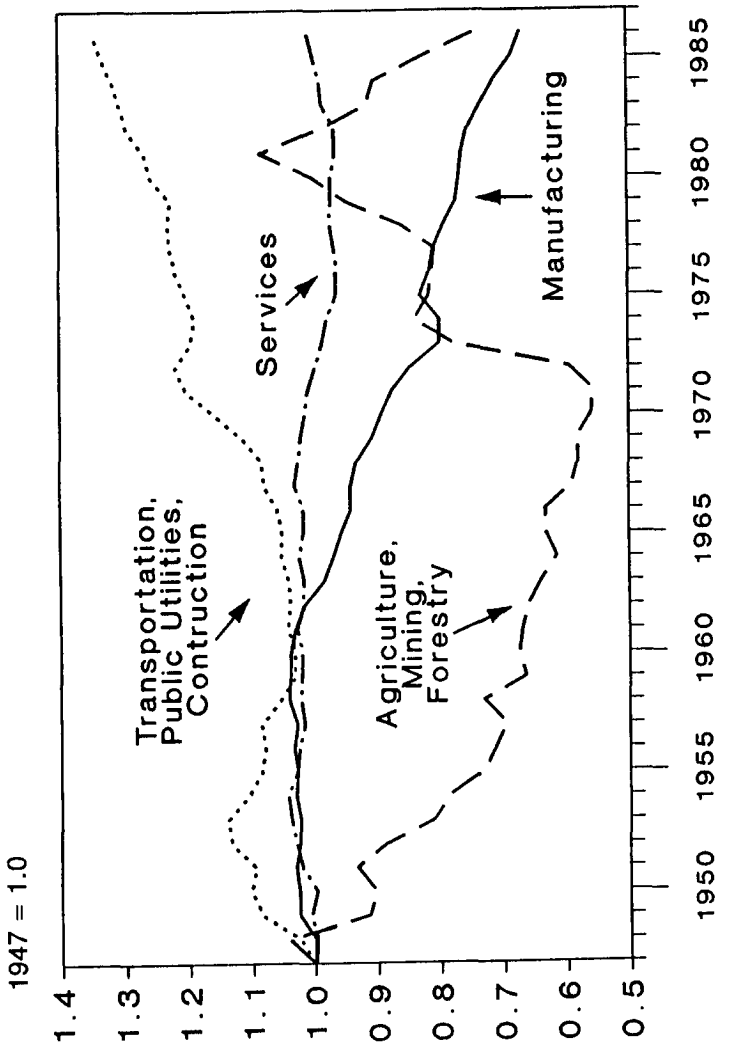
It is conceivable that the stable share of manufactures in total U.S. output is the consequence of a number of offsetting factors, and that the effects of real exchange rate movements on output composition have been counterbalanced by other factors.

Several recent empirical studies have examined the effects of real exchange rate movements on tradable goods production, and the production of manufacturing goods in particular [Branson, 1986; Branson and Love, 1986; 1987, and 1988; Brinner, 1985].[8] Branson and Love, for example, have estimated regressions of the log level of manufactures output (and subcom-

7. It should be noted, however, that because of relative productivity gains employment levels in the manufacturing sector have fallen in comparison to that of other sectors.

8. Branson and Love [1986; 1987; 1988] detail the employment and output effects of dollar appreciation by geographic regions (cities, states, regions, etc.) and by the type of production. Brinner [1985] presents Data Resources, Inc. (DRI) estimates of the effects of dollar appreciation on various macroeconomic aggregates, on nineteen categories of durable and nondurable production (with forecasts out half a decade), and on employment in each state.

FIGURE 1
Relative Prices



ponents disaggregated along product lines and geographic areas) on contemporaneous and lagged values of the real dollar exchange rate, the relative price of energy, and the unemployment rate, as well as a constant and a linear time trend:

$$Q_{it} = B_{0i} + B_{1i}TR + \sum_{j=0}^{4} B_{2ij}UN_{t-j} + \sum_{j=0}^{4} B_{3ij}OIL_{t-j} + \sum_{j=0}^{6} B_{4ij}XR_{t-j} + \varepsilon_{it} \qquad (6)$$

where:

Q_i = log of real output in sector i,
TR = time trend,
UN = log of the U.S. unemployment rate,
OIL = log of the relative price of oil,
XR = log of the real trade-weighted value of the dollar (defined so that a rise denotes a real dollar appreciation),
ε_i = stochastic error term,

and the B's are the parameters to be estimated. The inclusion of the unemployment rate and relative price of energy is intended to control for business cycle and supply-side effects, respectively.

