ECONOMIC RESEARCH REPORTS

NOMINAL EXCHANGE RATE PATTERNS: EFFECTS ON ENTRY, EXIT AND INVESTMENT IN UNITED STATES INDUSTRY

by

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R.R. #89-25 September 1989

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July 15, 1989
(revised August 1989)

Abstract

Nominal exchange rate trend and volatility are significantly correlated with entry, exit and investment in many sectors of United States industry. In general, business formation and business failure rates were more sensitive to exchange rate patterns in the 1970s than in the 1980s. Industry responses to short–term trends in exchange rates were weaker in the 1970s than in the 1980s. Short term exchange rate trend appreciations led to both contractions and expansions in the 1970s, but were more generally associated with investment expansions in the 1980s. In high dollar volatility periods, industries were more likely to contract investment in response to appreciations. In the 1970s exchange rate volatility was linked significantly with reallocation of investment resources across sectors. In the 1980s, increased volatility contracted investment in most sectors, with the negative impetus magnified during appreciation periods in some sectors of the U.S. economy.

Preliminary. Comments Welcome.

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INTRODUCTION:[1] While business cycle theorists continue to debate the enigmatic relationship between investment, output and the cost of capital, the linkage between real investment in the United States and international influences is largely ignored. Recent research in international economics emphasizes that exchange rate patterns may have important influences on activity within United States industry, including the entry, exit and investment of foreign and domestic firms across markets. In turn, in this paper we examine whether the data reveal a sensitivity of aggregate business indicators and sectoral investment activity to contemporaneous exchange rates and exchange rate trend and volatility. First we test for statistical causality between exchange rate patterns and real physical investment, business formation and business failure in United States industry. Next we estimate sectoral and aggregate investment, entry and exit response elasticities with respect to measures of exchange rate trend and volatility which correspond with various assumptions about exchange rate expectations formation. We distinguish between the effects of exchange rate trends when volatility is exceptionally high, and the effects of volatility when the dollar is on appreciation and depreciation paths. The variate relationships are examined for the 1970s and the 1980s.

The primary intent of the analysis is to provide general insights into the effects of nominal exchange rate movements on aggregate entry and exit activities and investment resource reallocation. Three forces are triggered by exchange rate activity: (i) output demand effects brought about by relative price changes; (ii) location effects as dollar realignments and volatility change the relative attractiveness of production locations; and (iii) wealth effects as exchange rate changes redistribute relative wealth across countries.

Theoretically, by the demand effect for normal goods and the location effect, trend depreciations (appreciations) of the dollar should stimulate (depress) investment in the (traded goods sectors of the) United States economy. The direction of the wealth redistribution effects attributed to exchange rate movements depends on relative characteristics of countries such as risk aversion and home asset preference levels. Increased product demand arising from depreciations leads to capacity expansions independent of the conventionally studied forces arising from expansion of domestic demand. In addition, further investment stimuli occurs as the attractiveness of the United States increases as a location for home and foreign based production activities.

These effects of exchange rate trends may be moderated or amplified by exchange rate volatility. The influence on investment of exchange rate volatility depends on the specific volatility facing investors in different countries, the currency of invoicing used in trade, the composition of inputs into production, and the competitive structure of demand and supply across industries.

Controlling for aggregate output movements, we find that both nominal exchange rate trend and volatility are significantly correlated with entry, exit and investment in new plant and equipment in many sectors of United States industry. If significant correlations are interpreted as indicative of causality, our results show that in the 1970s new business formation contracted in response to contemporaneous dollar appreciations and exchange rate volatility increases, but were insensitive to short and long term exchange rate trends. In the 1980s, new business formation contracted only in response to volatility.

In the 1970s, business incorporations expanded in response to trend appreciations, and weakly contracted in response to high volatility. In the 1980s the expansionary effects of exchange rate appreciations were highly significant, while long term trend appreciations had overall depressing effects and volatility increases had expansionary effects.

The failure rates of large and small businesses responded differently to exchange rate patterns. In both the 1970s and the 1980s the number of small business failures decreased along with trend appreciations, although failures increased in response to contemporaneous appreciations. The effects of volatility on small business failures were ambiguous. Large business failures were decreased in the 1970s and increased in the 1980s in response to contemporaneous appreciations. Appreciation trends tended to lower large business failure numbers, but only during periods of high exchange rate volatility. Increases in long term exchange rate volatility were correlated with increaseed failures of large businesses in the 1970s and had no significant effects in the 1980s.

While contemporaneous dollar appreciations generally were associated with contracted investment in new plant and equipment in the 1970s, in the 1980s appreciations were associated with investment expansions. Investment response to short and long term exchange rate trends differed across the 1970s and the 1980s, and across high and low dollar volatility periods. Industry response to short trends were weaker in the 1970s than in the 1980s. Short term exchange rate trend appreciations led to both contractions and expansions in the 1970s, but were more generally associated with investment expansions in the 1980s. In high dollar volatility periods, industries were more likely to contract investment in response to short term appreciations.

Investment response to long term trends was stronger than the response to short term trends in both the 1970s and the 1980s. During the 1970s, the association between trend movements of exchange rates and investment was independent of the uncertainty surrounding exchange rates. During the low volatility periods of the 1980s trend exchange rate movements led to sectoral resource redistribution. During high volatility periods, trend appreciations led to significantly greater overall investment contractions.

Section I discusses the expected influence of exchange rate trend and volatility on business activity and investment. Empirical and theoretical models of investment activity are briefly discussed. Section II presents the data, the methodology for deriving trend and volatility measures, and the results of empirical testing. Section III relates investment elasticities to exchange rate trend and volatility to industry exchange rate pass—through, mark—up, factor intensity, and external openness characteristics. Section IV provides caveats and concluding remarks.

I. BACKGROUND: Firms may respond to exchange rate patterns by expanding or contracting existing production operations, entering or exiting foreign markets, changing the location of production facilities, or consolidating market power through mergers and acquisitions. If exchange rate movements lead to strong relative price effects on demand, firms might respond by expanding or contracting investment in capacity and new plant and equipment, or even closing their doors due to a loss of international competitiveness. Those traded goods industries in which exchange rate pass–through into prics is highest and sunk costs of investment are lowest are thereby expected to have higher investment sensitivity to exchange rate trends. Other industries less involved in external trade may be affected indirectly by exchange rates when investment capital is redirected between traded and nontraded goods sectors. If demand for a traded good falls due to appreciation, relocation of capital away from this industry towards the production of nontradeables may occur. However, short term tendencies in exchange rates are not always sufficient stimuli for investment decisions. Since the relocation of resources across sectors is costly, the greater the amount of uncertainty surrounding exchange rate movements, the more reluctantly will resources be transferred [Krugman (1989)].[2]

Exchange rate movements may also trigger relocation of production facilities across countries. The "location effect" of exchange rates on investment refers to the entry and exit of firms from a market in response to exchange rate trend and volatility patterns. The significance of this effect depends on the nature of barriers to entry and nonrecoverable costs of exiting an industry. Since greater exchange rate volatility makes foreign and domestic firms more hesitant to enter or exit industries in response to exchange rate changes, the elasticity of investment response to exchange rate volatility should be negative. Those industries with the highest sunk costs of investment are expected to have investment patterns which are relatively unresponsive to exchange rate patterns.

After initial entry into a market via exports, foreign firms may seek to switch to local production under favorable movements in exchange rates. This relocation process would be slowed by "the possible loss of economies of scale, the fixed costs off setting up a new production facility in an unfamiliar location, and the risks of deal with foreign currencies and foreign governments and institutions". (Stevens and Lipsey (1988) pp.11) Relocation is magnified by the incentive to retain or increase market share following the imposition of tariff or nontariff barriers. Thus we would expect that foreign suppliers establish, with greatest ease, beachheads in domestic markets in response to small trend depreciations (or abandoning positions in response to trend appreciations) in industries which have low scale economies, high exposure to foreign exchange risk, and high trade consumption levels in domestic markets. It follows that the businesses newly established by foreigners would be in low scale economy and sunk costs of production industries, while acquired businesses might be characterized by higher scale economies and sunk costs.

The effects of exchange rate volatility on investment also depend on maintained industry exposure to exchange risk through invoicing practices and imported intermediates. While exchange risk randomizes profits regardless of the choice of invoicing currency, risk enters the profit function through distinct channels. If the domestic firm invoices exports in the home currency, exchange rate variability translates into an uncertain foreign currency price and uncertain quantity demanded of the home product. Although the domestic producer has locked in his price, exchange rate variability increases the costs of production and inventory management. If these increased costs are high enough and volatility wide enough, the producer may prefer to hedge against exchange rate risk by constructing part of his production facilities abroad, essentially entering new markets by establishing beachheads on foreign shores. Increased exchange rate volatility might lead U.S. firms to substitute foreign investment for domestic investment. This would be least prevalent in industries with high economies of scale and highly specific labor forces.

