

**Exchange Rate Exposure, Competition, and Investments: Firm-Level Evidence from Around the
World**

Kaysia Campbell
Assistant Professor
College of Business Administration
East Carolina University
Greenville, NC 27858
(252) 328-6372 (Phone)
(252) 328-6870 (Fax)
campbellka@ecu.edu

Delroy M. Hunter
Assistant Professor
College of Business Administration
University of South Florida
Tampa, FL 33620
(813) 974-6319 (Phone)
(813) 974-3084 (Fax)
dhunter@coba.usf.edu (e-mail)

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Abstract

This paper uses survey-based data on 1781 firms from 53 countries to investigate how exchange rate exposure affects firms' investment. Though there is some evidence at the level of the economy, the available firm-level evidence is sparse, specific to large manufacturing firms, and restricted to two countries. This is partly because academics have not, as a necessary first step, unambiguously established that exchange rate movements affect individual firms' cash flow. Using the survey responses, we present large-sample, multi-country, size-stratified, firm-level evidence on the determinants of the level of exchange rate exposure and that firm-level investment is sensitive to exchange rate movements. In the next stage we will examine the impact of exchange rate movements on the firm's option to wait to invest and carry out several robustness tests of the above results.

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Economic theory indicates that exchange rate movements significantly affect the operations of multinational firms, domestic firms engaging in exports and/or imports, as well as purely-domestic firms facing import competition, via their effect on firms' expected future cash flows (expenditures or revenues) and cost of capital. Surprisingly, numerous empirical studies generally conclude that exchange rate movements do not have a material effect on firms' cash flow.¹ Perhaps because of this failure to unambiguously establish that exchange rate movements affect firms' cash flow, empiricists have expended relatively little effort to examine if and how exchange rate movements impact other aspects of the firm, e.g., the firm's investment.

While there is abundant evidence of a link between exchange rate movements on investment at the industry (e.g., Goldberg (1993), Campa and Goldberg (1995), Darby et al. (1999)) and country levels (e.g., Serven (2003)), evidence at the firm level is sparse. Using firm-level data, Nucci and Pozzolo (2001) and Atella et al. (2003) study the effect of exchange rate uncertainty on the investment decisions of Italian firms, and Fuentes (2005) studies its effect on Chilean firms. Though insightful, these studies are based on a small sample of large manufacturing firms in two countries and their results display significant heterogeneity in the exchange rate sensitivity of investment for manufacturing firms to indicate that it is not a foregone conclusion that exchange rate movements have a negative or a positive effect on firm-level investment. Therefore, there is still a significant gap in the minds of investors, monetary policy officials, and even corporate managers as to the relationship between exchange rate movements and firm investment to warrant further examination.

This paper provides the first large-sample, multi-country, size-stratified evidence on how firm, industry, and country characteristics affect the exchange rate sensitivity of firm-level investment. The paper proceeds in three steps. First, using new survey-based data on the effect of exchange rate movements on the operations of a large number of firms from several countries, we examine the question: what determines the cross-sectional differences in exposure across firms?

There is some cross-sectional evidence on the determinants of firms' exchange rate exposure (see, e.g., Bodnar and Gentry (1993), Dominguez and Tesar (2006), Doidge, Griffin, and Williamson (2005)). Their results are typically based on large firms that report their export activities and the determinants of exposure are usually foreign-trade-related variables. The richness of the survey data allows us to extend the analysis beyond that in earlier papers. We are able to examine several other firm, industry, and

¹ Several studies find that exchange rate movements have little effect on firms' cash flows (e.g., Jorion (1990), Amihud (1994), Bartov and Bodnar (1994), Williamson (2001), Doidge et al. (2005), Starks and Wei (2006)) and pricing policy (e.g., Allayannis and Ihrig (2001), Bodnar et al. (2002), Goldberg and Knetter (1997)).

country factors that affect exchange rate exposure, such as firm size, foreign ownership, sales or ownership relationship with the state, access to trade financing and export subsidy, and firm-level importing activities, which is not available in the usual databases because it is a component of firms' costs. Moreover, the existing evidence that exchange rate movements do not significantly affect individual firms might have resulted because previous papers underestimated firms' exchange rate exposure.² Hence, these papers may suffer from an errors-in-variables problem given that they use their first-pass estimates of exposure in the determination of exposure. The benefit of using survey data is that it is much less likely that managers would underestimate the effects of exchange rate movements on their operations.