Using their most representative sample period with quarterly data, 1970:1–1986:1, Branson and Love [1988] find that real exchange rate movements have a significant effect on output and employment in the manufacturing sector. They conclude, moreover, that the more than 50 percent real appreciation of the dollar from 1980 to 1985 led to the loss of about 1 million manufacturing jobs for the country as a whole. These estimates correspond in general order of magnitude to those of Brinner [1985, p. 21] who concludes that 1.4 million manufacturing jobs were lost over this period due to the higher value of the dollar.

The basic premise that real exchange rate appreciation hurts tradable goods should not be confined to manufactures, however; other tradables should be affected as well. Moreover, to the extent that real exchange rate movements represent relative price shifts signalling the transfer of resources from one sector to another, a real appreciation of the dollar should cause an output rise in the nontradable goods sector of the economy. Analysis of the exchange rate effects in both tradable and nontradable sectors of the economy would appear warranted in order to discriminate between explanations focusing on sectoral reallocations of resources as opposed to those based on aggregate output effects.

In column 1, Table I, we reproduce the basic equation for aggregate manufacturing output estimated by Branson and Love using their 1970:1–1986:1 period, and obtain their result that real exchange rate appreciation is followed

TABLE I

U.S. Sectoral Output Regressions
Branson-Love Specification, 1970:1–1986:1

Dependent Variable	Manufactures	Agriculture and Mining	Construction, Transport, Utilities	Services
Constant	7.56 (24.3)***	8.68 (4.94)***	5.98 (16.3)***	6.16 (28.0)***
TR	0.002 (2.13)**	0.006 (1.29)	0.007 (6.90)***	0.010 (19.0)***
Σ *UN*	−.18 (4.75)***	−.27 (1.56)	−.08 (2.44)***	−.06 (3.38)***
Σ *OIL*	.03 (.99)	−.05 (.28)	−.03 (.86)	−.03 (1.99)*
Σ *XR*	−0.25 (3.81)***	−0.85 (2.36)**	−0.17 (2.24)**	−0.06 (1.32)
F–*XR*	3.98***	2.11*	1.98*	2.30**
$\bar{R}^2$	0.94	0.81	0.98	0.99
SEE	0.019	0.068	0.013	0.007
ρ	0.51 (3.73)***	0.75 (6.53)***	0.76 (6.50)***	0.79 (6.75)***

Notes: All variables are in logs. *TR* = trend, *UN* = unemployment rate, *OIL* = relative price of oil, *XR* = real trade-weighted value of the dollar (a rise corresponds to an appreciation of the dollar). The table presents the sum of current and lagged coefficients (4 lags for *UN*, *OIL*; 6 lags for *XR*). The t-statistics are in parentheses below the coefficient estimates. Coefficients significant at the .10, .05, and .01 (two-tail) levels are indicated by *, **, and ***, respectively. The F-statistic tests the null hypothesis that the set of coefficients for *XR* are equal to zero.

by a significant contraction in the manufacturing sector.[9] A 10 percent real appreciation of the dollar is estimated to reduce output in the manufacturing sector by 2.5 percent over a period of six quarters; the sum of the contemporaneous and lagged coefficients on the real exchange rate is significant at the .01 level of confidence, and the null hypothesis that the set of coefficients for the real exchange rate is equal to zero can be rejected at the .01 level (the F-statistic equals 3.98). The rate of unemployment is also significantly negative, as they hypothesized.

9. Data on U.S. nominal and real sectoral output and unemployment are Commerce Department data obtained from the Citibase tape. Exchange rate data were obtained from the Federal Reserve Board. Relative oil prices were calculated from the Saudi Arabian crude oil price series in the IMF *International Financial Statistics* divided by the U.S. GNP deflator from Citibase. The equation—following Branson and Love—is estimated using the Beach-MacKinnon maximum likelihood procedure to correct for first-order serial correlation.

In order to test whether these results extend to nonmanufactured tradable goods in the economy, and whether a real exchange rate appreciation has the expansionary effect on nontradable goods production predicted if resources are flowing in from tradables production, we divide the nonmanufactures components of GNP into three categories: (i) agriculture, mining, forestry and fishing industries; (ii) construction, transportation, and public utility industries; and (iii) services (retail trade, wholesale trade, finance, insurance, real estate, and other service industries). We regard the first as a tradable sector, and the latter two as nontradables.