Producers invoicing sales in foreign currency expose themselves to price uncertainty rather that quantity uncertainty, since the foreign demand curve remains stable despite exchange fluctuations. Random profits are attributed to uncertain revenue streams but not uncertain costs. In this case, firms might hedge against the short term volatility of exchange rates using futures markets and consider relocation only in response to exchange rate trends. Invoicing motives for significant effects of volatility on investment are weakened by the existences of forward markets in which producers can hedge against short term foreign exchange risk. If producers are more likely to hold open postitions relative to longer term volatility, it is expected that this class of variance has more significant effects on investment positions. Since formal hedging operations had not be in widespread usage in the U.S. prior to the late 1970s, short term risk may have more significant effects in the early interval. If contracts for production and scale conclude within (beyond) a year of issue date, the twelve month volatility measure is expected to have greater (lesser) significance for an industry than its twenty–four month counterpart.

The location effects of exchange rate volatility on investment in U.S. industries depends on how exchange rate patterns affect both domestic and foreign producers. If the exchange rate risk perceived by foreign producers is positively correlated with that perceived by domestic producers, the direction of change in net U.S. foreign investment is ambiguous. Outflows of capital by domestic investors must be weighed against inflows by their foreign investors. Thus by the location effect, positive correlation among realized volatility changes the composition of investors in U.S. but has an undetermined effect on investment quantity. The balance depends on the capital relocated by respective investors. If the volatility facing domestic and foreign producers are negatively correlated, increased dollar volatility leads both domestic and foreign producers to contract investment in the U.S.. Between 1975 and 1984, volatility of the U.S. real rate was positively correlated with yen volatility but negatively correlated with the volatility facing Italians and

Canadians. The overall effect on investment is a portfolio of activities across national investors. Of course, while volatility theoretically affects investment flows, it is probably not the most important factor. As suggested by neoclassical and neo–Keynesian theories of investment, demand conditions, productivity and other supply shocks, the replacement cost and market value of capital are among the forces which drive the investment component of the business cycle.

The wealth effect of exchange rates enters through the redistribution of resources available for investment demand. For example, if the dollar depreciates against the yen, the Japanese become relatively wealthier than their U.S. counterparts. The traditional avenue by which wealth effects are realized is in the shift of portfolio and direct investment demands. The wealth effect could potentially reduce domestic investment if the Japanese have strong home asset preference. Total investment resources might shift away from U.S. industry. However, another avenue for wealth effects enters through the ability of investors to leverage their investments. As emphasized by Froot and Stein (1989), a dollar depreciation can makes it easier for foreign firms to outbid domestic firms in competition for assets. If the wealth effects surface only through acquisitions, investment statistics will not vary much. If the wealth effects provide for the establishment of new businesses and structures, we would expect depreciations to lead to domestic investment expansions.

In our analysis we do not distinguish between domestic and foreign investors. Instead our analysis of time series uses aggregated and disaggregated data on business failures (monthly), business formation (monthly), business incorporations (monthly) and sectoral investment in new plant and equipment (quarterly). We do not test a particular structural equation: instead we test for sample correlations which provide useful insights for theoretical studies. The causality tests pick up significant correlations between exchange rate changes and market activity which arise up to two years after their occurrence. Other regressions analyze the response of the aggregate measures of entry, exit and investment to exchange rate trend and volatility constructed using one and two years of data. A distinction is made between: i) the effects of volatility across appreciation and depreciation periods; and ii) the effects of trends across high and low volatility periods. All relationships are examined for both the 1970s and the 1980s to capture structural shifts in response elasticities. Finally, industry specific responses to exchange rates patterns are related to inter–industry characteristics including pass–through parameters, capital intensity of production, and foreign presence in domestic markets.

II. METHODOLOGY:

Since investment decisions are made on expected future economic conditions, past patterns in exchange rates are used for projecting future exchange rate trend and volatility. This forecasting model implicitly treats exchange rate trends as evolving historically rather than determined in a broader general equilibrium model. Chosen for their tractability, the measures remain arbitrary in construction, in interval of estimations and in the frequency of data. While alternative approaches could have been applied, given the vagaries of exchange rate forecasting our simple measures appear to be reasonable indicators of trend and volatility. Each measure is based on a different assumption about agents' formation of expectations: the first measure assumes that percentage changes in exchange rates follow historical averages; the second measure assumes that percentage changes in exchange rates evolve according to past trends.[3] Two versions of each of the two measures are constructed using rolling samples of either twelve or twenty–four months of data preceding and inclusive of the period for which a trend or volatility measure is reported.

Volatility measure 1 (M1N12 or M1N24) measures average volatility over an interval. It is constructed as the standard deviation of the monthly (percentage) change in the exchange rate about the average percentage change of the exchange rate. Trend 1 (T1N12 or T1N24) is the average percentage change of the exchange rate over the interval.[4]

Volatility measure 2 (M2N12 or M2N24) measures the deviations of the rate of change of the exchange rate about its time trend and is consistent with the assumption that the expected exchange rate evolves according to trend changes. It is constructed as the standard deviation of the exchange rate around its log–linear trend. Trend (T2N12 or T2N24) is the estimated log–linear trend.[56]

The U.S. dollar exchange rate is a constructed as a trade weighted basket of the G–10 currencies. As the trend indicators reflect, over the first half of the 1970s the dollar had trend depreciations and appreciations, followed by a sharp decline in value in the interval between 1977 and 1980. The dollar rose sharply in the first half of the 1980s, peaked in 1985 and lost considerable strength by the end of the sample, 1988:12. [Figures 1a and 1b]. Appreciations are positive dollar movements and depreciations are negative dollar movements. While exchange rates were highly volatile in 1973 and 1974, volatility dropped off in the mid 1970s, increased once again in 1979, and moved variably upwards until its sample peak in 1985 (Figures 2a and 2b). All volatility measures reflect roughly the same patterns of exchange rate shocks.

We use a nominal exchange rate index rather than a real index for several reasons. While the theoretical motives behind the effects of exchange rates generally hinge on relative price or wealth effects and suggest the use of a real rate, the appropriate construction of relevant real rate indices quickly becomes complicated. If we are to avoid constructing industry specific real exchange rate indices, the alternative construction is to use a real rate defined over CPIs or unit labor costs. However, over the period examined the real exchange rate was highly correlated with nominal exchange rate movements. Specifically, for the subsample 1978 through 1988 the correlation between the nominal weighted rates and their real counterparts, using either CPI or ULC, were in excess of 0.98. Therefore, the use of a nominal rate instead of a real rate, possibly constructed incorrectly, should not limit the generality of our results.

Responsiveness of Net Aggregate Entry and Exit to Exchange Rates

Proxies for aggregate U.S. industry "entry" include the number of new business incorporations (monthly), an index of new business formation (monthly), and an aggregate measure of investment in new plant and equipment (quarterly). New business formation differs from new business incorporations by the number of new unincorporated businesses and by existing businesses which decide to incorporate. If unincorporated businesses are on average smaller than incorporated businesses, differences in sensitivity of measures to exchange rates could be evidence of the divergent responses of large and small business.

Proxies for aggregate "exit" include average weekly number of business failures for businesses with liabilities in excess of $100,000 (monthly), and average weekly number of business failures for businesses with liabilities less than $100,000 (monthly). The "exit" data reflect commercial and industrial failures, excluding failures of banks, railroads, real estate, insurance, holding and financial companies, steamship lines, travel agencies, etc.[7] While we will refer to these as failures of large and small businesses, this interpretation is not entirely accurate. Instead, the data connote failures of large and small debtors, without adjusting for the respective asset positions of the firms. Note that these failure measures do not capture other important avenues by which a firm can exit a market, including mergers and acquisitions.

Effects of Exchange Rates on Entry and Exit: Using data for the 1971:1 to 1988:12 interval causally tests between twelve months of lagged exchange rates and the aggregate entry and exit proxies use estimating equations of the form:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 er_t + a_4 er_{t-1} + \ldots + a_{15} er_{t-12}$$

where the y_t are logarithms of entry and exit proxies and the x_t are the logarithms of exchange rates. Causality is interpreted in the Granger sense, where statistical significance of right hand side variables reflects simple correlation. The impact elasticity of response to the exchange rate is the coefficient on the contemporaneous exchange rate (a_3). Lagged exchange rates are included to permit delayed response to shocks and delays in registering or disbanding operations. The total effect of exchange rates on y_t is the sum of statistically significant coefficients on exchange rates, where statistical significance is defined at the 10 percent level. The results for the 1970s and 1980s are summarized in Table 1.

During the 1970s exchange rate appreciations (depreciations) "caused" declines (increases) in business incorporations, while new business formation was generally unaffected by exchange rate levels. If we are picking up something more than spurious causality, this result may suggest that changes in ownership and management patterns are significantly influenced by exchange rate activity, while aggregate numbers of businesses are not.

The sensitivity of business failures of liability classes to exchange rates differs between the 1970s and the 1980s. Although small business failures were unresponsive to exchange rate patterns in the 1970s, in the early 1980s small business failures increased sharply with the lagged effects of dollar appreciations. Large business failure increased in response to dollar appreciations in both the 1970s and early 1980s, with the impact in the 1980s considerably higher. One hypothesis explaining this phenomenon is that foreign competition increased in those industries dominated by small businesses. Another possible explanation is simply that dollar appreciations were correlated with business or political climates unfavorable to small businesses.

