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Abstract

This paper examines the role of country-specific sources of output and interest rate or exchange rate volatility in driving FDI activities. Building on a dataset with bilateral FDI flows among 24 OECD economies over the period 1985-2007, we find that nominal and real volatility strongly deter foreign investments. Output and exchange rate volatility matter in particular for the decision whether to invest in a foreign country in the first place. Interest rate volatility mainly influences the amount of foreign investments.

JEL classification: F21, E22, F42.

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1 Introduction

Bilateral FDI flows appear to vary considerably across countries and over time. So far, empirical studies have mainly focused on the cross-country dimension by looking at the reasons why firms may decide to invest in a foreign country and become multinational. They typically consider the determinants of foreign investments as stressed in models with multinational firms. These include measures of market size, distance, similarity in terms of GDP per capita and costs of market access in the host and source countries.[1] As such factors are relatively persistent over time, they largely neglect the influence of business cycle developments.

Yet, there are good reasons why FDI might be related with the cycle. Foreign investments have increased dramatically in the last decades, especially among developed economies, out-pacing even the remarkable expansion of trade that has occurred in the period up to the global crisis (see UNCTAD (2007)). In this period, business cycles have become more synchronized among developed economies, displaying a tendency towards a general decline in output volatility (see for example Artis (2003), Bordo and Helbling (2004) and Prasad et al. (2003)). Several authors have investigated the relation between these observations, finding evidence in support of the view that FDI constitute an important channel through which economies may affect each other.[2]

On the theoretical ground, there are two main reasons why investments might vary over the cycle. In models with capital market imperfections, a mechanism of financial accelerator typically leads to pro-cyclical investments. In cyclical expansions, rising prices will increase the net worth of firms, thereby augmenting collaterazible wealth and therefore facilitating the financing of new investments. Foreign investments might move procyclically relative to the cycle in the source or the host country depending on whether they are mainly financed at home or abroad. In models with sunk costs of entry, the decision whether to invest in the first place depends on current and prospective cyclical conditions. Entry in a foreign country will take place up to the point where the value of the foreign subsidiary of a multinational firm equalizes the sunk costs associated with opening a production facility offshore.

Both approaches suggest that FDI activities may respond to output and interest rate fluctuations over the cycle. The aim of this paper is to verify whether such a relation exists in the data and whether it depends on the underlying source of business cycle volatility.

The paper investigates the business cycle determinants of bilateral FDI flows in a panel of 24 OECD economies over the period 1985-2007. As a first step in our empirical strategy, we build country-specific measures for real and nominal volatility so as to capture macroeconomic risk originated from, respectively, output and monetary policy innovations. Output volatility is obtained using a band pass filter à la Baxter and King (1999), as common practice in real business cycle studies. Nominal volatility is the coefficient of variation in monthly short-term interest rates or in monthly exchange rates vis à vis Special Drawing Rights. As a second step, we regress bilateral FDI outflows on these measures after controlling for the standard gravity factors.

Remarkably, we find a strong negative relationship between FDI and output and interest or exchange rate volatility. Drawing on our country-specific measures of volatility,

[1] Razin and Sadka (2007) and more recently Blonigen and Piger (2010) provide comprehensive surveys of this literature.

[2] See Jansen and Stockman (2004) for example.

we can detect a number of relevant differences in the impact of real and nominal volatility in host and source countries as well as in their cyclical properties.

The rest of the paper is organized as follows: in section 2 we discuss the theoretical framework behind the relation between economic fluctuations and FDI decisions. In section 3 we describe the data and explain the details of our empirical strategy. Section 4 presents the results and section 5 concludes.

2 Theoretical background

Macroeconomic models provide two main reasons why foreign investments may react to business cycle fluctuations. One approach stresses the role of imperfections in financial markets in influencing investment decisions over the cycle. A second approach points to the sunk costs that firms face when deciding whether to access foreign markets in the first place.

