

**EXCHANGE RATES AND INVESTMENT BY MULTINATIONAL  
CORPORATIONS:**

A Firm-Level Test of the Imperfect Capital Markets Result.

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The real value of the U.S. dollar and the level of U.S. foreign direct investment (FDI) have shown a strong correlation since the 1970s. Previous empirical studies on this relationship use primarily national or industry level data. This study uses firm-level data to test the hypothesis that exchange rates affect investment decisions of corporations by affecting the foreign currency value of their internal wealth. Implications from this model of firm behavior are tested using firm-level and geographically detailed data from U.S. national and multinational corporations. The results are inconsistent with the wealth effect explanation of FDI.

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## **I. Introduction**

Since the mid 1970s, there has existed a strong relationship between foreign direct investment (FDI) and the real value of the U.S. dollar. Figure 1 depicts this relationship. A linear regression estimate of the relationship between a real effective exchange rate index for the U.S. Dollar and inward U.S. FDI is plotted with the actual FDI for the period from 1976 to 1978. A similar relationship exists between outward FDI and the real value of the U.S. Dollar. Many studies confirm this strong correlation between actual FDI and the real value of the U.S. dollar, as well as similar relationships for other countries and currencies. This research seeks to determine if this correlation is due at all to a “wealth effect” for firms, created by changes in exchange rates. That is, do movements in exchange rates affect the firm’s wealth and therefore its ability to invest at home or abroad?

A widely cited theoretical model of foreign direct investment (FDI), Froot and Stein (1991), shows that exchange rate movements change the ability of firms to compete with their foreign counterparts for assets. This result has been called the “wealth effect” of foreign direct investment. According to this model depreciation in the value of foreign currencies should lead to increased investment by U.S. firms due to a stronger value of their home currency. Previous empirical work testing the relationship between FDI and currency exchange rates uses data at the country or industry-level. However, the implication that individual firms alter their investment strategies when exchange rates change because the value of their internal wealth has changed has not been directly tested.

This study contributes to the literature in three ways. First, the empirical work presented here goes further than previous studies by using firm-level, geographically segmented data. The sample of U.S. multinational firms for this study includes information on investment activity in various geographical regions and currencies. The non-aggregated data are better measures of the factors affecting investment decisions as modeled by Froot and Stein. Second, the previous findings that firms alter their investment positions in response to exchange rate movements is inconsistent with many models of firms' financial hedging decisions. For example, when external financing of investment is more costly than using internally generated funds, any variation in internal cash-flow inevitably leads to variations in investment. Hedging exchange rate risk reduces variations in cash-flow and, therefore, reduces variations in investment.<sup>1</sup> This study incorporates information on firms' hedging activity while testing for the wealth effect. Third, previous empirical studies of the wealth effect do not control for the firm-level source of this effect, the firm's use of external financing. In the model of Froot and Stein, imperfect capital markets, and the resulting increasing costs of external financing, are the cause of the wealth effect. Without this assumption in the model, firm investment expenditures are invariant with respect to firm wealth. Firm-level data on external financing is used in this study to control for this effect. The evidence from this geographically segmented sample of U.S. multinational firms is inconsistent with the wealth effect explanation of FDI.

In the next section of this paper, a review of the theoretical explanations of the correlation between FDI and exchange rates is presented, along with a discussion of the

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<sup>1</sup> Mello, Parsons and Triantis (1995) and Froot, Scharfstein, and Stein (1993) are models that find incentives to hedge and the relationship between financial hedges and foreign investment.

previous empirical research. The third section is a presentation of the empirical model and a discussion of the key hypothesis test. The fourth section describes the firm-level data for this study. The fifth section presents the empirical results including sensitivity tests of the model. The sixth section concludes.

## **II. Literature Review**

### *A. Theoretical explanations for FDI*

Froot and Stein (1991) first put forth the hypothesis that when firms deal in imperfect capital markets, exchange rate movements change the incentive of firms to invest at home or abroad. Depreciation in the currency of a foreign firm leads to a perceived lower cost of capital for the home-country firm. The home firm is therefore able to increase its bid for assets over its foreign competitor. The main implication of the model is this wealth effect of currency appreciation; the competitive position of a firm appreciates with its currency's appreciation, leading to increased investment expenditures by the firm.

Imperfect capital markets imply an increasing cost of external financing. In the absence of imperfect capital markets, firms could meet all investment opportunities with external funds, and any variations in internal cash-flow would be irrelevant to investment decisions. However, external funds have monitoring costs, due to information asymmetries between the firm and its financiers, which increase with increased use of such funds. The Froot and Stein model implies that an investor's reservation price for an asset increases, at a decreasing rate, with his or her wealth. At lower levels of wealth, some investment opportunities are missed due to the inability to raise sufficient external

capital. The important implication here is that the relationship between cash-flow and investment is non-constant; it varies across levels of internal and external sources of funds. The empirical tests of this study control for the debt capacity of the firm and the non-constant relationship between investment and cash-flow at different levels of internally generated wealth.

In contrast to the model of Froot and Stein, conventional wisdom holds that exchange rates should not affect firms' investment or FDI. One counter argument is that only the rate of return on assets matter. Since foreign investors convert earnings into their home currency, a depreciation of their currency with respect to another affects not only the price of assets in each country, but equally affects nominal returns. Thus, when foreign investors convert the return from the asset into their own currency as it depreciates, the return also declines. In this framework, the finding of a significant correlation between inward FDI and the real exchange rate since the early 1970s must be due to some difference in the return on assets across countries. This argument supports the testing of any relationship between exchange rates and FDI using data on investment across different countries and currencies.

### *B. Previous Empirical Studies*

Froot and Stein (1991) present empirical work on the relationship between exchange rates and FDI to test their hypothesis. They identified the relationship shown in Figure 1, but conclude that although this relationship is consistent with their theory, it does not discriminate between possible alternative theories. Many other studies confirm the correlation between exchange rates and FDI (Harris and Ravenscraft 1991, Klein and

Rosengren 1992, Swensen 1993), but also do not directly support a “wealth effect” explanation for FDI. In these studies, there is no measure of exchange rate effects on firm wealth, and the correlation between FDI and exchange rates does not hold for some countries or industries. In addition, the relationship does not hold for some types of FDI, such as expansion of existing assets. The results of these studies suggest that there are country, industry, and firm-specific factors in the data that must be controlled for when attempting to explain movements FDI. Klein and Rosengren (1992) note in their conclusion that their study ignores some firm or industry-level motivations for FDI because they are limited by the use of aggregate data.

