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EXCHANGE RATE VOLATILITY AND FIRST-TIME ENTRY BY MULTINATIONAL FIRMS

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ABSTRACT

Using a model with upfront sunk costs, heterogeneous firms, and endogenous exchange rates, this paper demonstrates theoretically that volatility in fundamental variables such as the nominal interest rate that drive exchange rate volatility can simultaneously impact the entry behavior of multinational firms through a relative price channel unrelated to exchange rate risk. It then provides an empirical illustration of the bias this endogeneity can cause when regressing measures of foreign direct investment on exchange rate volatility. It is the first paper to provide empirical evidence that interest rate volatility may influence the behavior of multinational firms.

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1 Introduction

Foreign direct investment (FDI) is the single largest source of capital inflows for developing countries. In industrialized countries, the size of FDI inflows ranges from zero to almost half the size of gross fixed capital formation. Surprisingly, the impact of exchange rate variability on foreign direct investment rarely enters debates over exchange rate management or monetary policy. One reason for this omission could be the lack of conclusive evidence regarding the impact of exchange rate variability on the investment behavior of multinational firms. A long list of studies provide patches of evidence that multinational firms are likely to consider the level and volatility of exchange rates before investing in overseas branches, but yield conflicting theoretical predictions and empirical results. This study takes a fresh look at the issue using a model with upfront sunk costs and endogenous exchange rates. Though it does not resolve the puzzle, the model and subsequent empirical examination provide one explanation for why exchange rate volatility has been seen to both increase and decrease observed levels of foreign direct investment by showing that underlying interest rate volatility is often positively correlated with exchange rate volatility, but can have quite different effects on entry by foreign firms. The findings also show for the first time using data on entry by individual firms that one-time sunk costs are a likely engine through which interest rate volatility impacts the investment behavior of multinational firms.

The intuition underlying the model rests on four principal assumptions. First, an unrecoverable upfront entry cost– here, the costs associated with conducting mergers and acquisitions (M&As)– effectively creates an option value in the tradition of Dixit and Pindyck (1994). In a world with no upfront costs, a firm could simply take over a new plant without regard to future conditions in any period when demand was strong enough to yield positive profits. In contrast, the sunk nature of the initial investment in this model forces the firm to weigh the present discounted value of all potential future profits against the anticipated upfront cost of starting to produce in a foreign country for the first time. The one-time entry cost is in essence an exercise price–a fee paid to exercise the option of taking over a plant abroad.

Second, price stickiness causes an inverse relationship between the interest rate and demand for goods produced by any firm, whether domestic or foreign-owned. Any uncertainty in underlying macroeconomic variables may either encourage or deter firms from entering the market, depending on the net impact it has on the present discounted value of future profits via the resulting covariance of the expected exchange rate with demand and production costs. Further, uncertainty has the effect of increasing the expected discounted value of marginal costs for firms setting prices in advance, causing them to set higher prices and pushing up the equilibrium aggregate price level. In this model, a higher price level translates into higher entry costs. Thus, sticky prices affect both the option value and the exercise price of investing abroad in the presence of uncertainty.

Third, for simplicity exchange rate behavior follows an uncovered interest rate parity condition derived from the consumers' choice between domestic and foreign bonds. This means that exchange rate fluctuations are driven by interest rate shocks in the host and source countries. In particular, an increase in interest rate volatility in either country increases exchange rate volatility. The impact of exchange rate fluctuations on the expected discounted value of variable profits is neutralized for foreign firms by the risk-sharing properties of trading home and foreign bonds. However, by influencing the price level, the underlying interest rate volatility has a direct effect on the effective cost of upfront investment expenditures. I argue and show empirically that the impact of interest rate volatility on the magnitude of the sunk costs involved in investment affects first-time foreign investors in the home country differently than firms that already possess a functional facility in the home country, whether they are home-owned or "veteran" foreign-owned firms that have already invested there through mergers and acquisitions in prior periods.

Boosting foreign (source-country) interest rate volatility, for instance, pushes up the foreign price level, which increases the one-time upfront coordination costs of transferring technological and management know-how to a new country for the first time. That is, it increases the exercise price described above for first-time foreign investors. This is not the case for domestically owned home firms or for "veteran" foreign firms undertaking repeated investments in the home country, who do not bear this upfront coordination cost because they either are operating in their native land or already paid it when they entered the country for the first time. Home (host-country) interest rate volatility has a quite different impact. By increasing the price level, it pushes up the price of target firms on the home merger market. This increases the opportunity cost of refusing to cash out for firms that already possess a viable facility. It increases their willingness to sell faster than it dampens the willingness of first-time foreign investors to buy, which ends up increasing first-time FDI while decreasing domestic and veteran foreign entry. I quantify this wedge between the two groups' behavior as a function of their fixed costs of entry (and the opportunity cost of deciding not to cash out). Thus, depending on whether home or foreign interest rate volatility is driving exchange rate risk, one can expect quite different impacts on entry by new and veteran foreign firms. The combination of sticky prices and endogenous exchange rates motivates a well known endogeneity problem first uncovered in aggregate data on bilateral flows of FDI between the US, Canada, and the UK by Linda Goldberg and Charles Kolstad (1995).

Finally, the assumption that firms have heterogeneous productivity levels allows the model to predict *how many* firms will invest abroad. Russ (2007) discusses the difficulties that arise when addressing the question of how exchange rate risk affects FDI in a representative firm framework, where either all firms invest abroad or none do. In this case, one can proxy changes in FDI by observing whether production by the representative MNE increases or decreases in a particular period, but it is difficult to address questions about firms' willingness to enter a market or, more broadly, why they would invest abroad in an environment with zero profits. The heterogeneous framework below allows one to predict that a larger or smaller number of firms will invest abroad given a particular set of macroeconomic conditions. It also embraces positive profits as an incentive to invest at home or abroad and corresponds with stylized facts regarding the size and value-added per worker of MNEs compared to firms that operate only in their native country discussed in Helpman, Melitz, and Yeaple (2003) and documented in Bernard, Jensen, and Schott (2005). Though this model is considerably more stripped down insofar as it eliminates interesting features such as persistence in exchange rate behavior, Ghironi and Melitz (2005) blazed a trail for introducing cross-border asset trade into a model of heterogeneous firms with one-time sunk costs and endogenous exchange rates.

Previous empirical studies, listed in Table 1, have used a variety of data sources, measures of FDI (i.e., as a percentage of GDP, as a proportion of domestic investment, or in absolute levels), definitions of volatility, regression methods, and country breakdowns.[2] Table 2 shows that whether investigators focus on real or nominal exchange rate fluctuations, the relationship between FDI and exchange rate volatility varies depending on the sample period, country sample, and method of measuring volatility. An important theoretical result in this study is that mergers and acquisitions by veteran foreign investors[3] respond quite differently to the interest rate volatility that generates exchange rate volatility in the model. The empirical analysis below supports the predictions of the model for first-time and veteran cross-border mergers and acquisitions between OECD countries. This may be one more reason that past studies have found conflicting estimates of the relationship between aggregate FDI flows and exchange rate risk–the obseved relationship may vary depending on the proportion of parent firms that are investing in a particular country for the first time.

2 The Model

The representative consumer maximizes lifetime utility

$$\max \sum_{t=0}^{\infty} U\left(C_t, L_t, \frac{M_t}{P_t}\right),$$

with

$$U\left(C_t, L_t, \frac{M_t}{P_t}\right) = \frac{1}{1-\rho} C_t^{1-\rho} + \ln \chi \left(\frac{M_t}{P_t}\right) - \kappa L_t,$$

[2]Please see Russ (2007) for a detailed survey of the theoretical and empirical literature on exchange rate volatility and FDI.

[3]Veteran foreign investors are firms who have already acquired one firm in a particular country outside their native market and are making additional acquisitions there.

C_t representing the aggregate consumption bundle in the home country, L_t the total amount of labor supplied, and $\frac{M_t}{P_t}$ the demand for real money balances.

The consumer has the option to invest at time t in assets denominated in home or foreign currency (B_t and B_t^*) which will pay a known, fixed gross return of i_t and i_t^* at the beginning of period $t+1$. She also receives profits from the portfolio of home-owned firms operating at home or abroad in the form of a dividend, Π_t, which includes net revenues from firms' merger market activities at home and abroad, so that the budget constraint is of the form

$$B_t + S_t B_t^* + P_t C_t + M_{t+1} = W_t L_t + \Pi_t + i_{t-1} B_{t-1} + S_t i_{t-1}^* B_{t-1}^* + M_{t-1} + T_t.$$

All seignorage revenue is transferred to consumers in the form of the lump-sum tax, T_t. Preferences exhibit constant elasticity of substitution (CES) across goods so that demand relations are downward sloping in the price of each good and expressed as a fraction of aggregate consumption,

$$\begin{aligned} c_{h,t}(i) &= \left(\frac{p_{h,t}(i)}{P_t}\right)^{-\theta} \\ c_{f,t}(i) &= \left(\frac{p_{f,t}(i)}{P_t}\right)^{-\theta}, \end{aligned}$$

where $c_{j,t}(i)$ is the consumption by home consumers of a good produced by a firm owned by residents of country j ($j \in (f,h)$) operating in the home country. The CES preferences yield an aggregate home price index, P_t, of the usual form,

$$P_t = \left(\int_0^{n_{h,t}} p_{h,t}(i)^{1-\theta} di + \int_1^{1+n_{f,t}} p_{f,t}(i)^{1-\theta} di \right)^{\frac{1}{1-\theta}}.$$

Analogous equations apply for the representative foreign consumer, with an asterisk used to denote variables involving levels of consumption, labor, assets, dividends, money, and prices pertaining to activity in the foreign country.

2.1 Consumption and the exchange rate

There is a very simple interest rate rule in each country,

$$\begin{aligned} i_t &= \bar{\imath} e^{\varepsilon_t} \\ i_t^* &= \bar{\imath}^* e^{\varepsilon_t^*} \end{aligned}$$

with shocks $\varepsilon_t \backsim N(-\frac{\sigma_i^2}{2}, \sigma_i^2)$ and $\varepsilon_t^* \backsim N(-\frac{\sigma_i^2}{2}, \sigma_{i^*}^2)$. It is assumed that the money supply is inversely related to the interest rate,

$$\begin{aligned} M_t &= \frac{\mu}{i_t - 1} \\ M_t^* &= \frac{\mu}{i_t^* - 1}, \end{aligned}$$

where μ is a constant. Taking first-order conditions with respect to B_t, B_t^*, C_t, L_t and M_t and rearranging yields an expression for consumption,[4]

$$C_t^\rho = \left(\frac{1}{P_t}\right)\left(\frac{\mu}{\chi i_t}\right), \tag{1}$$

the wage rate,

$$W_t = \frac{\kappa\mu}{\chi i_t} \tag{2}$$

and S_t, the (spot) exchange rate, which is governed uncovered interest rate parity (UIP)

$$\frac{E_t\left[S_{t+1}\right]}{S_t} = \frac{i_t}{i_t^*}.$$

The UIP relation implies that a high home interest rate in period t will bring about a lower value of S_t, meaning that– holding expectations of the future exchange rate constant– there is an immediate appreciation in the home currency when the interest rate on home bonds improves relative to foreign bonds. Thus, the covariance between consumption and the exchange rate differs depending on whether fluctuations in the host or source country interest rate are the main drivers of exchange rate

[4]See Appendix for derivations.