The first approach builds on a closed economy model with financial frictions (see Bernanke, Gertler and Gilchrist 2000) that links pro-cyclical investments to changes in the net worth of firms and changes in the marginal cost of finance. The financial accelerator effect carries through in an international setting (e.g. Gilchrist, Hairault, and Kempf 2002; Faia 2010). As long as the net worth of multinational firms varies pro-cyclically, these models imply that foreign investments should increase during cyclical expansions in the host country.

Despite the appeal of theoretical models, empirical research in the spirit of the financial accelerator provides no conclusive evidence as far as foreign investments are concerned. Early attempts to investigate the role of a firm's borrowing opportunity for financing an investment overseas have mainly focused on the link between exchange rates and FDI (see Froot and Stein (1991)). The idea is that a depreciation of, say, the US dollar lowers the real value of foreign firms contemplating to invest in the US, thereby reducing FDI towards the US.

The relation between aggregate FDI inflows and the level of exchange rates, however, appears to be highly unstable (see Stevens (1998)). Theoretically, the effect of an increase in volatility is a priori ambiguous. It may reduce the profitability of FDI whenever foreign investments are to some extent irreversible (Aizenman 1992). Risk aversion motives, however, call for a positive effect. Empirically Cushman (1985 and 1988), Goldberg and Kolstadt (1995) and Zhang (2003) find a positive effect of exchange rate volatility on FDI. Evidence of a negative effect is provided, among others, by Campa (1993) and Chakrabarti and Scholnick (2002)[3].

A second strand of research draws on a novel wave of general equilibrium models with endogenous entry of firms.[4] In these models, a firm will decide to engage in investments abroad, becoming a multinational, as long as the expected revenue from the investment covers the sunk cost associated with locating a production facility (or expanding capacity) in a foreign country. In principle, business cycle fluctuations, both at home and abroad,

[3]The negative relation between exchange rates and foreign investment activity appears more stable using data aggregated at the industry level (see Campa and Goldberg 1995). Nucci and Pozzolo (2001) find a significant negative relation using firm-level data in a sample of Italian manufacturing firms.

[4]See, among others, Holzl (2005) Cavallari (2007, 2010), Ghironi and Mélitz (2005), Corsetti, Pesenti and Martin (2007), Bilbiie, Ghironi and Mélitz (2007) and Russ (2007).

may affect the entry cost and the prospective revenues from foreign investments with opposing consequences for FDI activities.

In a context with flexible prices and heterogeneous firms, Helpman, Mélitz and Yeaple (2005) show that high productivity is required in order to cope with the large macroeconomic risks associated with foreign market activity. A testable implication of their model is that a positive aggregate shock to output, by increasing the average productivity in the economy, should lead to higher direct investments. Thus foreign investments are expected to be pro-cyclical with respect to the business cycle in the multinationals' native country.

In the presence of sticky prices, uncertainty over monetary policy also plays a role in foreign market entry. Russ (2007) shows that an increase in interest rate volatility may in principle attract or deter foreign investments, depending on whether it originates in the domestic or the foreign country. The reason is that multinational activities offer a natural hedge against currency risks generated by interest rate changes in the host country. In periods of low demand in the host-country market, namely when foreign interest rates are high, multinational profits in fact appreciate in domestic currency. The opposite clearly occurs when monetary uncertainty originates in the multinational's native country. A rise in foreign interest rate volatility, however, may induce a substitution effect in favor of exports that actually reduces foreign investments. In a setting where exports are priced in the currency of producers while multinational sales are set in local (consumers') currency, exchange rate changes originated abroad help exporters to adjust the price of their products, thereby making exports more attractive than multinational sales.[5]