Klein and Rosengren (1994) study FDI to test two competing theories, relative wealth and relative wages. The relative wage theory states that firms increase FDI in order to capitalize on lower labor costs. Using aggregate stock market and wage data for seven industrial countries, they find support for the wealth effect and fail to find support for a wage effect. The authors conclude that previous studies supporting the relative wage theory may be picking up the wealth effect. Additionally, they provide some evidence that the wealth effect was not due to country-specific productivity. Between 1989 and 1991 FDI into the U.S. from Canada and Japan was positively correlated with the stock market values of those countries and inversely correlated with their productivity levels. The authors suggest that this supports the imperfect capital markets model over a model of productivity. However, since productivity varies greatly across industries, these aggregate numbers may not show firm or industry productivity changes. Firms or

industries that experienced greater productivity shocks may be responsible for the majority of FDI.<sup>2</sup>

Dewenter (1995) uses more specific, industry-level data, including a proxy variable for country and industry wealth, and finds a relationship between exchange rates and investment that is due only to industry or firm-level factors. For example, wealth, as measured by stock price indices, is a significant explanatory factor for FDI in only machinery industries and some service industries. When controlling for these industry factors, Dewenter finds that bilateral exchange rates do not influence FDI. Dewenter concludes that better measures of wealth are necessary to test the model of Froot and Stein. This study uses not only a firm-level measure of wealth, but a measure of the firm's internal wealth as well. Also, this study includes a measure of debt capacity for the firm that is not included in the empirical models of Klein and Rosengren or Dewenter.

Blonigen (1997) presents a model and supporting empirical work of FDI through acquisition. The implication for investment from this model is that when firms are able to generate differing returns from the same assets, changes in exchange rates lead to different valuations of the assets. Using industry-level data on acquisitions of U.S. assets by Japanese and West German firms, the empirical results support the hypothesis. As in Dewenter, the measure of wealth in the models was external stock market data. The study presented here furthers such work at the firm-level by analyzing the investment activity of U.S. firms, both at home and in various geographic regions abroad. Firm-level

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<sup>2</sup> For evidence that the correlation between FDI and exchange rates significantly differs across industries and countries see Table III in Froot and Stein (1991) and Table 8 of Klein and Rosengren (1994). Goldberg (1993) also provides evidence that the aggregate data does not reflect important differences between industries.

measures of external financing and internal wealth are used in this study, as opposed to country or industry measures.

Overall, the empirical research to date is inconclusive with regard to the wealth effect, but suggests that there exist country, industry, and firm-specific factors in the data that may explain FDI. To control for all these factors, the theoretical explanation of a wealth effect is best tested using data on the actual investment activity of the firm, both at home and across different countries or regions. Additionally, the ambiguous results above may be due to firms' ability to hedge against any possible adverse wealth effect. This research, therefore, seeks to test the wealth effect explanation for investment, and particularly FDI, using firm-level, geographically segmented investment data, while controlling for foreign currency hedging and the increasing costs of external finance.

### **III. Empirical Model and Hypotheses Tests**

To test the model of Froot and Stein, this study measures firm-level investment, as opposed to the industry and national measures in previous research, against firm-level measures of wealth and the real value of the firm's home currency. In the Froot and Stein model a domestic investor's reservation price for an asset is increasing in wealth and ability and decreasing in agency costs. The investor's willingness to invest is dependent on both their level of internal wealth and the costs of accessing external funds. The investor is less likely to invest if the level of their internal cash is not sufficient since the more costly external funds lower the investment's return.

Furthermore, the investor's internal cash, or wealth, is dependent on the exchange rate. In the Froot and Stein model, investors with cash-flow denominated in foreign

currency (e.g. a multinational firms), have wealth that is a linear function of the exchange rate. Together these conditions imply that exchange rate movements change the value of wealth, and correspondingly, levels of investment. To test for the relationship between exchange rates and firms' investment activity, Froot, Scharfstein, and Stein (1993) propose a simple empirical specification of the form:

$$I_{i,t} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \varepsilon_{i,t} \quad (1)$$

where  $I_{i,t}$  is cash used for investment by firm  $i$  in period  $t$ ,  $w_{i,t}$  is firm  $i$ 's internal wealth in period  $t$  as measured by its cash flow from operations, and  $e_t$  is an index of the U.S. dollar relative to foreign currencies in period  $t$ . Equation (1) describes two determinants of investment: internal wealth and exchange rates. First, the expected sign of  $\alpha_1$  is positive; investment expenditures increase with increases in internal wealth. Second, the marginal value of investment with respect to the exchange rate is  $\alpha_3 + \alpha_2 w$ . The interactive term allows the exchange rate to affect investment through cash flow. According to the wealth effect model, movements in exchange rate affect a firm's investment expenditures by changing the relative value of internal wealth. A statistically significant estimate of  $\alpha_2$  supports the hypothesis that exchange rates affect firms' ability to invest by affecting cash-flow. However, this effect of exchange rates on investment is lower at higher levels of cash flow. Thus, the expected sign of  $\alpha_2$  negative. The coefficient,  $\alpha_3$ , measures other possible effects on investment from movements through exchange rates. If an appreciation of the firm's home currency increases its investments, the expected sign of  $\alpha_3$  is positive. The firm wins more bids for assets over foreign competitors and thereby increases its investments.

To incorporate the costs of external financing and other effects on investment, two controls on the model are necessary. First, equation (1) does not include a measure of the increasing costs of external financing, such as debt financing, which is necessary for the relationship being tested. Second, a firm's investment expenditures will change with changes in overall market conditions. A control for various market influences is necessary. Additionally, to control for the possible difference between the return on firm-level assets discussed earlier, some measure of such assets in the firm is needed. Adding variables for these three items to equation (1) gives

$$I_{i,t} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t} \quad (2)$$

where  $V_{i,t}$  is the value of firm  $i$  in period  $t$  as measured by its market-to-book value,  $D_{i,t}$  is the debt level of firm  $i$  in period  $t$  as measured by the ratio of long-term debt to total capital, and  $R_{i,t}$  is the level of firm-specific assets in firm  $i$  in period  $t$ , as measured by the ratio of research and development expenses to total sales.

The value of the firm,  $V_{i,t}$ , reflects investors' expectations for the firm's investment opportunities such as increasing market demand. The expected sign of  $\alpha_4$  is positive; the firm increases its investment expenditures with increases in expected value. A higher value for the firm indicates higher future earnings potential from current and previous investments.

As previously noted, the relationship between investing activity and exchange rates in the Froot and Stein model is conditional on agency costs in the capital markets. That is, firms face increasing costs of external finance due to information problems. At higher levels of debt more monitoring costs are incurred and the risk of financial distress increases. The expected sign of  $\alpha_5$  is therefore negative; investing activity decreases with

increases in debt financing. Estimates of  $\alpha_5$  measure the relationship between investing and debt holding wealth, and all other variables in the model, constant. However, the model of Froot and Stein implies that investment and wealth, as measured by cash flow, will be most highly correlated for firms with high levels of debt to capital. To further test this implication equation (2) (absent  $D_{i,t}$ ) is estimated separately for high and low debt firms.