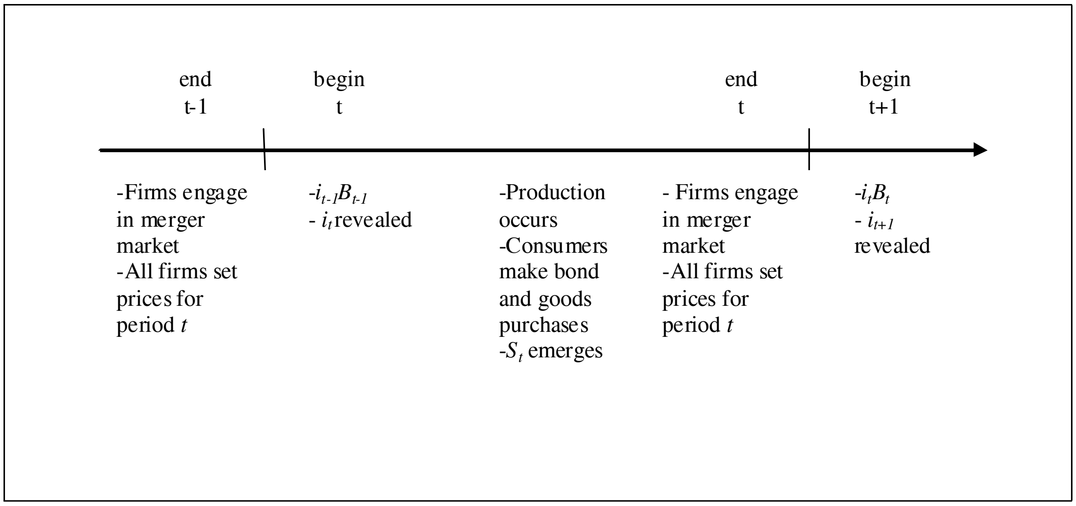

Figure 1: Timeline

volatility, which here is equal to $\sigma_i^2 + \sigma_{i^*}^2 - 2cov(i_t, i_t^*)$.

2.2 Firms and entry

Firms are permanently endowed with a labor productivity level, φ. The timeline in Figure 1 displays the order of events in the economy. At the end of period $t-1$, all firms set prices and firms that operate only in their native market decide if they will purchase a local marketing and distribution network in the market for mergers and acquisitions. Firms with an efficient technology but no viable marketing and distribution network in their own native market also must decide whether to purchase a facility. At the beginning of period t, consumers receive (gross) interest payments on government bonds purchased in the previous period and i_t is revealed. Then, several things happen simultaneously: new firms pay entry costs, all production takes place, consumers purchase bonds and goods, and the period-t exchange rate materializes amidst the bond trading. The exchange rate is endogenous to bond trading, but is not impacted by foreign direct investment activities.[5]

[5]See Lubik and Russ (2006) for a model where the exchange rate is endogenous to multinational activity.

The output of any firm operating in the home country owned by agents in country j operating in the home market is given by

$$c_{j,t}(\varphi) = \varphi l_{j,t}(\varphi).$$

They earn profits in each period

$$\pi_{j,t}(\varphi) = p_{j,t}(\varphi)c_{j,t}(\varphi) - W_t l_{j,t}(\varphi).$$

Firms set prices in advance, so that period t prices are set given information available at the end of period $t-1$. They each choose a price for their goods by maximizing profits subject to the consumer demand relations above, which turns out to be a markup over the expected discounted value of marginal costs

$$\begin{aligned} p_{h,t}(\varphi) &= \left(\frac{\theta}{\theta-1}\right)\frac{E_{t-1}\left[d_t W_t C_t\right]}{E_{t-1}\left[d_t C_t\right]} \\ p_{f,t}(\varphi) &= \left(\frac{\theta}{\theta-1}\right)\frac{E_{t-1}\left[d_t^* \frac{W_t C_t}{S_t}\right]}{E_{t-1}\left[d_t^* \frac{C_t}{S_t}\right]}, \end{aligned}$$

where the stochastic discount factor for home firm managers, derived from the consumer's first-order conditions,[6] is $d_t = \frac{\beta P_t C_t^{\rho}}{P_{t-1}C_{t-1}^{\rho}}$ and $d_t^* = \frac{\beta P_t^* C_t^{*\rho}}{P_{t-1}^* C_{t-1}^{*\rho}}$ for foreign firm managers.[7] Using the consumption equation and the reduced-form expression for the wage (equations (1) and (2)), the pricing rules simplify to

$$p_{j,t}(\varphi) = \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\varphi E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]}.$$

In the home market, $V_{t-1}(0)$ represents the the endogenously determined price of

[6]See Appendix. Results are qualitatively the same even if a constant discount factor is used.

[7]From the first-order conditions derived in the Appendix, it can be seen that these are equal to the inverse of the nominal interest rate on B_t in each country.

a network denominated in units of the home consumption bundle. The efficiency of the parent firm is transferred to the target firm, so a target firm's labor productivity parameter has no impact at all on its takeover price. The takeover cost is paid at the end of period $t-1$. Firms observed in the data purchasing more than one network in the merger market are treated in this model as though they are beginning to market a brand new product line, with no economies of scope. Multinational firms investing for the first time in a particular country must also devote some resources at their headquarters to transfer their technology to the new country and integrate the overseas branch (in a way that conforms to both countries' cultural and legal systems) into their management structure. The cost is denominated in units of the composite consumption good in the source country. For foreign firms investing for the first time in the home country, this cost is represented by $P_{t-1}^{*}f$.

Equilibrium is governed by an entry condition which stipulates that the expected present discounted value of all future profits accrued by the least productive firm entering the overseas market equals the cost of entry. If it were more than the entry cost, more firms would desire to invest. If it were less, firms would exit by liquidating their overseas assets. I abstract from the purchase and sale of fixed assets, assuming here for simplicity that local firm assets are perfectly liquid within the local market and efficiently priced, so that there are no expected capital gains on fixed assets in the steady state. The condition governing the behavior of foreign firms deciding at time $t-1$ whether to invest in the home market *for the first time* (FT) and begin prodution in period t is expressed in terms of the value of potential overseas operations,

$$V_{f,t-1}^{FT}(\hat{\varphi}_{f,t}) = E_{t-1}\left[\sum_{k=1}^{\infty}\left(\prod_{m=0}^{k} d_{t+m}^{*}\right)\frac{\pi_{f,t+k}(\hat{\varphi}_{f,t})}{S_{t+k}}\right] - \frac{P_{t-1}V_{t-1}(0)}{S_{t-1}} - P_{t-1}^{*}f \equiv 0, \quad (3)$$

where the expression $\prod_{m=0}^{k} d_{t+m}$ represents the compounding of the inverted gross discount rate as the firm considers profits that would be reaped further and further into the future, making the present discounted value of total expected profits finite.

Similarly, the entry condition for home-owned firms is

$$V_{h,t-1}(\varphi) = E_{t-1}\left[\sum_{k=1}^{\infty}\left(\prod_{m=0}^{k} d_{t+m}\right)\pi_{h,t+k}(\hat{\varphi}_{h,t})\right] - P_{t-1}V_{t-1}(0) \equiv 0. \tag{4}$$

Further, for any home firm with $\varphi < \hat{\varphi}_{h,t}$, the cash payment for its marketing and distribution network on the merger market will exceed its expected discounted future profits from active production. That is, home firms drawing φ less than the threshold value will have

$$V_{h,t-1}(\varphi) = E_{t-1}\left[\sum_{k=1}^{\infty}\left(\prod_{m=0}^{k} d_{t+m}\right)\pi_{h,t+k}(\hat{\varphi}_{h,t})\right] < P_{t-1}V_{t-1}(0)$$

and will immediately sell their facilities on the merger market for the amount $P_{t-1}V_{t-1}(0)$ rather than engaging in production.

Substituting the pricing rules for each good into the formula for the aggregate price level, one obtains an expression in terms of the endogenous variables $\hat{\varphi}_{f,t}$ and $\hat{\varphi}_{f,t}$:

$$P_t = \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\bar{\varphi}_t E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]},$$

where $\bar{\varphi}_t$ represents the aggregate productivity level in the home economy, defined by

$$\bar{\varphi}_t = \left(\int_{\hat{\varphi}_{h,t}}^{\infty}\varphi^{\theta-1}dG(\varphi) + \int_{\hat{\varphi}_{f,t}}^{\infty}\varphi^{\theta-1}dG(\varphi)\right)^{\frac{1}{\theta-1}}.$$

Supposing that firms draw their labor productivity endowment from a cumulative distribution with Pareto form, $G(\varphi) = 1-\varphi^{-k}$, then the number of firms operating in the home country owned by residents of country j will equal $n_{j,t} = 1-G(\hat{\varphi}_{j,t}) = \hat{\varphi}_{j,t}^{-k}$, where k is an exogenous shape parameter restricted to values greater than $\theta+1$.

Substituting expressions for wages, consumption, prices, the discount rate, the exchange rate (using the UIP equation), and expected interest rates and normalizing $S_{t-1} \equiv 1$, one obtains a pseudo-reduced form in the steady state for equation (3),[8]

$$V_f^{FT}(\hat{\varphi}_f) = \hat{\varphi}_f^{\theta-1}\bar{\varphi}^{\frac{1}{\rho}-\theta}\left(\frac{\theta-1}{\theta\kappa}\right)^{\frac{1}{\rho}} e^{\left(\frac{\rho-1}{2\rho^2}\right)\sigma_i^2} - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma_i^2}V(0) - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}^*}fe^{\frac{1}{\rho}\sigma_{i^*}^2} \equiv 0. \tag{5}$$

One might surmise that "veteran" foreign firms making repeated takeovers in the home country might also incur a headquarters coordination cost, but that it would be much smaller than f, so that foreign interest rate volatility would have much less or even zero deterrent effect in comparison with first-time foreign investors. Suppose, for simplicity, that there is no additional headquarters coordination cost for veteran foreign investors. Then, once we use the risk-sharing result from frictionless nominal bond trading, $d_t = S_t d_t^*$, their entry condition is identical to that of home firms investing in their native market. Using equation (4), the analogous equation for home firms is

$$V_h(\hat{\varphi}_h) = V_f^{Veteran}(\hat{\varphi}_f^V) = \hat{\varphi}_h^{\theta-1}\bar{\varphi}^{\frac{1}{\rho}-\theta}\left(\frac{\theta-1}{\theta\kappa}\right)^{\frac{1}{\rho}} e^{\left(\frac{\rho-1}{2\rho^2}\right)\sigma_i^2} - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma_i^2}V(0) \equiv 0 \tag{6}$$

Using the implicit function rule, one can determine that *ceteris paribus*, a small increase in interest rate volatility arising in the source country will cause fewer firms to invest, while a small increase in host country interest rate volatility will entice more entry. That is, given a specific price, $V(0)$[9]

$$\frac{\partial\hat{\varphi}_f}{\partial\sigma_{i^*}^2} = -\frac{\frac{\partial V_f}{\partial\sigma_{i^*}^2}}{\frac{\partial V_f}{\partial\hat{\varphi}_f}} \geq 0$$

and

$$\frac{\partial\hat{\varphi}_f}{\partial\sigma_i^2} = -\frac{\frac{\partial V_f}{\partial\sigma_{i^*}^2}}{\frac{\partial V_f}{\partial\hat{\varphi}_f}} < 0.$$

[8] See Appendix for derivation.