The overall effect of output and interest rate or exchange rate volatility is an open question for empirical research. The evidence so far suggests that FDI activities respond to macroeconomic fluctuations over the cycle. Our knowledge, however, is still very limited as regards the contribution of alternative sources of volatility. It is not clear whether it is mainly real or nominal volatility that matters for FDI activity nor whether there are systematic differences between host and source countries. Focusing on the business cycle in the source country, for example, Wang and Wong (2007) find that an increase in output volatility reduces FDI outflows, especially among OECD countries. In this vein, Levy Yeyaty et al. (2007) find that FDI flows from developed towards developing countries move counter-cyclically with respect to both output and interest rate cycles in the source country. [6] Considering the business cycle in the host country, Buch and Lipponer (2005) document that FDI move in a counter-cyclical way relative to the cycle in the country of destination. None of these studies accounts for country-specific measures of output and interest rate or exchange rate volatility as we do in this paper.

3 Empirical analysis

3.1 Baseline regression

We investigate the role of real and nominal volatility as determinants of FDI using a panel regression approach. The baseline regression is given by:

[5]See for instance Cavallari (2007) and Lewis (2010).

[6]For evidence on the impact of interest rate volatility on FDI see also Russ (2009). Using data on entry by US multinational firms, she finds that one-time sunk costs are an important engine through which heterogeneous firms respond to exchange rate risk generated by interest rate volatility.

$$FDI_{sh,t} = \alpha + \beta_s vol^n_{s,t} + \beta_h vol^n_{h,t} + \gamma_s vol^r_{s,t} + \gamma_h vol^r_{h,t} + \delta Z_t + \epsilon_{sh,t}, \quad (1)$$

where $FDI_{sh,t}$ is the outflow of FDI from country s (source) to country h (host), $vol^n_{i,t}$ the indicator of nominal volatility in country $i = (s, h)$, $vol^r_{i,t}$ the indicator of real volatility, Z_t a vector of control variables and $\epsilon_{sh,t}$ is an i.i.d normal error term.

As standard practice in gravity models, we use the log of the dependent variable. The log transformation reduces the weight of very large country pairs and simplifies the interpretation of coefficients as elasticities. Taking the log of the dependent variable is, however, problematic with FDI data. Approximately 16.6% of country pairs in our panel are zero while 16.5% are negative. Following Levy Yeyati et al. (2007), we therefore use the semi-log transformation:

$$\widehat{FDI} = sign(FDI) \log(1 + \mid FDI \mid)$$

The transformation above has the advantage of preserving the sign of the FDI flow at the cost of losing constant elasticity estimates. For large values of the dependent variable, however, the cost is small (equivalent to 1 dollar per unit of FDI flow in our data) and the coefficients can be safely interpreted as (semi) elasticities.

A further problem with FDI data is the selection bias that might affect the sample. FDI flows, in fact, are based on a prior decision whether to invest or disinvest in the first place which generates a zero entry when the investment does not take place and a negative entry in case of disinvestments. To control for the endogeneity of the decision process, we employ the selection model of Heckman (1979). The model jointly estimates the likelihood of surpassing a zero threshold, by means of a "selection equation" , and the magnitude of the FDI flow provided that the threshold is indeed surpassed, expressed with a "flow equation". In this context, a negative investment flow, i.e. a disinvestment, is treated as a decision not to invest. We specify the flow equation as:

$$\widehat{FDI}_{sh,t} = \begin{cases} FDI^*_{sh,t} = \alpha + \beta_s vol^n_{s,t} + \beta_h vol^n_{h,t} & \\ +\gamma_s vol^r_{s,t} + \gamma_h vol^r_{h,t} + \delta Z_t + \epsilon_{sh,t} & \text{if } \pi^*_{sh,t} > 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

and the selection equation as:

$$\pi^*_{sh,t} = W_t \theta + \mu_{sh,t},$$

where $\pi^*_{sh,t}$ is the probability of surpassing the zero threshold, $FDI^*_{sh,t}$ is a latent variable indicating the notional outflow of FDI from country s to country h, W_t the vector of explanatory variables for the selection equation and $\mu_{sh,t}$ are normal i.i.d. error terms. The vector W contains the regressors in the flow equation together with the lagged value of the dependent variable. The reason for including past investments in the selection equation is that they capture sunk costs of entry and exit in foreign markets. A high value of past investments reduces the costs of further investing while raising exit costs in case of disinvestments. In both cases, it increases the probability of selection.