To control for the cross-sectional differences between the return on assets, equation (2) includes a rough measure of the firm's ability to generate different returns than their competitors from the same assets.  $R_{i,t}$  is the ratio of research and development expenses to total sales. This ratio measures the level of process technologies, product innovations, and other competitive advantages. The expected sign of its coefficient,  $\alpha_6$ , is positive. The investing activity of the firm increases with its level of technological advancement or innovation. Additionally, equation (2) (absent  $R_{i,t}$ ) is estimated separately for firms with high and low research and development expenditures.

As previously mentioned, previous empirical studies do not include measures of firm activity designed to mitigate the effect of exchange rates on the firms' activities. To test if firms mitigate any "wealth effects", equation (2) is estimated separately for firms that hedge foreign exchange rate risk and those that do not. For this study, a firm is considered hedging exchange rates if it reports the use of foreign currency derivatives (FCDs) in its financial statements. A significant difference in the estimate of  $\alpha_2$  between the two sub-samples supports the hypothesis that the use of FCDs mitigates the effect of foreign exchange rate risk on investment expenditures. Alternatively, an additional regressor, an intercept and slope dummy variable, which equals one if the firm reports the

use of FCDs, is included in the estimation of equation (2). A significantly positive estimate of the slope dummy coefficient on such a regressor supports the same conclusion. Both approaches are used in the results that follow.

The firm-level data for this study provides an additional means to test the Froot and Stein explanation for the relationship between FDI and exchange rates. Equation (2) is estimated across many different industries. Such variation in industry effects is found in Harris and Ravenscraft (1991). Further, Froot and Stein show that the relationship between FDI and the exchange rate is more pronounced for more information-intensive assets. This follows from their model since the source of imperfection in the capital markets is an information asymmetry. For this study, both 1-digit and 2-digit SIC codes are used to identify any differing impact of exchange rates due to different monitoring costs of external finance, or due to a different nature of firm assets (e.g., capital intensive or intangible). Also, an implication of the Froot and Stein model is that *total* investment by the firm will change in response to changes in the exchange rate. Klein and Rosengren (1994) and (1992) find support for the wealth effect using data on inward and outward FDI, respectively. So to better observe the relationship between exchange rates and foreign investment the model is also estimated for firms' investments across different regions and currencies. This is outward FDI of U.S. multinationals.

To test the investment activity of U.S. based multinationals outside of the U.S financial data and bilateral exchange rate indices for two regions (Europe and Asia-Pacific) and one specific country (Canada) are used in this study. In this framework, the model takes the form:

$$IAG_{i,t,j} = \alpha_0 + w_{i,t} (\alpha_1 + \alpha_2 e_{t,j}) + \alpha_3 e_{t,j} + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t,j} \quad (3)$$

where  $IAG_{i,t}$  is the ratio of identifiable assets by geographic segment to total assets of the firm at time  $t$  and the subscript  $j$  indicates the country or geographic region where the firm has investments. In addition to measuring foreign investment by U.S. firms, this specification allows for testing the wealth effect for outward FDI while controlling for the country-specific factors found in previous empirical work, such as Klein and Rosengren (1994).

#### **IV. Data**

The data used in this study provide a unique opportunity to test the wealth effect of exchange rate changes on firms' investing activity, while controlling for firm-specific factors. To obtain firm-level information on investing activity, the data were collected from the S&P COMPUSTAT database. First, to insure a wide selection of firms with both international and national investment activity, the S&P 500 index of companies was chosen as a beginning sample. This index is comprised of many large multinational firms with foreign investment activity across many geographical locations. The large size of the firms in the sample creates potential bias; however, data limitations preclude the use of a broader cross-section of firms. Specifically, smaller firms often do not meet the 10% of total operations reporting requirement for foreign assets or sales.<sup>3</sup>

Second, the period, 1992 to 1997, is used to control for financial hedging activity. Beginning in June of 1990, firms that issue stock in the U.S. were required to report their use of foreign currency derivatives (FCDs). Widespread reporting of FCDs is first

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<sup>3</sup> Financial Accounting Standards Board (FASB) Statement No. 14 requires a publicly held company to present information on revenues, profitability, identifiable assets, and other related disclosures (such as the aggregate amount of a segment's depreciation, depletion, and amortization expense) for its operations

evident in 1992. The data on exchange rate hedging activity of the S&P 500 firms were collected from the 10-K reports to the U.S. Securities and Exchange Commission (SEC) for each firm.

Appendix 1 details the variables used in each of the hypothesis tests. Banks, utilities, and property and casualty firms are excluded from the estimates of equations (2) and (3) because cash-flow accounting statements for these firms are not prepared in the same manner as manufacturing and other services. Banks are also excluded since many are market makers for FCDs and may hold foreign currency for trading purposes. Including only those firms reporting research and development expenditures provides a sample of 259 firms national and multinational firms.

Using geographically segmented data from the S&P COMPUSTAT database for multinational corporations in the S&P 500 index allows for estimation of equation (3). In the financial statements of U.S. firms assets identified with a geographic segment of the firm's operations are translated to U.S. dollars at an average of the exchange rate over the period. The effect of currency translations on any existing assets of the firm are reported in the shareholder equity portion of the firm's balance sheet.<sup>4</sup> An ideal data set would include geographic segmentation for each country and its corresponding currency. However, most firms report segmented data for geographic regions only. The most common, non-domestic, regions reported for multinational corporations in the S&P 500 are Europe and Asia-Pacific. The data for estimates of equation (3) also include one single country, Canada.

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qualifying as a reportable segment. If 10 percent or more of operating sales are derived from any single country or geographic region, that fact and the amount from each must be disclosed.

<sup>4</sup> See Jensen, D.L. and E. N. Coffman and R. G. Stephens and T. J. Burns (1994) Chapters 9 and 13.

The exchange rate data are from the Federal Reserve Bank of Atlanta Dollar Index Data. The Atlanta Fed calculates a U.S. dollar index using 1984 bilateral trade weights for 18 currencies. In addition, the Atlanta Fed calculates three sub-indices. The European sub-index includes Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom. The Pacific group includes Australia, China, Hong Kong, Japan, Singapore, South Korea and Taiwan (the Canadian dollar is treated as a separate sub-index, and the overall dollar index includes the Saudi Arabian Riyal along with the foregoing 17 currencies). A rise in the index or sub-index reflects a strengthening of the dollar against currencies included. The Atlanta Fed U.S. dollar index and sub-indices are used in this study because their trade-weighted construction serves to mirror changes in the real value of the U.S. dollar. Hunter (1990) shows that this nominal index and each sub-index is highly correlated with a real index of the value of the U.S. dollar and is therefore a good proxy for the real exchange rate.