[9] See Appendix for proof.

Moving fixed costs to the right and dividing equations (5) and (6), one can also see the relationship between the home and first-time foreign entry behavior:

$$\left(\frac{\hat{\varphi}_f}{\hat{\varphi}_h}\right)^{\theta-1} = \left(\frac{\hat{\varphi}_f}{\hat{\varphi}_f^V}\right)^{\theta-1} = 1 + \frac{P^* f}{PV(0)}. \tag{7}$$

Numerical exercises below will show that the wedge between the total fixed cost of entry for first time foreign investors versus domestic or veteran foreign investors, $1+\frac{P^* f}{PV(0)}$, falls as σ_i^2 increases and rises as $\sigma_{i^*}^2$ increases. That is, increases in σ_i^2 drive up the total fixed cost of entry at a faster rate for domestic and veteran entrants than for first-time foreign entrants, for whom the headquarters coordination cost, $P^* f$, is relatively unaffected by home interest rate volatility.[10]

Solving the full model numerically requires six equations: two entry conditions for first-time multinational entrants, two for native entrants, and a merger-market clearing condition in each country. Merger-market clearing conditions in steady state require that the number of active firms equal the number of existing marketing and distribution networks. If a proportion η of all potential native entrepreneurs in each country draw a viable network, then the steady-state merger market clearing conditions are given by $n_h + n_f = \eta$ in the home country and $n_h^* + n_f^* = \eta^*$ in the foreign country. One can also include two additional equations for veteran multinational investors in each country, but (assuming that the headquarters coordination cost is zero for repeated overseas takeovers) these turn out to be identical to the two equations for native entrants, so they are left out of the numerical solution below with the understanding that domestic and veteran foreign firms will have the same response to changes in volatility. Thus, the numerical solutions mapped below capture a succession of steady states which vary only according to the level of home or foreign interest rate volatility treating all foreign entrants into the home country as though they are undertaking their first overseas acquisition. The exact calibration is written in the Appendix, but the basic result, that home volatility has little (zero or a small positive) effect whereas foreign interest rate volatility has an unequivo-

[10] P^* is affected indirectly, through changes in $\hat{\varphi}_h^*$.

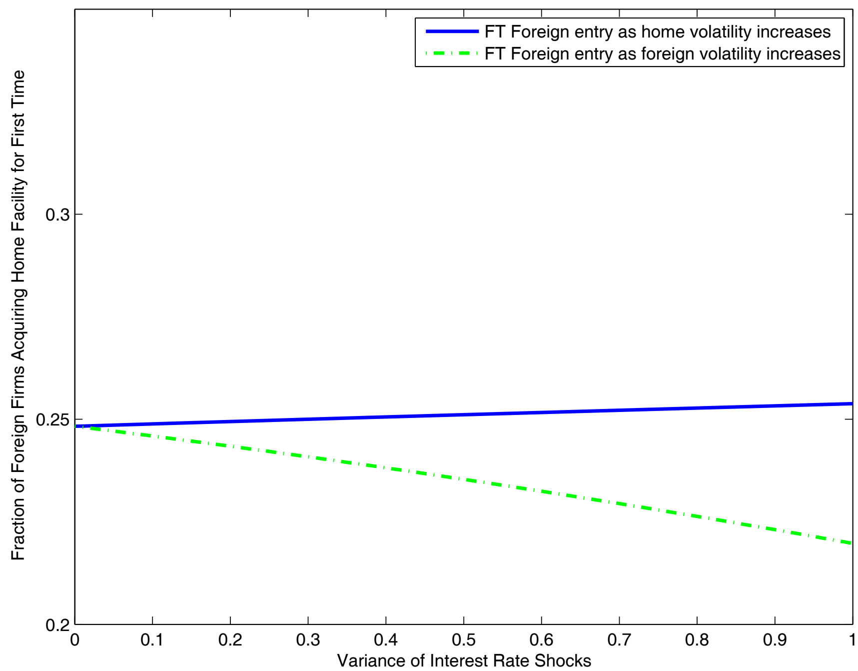

Figure 2: Impact of Home i-rate volatility on First-Time Foreign entry into the Home market

cally negative effect on first-time entry by foreign firms is robust to a wide range of parameter values, as long as consumers are sufficiently risk averse ($\rho \geq 1$).

It is not possible to obtain an analytical solution for $\hat{\varphi}_f$ (and thus $n_f = \hat{\varphi}_f^{-\gamma}$) given the calibration used here ($\rho > 1$, $\theta > 2$), but the relationship between home interest rate volatility, foreign interest rate volatility, and the number of first-time foreign entrants from numerical solution is shown in Figure 2. No linearization is necessary to obtain the solutions. The model predicts that volatility in the host country lowers the threshold productivity level for first-time foreign investors, meaning that for $\rho > 1$, is easier for foreign firms to enter when σ_i^2 is higher. In contrast, volatility originating in the source (foreign) country reduces entry by first-time foreign entrants, with little effect on entry by native or veteran foreign investors except insofar as it loosens up the merger market (lowering $V(0)$). Note from the reduced form of the

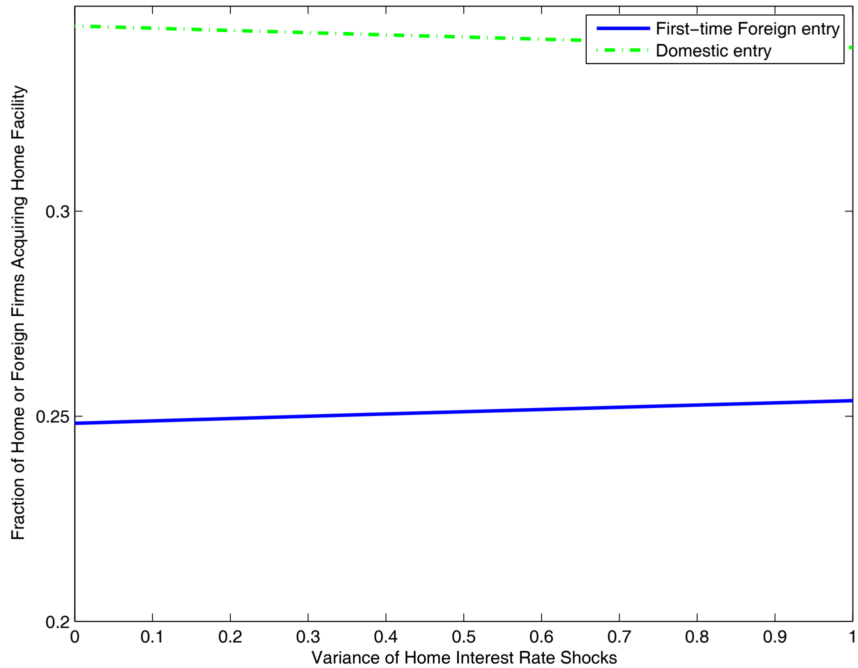

Figure 3: Impact of Home Interest Rate volatility on First-Time Foreign Entry

value function for the threshold firm that this impact grows with the size of the sunk cost (f). Thus, the model predicts that while exchange rate volatility is positively correlated with both home and foreign interest rate volatility, these two sources of uncertainty have a very different impact on foreign direct investment in the home country. Home interest rate volatility has either a positive or zero impact on foreign direct investment, while the relationship between foreign interest rate volatility and entry is negative.

Figure 3 contrasts entry by first-time foreign investors and domestically owned home firms as home interest rate volatility increases.[11] As home interest rate volatility increases, P also increases, the total cost of entry increases faster for home (and similarly, veteran foreign) firms than for first-time foreign entrants. Figure

[11]For the case of logarithmic preferences, where $\rho = 1$, both lines in this graph would be flat and home interest rate volatility would have no effect on either variable.

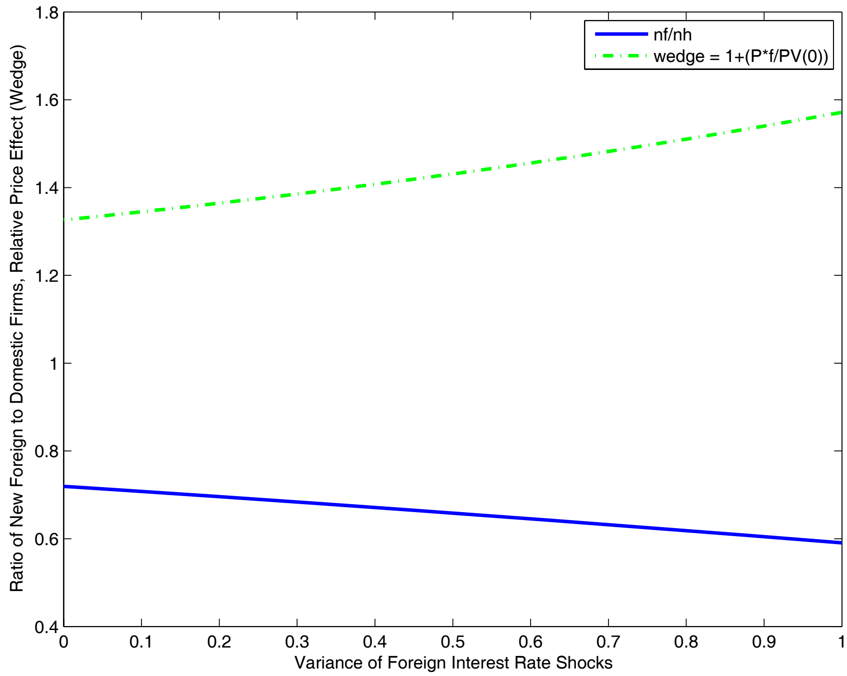

Figure 4: Relative Entry Rates and the Relative Price Effect

4 illustrates the relative price effect–the relationship between the ratio of entry rates $(\frac{n_h}{n_f})$ and the wedge between total fixed costs of entry depicted in equation (7), $1 + \frac{P^*f}{PV(0)}$ as foreign interest rate volatility increases.[12]