The indicators of nominal volatility are meant to capture uncertainty in monetary policy driven by interest rate changes. As already discussed, the overall effect of a rise in interest rate volatility is a priori ambiguous and may well vary depending on the country where it originates. For this reason, we construct a country-specific measure. For ease

of comparison with earlier studies stressing the role of exchange rates in FDI activities, we also experiment with a measure of volatility based on exchange rate changes. Nominal volatility in this case captures the role of country-specific currency risk. As before, also exchange rate volatility can influence FDI flows in opposing direction depending on whether it originates in the multinational's native or host country. We therefore construct a country-specific measure.

The indicators of real volatility represent uncertainty over output fluctuations. In principle, an increase in output volatility can have a positive or a negative impact on investments depending on the relative magnitude of income and substitution effects. A rise in, say, the source country's output volatility reduces FDI outflows via the income channel while making foreign investments relatively more attractive (positive substitution effect). With a country-specific measure of output volatility, we allow for cross-country differences in these effects.

Finally, a standard set of control variables in the spirit of the gravity model pioneered by Anderson (1979), completes our panel: population and output in the host and source country, host-source country pairs for distance and a set of dummies for common borders, common language and colonial ties. The former two variables capture the effect of country's size and their expected sign is positive. Distance represents the costs of accessing foreign markets and its expected sign is negative. The dummies capture cultural and historical ties which might facilitate bilateral investments and have therefore a positive expected sign.

3.2 Data

FDI data are from the OECD's *International Direct Investment Database.* They comprise annual bilateral FDI flows among 24 OECD economies from 1985 to 2007, for a total of 552 country pairs and 7832 observations out of a maximum possibility of 12966 (24x23x23).[7] FDI flows represent the total equity outflow from each country to any other country in the sample, including retained earnings and intra-firm transfers. Negative flows represent disinvestments. FDI in current dollars are deflated using the source country's GDP deflator.

FDI data exhibit high variability across country pairs and over time. The average amount of FDI outflow over the whole period is equal to 849.63 millions of dollars, ranging from a low of -29.159 billions from the Netherlands to the US in 2007 to a maximum amount of 172.210 billions from the UK to Germany in 2000.

Data on interest rates and prices are from the OECD's *Main Economic Indicators (MEI).* Interest rate volatility for each country and for each year in the dataset is the coefficient of variation of monthly short-term interest rates (T-Bill rates when available, otherwise interbank rates). Exchange rates and GDP are from the OECD's *National Account Statistics Database.* Exchange rate volatility is the coefficient of variation of monthly nominal exchange rates in domestic currency vis à vis Special Drawing Rights (SDRs)[8].

The indicator of real business cycle volatility (vol_i^r) for country i is the mean squared difference of the cyclical component of output. As standard practice in business cycle

[7]The countries included in the dataset are: Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

[8]We use SDRs rather than bilateral exchange rates in order to have a country-specific measure.

studies, cyclical fluctuations are identified by a filter that decomposes original data by frequency band. Our measure of cyclical output is the band pass filter described in Baxter and King (1999).[9] The filter isolates the irregular (high frequency), "business cycle" (medium frequency) and "trend" (low frequency) components of each GDP series. Compared to the Hodrick and Prescott (1997) (HP) filter, the band pass can remove high-frequency volatility, thereby reducing the risk that transient noise might disguise the underlying business cycle components of the data.[10]

Finally, the control variables comprise: population, the log of real GDP and a series of dummies for common language, common border and former colony status.[11]

3.3 Results

Table 1 reports the results of the baseline regression in equation (1), estimated with country-pair fixed effects and clustered errors, and those based on the selection model in equation (2) (second column).[12]

Looking at the volatility indicators, our results provide a number of interesting insights on the relationship between the business cycle and FDI.

