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The "Euro Effect" and Outward Foreign Direct Investment

El "efecto euro" y las inversiones extranjeras directas salientes

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Abstract

The "euro effect" is an important phenomenon in the debate on monetary integration results in Europe. While in the existing literature the impact of the euro adoption is usually studied on trade data, the main goal of the paper is to examine whether the "euro effect" can be detected in Outward Foreign Direct Investment flows from the OECD countries.

Using the difference-in-differences method and the gravity equation corrected for the sample selection and firm-heterogeneity biases, we investigate the trends of the strength of the impact of the euro over the 1985-2012 period. Our results suggest that the influence is positive, is not time invariant and does not display a clear trend. It was the strongest in the years 2003-2005 and 2010-2011. The impact faded in the years 2006-2007, and the euro was insignificant shortly after its introduction and during the global financial crisis.

Keywords: Euro effect; Foreign Direct Investment; Gravity Equation.

Resumen

El «efecto euro» es un fenómeno importante en el debate sobre los efectos de la integración monetaria en Europa. Si bien en la literatura existente los efectos de la adopción del euro generalmente se analizan sobre la base de datos de comercio, el propósito principal del artículo es comprobar si el efecto euro puede también afectar a las inversiones extranjeras directas salientes en los países de la OCDE.

Usando el método «diferencias en diferencias» y el modelo gravitacional ajustado al muestreo y el problema de la heterogeneidad de las empresas, examinamos los efectos del euro sobre las inversiones directas salientes en los años 1985–2012. Nuestros resultados sugieren que el efecto euro es positivo, pero no invariable en el tiempo. Fue más fuerte en los años 2003-2005 y 2010–2011. El efecto euro desapareció en los años 2006-2007 y la introducción de la moneda común era irrelevante en poco tiempo después de su introducción y durante la crisis financiera mundial.

Palabras clave: Efecto euro; Inversiones extranjeras directas salientes; Modelo gravitacional.

JEL Classification: F21, F36.

1. Introduction[1]

The idea of analyzing the "euro effect" on Outward Foreign Direct Investment (OFDI) has its roots in an expected trade and FDI flows increase due to the euro introduction. The debate over the phenomenon of the "euro effect" started long before the single currency appeared and was speeded up by A. Rose (2000). Based on the analysis of different forms of monetary unification, Rose suggested that countries sharing the same currency may trade 2.35 times more with each other than countries with different currencies. Though his research did not relate directly to the euro area, a trade increase as a result of monetary integration is often called "Rose effect" and the "euro effect". Although Rose's initial results were seriously criticized as too optimistic, they have become an important argument in the discussion on the (endogeneity) Optimum Currency Area Theory (OCAT) and also spurred a debate on possible results of the monetary integration in Europe[2].

From the monetary integration and OCAT point of view, the euro introduction should increase trade between countries because of exchange rate volatility reduction/elimination, lower transaction costs and prices, deeper competition and broader market perspective as well as a more credible commitment than in the case of the conventional fixed exchange rate arrangements (De Grauwe and Mongelli, 2005; Dinga and Dingová, 2011). In the macroeconomic research, the euro introduction was usually considered as bringing results similar to a trade tariff reduction and deepening economic integration with expected positive results (Flam and Nordström, 2006). The anticipated trade and FDI flows increase is also justified from the perspective of a "new" new trade theory which has microeconomic foundations. According to this framework, firms are heterogeneous in terms of productivity and only the most efficient companies may export because they can cover fixed costs of trade, and only "the happy few" of them can afford to use FDI as an internationalization strategy (Mayer and Ottaviano, 2007). The euro introduction could reduce

[1] The article is a part of the project which received funding from the National Science Center through the grant no. DEC-2011/03/D/HS4/01954.

[2] The most in-depth criticism of the "Rose garden", where Rose developed his approach, was presented in Baldwin, Di Nino, Fontagné, De Santis and Taglioni (2008). An interesting view on the "euro effect" is also presented in Havránek (2010). In his meta-analysis, the author suggests that in the case of examining the "euro effect", the phenomenon of novelty and fashion in economic research resulted with a possible *publication bias*.

sunk costs and increase ability to internationalise through exports and more sophisticated forms as FDI.

Companies are heterogeneous and have different resources, motives and experience, so they can expand abroad through export and OFDI. However, the "euro effect" has been usually examined on aggregate trade data (mainly export of goods) and to a lesser extent on FDI data. Minor literature on FDI and the "euro effect" is mainly focused on the FDI inflow or flow (measured as an average of the sum of inflow and outflow), neglecting market expansion in the form of OFDI. To our best knowledge, there are only a few analyses examining directly the "euro effect" on OFDI in the euro area (De Sousa and Lochard, 2006; De Sousa and Lochard 2011).