Second, we examine the exchange rate sensitivity of firm-level investment. Specifically, we ask (1) does exchange rate exposure affect investment at the firm level? (2) are the investment patterns of small, medium-sized, and large firms or exporters and importers different and if so, can this be attributed to differences in exchange rate exposure? and (3) how do industry and country characteristics interact with firm-level exchange rate exposure to influence firms' investment decisions? Third, because corporate managers communicated the level of planned investment over the next three years, we also ask whether and how exchange rate exposure affect the "option to wait" to invest.³

The paper is organized as follows. In section I, we discuss relevant theories of the exchange rate sensitivity of firm-level investment and develop our hypotheses. In section II we discuss the data and methodology, while in section III we discuss our results.

(Preliminary results are included with the analysis to be concluded later)

I. Theory and Hypotheses Development

There are several theories explaining the exchange rate sensitivity of firm-level investment. By conventional wisdom, the most important factors are the proportion of foreign sales to total sales and the reliance on foreign inputs or finished goods for resale (see, e.g., Nucci and Pozzolo (2001)). However, the effect of a depreciation of the domestic currency on a domestic firm depends on the configuration of the firm's costs and revenues and the sensitivity of its cost-to-price margin. Hence, it is not a foregone

² Anecdotal evidence that exposure might have been understated arises from a recent Philadelphia Fed survey in which over 45% of U.S. firms reported being adversely affected by a strong dollar (See Rosenberg (2003), p.53) and numerous press reports (e.g., BusinessWeek, May 16, 2003, p.157) that U.S. firms benefit from a weak dollar.

³ Because broadly the same factors that determine the exchange rate sensitivity of investment also influence the exchange rate exposure and the decision to exercise the option to wait until there is some resolution of uncertainty about the exchange rate, in the discussion below we focus on the determinants of the exchange rate sensitivity of investment.

conclusion that depreciation increases or decreases investment (Cushman (1985)). For a firm that produces for the domestic market but is highly dependent on foreign inputs, depreciation generally increases its variable costs and reduces the marginal value of its capital, thus causing an expected decline in investment. However, depreciation might have no effect if it induces a switch to local inputs. In contrast, depreciation increases the price competitiveness of a firm that produces locally from domestically sourced inputs but is highly dependent on foreign sales. As such, the expected increase in cash flows is likely to increase its investment. If a firm engages in both exports and imports, depreciation can have a positive effect on investment via the revenue channel and a negative effect via the cost channel. Hence, it is an empirical issue whether exchange rate exposure has a significant net impact on the firm's investment.

Whether or not a firm's investment displays significant sensitivity to exchange rate movements is decidedly more complex than the above would suggest. In particular, the impact of exchange rate shocks on the firm's cash flows may be amplified or mitigated by competition, the existence of export subsidies, availability of trade financing, foreign ownership, and several other factors. Hence, the conventional wisdom that exchange rate movements reduce or increase investment does not hold under all conditions (Derby et al. (1999)). In fact, exchange rate changes might have no effect on the investment of some firms that engage in foreign trade.

Consistent with the Dixit-Pindyck (1994) framework of investment under uncertainty, while it is generally expected that unfavorable exchange rate movements reduce current investments by increasing the value of the option to wait, this needs not be the case because competition erodes the value of this option (see, e.g., Akdogu and MacKay (2006)). A firm will invest if the present value of the project's revenues is greater than the sunk cost of entry by an amount equal to the value of the option to wait. Hence, even if exchange rate movements are unfavorable, a firm may increase its investment if there is a high opportunity cost of exercising the option to wait.⁴ If the rate of return on the particular type of investment is generally high, then waiting rather than investing may lead to a significant loss of future revenues. This is because a highly contestable investment may be lost to competitors.