In the baseline regression, the coefficient on output volatility in the source country (vol_s^r) is negative and significant at the 1% level. The coefficient suggests that a 1% increase in volatility reduces the average amount of FDI outflows by 1.33%. The finding can be explained as a negative income effect. An increase in output volatility reduces the resources available to potential investors as long as capital markets provide an incomplete insurance against income risks. Lower incomes in highly volatile economies, in turn, discourage investments abroad (see Wang and Wong (2007)). The coefficient on output volatility in the host country is, on the contrary, positive and significant at the 5% level. The combined effect of an increase in vol_s^r and vol_h^r, is, however, negative. Asymmetry in the behavior of investments in host and source countries is consistent with the view that investors may arbitrage between investment options at home and abroad. In this vein, our results complement those of Levy Yeyati et al. (2007) showing that local and foreign investments tend to move in opposite directions relative to the cycle in the source country.

As regards nominal uncertainty, our estimates show that interest rate volatility in the host country (vol_h^n) has a negative effect on FDI. A 1% increase in foreign volatility leads to an average drop of 2.55% in the amount of FDI. A rise in domestic volatility, on the contrary, has no significant impact on foreign investments. These results are compatible with the predictions of recent models that explain the mode of foreign market access in an environment with sticky prices. As already discussed, an increase in foreign interest rate volatility is expected to reduce the profitability of multinational sales relative to exports, leading to a drop in foreign investments. A rise in domestic volatility, on the contrary, has only a minor (positive) effect on the relative attractiveness of multinational sales.

[9] GDP in measured in current dollars and deflated using the consumer price index.

[10] We have also experimented with the HP filter, obtaining very similar results. These estimates are available upon request.

[11] The control variables are taken from Andrew Rose's webpage at www.haas.berkeley.edu/ arose.

[12] We also estimated equation (1) assuming uncorrelated individual heterogeneity (i.e. with random effects). The Hausman test rejected the random effect. In what follows, we will therefore focus on the specification with fixed effects.

The second column of Table 1 contains the results for the selection model in equation (2), estimated using a two-step procedure. We have opted for this method after a formal test that fails to reject the hypothesis of zero correlation between the error terms in the flow and the selection equations. The absence of correlation makes a maximum likelihood estimation inappropriate in our dataset.

The selection model confirms the negative relation between FDI outflows and both real and nominal volatility already found in the baseline case. It further qualifies the nature of this relation by distinguishing between a decision on the amount of FDI flows and a decision whether to invest or disinvest in the first place. In the flow equation, the coefficient on interest rate volatility in the host country has almost the same value and level of significance as before. The effect of vol_h^n is independent of any possible selection bias that might affect the sample. The same cannot be said for the other parameters of interest. An increase in interest rate volatility in the source country has now a positive impact on FDI that was absent in the baseline case. More importantly, output volatility in the host and source country do not have a significant effect on the amount of FDI outflows.

Real uncertainty is indeed crucial for the decision whether to invest or disinvest in a foreign country. In the selection equation, the coefficients on output volatility in both countries are negative. As in the baseline case, the impact of domestic volatility is larger. A 1% rise in output volatility in the source country reduces by 0.6% the probability of generating investments in any other country. A comparable increase in the volatility of the host country reduces the probability of receiving FDI by 0.28%.

For ease of comparison with earlier studies stressing the role of exchange rates, we run the same set of regressions above using exchange rate volatility as a measure of nominal uncertainty. Results are reported in Table 2.

In the baseline regression, only output volatility in the source country is significant. As before and for essentially the same motives, the coefficient is negative. Nominal volatility, instead, does not have a significant impact on FDI outflows independently of whether it originates in the country of origin or in the country of destination of foreign investments.