The main goal of the paper is to examine whether the "euro effect" can be detected in OFDI of OECD countries. Using the gravity model within the difference and difference approach we contribute to the existing literature in three ways.

Firstly, we cover long-term data form 1985 till 2012, including the financial crisis, while available empirical results are usually based on the observations ending in 2008. Secondly, we applied a methodological approach that improves upon the traditional gravity approach because it takes into account the biases arising from exclusion of zero FDI flows from the sample and neglect of firm heterogeneity. Thirdly, we aimed to examine the time-evolving strength of the euro effect by applying the rolling regression method.

The structure of the article is as follows. In the second section we described the euro impact on trade and FDI identified in the literature. In the third section we presented the empirical strategy, description of chosen variables and the sources of data. In the fourth section we presented estimation results of the euro effect and other standard gravity variables. The fifth section summarizes the main results.

2. Literature Survey

2.1. The "Euro Effect" on Trade

We assume that trade and FDI flows are interconnected and complementary in the EU and in the euro area as confirmed in many studies highlighting that FDI serves as an export platform (Jensen, 2004; Ekholm, Forslid and Markusen 2007). It is justifiable to remind results of the euro effect on trade. The first examination of the "euro effect" on trade, covering data between mid-90s and 2005, confirmed its presence in trade between the euro area member states and with third countries. Depending on the data aggregation, country sample, methodology and length of time series, results indicated that the "euro effect" equals from 4-16% (Micco, Stein and Ordonez, 2003; including the period of 1992-2002) to 20-26% (Flam and Nordstrom, 2006; 1995-2005 period).

An in-depth study of the previous works collected and analyzed by Baldwin *et al.* (2008) demonstrated that the magnitude of the "euro effect" is signifi-

cantly lower (about 3-5%) than previously thought based on Rose's research[3]. A further analysis, based on a longer time series, undermined the first results and showed a diminishing or even negligible "euro effect" (Silva and Tenreyro, 2010). Economists also mentioned that the "EU effect" related to the membership in the EU, which was sometimes ignored in the previous results, is probably a more important factor increasing trade than monetary unification. The researchers tried to overcome earlier econometric problems (e.g., Herwartz and Weber, 2010) and found evidence that small but statistically significant "euro effect" exists. They argue that the "euro effect" should be perceived from the long-term perspective as complementary to the Single Market effects. Many other studies also indicate that the euro effect on trade can be determined by the different countries, sectors and companies characteristics (see Faruqee, 2004; De Nardis, De Santis and Vicarelli, 2008; Pappalardo and Vicarelli, 2017).

2.2. The "Euro Effect" on FDI

The euro adoption should influence FDI flows in a similar way to trade. Early literature indicates a positive impact of the single currency on the FDI flows between the euro-area countries as well as between the euro area and the world. However, the scale of that effect is a subject of discussion. Schiavo (2007), working on annual FDI flows in 25 OECD countries for 22 years (1980-2001), indicated that the euro increases cross-country investment flows by 160 to 320 percent. Petrolaus (2007), who based his research on a panel data analysis which covered 18 OECD countries from 1992 to 2001, confirmed that the euro introduction had increased FDI flows between member countries by 14-16%. Simultaneously, he stated that the euro could spur FDI flows between the euro area and third countries – inward FDI from member countries to non-members could increase by 11-13% and inward FDI from third countries to the euro area could increase by 8%. Excluding Germany and Belgium-Luxemburg, the euro effect diminishes, indicating an important role of those economies as location countries. The author also underlines that the euro effect on FDI flows may be stronger for big euro area economies (Germany, France, Italy, Spain), while the euro effect on trade is more intensive in the case of small euro area countries.

De Sousa and Lochard (2006) point out that the euro has a positive influence on inward and outward FDI stocks within and beyond the euro area. They used the gravity model and examined bilateral flows between 23 OECD countries from 1982 to 2002. According to their estimates, the euro increased FDI flows in the euro-area countries by 30 % in comparison with non-euro-area countries. They also indicate that FDI was higher in peripheral countries. In an

[3] Baldwin *et al.* (2008), explaining the "technology" of different econometric models and techniques, showed many reasons for an upward bias in many "euro effect" research studies.

updated and modified study concentrated only on OFDI, the same authors, working on data covering 21 OECD countries in the period 1992-2005, confirmed a positive euro effect of about 30% (De Sousa and Lochard, 2011).