3 Empirical Analysis

Given the model above, I estimate the reduced-form equations

$$\ln n_{f,t} = \alpha + \beta_1 t + \beta_2 t^2 + \gamma D_t + \delta_1 \sigma^2_{i,t} + \delta_2 \sigma^2_{i*,t}, \tag{8}$$

[12]An analogous graph with home volatility on the x-axis would show the lines growing closer together on the right side at higher, rather than lower values of volatility.

and

$$\ln\left(\frac{n_{f,t}}{n_{h,t}}\right) = \alpha + \beta_1 t + \beta_2 t^2 + \gamma D_t + \delta_1 \sigma_{i,t}^2 + \delta_2 \sigma_{i^*,t}^2, \quad (9)$$

where t is a time trend and D_t is a vector of fixed effects. I assume that although volatility might change from year to year, prospective investors consider information accumulated over several years prior to investing and expect volatility to remain roughly the same as the level they observe in the period when they decide to invest. Thus, each year t would represent *a particular steady state* from the perspective of the investor. For both equations, the theory and numerical steady states above imply that $\delta_1 \geq 0$ and $\delta_2 < 0$ for first-time cross-border investment. The empirical analysis takes place in four parts. First, regressions are run based on (8) for the log number of firms investing in a country for the first time. Second, to show the importance of the sunk cost, the same regressions are run for all incidences of veteran cross-border investment in the panel– investments by foreign firms that have already invested in the host country– with quite different results. Third, to neutralize the impact of any time-varying, unobserved variables that may be impacting both the volatility of interest rates and the general investment environment within each country, which could cause an endogeneity problem similar to that described in Russ (2007), all regressions are also run using the log ratio of foreign to domestic first-time acquirors, based on (9). Finally, to avoid the bias that taking logs and ignoring zero-observations can generate in the standard linear regressions, described in detail by Silva and Tenreyro (2006), a count-data regression is run based on equation (8) using Poisson quasi-maximum-likelihood estimation. Results are robust to all specifications.

Many factors can influence exchange rate volatility. Ideally, one would want to be regressing the entry variables on the portion of exchange rate volatility generated by interest rate volatility. A structural vector autoregression (SVAR) is often used for this type of variance decomposition. The panel specification here is chosen over an SVAR for several reasons. The most practical reason is that most SVAR specifications assume a constant variance over the sample period. Using a multivariate GARCH framework can address this problem, but even for a two-country analysis, there is a large dimensionality obstacle. The panel also allows one to consider information from a wider array of countries at once and the technique used to measure volatility here meshes with the approaches used in most prior studies of FDI. Nonetheless, nesting the entry behavior of multinational firms in a rigorous time series model remains interesting ground for future research.

3.1 Data

Data on mergers and acquisitions is taken from Thomsons SDC Platinum database. The dataset begins in 1980 and the sample used below starts with firms reporting investment in a new country in 1986, based on dates the deals were executed (the "effective date"). Firms are assumed not to have conducted overseas mergers and acquisitions prior to 1980. The number of firms native to one OECD country and investing for the first time in a different OECD country are totalled by year, from 1986 through 2005. To clarify, a German firm conducting an M&A in the US in 1989 would be categorized as a first-time entrant if it had no recorded acquisitions in the US between 1980 and 1988, but a veteran entrant if it had already made an acquisition in the US during that time. Interest rate variables are from the monthly series corresponding to the US Fed Funds Rate in the IMF *International Financial Statistics*. Where that was not available, the *IFS* series most closely corresponding to an overnight rate was used. Volatility is measured in three different ways, all of which yield similar results: (1) the standard deviation of the demeaned change in the monthly short-term interest rate, (2) the standard deviation of departures from the mean short-term interest rate, and (3) the standard deviation of errors from a simple AR-1 process ($i_t = \phi i_{t-1} + u_t$). All three methods are computed using 24-month rolling windows, then taking an average of the changing monthly volatility measures for each year. The first method is a rigorous construction of σ_i^2 and σ_{i*}^2 as they are rather simplistically modeled above, so results reported here are based on this measurement approach, but the results are robust to each method. Fixed effects are included for host-source country pairs, flows between EMU members, being about to join the EMU, and the East Asian crisis years (1997, 1998, and 1999). I also include a linear and quadratic time trend to account for the fact that cross-border mergers and acquistions are generally increasing across all countries during the sample period.

3.2 Results for first-time investment

Table 3 displays results from regressions of the (log) number of cross-border mergers and acquisitions from each country to each country in each year on interest rate volatilility in the source and host countries, which in this model represent the reduced-form components of exchange rate volatility. A simple OLS regression reveals coefficients on volatility of the expected sign, though only the negative effect of volatility originating in the source country is significant. One might be concerned that if monetary policy is coordinated in any degree across industrialized countries, source and host interest rate volatility may be correlated. To address this problem, the regression is also run on the difference between source and host volatility ($\sigma^2_{i^*} - \sigma^2_i$), for which the coefficient should negative, given the predictions for δ_1 and δ_2. The coefficient in this case is negative and still significant. Using cluster-robust errors in the OLS equation, as in columns (3) and (4), the coefficients are all still of the same sign but again only source-country interest rate volatility (column (3)) and the difference between source and host volatility (column (4)) have a significant impact. Clustering in this case is done by country pair, taking into account the direction of flows, so flows from the US to Canada and from Canada to the US count as two separate country pairs.

The levels of M&As between the country pairs are highly persistent: the Arrellano-Bond test statistic reveals residuals with autocorrelation of degree one. I address this problem using two different methods. First, I use feasible generalized least squares (FGLS), imposing a common level of autocorrelation in the errors across the entire panel, but allowing for heteroskedasticity between country pairs, displayed in column (5) of Table 3. The results are still of the same sign and both variables of interest are now significant at the 1% level, as is the volatility differential in column (6). Second, I use an Arellano-Bond specification. The GMM results in columns (7) and (8) reveal that previous growth in entry is by far the best predictor of future growth in entry by foreigners. Again, the variables of interest, though small in magnitude, are all of the predicted sign and with the exception of growth in host volatility, are significant at the 1% or 5% level. All results are robust to whether the entire OECD sample is used or just a subset of outflows to all OECD countries from G-7 countries. Thus, it is not likely that source-country interest rate volatility simply indicates institutional instability that drives investment overseas.

3.3 Other determinants of FDI

Previous studies have linked numerous other variables to the propensity of foreigners to invest in a particular country, including distance, host-country GDP and GDP growth, and capital controls in the host country. The host-source country pair fixed effects included in specifications (1)-(8) of Table 3 are interpreted as controlling for distance. To control for changes in the host country's macroeconomic environment that are not captured in the simple model above, such as GDP growth, I run all of the above specifications using the ratio of foreign to domestic mergers and acquisitions as the dependent variable. Table 4 contains the results for this exercise, showing that the sign of all coefficients estimated on the variables of interest are again of the predicted sign– negative for the level of interest rate volatility in the source country and positive for the level of volatility in the host country for columns (1)-(6), where the dependent variable is the log ratio of foreign to domestic M&As. The coefficients are also of predicted sign for the GMM estimations in columns (7) and (8), where the dependent variable is the change in the log ratio of foreign to domestic M&As. However, it is likely that autocorrelation is more of a concern in all of these specifications, as the estimated autocorrelation coefficients for the errors across the panel in the FGLS regressions are twice as large as in Table 3 (0.18 vs 0.9). Host country volatility yields a significant impact on the investment ratio only for the GMM specifications, where it is positive and significant at the 5% level. The negative impact of source volatility is significant for the OLS estimates, as is the source-host volatility differential in the FGLS specification, but there is no evidence of a significant negative link under the GMM specification, as columns (7) and (8) demonstrate that the coefficient is of about the same magnitude whether source and host volatilities are considered separately or combined into the source-host volatility differential.

3.4 Repeat investors

All of these regressions are now conducted for veteran foreign investors–firms conducting M&As in countries where they have already made at least one investment. Table 5 shows no evidence that contemporaneous levels of source-country interest rate volatility impact the decisions of veteran firms. In addition, column (7) in Table 5 reveals a negative relationship between veteran FDI and host-country interest rate volatility. In Table 6, noting the GMM specifications in columns (7) and (8), there is again no clear evidence that veteran foreign investors respond any differently to host- or source-country interest rate volatility than domestic investors. The FGLS specifications show that veteran foreign investors might be more deterred by any kind of interest rate volatility than domestic veteran investors, but the sign for host country volatility and the volatility differential is different than in any of the clustered OLS or GMM specifications, calling into question its robustness. This result is important because it clarifies the nature of sunk costs–that one-time, upfront sunk costs of the sort modeled above make firms more sensitive to volatility in the fundamental variables, whether it arises from host- or source-country interest rates. In contrast, repeated costs such as overhead, taxes, maintenance of distribution networks, and certain types of contracted labor that also may be sunk insofar as they are paid or promised before the firm makes its sales and repatriates the profits at a future exchange rate, are not likely to have this effect.

3.5 The Poisson specification

Regressions above refer only to country pairs between which cross-border M&As are actually taking place. Zero-observation pairs may also contain important information, insofar as omitting them can generate selection bias in the estimated coefficients. Further, Silva and Tenreyro (2006) demonstrate that bias can also arise when using logarithmic transformations of variables in the presence of heteroskedasticity. To address both of these issues, Table 7 presents estimates from a Poisson quasi-maximum-likelihood specification with robust standard errors using a count of the number of M&As,

$$n_{f,t} = \alpha + \beta_1 t + \beta_2 t^2 + \gamma D_t + \delta_1 \sigma^2_{i,t} + \delta_2 \sigma^2_{i^*,t}.$$

Source-country interest rate volatility has a strongly significant negative impact on first-time cross-border M&As, while host-country interest rate volatility has no significant impact. Joining the EMU increases the incidence rate for first-time FDI by about 21 percent and veteran FDI by 15 percent. In terms of size, joining the Euro Area boosts first-time FDI by about 10 times more than a one unit increase in source-country volatility would dampen it. A one unit increase in volatility is an increase of about 2.2 standard deviations for the US (which has a minimum volatility measure of 0.14 and a maximum of 1.8) and Switzerland, 3 standard deviations for the Netherlands, 2 for the UK, 1.2 for Australia, 0.5 for South Korea, 0.26 for Sweden, and 0.04 for Turkey. The standard deviation for the sample as a whole is 5.3. These patterns for hold for first-timers even when EMU members are excluded, when the US is excluded, and when only inflows to the US and UK are used. They hold whether interest rate volatility is defined as the variance of departures in the monthy interest rate from the mean interest rate over two-year rolling windows (reported here) or as the variance of demeaned changes in the interest rate over two-year rolling windows. They do not hold for intra-EMU member flows, where interest rate volatility has no significant impact on first-time FDI. It is not clear whether this is due to the common currency or due to the dramatically reduced sample size.