## **V. Empirical Results**

### *A. Exchange Rates and Investment - Full Sample.*

Descriptive statistics for the full sample of 488 firms are reported in Table 1. Correlation coefficients and corresponding levels of significance are reported in Table 2. The sample is composed of primarily large firms with generally positive investment expenditures over the sample period. The median firm has assets of more than \$5 billion and cash used for investments was negative in only 14% of the observations. The positive investment activity is consistent with the relationship in Figure (1) given the overall direction of in exchange rates for the period.

OLS estimation of the specification in Equation (2) provides constant slope coefficient and non-constant elasticity measures. As noted, the model of Froot and Stein predicts, however, that both slope coefficients and elasticity are non-constant. To incorporate this condition, a left-side, semi-log specification for equations (2) and (3) is also estimated. Since investment is a flow variable, the data includes both zero and negative values for investing activity. The dependent variable of equation (2),  $I$ , is therefore transformed using the Box-Cox technique instead of logs and the results that follow include this non-linear in the variables specification.<sup>5</sup>

A further potential problem with the specification of equations (2) and (3) is that  $w$ , cash-flow for the firm, is endogenous. Contemporaneous cash-flow is likely determined by current and past investment. Therefore, each of the estimates that follow were also calculated using an instrumental variable for  $w$ . Table 2 shows that operating income before depreciation,  $OPI$ , is highly correlated with cash-flow,  $w$ , but not highly correlated with investment. Any significant differences in the estimates using this instrument are reported below.

Estimation of equation (2) for the 259 firms with complete data are reported in Table 3. These first results provide evidence consistent with the “wealth effect” hypothesis. In both specifications the coefficient on cash-flow is positive and significant; investment expenditures increase with increases in internal wealth. According to the model of Froot and Stein, movements in exchange rates affect a firm’s investment expenditures by changing the relative value of internal wealth. The coefficient estimate for the interactive variable, cash-flow multiplied by the exchange rate, is negative and

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<sup>5</sup> The Box-Cox technique is appropriate given both the non-positive observations and the skewness of the dependent variable in the sample. The method of transformation follows John and Draper (1980).

statistically significant. Also, the coefficient on the measure of the firm's debt capacity, long-term debt to total capital, is negative and statistically significant for semi-log specification (the coefficient is negative and statistically significant for both specifications when the instrumental variable is used). This non-linear specification is more closely aligned to the imperfect capital markets assumption of the model. These results are consistent with the hypothesis that exchange rates affect firms' ability to invest due to financing constraints from imperfect capital markets.

The marginal effect of exchange rates on investment is, however, very small. The marginal value of investment with respect to the exchange rate in equation (2) equals  $\alpha_3 + \alpha_2 w$ . Using the coefficient estimates in Table 3 and mean values for the sample from Table 1, the marginal effect is -0.0000759 and 0.0000067 for the linear (OLS) and non-linear specifications, respectively. The estimated exchange rate elasticity for each specification is -0.08861 and 0.00786 respectively. This suggests that a one percent move in the exchange rate leads to less than a one-tenth of one percent move in the ratio of cash used for investment to total assets.<sup>6</sup>

With respect to the source of the wealth effect, imperfect capital markets, the model of Froot and Stein implies that the correlation between investment and wealth is higher for firms with higher use of external funds, or debt. The estimates of the exchange rate effect in Table 3 are measured holding debt constant. To test this condition of the Froot and Stein model, equation (2) without the variable D, is estimated separately (not reported) for firms with a debt to capital ratio above and below the mean value for the sample (0.40). Contrary to the Froot and Stein model, the wealth effect, as measured by

the coefficient on the interactive variable, is statistically different from zero only for firms with a low level of debt to total capital, in the semi-log specification only.

*B. Exchange Rates and Investment – Controlling for Hedging.*

Table 4 reports estimates for the OLS and semi-log specifications of equation (2) with the addition of a dummy variable that indicates the firm uses foreign currency derivatives to hedge its exposure to exchange rates. The coefficient on the dummy variable is not statistically significant for either specification. This suggests that the use of FCDs may not completely hedge the affect of exchange rates on internal wealth. Separate estimates of equation (2) for firms that use FCDs and those that do not are reported in Table 5. The coefficient estimate for the interactive variable, cash-flow multiplied by the exchange rate, is statistically significant only for the firms in the sample that actively hedge exchange rate risk. The estimated effect of exchange rates is not significantly different from zero for firms that do not report the use of FCDs under both specifications. The estimated marginal effect of exchange rates on investment for firms that report the use of FCDs is 0.00009 and 0.00021 under the OLS and semi-log specifications, respectively (again using the mean value for wealth). This suggests that the elasticity of investment with respect to exchange rates is less than one one-hundredth of a percent. These marginal effects, although small, are larger than those found in Table 3. If the wealth effect is greater for firms that are actively seeking to eliminate such effect, the estimates of equation (2) may reflect an exchange rate effect other than that modeled in Froot and Stein, or the hedging activity of the firms in this sample is not very

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<sup>6</sup> The estimates in Table 3 are insensitive to an alternate specification of exchange rates. Using an AR(1) model of exchange rates, estimated from monthly observations of the Federal Reserve Bank of Atlanta

effective. A possible explanation is that firms do not seek to hedge all of their exposure to exchange rates in order to capture some advantageous moves in exchange rates.

*C. Exchange Rates and Investment - Firm-Specific Assets.*

The coefficient on research and development expenditures is positive and highly significant for the estimates in Tables 3 and 4.<sup>7</sup> This suggests that other, firm-specific factors may be influencing the results. The estimate of this coefficient, however, is measured holding the exchange rate variables in the model constant. To look at this more closely, Table 6 reports separate estimations of equation (2). Those firms whose research and development expenditures, as a percentage of their total sales, are greater than the median value for the sample are considered high R&D firms. The coefficient estimate for the interactive variable, cash-flow multiplied by the exchange rate, is statistically significant only for these high R&D firms. Furthermore, the direct effect of exchange rates is higher for high R&D firms. The results are qualitatively similar, but less precise, for estimates using the instrumental variable.<sup>8</sup>

Further tests of the model describe the industry differences between exchange rate effects. Table 7 reports estimates for the OLS specification of equation (2) by 1-digit SIC code. The coefficient estimate for the interactive variable, cash-flow multiplied by the

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Dollar Index, provides practically identical results (not reported).

