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Does the Single Currency Affect Foreign Direct Investment?*

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Abstract

Does the creation of the euro partly explain the sharp increase in European investments? To address this question, we derive a simple gravity-like model for bilateral foreign direct investment (FDI). Using this model, we find that the Economic and Monetary Union (EMU) has increased intra-EMU FDI stocks on average by around 30 percent. This effect varies over time and across EMU members. It is found to be larger for the outward investments of the less-developed EMU members. Moreover, contrary to early expectations of FDI diversion effects, EMU countries have invested more in non-EMU countries since the launch of the euro.

Keywords: Foreign direct investment; euro; gravity model; monetary union

JEL classification: *F*15; *F*21; *F*33

I. Introduction

In the last 20 years, world foreign direct investment (FDI) has grown much faster than world trade and world gross domestic product (GDP). Some stylized facts emerging from the data (see Barba-Navaretti and Venables, 2004) document that European Union (EU) countries have greatly contributed to this trend. Between 1998 and 2001, around 50 percent of world FDI inflows went to European countries and about 70 percent of world FDI outflows originated from European countries. Moreover, both numbers are 20 percentage points higher than during the previous three years, between 1995 and 1997. Finally, much of this sharp increase is driven by intra-EU investments.

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Does the creation of the euro in 1999 partly explain these figures? Does it alter the pattern of FDI in a systematic way? In this paper, we attempt to answer these questions, which are "key issues in the economic debate between those who see major advantages (...) adopting the euro and those who see more costs than benefits" (Barr *et al.*, 2003, p. 585).

To derive a simple analytical structure on which to base the estimation of the euro effect, we build on Head and Ries (2008) (henceforth HR). In the model of HR, multinational firms bid against each other to control a given existing overseas asset. The highest bidder across all parent countries acquires the target through a merger and acquisition (M&A). We assume instead that a given multinational, contemplating an overseas investment project, considers various countries in which to invest and selects the best project across all host countries.[1] In contrast with HR, this assumption allows us first to consider different forms of FDI: M&A as in HR, but also greenfield investments, which account for roughly one-third of FDI. Second, we can introduce transaction costs in a natural way as these affect the attractiveness of host countries.

Transaction costs encompass currency risk, exchange-rate transaction costs, trading- and liquidity-related costs as well as differentials of taxation, accounting, and legal standards in a broader interpretation. We argue that the Economic and Monetary Union (EMU) may affect the amount of foreign investments through a reduction in transaction costs. Among others, the EMU: (1) removes currency conversion costs; (2) suppresses in-house costs of maintaining separate foreign currency expertise; (3) eases price decisions and comparison of international costs; (4) irrevocably removes intra-eurozone exchange-rate volatility.

Following our assumption, we provide, as in HR, a set of micro foundations for a simple gravity-like equation for bilateral FDI. This equation stresses not only the role of bilateral frictions, such as inspection and transaction costs, but also the role of multilateral frictions: the more attractive all other locations are, the less a country is pushed to invest in a given bilateral partner.[2]

We fit our specification to data and we use a panel estimator to exploit time series and cross-sectional variation. Over the period 1992–2005, our results indicate that euro adoption has increased intra-EMU FDI stocks on average by around 30 percent. Beyond simple stylized facts (Barr *et al.*, 2003; HM Treasury, 2003), recent studies provide related estimations. De Sousa and Lochard (2006) and Petroulas (2007) have been among the first

[1] This assumption complies with an important empirical regularity. Countries compete against each other to attract multinationals. They offer incentives such as tax reductions, investment allowances, exemptions from trade duties, and subsidies (see, for example, Oman, 2000).

[2] Multilateral effects are empirically well documented. Baltagi *et al.* (2007), for example, emphasize the role of spatially weighted third-country determinants of FDI.

to document a positive euro impact on FDI in the very early years of EMU. Both estimations are based on the theoretical knowledge–capital model of the multinational firm (Carr *et al.*, 2001). This two-country framework "assumes that the FDI decisions by multinational firms in a parent country into a particular host country are independent of their FDI decisions to any other host country" (Blonigen, 2005). We theoretically and empirically document the opposite. An additional concern is the use of FDI flows (as in Petroulas, 2007), which present more negative values and are less reliable and persistent through time than stocks. Based on a unique database of cross-border M&A flows at the sectoral level, Coeurdacier *et al.* (2009) find a dramatic euro effect moving from 100 to 200 percent. In queries about these magnitudes, the fact that the database contains only 5 percent of non-zero observations is a concern. To some extent, the use of aggregate-level data avoids this issue.

Our results also document that the EMU effect varies across EMU members. In particular, the impact is found to be larger for the outward investments of the less-developed EMU members. A reasonable explanation is that the less-advanced members could have benefited relatively more from the transaction cost reduction generated by the euro. We also find that the EMU effect varies over time.

In a stimulating paper, Flam and Nordström (2007) find that two countries sharing the euro do not invest more than they would with different currencies. In contrast, they document a large Single Market (SM) effect. However, as recognized by the authors, there is considerable overlap between the countries participating in the two integration processes. This introduces multicollinearity and causes identification problems. In our sample, controlling for the SM effect, we still find a robust positive euro effect. Moreover, in a crude attempt to disentangle the economic from the monetary integration effects, we investigate the euro's impact on FDI outside the eurozone. To some extent, if the EMU increases financial integration and reduces the cost of capital (see Lane, 2008), it may also facilitate cross-border investments by EMU members outside the eurozone. Indeed, we document that EMU members have invested more in non-EMU countries and only after the launch of the single currency in 1999. In contrast, non-EMU countries have not invested more in the eurozone since 1999.

The rest of the paper is organized as follows. In Section II, we present the theoretical approach and we derive a simple gravity equation for bilateral FDI stocks. In Section III, we introduce the empirical model and we describe the dataset. In Section IV, we present the results regarding the impact of the single currency on FDI and some sensitivity tests. In Section V, we examine the timing of the euro effect. In Section VI, we assess the distribution of the euro effect on FDI at the country level and

we investigate possible diversion effects. In the last section, we provide some concluding remarks.

II. A Simple Model of Bilateral Foreign Investment

We proceed in two steps to develop a simple and stylized model of bilateral foreign investment. First, we determine the pay-off of a multinational related to a given overseas investment project, and we describe how it is affected by monetary integration. Second, we specify how the multinational's pay-off influences the choice of an investment project in a given host country. Then, resorting to discrete choice theory, we determine the share of this particular host country in the total value of a parent country's investments. Thus, we derive a gravity-like model explaining bilateral FDI outward stocks. This model allows us to derive simple testable implications.

Multinational Firm's Pay-off and Monetary Integration

To determine the multinational firm's pay-off, we follow Head and Ries (2008). We consider a simple inspection game between a multinational manager (hereafter MM) and its foreign subsidiary (hereafter Sub). This game illustrates, in a parsimonious way, the trade-off between the benefits of a foreign subsidiary and its inspection costs. We modify this trade-off by introducing transaction costs along with inspection costs.