Columns 2 to 4 in Table I show the results of estimating equations (analogous to that for manufactures) for the other components of output. As for manufactures production, a real exchange rate appreciation leads to a significant contraction in agriculture and mining output: a 10 percent real appreciation is estimated to cause an 8.5 percent output decline.[10]

The results reported in columns 3 and 4, however, do *not* support the implication of the view that the nontradable goods sector has expanded at the expense of tradable goods production. A real exchange rate appreciation appears to have either a neutral or a contractionary effect on nontradables goods production. For example, construction, transport and public utilities output is estimated to fall by 1.7 percent following a 10 percent real exchange rate appreciation. This result suggests that in the Branson and Love representative sample period, a real exchange rate appreciation is associated with a broad-based decline in output across tradable and nontradable sectors of the economy, not just a contraction of tradable goods.

Instability

In section II we argued that the link between the real exchange rate and the sectoral composition of output is unlikely to be stable unless the pattern of shocks underlying exchange rate movements remains constant. To investigate the stability of the response of output composition to exchange rate movements, we change the sample period from the Branson and Love 1970:1–1986:1 period which mixes fixed and floating rates to the period of generalized floating exchange rates for which data are presently available, 1973:2–1987:1.

Results comparable to those in Table I are presented in Table II. Observe that the manufactures regression equation (Table II, column 1) for the 1973:2–1987:1 sample now shows no significant relation between real exchange rate fluctuations and the output of manufactures. Neither the sum of

10. While the unemployment rate is included to control for business cycle effects, it may also be endogenously related to exchange rates. This endogenuity may bias the estimated exchange rate coefficients. For example, an exogenous exchange rate appreciation may raise unemployment and dampen output indirectly. This indirect effect may imply an understatement of the estimated direct effect of the appreciation on output. We are indebted to a referee for raising this point.

TABLE II
U.S. Sectoral Output Regressions
Branson-Love Specification, 1973:2–1987:1

Dependent Variable	Manufactures	Agriculture and Mining	Construction, Transport, Utilities	Services
Constant	7.08 (13.2)***	7.37 (7.68)***	5.46 (14.6)***	6.10 (42.3)***
TR	0.000 (0.03)	0.003 (1.15)	0.004 (4.88)***	0.009 (24.5)***
Σ *UN*	–0.15 (2.03)**	–0.37 (2.17)**	–0.15 (2.93)***	–0.10 (4.22)***
Σ *OIL*	0.06 (1.29)	–0.09 (0.79)	–0.04 (1.45)	–0.04 (0.29)
Σ *XR*	–0.13 (1.19)	–0.39 (1.83)*	–0.03 (0.47)	–0.03 (1.24)
F–*XR*	0.70	2.21*	1.72	3.14***
R^2	0.90	0.48	0.98	0.99
SEE	0.018	0.069	0.013	0.006
ρ	0.80 (6.63)***	0.33 (2.04)**	0.80 (6.39)***	0.64 (4.10)***

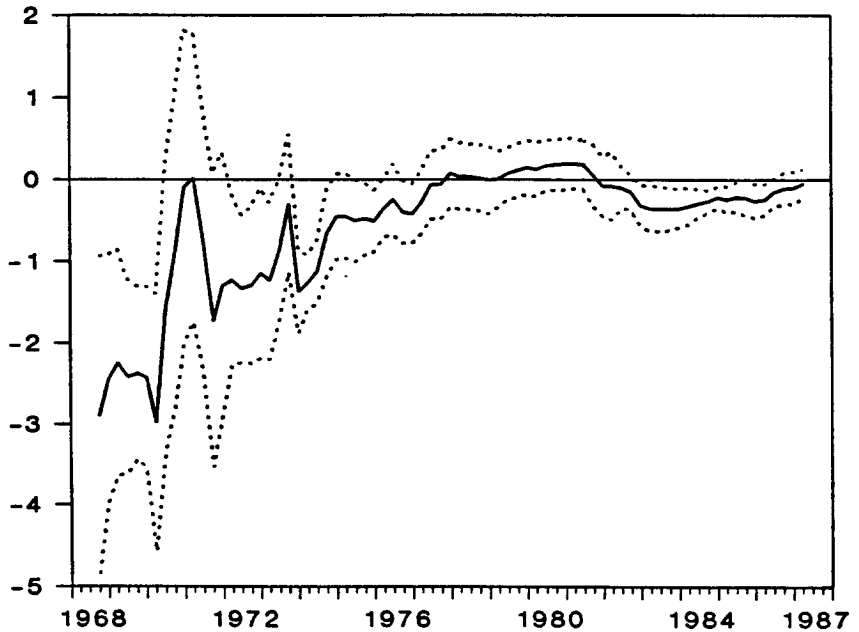
Notes: See Table I.