The situation is exactly the reverse for veteran cross-border investment. For veteran cross-border investors, it is again host-country interest rate volatility that acts as a deterrent, while source volatility has no significant impact. This is true when excluding EMU members, when excluding the US, and when using only flows into the UK and US. It also holds for both definitions of interest rate volatility (variance of departures from the mean or of demeaned changes). Interest rate volatility has no significant measurable impact on intra-EMU flows. Again, a one unit increase in host volatility has an impact about one-tenth the size of joining the EMU.

The UIP condition used here to govern the behavior of expected exchange rates is quite simplistic. One might conjecture that the measure of interest rate volatility in the empirical analysis could be acting as a proxy for overall macroeconomic or institutional uncertainty in the host and source countries. If this were the case, then one would expect volatility to induce capital flight– increased flows of outward FDI. However, it is seen in Tables 3, 4, and 7 that source country volatility consistently either reduces or has no effect on (outward) FDI, rather than increasing it. Hausman and Fernandez-Arias (2001) provide convincing evidence that in emerging markets, a high proportion of FDI relative to other types of investment may be the result of investors trying to cope with institutional or other types of systemic instability in the host country. This study complements those findings insofar as it finds a positive link between host-country volatility and cross-border acquisitions. However, the sample considered here consists of OECD countries and the results hold even for inflows into the US and UK, where investors are not likely to have had such concerns in recent years.

3.6 Actual exchange rate volatility

This model captures only a small part of the relationship between the exchange rate and FDI, so it does not entirely resolve the puzzle by any means. To illustrate, I take the case of flows involving US firms as targets or acquirors. I draw montly data on the bilateral exchange rate against the dollar from the St. Louis Federal Reserve Bank's FRED database for each country except the US and use FRED's broad trade-weighted (US dollar) exchange rate for the US. To illustrate, column (1) in Table 8 shows the coefficients from an OLS regression on the equation

$$\sigma_s^2 = \alpha + \beta_1 t + \beta_2 t^2 + \lambda_1 \sigma_{i,t}^2 + \lambda_2 \sigma_{i*,t}^2 + \varepsilon_t$$

for the two definitions of volatility, in the spirit of Engel, Mark, and West (2007), who find that monetary variables are useful to predict exchange rate volatility, if not always exchange rate levels. Within the sample here, bilateral exchange rate volatility against the US dollar is positively correlated with both host- and source-country interest rate volatility, though only the coefficient for host interest rate volatility is significant. In support of the modelabove, there is no statistically significant relationship between first-time cross-border entry and the predicted volatility from this equation ($\hat{\sigma}_s^2 = \alpha + \beta_1 t + \beta_2 t^2 + \lambda_1 \sigma_{i,t}^2 + \lambda_2 \sigma_{i^*,t}^2$), regardless of how volatility is defined.

However, the definition of volatility does matter, both for the sign of the coefficient estimated for exchange rate volatility and for the impact of trying to clean out the endogeneity problem discussed above. For volatility defined as the variance of departures from the mean (exchange rate or interest rate), we observe a negative and weakly statistically significant relationship between FDI and exchange rate volatility in Column 3,[13] which persists and gets somewhat larger when regressing $n_{f,t}$ on ε_t instead of σ_s^2, shown in Column 4. Column 5 and 6 show the same regressions run for volatility defined as demeaned changes in the exchange rate. Whereas exchange rate volatility initially has no statistically significant relationship with first-time foreign entry, the portion of exchange rate volatility not attributable to interest rate volatility ("cleaned" of the source of endogeneity discussed in this paper) has a positive coefficient that is weakly statistically significant and three times larger than that for σ_s^2. For first-time foreign investment, the definition of volatility is important–it is not clear why one definition has a positive relationship with first-time entry and the other a negative one–but endogeneity, clearly at work in Columns 5 and 6, is also important. For veteran investors (not shown here), neither the raw (σ_s^2) nor the cleaned (ε_t) measures of exchange rate volatility have a significant relationship with the number of cross-border M&As. The fact that the two raw measures of exchange rate volatility have statistically significant correlations with first-time FDI but not with repeat foreign investment offers another explanation for conflicting estimates

[13]Columns 3, 4, 5, and 6 of Table 8 all refer to Poisson quasi-MLE regressions with robust standard errors, as in Table 7.

across studies.

4 Conclusions

In summary, though interest rate volatility in this study's panel is positively correlated with the volatility of its exchange rate, host and source interest rate volatility have quite different effects on first-time and veteran foreign direct investment. Interest rate volatility in the host country encourages or has no effect on first-time acquisitions by foreign firms, but soundly disourages veteran investors. In contrast, interest rate volatility in the source country has little effect on veteran cross-border investors, but deters firms considering investing in a particular country for the first time. At the same time, both sources of volatility have (on average) a positive correlation with exchange rate volatility in the sample studied here. Thus, the empirical findings combined with the theoretical model above provide a clue to the puzzle in existing literature trying to pindown the relationship between foreign direct investment and exchange rate volatility.

The findings also demonstrate that the size of estimated coefficients on exchange rate volatility can be dampened by this endogeneity, but do not explain exactly why the direction of the correlation between FDI and exchange rate volatility is positive in some studies and negative in others. Further, common measures of exchange rate volatility have significant correlations with first-time foreign investment, but not with veteran investment for US bilateral flows, which can not be accounted for in the model here. Two possible reasons for these lingering pieces of the exchange rate-FDI puzzle are (1) that financial flows involved in overseas investment and repatriated profits themselves influence the exchange rate, as suggested by the literature on valuation effects and modeled in Lubik and Russ (2006) and (2) that firms' sensitivity to risk in exchange rates and any fundamental variables that may drive them depends on whether they are investing to sell goods locally or for export, as suggested by Burstein, Kurtz, and Tesar (2007). Both directions provide plentiful ground for future research.

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A Derivation of the aggregate price level

The pseudo-reduced form equation for the aggregate price level is calculated in three steps: First, I define aggregate consumption as a function of the aggregate price index and the exogenous interest rate, which lets me define the wage rate as a function of the exogenous interest rate and underlying preference parameters. Second, I find the firm's pricing rule in terms of expected aggregate consumption and the wage rate. These pricing rules now reduce to a function of the (exogenous) expected interest rate and underlying parameters. Third, I substitute these firm pricing rules into the definition of the aggregate price index to redefine the index only in terms of the expected interest rate, underlying parameters, and the endogenous cutoff productivity levels for home- and foreign-owned firms operating in the home economy.

A.1 Consumption and wages

Money demand and consumption. Based on the maximization problem described in the text, standard first-order conditions for the consumer's problem (with λ_t representing the Lagrange multiplier for the budget constraint) are as follows:

$$\frac{\partial \pounds}{\partial C_t} \quad : \quad \lambda_t = \frac{1}{P_t C_t^{\rho}} \tag{A1.a}$$

$$\frac{\partial \pounds}{\partial B_t} \quad : \quad \frac{1}{i_t} = E_t \left[\frac{\beta P_t C_t^{\rho}}{P_{t+1} C_{t+1}^{\rho}} \right] \equiv d_t \tag{A1.b}$$

$$\frac{\partial \pounds}{\partial B_t^*} \quad : \quad S_t \lambda_t = \beta i_t^* E_t \left[\lambda_{t+1} S_{t+1} \right] \tag{A1.c}$$

$$\frac{\partial \pounds}{\partial M_t} \quad : \quad \frac{\chi}{M_t} = \lambda_t - \beta E_t \left[\lambda_{t+1} \right] \tag{A1.d}$$

$$\frac{\partial \pounds}{\partial L_t} \quad : \quad W_t = \frac{\kappa}{\lambda_t} = \kappa P_t C_t^{\rho} \tag{A1.e}$$

Dividing A1.c by λ_t, then substituting in A1.a and A1.b, A1.c yields the UIP equation in the text. Similarly, dividing A1.d by λ_t yields

$$\frac{\chi}{\lambda_t M_t} = 1 - \beta E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \right],$$

then substituting in A1.a

$$\frac{P_t C_t^{\rho} \chi}{M_t} = 1 - E_t \left[\frac{\beta P_t C_t^{\rho}}{P_{t+1} C_{t+1}^{\rho}} \right],$$

and substituting A1.b then gives an equation for the demand for real money balances as a function of aggregate consumption and the interest rate,

$$\begin{aligned} \frac{P_t C_t^{\rho} \chi}{M_t} &= 1 - \frac{1}{i_t} \\ \frac{M_t^D}{P_t} &= \frac{C_t^{\rho} \chi i_t}{i_t - 1}. \end{aligned} \tag{A2}$$

In the text, I assume that the interest rate is exogenous and that the money supply is an inverse function of the interest rate, $M_t^S = \frac{\mu}{i_t - 1}$, so that an increase in the interest rate reduces the money supply and vice versa. To get the consumption equation (equation (1) in the main text), I set $M_t^D \equiv M_t^S$, or

$$\begin{aligned} \frac{M_t^S}{P_t} &= \frac{C_t^{\rho} \chi i_t}{i_t - 1} \\ \frac{\mu}{P_t(i_t - 1)} &= C_t^{\rho} \chi \left(\frac{i_t}{i_t - 1} \right) \\ C_t^{\rho} &= \left(\frac{1}{P_t} \right) \frac{\mu}{\chi i_t}. \end{aligned} \tag{A3}$$

Wages. To calculate the aggregate price level, I use the wage rate derived from the consumer's first order condition A1.e, combined with the consumption equation, labeled equation (A3) here. This generates a formula for the wage (equation (2) in the main text) as a function of the interest rate,

$$\begin{aligned} W_t &= \kappa P_t C_t^{\rho} \\ &= \frac{\kappa \mu}{\chi i_t}. \end{aligned} \tag{A4}$$

A.2 The firms' pricing rules

After substituting in the consumption and wage equations above, pricing rules for individual firms selling in the home market are derived as a function of the expected home interest rate,

$$p_{h,t}(\varphi) = p_{f,t}(\varphi) = \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\varphi E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]} \tag{A5}$$

A.3 The aggregate price level

Minimizing the expenditure necessary to consume one unit of the aggregate consumption bundle gives the aggregate price index in this CES framework shown in the main text,

$$P_t = \left(\int_0^{n_{h,t}} p_{h,t}(i)^{1-\theta}di + \int_1^{1+n_{f,t}} p_{f,t}(i)^{1-\theta}di\right)^{\frac{1}{1-\theta}}.$$