To represent the impact of demand and business cycle conditions on investment, entry and exit, contemporaneous real gross domestic product is included in regressions along side trend and volatility. Investment variations have been shown to be strongly positively related to variations in output. This reflects the accelerator model of investment: investment responds to desired stocks of capital which are themselves determined by demand conditions. In addition, the correlation may reflect the preponderence of shocks to aggregate production. As noted by Shapiro (1986) and Tobin (1986), a positive productivity shock may raise both output and the marginal product of capital. Such productivity shocks can potentially explain the strong correlation of investment and output, and the much weaker correlation of investment and the cost of capital. While the market valuation of capital relative to its replacement cost, denoted by q, may be a better measure of investment motivation than the cost of capital, the evidence supporting this measure is relatively weak. For these reasons we exclude the cost of capital from our regressions despite its firm theoretical foundations.[8]

The responsiveness of aggregate measures of entry and exit to exchange rate trend and volatility, controlling for cyclical patterns within the dependent variables, is tested using

$$y_t = a_0 + \Sigma\alpha_k y_{t-k} + a_1 Mij_t + a_2 DUMA_t{}^* Mij_t + a_3 Tij_t + a_4 DUMB_t{}^* Tij_t$$

where i=1,2 depict the choice of trend and volatility pair, j=12, 24 represents the number of months used in construction of the measure, and all data are in logarithms. DUMA equals 1 during trend appreciations and equals 0 otherwise. DUMB equals 1 during periods of higher than average volatility and equals 0 otherwise.[9] These adjustments are intended to capture whether entry and exit respond to volatility differently during appreciation and depreciation periods, and to trend differently during high and low volatility periods. The estimation results for the 1970s and the 1980s are presented in Table 2.

While in general trend exchange rate movements did not significantly impact new business formation in either the 1970s or 1980s, in the 1970s the contemporaneous appreciations of the exchange rate were associated with reduced new business formation. In both intervals, increased volatility was associated with significant reductions in new business formation, with the elasticities of response much greater in the 1980s.

While contemporaneous appreciations had no significant effect on business incorporations in the 1970s, in the 1980s the expansionary effects were highly significant.

Increased business incorporations were associated with trend appreciations in the 1970s and trend depreciations in the 1980s.[10] Long term exchange rate variability stimulated incorporations only in the 1980s.

While increased short term exchange rate volatility weakly decreased failure rates of small businesses in the 1970s and 1980s, longer term volatility did not effect failure rates. Contemporaneous exchange rate appreciations tended to depress failure rates over the whole interval. Contemporaneous appreciations had depressing effects on large business failures in the 1970s and stimulating effects in the 1980s. In the 1980s, trend appreciations tended to lower the number of large business failures.

One possible explanation for the shift in behavior across the 1970s and the 1980s is that increased exchange rate volatility encouraged foreign investors to acquire ailing large U.S. businesses. This hypothesis is consistent with the patterns in new business formation and business incorporations, Unfortunately, the data on mergers and acquisitions do not bear out this theory. Preliminary analysis of this data shows that both the average size of businesses acquired and the number of businesses acquired decreased steadily between 1981 and 1983.

Another possible explanation is that firms established offshore facilities instead of absorbing the high costs of volatility and suffering the effects of the strong dollar. To provide further insights into the sectoral effects of exchange rate patterns, below we study the responsiveness of sectoral investment in new plant and equipment.

Sectoral Investment Elasticity of Response to Exchange Rates

The quarterly data on expenditure on new plant and equipment in the U.S. is disaggregated by broad industry manufacturing and nonmanufacturing categories.[11] Two sets of tests are performed on the data. The first set provides causality tests which use only lagged values of investment and exchange rates:

$$I^j_t = b_0 + b_1 I^j_{t-1} + b_2 I^j_{t-2} + \Sigma\beta_k er_{t-k}$$

where the I^j_t are logarithms of investment series by industry j and the er_t are the logarithms of exchange rates, with k=0,..,8.[12] Table 3 summarizes the results for the 1970s and 1980s.

In the second set of tests we use least squares regressions to relate sectoral investment to exchange rates, exchange rate trend and volatility:

$$I^j_t = b_0 + \Sigma\beta_k I^j_{t-k} + b_1 DUMA^*Mij_t + b_2 Mij_t + b_3 DUMB^*Tij_t + b_4 Tij_t + b_5 GDP82_t$$

where i=1,2,3 depict the choice of trend and volatility pair, j=12, 24 represents the number of months used in construction of the measure, and all variables are in logarithms. The investment data are filtered to isolate their own lagged behavior and aggregate demand patterns before the exchange rate measures are introduced. We distinguish between impact effects of exchange rates, short and long term trends, and short and long term exchange rate volatility. In addition, we use dummy variables to indicate differential investment response to volatility across appreciation and depreciation periods, and trend response across high and low volatility periods. DUMA equals 1 during trend appreciations and equals 0 otherwise. DUMB equals 1 during periods of higher than average volatility and equals 0 otherwise. The model is estimated separately for the 1970s, the 1980s and the complete sample to indicate the differential response of investment over time. The responsiveness of investment to exchange rate trends and exchange rate volatility are reported in Tables 4a and 4b and 5a and 5b.[13]

Trend depreciations are expected to increase the competitiveness of United States goods in international markets, and increase the competitiveness of the United States as a location for industrial facitilities. If relative prices and demand are elastic, trend depreciations will stimulate domestic investment through the goods market effect. If trend depreciations also depress the relative cost of production, domestic investment will be stimulated through the location effect. This effect is expected to be strongest for firms with low specific labor forces and low sunk costs of investment.

By the causality test results, in the 1970s, while the impact effects of exchange rates on investment insignificant (with the exception of transportation), the cumulative lagged effects of exchange rates were significant for many sectors. Dollar appreciations caused depressed investment in durable goods manufacturing and chemicals, and stimulated investment in textiles, rubber, and commercial and other industries (wholesale and retail trade, finance and insurance, and personal and business services).

Over the 1980s, on impact dollar appreciations either stimulated or had no significant effect on investment. The total elasticity of response of investment to dollar movements differed markedly from behavior in the 1970s. Contrary to expectations and previous history, dollar depreciations (appreciations) were associated with reduced (increased) investment in many sectors of the United States economy,[14] while investment in other industries[15] expanded in response to dollar depreciations. While these latter results are consistent with predictions of theory, the behavior was curiously at odds with earlier patterns in these industries. The total responsiveness of investment to exchange rates appears unstable both qualitatively and quantitatively across subintervals.

The causality test results suggest that if investment does not respond to exchange rates within a year, it is unlikely that it will respond within two years. In the 1970s, only four of the thirty–one industries proved responsive only during the second year. In the 1980s only two of thirty–one industries showed only second year response. In contrast to the 1970s, in the 1980s lagged reactions to exchange rates exceeded first year reactions in a number of industries [other durables, blast furnaces and steelworks, rubber, nonmanufacturing, mining and finance and insurance]. Exchange rate volatility may have delayed market response to exchange rates.

The main results from the second set of tests are the following:

I. Investment Responsiveness to Contemporaneous Nominal Exchange Rates

While investment was sensitive to contemporaneous exchange rate changes for half of the industries examined, the pattern of response changed across the 1970s and the 1980s. In the 1970s a contemporaneous appreciation of the dollar was correlated with investment contraction in eleven industries and investment expansion in four industries. Over the aggregate, investment did not show significant response to exchange rate changes, although manufacturing investment did respond: investment in durables expanded and investment in nondurables contracted. In the 1980s, dollar appreciations were correlated with investment contractions in only two industries, while investment expanded (contracted) significantly with appreciations (depreciations) in 15 industrial categories.

II. Investment Responsiveness to Short–Term Trends in Nominal Exchange Rates

In the 1970s only 7 of 31 categories of investment significantly responded to some measure of short term trend. In low exchange rate volatility periods trend appreciations (depreciations) were associated with investment contractions in 1 industry and expansions in 3 industries. In high dollar volatility periods, trend appreciations were associated with investment contractions in 3 industries and expansions in three industries.

In the 1980s 13 of the 31 categories were responsive to some measure of short–term trend. In periods of below average volatility, trend appreciations are correlated with investment expansions in 9 industries and contractions in 1 industry. In periods of above average volatility trend appreciations are correlated with expansion in 8 industries and contractions in 5 industries.

III. Investment Responsiveness to Long–Term Trends in Nominal Exchange Rates

In the 1970s 14 of the 31 categories of investment responded significantly to some measure of long term exchange rate trend. In response to trend appreciations, 9 industries contracted and 4 industries expanded investment. While the qualitative response to trend did not vary across high and low dollar volatility periods, 7 industries exhibited statistically significant differences in response elasticities.

In the 1980s 16 of the 31 categories responded significantly to some measure of long term trend. In low dollar volatilitly periods, trend appreciations contracted investment in 7 industries and expanded investment in 4 industries. In periods of high dollar volatility trend appreciations were correlated with significant investment contractions in 15 out of 16 industries.

IV. Investment Responsiveness to Short–Term Nominal Exchange Rate Volatility

For the 1970s, during periods of trend depreciations, few industries were responsive to short term exchange rate volatility. (Of the 3 responsive industries, 1 contracted and 2 expanded investment.) Investment response to short term volatility was significantly broader during trend appreciation periods. Of the 11 industries in which investment responded significantly to volatility, investment expanded in 9 and contracted in only 1.