the exchange rate coefficients (t-statistic= 1.19) nor the explanatory power of the set of exchange rate coefficients taken as a group (F-statistic = .70) are significant at the .10 level of significance.[11]

The strong negative impact of a real exchange rate appreciation on the tradable goods sector found by previous research thus appears sample specific and not stable over time. To investigate the issue of instability more systematically, we employ a series of forty-five-quarter rolling regressions using the same specification and estimation procedure as with equation (6) over the 1957:3 to 1987:1 period (i.e., the first estimation period covers 1957:3 to 1968:3, the second period covers 1957:4 to 1968:4, and so on until the last period covering 1976:1 to 1987:1). Each regression has twenty-five degrees of freedom. These results are summarized in Figure 2 where the

11. The secular rise in unemployment over the post-war period may limit its usefulness as a cyclical measure of economic activity. To address this point we also used a detrended unemployment rate as our cyclical variable. The results are not qualitatively different from those reported in the text, however, and are not reported for brevity. They are available upon request.

FIGURE 2
Output Effects of Exchange Rate



Note: The chart plots the sum of exchange rate coefficients in 45-quarter rolling regressions for manufacturing output that end on the dates on the horizontal axis. The dotted lines bound 95 percent confidence intervals.

sums of the coefficients on the real exchange rate variable (ΣB_{4ij}) in the rolling manufacturing sector regressions are plotted. The identifying date noted in the chart represents the end of the forty-five-quarter sample period for each of the rolling regressions. A .05 statistical confidence interval on the point coefficient estimates is also plotted. The results of the rolling regressions clearly demonstrate instability in the relationship between manufacturing output and real exchange rates.[12]

12. One referee suggested that because of concern for variable nonstationarity it would preferable to estimate equation (6) in first-difference form rather than in log-linear form with serial correlation correction as we have done. Our specification was motivated by the desire to provide a direct comparison with the Branson-Love results. Estimating equation (6) in first differences, we found that exchange rate changes had no significant effect on sectoral output. For the representative sample period 1970:1–1986:1, the t-statistics for the sum of current and lagged exchange rate changes were for manufactures, −.89; for agriculture and mining, −.71; for transportation, public utilities, and construction, −.10; and for services, −1.04. The corresponding F-statistics were .61, 1.57, .80, and 1.53, respectively. The results are available upon request.

IV. OUTPUT COMPOSITION AND FISCAL POLICY: EMPIRICAL EVIDENCE

The quasi-reduced form output-exchange rate estimates reported in support of the view that real exchange appreciation has contributed to the "deindustrialization" of the U.S. economy are clearly unreliable due to the sample-specific nature of the results shown above. They are also misleading when researchers, by not sufficiently recognizing that measured exchange rate changes are endogenous, improperly attribute to the exchange rate the effects of underlying exogenous disturbances.

In this regard, the expansionary fiscal policy pursued in the U.S. in the early 1980s, that most view as largely responsible for the appreciation of the dollar, may be viewed as a possible cause of crowding out of industrial production. This suggests that a reduced-form approach relating sectoral output directly to underlying macroeconomic disturbances, such as fiscal policy, is more appropriate.

In order to shed some light on the linkage between sectoral output growth and underlying policy changes and disturbances, we estimate several general reduced-form equations. The dependent variables are sectoral output growth and the independent variables include measures of fiscal stance, monetary policy, aggregate supply shocks, and trend growth.