Furthermore, firms with highly contestable investment opportunities may invest sooner and invest more as a necessary strategy to fend off competitors, who if they were to capture market share during periods of exchange rate uncertainty when the firm places its potential projects on hold would not relinquish any grounds when exchange rate uncertainty subsides (see, e.g. Grenadier (2000)). Hence, we hypothesize that firms that face intense import competition or which have domestic rivals that aggressively attempt to undercut their prices have a lower exchange rate sensitivity of investment (i.e., will invest more). However, in contrast to the above, Leahy (1993) demonstrates that competitors'

⁴ Similarly, a firm is more likely to invest when the investment has a high scrap value or is reversible.

actions need not affect the firm's equilibrium investment behavior. Similarly, if the firm has a long-term guaranteed sales contract with the state and/or is owned and, hence, financed by the state, its investment may be insensitive to import penetration. The latter is more likely to exist in developing economies.

Under the imperfect capital market theory of Froot and Stein (1991), competition also gives rise to another channel via which exchange rate movements affect the amount, if not the timing, of a firm's investment. In informationally opaque financial markets, lenders will not fully fund a project because they face asymmetric information about the future payoffs of the project. This leaves the firm to generate a portion of the investment cost from internal funds. Hence, the demand for investments is a function of the "wealth" (e.g., investable cash) of the firm. If exchange rate changes systematically reduce the wealth of domestic firms relative to that of foreign competitors, then domestic firms will not engage in certain investments (such as acquisitions of existing assets) simply because foreign firms will outbid them for these positive NPV projects. Hence, we hypothesize that the exchange rate sensitivity of investment decreases with the level of openness and development of a country's financial system. Similarly, since financial openness and development are correlated with economic development, we hypothesize that exchange rate sensitivity of investment is higher in developing economies. Further, we hypothesize that exchange rate sensitivity of investment is higher for smaller firms that typically have higher information asymmetry and lower net wealth.

An implication of the imperfect capital market theory of Froot and Stein (1991) is that the exchange rate sensitivity of investment can be mitigated by any mechanism that increases the net wealth or investable cash of the firm. Hence, we hypothesize that the firm's exchange rate sensitivity of investment decreases with access to subsidies or specialized export financing, with the level of state ownership, the level of foreign ownership, and with the proportion of total output sold to the state. Further, given that large firms typically have greater investable cash due to their internal capital markets, are more attractive to foreign acquirers, and are more likely to be owned by the state, than small or medium-sized firms, we hypothesize that exchange rate sensitivity of investment declines with firm size.⁵ Finally, we hypothesize that the exchange rate sensitivity of investment will be greater in developing than in industrialized countries, where there is likely to be more trade/export financing, currency hedges, and other services reflecting a well-developed market.

Data and Methodology

II A. Data

⁵ We are unable to say a priori the effect of export financing or subsidy because, while several governments provide such subsidies to large firms, governments also promote small firm development by providing export subsidy.

Our sample is drawn from responses of 10,000 firms in 80 countries to the World Business Environment Survey (WBES) conducted by the World Bank in 1999 to 2000. After careful screening and accounting for non-responses, the final sample for the test of the determination of exchange rate exposure consist of a maximum of 1781 firms from 53 countries. We measure exchange rate exposure as the response to the question: how problematic is exchange rates for the operation and growth of the business? The responses are coded as 1 (No Obstacle), 2 (Minor Obstacle), 3 (Moderate Obstacle), and 4 (Major Obstacle). Our results are based on a slight recoding of the responses, where we use 1 if the exchange rate response is 4 and 0 if it is 1. Because the question does not allow us (or the respondents) to differentiate between a problem arising from changes in the exchange rates and the volatility of the changes in the exchange rates, we supplement this information with exchange rate changes and the volatility of changes using the JP Morgan real broad effective exchange rate index for each country and in its absence the similar index from the International Financial Statistics (IFS) of the IMF. These indices represent the trade-weight exchange rate of the currencies of the major trading partners of each country per unit of the domestic currency. Hence, an increase in the currency index represents an appreciation of the domestic currency against the average currency in the index. Specifically, for each country, we take the average of the monthly percentage change in the index over the 36 months prior to 1999 (*%FXChange*). Similarly, we use the standard deviation of these monthly percentage changes as the volatility of exchange rate (*FXVolatility*).⁶

Our measure of investment is also obtained from the survey and is the change in (growth rate of) investment over the last three years. We also obtained GDP and the growth rate of GDP from the IFS database. All other variables were obtained from the WBES database and are described in the equations below.