The parties have differing interests. MM always contributes to the joint gross profits by adding $m > 0$, while Sub adds $s > 0$, only if he exerts an effort. This effort is costly, and Sub is incited to shirk. Shirking is, however, risky because MM can either inspect or trust. An inspection costs $c > 0$, but offers evidence of whether Sub shirks. When s is added to the joint gross profits, we argue that a transaction cost $\tau > 0$ is incurred. This cost lowers the contribution of the subsidiary independently of the level of inspection costs. However, to make the subsidiary abroad profitable, we assume that Sub's value-added is larger than the sum of transaction and inspection costs, so that $s > c + \tau$. In this game, there is no Nash equilibrium in pure strategies. For instance, if Sub were to work, MM would be better off trusting, and if Sub were to shirk, MM would be better off inspecting. Thus, both players play a mixed strategy in equilibrium, which gives the following multinational pay-off (v):[3]

$$v = m + s - \tau - 2\sqrt{c(s-\tau)}. \tag{1}$$

[3] This pay-off can be easily derived using the pay-off equating method (see supplemental material downloadable from http://jdesousa.univ.free.fr/research/sup.htm).

This pay-off differs from that of HR in one dimension: the introduction of transaction costs (τ), which affect the multinational's decision. Equation (1) indicates that the multinational's pay-off depends positively on both its contribution to gross profits (m) and the Sub's value-added (s). Moreover, equation (1) states that higher inspection (c) and transaction (τ) costs lower the value of the subsidiary to the multinational.[4] Thus, monetary integration may increase the value of a subsidiary by reducing transaction costs (see above).

Bilateral Foreign Investment

We now consider a multicountry framework to determine a gravity-like equation for bilateral foreign investment. Each country, $i, j = 1, \ldots, C$, has multinationals and offers investment projects. Let i denote the parent country of investment and j the host country. We assume that each project, $k = 1, \ldots, n_j$, in country j has a different pay-off as a result of "incomplete monitoring".[5] The factors unobserved by the multinational, labelled ϵ_j, are considered random. Using equation (1), these factors are introduced in a natural way in the pay-off of a given multinational in country i investing in country j:

$$\widetilde{v}_{ij} = m_i + s_j + \epsilon_j - \tau_{ij} - 2\sqrt{c_{ij}(s_j - \tau_{ij})}, \tag{2}$$

where ϵ_j is i.i.d. and follows a Gumbel distribution (see below). Denoting K_i as the parent country's total capital stock, we define the outward amount invested by country i in country j as

$$F_{ij} \equiv \pi_{ij} K_i, \tag{3}$$

where π_{ij} denotes the share of country j in the total outward investments of country i. Equation (3) represents a second departure from the HR setting. HR instead define an inward equation by considering the amount of inward M&A in country j from i. This departure results in a somewhat different bilateral FDI equation (see below).

How can π_{ij} be specified? This share depends on the probability $P_{r(ij)}$ that a multinational in country i invests in a project k in country j. To specify this probability, we assume that the multinational in a given parent country compares the pay-off of different projects around the world

[4] Note that as long as

$$s > c + \tau \quad \frac{\mathrm{d}v}{\mathrm{d}\tau} = -1 + \frac{c}{\sqrt{c(s-\tau)}} < 0, \quad \text{and} \quad \frac{\mathrm{d}v}{\mathrm{d}c} = -\frac{s-t}{\sqrt{c(s-\tau)}} < 0.$$

[5] Monitoring only circumvents part of the informational problems associated with international investment, such as adverse selection or moral hazard.

and selects the best project across all host countries.[6] Consequently, the multinational in country i chooses a project in country j such that $\max \widetilde{v}_{ij} > \max \widetilde{v}_{i\ell}$ for all countries $\ell \neq j$. This choice is associated with the Gumbel-distributed ϵ_j, which renders the multinational's pay-off stochastic. The Gumbel distribution is attractive because it features an important reproductive property for its own maximum sample extreme (Bury, 1999, p. 271).[7] That is, the distribution of the maximum of ϵ_j, drawn from the number of investment projects n_j, is again Gumbel, with known parameters. The corresponding cumulative distribution function is

$$F_{j|k=1,\ldots,n_j}(x) = P_r(\max \epsilon_j \leq x) = \exp\left\{-\exp\left[-\frac{x-(\mu_j+\sigma \ln n_j)}{\sigma}\right]\right\},$$

where σ is a scale parameter, measuring the degree of heterogeneity across projects, and μ_j is a location parameter, measuring the average supplier contribution to the pay-off in j. Based on these known parameters, the probability that a given draw is the maximum draw takes a tractable analytical form:

$$P_{r(ij)} = \frac{\exp[\mu_j/\sigma + \ln n_j + s_j/\sigma - \tau_{ij}/\sigma - 2\sqrt{c_{ij}(s_j-\tau_{ij})}/\sigma]}{\sum_{\ell} \exp[\mu_\ell/\sigma + \ln n_\ell + s_\ell/\sigma - \tau_{i\ell}/\sigma - 2\sqrt{c_{i\ell}(s_\ell-\tau_{i\ell})}/\sigma]}. \quad (4)$$

The derived probability $P_{r(ij)}$, that a multinational in country i invests in country j, allows us to determine the share π_{ij} of country j in the total investments of country i and, consequently, to quantify the capital stock invested by i in j (F_{ij}). In fact, the share π_{ij} converges on the probability $P_{r(ij)}$ when the number of multinationals and investment projects is large. Because this is relevant for our countries under review (the OECD countries) we can rewrite equation (3) as

$$F_{ij} = K_i n_j \exp[(\mu_j + s_j)/\sigma - T_{ij}] A_{i\ell}^{-1}, \quad (5)$$

where $T_{ij} \equiv \tau_{ij}/\sigma + 2\sqrt{c_{ij}(s_j-\tau_{ij})}/\sigma$ represents bilateral investment costs. The first term of T_{ij} illustrates that higher transaction costs (τ_{ij}) reduce the capital stock invested by i in j. The second term of T_{ij} indicates that the negative impact of inspection costs (c_{ij}) is magnified when the Sub's

[6] Eaton and Kortum (2002) use a related strategy for trade decisions. A buyer shops around the world for the best deal and the price paid for a given good will be the lowest across all sources. In their control-based model with an inward equation, HR assume that the multinational making the highest bid across all parent countries takes control of a given existing target in a host country.

[7] This is only the case for extreme value distributions: Gumbel, Frechet, and Weibull. We decided to follow HR's approach and to use the type I model of maxima (i.e., Gumbel).

value-added, net of transaction costs ($s_j - \tau_{ij}$), is high. In addition,

$$A_{i\ell} \equiv \sum_{\ell} n_\ell \exp[(\mu_\ell + s_\ell)/\sigma - T_{i\ell}] \tag{6}$$

can be thought of as an index of the attractiveness of alternative location countries ℓ for i.[8] This attractiveness is increasing with Sub's value-added (s_ℓ) and decreasing with bilateral costs (T_{il}).

III. Estimation

Simple inspection shows that equation (5) is a gravity-like model for explaining capital stock invested by country i in country j (i.e., bilateral FDI). We thus derive straightforward empirical implications. First, bilateral FDI is proportional to economic size: F_{ij} is unambiguously increasing with both the number of investment projects offered in j (n_j) and the capital stock of country i (K_i). Second, F_{ij} is unambiguously decreasing with bilateral T_{ij} and multilateral A_{il} frictions. In particular, monetary integration may affect bilateral investments directly through T_{ij} and indirectly through A_{il} if other countries than j share a currency with country i. To estimate these predictions, we design an empirical specification based on equation (5). We now present the estimation strategy used to fit this equation to data, the estimated specification, and the dataset.