On the other hand, Taylor (2008), who assessed the first 5 years of the euro effect on FDI, comes up with less encouraging conclusions. He observes that, excluding the flows to Luxembourg from the group of the analyzed countries, changes in the FDI flows between the euro-area countries were below average for all countries worldwide. As regards the significance of the euro introduction for FDI, studies by Flam and Nordstrom (2008) indicate that common currency cannot be considered as a decisive factor. They suggest that the single market effect may be more important for FDI flows. Dinga and Dingová, (2011) are also far from confirming the influence of the euro on FDI. What they notice, instead, is the significance of the EU membership as a factor stimulating the FDI flows.

2.3. The Euro Effect over Time

Some studies tried to examine the euro effect over time in the case of trade and FDI, which was motivated by the need to assess the coexistence of different institutional integration stages (EU membership, euro area membership) and possible magnitude changes of other factors.

The strongest single currency influence on trade is usually mentioned in the earliest studies (the above mentioned Micco *et al.*, 2003; Flam and Nordstrom, 2006 and also Barr, Breedon, and Miles, 2003; Bun and Klaassen, 2002), mainly due to short time series coverage ending usually in 2001-2003. They pointed out the most pronounced effect in 1998-2001. Further research shifts the time period when the euro effect was strongest to somewhere between 2002 and 2005. Gómez-Herrera and Baleix (2012), examining bilateral export for 80 countries, identified a positive euro effect in 1999-2009 and stated that it reached its maximum in 2003-2005. Herwartz and Weber (2010), studying data between January1995 and May 2006, found that aggregate export within the euro area increased mainly between 2000 and 2002 (by 15 to 25 percent compared with trade with non-members). De Sousa (2012) advocates that the "euro effect" is positive but due to the globalization and impact of many other factors determining trade, it diminishes over time.

In the case of OFDI, De Sousa and Lochard (2011) found that the euro effect becomes significant from 1997 to 2004 and the strongest effects are found in 1999 and from 2002 to 2004. In section 4 we discuss the results of our analysis spanning years 1985-2012.

3. Empirical Methodology

The gravity equation has been an essential tool to study empirically the bilateral trade flows and its theoretical foundations can be attributed to Anderson (1979). Researchers seeking to explain bilateral FDI flows have mechanically applied the gravity equation without taking into account the specificity of long-term capital flows which are a different form of foreign market entry than exporting. The theoretical underpinnings of the relation between, on the one hand, the host and home country size, the distance between them and, on the other hand, foreign direct investment and foreign affiliates sales have been elaborated only recently.

Bergstrand and Egger (2007) introduced physical capital in the two-factor Markusen's "knowledge-capital" model of multinational enterprise to show that national exporting enterprises could coexist with horizontal multinational enterprises. Adding the third country to the model allowed for concluding that foreign affiliates sales are maximized when a pair of countries' GDPs are identical and explain why FDI from one country to another is not maximized when GDPs are identical. Kleinert and Toubal (2010) go a step further and show that the gravity equation can be derived from three different theoretical models, namely monopolistic competition with symmetric firms, heterogeneous firms, and a factor-proportions approach with vertical multinational firms. The consequences of firms heterogeneity for the empirical model specification have been studied by Waglé (2010), who adapted for bilateral FDI flows the methodology developed in Helpman, Melitz and Rubinstein (2008) in order to estimate trade flows.

Helpman *et al.* (2008) elaborated estimation procedures that exploit the information contained in data sets of trading and non-trading countries alike, thus eliminating the sample selection bias, which is relevant for FDI data as well. Moreover, their methodology makes it possible to obtain consistent estimates of a gravity equation because it also corrects the second bias, namely the heterogeneity bias. The latter is due to the fact that omitting the variable that captures the fraction of firms that are able to undertake FDI would induce an upward bias in the estimated coefficient on any proxy for a potential FDI barrier.

It has to be acknowledged that total FDI flows depend on firm-level investment and the fraction of firms with productivity level sufficient to profitably set up and operate a foreign plant. Estimates of the gravity equation without a variable that measures the fraction of firms able to undertake FDI do not allow for distinguishing the impact of an FDI barrier on firm-level investment from its effect on the proportion of firms undertaking investment, which depends on the productivity level. Correcting this bias is of paramount importance for assessing the impact of the euro adoption which can be interpreted as a reduction in FDI barriers.