II B. Methodology

In estimating our models, we recognize the possibility that the investment decisions and the level of exchange rate exposure of individual firms within a country may not be independent. For instance, to counter a strong currency, which makes exporters' goods and services less attractive to foreign consumers, a government may decide to lower interest rates. This, in turn, could spur investment growth by exporting, importing, and purely domestic firms. Similarly, while several variables in our model, such as firm size, percentage of sales to the state, and others, are firm specific, other variables like GDP growth rate are common across firms within a country.

⁶ The data from JP Morgan was obtained from their web site in October 2004. These data are no longer available. In our estimation we used averages for 36 and 60 months. The results are similar.

The implication of the above is that failing to account for this “clustering” among firms within a country understates the standard errors and, therefore, overstates the significance of the estimated coefficients. For our model of firm-level investment, we use a linear mixed effects model that accounts for country random effects (see, e.g., Singer (1998), Primo, Jacobsmeier, and Milyo (2006)). For robustness tests and the estimation of all other models we use OLS or logit, as appropriate, and account for the clustering with Rogers standard errors.

To estimate the exchange rate sensitivity of investment, we estimate cross-sectional models in which the growth rate of investment averaged over the previous three years ($\Delta Investment$) is regressed on the firm-level exchange rate exposure ($FXExposure$) and other variables. The most general model is:

$$\begin{aligned} \Delta Investment = & \beta_0 + \beta_1 * Exporter + \beta_2 * Importer + \beta_3 * SalesGrowth + \beta_4 * Mfng + \beta_5 * Svcs + \\ & \beta_6 * FinancialObstacle + \beta_7 * StateOwn + \beta_8 * ForeignOwn + \beta_9 * SaletoState + \beta_{10} * Competitor + \\ & \beta_{11} * ExportFinancing + \beta_{12} * LogSales + \beta_{13} * LogGDP + \beta_{14} * GDPGrowth + \beta_{15} * FXExposure + \\ & \beta_{16} * Small + \beta_{17} * Debt / FA + \beta_{18} * \% FXChange + \beta_{19} * FXVolatility + \\ & \beta_{20} * \% FXChange * FXExposure + \beta_{21} * FXVolatility * FXExposure + \varepsilon \end{aligned} \tag{1}$$

In equation (1), the explanatory variables are a dummy variable (*Exporter or Importer*) defined as 1 if the firm exports or imports, respectively, and 0 otherwise, with the omitted category being purely domestic firms; growth in sales (*SaleGrowth*) as a proxy for firm growth; a dummy variable (*Mfng or Svcs*) defined as 1 for manufacturing or service firms, respectively, and zero otherwise (the survey breaks the firms into three categories); general financial obstacle (*FinancialObstacle*), measured as 1 (No Obstacle), 2 (Minor Obstacle), 3 (Moderate Obstacle), and 4 (Major Obstacle); a dummy variable (*StateOwn*) defined as 1 if the firm is government owned and zero otherwise; a dummy variable (*ForeignOwn*) defined as 1 if the firm is owned by foreigners and zero otherwise; the proportion of total sales made to the state (*SaletoState*); a measure of the firm’s perception of its competition (*Competition*; to be discussed in more detail later); obstacles to obtaining export financing (*ExportFinancing*) measured similar to financial obstacle; natural log of sales (*LogSales*), used as a proxy for firm earnings; the natural log of GDP (*LogGDP*) and GDP growth rate (*GDPGrowth*); a dummy variable (*Small or Medium*) defined as 1 if the firm is a small or medium-sized firm and zero otherwise; the leverage of the firm (*Debt/FA*), proxied by debt as a percentage of total fixed assets. In robustness tests, we will replace *Exporter* with *ExportRatio*, defined as export sales as a percentage of total sales. This variable captures the export intensity of firms.

To determine if the exchange rate sensitivity of investment is affected by the factors discussed above, we will augment the model with interaction variables. For instant, the coefficient on $FXExposure * Small$ would indicate if the exchange rate sensitivity of investment for small firms is

different from that of large firms and $FXExposure*Small*Developing$ indicates if it is different in developing countries.

In our examination of the determinants of exchange rate exposure, we will follow broadly the same procedure as that outlined above.