Estimation Strategy

To ease the presentation, we decompose equation (5) into three components. The first component includes both the parent and the host country effects, i.e., the parent's country capital stock (K_i), the number of the host's country projects (n_j), and a specific host country term, related to the subsidiary contribution $[(\mu_j + s_j)/\sigma]$. The second is a bilateral effect, which is made up of bilateral transaction and inspection costs (T_{ij}). Finally, the third is a multilateral effect, representing the attractiveness of the alternative locations ℓ ($A_{i\ell}$). We now successively consider these components.

Parent and Host Country Effects. A natural strategy for capturing country-specific effects would be to use country-specific dummies. This addresses the fact that we cannot observe country-specific economic variables that correspond exactly to the theory. This is a common approach in estimating cross-sectional regressions in the literature on FDI (see Head and Ries, 2008) or trade (see Eaton and Kortum, 2002). Here, we adopt a different

[8] HR's model includes a somewhat less general multilateral effect defined as a "bid competition" for existing targets in the host country.

strategy because we estimate the euro effect on FDI over the time period 1992–2005. We exploit the time series properties of the data by using the "within" estimator. This entails introducing country-pair dummies instead of country dummies. In this way, we control for any time-independent factor affecting bilateral FDI (i.e., country and country-pair specific effects). Hence, the within estimator is more general and superior than the ordinary least-squares estimator with country dummies.[9] To control for the time-dependent factors, we proceed as follows. First, we proxy the parent country's capital stock with GDP. Indeed, HR report that variation in (log) GDP explains over 93 percent of the variation in (log) capital stocks in 1990. Moreover, we proxy the number of the host country's investment projects also using GDP. This is in line with the evidence that FDI goes predominantly to advanced and large host countries (Barba-Navaretti and Venables, 2004). Finally, we further check the robustness of our results to potential omitted time-dependent host country factors, such as unit labour cost or tax rate (see Section IV).

Bilateral Effect. The bilateral effect T_{ij} represents bilateral inspection and transaction costs, which may be either time-dependent or -independent. Bilateral time-independent costs are captured by the country-pair dummies. These dummies also capture time-dependent costs correlated with invariant factors, such as geographic distance (see Fink *et al.*, 2005). The introduction of a set of year dummies into the regression allows us to control for time-dependent costs that are monotonically decreasing (or increasing) over time for all country-pairs, such as bilateral calling prices. However, beyond year and country-pair dummies, we assume that the bilateral effect is a function of three time-dependent observable elements:

$$T_{ijt} = \exp\left(\delta_1 \mathrm{EU}_{ijt} + \delta_2 \mathrm{EMU}_{ijt} + \delta_3 \mathrm{EXR\_Volat}_{ijt}\right). \tag{7}$$

Here, the time subscripts t indicate that all variables are time-varying. The first element of equation (7) is related to the degree of integration among countries. *Ceteris paribus*, integrated countries face lower bilateral costs than do non-integrated countries. In particular, the European economic integration process has lowered internal transaction costs with the launch of the SM programme. We follow the literature and measure the European economic integration process by adding an EU_{ijt} membership dummy variable into the regression. As a robustness check, we also add an SM dummy and we decompose its effect over time. The second element is related to EMU creation. It is expected to further increase integration among members and to reduce bilateral transaction costs. Thus, holding other factors

[9] Note that we are prepared to ignore the potential lack of efficiency of the within estimator because our dataset is relatively large.

fixed, it is reasonable to assume that a pair of eurozone members faces lower transaction costs than a similar pair of non-eurozone members. We follow the trade literature (e.g., Micco *et al.*, 2003; Baldwin, 2006) and we use an EMU_{ijt} dummy variable to indicate whether the parent and the host countries share the euro.[10] Finally, we control for bilateral exchange-rate volatility (EXR_Volat) as another important time-dependent bilateral effect. In fact, the removal of exchange-rate volatility within the eurozone could be a possible channel through which the monetary union may affect FDI. Theoretically, exchange-rate volatility causes ambiguous effects on FDI. A decrease in exchange-rate volatility may favour vertical FDI insofar as firms fragment their production and locate their activities in different countries according to international differences in factor prices. However, if foreign investment is a way to serve foreign markets, a decrease in volatility may reduce horizontal FDI and increase trade as a substitute.

Multilateral Effect. Equation (5) highlights that the amount of capital invested by country i in country j depends on the attractiveness of the alternative locations ℓ ($A_{i\ell}$). Measuring this multilateral effect (equation (6)) is an issue because it is time-varying and essentially unobservable. We construct a simple estimated time-varying multilateral effect by exploiting information on annual FDI regressions.[11]

The construction of $A_{i\ell}$ relies on four steps. First, we collect the country's total annual inward FDI for a "world" sample of 198 countries. This allows us to assess the FDI attractiveness of a given host country j relative to a large number of alternative countries ℓ. Second, we weight the country's inward FDI by its own GDP because economic size (i.e., the number of investment projects offered in a host country) matters. Third, we regress this weighted variable on a set of two dummies and we exploit information from this estimation to construct the multilateral effect:

$$\ln\left(\frac{\text{Total FDI}_j}{\text{GDP}_j}\right) = \alpha_0 + \alpha_1 \text{Dummy}_{i|i\neq j} + \alpha_2 \text{Dummy}_{-j} + u_j. \qquad (8)$$

Here, the dependent variable is the log of the ratio of the total inward FDI of j to its GDP;[12] (Dummy_i) is unity for country $i \neq j$ and zero otherwise;

[10] The dummy is indeed a useful and conventional method to measure the influence of a qualitative phenomenon, difficult, by nature, to quantify.

[11] A different way to measure $A_{i\ell}$ would be to estimate each of the elements in equation (6) and to calculate the sum of the predicted values for each year and country-pair. However, this estimation requires bilateral data on a large scale in terms of time and countries, whereas bilateral FDI data, for instance, are readily available only for the OECD countries. The methodology used here to construct $A_{i\ell}$ is less demanding in terms of data.

[12] FDI and GDP data come from the OECD and the World Development Indicators, respectively.

(Dummy$_{-j}$) is zero for country j and unity otherwise. The ordinary least-squares estimate ($\hat{\alpha}_2$) of the (Dummy$_{-j}$) is here our coefficient of interest. Given the construction of the dummy variable, this estimate provides the difference in FDI between j, the comparison group, and the other countries in the sample (i.e., countries $\ell \neq i, j$). In other words, $\hat{\alpha_2}$ measures the FDI attractiveness of countries $\ell \neq i, j$ *vis-à-vis* country j.[13]

Our "bilateral" sample of OECD countries, used to estimate the euro effect, potentially contains 5,880 observations on bilateral FDI, i.e., 21 parent countries $i \times 20$ host countries $j \times 14$ years (1992–2005). Consequently, using the above world sample, we run equation (8) 5,880 times, by specifying for each regression a different combination of (Dummy$_i$) and (Dummy$_{-j}$) according to the 21×20 country-pair ij and the 14 years included in the bilateral sample. Finally, in the last step, we take the antilog of ($\hat{\alpha}_2$) for each of the 5,880 regressions and we obtain for each country-pair a time-varying measure of the attractiveness of alternative locations ($A_{i\ell}$).