As pointed out above, earlier studies have often failed to find a significant and stable relationship between FDI and exchange rate volatility. In our data, the difficulty may be explained with a selection bias in the sample. Exchange rate volatility, in fact, turns significant in the Heckman (1979) model. In the selection equation, an increase in exchange rate volatility, wherever it is originated, leads to a sharp drop in the occurrence of foreign investments. A 1% rise in volatility reduces the probability of investing abroad more than 3 times as much, precisely by 3.25% when it originates in the source country, and by 3.6% in the host country. This finding accords with the theoretical predictions of models stressing the relevance of sunk costs in the decision whether to invest abroad. As long as investments are to some extent irreversible, an increase in exchange rate volatility reduces the expected profits from foreign investment, regardless of its underlying source. We stress that the sunk cost argument matters in particular for the decision whether to engage in investments in the first place, while it has only a minor effect on the choice of how much to invest. The estimates for the flow equation confirm that in this respect only the nominal volatility in the country of destination of the investments matters. The presence of a strong selection bias as far as nominal volatility is concerned constitutes a major departure from the regressions with interest rate volatility in table 1. It may reflect a closer link of exchange rate changes with the risk that multinationals actually face.

[Table 1 about here.]

[Table 2 about here.]

3.4 The role of the business cycle

Up to now, we have shown that output and interest or exchange rate uncertainties are inversely related with FDI outflows. A given change in volatility, however, might have a different impact on foreign investments depending on the business cycle of host and source country respectively. Moreover, real and nominal measures of volatility might well be related as a consequence of monetary policy operations in response to output fluctuations. The observation of, say, a low realization of nominal volatility might be virtually indistinguishable from an endogenous adjustment to favorable cyclical conditions. Consequently, failing to account for the state of the business cycle in our model could imply an endogeneity bias.

A simple way to account for the state of the economy, while at the same time allowing for asymmetric movements in foreign investments over the cycle, is to include in our baseline regression a set of cyclical dummies and their interaction with the measures of volatility. For each country in the sample, we define a dummy "boom" as a positive realization of the output gap, i.e. a positive difference between cyclical and trend output. A significant coefficient on the dummy for, say, a source country means that a boom in the source country has an effect on the average amount of FDI outflows originating from that country. We then interact dummies for boom in host and source countries with our country-specific measures of nominal and real volatility. Each interaction term, therefore, captures the effect of a given regressor when the source or the host country is in a positive phase of the cycle. For instance, the term $vol_h^n \times dummy_s$ captures the effect of a rise in nominal volatility in the host country when the source country is in a boom. The effect of vol_h^n when both countries are in a boom is given by the sum of the coefficients on $vol_h^n \times dummy_s$ and $vol_h^n \times dummy_h$, while the effect when, say, the host country is in a boom and the source country is in a recession is given by $(1 - dummy_s) \times vol_h^n + vol_h^n \times dummy_h$. The residual case of a recession in both countries is captured by the constant.

Tables 3 and 4 report the results of the regressions with cyclical dummies when nominal uncertainty is measured by, respectively, interest and exchange rate volatility. They disclose relevant asymmetry in the cyclical determinants of FDI.

In both regressions, the dummy boom is significant only in the source country and with a value very close to 1. This implies that cyclical conditions matter for the average dimension of FDI outflows only insofar as they refer to the country of origin of FDI. Moreover, the value of the coefficient suggests that the dimension of this effect is roughly the same in booms and recessions.

Cyclical conditions, whether in the host or in the source country, do not appear to affect the elasticity of FDI to a change in output volatility. As in the baseline case, a rise in output volatility has a negative effect on FDI, slightly larger in the regressions with interest rates than in those with exchange rates. None of the interaction terms with real volatility is significantly different from zero.