The empirical methodology of Helpman *et al.* (2008) adapted to FDI flows by Waglé (2010) is based on the following estimating equation:

$$OFDI_{ijt} = \beta_0 + \beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 d_{ij} + \beta_4 w_{ijt} + \beta_5 \gamma_i + \beta_6 \lambda_j + \beta_7 eu_{it} + \beta_8 eu_{jt} + \beta_9 time_t + \varepsilon_{ijt} \quad (1)$$

where t denotes time index, $OFDI_{ij}$ stands for the log of outward FDI flow (at current prices) from country i to country j, γ and λ are the dummy variables for the home and the host country, respectively, eu_i (eu_j) is a dummy variable equal to one if the country is an EU member state, time is a set of time dummies and ε is the residual. The GDP level at current prices (in logs) of both countries, labeled GDP_i and GDP_j, is intended to capture the size of their economies.

Several variables have been employed to proxy FDI barriers and denoted by the vector d_{ij}. They are time invariant characteristics of a pair of countries and include the log of the distance between capital cities (*dist*), a dummy equal to one if countries have a common official language (*lang*), a dummy equal to one if countries have a common border (*contig*), and a dummy equal to one if countries have colonial ties (*colony*).

The variable w_{ij} in equation (1) measures the fraction of firms which are able to undertake profitable investment abroad. This variable is a function of the threshold value of productivity above which a firm can cover fixed costs of establishing a plant abroad. Helpman *et al.* (2008) showed that it depends in a non-linear manner on a latent variable z_{ij}, which in turn is influenced by all the variables that determine the observed positive FDI flows. The latter is composed of the set of all the right hand side variables in equation (1) augmented to include a measure of fixed costs of establishing a plant abroad. In this paper we used the civil liberties index of Freedom House, which comprises, among others, a measure of people's ability to enjoy social and economic freedoms, including equal access to economic opportunities and the right to hold private property. This index has been selected because the data is available for the majority of the host countries since 1985 when the sample period starts.

To obtain the value of the latent variable z_{ij}, one has to realize that we observe positive FDI flows only if the value of z_{ij} ensures the value of w_{ij} corresponding to productivity levels high enough to enable the firm to choose direct investment mode of entry into a foreign market. Let's define an indicator variable I_{ij} equal to one when country i locates FDI in country j and 0 in the absence of FDI flows. The following probit equation is specified:

$$p_{ijt} = \Pr\left[I_{ijt} = 1 \mid explanatory\ variables\right] = \Phi(\mu_0 + \mu_1 GDP_{it} + \mu_2 GDP_{jt} + \mu_3 d_{ij} + \mu_4 \gamma_i + \mu_5 \lambda_j + \mu_6 eu_{it} + \mu_7 eu_{jt} + \mu_8 time_t + \mu_9 cl_{jt} + \eta_{ijt}) \quad (2)$$

where Φ is the cumulative distribution function of the unit-normal distribution and cl_{jt} stands for the index of civil liberties in the host country, and η_{ij} is the residual. All right hand side variables are divided by the standard deviation of η_{ij}. Equation (2) is the selection equation and the inverse Mills ratio, which can be

calculated from its estimates, should be included as an additional regressor in the original gravity equation (1) to correct the sample selection bias. Moreover, the predicted value of the latent variable z_{ij} (divided by the standard deviation of η_{ij}), $\hat{z}_{ijt} = \Phi^{-1}(\hat{p}_{ijt})$, can be used to derive consistent estimates of the fraction of firms undertaking FDI. More precisely, w_{ijt} can be proxied by the third degree polynomial of $\hat{z}_{ijt}$ and included as additional regressor in equation (1) to correct the firm-heterogeneity bias.

In summary, the two-step procedure outlined above allows for eliminating the sample selection and firm heterogeneity biases. The first step consists in estimating a probit equation (2) to derive the Mills ratio and the predicted value of variable z_{ij}. The third degree polynomial of the latter provides a proxy of the fraction of firms productive enough to surmount the costs of setting up a foreign subsidiary. In the second step the standard gravity equation (1) is estimated for all country pairs with positive OFDI flows with the variables obtained in the first step inserted among the covariates.

We rely on the difference-in-differences (DID) methodology to accomplish the main objective of this paper and assess the impact of the euro adoption on outward FDI flows. The DID method allows for evaluating the effects of a program by comparing the outcome in two groups observed before and after the implementation of a program. In our case the outcome is the OFDI flow and the program, or the so called treatment, is defined as the adoption of the euro. The value of OFDI in the treatment group has to be compared with investment flows from the control group, that is with countries that have not joined the EMU but are similar with respect to other characteristics.