During the 1980s, investment in 11 of 31 industries responded significantly to altered volatility. In trend depreciation periods increased volatility was associated with expanded investment in 4 industries and contracted investment in two industries. In trend appreciation periods increaseed vvolatility was associated with expansions in 6 industries and contractions in 5 industries.

V. Investment Responsiveness to Long–Term Nominal Exchange Rate Volatility

In the 1970s, 13 of 31 industries were responsive to long term volatility. During dollar depreciation periods, increased volatility was associated with investment contractions in 5 industries and expansions in 3 industries. During appreciation periods, higher volatility was correlated with investment expansion in 2 industries and contractions in 10 industries.

In the 1980s 18 of 31 industries exhibited significant investment response to long term exchange rate volatility. The contractionary effects of volatility were quite strong:

investment contracted significantly in 17 industries during trend appreciation periods and in 14 industries during trend depreciation periods. Investment expanded with increased volatility in only 1 industry.

Some general conclusions can be drawn from these results.

i) While contemporaneous dollar appreciations generally were associated with investment contractions in the 1970s, in the 1980s appreciations were associated with investment expansions.

ii) Investment response to short and long term exchange rate trends differed across the 1970s and the 1980s, and across high and low dollar volatility periods. Industry response to short trends were weaker in the 1970s than in the 1980s. Short term exchange rate trend appreciations led to both contractions and expansions in the 1970s, but were more generally associated with investment expansions in the 1980s. In high dollar volatility periods, industries were more likely to contract investment in response to appreciations.

iii) Investment response to long term trends was stronger than the response to short term trends in both the 1970s and the 1980s. During the 1970s, the association between trend movements of exchange rates and investment was independent of the uncertainty surrounding exchange rates. During the low volatility periods of the 1980s trend exchange rate movements led to sectoral resource redistribution. During high volatility periods, trend appreciations led to overall investment contractions.

iv) During the 1970s the effects of volatility on investment were varied. While the response to short term volatility is weak for the 1970s and mixed in the 1980s, the response of investment to long term variability of exchange rates is more definite. During the 1970s the contractionary stimuli from volatility was strongest in trend appreciation periods. During the 1980s exchange rate volatility had strong depressing effects on investments across much of the U.S. economy, regardless of the direction of exchange rate trends.

The trend and volatility measures are used as proxies for expected paths and risk associated with exchange rates. Earlier we posited that trend depreciations lead to investment expansions through the location and demand effects. If investors are to undertake long term investment decisions, longer term trends and associated risk are expected to contain more relevant information for investment decisions than the short term counterparts. The exception to this rule is if firms are using investments to hedge against short term exchange rate risk. If trend depreciations raise the relative price of traded goods, in the absence of distorting income effects on demand we would expect positive demand stimuli in domestic competing tradables. If resources are drawn away from nontradeable sectors, investment in nontradeables may decline in response to trend depreciations. The location effect would make domestic facilities more attractive to both domestic and foreign parents, and thereby links depreciation trends with investment expansions.

The argument that dollar appreciations (depreciations) lead to a deindustrialization (industrialization) of the domestic economy, as compared with a reallocation of resources across industrial sectors, is not rejected by our results: declines in business incorporations and investment in new plant and equipment are significantly correlated with long term trend appreciations. Appreciations also have a second order effect: during appreciation periods the negative and significant correlation between exchange rate volatility and investment is increased.

III. Investment Response Elasticities and Industry Characteristics

Further insights to industry response to exchange rates are gained by relating the response elasticities to industry characteristics including: import and export exposure,[16] capital to labor ratios, price over cost mark–ups, employment sensitivity to exchange rates, average share of foreign investment in total new plant and equipment expenditures, and exchange rate price pass–through elasticities.

Recent theoretical studies of exchange rate pass–through emphasize that price elasticity of response to exchange rates depend on industrial structure, market demand structure, capital intensity of production, the substitutability of foreign and domestic products, and the fixed costs of entry and exit. Dornbusch (1987) and Feinberg (1989) suggest that exchange rate pass–through into domestic import prices is highest (and profit margin sensitivity lowest) in relatively homogeneous product groups, such as food and semi–manufactures. In finished manufactures, where price setting behavior, product differentiation, and capital intensity of production can be important, export and import prices tend to diverge more often, and exchange rate pass–through is low.

By the demand effect, if a tradeoff of price for quantity adjustment occurs in response to exchange rates, low pass–through elasticities may be associated with high investment elasticity. The location effects of exchange rate trends on investment are: i) dampened by high sunk costs of investment and scale economies; ii) heightened by foreign presence in the domestic market. [Since existing footholds on a market make it easier to reach efficient economies of scale, the higher the foreign penetration of domestic markets, as measured by domestic imports to new supply, the higher the expected foreign positive response to exchange rate depreciation trends.]; and heightened by domestic presence in foreign markets. [The higher the export dependence of domestic producers, the greater their relocation motive during strong dollar periods and overall negative impetus to domestic investment.]

We use two indicators of foreign presence in domestic markets: 1) the ratio of imports to new supply in manufacturing industries; and 2) the share of total investment in new plant and equipment accounted for by U.S. affiliates of foreign firms. To indicate market structure, we rely on comparative pass–through elasticities and price over cost mark–up ratios. Using price data for the 1980s, Cumby and Huizinga's (1989) measured export price pass–through elasticities for the 1980s share a number of industries with our sample.[17] Mark–up ratios of prices over costs[18] provide some indication of the profitability and competitive structure of the industries. The higher the mark–up the less the industry resembles a perfectly competitive market.

Foreign industrial presence in U.S. markets, as indicated by the share of total investment in new plant and equipment accounted for by U.S. affiliates of foreign firms, increase over the dollar appreciation period in food and kindred products, fabricated metals, stone clay and glass, textiles, transportation equipment, finance (excluding banking), and services. The foreign share of investment in domestic new plant and equipment decreased in petroleum, mining, chemicals, nonelectrical machinery, electrical machinery, paper, rubber and retail trade. As the dollar depreciated, foreign investment share decreased in food, fabricated metal products, chemical, rubber and services. The foreign investment share increased in petroleum, mining, primary metals, electrical machinery, textiles, stone, clay and glass, and finance industries.

In part due to the limited number of significant observations, sectoral characteristics, presented in Table 6, met with limited success at explaining investment responsiveness to exchange rate patterns. Using averages of imports to new supply (computed using 1980 to 1986 data), there is weak evidence that:

· the higher the ratio of imports to new supply, the higher the contractionary effect of volatility on investment;

· the higher the import penetration the larger the probability that dollar appreciations are correlated with contractions of domestic investment. Notable exceptions are transportation equipment and motor vehicles.

· the higher the export dependence of an industry, as measured by the ratio of exports to total shipments, the greater the tendency of domestic investment to respond to a dollar trend.

· the stronger the foreign presence, as measured by the average share of domestic investment undertaken by foreign firms, the greater the investment response to contemporaneous depreciation.

· the investment response to exchange rate trend and volatility appears largely unrelated to the foreign share of new investment in an industry.

· No clear relationship surfaces between industry mark–up, pass–through elasticities, and investment responsiveness to exchange rate trend and volatility. No insight on the degree of substitutability or complementarity between the investment decision and the pricing decisions is obtained.

· Investment and employment decisions appear complementary. Branson and Love (1988) find that dollar appreciations in the 1980s are associated with heavy job losses in a number of industries.[19] Strong elasticities of response of employment and of investment are observed in primary metal products, nonelectrical machinery, and food and kindred products. Although Branson and Love find employment effects of exchange rates on fabricated metal products, transportation equipment, textiles, chemicals and rubber, we do no pick up statistically significant investment response to exchange rates or long term trends in these sectors. However, investment in textiles and chemicals does significantly contract in response to exchange rate volatility, with the chemical industry more responsive during the appreciation period which weighs heavily in the interval tested by Branson and Love. While the employment effects of exchange rates appear insignificant in both paper and electrical machinery, both exhibit significant investment correlations with contemporaneous exchange rates and strong contractions in response to exchange rate volatility.

Caveats on Interpretation of the Results

The results of our analyses should be interpreted cautiously. Since we have not presented a fully specified reduced form model of aggregate entry and exit or sectoral investment, the results represent correlations among variables rather than true cause and effect relationships. In addition, we have not examined the possibility of hysteresis in activity which would lead to asymmetry in the coefficients on trends across appreciation and depreciation intervals. As in all tests of this nature, possible problems of spurious correlation generate potentially misleading interpretations of results.

IV. Concluding Remarks: This paper suggests that business formation, business failures, and sectoral investment are effected by nominal exchange rate patterns. In the 1970s trend appreciations of the dollar only weakly impacted new business formation and had mixed effects on new business incorporations. The failure rates of large and small businesses tended to decline over trend appreciation periods. Contemporaneous exchange rate appreciations tended to decrease failure rates in the 1970s and increase failure rates in the 1980s. Investment in most sectors of the economy declined with trend appreciations of the dollar and increased over depreciation periods. For most sectors of the economy, investment in new plant and equipment declined in response to long–run trend appreciations of the dollar. The industries in which real investment was insensitive to exchange rate trends in both the 1970s and 1980s were nonmanufacturing, commercial and other nonmanufacturing, food, electrical machinery, transportation equipment, motor vehicles, other nondurables (including apparel, tobacco, leather and printing–publishing) and communications.