Empirical Specification

We build our empirical specification on equation (5). We take logs of both sides, we introduce time subscripts, and we apply the above estimation strategy to proxy parent, host, bilateral, and multilateral effects. Thus, we specify the following reduced-form, log-linear bilateral FDI equation:

$$\ln(F_{ijt}) = \beta_0 + \beta_1 \ln(\text{GDP}_{it}) + \beta_2 \ln(\text{GDP}_{jt}) + \delta_1 \text{EU}_{ijt} + \delta_2 \text{EMU}_{ijt} + \delta_3 \text{EXR\_Volat}_{ijt} + \beta_3 \ln(A_{il_t}) + \gamma_{ij} + \rho_t + \epsilon_{ijt}. \quad (9)$$

Here, F_{ijt} is the value of FDI outward stocks between the parent country i and the host country j at time t. Regressors are defined as follows: $\text{EU}_{ijt} = 1$ if i and j are members of the EU at time t and 0 otherwise; $\text{EMU}_{ijt} = 1$ if i and j are members of the EMU at time t and 0 otherwise; EXR_Volat_{ijt} denotes bilateral exchange-rate volatility at time t; $A_{i\ell t}$ is a computed index of the attractiveness of alternative locations ℓ for i at time t; γ_{ij} denotes country-pair dummies, capturing all bilateral time-independent factors; ρ_t denotes year dummies, capturing the general evolution of FDI and controlling for the global increase of FDI at the end of the 1990s, which is concomitant to the launch of the EMU; ϵ_{ijt} reflects measurement error for FDI and a myriad of other time-dependent influences.[14]

[13] The introduction of the country dummy i into equation (8) removes country i from the group of countries ℓ. This is required because we aim to measure the attractiveness of countries ℓ, *vis-à-vis* country j, for a given country i.

[14] Further information on the construction of variables (Table A1) and summary statistics (Table A2) is provided in Appendix A.

Two points related to the empirical specification (9) are worth noting. First, the estimation in logs provides two major advantages. The first advantage is the reduction in the skewness of the distribution, which is very high in the level specification, because low FDI values prevail in the sample. The second is the interpretation of the estimated coefficients in terms of elasticity. On the downside, the log model reduces the size of the sample, notably by dropping negative and zero values of the dependent variable. There is no consensual way in the literature to deal with this problem. However, by using FDI stocks instead of FDI flows, we mitigate this problem. Stocks indeed present fewer null and negative values than flows. The second point relates to our coefficient of interest δ_2, measuring the EMU effect on FDI. Using the within estimator, we are able to answer a relevant policy question: "Does the single currency's creation affect FDI?" Indeed, what policy-makers would want to know is the impact of a monetary union on those countries that adopt it.[15] The within estimator allows us to answer this question by exploiting the time-series properties of the data. The euro effect is thus estimated by comparing, within each pair of countries, the evolution of FDI before and after the creation of the euro. Moreover, by controlling for every unobservable time-independent country-pair characteristics that affect FDI, the within estimator reduces the potential endogeneity of the euro effect. To some extent, we avoid picking up unobservable and constant factors peculiar to bilateral relationships between EMU countries but unrelated to the euro. However, part of endogeneity remains if the EMU members have adopted the euro because of a surge in mutual FDI within the sample period. The use of a relatively small sample period helps to mitigate this problem (see below).

The Dataset

The sample covers 21 OECD countries: 11 EMU members (Austria, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and Belgium–Luxembourg together) and 10 non-EMU members (Australia, Canada, Denmark, Japan, Norway, South Korea, Sweden, Switzerland, the UK, and the US). We use a 14-year sample period of estimation from 1992 to 2005. The starting year was chosen to select a symmetrical sample period before and after euro creation on January 1, 1999. This is done to avoid the comparison of two very different periods of time, which might have biased the estimation of the euro effect.

We use FDI outward stocks as our dependent variable. Data on the regressors come from various sources (see Table A1 in Appendix A). FDI

[15] See Glick and Rose (2002) and Micco *et al.* (2003) for a similar approach in the trade literature.

data come from the *International Direct Investment Statistics Yearbook* (OECD). One of the major advantages of this database is that stocks of FDI have been registered by country of origin and destination since 1980.[16]

FDI data are constructed and harmonized based on balance-of-payments statistics published by central banks and statistical offices. From a general point of view, FDI statistics must be used carefully. There are still some limitations in comparability across countries because of differences in FDI definitions.

IV. Econometric Results

Benchmark Estimates

The estimation results of equation (9) are reported in Table 1. Our empirical model works reasonably well, explaining half of the variation in bilateral FDI stocks. Standard errors are clustered at the country-pair level and bootstrapped (200 replications). We employ bootstrap techniques because the attractiveness of the alternative locations variable (A_{it}) has been estimated and may invalidate the standard errors.

In all regressions, estimated coefficients of the GDP variables are statistically and economically significant and exhibit the expected positive signs. Moreover, as expected, the more attractive all other locations are, the less a country is pushed to invest in a given bilateral partner. Beyond these factors, there is evidence that monetary integration matters.

In column (1), for the period 1992–2005, the EMU estimate is economically and statistically significant. Our estimation indicates that, *ceteris paribus*, the adoption of the euro increases intra-EMU FDI stocks, on average, by about 29 percent $[=(\exp[0.257]-1)*100]$. The range of this estimate, plus or minus two standard errors, is 8–55 percent. We show evidence that the magnitude of this average effect varies according to the EMU member considered.

In column (2), the euro effect is robust to the introduction of two additional bilateral controls: EU membership and exchange-rate volatility. Estimates of the two controls are not statistically significant.[17] The result for exchange-rate volatility is in line with previous mixed empirical findings

[16] Another source is Eurostat (see Petroulas, 2007). However, it covers fewer countries and years. Furthermore, Eurostat collects data via common OECD–Eurostat questionnaires. Consequently, OECD and Eurostat FDI stock series are highly correlated (the correlation is about 0.99 for 18 countries over the period 1994–2002). Another approach to measuring FDI is the use of firm-level survey data. These provide more precise information on FDI issues. However, these are subject to confidentiality requirements and lead to country-specific results.

[17] Similar results are obtained when the two variables are added separately into the regression.

Table 1. *Euro effect and FDI*

Dependent variable	ln(bilateral FDI outstock)		
Period of estimation	1992–2005		1982–2005
Model	(1)	(2)	(3)
ln(parent country GDP)	1.219***	1.224***	1.425***
	(0.180)	(0.195)	(0.175)
ln(host country GDP)	0.671***	0.676***	0.933***
	(0.224)	(0.227)	(0.173)
EMU dummy	**0.257****	**0.270****	**0.357****
	(0.092)	(0.086)	(0.099)
EU dummy		0.004	0.297***
		(0.096)	(0.106)
Exchange-rate volatility		0.018	0.052***
		(0.016)	(0.018)
ln(attractiveness of alternative locations)	−0.474***	−0.476***	−0.349***
	(0.099)	(0.105)	(0.093)
R^2-within	0.501	0.501	0.657
No. of observations	4,306	4,306	6,094
Country-pair dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes

Notes: Standard errors in parentheses are bootstrapped (200 replications) and clustered at the country-pair level. *** denotes significance at the 1 percent levels. Constant, country-pair, and year dummies estimates are not reported. Estimation results are based on equation (9).