It is useful now to identify firms by their productivity parameter, φ, rather than the firm subscript, i. Every firm draws its productivity parameter independently from an identical distribution, $G(\varphi)$, allowing me to use the law of large numbers to assert that the distribution of productivity levels for the economy as a whole will be the same as the firm-specific distribution. Then, substituting in the pricing rules, we have

$$\begin{aligned} P_t &= \left(\int_{\hat{\varphi}_{h,t}}^{\infty}\left[\left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\varphi E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]}\right]^{1-\theta} dG(\varphi) + \int_{\hat{\varphi}_{f,t}}^{\infty}\left[\left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\varphi E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]}\right]^{1-\theta} dG(\varphi)\right)^{\frac{1}{1-\theta}} \\ &= \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi\bar{\varphi}_t E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]}, \end{aligned}$$

where

$$\bar{\varphi}_t = \left(\int_{\hat{\varphi}_{h,t}}^{\infty} \varphi^{\theta-1} dG(\varphi) + \int_{\hat{\varphi}_{f,t}}^{\infty} \varphi^{\theta-1} dG(\varphi) \right)^{\frac{1}{\theta-1}}.$$

A.4 Determinacy

As long as there is a unique solution for $\hat{\varphi}_{h,t}$ and $\hat{\varphi}_{f,t}$, there is a unique solution for the price level. In a model where these two variables enter the zero-profit conditions with no other endogenous variables, one can show analytically that the zero-profit conditions are monotonically increasing in these cutoff productivity levels. In this model, an analytical proof is not possible due to the presence of the takeover price $V(0)$, so I show a graphical proof below that $V_h(\varphi)$, or equation (6) from the main text, is monotonically increasing in φ, implying the existence of a unique solution for $\hat{\varphi}_{h,t}$. Specifically, I calibrate the model as described in Appendix D, setting interest rate volatility in both countries to 0.1 (the particular value for volatility does not affect the monotonicity). Then, I specify values of φ such that $1 < \varphi < \infty$ and solve the system described in the text omitting the equation for $V_h(\varphi)$ (that is, $V_h(\hat{\varphi}_{h,t})$) so that all other endogenous values are solved for given the level of φ specified. Finally, I numerically compute $V_h(\varphi)$ given the solution values of all other endogenous variables corresponding to various values of φ.

B First-order conditions for the firm's problem

To set prices for the following period, firms maximize the expected value of profits with respect to the prices they will set subject to the demand equations in the text (derived explicitly in the technical appendix for Russ (2006),

$$\max_{p_{h,t}(\varphi), p^*_{h,t}(\varphi)} E_{t-1}[d_t \left(\pi_{h,t}(\varphi) + S_t \pi^*_{h,t}(\varphi) \right)]$$

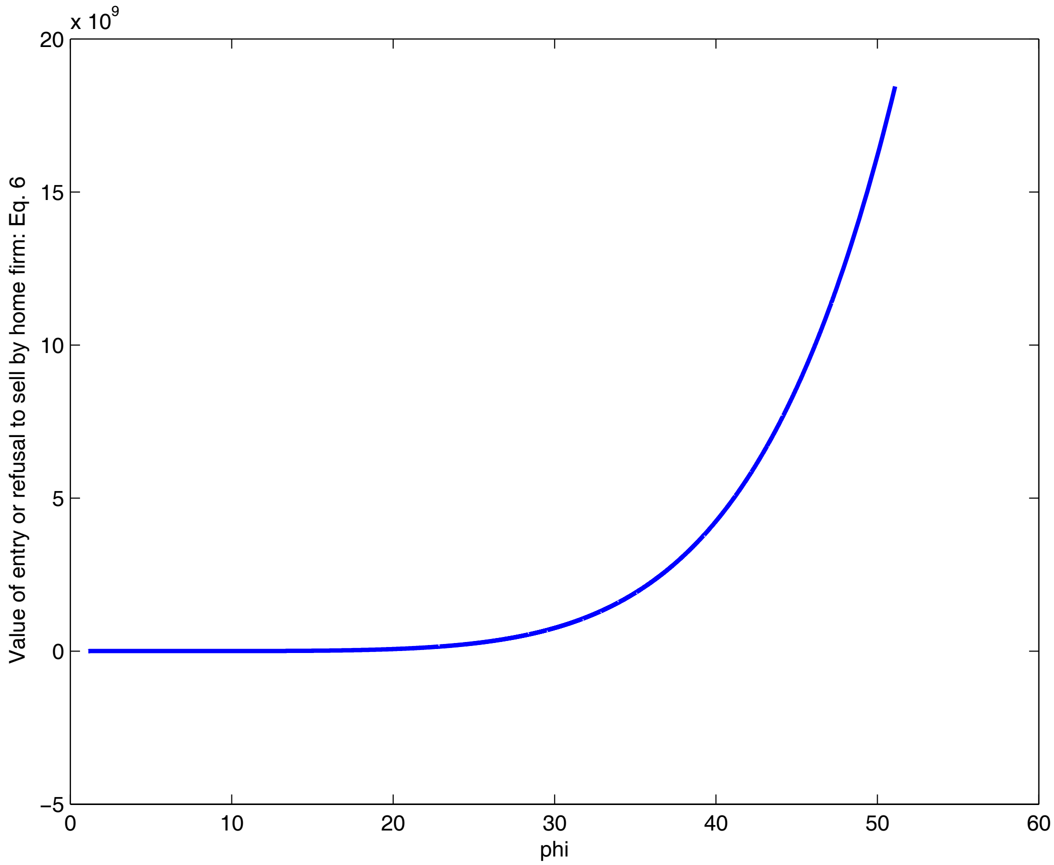

Figure 5: The monotonicity of the value function (equation (6)) in φ

for home-owned firms and

$$\max_{p_{f,t}(\varphi),p^*_{f,t}(\varphi)} E_{t-1}[d^*_t \left(\pi^*_{f,t}(\varphi) + \frac{\pi_{f,t}(\varphi)}{S_t} \right)]$$

for foreign firms. The first-order conditions for firms operating in the home market are then

$$\begin{aligned} \frac{\partial \pounds_h}{\partial p_{h,t}(\varphi)} &: \quad E_{t-1}[d_t \left(c_{h,t}(\varphi) + p_{h,t}(\varphi) \frac{\partial c_{h,t}(\varphi)}{\partial p_{h,t}(\varphi)} - \frac{W_t}{\varphi} \frac{\partial c_{h,t}(\varphi)}{\partial p_{h,t}(\varphi)} \right)] \\ \frac{\partial \pounds_f}{\partial p_{f,t}(\varphi)} &: \quad E_{t-1}[\frac{d^*_t}{S_t} \left(c_{f,t}(\varphi) + p_{f,t}(\varphi) \frac{\partial c_{f,t}(\varphi)}{\partial p_{f,t}(\varphi)} - \frac{W_t}{\varphi} \frac{\partial c_{f,t}(\varphi)}{\partial p_{f,t}(\varphi)} \right)]. \end{aligned}$$

Assuming that firms take all competitors' prices (and the aggregate price level) as given, substituting the equations for goods demand, and the derivatives of the goods demand equations, the first-order conditions reduce to

$$\begin{aligned} p_{h,t}(\varphi) &= \left(\frac{\theta}{\theta - 1} \right) \frac{E_{t-1}\left[d_t W_t C_t\right]}{E_{t-1}\left[d_t C_t\right]} \\ p_{f,t}(\varphi) &= \left(\frac{\theta}{\theta - 1} \right) \frac{E_{t-1}\left[d^*_t \frac{W_t C_t}{S_t}\right]}{E_{t-1}\left[d^*_t \frac{C_t}{S_t}\right]}, \end{aligned}$$

as in Bacchetta and van Wincoop (2000). Reduced forms can be obtained by substituting equation (A1.b) and equations (1) and (2) in the main text:

$$p_{j,t}(\varphi) = \left(\frac{\theta}{\theta - 1} \right) \frac{\kappa \mu E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right]}{\chi E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right]},$$

for $j \in (h, j)$.

C Deriving the impact of home and foreign volatility on MNE entry

Starting with the entry condition for foreign firms considering entry into the home market,

$$V_{f,t-1}(\hat{\varphi}_{f,t}) = E_{t-1}\left[\sum_{k=0}^{\infty}\left(\prod_{m=0}^{k} d^*_{t+m}\right)\frac{\pi_{f,t+k}(\hat{\varphi}_{f,t})}{S_{t+k}}\right] - \frac{P_{t-1}V_{t-1}(0)}{S_{t-1}} - P^*_{t-1}f \equiv 0,$$

one can substitute in equation A1.b iterated over future periods and the UIP equation for period $t+k$ to obtain[14]

$$\begin{aligned}
V_{f,t-1}(\hat{\varphi}_{f,t}) \equiv\ & 0 = E_{t-1}\left[\sum_{k=0}^{\infty}\left(\prod_{m=0}^{k}\frac{\beta P^*_{t+m-1}C^{*\rho}_{t+m-1}}{P^*_{t+m}C^{*\rho}_{t+m}}\right)\frac{i_{t+k}}{i^*_{t+k}E_{t+k}[S_{t+k+1}]}\pi_{f,t+k}(\hat{\varphi}_{f,t})\right] \\
& -\frac{P_{t-1}V_{t-1}(0)}{S_{t-1}} - P^*_{t-1}f \\
=\ & E_{t-1}\left[\sum_{k=0}^{\infty}\left(\frac{\beta P^*_{t-1}C^{*\rho}_{t-1}}{P^*_{t}C^{*\rho}_{t}} * \frac{\beta P^*_{t}C^{*\rho}_{t}}{P^*_{t+1}C^{*\rho}_{t+1}} * \ldots * \frac{\beta P^*_{t+k-1}C^{*\rho}_{t+k-1}}{P^*_{t+k}C^{*\rho}_{t+k}}\right)\frac{i_{t+k}\pi_{f,t+k}(\hat{\varphi}_{f,t})}{i^*_{t+k}E_{t+k}[S_{t+k+1}]}\right] \\
& -\frac{P_{t-1}V_{t-1}(0)}{S_{t-1}} - P^*_{t-1}f \\
=\ & E_{t-1}\left[\sum_{k=0}^{\infty}\left(\frac{\beta^k P^*_{t-1}C^{*\rho}_{t-1}}{P^*_{t+k}C^{*\rho}_{t+k}}\right)\frac{i_{t+k}}{i^*_{t+k}E_{t+k}[S_{t+k+1}]}\pi_{f,t+k}(\hat{\varphi}_{f,t})\right] \\
& -\left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma^2_i}V(0) - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}^*}fe^{\frac{1}{\rho}\sigma^2_{i^*}}.
\end{aligned}$$

[14]To illustrate the mechanics of the algebra in the proof, the second line below is presented as though $k > 2$, though of course the sequences start for $k = 0$.