<sup>7</sup> Estimates of the coefficient on firm value,  $V$ , are insignificant throughout this study, but this is likely due to high collinearity with the firm-specific asset variable,  $R$  (See Table 2), and the  $V$  was therefore not dropped from the model. When  $R$  is dropped and the model is estimated for the full sample,  $V$  is significant, and qualitatively similar results for all other variables are found for Table 3 and 4 (not reported).

<sup>8</sup> Equation (2) was also estimated using the ratio of advertising expenses to total sales as an alternative proxy for firm-specific assets. The results (not reported) are similar, but less precise. All coefficient estimates are insignificant and both the linear and non-linear models are insignificant (as measured by the F-test of overall significance). This results is likely due to the limited data available on advertising

exchange rate, is statistically significant for only one industry, SIC code 3 – Manufacturing (similarly for the semi-log specification, not reported).<sup>9</sup> These results are consistent with previous work, but inconsistent with the model of Froot and Stein. The coefficient on the measure of the firm’s debt capacity, long-term debt to total capital, is insignificant at standard levels. Investment expenditures are not affected by the debt capacity of these firms which is inconsistent with the prediction of the model that exchange rates have no affect when the firm is not constrained by its debt capacity.

Equation (2) is estimated using fixed-effects assumptions to further look at firm-specific effects and the results are reported in Table 8. The inclusion of the firm dummy variables eliminates all effects except for the effect of R&D in the semi-log specification. This result suggests that previous findings of a wealth effect in studies using aggregated data may be picking up a firm-specific effect.

#### *A. Exchange Rates and Investment - Geographic Regions.*

Next, estimates of equation (3) for sub-sample of 200 firms reporting geographically segmented financial data are reported in Table 9. The firms’ investments across different regions and currencies are measured using regional financial data and bilateral exchange rate indices for each region. To capture the firm-specific effects found above, the model is estimated using a the fixed-effects assumption. In these estimates, the exchange rate has a direct effect on investment; estimates of  $\alpha_3$  are positive and

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expenses. Using this measure severely lowers the number of observations. Only 797 observations are available over the six years of the sample.

<sup>9</sup> This result does not hold when the model is estimated using the instrumental variable. Also, estimation of the model using 2-digit SIC codes (not reported) provides inconclusive results. The coefficient estimate for the interactive variable is not negative and statistically significant for any industry but there are very few observations for each 2-digit code.

statistically different from zero. The indirect effect through the firms' internal wealth, or cash-flow is significant for the OLS specification only. The coefficient on the debt variable is, however, not statistically different from zero and the estimated marginal effect is once again very small. Using the coefficient estimates in Table 9 and the mean values of exchange rates, cash-flow, and investment for this sample (102.79, 0.1117, and 0.1748, respectively), the estimated marginal effect of exchange rates on investment in the geographic region is 0.0018 and 0.0028 for the OLS and semi-log specification, respectively. The estimated exchange rate elasticities are 0.0103 and 0.0162. Since the coefficient on the debt capacity variable is not significantly different from zero, the estimated coefficient on the interactive variable is likely picking up an exchange rate effect other than that produced by imperfect capital markets.

To test the model across geographic segments, estimates of equation (3) are obtained separately for each of the three geographic regions. Table 10 reports the results for the Asia-Pacific, European, and Canadian segments, respectively. Again, there is no evidence of an effect on investment through cash flow, and a direct effect of exchange rate changes is evident strongest (point estimates and significance) for the European region only. However, the sign is not as expected suggesting possible omitted variables. Firms in the sample generally report information for more than one of the three regions. Excluding the information on the other regions for the firm may be biasing the results. The only consistent determinant of firms' investing activity across regions is research and development expenditures.

## VI. Conclusions

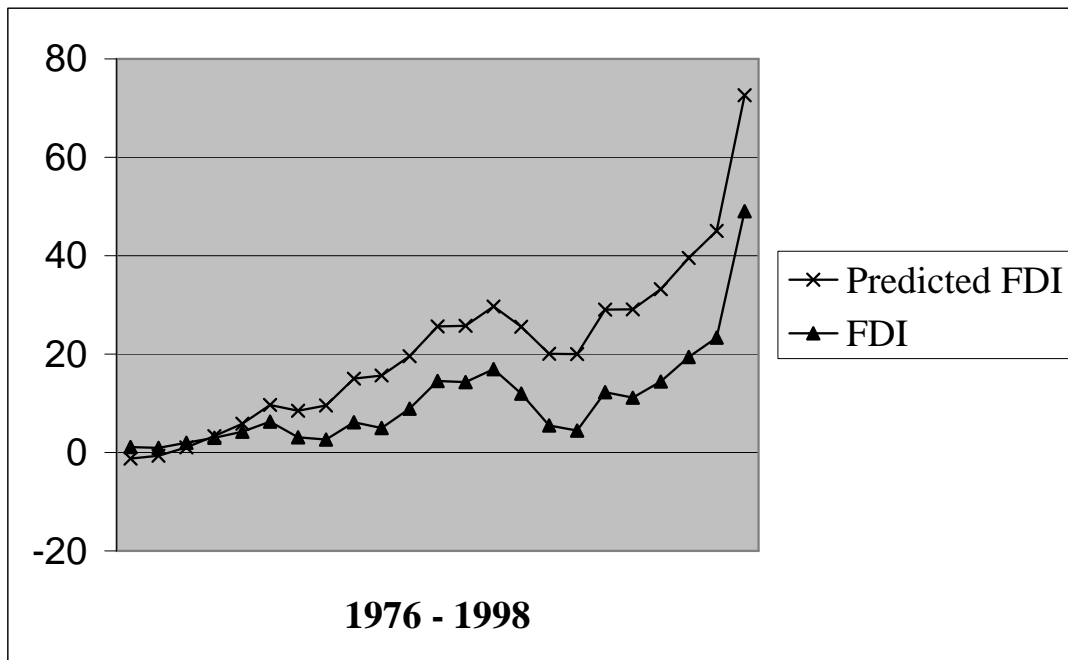
Do multinational firms alter their international investment strategies in response to exchange rate movements? Evidence from the both the total and foreign investment activity of U.S. multinational corporations presented here suggests the answer is yes, but that this response to exchange rates is not due to a change in the relative value of wealth. The evidence is more consistent with other, more firm-level, explanations for the relationship between exchange rates and FDI. Controlling for the source of the wealth effect, imperfect capital markets, and measuring such effects for different industries, geographical regions, and foreign currency hedging policies, the results from this study are inconsistent with the implications of the Froot and Stein model. A measure of the firms' production technologies and process innovations is a consistently more powerful explanatory variable for investment than a measure of the effect of exchange rates on investment through the firm's internal wealth. This may suggest that the firms' specific asset positions are a more likely determinant of firms' foreign investment decisions.