In the 1970s, increased exchange rate volatility was significantly correlated with depressed business incorporations, depressed business formation, and increased failures of large businesses. Investment in many sectors of the economy contracted with increased levels of nominal exchange rate volatility. In the 1980s volatility was significantly correlated with increased new business incorporations and decrease business formation. During the 1970s, exchange rate volatility was significantly correlated with relocation of investment resources across sectors. During the 1980s the contractionary effects of nominal exchange rate volatility were more resoundingly felt.

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[1]New York University, New York, N.Y. 10003, and NBER program in International Economics. This project was supported in part by a New York University Research Challenge Fund Grant and by a grant from the C.V. Starr Center of Applied Economics. Discussions with Roman Frydman, Michael Klein, Robert Lipsey and Mark Speigel have been useful. Yvonne Manu provided valuable research assistance.

[2]Dixit (1987), Dumas (1989) and Krugman (1988) all show that such uncertainty engenders a wait–and–see attitude among investors.

[3]We follow de Grauwe et al. (1985), Kenen and Rodrik (1986), and Mann (1988). Kenen and Rodrik (1986) derived volatility measures to study the effects of exchange rate volatility on the imports of industrial countries. Mann (1988) used similar measures to study the effects of exchange rate volatility on pass–through.

[4]$M1N_{jt} = \Sigma^{t}_{t-(j-1)} (S\cdot_t - T1N_{jt})^2/(j-1)$

where $T1N_{jt} = 1/j\, \Sigma^{t}_{t-(j-1)} S\cdot_t$

and $S\cdot_t = (S_t - S_{t-1})/S_{t-1}$

[5] $\ln(S_t) = \alpha_t + \beta_t t + \epsilon_t$

so that $\ln(\hat{S}_t) = \alpha_t + \beta_t t$ and

$M2N_{jt} = \Sigma^{t}_{t-(j-1)} (\ln(S_t) - \ln(\tilde{S}_j))^2/(j-1)$

[6]See Nelson,C. and H. Kang, "Pitfalls in the Use of Time as an Explanatory Variable in Regression"Journal of Business and Economic Statistics vol.2 (January 1984) pp.73–82.

[7]The business failure data are available only through the end of 1983. More recent data are not included in this study since they are based on expanded coverage and are generally not compatible with the earlier series. All The data are either available from the U.S. Department of Commerce or from Dun & Bradstreet.

[8]The empirically weak response of investment to changes in the cost of capital is somewhat puzzling given neoclassical and neo–Keynesian theories of investment: Allowing for delivery lags or adjustment costs, place heavy emphasis on the importance of factor prices and investor rates of return for determining changes in investment. Clark (1979) concludes that capital aggregation problems and slow adjustment of the capital stock rather than defects of the theory account for the poor performance of the neoclassical model. Bosworth's (1985) examination of data through 1985:3 finds little support for the hypothesis that the cost of capital affects investment. Abel and Blanchard (1986) note that studies which regress investment on q typically find that q does not explain a large part of the variation in investment and that the unexplained movement in investment is highly serially correlated. While these studies generally rely on average rather than marginal q, their analysis using marginal q reaches the same conclusion.

[9]Each of the dummy variables used in regressions is specific to the interval and measure to which it is applied.

[10]Possible spurious correlations may be attributable to tax code changes.

[11]All expenditure figures are quarterly data reported in constant dollars.

[12]As in the analysis of aggregate measures, the impact elasticity of exchange rates are taken to be the coefficients b_3 on the contemporaneous exchange rate variable. The total effect of exchange rates on y_t is represented by the sum of statistically significant coefficients on the exchange rate variables, where statistical significance is defined at the 10 percent level.

[13]Further econometric results and regression statistics are available upon request.

[14]Including electrical machinery, aircraft, stone, clay and glass, other durables, textiles, and some elements of nonmanufacturing.

[15]finance and insurance, personal and business services, communications, food, rubber, mining and steel

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[17]Food and kindred products, lumber and wood products, furniture and fixtures, paper and allied products, chemicals and allied products, petroleum and coal products, primary metal products, industrial machinery and equipment, electronic and other electrical equipment, and transportation equipment. The industries used in the Mann (1988) and Feinberg (1987) studies are too specific to be useful for our purposes.

[18]Computed by Hall (1988) using data for 1953 to 1984

[19]primary metals, fabricated metal products, nonelectrical machinery, transportation equipment, stone, clay and glass, food and kindred products, textile mill products and rubber and miscellaneous plastics.

Table 1: Aggregate Elasticities of Response to Exchange Rates

	Impact	% of Total Effect in Year One	Total
Business Incorporations			
1971:06– 1979:12	0.0	100	−0.568
1980:01– 1988:06	0.0	0	0.923
New Business Formation			
1971:06– 1979:12	0.0	100	0.020
1980:01– 1988:06	0.0	na	0.000
Small Business Failures[1]			
1971:06– 1983:12	0.0	0	3.038
1971:06– 1979:12	0.0	0	0.000
Large Business Failures[2]			
1971:06– 1983:12	0.0	V(−,+)	0.551
1971:06– 1979:12	1.319	100	−1.015

Coefficients reported in summations as equal to zero unless statistically significant at the 10 percent level.

na: not applicable

V : sign of response elasticities vary between first and second year

[1] Small Businesses are defined as those with liabilities less than $100,000.

[2] Large Businesses are defined as those with liabilities greater than $100,000.

From regressions of the form: $y_t = c + \Sigma\alpha_i y_{t-i} + \Sigma\beta_j ER_{t-j}$ $\quad i=1,..6 \quad j=0,..24$

TABLE 2A: AGGREGATE ELASTICITY OF RESPONSE TO EXCHANGE RATES AND EXCHANGE RATE TRENDS

INDUSTRY	ER	T1R12	D1R12	ER	T2R12	D2R12	ER	T1R24	D1R24	ER	T2R24	D2R24
Small Business Failures												
1971:06-1983:12	0.157	0.049	-0.008	0.213	0.060	0.002	0.379*	0.043	-0.029	0.288	-0.005	-0.001
1971:06-1979:12	0.171	-0.028	-0.008	0.070	-0.021	0.001	0.550**	-0.250**	-0.009	0.367	-0.255*	-0.003
1980:01-1983:12	0.851**	0.073	-0.122*	0.068	-0.015	-0.015	0.859**	0.009	-0.083	0.910**	-0.089	-0.006
Large Business Failures												
1971:06-1983:12	-0.187	0.027	0.007	-0.238**	0.077	0.001	-0.136	0.064	-0.043	-0.235	0.065	0.008
1971:06-1979:12	-0.592**	0.026	0.038	-0.575**	0.015	-0.021	-0.489*	0.144	-0.016	-0.525*	0.268	0.012
1980:01-1983:12	1.563**	0.154	-0.166*	0.042	0.129	-0.018	0.697*	0.427	-0.157*	0.473	0.496	-0.007
New Business Formation												
1971:06-1988:06	0.006	0.002	-0.004	-0.000	0.005	0.001	-0.046	-0.005	0.004	0.002	-0.008	-0.001
1971:06-1979:12	-0.063*	0.008	-0.004	-0.075**	0.007	0.001	-0.139**	0.032	0.003	-0.115**	0.002	-0.001
1980:01-1988:06	0.001	0.001	-0.004	0.002	0.007	0.003*	0.008	0.004	-0.007	0.007	-0.007	0.000
New Business Incorporation												
1971:06-1988:06	0.024	0.021**	-0.016**	0.012	0.019*	0.003	-0.011	0.010	0.006	0.007	0.003	-0.002
1971:06-1979:12	-0.031	0.064**	-0.026**	-0.052	0.040	0.003	-0.165	0.096*	0.003	-0.031	0.047	-0.001
1980:01-1988:06	0.084**	0.003	-0.028**	0.098**	0.004	0.013**	0.125**	-0.044	-0.015	0.158**	-0.088**	0.001

* Indicates statistical significance at the 10 percent level

** Indicates statistical significance at the 5 percent level

Table 2B: Entry and Exit Response Elasticities to Exchange Rate Volatility Measures

	M1R12	B1R12	M2R12	B2R12	M1R24	B1R24	M2R24	B2R24
Small Business Failures								
1971:06–1983:12	0.061**	−0.028	0.016	−0.007	0.082**	0.015	0.075*	−0.002
1971:06–1979:12	0.026	0.025	0.001	−0.009*	0.055	0.076	0.058	−0.006
1980:01–1983:12	0.059	−0.160	−0.262**	−0.016	−0.372	0.129	−0.203	0.003
Lg. Business Failures								
1971:06–1983:12	0.019	0.019	−0.016	−0.010*	0.060	−0.030	0.030	−0.003
1971:06–1979:12	−0.020	0.081	−0.040	−0.019**	0.152**	−0.067	0.146**	0.007
1980:01–1983:12	0.425	−0.204	−0.092	0.001	−0.095	0.186	−0.181	−0.003
New Business Formation								
1971:06–1988:06	−0.002	−0.006	−0.000	0.001**	−0.010*	−0.000	−0.007	0.001
1971:06–1979:12	−0.005	−0.009	−0.003	0.002**	−0.017**	−0.010	−0.016**	0.001
1980:01–1988:06	−0.043**	0.025	−0.005	0.000	−0.057**	0.021	−0.009	0.001
New Business Incorporation								
1971:06–1988:06	−0.006	−0.008	−0.013*	−0.001	−0.017	0.009	−0.007	0.001
1971:06–1979:12	−0.008	−0.014	−0.016*	−0.001	−0.014	−0.017	−0.014	−0.001
1980:01–1988:06	−0.005	−0.008	−0.017	−0.002	−0.039	0.050	0.052*	0.004*

* indicates statistical significance at the 10 percent level.