We do not suggest that our specification represents a fully-specified reduced-form equation for output growth in each sector. Our objective here is to focus on the systematic effects of fiscal policy, while holding constant other exogenous macroeconomic factors that have likely played an important role in the evolution of sectoral output. The equation estimated is of the form:

$$\Delta Q_{it} = B_{0i} + B_{1_{it}} TR + H_i(L)\Delta M_t + I_i(L)\Delta G_t + J_i(L)\Delta(T-G)_t + K_i(L)\Delta OIL_t + \varepsilon_{it} \tag{7}$$

where:

Q_i = log of real output in sector i,
M = log of the money supply (M1),
G = middle-expansion path real Federal government expenditures scaled by trend real GNP,
$T–G$ = middle-expansion path real Federal government surplus scaled by trend real GNP,
OIL = log of the relative price of oil,
ε_i = stochastic error term,

and Δ denotes the first difference operator, and $H(L)$, $I(L)$, $J(L)$, $K(L)$ represent vectors of coefficients with the backshift operator in the polynomial L. The lag structure is constrained to eight lags (twelve lags for money) following a fourth-degree polynomial. A constant and time trend (TR) are also included.

Q, M, and OIL are expressed in log first differences (percentage change) to ensure stationarity. The fiscal variables (G and $T-G$) are cyclically adjusted to remove business-cycle feedback effects and are also first differenced and are scaled by the linear trend of real GNP.

An increase in G, holding $T-G$ constant, represents a balanced budget change in fiscal policy; an increase in $T-G$, holding G constant, represents a bond-financed adjustment in fiscal policy [see Evans, 1986]. To the extent that fiscal stimulus—either in the form of a government expenditure rise or a budget surplus reduction—tends to crowd out tradable goods production and expand nontradables, we anticipate a negative (positive) sign on the ΔG ($\Delta(T-G)$) coefficient for the two tradable goods sectors and the reverse for the two nontradable goods sectors. We anticipate the ΔOIL coefficient to be negative across sectors. To the extent that money is neutral in the long run, we expect the sum of current and lagged coefficients on ΔM to be insignificant.

The results of estimating equation (7) are presented in Table III for the 1973:2–1987:1 sample period.[13] Observe first that an increase in government expenditures is insignificant in all cases except for services output. A rise in the government budget surplus is significantly negative in all cases except for agriculture and mining. The contractionary effect on manufactures, however, is opposite to that predicted by the view that fiscal expansion leads to the crowding out of tradable goods production. Note also that monetary policy has no significant long run effect on output in any sector.[14]

On balance, these results provide little support for the view that a fiscal expansion tends to reallocate resources from tradables to nontradable production. To the extent that fiscal effects are indicated, the signs are more in line with the general Keynesian aggregate demand view—a fiscal stimulus (measured as either a fall in $T-G$ or a rise in G) tends to cause a broad-based output expansion across tradable and nontradable sectors.

These results are not intended to provide definitive conclusions about the determinants of output changes in each sector of the economy. However, they do raise doubts about the contention that fiscal stimulus in the United States

13. Statistics for middle-expansion trend government nominal expenditures and receipts were obtained from the *Survey of Current Business*, May 1987 [1985:1–1985:4], November 1986 [1984:1–1984:4], March 1985 [1981:1–1983:4], and from unpublished data provided by the Department of Commerce [1970:1–1980:4]. Real figures were computed by deflating the nominal figures by the GNP deflator. M1 data were obtained from the Citibase data tape. The sources of all other data are as described in footnote 9.

14. It is important to recognize that reduced-form equations such as (7) may still exhibit parameter instability if there are regime shifts affecting structural parameters, though the coefficient estimates will not be affected by changing patterns in exogenous variables and shocks. Equations such as (6), reported in Tables I and II, will exhibit both types of instability. To investigate this issue we also calculated rolling regressions for the reduced-form parameters in Table III. Although we find some evidence of instability in these coefficient estimates, they are significantly more stable than in equation (6). These results are not reported for brevity, but are available from the authors upon request.

TABLE III
U.S. Sectoral Output Regressions
Percent Change, 1973:2–1987:1

Dependent Variable	Manufactures	Agriculture and Mining	Construction, Transport, Utilities	Services
Constant	0.08 (1.80)*	0.15 (1.00)	0.04 (1.44)	0.02 (1.16)
TR	–0.001 (1.34)	–0.003 (1.55)	–0.000 (0.02)	–0.000 (0.21)
$\Sigma\Delta M$	1.44 (0.64)	7.12 (0.93)	–1.51 (1.08)	–0.46 (0.59)
$\Sigma\Delta G$	–0.07 (0.76)	0.61 (1.91)*	–0.05 (0.93)	–0.04 (1.18)
F–ΔG	0.96	1.58	1.51	1.27
$\Sigma\,\Delta(T-G)$	–0.08 (2.17)**	0.15 (1.12)	–0.05 (1.90)*	–0.02 (1.55)
F–$\Delta(T-G)$	2.06*	0.66	2.39*	1.40
$\Sigma\Delta OIL$	0.01 (0.07)	–0.41 (1.18)	–0.02 (0.40)	–0.03 (0.80)
$\bar{R}^2$	0.14	0.03	0.22	0.26
SEE	0.024	0.081	0.014	0.008
Q	20.08	34.12**	41.64***	12.35