To assess the impact of the euro on any outcome variable y, the following equation can be estimated:

$$y = \delta_0 + \delta_1 emu + \delta_2 intro + \delta_3 (emu \cdot intro) + u \qquad (3)$$

where *emu* is a dummy variable equal to 1 if a country is a prospective or current EMU member, intro is a dummy variable equal to one since a country's entrance into the euro zone. The coefficient of interest, δ_3, is accompanying the interaction term corresponding to a dummy variable equal to 1 in the member countries of the EMU after their accession. Hence the estimated value of this coefficient, δ_3 , captures the impact of the euro on OFDI and it is called a difference-in-differences estimator because it can be decomposed into the two following terms:

$$\hat{\delta}_3 = \left(\bar{y}_{emu,after} - \bar{y}_{emu,before}\right) - \left(\bar{y}_{non-emu,after} - \bar{y}_{non-emu,before}\right) \qquad (4)$$

where $\bar{y}$ stands for the average value of OFDI flows. The term in first brackets measures the difference in average OFDI flows in the group of EMU members before and after the euro adoption. The term in second brackets reflects the impact of the euro adoption in the control group of non-EMU countries.

This paper combines the bias-corrected gravity equation with the DID method. First, the probit model will be used to obtain estimates of the inverse Mills ra-

tio and the latent variable that proxies the percentage of firms investing abroad. The estimating equation includes the set of dummies typical of the DID method:

$$\begin{aligned} p_{ijt} &= \Pr\left[I_{ijt} = 1 \mid explanatory\ variables\right] = \\ &\Phi[\mu_0 + \mu_1 GDP_{it} + \mu_2 GDP_{jt} + \mu_3 d_{ij} \\ &+ \mu_4 \gamma_i + \mu_5 \lambda_j + \mu_6 eu_{it} + \mu_7 eu_{jt} + \mu_8 time_t + \mu_9 cl_{jt} \\ &\mu_{10} emu + \mu_{11} intro + \mu_{12}(emu \cdot intro) + \eta_{ijt}] \end{aligned} \tag{5}$$

The inverse Mills ratio (mills) and the predicted value of the latent variable Z_{ij}, $\hat{z}_{ijt} = \Phi^{-1}(\hat{p}_{ijt})$, obtained from equation (5) allow for correcting the selection and heterogeneity biases of the gravity equation. As mentioned before, the fraction of firms able to undertake investment abroad is a non-linear function of $\hat{z}_{ijt}$ and its third-degree polynomial is added to the set of explanatory variables in the gravity equation which takes the following form:

$$\begin{aligned} OFDI_{ijt} &= \beta_0 + \beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 dist_{ij} + \beta_4 lang_{ij} + \beta_5 cont \\ &+ \beta_7 \gamma_i + \beta_8 \lambda_j + \beta_9 eu_{it} + \beta_{10} eu_{jt} + \beta_{11} time_t \\ &+ \beta_{12} emu + \beta_{13} intro + \beta_{14}(emu \cdot intro) \\ &+ \beta_{15} mills + \beta_{16} \hat{z}_{ijt} + \beta_{17}(\hat{z}_{ijt})^2 + \beta_{18}(\hat{z}_{ijt})^3 + \varepsilon_{ijt} \end{aligned} \tag{6}$$

The first row of equation (6) contains the typical gravity equation variables related to size of the home and host economies and the geographical and cultural distance between them. In the second row are the dummy variables for the home and host economy and for the EU membership. The third-row variables are derived from the DID approach and they are crucial to assess the impact of the euro adoption on OFDI flows. The variables that allow for obtaining unbiased estimates are included in the last row. It should be noted that the identifying variable, cl, intended to measure the fixed costs of setting up a foreign subsidiary is excluded from equation (6). Equation (6) will be estimated using the OLS method.

The sample comprises outward FDI flow from all OECD countries in the 1985-2012 period. The group of OECD members is homogenous and the DID approach can be applied to study the effects of the euro introduction. The list of host countries has not been restricted and is composed of all economies for which data was available. The data on OFDI flows was collected from the OECD database, GDP levels are from World Bank World Development Indicators, measures of geographical and cultural distance come from the CEPII database.