Substituting the consumption equation from the main text, we have

$$\begin{aligned} V_{f,t-1}(\hat{\varphi}_{f,t}) &= \left(\frac{1}{E_{t+k}[S_{t+k+1}]i^*_{t-1}}\right) E_{t-1}\left[\sum_{k=0}^{\infty}\beta^k i^*_{t+k}\frac{i_{t+k}}{i^*_{t+k}}\pi_{f,t+k}(\hat{\varphi}_{f,t})\right] \\ &\quad - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma_i^2}V(0) - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}^*}fe^{\frac{1}{\rho}\sigma_{i^*}^2} \qquad (A6) \\ &= E_{t-1}\left[\sum_{k=0}^{\infty}\beta^k\frac{i_{t+k}}{E_{t+k}[S_{t+k+1}]}\pi_{f,t+k}(\hat{\varphi}_{f,t})\right] \\ &\quad - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma_i^2}V(0) - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}^*}fe^{\frac{1}{\rho}\sigma_{i^*}^2} \\ &= E_{t-1}\left[\sum_{k=0}^{\infty}\beta^k\frac{i_{t+k}}{E_{t+k}[S_{t+k+1}]}c_{f,t+k}(\hat{\varphi}_{f,t})\left(p_{f,t+k}(\hat{\varphi}_{f,t}) - \frac{W_{t+k}}{\hat{\varphi}_{f,t}}\right)\right] \\ &\quad - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}}e^{\frac{1}{\rho}\sigma_i^2}V(0) - \left(\frac{\theta}{\theta-1}\right)\frac{\kappa\mu}{\chi\bar{\varphi}^*}fe^{\frac{1}{\rho}\sigma_{i^*}^2}. \qquad (A7) \end{aligned}$$

In this paper, the objective is to compare entry across steady states. In a steady state, agents expect the one-period-ahead forecast of the nominal exchange rate and functions of the nominal interest rate to be constant across all future periods. In steady state, the number of active firms from abroad and the price level are also constant. That is, for all $k \geq 0$,

$$\begin{aligned} E_{t-1}\left[E_t[S_{t+1}]\right] &= E_{t-1}\left[E_{t+k}[S_{t+k+1}]\right], \\ E_{t-1}\left[E_{t+k-1}\left[i_{t+k}^{-\frac{1}{\rho}}\right]\right] &= E_{t-1}\left[i_t^{-\frac{1}{\rho}}\right] \\ E_{t-1}\left[E_{t+k-1}\left[i_{t+k}^{\frac{\rho-1}{\rho}}\right]\right] &= E_{t-1}\left[i_t^{\frac{\rho-1}{\rho}}\right] \\ \hat{\varphi}_{f,t} &= \hat{\varphi}_{f,t+k} = \hat{\varphi}_f \Longrightarrow \bar{\varphi}_t = \bar{\varphi}_{t+k} = \bar{\varphi} \end{aligned}$$

Thus, the expected exchange rate on each side of (A7) cancels out. Substituting the equations for the demand for an individual good, the pricing rule, and the wage relation, the value function above reduces further:

$$
\begin{aligned}
V_{f,t-1}(\hat{\varphi}_{f,t}) &= \frac{1}{\hat{\varphi}_{f,t}} E_{t-1}\left[\sum_{k=0}^{\infty}\beta^k\left(\frac{p_{f,t+k}(\hat{\varphi}_{f,t})}{P_{t+k}}\right)^{-\sigma}\left(\frac{\mu}{\chi P_{t+k} i_{t+k}}\right)^{\frac{1}{\rho}}\left(\frac{\sigma i_{t+k} E_{t+k-1}\left[i_{t+k}^{-\frac{1}{\rho}}\right]}{(\sigma-1)E_{t+k-1}\left[i_{t+k}^{\frac{\rho-1}{\rho}}\right]}-1\right)\right] \\
&\quad - f_e E_{t-1}\left[\frac{1}{i_t^*}\right] \\
&= \hat{\varphi}_f^{\sigma-1}\bar{\varphi}_f^{\frac{1}{\rho}-\sigma}\left(\frac{\kappa\sigma}{\sigma-1}\right)^{-\frac{1}{\rho}}\sum_{k=0}^{\infty}\beta^k\left(\frac{E_{t+k-1}\left[i_{t+k}^{-\frac{1}{\rho}}\right]}{E_{t+k-1}\left[i_{t+k}^{\frac{\rho-1}{\rho}}\right]}\right)^{-\frac{1}{\rho}} \\
&\quad * \left(\frac{\sigma E_{t+k-1}\left[i_{t+k}^{1-\frac{1}{\rho}}\right]E_{t+k-1}\left[i_{t+k}^{-\frac{1}{\rho}}\right]}{(\sigma-1)E_{t+k-1}\left[i_{t+k}^{\frac{\rho-1}{\rho}}\right]} - E_{t+k-1}\left[i_{t+k}^{-\frac{1}{\rho}}\right]\right) - f_e E_{t-1}\left[\frac{1}{i_t^*}\right] \\
&= \hat{\varphi}_f^{\sigma-1}\bar{\varphi}_f^{\frac{1}{\rho}-\sigma}\left(\frac{\kappa\theta}{\theta-1}\right)^{-\frac{1}{\rho}}\bar{\imath}^{\frac{1}{\rho}}e^{-\frac{\sigma_i^2}{\rho^2}}\left[\left(\frac{\theta}{\theta-1}\right)\bar{\imath}^{\frac{-1}{\rho}}e^{\left(\frac{1-\rho}{2\rho^2}+\frac{1}{\rho}\right)\sigma_i^2} - \bar{\imath}^{\frac{-1}{\rho}}e^{\frac{\rho+1}{2\rho^2}\sigma_i^2}\right] \\
&\quad * \sum_{k=0}^{\infty}\beta^k - f_e e^{\sigma_{i^*}^2} \\
&= \hat{\varphi}_f^{\sigma-1}\bar{\varphi}_f^{\frac{1}{\rho}-\sigma}\left(\frac{1}{(\kappa-1)(1-\beta)}\right)\left(\frac{\kappa\theta}{\theta-1}\right)^{-\frac{1}{\rho}}\bar{\imath}^{\frac{1}{\rho}}e^{\frac{\rho-1}{2\rho^2}\sigma_i^2} - f_e e^{\sigma_{i^*}^2}
\end{aligned}
$$

D Calibration

Parameters are assigned the following values: $\beta = 0.96$, $\theta = 7$ (between the standard values of 2 and 11 used in international macroeconomics literature), $\gamma = \theta + 1$ (to ensure the boundedness of the variance of output-weighted average productivity), $\kappa = 1$, $f = 0.55$ (so that approximately 25% of foreign firms invest if $\sigma_i^2 = \sigma_{i^*}^2 = 0$), $\rho = 2$, $\eta = 0.5$ (meaning half of all active domestically owned firms must purchase a marketing and distribution facility), $\bar{\imath} = \bar{\imath}^* = 1.045$ (corresponding to a target rate of 4.5%, similar to the Federal Reserve's stated policies).

Author	**Period**	**Freq. of FDI Data**	**Freq. of ER Data**
Alaba (2003)	unclear	quarterly[1]	quarterly
Amuedo Dorantes and Pozo (2001)	1776I-98III	quarterly[2]	unclear
Campa (1993)	1981-87	annual[3]	monthly
Chakrabarti and Scholnick (2002)	1982-95	annual[4]	monthly
Cushman (1985)	1963-78	annual[5]	quarterly
Cushman (1989)	1963-86	annual[6]	quarterly
Goldberg and Kolstad (1995)	1978-92	quarterly[7]	quarterly
Sekkat and Galgau (2004)	1980-94	annual[8]	monthly
Zhang (2003)	1982-1999	annual[9]	unclear

[1]Nigeria

[2]Aggregate flows into US

[3]Startups in US from Canada, France, Germany, Japan, South Korea, Sweden, UK

[4]Flows from US to 20 OECD countries

[5]Flows from US to Canada, France, Germany, Japan, UK

[6]Flows to US from Canada, France, Germany, Japan, UK

[7]FDI/GFCF to and from US and Canada, Japan, and UK

[8]OECD

[9]EU member countries (15)

Table 1: Previous Studies (Samples and Frequencies)

Author	Real/Nom.	Definition of ER Volatility	Effect of Volatility on FDI
Alaba (2003)	nominal	GARCH	(+) in agricultural sector (-) in manufacturing sector
Amuedo Dorantes and Pozo (2001)	real	(1) st.dev. (1-yr) (2) GARCH	(+) for st.dev. (-) for GARCH
Campa (1993)	real	(1) st.dev. (2-yr) (2) st.dev. (2-yr, forward)	(-)
Chakrabarti and Scholnick (2002)	nominal	st.dev. of percent changes (1-yr)	(-)
Cushman (1985)	real	(1) st.dev. (4-qtr) (2) average level of deviations from expected ppp (1-yr)	(+)
Cushman (1989)	real	(1) st.dev. (4-qtr) (2) st.dev. (12-qtr)	(+)
Goldberg and Kolstad (1995)	real	st.dev. (12-qtr)	(+)
Sekkat and Galgau (2004)	nominal	(1) st.dev. of monthly level (2) st.dev. of monthly pecent change (3) st.dev. of annual percent change (5-yr)	(+) between EU countries (-) between EU and non-EU countries
Zhang (2003)	nominal	st.dev. of percent change	(+)

Table 2: Previous Studies (Definitions of Volatility and Results)

Table 3: Results for level of first-time cross-border M&As

Dependent Variable: Log of number of first-time cross-border M&As (n_f)

	(1) OLS	(2) OLS	(3) OLS Clustered	(4) OLS Clustered	(5) FGLS	(6) FGLS	(7) GMM (Ar-Bn) (dep var: Δn_f)	(8) GMM (Ar-Bn) (dep var: Δn_f)
$\sigma_{i^*}^2$	-.039***		-.039***		-.003***			
	(-4.19)		(3.57)		(-4.76)			
σ_i^2	.001		.001		.002***			
	(0.30)		(0.29)		(3.05)			
$\Delta\sigma_{i^*}^2$	.031***		.031**				-.048***	
	(3.51)		(4.15)				(-4.30)	
$\Delta\sigma_i^2$	.002		.002				.005	
	(0.59)		(0.90)				(1.26)	
$\sigma_{i^*}^2 - \sigma_i^2$		-.006**		-.006**		-.002***		
		(-1.84)		(-1.50)		(-7.59)		
$\Delta(\sigma_{i^*}^2 - \sigma_i^2)$		.003		.003				-.004**
		(0.79)		(0.79)				(-8.15)
$\Delta n_{f,t-1}$							.247***	.247***
							(9.97)	(9.99)
Fixed effects								
East Asian Crisis	Y	Y	Y	Y	Y	Y	N/A	N/A
Host-source country pair	Y	Y	Y	Y	Y	Y	N/A	N/A
Active EMU member	Y	Y	Y	Y	Y	Y	N/A	N/A
1year before joining EMU	Y	Y	Y	Y	Y	Y	N/A	N/A
Linear and quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y
Host-source pair heterosk.	N	N	Y	Y	Y	Y	N	N
Allow for autocorrelated error	N	N	N	N	Y	Y	Y	Y
No. observations	4070	4070	4070	4070	5586	5586	3357	3357
Clusters or groups			448	448	522	522	366	366
R-squared	.766	.766	.766	.766				
Wald chi-squared(530)					53718			
Wald chi-squared(529)						53930		
AR(1) coefficient					.092	.090		
Wald chi-squared(5)							326.81	
Wald chi-squared(4)								312.45