A major departure from the baseline case occurs with nominal volatility in the regression with interest rates (see Table 3). In this case, nominal volatility in the host country is not significantly different from zero. Nominal volatility in the source country, instead, turns significant when interacted with the dummy boom in the host country. The value of the coefficient suggests that it has a positive effect on FDI when the host country is in

a boom (with elasticity 2.55) and a negative effect when it is in a recession (with elasticity -1.55). These findings are compatible with the idea of investment arbitrage between domestic and foreign markets. In our setup, this implies that nominal volatility matters only insofar as it changes the attractiveness of foreign investments. An increase in domestic volatility helps making foreign investments more attractive as long as the country of destination of the investment is in a boom. The opposite is true in case of a recession in the host country. Hence, a rise in domestic volatility contributes to further deter foreign investments.

In line with the baseline case, the regressions with exchange rates provide no significant effect of nominal volatility (see Table 4).

[Table 3 about here.]

[Table 4 about here.]

4 Conclusions

This paper investigated the role of country-specific measures of output and nominal volatility in driving bilateral FDI flows among 24 OECD economies over the period 1985-2007.

Beginning with output volatility, we provide evidence of a negative relation with foreign investments. This relation is particularly strong when output volatility originates in the source country. Accounting for a selection bias in the sample, we further show that output volatility is crucial for the decision whether to invest or disinvest in the first place. The relation between output volatility and FDI is found to be symmetric over the cycle.

As regards nominal volatility, we similarly find evidence of a negative relation with FDI, although key features of this relation depends on the measure of nominal volatility employed. In regressions with interest rates, an increase in volatility has a negative effect on foreign investments when it originates in the host country. This effect is robust to accounting for a selection bias in the sample. Relevant deviations from the baseline case materialize instead when we measure nominal volatility with exchange rates changes. We show that a rise in exchange rate volatility strongly deters foreign investments only when selection bias is properly accounted for. Differently from the regressions with interest rates, this effect does not depend on the country where volatility originates. Finally, in the regressions with interest rates we document cyclical asymmetry in the responses of FDI that is absent in the regressions with exchange rates.

The evidence provided in this paper is relevant for two strands of empirical research. First, it contributes to the debate, dating back to the 80s, on the relation between foreign direct investments and uncertainty in monetary policy. Our main point in this regard is the need to account for country-specific sources of risk which might affect FDI in different directions and/or with different intensity. A failure to distinguish between host and source country volatility may be a reason for the inconclusive results found in previous studies. In our setting with country-specific measures of volatility, we find that both interest and exchange rate volatility are a powerful deterrent for FDI activities. Second, we contribute to a more recent literature on the business cycle properties of FDI. Once again, we are able to unveil systematic differences in the impact of output and interest rate volatility depending on whether they originate in the source or the host country.

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Table 1: Benchmark regression using interest rates

This table reports the estimates of the baseline model in equation 1 (first column) as well as the estimates from the Heckman (1979) specification (second column). The dependent variable is the semi-log transformation of FDI outflows expressed in real dollars.

	Country-pair fixed effect	Heckman selection model
		Flow equation
Nom. Vol. source (x_s^n)	.898	1.5*
Nom. Vol. host (x_h^n)	-2.55***	-2.5***
Real Vol. source (x_s^r)	-1.33***	.0596
Real Vol. host (x_h^r)	.677*	.287
Population source	9.61e-07	2.95e-06
Population host	1.65e-06	.0000139***
Log GDP source	-.883*	1.5***
Log GDP host	-1.12***	.571**
Distance		-.000444***
Common borders		1.4**
Colony		1.76**
Common language		.646
Constant	39.6***	-22.2***
		Selection equation
Nom. Vol. source (x_s^n)		.153
Nom. Vol. host (x_h^n)		-.184
Real Vol. source (x_s^r)		-.642***
Real Vol. host (x_h^r)		-.28***
Population source		-4.02e-07
Population host		-2.57e-07
Log GDP source		.292***
Log GDP host		.348***
Distance		-.000127***
Common borders		.493**
Colony		.49**
Common language		.471***
Lagged fdi		.017***
Constant		-7.81***
Mills lambda		1.01
Obs.	7832	7306
F stat.	5.931	
χ^2		1177.234
p-value	0.000	0.000
R^2 with.	0.007	
R^2 betw.	0.328	
R^2 over.	0.048	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Benchmark regression using exchange rates

This table reports the estimates of the baseline model in equation 1 (first column) as well as the estimates from the Heckman (1979) specification (second column). The dependent variable is the semi-log transformation of FDI outflows expressed in real dollars.