4. RESULTS

Table 1 reports in the first column the results of traditional gravity equation estimates which are biased because of the exclusion of explanatory variables from the last row of equation (6). The results of estimates of the probit equation are displayed in the second column and the bias-corrected estimates of the complete specification of gravity equation (6) are shown in the third col-

umn. For the sake of clarity, the estimated coefficients of the vectors of country and time dummies are not shown in the table. Errors contain unobserved variables which may be grouped (clustered) across the reporting, that is home, countries. We report the value of robust cluster variance estimators.

Table 1. Determinants of OFDI Flows in the 1985-2012 Period

Variables	Traditional	Probit	Bias-corrected
constant	-23,67***	-11,30***	-3,156
	(4,351)	(3,798)	(7,216)
GDP(home)	1,478***	0,677***	0,842**
	(0,295)	(0,229)	(0,410)
GDP(host)	0,603***	0,177***	0,441***
	(0,0983)	(0,0462)	(0,123)
dist	-1,034***	-0,336***	-0,729***
	(0,0746)	(0,0496)	(0,124)
lang	0,619***	0,134*	0,502**
	(0,186)	(0,0804)	(0,191)
contig	0,350*	-0,0147	0,346
	(0,193)	(0,114)	(0,206)
colony	0,907***	0,241***	0,682***
	(0,163)	(0,0744)	(0,183)
EU(home)	0,590**	-0,211	0,797***
	(0,245)	(0,146)	(0,263)
EU(host)	0,482***	-0,0141	0,477***
	(0,113)	(0,113)	(0,115)
cl		-0,0829***	
		(0,0258)	
emu	-0,748	2,093*	-4,232***
	(1,575)	(1,264)	(0,807)
intro	-0,515**	-0,239	-0,248
	(0,234)	(0,148)	(0,263)
emuintro	0,756***	0,314*	0,450
	(0,226)	(0,184)	(0,269)
mills			-6,725
			(6,340)
$\hat{z}$			-3,346
			(3,863)
$\hat{z}^2$			1,302*
			(0,731)
$\hat{z}^3$			-0,180**
			(0,0695)

Observations	28211	69685	27626
R-squared (pseudo R2 for probit)	0,671	0,283	0,675

Robust standard errors in parentheses; *** p < 0,01, ** p < 0,05, * p < 0,1. Home and host countries and time dummies included.

The results displayed in the first column show that the standard gravity equation determinants of OFDI are valid in our sample. The size of the home and host country as well as cultural proximity and the EU membership boost OFDI flows. The physical distance puts a brake on outward FDI. The effect of the introduction of the euro is significantly positive. The estimation of the selection probit equation shown in the second column seems to support our conjecture that the degree of civil liberties is a good proxy for fixed costs of setting up a plant abroad. The identifying variable *cl* is statistically significant and its coefficient is negative pointing to the fact that lower degree of civil liberties in the host economy (higher value of *cl*) is associated with smaller OFDI. The size and distance variables affect the probability of a positive OFDI and have expected signs. It is noteworthy that the EU membership is not a significant selection variable and the significance of the introduction of the euro has been reduced in the second column of Table 1.

The third column of Table 1 demonstrates that the selection and heterogeneity biases are substantial. The coefficients of distance (except for the common border effect), GDP levels, cultural proximity and the EU membership of the host country drop but remain significant. By contrast, the coefficient of the euro adoption effect ceases to be statistically significant. We therefore conclude that the estimation of a standard gravity equation for all country pairs with positive OFDI flows leads to a biased result that the euro adoption boosts investment. Accounting for selection and firm heterogeneity biases reveals that joining the EMU does not encourage a country to undertake more OFDI. We argue that the impact of the euro adoption on OFDI is not time invariant and therefore the results obtained for the entire 1985-2012 period obscure the evolving influence of the common currency on firms establishing foreign subsidiaries.

To verify our conjecture that the euro effect on OFDI changes over time, we run a rolling regression with a window size of 16 years based on equation (6), that is correcting the selection and heterogeneity biases. The first period covers the years 1985-2000, that is two years after the establishment of the EMU are included in the sample. The next sample is extended by one year at a time and the observations from the initial year in the previous sample are dropped. The last window spans 1997-2012, that is the entire period of the euro's existence. The detailed moving-window estimation results obtained using the OLS are presented in Table 2. The coefficient of country and time dummies are omitted to save space.