To investigate if firms wait to invest because of exchange rate exposure, we first re-estimate the above models after replacing the dependent variable with future growth rate of investment (*FutureInvest*). Next, we use the following logit model to relate the probability of waiting to invest to firm-specific characteristics:

$$\Pr(\text{OptionExercised}) = \alpha + \beta_1 * \text{Exporter} + \beta_2 * \text{Im porter} + \beta_3 * \text{SaleGrowth} + \beta_4 * \text{Irreversible} + \beta_5 * \text{FinanceObstacle} + \beta_6 * \text{StateOwn} + \beta_7 * \text{ForeignOwn} + \beta_8 * \text{SaletoState} + \beta_9 * \# \text{Competitor} + \beta_{10} * \text{ExportFinancing} + \beta_{11} * \text{Small} + \beta_{12} * \text{Medium} + \varepsilon \quad (2)$$

where *Irreversible* is a dummy variable defined as 1 if the main industry of the firm requires irreversible investments and zero otherwise. *OptionExercised* is a dummy defined as 1 if the firm indicated that over the next three years the change in investments will be zero or negative.

III. Results

A. Determinants of Exchange Rate Exposure

The results are reported in Table 1.

B. Exchange Rate Sensitivity of Investments

The results are reported in Table 2.

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Table 1: Determinants of Exchange Rate Exposure

Exchange Rate Exposure	Model 1	Model 2
Intercept	1.096**	-0.268
Exporting firm dummy	0.033	-0.022
Importing firm dummy	0.068**	0.070**
Mnfg industry dummy	0.078*	0.054
Service industry dummy	0.088**	0.044
General financing obstacle	0.056***	0.081***
Export financing obstacle	0.059***	0.047***
Gov't owned dummy	0.116**	0.035
Foreign owned dummy	0.014	0.020
% Sale to state	-0.012	-0.022
Debt/total fixed assets	0.002	0.004
Log(sales)	0.007	0.001
Log(GDP)	-0.037*	0.008
GDP growth rate	-0.044**	-0.028***
Economy is predictable	0.010	0.020
Small firm dummy	-0.023	-0.043
Medium-sized firm dummy	-0.032	-0.047
Dealing with customs pose obstacles to business		0.018
FX regulations pose obstacles to business		0.158***

Table 2: Exchange Rate Sensitivity of Firm-Level Investment

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff
Intercept	-12.397	49.431	38.390	43.285	37.029	47.564	19.119	22.797
GDP growth rate	0.525	-0.499	0.262	-1.361	-0.668	-1.056	0.032	0.630
Log(GDP)	1.167	-0.636	-0.371	-0.432	-0.331	-0.751	-0.120	-0.428
Exchange rate exposure	-4.287			-7.148	-8.446*	-5.109	8.740	9.669
Export financing obstacle	0.662	0.135	0.195	1.605	1.588	1.585	0.548	0.561
General financing obstacle	-1.245	-1.405	-1.711	-0.568	-0.723	-0.572	0.312	0.238
Mnfg industry dummy	5.356	-7.061	-6.532	-5.511	-4.312	-4.855	-6.341	-6.678
Service industry dummy	6.310	-3.718	-3.662	-4.084	-3.412	-3.493	-5.172	-5.013
Foreign owned dummy	7.429	6.263	5.884	6.228	5.472	5.914	5.841	5.754
Gov't owned dummy	-4.652	-15.867***	-16.506***	-15.464**	-16.242**	-16.018**	-15.954**	-16.994**
% Sale to state	-1.420	-1.081	-0.899	0.093	-0.049	0.379	0.642	0.850
Small firm dummy	-9.932 **	-11.860***	-11.427***	-14.393***	-14.220***	-14.411***	-13.497***	-13.938***
% Apprec of dom currency		8.987*		7.113		27.988**		19.067
% Apprec *FX exposure						-25.950*		-15.227
Currency volatility			1.128		0.949		4.993***	4.938***
Currency vol*FX exposure							-6.204***	-5.849***
Exporting firm dummy	3.630	5.357	5.358	5.972	5.772	6.292	4.948	5.377
Importing firm dummy	8.139*	8.256**	8.578**	9.762*	9.916**	9.131*	10.349**	9.806**
Debt/total fixed assets	0.086	0.232	0.256	0.452	0.489	0.404	0.425	0.364
Log(sales)	-0.644*	-0.911***	-1.001***	-0.784*	-0.845**	-0.730*	-0.661	-0.545