** indicates statistical significance at the 5 percent level.

Table 3: Elasticities of Investment Response to Exchange Rates

Industry	1970s Impact	1970s −1yr shr−	1970s Total	1980s Impact	1980s −1yr shr−	1980s Total
All industries	0.0	na	0.0	0.218	50.7	0.221(+,+)
Manufacturing	0.0	na	0.0	0.259	100.0	0.259(+,0)
Durable Goods	0.0	0.0	−0.472(0,−)	0.0	na	0.0
Prim.Met.[1]	0.0	0.0	0.693(0,+)	0.0	94.3	1.058(+,+)
Steel&Blast	0.0	na	0.0	0.0	0.0	−0.106(0,−)
Nonfer.Met	0.0	na	0.0	0.0	na	0.0
Fab. Metals	0.0	V	−0.498(+,−)	0.0	na	0.0
Elect. Mach.	0.0	na	0.0	1.018	100.0	1.018(+,0)
Mach,x.Elec.	0.0	V	−0.365(−,+)	0.0	na	0.0
Transp.Eqp.[1]	0.0	na	0.0	0.0	na	0.0
Motor Vehcl						
Aircraft	0.0	na	0.0	0.0	100.0	1.465(+,0)
Stone,Clay&G	0.0	5.9	−0.846	0.661	100.0	0.661(+,0)
Other Durable[2]	0.0	na	0.0	0.694	V	0.970(−,+)
Nondurable Gd	0.0	na	0.0	0.317	32.4	0.977(+,+)
Food&Bev.	0.0	na	0.0	0.0	V	−0.534(−,+)
Textiles	0.0	V	1.845(−,+)	0.712	100.0	0.712(+,0)
Paper	0.0	na	0.0	0.0	na	0.0
Chemicals	0.0	100.0	−0.055(−,0)	0.0	na	0.0
Petroleum	0.0	na	0.0	0.0	na	0.0
Rubber	0.0	0.0	2.621(0,+)	0.0	0.0	−1.793(0,−)
Other Nondur[3]	0.0	na	0.0	0.0	na	0.0
Nonmanufacture	0.0	na	0.0	0.0	V	0.457(−,+)
Mining	0.0	na	0.0	0.693	V	−0.51 (+,−)
Transportatn	−0.877	39.6	−2.213(−,−)	0.0	na	0.0
Public Utility	0.0	0.0	0.0	0.0	0.0	0.0
Commerc.&etc	0.0	na	0.0	0.0	100.0	0.432(+,0)
Wholesale&Ret.	0.0	100.0	1.259(+,0)	0.0	na	0.0
Finance&Insur.	0.0	0.0	1.564(0,+)	0.0	V	−0.192(+,−)
Pers&Bus.Svc.	0.0	0.0	1.638(0,+)	0.481	V	−0.532(−,+)
Communication	0.0	na	0.0	0.0	51.8	−2.148(−,−)

1−yr−shr: share of total significant response attributed to response within the first year.
V: first year response direction departs from second year response direction. First and second year response pattern in parentheses.
(1) includes industries not shown separately; (2) consists of lumber, furniture, instruments, and miscellaneous; (3) consists of apparel, tobacco, leather, and printing−publishing.

Only elasticities significant at the 10 percent level are reported as nonzero.

TABLE 4A: INVESTMENT ELASTICITY OF RESPONSE TO EXCHANGE RATES AND EXCHANGE RATE TRENDS: 1970s

INDUSTRY	T1R12	D1R12	ER	T2R12	D2R12	ER	T1R24	D1R24	ER	T2R24	D2R24	ER
ALL INDUSTRIES	0.012	0.000	-0.160	0.280	0.000	-0.282	-0.085	0.016	0.330	-1.546*	-0.020	0.193
MANUFACTURING	0.030	0.012	-0.515	0.374	-0.013	-0.528**	0.113	0.009	0.342	-2.787**	0.027	0.319
DURABLE GOODS	-0.019	0.025	-0.119	0.440	0.000	-0.289	-0.128**	0.017	0.505**	-1.370	-0.009	0.088
PRIMARY METALS	0.067	0.047	-0.452*	-0.775	-0.039	-0.438*	0.243	-0.042	-0.364	8.426**	0.023	-0.816**
STEELWORKS[1]	0.190*	0.008	-0.756*	2.306*	-0.017	-0.573*	0.191	-0.003	-0.506	10.059**	0.013	-1.203**
NON FERROUS MET	-0.117	0.073	0.350	-2.412	-0.075	0.285	-0.158	-0.140	1.118*	-1.836	0.072	0.612
FABRICATED METAL	-0.085	0.032	0.269	0.689	0.024	-0.255	-0.045	-0.067	0.434	-3.140**	0.044	0.126
ELECTRIC MACH.	-0.020	0.033	-0.458	0.345	0.002	-0.534*	-0.034	0.016	0.105	-1.027	0.037	0.422
NON ELECT. MACH.	0.169	-0.004	-1.523*	2.599	0.012	-1.252*	0.017	0.093	0.292	-1.832	-0.032	-0.086
TRANS. EQUIPMENT	-0.142*	0.054	0.225	-2.059*	-0.038	0.120	-0.180	-0.071	0.348	-3.058	-0.066	-0.107
MOTOR VEHICLES	0.017	-0.066	0.237	0.254	0.044	0.294*	0.039	-0.027	0.366**	-2.544	-0.097	0.329*
AIRCRAFT	-0.109	0.067	-0.761	-0.456	-0.018	-0.819	0.056	-0.056	-1.217	-0.062	0.054	-0.936
STONE CLAY&GLASS	-0.140	0.032	-0.120	-0.620	0.008	-0.350	-0.136	-0.007	-0.056	-2.506	-0.001	-0.210
OTHER DURABLES[2]	-0.119	0.056	0.164	-1.305	-0.029	0.175	-0.275**	0.097**	0.331	-2.770	-0.010	0.256
NONDURABLE GOODS	0.112**	0.002	-0.929**	0.856	-0.019	-0.746**	0.028	-0.012	-0.243	-2.996	-0.031	0.258
FOOD INCL. BEV.	0.026	0.001	-0.464	0.266	-0.006	-0.614**	0.061	-0.024	-0.326	-2.691*	-0.069**	0.222
TEXTILE PRODUCTS	-0.103	0.004	0.646*	-2.052	-0.030	0.672**	0.335	0.074	0.533	-4.949**	0.080**	1.239**
PAPER PRODUCTS	0.071	0.036	-1.448**	0.034	-0.060**	1.076**	0.430*	0.116*	0.466	-3.797	-0.010	0.223
CHEMICAL	0.173**	0.005	-0.881**	1.674**	0.003	-0.647**	0.131	-0.068*	-0.312	-1.421	-0.022	-0.156
PETROLEUM	0.120	0.021	-0.919**	0.124	-0.056	-0.591	0.626**	0.062	-1.750**	4.742	0.005	-0.874*
RUBBER & PLASTICS	0.056	-0.096	0.997**	0.511	0.046	0.430	-0.215	0.039	1.103**	-6.526**	0.081*	0.892**
OTHER NON DUR.[3]	0.028	-0.017	-0.551	1.005	0.008	-0.743	0.006	-0.032	-0.447	-2.223	-0.016	-0.467
NONMANUFACTURING	-0.030	0.008	0.184	-0.198	-0.001	0.008	-0.046	0.018	0.161	-0.806	-0.014	0.059
MINING	-0.024	0.079*	-0.497	-0.865	-0.064**	0.296	-0.061	0.082	-0.043	2.914	-0.026	-0.683
TRANSPORTATION	0.000	0.047	-1.148**	0.965	-0.058**	-0.860**	0.163	0.034	0.222	-0.949	-0.028	-0.521*
PUBLIC UTILITIES	-0.047	0.007	-0.220	-0.577	-0.004	-0.176	-0.071	0.054	-0.138	-0.480	0.002	-0.316
COMMERCIAL&OTHER	-0.006	-0.016	0.377	0.266	0.019	0.124	-0.013	-0.007	0.254	0.443	0.046	0.145
WHOLESALE&RETAIL	-0.042	0.028	0.265	0.454	0.004	-0.322	0.002	-0.034	0.314	-0.599	0.008	0.181
FINANCE & INSUR.	0.004	-0.052	-0.876	0.173	0.037	-0.990	0.140	-0.058	-1.372**	2.935*	0.077**	1.200**
SERVICES[4]	-0.058	-0.046	0.637	1.466	0.044	0.343	0.023	-0.023	0.381	-2.813	-0.054	0.165
COMMUNICATION	-0.025	0.015	-0.146	-0.497	-0.018	-0.183	0.011	0.023	0.001	-0.920	-0.013	0.179