Table 2. Determinants of OFDI Flows: Rolling Window Bias-Corrected Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Variables	1985-2000	1986-2001	1987-2002	1988-2003	1989-2004	1990-2005	1991-2006	1992-2007	1993-2008	1994-2009	1995-2010	1996-2011	1997-2012
constant	-4,643	-5,383	-7,031	-0,750	-5,782	-3,840	-3,373	-19,18	-19,28	-9,816	2,914	18,54	103,6*
	(7,124)	(7,019)	(6,603)	(6,007)	(7,585)	(9,284)	(11,91)	(14,30)	(13,73)	(22,53)	(23,09)	(18,21)	(53,26)
GDP(home)	0,699*	0,730*	0,671**	0,474	0,676*	0,573	0,513	1,429*	1,945**	1,385	0,608	-0,209	-6,524*
	(0,361)	(0,368)	(0,317)	(0,323)	(0,355)	(0,459)	(0,817)	(0,707)	(0,943)	(1,468)	(1,226)	(1,240)	(3,651)
GDP(host)	0,748***	0,696***	0,567***	0,471***	0,417***	0,437**	0,424*	0,579*	0,733*	0,482	0,145	-0,190	-3,509*
	(0,0988)	(0,117)	(0,121)	(0,127)	(0,146)	(0,179)	(0,247)	(0,289)	(0,420)	(0,800)	(0,609)	(0,595)	(1,923)
dist	-0,479**	-0,463**	-0,429**	-0,415*	-0,573**	-0,636	-0,549	-1,163**	-1,399**	-0,954	-0,460	-0,104	2,987
	(0,174)	(0,180)	(0,171)	(0,204)	(0,270)	(0,381)	(0,663)	(0,513)	(0,656)	(1,041)	(0,773)	(0,702)	(1,904)
lang	0,488**	0,499**	0,427*	0,424**	0,403**	0,413**	0,391	0,541**	0,599**	0,511	0,344	0,243	-0,952
	(0,236)	(0,228)	(0,208)	(0,192)	(0,188)	(0,195)	(0,232)	(0,238)	(0,284)	(0,391)	(0,353)	(0,341)	(0,768)
contig	0,155	0,142	0,109	0,158	0,208	0,253	0,329	0,389*	0,328	0,359	0,477*	0,537*	1,040**
	(0,225)	(0,225)	(0,225)	(0,220)	(0,216)	(0,216)	(0,202)	(0,199)	(0,235)	(0,331)	(0,272)	(0,269)	(0,432)
colony	0,587**	0,581**	0,630***	0,571**	0,715***	0,752**	0,637	1,095**	1,246**	0,857	0,477	0,102	-2,392
	(0,230)	(0,226)	(0,224)	(0,231)	(0,244)	(0,304)	(0,564)	(0,436)	(0,579)	(0,907)	(0,653)	(0,651)	(1,611)
EU(home)	0,273	0,333	0,492*	0,624**	0,501*	0,515**	0,565**	0,464*	0,375	0,559	0,942**	1,216***	2,871***
	(0,247)	(0,269)	(0,287)	(0,287)	(0,253)	(0,230)	(0,231)	(0,228)	(0,271)	(0,379)	(0,405)	(0,433)	(1,046)
EU(host)	0,577**	0,600**	0,437**	0,284	0,178	0,176	0,132	0,448*	0,490*	0,405**	0,318**	0,265**	0,297**
	(0,225)	(0,238)	(0,210)	(0,204)	(0,159)	(0,197)	(0,310)	(0,253)	(0,258)	(0,159)	(0,147)	(0,123)	(0,114)