Two concerns with the evidence presented are the size of the firms and the proxy variable for firm-specific assets. The large firms sampled for this study may generate sufficient cash flow such that their reservation price for assets as modeled in Froot and Stein would not vary and therefore their investment activity is unaffected by changes in cash flow. Nonetheless, this problem should also be present in the previous studies that found a wealth effect using aggregated data. A second potential problem is that research and development expenditures may not be the best measure of firm-specific assets. Although the results of this study are more consistent with alternative explanation for the correlation between FDI and exchange rates presented earlier, the model used for this

research does not directly test for this relationship. Future work in this area will hopefully involve better firm-level measures of different returns on assets across industries and geographical regions.

**Figure 1. FDI and the Real Value of the U.S. Dollar**

Actually U.S. inward FDI (in billions of U.S. dollars) from the U.S. Bureau of Economic Analysis and the predicted value of FDI based on the real exchange rate value of the U.S. Dollar. The predicted value of FDI is generated by regressing inward FDI against a real exchange rate index (Federal Reserve Bank of Dallas) and a time trend.



## Appendix 1

**I:** The ratio of cash used for investment activities to total assets. This item represents net cash received or paid for all transactions classified as investing activities on the Statement of Cash Flows

**w:** The ratio of cash from operations to total assets.

**e:** The Federal Reserve Bank of Atlanta's U.S. dollar value index. The index uses 1984 bilateral trade weights for 18 currencies. For estimates of equation (3) the European sub-index includes Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom. The Pacific group includes Australia, China, Hong Kong, Japan, Singapore, South Korea and Taiwan. The Canadian dollar is treated as a separate sub-index.

**V:** The ratio of the firm's market value at fiscal year end to its book value. The closing price for the firm's common stock at fiscal year end multiplied by the company's common shares outstanding and divided by the common shareholders' interest in the company

**D:** The ratio of long-term debt to total capital.

**R:** The ratio of total expenditures for research and development to total sales.

**FCD:** a dummy variable equal to one if the firm reports the use of foreign exchange contracts.

**IAG:** The ratio of identifiable assets by geographic segment to total assets of the firm.

**OPI:** The ratio of operating income of the firm after amortization and depreciation to total assets.

**SIC:** The primary standard industrial classification for the firm.

Sources: S&P COMPUSTAT database and 10-K reports to the U.S. Securities and Exchange Commission (SEC).

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**Table 1.****Descriptive Statistics**

Descriptive statistics for U.S. national and multinational firms in the S&P 500 Index (excluding banks, utilities, and property and casualty firms) from 1992 to 1997.

| Variable           | # of Obs. | Mean        | Std. Deviation | Median     | 1st Quartile | 3rd Quartile |
|--------------------|-----------|-------------|----------------|------------|--------------|--------------|
| Total Assets (mil) | 2896      | \$16,408.55 | \$35,970.89    | \$5,097.15 | \$2,030.33   | \$13,932.00  |
| I                  | 2696      | 8.58%       | 9.64%          | 7.65%      | 4.35%        | 12.05%       |
| w                  | 2778      | 10.02%      | 6.73%          | 9.84%      | 5.82%        | 13.75%       |
| V                  | 2868      | 2.8108      | 26.7024        | 2.5215     | 1.73         | 3.90         |
| D                  | 2880      | 40.02%      | 199.46%        | 33.79%     | 17.40%       | 48.53%       |
| R                  | 1463      | 4.25%       | 4.94%          | 2.43%      | 0.66%        | 6.47%        |
| IAG                | 2198      | 17.48%      | 14.94%         | 13.44%     | 7.89%        | 23.12%       |

**Table 2.**  
**Correlation Matrix**

Pearson correlation coefficients for key variables from the sample of U.S. national and multinational firms. Includes number of observations used to calculate significance.

|     | I               | w                | OPI              | e               | V               | D              | R |
|-----|-----------------|------------------|------------------|-----------------|-----------------|----------------|---|
| I   | 1<br>2696       |                  |                  |                 |                 |                |   |
| w   | 0.1997*<br>2622 | 1<br>2778        |                  |                 |                 |                |   |
| OPI | 0.1933*<br>2630 | 0.8897*<br>2778  | 1<br>2828        |                 |                 |                |   |
| e   | -0.0023<br>2696 | -0.03<br>2778    | -0.0012<br>2828  | 1<br>2928       |                 |                |   |
| V   | 0.0221<br>2669  | 0.0392*<br>2752  | 0.025<br>2802    | 0.019<br>2868   | 1<br>2868       |                |   |
| D   | -0.0149<br>2681 | -0.0627*<br>2763 | -0.0477*<br>2813 | -0.0026<br>2880 | -0.0134<br>2855 | 1<br>2880      |   |
| R   | 0.1960*<br>1463 | 0.2825*<br>1463  | 0.3570*<br>1463  | 0.0434<br>1463  | 0.2012*<br>1452 | -0.046<br>1452 | 1 |

\* indicates significance at the 5% level.

**Table 3.****Estimates Of The Effect Of Exchange Rates On Firm Investment**

$$I_{i,t} = \alpha_0 + w_{i,t} (\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t}$$

Estimates of the above model for 259 firms from 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification.

| Dependent Variable: Investment Activity |               |                |
|---|---------------|----------------|
| Variables                               | Linear        | Non-linear     |
| w                                       | 2.197912 **   | 1.256898 *     |
|   | 0.9096        | 0.4876         |
| w*e                                     | -0.0185749 ** | -0.0103449 **  |
|   | 0.0088        | 0.0048         |
| e                                       | 0.0017856     | 0.0011152 ***  |
|   | 0.0012        | 0.0007         |
| V                                       | 0.0427827     | 0.0264069      |
|   | 0.0655        | 0.0410         |
| D                                       | -0.0001348    | -0.0001465 *** |
|   | 0.0001        | 0.0001         |
| R                                       | 0.259246 *    | 0.1549169 *    |
|   | 0.0670        | 0.0412         |
| F-Statistic                             | 10.17         | 12.69          |
| <i>p-value</i>                          | 0.0000        | 0.0000         |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Estimated with year dummy variables (not reported and statistically insignificant).