* Indicates statistical significance at the 10 percent level

** Indicates statistical significance at the 5 percent level

[1] Blast Furnaces and Steelworks; [2] Consists of Lumber, Furniture, Instruments and Misc.;

[3] Consists of Apparel, Tobacco, Leather and Printing Publishing; [4] Consists of Personal and Business Services

TABLE 4B: INVESTMENT ELASTICITY OR RESPONSE TO EXCHANGE RATES AND EXCHANGE RATE TRENDS: 1980s

INDUSTRY	T1R12	DUMA	ER	T2R12	DUMA	ER	T1R24	DUMA	ER	T2R24	DUMA	ER
ALL INDUSTRIES	0.006	-0.017	0.035	-0.061	-0.001	0.010	-0.008	-0.006	0.062	-0.657**	0.006	0.069*
MANUFACTURING	0.009	-0.028*	0.048	-0.012	0.010	0.025	-0.010	-0.010	0.069	-0.929**	0.014	0.096*
DURABLE GOODS	0.004	-0.027	0.025	-0.361	0.005	0.006	-0.018	-0.016	0.087	-1.066**	0.012	0.110*
PRIMARY METALS	0.020	-0.057	-0.142	0.053	0.053	-0.179*	-0.067	0.026	0.043	-1.763*	-0.032	0.163
STEELWORKS[1]	0.041**	0.082	-0.099	0.600	0.035	-0.142	-0.113	0.081	-0.043	-1.713	-0.042	0.070
NONFERROUS METAL	0.012	-0.061	-0.194	0.303	0.034	-0.319*	0.058	-0.074	-0.248	0.225	-0.007	-0.293*
FABRICATED METAL	0.000	-0.024	-0.052	-0.138	0.026	0.025	0.010	-0.064	0.061	-1.020	-0.002	0.070
ELECTRIC MACH.	0.011	-0.019	0.030	0.139	-0.036	-0.132	0.044	-0.081	0.203	-0.277	0.049	0.206*
NON ELECT. MACH.	0.019	-0.023	0.039	0.055	0.013	0.076	-0.043	-0.058	0.297**	-1.520	-0.051	0.151
TRANS. EQUIPMENT	0.012	-0.045	0.216*	0.202	0.040	0.168	0.052	0.058	0.297**	-1.184*	-0.041	0.132
MOTOR VEHICLES	0.069	0.023	-0.447	0.212	0.024	-0.359	-0.261**	0.168**	0.390*	-3.956*	-0.098**	0.081
AIRCRAFT	-0.013	-0.027	0.084	-1.062	-0.017	0.017	0.088*	-0.172**	0.186	0.388	0.071	0.098
STONE CLAY&GLASS	0.024**	0.059*	0.143	0.800	0.057	0.036	0.044	-0.090**	0.032	-1.174	0.009	0.298**
OTHER DURABLES[2]	0.003	0.011	0.122	0.401	0.023	0.098	0.028	-0.087**	0.253**	-0.944	0.019	0.227**
NONDURABLE GOODS	0.023**	0.034*	0.049	0.337	0.024	0.044	-0.002	-0.011	0.075	-0.759	-0.027	0.082
FOOD INCL. BEV.	0.007	-0.026	0.016	-0.201	0.000	-0.035	0.020	-0.042	0.153	-1.530**	0.048	0.144
TEXTILES & MILL	0.006	-0.010	-0.033	0.856	0.053	-0.023	0.009	-0.034	0.095	-1.434	-0.016	0.145
PAPER PRODUCTS	0.010	-0.034	0.115	0.328	0.063**	0.077	-0.006	-0.052	0.198**	-0.139	0.028	0.150**
CHEMICAL	0.006	-0.025	0.082	0.189	-0.005	-0.004	0.047	-0.102*	0.170	0.076	0.052	0.173
PETROLEUM	0.057**	0.034	0.053	1.459**	0.002	0.096	0.123**	0.061	0.047	0.066	-0.116**	0.049
RUBBER	0.020	-0.118*	0.402**	0.258	0.015	0.268	-0.046	0.002	0.316	-1.644	-0.044	0.306
OTHER NONDUR.[3]	-0.003	0.039	0.039	0.617	0.025	0.088	-0.006	-0.077	0.237**	-0.547	0.042	0.223**
NONMANUFACTURING	0.006	-0.012	0.044	-0.051	-0.003	0.015	-0.011	-0.006	0.075*	-0.540	0.001	0.068
MINING	0.033**	0.003	-0.043	0.948	-0.019	-0.092	0.021	0.059	-0.093	-0.877	-0.119**	0.102
TRANSPORTATION	0.007	-0.030	0.028	0.884**	0.062**	0.015	0.035	-0.075*	0.079	-0.404	0.015	0.104
PUBLIC UTILITIES	0.001	0.021*	0.069	0.475**	0.013	0.076**	0.040**	0.017	0.100**	0.962**	0.024	0.065*
COMMERCIAL&OTHER	0.005	-0.010	0.067	-0.283	-0.027	0.030	-0.013	0.001	0.096*	-1.529	-0.042	-0.101
WHOLESALE&RETAIL	-0.001	0.005	0.060	-0.521*	-0.065**	0.014	-0.007	-0.003	0.105	-0.218	0.003	0.075
FINANCE & INSUR.	0.015**	0.033	0.086	0.236	0.008	0.049	-0.008	-0.004	0.093	-0.932	-0.035	0.108
SERVICES[4]	0.011	-0.032	-0.022	0.118	0.020	-0.032	-0.014	-0.001	-0.016	-1.282**	0.038	0.026
COMMUNICATION	-0.003	0.000	0.083	-0.059	0.002	0.074	0.068*	-0.102**	0.383**	-0.631	-0.009	0.090

* Indicates statistical significance at the 10 percent level

** Indicates statistical significance at the 5 percent level

[1] Blast Furnaces and Steelworks; [2] Consists of Lumber, Furniture, Instruments, and Misc.;

[3] Consists of Apparel, Tobacco, Leather and Printing Publishing; [4] Consists of Personal and Business Services.

TABLE 5A: INVESTMENT ELASTICITY OF RESPONSE TO EXCHANGE RATE VOLATILTY: 1970s

INDUSTRY	M1R12	DUMA	M2R12	DUMA	M1R24	DUMA	M2R24	DUMA
ALL INDUSTRIES	0.001	-0.023	0.004	0.005	0.006	-0.051	-0.024	0.000
MANUFACTURING	-0.023	0.011	-0.003	0.004	0.007	-0.045	-0.019	0.000
DURRABLE GOODS	-0.003	-0.014	0.001	0.003	0.027	-0.115**	0.020	0.002
PRIMARY METALS	0.031	0.028	0.030	-0.002	0.111*	0.030	0.152**	0.006
STEELWORKS[1]	-0.017	0.082	-0.017	-0.011	0.043	0.107	0.068	-0.015**
NONFERROUS METAL	0.080	0.073	0.105*	0.002	0.206**	0.003	0.180*	0.009
FABRICATED METAL	0.033	-0.091	0.027	0.010	0.051	-0.166**	0.029	0.003
ELECTRIC MACH.	-0.039	-0.017	-0.031	0.004	0.001	0.138*	-0.086*	0.000
NONELECTR. MACH.	-0.049	0.040	0.000	0.007	0.041	-0.112	0.004	0.005
TRANS. EQUIPMENT	-0.036	-0.015	-0.010	0.008	0.008	-0.126	-0.042	0.003
MOTOR VEHICLES	-0.086	0.085	-0.051	-0.006	0.008	-0.136	-0.048	0.002
AIRCRAFT	-0.039	0.057	0.020	0.007	-0.073	0.058	-0.021	-0.001
STONE CLAY&GLASS	-0.060	-0.006	-0.035	0.005	0.000	-0.225**	0.027	0.020**
OTHER DURABLES[2]	-0.002	0.018	0.036	0.003	0.040	-0.101	0.033	0.006
NONDURABLE GOODS	-0.038	0.033	-0.004	0.004	-0.008	0.009	-0.011	-0.003
FOOD INCL. BEV.	0.007	-0.039	0.023	0.012**	0.035	-0.094	-0.035	-0.003
TEXTILES & MILL	0.011	0.048	0.012	-0.006	-0.076	0.093	0.005	0.001
PAPER PRODUCTS	-0.095*	0.185**	0.001	-0.002	0.028	-0.050	0.065	0.011
CHEMICAL	0.000	0.049	0.028	0.002	0.051	-0.016	-0.005	-0.006
PETROLEUM	-0.078	0.061	-0.010	0.005	-0.090	0.060	-0.063	-0.009
RUBBER	0.114	-0.245**	0.039	0.018	-0.054	-0.159	-0.116*	0.005
OTHER NONDUR.[3]	-0.021	-0.030	-0.052	-0.003	-0.009	-0.067	-0.033	0.001
NONMANUFACTURING	0.008	-0.036	0.009	0.006**	0.003	-0.048	-0.030	0.000
MINING	-0.103*	0.145*	-0.032	-0.003	0.058	0.005	0.038	0.002
TRANSPORTATION	-0.078	0.087	-0.020	0.000	0.125*	-0.193**	0.047	0.008
PUBLIC UTILITIES	-0.021	0.023	-0.009	0.000	-0.030	-0.016	-0.037	-0.001
COMMERCIAL&OTHER	0.021	-0.066	0.015	0.009**	0.027	-0.039	-0.055**	-0.002
WHOLESALE&RETAIL	0.023	-0.069	0.010	0.010**	0.036	-0.130*	-0.032	0.003
FINANCE & INSUR.	0.027	-0.097	-0.023	0.002	-0.100	0.063	-0.121**	-0.010*
SERVICES[4]	0.053	-0.109	0.041	0.015**	0.009	-0.105	-0.044	0.001
COMMUNICATION	-0.019	-0.037	0.015	0.014**	0.020	-0.060	-0.058*	-0.005

* Indicates statistical significance at the 10 percent level

** Indicates statistical significance at the 5 percent level

1 Blast Furnaces and Steelworks; 2 Consists of Lumber, Furniture, Instruments and Misc.; 3 Consists of Apparel, Tobacco, Leather and Printing Publishing; 4 Consists of Personal and Business Services.