(see Blonigen, 2005). Theoretically, as pointed out above, an increase in exchange-rate volatility can decrease vertical FDI and increase horizontal FDI. Our non-significant estimate could be the result of such an ambiguity. The result regarding the EU dummy is also not very surprising. The within estimator exploits changes in the EU membership status within the time period considered. In our sample and time period, the only change relates to the admission of Austria, Finland, and Sweden in 1995. Thus, we lack time and within-pair variation in evaluating the EU effect.

In column (3), the year 1982 is used as an earlier starting year. Three results are noticeable. First, the exchange-rate volatility estimate is now statistically significant and positive. This result is in line with the horizontal motive of FDI (see above), while the vertical motive becomes prevalent mostly in the 1990s with the vertical disintegration of production. Second, this longer time span allows for a better assessment of the European integration. It encompasses now two enlargements: Portugal and Spain in 1986, along with Austria, Finland, and Sweden in 1995. We now find that joining the EU increases bilateral FDI by about 35 percent on average. Third, as expected, increasing the period of estimation affects the EMU estimate, which now amounts to a 43 percent effect [$= (\exp[0.357] - 1) * 100$]. This larger estimate seems to be related to the comparison of disproportionate periods of time before (1982–1998) and after (1999–2005)

the creation of the euro. This raises the probability of finding differences unrelated to monetary integration between the two periods.

Single Market (SM) Effects

The EU dummy may not control properly for SM effects. For instance, countries that entered the EU in 1995 already participated in that programme. Moreover, some non-EU countries (Norway and Switzerland in our sample) participate in the SM. Thus, in column (1) of Table 2, we add an SM dummy variable, equal to one if i and j are members of the SM programme at time t, and zero otherwise.[18] In column (2), we allow the SM variable to vary over time by interacting the dummy with the year dummies. However, neither the SM dummy estimate in column (1), nor the annual SM estimates in column (2) are significantly different from zero. In this short sample period, the within estimator with year dummies seems to capture largely the gradual SM effect.[19] It is worth noting that the other coefficients are minimally affected. In particular, in column (2), the EMU coefficient appears to be slightly lower, but still significant ($p < 0.05$).

Over a longer time period (1982–2005), the overall SM dummy (column (3)) and most of the annual SM dummies are significant (column (4)). In particular, we find large and highly significant estimates for the "1994 SM dummy", corresponding to the establishment of the European Economic Area, and the "2002 SM dummy", corresponding to the ratification of the bilateral agreement between Switzerland and the EU. Here again, the other coefficients are little affected, except that part of the EU integration effect is now captured in the SM estimate.

Host Country Controls

We now check the robustness of the euro effect by introducing additional time-dependent host country characteristics. First, we control for the host country's unit labour cost. We expect that higher labour costs deter FDI by reducing the value of the foreign subsidiary to multinationals. Second, we control for the host country's employment protection legislation. Labour market regulations may influence multinationals' decisions to invest abroad (Javorcik and Spatareanu, 2005). Third, we account for taxation issues, which may play a part in investment decisions (see de Mooij and Ederveen, 2003). We expect that a higher tax rate in the host country will reduce its attractiveness for international investments. Finally, we control for the host country's macroeconomic risk, which may influence

[18] The SM dummy includes EU members since 1993; Austria, Finland, Norway, and Sweden since 1994 (following the establishment of the European Economic Area); Switzerland since 2002 (following their bilateral treaty with the EU).

[19] Indeed, when we estimate the same equation without year dummies, most of the annual SM dummies are significant.

Table 2. *Euro effect, Single Market, and FDI*

Dependent variable	ln(bilateral FDI outstock)							
Period of estimation	1992–2005				1982–2005			
Model	(1)		(2)		(3)		(4)	
	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
ln(parent country GDP)	1.238***	(0.183)	1.237***	(0.188)	1.421***	(0.173)	1.430***	(0.175)
ln(host country GDP)	0.677***	(0.214)	0.671***	(0.225)	0.913***	(0.183)	0.923***	(0.173)
EMU dummy	**0.270****	(0.087)	**0.232****	(0.099)	**0.313****	(0.093)	**0.272****	(0.100)
EU dummy	−0.036	(0.099)	−0.055	(0.105)	0.204*	(0.109)	0.208*	(0.121)
Exchange-rate volatility	0.018	(0.014)	0.010	(0.016)	0.050***	(0.018)	0.047***	(0.018)
ln(attractiveness of alt. loc.)	−0.471***	(0.111)	−0.467***	(0.109)	−0.339***	(0.091)	−0.337***	(0.097)
Single Market dummy	0.092	(0.089)			0.204**	(0.085)		
Single Market 1993 dummy			0.001	(0.092)			0.018	(0.089)
Single Market 1994 dummy			0.025	(0.073)			0.219***	(0.082)
Single Market 1995 dummy			0.128	(0.101)			0.173*	(0.100)
Single Market 1996 dummy			0.173	(0.111)			0.247**	(0.105)
Single Market 1997 dummy			0.124	(0.110)			0.253***	(0.096)
Single Market 1998 dummy			−0.035	(0.111)			0.090	(0.103)
Single Market 1999 dummy			0.028	(0.124)			0.134	(0.108)
Single Market 2000 dummy			0.101	(0.118)			0.254**	(0.108)
Single Market 2001 dummy			0.128	(0.122)			0.276***	(0.107)
Single Market 2002 dummy			0.216	(0.139)			0.359***	(0.119)
Single Market 2003 dummy			0.154	(0.137)			0.241*	(0.128)
Single Market 2004 dummy			0.101	(0.132)			0.167	(0.120)
Single Market 2005 dummy			0.271*	(0.154)			0.408***	(0.141)
R^2-within	0.501		0.503		0.659		0.660	
No. of observations	4,306		4,306		6,094		6,094	
Country-pair dummies	Yes		Yes		Yes		Yes	
Year dummies	Yes		Yes		Yes		Yes	

Notes: Standard errors (s.e.) in parentheses are bootstrapped (200 replications) and clustered at the country-pair level. ***, ** and * denote significance at the 1, 5, and 10 percent levels, respectively. Constant, country-pair, and year dummy estimates are not reported.

investment profitability. A more risky environment is expected to discourage FDI. Indeed, uncertainty about future returns deters irreversible investments because there is an "option value" of waiting (Dixit and Pyndick, 1994). The source and definitions of these variables are detailed in Appendix A (Table A1).

The results are reported in columns (1)–(4) of Table 3 and confirm the robustness of the euro effect on FDI.[20] The results also suggest to some extent that our estimation strategy controls properly for the host country characteristics (see Section III). In fact, most estimates of the added controls are statistically insignificant, while they appear in the literature as important determinants of FDI (see Blonigen, 2005). One notable exception is the economic risk control (column (4)). In line with the theory, a higher level of economic risk in the host country appears to impede bilateral FDI. Following the literature on FDI determinants, we also introduced differences in unit labour cost, employment protection legislation, tax rate, and macroeconomic risk between the parent and host countries. The only significant estimate relates to the difference in unit labour cost (column (5)). This result suggests that a higher unit labour cost in the host country relative to the parent country deters bilateral FDI.