Quantities in parentheses are t-statistics, except in the case of the Arellano-Bond results in columns (7) and (8), in which case they are z-statistics. All variables pertain to period t unless otherwise indicated. Clustering by country-pair where noted.
***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level

Table 4: Results for level of first-time cross-border M&As relative to first-time domestic M&As

Dependent Variable: Log of ratio of cross-border M&As (n_f/n_h)

	(1) OLS	(2) OLS	(3) OLS Clustered	(4) OLS Clustered	(5) FGLS	(6) FGLS	(7) GMM (Ar-Bn) (dep var: Δn_f)	(8) GMM (Ar-Bn) (dep var: Δn_f)
$\sigma^2_{i^*}$	-.028** (-2.48)		-.028* (1.79)		.001 (.48)			
σ^2_{i}	.006 (1.46)		.006 (.94)		.002 (.83)			
$\Delta\sigma^2_{i^*}$	0.017 (2.48)		.017* (1.88)				-.005 (.35)	
$\Delta\sigma^2_{i}$	-.002 (-.460)		-.004 (-.59)				.011** (2.54)	
$\sigma^2_{i^*}-\sigma^2_{i}$		-.009* (-2.23)		-.009 (-1.31)		-.002*** (-2.79)		
$\Delta(\sigma^2_{i^*}-\sigma^2_{i})$		.006 (1.35)		.006 (.91)				-.010** (-2.51)
$\Delta n_{f,t-1}$							.350*** (12.58)	.351*** (12.69)
Fixed effects								
East Asian Crisis	Y	Y	Y	Y	Y	Y	N/A	N/A
Host-source country pair	Y	Y	Y	Y	Y	Y	N/A	N/A
Active EMU member	Y	Y	Y	Y	Y	Y	N/A	N/A
1 year before joining EMU	Y	Y	Y	Y	Y	Y	N/A	N/A
Linear and quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y
Host-source pair heterosk.	N	N	Y	Y	Y	Y	N	N
Allow for autocorrelated error	N	N	N	N	Y	Y	Y	Y
No. observations	4049	4050	4051	4052	3991	3991	3308	3308
Clusters or groups			448	448	389	389	366	366
R-squared	.844	.844	.844	.844				
Wald chi-squared(397)					191353			
Wald chi-squared(395)						173969		
AR(1) coefficient					.184	.184		
Wald chi-squared(5)							258	
Wald chi-squared(4)								258

Quantities in parentheses are t-statistics, except in the case of the Arellano-Bond results in columns (7) and (8), in which case they are z-statistics. All variables pertain to period t unless otherwise indicated. Clustering by country-pair where noted.
***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level

Table 5: Results for level of veteran cross-border M&As

Dependent Variable: Log of number of veteran cross-border M&As (n_f)

	(1) OLS	(2) OLS	(3) OLS Clustered	(4) OLS Clustered	(5) FGLS	(6) FGLS	(7) GMM (Ar-Bn) (dep var: Δn_f)	(8) GMM (Ar-Bn) (dep var: Δn_f)
$\sigma_{i^*}^2$	-.015		-.015		-.005			
	(-1.60)		(-1.53)		(.17)			
σ_i^2	.016*		-.016		-.001			
	(-1.82)		(1.90)		(.32)			
$\Delta\sigma_{i^*}^2$	.016*		.016**				-.003	
	(1.66)		(2.30)				(-.30)	
$\Delta\sigma_i^2$	.005		.005				-.018**	
	(0.72)		(0.79)				(-2.18)	
$\sigma_{i^*}^2 - \sigma_i^2$		.002		.002		.001		
		-0.23		(0.22)		(.49)		
$\Delta(\sigma_{i^*}^2 - \sigma_i^2)$		.004		.004				.010
		(0.69)		(0.86)				(1.48)
$\Delta n_{f,t-1}$							.140***	.140***
							(4.13)	(4.12)
Fixed effects								
East Asian Crisis	Y	Y	Y	Y	Y	Y	N/A	N/A
Host-source country pair	Y	Y	Y	Y	Y	Y	N/A	N/A
Active EMU member	Y	Y	Y	Y	Y	Y	N/A	N/A
1year before joining EMU	Y	Y	Y	Y	Y	Y	N/A	N/A
Linear and quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y
Host-source pair heterosk.	N	N	Y	Y	Y	Y	N	N
Allow for autocorrelated error	N	N	N	N	Y	Y	Y	Y
No. observations	2555	2555	2555	2555	3442	3442	2084	2084
Clusters or groups			312	312	366	366	254	254
R-squared	.818	.818	.818	.818				
Wald chi-squared(374)					126260			
Wald chi-squared(373)						79313		
AR(1) coefficient					.090	0.07		
Wald chi-squared(5)							408.97	
Wald chi-squared(4)								406.68

Quantities in parentheses are t-statistics, except in the case of the Arellano-Bond results in columns (7) and (8), in which case they are z-statistics. All variables pertain to period t unless otherwise indicated. Clustering by country-pair where noted.
***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level

Table 6: Results for level of veteran cross-border M&As relative to veteran domestic M&As

Dependent Variable: Log of ratio of veteran cross-border M&As (n_f/n_h)

	(1) OLS	(2) OLS	(3) OLS Clustered	(4) OLS Clustered	(5) FGLS	(6) FGLS	(7) GMM (Ar-Bn) (dep var: Δn_f)	(8) GMM (Ar-Bn) (dep var: Δn_f)
$\sigma^2_{i^*}$	-.033***		-.033***		-.027***			
	(-3.02)		(2.91)		(-4.14)			
σ^2_i	-.015		-.015		-.008***			
	(-1.41)		(-.80)		(-7.41)			
$\Delta\sigma^2_{i^*}$	.019*		.019*				-.000	
	(1.77)		(1.98)				(.00)	
$\Delta\sigma^2_i$	-.000		.000				.008	
	(.02)		(.01)				(-.81)	
$\sigma^2_{i^*} - \sigma^2_i$		.008		-.008		.003***		
		(-1.05)		(-.64)		(2.16)		
$\Delta(\sigma^2_{i^*} - \sigma^2_i)$		.010		.010				-.004
		(1.58)		(1.07)				(0.50)
$\Delta n_{f,t-1}$							.236***	.238***
							(6.21)	(6.28)
Fixed effects								
East Asian Crisis	Y	Y	Y	Y	Y	Y	N/A	N/A
Host-source country pair	Y	Y	Y	Y	Y	Y	N/A	N/A
Active EMU member	Y	Y	Y	Y	Y	Y	N/A	N/A
1year before joining EMU	Y	Y	Y	Y	Y	Y	N/A	N/A
Linear and quadratic time trend	Y	Y	Y	Y	Y	Y	Y	Y
Host-source pair heterosk.	N	N	Y	Y	Y	Y	N	N
Allow for autocorrelated error	N	N	N	N	Y	Y	Y	Y
No. observations	2544	2544	2544	2544	3395	2498	2073	2073
Clusters or groups			307	307	358	261	253	253
R-squared	.891	.890	.891	.89				
Wald chi-squared(366)					82619			
Wald chi-squared(365)						65776		
AR(1) coefficient					.126	.130		
Wald chi-squared(5)							62.54	
Wald chi-squared(4)								62.78

Quantities in parentheses are t-statistics, except in the case of the Arellano-Bond results in columns (7) and (8), in which case they are z-statistics. All variables pertain to period t unless otherwise indicated. Clustering by country-pair where noted.
***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level

Table 7: Poisson Quasi-Maximum-Likelihood Specifications

Dependent Variable: Number of cross-border M&As (n_f)	First-Time (1)	Veteran (2)
$\sigma^2_{i^*}$	-0.024***	-.009
	(-3.02)	(-0.92)
σ^2_{i}	-0.002	-0.01**
	(-0.51)	(-2.04)
Incidence Rate Ratios		
$\sigma^2_{i^*}$	0.976***	0.991
	(-3.02)	(-0.92)
σ^2_{i}	0.998	0.987**
	(-0.51)	(-2.04)
EMU	1.209***	1.151**
	(3.10)	(2.24)
Fixed effects		
East Asian Crisis	Y	Y
Host-source country pair	Y	Y
Active EMU member	Y	Y
1 year before joining EMU	Y	Y
Linear and quadratic time trend	Y	Y
Host-source pair heterosk.	Y	Y
Allow for autocorrelated error	N	N
No. observations	5586	3442
Clusters or groups	522	366
Wald chi-squared(9)	2320.62	1846.75

Quantities in parentheses are z-statistics.

***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level

Table 8: Endogeneity and Exchange Rates

	DepVar: σ_s^2		DepVar: n_f			
	(1) departure from mean	(2) demeaned change	(3)	(4)	(5)	(6)
$\sigma_{i^*}^2$	0.000	0.000				
	(0.20)	(-0.06)				
σ_i^2	0.003***	0.001***				
	13.30	13.30				
σ_s^2			-1.305*		2.772	
			(-1.91)		(0.89)	
ε_t				-1.456*		6.003*
				(-1.63)		(1.73)
Incidence Rate Ratios						
σ_s^2			0.271*		15.988	
			(-1.91)		(0.89)	
ε_t				0.233*		404.53*
				(-1.63)		(1.73)
Fixed effects						
East Asian Crisis	Y	Y	Y	Y	Y	Y
Host-source country pair	Y	Y	Y	Y	Y	Y
Active EMU member	Y	Y	Y	Y	Y	Y
1 year before joining EMU	Y	Y	Y	Y	Y	Y
Linear and quadratic time trend	Y	Y	Y	Y	Y	Y
Host-source pair heterosk.	N	N	Y	Y	Y	Y
Allow for autocorrelated error	N	N	N	N	N	N
No. observations	857	857	885	885	884	855
Clusters or groups	54	54	55	52	55	52
R-squared (overall)	0.30	0.31				
Wald chi-squared(7)			1449.47	1433.60	1440.66	1438.31

Quantities in parentheses are t-statstics in Columns1-2, z-statistics in Columns 3-6.

***: Significance at 1% level, **: Significance at 5% level, *: Significance at 10% level