**Table 4.****Estimates Of The Effect Of Exchange Rates On Firm Investment With Hedging**

$$I_{i,t} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \alpha_7 FCD + \alpha_8 FCD * e + \varepsilon_{i,t}$$

Estimates of the above model for 241 firms from 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification. FCD is dummy variable that indicates the firm actively uses foreign currency derivatives to hedge exchange rate risk.

| Dependent Variable: Investment Activity |             |             |
|---|-------------|-------------|
| Variables                               | Linear      | Non-linear  |
| w                                       | 2.395631 ** | 1.374822 *  |
|   | 0.9484      | 0.5011      |
| w*e                                     | -0.02173 ** | -0.01178 ** |
|   | 0.0097      | 0.0051      |
| e                                       | 0.001845    | 0.00114     |
|   | 0.0013      | 0.0007      |
| V                                       | -0.02008    | -0.00981    |
|   | 0.1019      | 0.0649      |
| D                                       | -0.00012    | -0.00014 ** |
|   | 0.0001      | 0.0001      |
| R                                       | 0.225957 *  | 0.140383 *  |
|   | 0.0690      | 0.0442      |
| FCD - intercept                         | -0.0191     | -0.0051     |
|   | 0.0209      | 0.0128      |
| FCD - slope                             | 0.001481    | 0.000409    |
|   | 0.0016      | 0.0010      |
| F-Statistic                             | 9.1         | 11.36       |
| p-value                                 | 0.0000      | 0.0000      |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Estimated with year dummy variables (not reported and statistically insignificant).

Table 5.

**Estimates Of The Effect Of Exchange Rates On Firm Investment fro hedging and Non-Hedging Firms.**

$$I_{i,t} = \alpha_0 + w_{i,t} (\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t}$$

Estimates of the above model for 26 non-hedging and 215 hedging firms from 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification. Hedgers are firms that report active use of foreign currency derivatives to hedge exchange rate risk.

| Variables   | Dependent Variable: Investment Activity |            |                |             |
|-------------|---|------------|----------------|-------------|
|             | <i>Non-Hedgers</i>                      |            | <i>Hedgers</i> |             |
|             | Linear                                  | Non-linear | Linear         | Non-linear  |
| w           | 1.079369                                | 0.730706   | 2.456398 **    | 1.388853 *  |
|             | 4.3467                                  | 2.4534     | 0.9519         | 0.4950      |
| w*e         | -0.00961                                | -0.00616   | -0.02079 **    | -0.01147 ** |
|             | 0.0435                                  | 0.0244     | 0.0091         | 0.0049      |
| e           | -0.0022                                 | -0.00104   | 0.002175 ***   | 0.00132 *** |
|             | 0.0055                                  | 0.0032     | 0.0013         | 0.0007      |
| V           | 0.261523                                | 0.163201   | -0.05432       | -0.0294     |
|             | 0.3483                                  | 0.2023     | 0.1085         | 0.0692      |
| D           | 0.008655                                | -0.01509   | -0.00014       | -0.00014 ** |
|             | 0.0868                                  | 0.0527     | 0.0001         | 0.0001      |
| R           | 0.308431                                | 0.157842   | 0.222037 *     | 0.137743 *  |
|             | 0.2017                                  | 0.1232     | 0.0766         | 0.0491      |
| F-Statistic | 5.52                                    | 6.1        | 9.16           | 11.45       |
| p-value     | 0.0003                                  | 0.0001     | 0.0000         | 0.0000      |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Estimated with year dummy variables (not reported and statistically significant in the non-linear specifications for non-hedgers only).

Table 6.

**Estimates Of The Effect Of Exchange Rates On Firm Investment For Low and High R&D firms**

$$I_{i,t} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \epsilon_{i,t}$$

Estimates of the above model for 143 low-R&D and 350 high-R&D firms for the years 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification. High-R&D firms are those firms whose R&D expenditures, as a percentage of their total sales, are greater than the median value for all firms.

| Variables      | Dependent Variable: Investment Activity |            |                     |              |
|----------------|---|------------|---------------------|--------------|
|                | <i>Low R&amp;D</i>                      |            | <i>High R&amp;D</i> |              |
|                | Linear                                  | Non-linear | Linear              | Non-linear   |
| w              | 0.075018                                | 0.159898   | 1.650976 **         | 1.038116 **  |
|                | 0.9025                                  | 0.6204     | 0.7380              | 0.4642       |
| w*e            | 0.002118                                | 0.000689   | -0.01323 ***        | -0.0081 ***  |
|                | 0.0089                                  | 0.0061     | 0.0069              | 0.0043       |
| e              | -0.00085                                | 0.000833   | 0.001388            | 0.001045 *** |
|                | 0.0012                                  | 0.0420     | 0.0009              | 0.0006       |
| V              | 0.033645                                | 0.014676   | 0.005441 *          | 0.004104 *   |
|                | 0.0576                                  | 0.0420     | 0.0018              | 0.0011       |
| D              | -0.00019                                | -0.0002 ** | 0.019595            | 0.014037     |
|                | 0.0001                                  | 0.0001     | 0.0167              | 0.0100       |
| Observations   | 717                                     | 717        | 1867                | 1867         |
| F-Statistic    | 6.11                                    | 7.73       | 2.25                | 2.62         |
| <i>p-value</i> | 0.0000                                  | 0.0000     | 0.0187              | 0.0061       |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Estimated with year dummy variables (not reported and not statistically significant).

**Table 7.****Estimates Of The Effect Of Exchange Rates On Firm Investment by SIC Code**

$$I_{i,t} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t}$$

Estimates of the above model across industries (by 1-digit SIC codes) for the years 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification.

| Dependent Variable: Investment Activity |            |            |            |             |          |         |            |
|---|------------|------------|------------|-------------|----------|---------|------------|
| SIC Code                                | 1          | 2          | 3          | 4           | 5        | 7       | 8          |
| <b>Variables</b>                        |            |            |            |             |          |         |            |
| w                                       | 1.9934     | 0.6455     | 3.5858 **  | -31.0770 ** | -0.2502  | 4.3113  | 0.8583     |
|   | 4.1255     | 1.3762     | 1.4109     | 9.9615      | 1.5653   | 3.9700  | 24.1575    |
| w*e                                     | -0.0188    | -0.0045    | -0.0318 ** | 0.3259 **   | 0.0052   | -0.0407 | -0.0066    |
|   | 0.0432     | 0.0132     | 0.0136     | 0.0996      | 0.0157   | 0.0413  | 0.2441     |
| e                                       | 0.0000     | 0.0000     | 0.0034 *** | -0.0451 *** | -0.0001  | 0.0037  | -0.0064    |
|   | 0.0026     | 0.0022     | 0.0018     | 0.0201      | 0.0024   | 0.0041  | 0.0247     |
| V                                       | 3.0300     | -0.1369 ** | 0.0606     | -0.7381     | 1.4842 * | 0.6739  | 0.9679     |
|   | 2.3217     | 0.0636     | 0.1210     | 1.4996      | 0.4149   | 0.4230  | 0.4767     |
| D                                       | 0.0242     | 0.0437     | 0.0000     | 0.1712      | 0.0126   | 0.0967  | 0.0220     |
|   | 0.0318     | 0.0326     | 0.0001     | 0.1757      | 0.0315   | 0.0552  | 0.0684     |
| R                                       | -0.3955 ** | 0.1392     | 0.4444 *   | 1.7510      | -0.2991  | 0.3016  | -4.5528 ** |
|   | 0.1364     | 0.1118     | 0.0899     | 1.3015      | 0.3777   | 0.1341  | 1.1645     |
| Observations                            | 27         | 420        | 695        | 21          | 163      | 91      | 21         |
| F-Statistic                             | 5.89       | 1.18       | 13.93      | 50.9        | 25.03    | 10.54   | 12.58      |
| p-value                                 | 0.0599     | 0.3188     | 0.0000     | 0.0003      | 0.0000   | 0.0000  | 0.0167     |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Estimated with year dummy variables (not reported and statistically significant for one year in SIC Code 5 only).