Notes: All variables except T and G are defined as first differences of logs. TR = trend, M = money, OIL = relative price of oil, ΔG = change in the middle-expansion path level of real Federal government expenditures as a percent of trend real GNP, and $\Delta(T-G)$ = change in middle-expansion path level of the real Federal government surplus as a percent of trend real GNP. Each independent variable was estimated as a fourth-order polynomial with eight lags, except in the case of money where twelve lags were employed. Σ denotes summation of the estimated coefficients. F–ΔG, F–$\Delta(T-G)$ denote the F-statistic testing the null hypothesis that the set of coefficients for ΔG and $\Delta(T-G)$, respectively, are equal to zero. The t statistics are in parentheses below the coefficient estimates. Significance at the .10, .05 and .01 (two-tail) levels is indicated by *, **, *** respectively.

has crowded out the manufacturing sector and contributed to a process of "deindustrialization."

V. CONCLUSION

Our results offer little support for the view that real exchange rate movements have played an important role in "deindustrializing" the U.S. economy. In particular, our results indicate that the relationship between real dollar

exchange rate fluctuations and the composition of output between tradables and nontradables in the economy is unstable over time and varies with underlying macroeconomic disturbances.

The statistics we present, consistent with these results, indicate moreover that rumors of the "death" of manufactures or the "deindustrialization" of America are greatly exaggerated. Indeed, the share of manufactures in real GNP has remained remarkably stable at roughly 21 percent over the past thirty years. The reason the share of nominal manufactures to nominal GNP has been in secular decline is entirely due to the secular fall in the relative price of manufactures.

Our methodological discussion suggests that the seeming lack of a systematic and robust correlation between real exchange rate movements and output composition is likely attributable to the diverse nature of underlying shocks affecting the economy. In particular, we argue that exchange rate appreciation may either be associated with an expansion or contraction of the tradable goods sector depending on the underlying source of the exchange rate change. A rise in foreign demand for the domestic tradable good, for example, is likely to be associated with exchange rate appreciation and expansion in the domestic tradable goods sector. A rise in government expenditures falling primarily on domestic nontradables, on the other hand, is likely to be associated with a real appreciation and fall in tradable goods production. Simple correlations between exchange rates and output composition will only be stable if the nature of the underlying shocks impacting the economy are similar over time.

Output composition changes ultimately depend on the nature of the underlying shocks. To the extent that a fiscal policy stimulus primarily increases the demand for nontradables, as conventional wisdom suggests, we would anticipate an expansion in nontradables and contraction (crowding out) of tradables. In an attempt to link production tradables and nontradables to underlying fiscal shocks, after controlling for money growth and real oil price shifts, we do not obtain results in support of this hypothesis. Subtle resource allocation effects are seemingly dominated by Keynesian aggregate demand effects: a fiscal expansion is estimated to expand output across both tradable and nontradable sectors in the economy.

These empirical results raise doubts about the role fiscal policy has generally played in generating resource shifts between tradable and nontradable goods production. Nonetheless, we believe the distinction between tradable and nontradable goods in an open economy analytical framework is important. Within this context, one additional potential explanation for the failure to find significant sectoral output effects in our work may be that a single aggregate measure of fiscal stance is inappropriate. Fiscal policy is a complex mix of spending, tax and financing policies, which will vary over time as public policy priorities evolve. The mix of government expenditures in the U.S. over the past seven years, for example, has shifted toward defense

spending and away from domestic social programs. Shifts in the composition of expenditure and tax policies, however, are likely to change the way these policies—measured as a single aggregate—impact the sectoral composition of output in the economy.

Addressing this problem by decomposing the fiscal stimulus measure into those components falling primarily on tradable goods and those falling primarily on nontradable goods is on our agenda for further research. Regardless of the results generated by this line of research, however, it is clear that no simple relation exists between aggregate measures of fiscal stance and output composition.

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