V. Timing of the Euro Effect on FDI

The EMU was achieved in three discrete but connected evolutionary stages.[21] The first stage began on July 1, 1990, and coincided with the liberalization of capital movements between EU members. The second stage was marked by the establishment of the European Monetary Institute (EMI) on January 1, 1994. On May 2, 1998, the Council of the EU decided that 11 Member States had fulfilled the conditions necessary for participation in the third stage. On January 1, 1999, the third and final stage of EMU began with two crucial decisions: (1) the irrevocable fixing of the exchange rates of the 11 initial members' currencies; (2) the creation of a single monetary policy under the responsibility of the European Central Bank.

This process suggests that the realization of the EMU has been progressive. Thus, its effects on FDI could have been anticipated in advance (i.e., before the formal creation of the euro). We try to assess this idea by conducting two very simple falsification exercises. The first exercise is as follows. We first redefine the EMU dummy as if the initial 11 EMU

[20] We also replaced our country-pair fixed effects with country-year fixed effects (as suggested by a referee), identifying all country-specific changes over time (in policy, for example). We still obtained a positive EMU estimate, but with a much larger magnitude than the within estimate.

[21] See http://www.ecb.int/ecb/history/emu/html/index.en.html for a history of the creation of the EMU.

Table 3. *Euro effect and host country controls*

Dependent variable	ln(bilateral FDI outstock)				
Model	(1)	(2)	(3)	(4)	(5)
ln(parent country GDP)	1.23***	1.22***	1.33***	0.86***	0.97***
	(0.18)	(0.17)	(0.19)	(0.17)	(0.19)
ln(host country GDP)	0.65***	0.58***	0.62***	0.60***	0.90***
	(0.23)	(0.11)	(0.21)	(0.22)	(0.21)
EMU dummy	**0.27****	**0.27****	**0.29****	**0.22****	**0.28****
	(0.09)	(0.10)	(0.09)	(0.10)	(0.09)
EU dummy	0.01	0.01	−0.03	0.02	0.02
	(0.10)	(0.10)	(0.10)	(0.07)	(0.09)
Exchange-rate volatility	0.02	0.02	0.03**	0.03	0.02
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
ln(attractiveness of alternative locations)	−0.48***	−0.49***	−0.46***	−0.41***	−0.45***
	(0.10)	(0.11)	(0.13)	(0.11)	(0.11)
ln(host country unit labour cost)	0.11				
	(0.50)				
ln(host country employment protection legislation)		0.05			
		(0.18)			
Host country tax rate			0.40		
			(0.63)		
ln(host country macroeconomic risk)				−1.00***	
				(0.45)	
Difference in ln(unit labour costs)					−0.92**
					(0.40)
R^2-within	0.50	0.50	0.51	0.41	0.50
No. of observations	4,306	4,306	3,976	3,514	4,306
Country-pair dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are bootstrapped (200 replications) and clustered at the country-pair level. *** and ** denote significance at the 1 and 5 percent levels, respectively. Constant, country-pair, and year dummy estimates are not reported. See text for more details.

members had adopted the euro since the beginning of our sample period of estimation (i.e., in 1992 instead of 1999). Greece adopted the euro later, in 2001, so we do not anticipate its entry. Thus, EMU_{ijt} is now unity in two cases: (1) if i and j are the initial EMU members throughout the whole sample period[22] or (2) if Greece is involved in a country-pair with an EMU member after 2001. Then, we interact EMU_{ijt} with the year dummies to create annual EMU dummies. Finally, we estimate equation (9) on the sample period 1992–2005 and we replace EMU_{ijt} with annual EMU dummies (while keeping separately the year dummies). The estimates of the annual EMU dummies are reported in column (1) of Table 4.[23]

[22] For example, the EMU dummy takes the value one for the country-pair (France, Germany) from 1992 to 2005.

[23] To save some space, we only report the annual EMU estimates. Overall results as well as estimates on the period 1982–2005 are available on http://jdesousa.univ.free.fr/research/sup.htm.

Table 4. *Timing of the euro effect on FDI*

Dependent variable	ln(bilateral FDI outstock)			
Model	(1)		(2)	
	Coeff.	(s.e.)	Coeff.	(s.e.)
(...)	(...)		(...)	
EMU–GRC dummy			−0.672*	(0.356)
EMU 1993 dummy	0.341**	(0.166)	0.093	(0.072)
EMU 1994 dummy	0.414***	(0.138)	0.166*	(0.090)
EMU 1995 dummy	0.410***	(0.145)	0.149	(0.109)
EMU 1996 dummy	0.422***	(0.143)	0.159	(0.117)
EMU 1997 dummy	0.462***	(0.138)	0.196*	(0.118)
EMU 1998 dummy	0.508***	(0.155)	0.239*	(0.124)
EMU 1999 dummy	0.572***	(0.147)	0.300**	(0.129)
EMU 2000 dummy	0.537***	(0.162)	0.254*	(0.152)
EMU 2001 dummy	0.593***	(0.166)	0.282*	(0.153)
EMU 2002 dummy	0.651***	(0.171)	0.342**	(0.150)
EMU 2003 dummy	0.637***	(0.166)	0.331**	(0.149)
EMU 2004 dummy	0.611***	(0.161)	0.299**	(0.147)
EMU 2005 dummy	0.599***	(0.204)	0.286	(0.193)
R^2-within	0.505		0.501	
No. of observations	4,306		4,306	
Country-pair dummies	Yes		Yes	
Year dummies	Yes		Yes	

Notes: Standard errors in parentheses are bootstrapped (200 replications) and clustered at the country-pair level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Other control variables, constant, country-pair, and year dummy estimates are not reported.

The group against which comparisons of the EMU estimates are made is both the bilateral level of EMU members' FDI in 1992 and the unique within-pair variation in this exercise (i.e., the country-pairs involving Greece and EMU members). The observed smooth upward trend of the EMU estimates across time might suggest that the impact of the EMU has been progressive since 1992 or it might simply that FDI between a pair of initial EMU members is larger than between Greece and EMU countries. In order to neutralize the latter effect, we conduct a second exercise. We introduce into the regression a dummy EMU–GRC$_{ijt}$, which is unity if Greece is involved in a country-pair with an EMU member before 2001.[24] We thus capture the above within-pair variation. The estimates are reported in column (2) of Table 4. The EMU–GRC$_{ijt}$ estimate is negative ($p = 0.06$) and we do not find conclusive evidence of a smooth upward trend of EMU estimates. This suggests that the trend increase found in column (1) is partly explained by a comparison with lower levels of bilateral FDI between Greece and EMU countries.

[24] For example, the EMU–GRC dummy takes the value 1 for the country-pair (France, Greece) before 2001 and the value 0 from 2001 to 2005.

The results are nevertheless informative. We observe a positive effect in 1994 (compared to 1992), at the 10 percent level of significance. The year 1994 is the year that marked the beginning of the second stage. Then, the EMU estimate becomes significant from 1997 to 2004. The strongest effects are found in 1999 and from 2002, the date of the launch of the euro in the form of physical coins and banknotes, to 2004.[25]

VI. Who Benefits from the Euro?

Within the Eurozone

Does the EMU effect vary across EMU members? To address this question, we use a simple approach. We design restricted samples by dropping from the original sample one EMU parent country or one EMU host country at a time. Then, we regress equation (9) on each restricted sample and we compare the EMU estimate to the average EMU effect obtained for the original sample in column (2) of Table 1.