**Table 8.****Estimates Of The Effect Of Exchange Rates On Firm Investment with Fixed Effects**

$$I_{i,t} = \alpha_0 + w_{i,t} (\alpha_1 + \alpha_2 e_t) + \alpha_3 e_t + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t}$$

Fixed Effects estimation of the above model for 259 firms from 1992 to 1997. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification.

| Dependent Variable: Investment Activity |          |            |
|---|----------|------------|
| Variables                               | Linear   | Non-linear |
| w                                       | 0.639649 | 0.3175204  |
|   | 0.8361   | 0.3838     |
| w*e                                     | -0.00568 | -0.0024835 |
|   | 0.0081   | 0.0037     |
| e                                       | 0.00024  | -0.0000943 |
|   | 0.0011   | 0.0050     |
| V                                       | 0.052567 | 0.0474055  |
|   | 0.0865   | 0.0397     |
| D                                       | -0.00063 | -0.000556  |
|   | 0.0010   | 0.0005     |
| R                                       | 0.16465  | 0.14437 ** |
|   | 0.1759   | 0.0807     |
| Fixed Effects:                          |          |            |
| F(258, 1177)                            | 1.637    | 12.69      |
| <i>p-value</i>                          | 0.0000   | 0.0000     |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Not estimated with year dummy variables.

**Table 9.****Estimates Of The Effect Of Exchange Rates On Foreign Investment by U.S. Multinationals**

$$IAG_{i,t,j} = \alpha_0 + w_{i,t} (\alpha_1 + \alpha_2 e_{t,j}) + \alpha_3 e_{t,j} + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t,j}$$

Fixed Effects estimation of the above model for 200 U.S. Multinational firms from 1992 to 1997. Data on the level of assets in each geographic area is from the firms' financial statements and the exchange rate data is the Federal Reserve bank of Atlanta's index for each region. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification.

| Dependent Variable: Identifiable Assets by Geographic Segment |              |              |
|---|--------------|--------------|
| Variables   | Linear       | Non-linear   |
| w   | 0.389522 *** | 0.247769 *** |
|   | 0.2348       | 0.1392       |
| w*e   | -0.00374 *** | -0.002       |
|   | 0.0021       | 0.0013       |
| e   | 0.002177 *   | 0.001578 *   |
|   | 0.0003       | 0.0002       |
| V   | 0.000627     | 0.000372     |
|   | 0.0008       | 0.0005       |
| D   | -0.00016     | -0.00012     |
|   | 0.0008       | 0.0005       |
| R   | 0.288015     | 0.140115     |
|   | 0.1987       | 0.1178       |
| Fixed Effects:  |              |              |
| F(199, 1422)  | 7.905        | 10.247       |
| p-value   | 0.0000       | 0.0000       |

\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Fixed-effects model estimates. Not estimated with year dummy variables.

Table 10.

**Estimates Of The Effect Of Exchange Rates On Foreign Investment by U.S. Multinationals By Geographic Region**

$$IAG_{i,t,j} = \alpha_0 + w_{i,t}(\alpha_1 + \alpha_2 e_{t,j}) + \alpha_3 e_{t,j} + \alpha_4 V_{i,t} + \alpha_5 D_{i,t} + \alpha_6 R_{i,t} + \varepsilon_{i,t,j}$$

Fixed Effects estimation of the above model for 200 U.S. Multinational firms from 1992 to 1997 across different geographic regions. Data on the level of assets in each geographic area is from financial statements and the exchange rate data is the Federal Reserve bank of Atlanta's index for each region. The Linear model is OLS estimates and the Non-linear model is a left-side, semi-log specification.

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Dependent Variable: Identifiable Assets by Geographic Segment

| Geographic Region: | Asia - Pacific       |                      | Europe               |                      | Canada              |                     |
|--------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|
|                    | Linear               | Non-linear           | Linear               | Non-linear           | Linear              | Non-linear          |
| Variables          |                      |                      |                      |                      |                     |                     |
| w                  | 0.4445 **<br>0.2243  | 2.3344<br>2.3539     | -0.4799<br>0.6220    | -5.8542<br>3.1918    | -3.5394<br>4.7429   | -15.1963<br>19.9149 |
| w*e                | -0.0042<br>0.0027    | -0.0106<br>0.0282    | 0.0043<br>0.0050     | 0.0503<br>0.0258     | 0.0274<br>0.0396    | 0.1247<br>0.1664    |
| e                  | 0.0008 **<br>0.0004  | 0.0034<br>0.0039     | -0.0014 **<br>0.0007 | -0.0114 *<br>0.0034  | -0.0023<br>0.0043   | -0.0120<br>0.0182   |
| V                  | 0.0003<br>0.0004     | 0.0024<br>0.0040     | 0.0011 **<br>0.0005  | 0.0048 ***<br>0.0026 | 0.0016<br>0.0033    | 0.0204<br>0.0139    |
| D                  | -0.0301 **<br>0.0138 | -0.3078 **<br>0.1453 | 0.0001<br>0.0005     | 0.0011<br>0.0027     | 0.0005<br>0.0024    | 0.0041<br>0.0099    |
| R                  | -0.1327 **<br>0.0797 | -0.5605<br>0.8362    | 0.5517 **<br>0.1537  | 2.6846 *<br>0.7859   | 2.4297 **<br>1.0420 | 8.1388 **<br>4.3615 |
| Observations       | 639                  | 639                  | 815                  | 814                  | 204                 | 203                 |
| F-Statistic        | 5.27                 | 3.58                 | 4.66                 | 5.45                 | 2.27                | 1.52                |
| p-value            | 0.0000               | 0.0018               | 0.0001               | 0.0000               | 0.0401              | 0.1756              |

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\*, \*\*, \*\*\* indicates significance at the 1%, 5%, and 10% respectively. Standard errors are corrected for heteroskedasticity. Fixed-effects model estimates. Not estimated with year dummy variables.