	Country fixed effect	Heckman selection model
		Flow equation
Nom. Vol. source (x_s^n)	-9.21	-1.61
Nom. Vol. host (x_h^n)	4.92	-10.9*
Real Vol. source (x_s^r)	-1.03**	.14
Real Vol. host (x_h^r)	.408	.447
Population source	4.29e-06	3.00e-06
Population host	4.07e-06	.000011**
Log GDP source	-1.07**	1.57***
Log GDP host	-1.29***	.748***
Distance		-.000485***
Common borders		1.08*
Colony		1.93**
Common language		.713
Constant	44.8***	-25.6***
		Selection equation
Nom. Vol. source (x_s^n)		-3.25**
Nom. Vol. host (x_h^n)		-3.6***
Real Vol. source (x_s^r)		-.559***
Real Vol. host (x_h^r)		-.177**
Population source		-6.18e-07
Population host		-8.23e-07
Log GDP source		.309***
Log GDP host		.369***
Distance		-.000123***
Common borders		.54**
Colony		.506***
Common language		.422***
Lagged fdi		.0187***
Constant		-8.22***
Mills lambda		1.76
Obs.	7832	7306
F stat.	4.465	
χ^2		1181.187
p-value	0.000	0.000
R^2 with.	0.006	
R^2 betw.	0.345	
R^2 over.	0.057	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: regression with interaction terms using interest rates

This table reports the estimates of the baseline model in equation 1 augmented with a dummy variable for the state of the economy in each country and the interaction terms between the volatility indicators and the dummies. The dependent variable is the semi-log trasformation of FDI outflows expressed in real dollars.

	Country-pair fixed effect
Nom. Vol. source (x_s^n)	-.142
Nom. Vol. host (x_h^n)	-1.21
Real Vol. source (x_s^r)	-1.81***
Real Vol. host (x_h^r)	.259
Population source	-7.48e-07
Population host	-1.04e-08
Log GDP source	-1.08**
Log GDP host	-1.29***
Boom source	1.04*
Boom host	-.259
Nom_s*boom source	.773
Real_s*boom source	.789
Nom_h*boom source	-1.51
Real_h*boom source	-.146
Nom_h*boom host	-1.3
Real_h*boom host	.691
Nom_s*boom host	2.54*
Real_s*boom host	-.161
Constant	45***
Obs.	7832
F stat.	4.311
p-value	0.000
R^2 with.	0.011
R^2 betw.	0.324
R^2 over.	0.044
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$	

Table 4: regression with interaction terms using exchange rates

This table reports the estimates of the baseline model in equation 1 augmented with a dummy variable for the state of the economy in each country and the interaction terms between the volatility indicators and the dummies. The dependent variable is the semi-log trasformation of FDI outflows expressed in real dollars.

	Country-pair fixed effect
Nom. Vol. source (x_s^n)	-9.43
Nom. Vol. host (x_h^n)	-1.64
Real Vol. source (x_s^r)	-1.41**
Real Vol. host (x_h^r)	.129
Population source	9.08e-06
Population host	9.07e-06
Log GDP source	-1.44***
Log GDP host	-1.66***
Boom source	.975*
Boom host	-.419
Nom_s*boom source	2.16
Real_s*boom source	.189
Nom_h*boom source	-2.19
Real_h*boom source	.0127
Nom_h*boom host	13.1
Real_h*boom host	.424
Nom_s*boom host	1.22
Real_s*boom host	.203
Constant	55.6***
Obs.	7832
F stat.	3.516
p-value	0.000
R^2 with.	0.009
R^2 betw.	0.338
R^2 over.	0.052
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$	