The results are presented in columns (1) and (2) of Table 5.[26] For example, the EMU estimate reported in row (a) and column (1) is obtained by regressing equation (9) on a restricted sample in which Austria, as a parent country, has been dropped. The results offer interesting insights. The EMU estimate remains statistically and economically significant in all restricted samples. However, we observe some differences across samples. Even if such differences are probably not statistically significant, they are worth commenting on briefly.

In column (1), for instance, when we drop Greece (row (g)) or Portugal (row (k)) as parent countries, the euro effect appears to be lower than the average effect, about 22 percent ($=\exp[0.20]-1$). This suggests a larger euro effect in these excluded countries, which are among the relatively less-developed EMU members. In contrast, other parent countries, such as Austria, Germany, France, or the Netherlands, apparently benefit from a smaller euro effect. For instance, when we remove Germany as a parent country from the sample (row (c)), the euro effect is about 39 percent ($=\exp[0.326]-1$), versus 31 percent in the original sample. In column (2), when we drop Germany as a host country (row (c)), the estimated effect of the euro is now lower than the average. This suggests that since the launch of the euro, Germany has received more intra-EMU FDI than the average

[25] Another falsification exercise is to redefine the EMU dummy as if the initial 11 EMU members and Greece had adopted the euro since the beginning of our sample period of estimation (i.e., in 1992). In that case, the annual EMU dummies become significant from 2000 onwards.

[26] To save some space, we only report EMU estimates. Overall results are available upon request.

Table 5. *EMU and FDI: excluded parent or host EMU countries*

	Dependent variable: ln(bilateral FDI outstock) EMU coefficient on the original sample (4,306 obs.): 0.270∗				
Model	(1)	(2)		(3)	(4)
Direction dropped:	As parent	As host	Direction dropped:	As parent	As host
Excluded country			Excluded group		
(a) Austria	0.333***	0.265***	(i) Relatively less-developed	0.105	0.319***
(s.e.)	(0.10)	(0.09)	(s.e.)	(0.08)	(0.10)
No. of obs.	4,069	4,105	No. of obs.	3,769	3,553
(b) Belgium	0.272***	0.303***	(j) Origin 6 EU members	0.504***	0.158
(s.e.)	(0.10)	(0.10)	(s.e.)	(0.16)	(0.15)
No. of obs.	4,186	4,102	No. of obs.	3,174	3,180
(c) Germany	0.326***	0.219**	(k) DM bloc	0.642***	0.221*
(s.e.)	(0.10)	(0.09)	(s.e.)	(0.14)	(0.13)
No. of obs.	4,047	4,072	No. of obs.	2,981	3,017
(d) Spain	0.268***	0.271***	(l) Nordic countries	0.284***	0.316***
(s.e.)	(0.09)	(0.10)	(s.e.)	(0.10)	(0.10)
No. of obs.	4,168	4,103	No. of obs.	3,457	3,580
(e) Finland	0.278***	0.269***			
(s.e.)	(0.08)	(0.09)			
No. of obs.	4,056	4,143			
(f) France	0.327***	0.278***			
(s.e.)	(0.10)	(0.10)			
No. of obs.	4,040	4,073			
(g) Greece	0.202**	0.246***			
(s.e.)	(0.10)	(0.10)			
No. of obs.	4,185	4,139			
(h) Ireland	0.288***	0.271***			
(s.e.)	(0.09)	(0.10)			
No. of obs.	4,193	4,115			
(i) Italy	0.269***	0.232**			
(s.e.)	(0.10)	(0.10)			
No. of obs.	4,088	4,085			
(j) Netherlands	0.302***	0.242***			
(s.e.)	(0.10)	(0.09)			
No. of obs.	4,037	4,072			
(k) Portugal	0.206***	0.321***			
(s.e.)	(0.09)	(0.09)			
No. of obs.	4,141	4,114			

Notes: Standard errors (s.e.) are bootstrapped (200 replications) and clustered at the country-pair level. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Other coefficients are available upon request. Columns (1) and (2) exclude one EMU parent country or one EMU host country at a time, respectively. Columns (3) and (4) exclude one group of EMU parent countries or one group of EMU host countries at a time, respectively. Excluded group: (i) Greece, Ireland, Portugal, and Spain; (j) Belgium and Luxembourg, France, Germany, the Netherlands, and Italy; (k) Austria, Belgium and Luxembourg, Denmark, Germany, France, and the Netherlands; (l) Denmark, Finland, and two non-EMU members (Sweden and Norway).

(column (2)) but has invested less within the eurozone than the average (column (1)).

In columns (3) and (4) of Table 5, we go a step further. We drop groups of EMU parent countries or groups of EMU host countries at one

time. Then, again, we compare the EMU estimate obtained using these restricted samples with the benchmark estimate. We drop alternatively the relatively less-developed EMU members (Greece, Ireland, Portugal, and Spain), the original six EU members (France, Germany, the Netherlands, Italy, Belgium, and Luxembourg), the DM bloc countries (Austria, Denmark, Germany, France, the Netherlands, Belgium, and Luxembourg), and the Nordic countries (Denmark, Finland, and two non-EMU countries—Sweden and Norway).

In columns (3) and (4), differences with the benchmark estimate are now significant. The EMU estimated coefficient becomes statistically insignificant when we drop the relatively less-developed EMU parent countries or the most tightly integrated EMU host countries (i.e., the original six EU countries or the DM bloc countries).[27] These results, in line with those in columns (1) and (2), suggest an interesting pattern: the creation of the euro could have induced the relatively less-developed EMU members to increase their outward investments in the most advanced and tightly integrated countries, such as the original six EU members and the DM bloc countries. A reasonable explanation is that the less-advanced members could have benefited relatively more from the transaction cost reduction generated by the euro. Such a reduction may have increased their opportunities to invest abroad.

Outside the Eurozone

We now investigate the FDI relationships between EMU and non-EMU members. In particular, we analyse whether diversion effects on FDI patterns occur because of the launch of the euro. EU members outside the eurozone, such as Denmark, Sweden or the UK in our sample, are currently debating the opportunity to join the eurozone.[28] These non-EMU countries fear attracting less FDI as a result of the single currency. However, we may also expect some investment creation effects. If the EMU has transformed eurozone financial markets and increased financial integration, it could have facilitated cross-border investments outside the eurozone as well, and mostly after 1999. To address these potential effects on non-EMU members, we estimate two variants of equation (9) and we report the results in Table 6.

[27] In terms of trade, the largest euro effect is found for the most central and tightly integrated countries, apart from Spain (Micco *et al.*, 2003; Baldwin, 2006). However, by summing imports and exports, most authors do not investigate the euro effect according to a particular direction of trade.

[28] This debate also concerns the new EU members of Eastern Europe which have not adopted the euro.