TABLE 5B: INVESTMENT ELASTICITY OF RESPONSE TO EXCHANGE RATE VOLATILTY: 1980s

I N D U S T R Y	M1R12	DUMA	M2R12	DUMA	M1R24	DUMA	M2R24	DUMA
ALL INDUSTRIES	0.007	-0.024	0.029	0.004	-0.032	-0.012	-0.023	0.000
MANUFACTURING	0.005	-0.023	0.032	0.003	-0.001	-0.026	-0.066	-0.004
DURRABLE GOODS	0.041	-0.040	0.028	0.001	-0.017	-0.022	-0.089	-0.003
PRIMARY METALS	0.122	-0.038	0.187**	0.007	0.103	-0.076	-0.378**	0.025**
STEELWORKS[1]	0.135	-0.064	0.262**	0.015	0.027	-0.021	-0.430**	0.031**
NONFERROUS METAL	-0.065	-0.042	-0.064	-0.011	0.157	-0.172*	-0.449**	0.036**
FABRICATED METAL	0.040	-0.054	0.018	0.007	0.124	-0.072	-0.024	0.001
ELECTRICAL MACH.	-0.090	-0.061	-0.155*	0.006	-0.269	-0.065	-0.342**	0.008
NONELECTR. MACH.	0.106	-0.079**	0.007	-0.001	-0.134	-0.013	-0.174**	0.005
TRANS. EQUIPMENT	-0.008	-0.021	0.004	-0.001	0.147	-0.152**	0.024	0.005
MOTOR VEHICLES	+0.149	-0.079	0.058	0.004	0.272	-0.198**	0.032	0.006
AIRCRAFT	-0.194	0.055	-0.121	-0.012	0.034	-0.072	-0.135	-0.005
STONE CLAY&GLASS	-0.231**	0.038	-0.001	0.006	-0.354	0.047	-0.271**	0.010
OTHER DURABLES[2]	-0.156	0.025	-0.016	0.004	-0.077	-0.056	-0.170*	-0.009
NONDURABLE GOODS	-0.046	-0.009	0.047	0.006	0.008	-0.041	-0.166**	0.007
FOOD INCL. BEV.	0.132	-0.098**	0.024	-0.002	-0.034**	0.062	0.002	0.010
TEXTILES & MILL	-0.033	-0.098**	0.089	0.004	-0.002	-0.139**	0.339**	0.012
PAPER PRODUCTS	-0.128	0.023	-0.050	-0.004	-0.193*	0.000	-0.188**	0.006
CHEMICAL	-0.094	-0.008	-0.030	0.002	-0.010	-0.040	-0.242**	0.016*
PETROLEUM	-0.063	0.030	0.142*	0.009	0.153	-0.101	-0.290**	0.014
RUBBER	0.078	-0.001	0.081	-0.001	0.375*	-0.148*	0.035	0.000
OTHER NONDUR.[3]	-0.099	0.020	0.029	0.010	-0.147	0.027	-0.141	-0.010
NONMANUFACTURING	0.007	-0.028	0.033	0.006*	-0.046	-0.006	-0.008	0.001
MINING	-0.147	0.008	0.056	0.009	-0.252	0.039	-0.273**	0.009
TRANSPORTATION	0.041	-0.044	0.060	0.009*	0.044	-0.049	-0.062	-0.004
PUBLIC UTILITIES	-0.049	0.017	-0.014	0.000	-0.119**	0.027	-0.027	-0.001
COMMERCIAL&OTHER	0.032	-0.033	0.026	0.004	-0.005	-0.016	0.016	0.004
WHOLESALE&RETAIL	0.075	-0.031	0.013	0.000	0.077	-0.029	0.102	0.008
FINANCE & INSUR.	0.031	-0.043	0.097**	0.014**	0.039	-0.012	-0.086	-0.003
SERVICES[4]	0.016	-0.040	0.033	0.005	-0.029	-0.028	-0.076	-0.002
COMMUNICATION	-0.020	-0.014	-0.076	-0.005	-0.065	-0.095*	-0.076	-0.001

* Indicates statistical significance at the 10 percent level

** Indicates statistical significance at the 5 percent level

1 Blast Furnaces and Steelworks; 2 Consists of Lumber, Furniture, Instruments and Misc.; 3 Consists of Apparel, Tobacco, Leather and Printing Publishing; 4 Consists of Personal and Business Services.

Table 6: Investment Elasticities and Industry Characteristics

Industry	ER	1980s T2R24/Duma	M2R24/Dumb	MarkUp μ–Hall	ExpPT C–H	Exp/ Ship	Imp/ Supply	Foreign %P&E
All industries	0.069*	−0.651**	0.0	na	na	na	na	7.7
Manufacturing	0.096**	−0.929**	0.0	na	na	0.087	0.099	7.3
Durable Goods	0.110*	−1.066**	0.0	2.058	na	na	na	na
Primary Metals[1]	0.0	−1.763*	−0.378**/−0.025**	2.172	0.107	0.045	0.148	10.0
Blast Furn&Steel	0.0	0.0	−0.430**/−0.031**	na	na	0.028	0.151	na
Nonferr. Metal	−0.293*	0.0	−0.449**/−0.036**	na	na	0.086	0.276	na
Fabricat.Metal	0.0	0.0	0.0	1.649	0.283	0.058	0.047	7.3
Electric.Machin.	0.206*	0.0	−0.342**	3.086	0.135	0.119	0.145	8.5
Machin,exc.Elec.	0.0	−1.184*	−0.174**	1.429	na	0.111	0.179	3.7
Transport.Equip.[1]	0.0	0.0	0.0	0.095	0.002	0.142	0.163	3.4
Motor Vehicles	0.329*	0.0	0.0	1.763	na	0.106	0.211	na
Aircraft	0.0	0.0	0.0	na	na	0.292	0.066	na
Stone,Clay&Glass	0.298**	0.0	−0.271**	2.536	0.347	0.039	0.063	12.1
Other Durables[2]	0.227**	0.0	−0.170*	1.889[4]	na	na	na	na
Nondurable Goods	0.0	0.0	−0.166**	3.096	na	na	na	na
Food inc.Bev.	0.0	−1.530**	0.0	5.291	0.048	0.043	0.041	7.3
Textiles	0.0	0.0	−0.339**	2.578	0.125	0.046	0.064	6.5
Paper	−0.150**	0.0	−0.188**	3.716	0.057	0.053	0.066	7.7
Chemicals	0.0	0.0	−0.242**/−0.016*	20.112	0.073	0.124	0.054	28.6
Petroleum	0.0	0/−0.116**	−0.290**	−139.48	na	0.027	0.084	22.9
Rubber	0.0	0.0	0.0	1.508	0.158	0.047	0.058	5.2
Other Nondur.[3]	0.223**	0.0	0.0	na	na	na	na	na
Nonmanufact.	0.0	0.0	0.0	na	na	na	na	na
Mining	0.0	0/−0.119**	−0.273**	na	na	na	na	4.2
Transportation	0.0	0.0	0.0	3.976	na	na	na	1.1
Public Util.	0.065*	0.962**	0.0	na	na	na	na	na
Commercial&etc.	0.090*	0.0	0.0	na	na	na	na	na
Wholesale&Ret.	0.0	0.0	0.0	−3.7&2.4	na	na	na	10.1
Finance&Insur.	0.0	0.0	0.0	3.300[5]	na	na	na	2.6
Pers& Bus.Svcs.	0.0	−1.282**	0.0	1.864[6]	na	na	na	2.7
Communication	0.0	0.0	0.0	36.313	na	na	na	na

The mark–up ratios of price over cost are reported in Hall (1988). ExpPT are export pass–through elasticities calculated by Cumby and Huizinga for prices during sub–intervals of the 1980s. Exp/Ship= Export to shipments for manufacturing industries, average over 1980 to 1986. Imp/Supply= Import to new supply for manufacturing industries, average over 1980 to 1986. Share of investment in new plant and equipment by foreign affiliates of US firms (computed using Commerce data).
na= not available; *elasticities significant at the 10 percent level; elasticities significant at the 5 percent level.
(1) includes industries not shown separately; (2) consists of lumber, furniture, instruments, and miscellaneous; (3) consists of apparel, tobacco, leather, and printing–publishing; (4) average of mark–up ratios for lumber and wood products (1.801) and furniture and fixtures (1.977); (5) includes real estate; (6) services.