Table 6. *Euro effects outside the eurozone*

Dependent variable Period of estimation	ln(bilateral FDI outstock) 1992–2005	
Model	(1)	(2)
ln(parent country GDP)	1.337***	1.341***
	(0.203)	(0.198)
ln(host country GDP)	0.639***	0.640***
	(0.221)	(0.220)
EMU dummy	**0.344****	**0.351****
	(0.113)	(0.135)
EMU to non-EMU dummy	0.312***	
	(0.122)	
EMU to DNK-SWE-UK dummy		−0.025
		(0.160)
EMU to other-non-EMU dummy		0.322***
		(0.111)
Non-EMU to EMU dummy	−0.093	
	(0.092)	
DNK-SWE-UK to EMU dummy		0.161
		(0.127)
Other-non-EMU to EMU dummy		−0.143
		(0.102)
EU dummy	−0.011	−0.023
	(0.101)	(0.094)
Exchange-rate volatility	0.020	0.020
	(0.015)	(0.015)
ln(attractiveness of alternative locations)	−0.461***	−0.467***
	(0.108)	(0.108)
R^2-within	0.509	0.510
No. of observations	4,306	4,306
Country-pair dummies	Yes	Yes
Year dummies	Yes	Yes

Notes: Standard errors in parentheses are bootstrapped (200 replications) and clustered at the country-pair level. *** and ** denote significance at the 1 and 5 percent levels, respectively. Constant country-pair and year dummy estimates are not reported.

In a first variant (column (1)), we estimate equation (9) with two additional dummies. The first dummy (EMU to non-EMU) takes the value of 1 if the parent country is an EMU member and the host country is not, and 0 otherwise. We expect a negative estimate if non-EMU members experience a decrease in FDI as a result of the euro. The second dummy (non-EMU to EMU) takes the value of 1 if the host country is an EMU member and the parent country is not, and 0 otherwise.[29]

In a second variant (column (2)), we decompose these two dummies. We take out of the non-EMU group our three EU countries that are participating

[29] For example, (EMU to non-EMU) = 1 for German outward investments in Australia after 1999 and (non-EMU to EMU) = 1 for Australian outward investments in Germany after 1999.

in the SM but not in the eurozone (i.e., Denmark, Sweden, and the UK, called hereafter DSUK). In this way, we evaluate more precisely the impact of the euro for these non-EMU countries. This decomposition amounts to including four dummies into equation (9): (EMU to DSUK), (DSUK to EMU), (EMU to other-non-EMU), and (other-non-EMU to EMU).[30]

The introduction of the non-EMU dummies does not much affect the other estimates, except the EMU effect, which is now larger (0.344 in column (1)) than the benchmark estimate (0.270). This is expected because of the change in the comparison group, which now comprises only relationships between non-EMU countries. Thus, the EMU effect is magnified by comparing the EMU country-pairs to non-EMU country-pairs only.

One broad conclusion drawn from the results is that the non-EMU countries have not received less FDI from the eurozone since its creation (columns (1) and (2)). On the contrary, we find that EMU members have invested more in non-EMU countries (column (1)) and especially in countries that are both non-EMU and non-EU members (column (2)). In addition, we find that differences in estimates between the (EMU) and (EMU to non-EMU) variables in column (1) or between the (EMU) and (EMU to other-non-EMU) variables in column (2) are not statistically significant. Overall, these findings comply with the idea that the creation of the EMU has transformed financial markets within the eurozone (see Lane, 2008). Markets have become more liquid and more integrated with the development and mergers of exchange markets in Europe, such as the pan-European stock exchange, Euronext. Consequently, the EMU has reduced the cost of capital for eurozone firms and facilitated their allocation of capital both within and outside the eurozone. In contrast, EMU members do not seem to benefit from additional FDI from non-EMU members (columns (1) and (2)). These results are reassuring regarding the euro effect on FDI because monetary integration has primarily affected EMU members' outward investments (within and outside the eurozone). In particular, we do not find any positive effect on the outward investments of Denmark, Sweden, and the UK, which are participating in the SM programme but not in the eurozone.

We have also assessed the evolution of the EMU investments outside the eurozone over time. We find that the EMU to non-EMU effect is statistically significant only after 1999.[31] Thus, we do not find evidence

[30] For instance, (EMU to DSUK) takes the value of 1 if the parent country is an EMU member and the host country is Denmark, Sweden, or the UK. In contrast, (DSUK to EMU) is unity if the parent country is Denmark, Sweden, or the UK and the host country is an EMU member.

[31] Estimation results are available as supplemental material on http://jdesousa.univ.free.fr/research/sup.htm.

of an anticipation of the euro effect for EMU investments outside the eurozone.

VII. Conclusion

In reducing transaction costs, monetary integration may stimulate foreign investments. To address this issue, we derive a simple gravity-like model for explaining bilateral FDI stocks and we use the creation of the euro as an experiment. We find that this creation has increased intra-EMU FDI stocks, on average, by around 30 percent, other things being equal. This result is robust to a variety of sensitivity tests. Moreover, we show that this effect varies over time and across EMU members. In particular, the euro might have induced the relatively less-developed EMU members to increase their investments in the most advanced and tightly integrated EMU member states. A reasonable explanation is that the less-advanced countries could have benefited relatively more from the transaction cost reduction generated by the euro. This reduction may have increased their opportunity to invest abroad.

Furthermore, we do not document any investment diversion effect of the euro. On the contrary, we find that EMU members have invested more in some non-EMU members, but this has only occurred since the launch of the single currency. In contrast, EMU members do not seem to benefit from additional FDI from non-EMU members.

Appendix A. Data Appendix

Table A1. *Data and variable definitions*

Foreign direct investment	Annual bilateral FDI outstocks come from OECD: *International Direct Investment Statistics Yearbook*.
GDP	Annual GDP data come from the *World Development Indicators* (World Bank).
Exchange-rate volatility	Computed as the standard deviation of the first difference in the log of the monthly nominal bilateral exchange rate in the preceding and current year. Nominal exchange rates come from *International Financial Statistics* (IMF).
Alternative locations	See Section III.
Unit labour cost	Index (2000 = 100) measuring the change in the total amount of wage and salary payments per unit of output. Source: OECD.
Employment protection legislation	The employment protection legislation index captures both hiring regulations (e.g., conditions for using fixed or temporary contracts, training requirements) and firing regulations (e.g., redundancy procedures, severance payments). This index is constructed for 1990, 1998, and 2003. We reproduce the 1990 value until 1997, then the 1998 value until 2002, and finally the 2003 value until 2005. Data come from the OECD's Labour Force Statistics database.

Table A1. *Continued*

Tax rate	Statutory tax rates come from Devereux *et al.* (2002).
Macroeconomic risk	The macroeconomic risk rating comes from the International Country Risk Guide (ICRG). It ranges from 0 to 50, a lower value indicating a higher risk. It is computed using several variables (GDP per capita, real GDP growth, annual inflation rates, budget balance, and current account as a percentage of GDP).

Table A2. *Summary statistics (1992–2005)*

	No. of obs.	Mean	Standard deviation	Min.	Max.
ln(FDI outstocks)	4,306	20.97	2.57	9.32	26.50
ln(GDP)	5,880	26.91	1.22	24.65	30.14
EMU	5,880	0.12	0.33	0	1
EU	5,880	0.40	0.49	0	1
Single Market	5,880	0.47	0.50	0	1
Exchange-rate volatility	5,880	1.93	1.39	0	9.30
ln(alternative locations)	5,880	−0.43	0.96	−2.90	2.66
ln(unit labour cost)	5,880	4.59	0.10	4	4.79
ln(employment protection legislation)	5,880	3.56	0.72	1.39	4.41
Tax rate	5,320	0.35	0.09	0.10	0.59
ln(macroeconomic risk)	4,620	3.70	0.71	3.43	3.87

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