emu	-1,560	1,250	-1,330	-0,131	0,152	-1,752	-3,366***	0,0301	-6,360**	-4,504	-3,021	-1,027	12,73
	(1,845)	(1,693)	(1,791)	(0,595)	(1,654)	(1,545)	(1,137)	(2,517)	(2,594)	(4,195)	(4,727)	(2,815)	(8,105)
intro	-0,0421	-0,152	-0,212	-0,287	-0,364	-0,311	-0,287	-0,440	-0,458	-0,225	-0,0488	-0,155	-0,165
	(0,286)	(0,291)	(0,283)	(0,302)	(0,299)	(0,304)	(0,394)	(0,295)	(0,272)	(0,382)	(0,355)	(0,251)	(0,225)
emuintro	0,505*	0,378	0,410	0,550**	0,594**	0,567**	0,528*	0,711**	0,780**	0,625	0,521**	0,461**	0,0499
	(0,285)	(0,278)	(0,254)	(0,239)	(0,231)	(0,221)	(0,275)	(0,289)	(0,354)	(0,387)	(0,255)	(0,212)	(0,310)
mills	-8,775*	-8,754*	-9,212*	-11,66**	-10,54*	-7,300	-7,313	-8,268	-8,683	-8,446	-10,84	-13,79**	-13,32**
	(4,630)	(4,267)	(4,500)	(5,085)	(5,246)	(6,279)	(6,412)	(5,863)	(6,189)	(6,757)	(6,425)	(5,937)	(5,789)
$\hat{z}$	-4,768	-4,718*	-4,839*	-6,255*	-5,795*	-3,809	-3,541	-5,516	-6,250	-4,915	-4,936	-5,623	4,832
	(2,884)	(2,646)	(2,794)	(3,172)	(3,326)	(4,057)	(4,188)	(3,635)	(3,995)	(4,600)	(4,259)	(3,903)	(6,130)
$\hat{z}^2$	1,525**	1,549***	1,561***	1,914***	1,728***	1,408*	1,444*	1,501**	1,528**	1,493*	1,739**	2,109***	2,003***
	(0,612)	(0,528)	(0,526)	(0,615)	(0,618)	(0,719)	(0,728)	(0,656)	(0,688)	(0,771)	(0,741)	(0,697)	(0,686)
$\hat{z}^3$	-0,137***	-0,139***	-0,129***	-0,153***	-0,141***	-0,177***	-0,189***	-0,178***	-0,180***	-0,178***	-0,170***	-0,169***	-0,155**
	(0,0489)	(0,0444)	(0,0416)	(0,0399)	(0,0409)	(0,0441)	(0,0440)	(0,0456)	(0,0502)	(0,0574)	(0,0608)	(0,0563)	(0,0569)
Observations	10,149	10,773	11,436	12,208	13,239	14,205	15,327	16,447	17,531	18,340	19,277	20,126	20,892
R-squared	0,709	0,707	0,706	0,703	0,699	0,696	0,695	0,693	0,693	0,688	0,686	0,685	0,683

Robust standard errors in parentheses; *** p<0,01, ** p<0,05, * p<0,1. Home and host countries and time dummies included.

The rolling regression estimates evince that the impact of the common currency in Europe on OFDI is not uniform across periods. However, a clear trend of the strength of the relationship between the euro and OFDI cannot be discerned. When the years 2001 and 2002 are included in the sample (columns 2 and 3 in Table 2) the coefficient of *emuintro* is not statistically significant. Extending the sample to the 2003-2006 period (columns 4-7 in Table 2) restores the statistical significance of the "euro effect". Inclusion of the two subsequent years, that is 2007 and 2008, leads to a sizable increase in the coefficient of *emuintro* by about 40%.

The global financial and fiscal crises in Europe during 2009-2011 were marked by an abrupt reduction in the level of FDI flows. The results of the rolling window regression support the view that this period was specific in terms of OFDI determinants. The size variables, physical and cultural distance were not affecting long-term capital outflows. The impact of the euro weakened: it was not significant in the sample encompassing year 2009, and the value of the coefficient accompanying *emuintro* shrank to the level observed in the infancy of the euro when the years 2010 and 2011 are included. It is noteworthy that being a member of the EU attracted foreign investors from the OECD countries at that time as shown by the significance of the variable EU(host) in columns (9)-(12). In the 1997-2012 period the impact of the euro is not statistically significant (column 13 in Table 2) whereas the standard determinants of FDI flows derived from the gravity equation regain statistical significance.

To check the robustness of our results, we considered an alternative measure of the costs of entry into a foreign market via direct investment, namely the International Country Risk Guide Indicator of Quality of Government elaborated by the PRS Group. It combines assessment of corruption within the political system with assessment of the strength and impartiality of the legal system and the institutional strength and quality of the bureaucracy. There is no doubt that all three components of the Quality of Government indicator impinge on the fixed costs of engaging in OFDI. Hence, we rerun estimation of the traditional gravity equation, the probit equation with the new variable *gov_qual* in place of *cl* and the bias-corrected gravity equation. The results are presented in Table 3.

Table 3. Determinants of OFDI Flows in the 1985-2012 Period; The Quality of Government Indicator in the Host Economy Used as the Selection Variable

Variables	Traditional	Probit	Bias-corrected
constant	-19,72***	-12,42***	-6,741
	(4,114)	(3,645)	(8,823)
GDP(home)	1,547***	0,690***	0,871*
	(0,278)	(0,218)	(0,490)
GDP(host)	0,575***	0,194***	0,426***
	(0,110)	(0,0487)	(0,155)
dist	-1,014***	-0,310***	-0,760***
	(0,0730)	(0,0491)	(0,185)
lang	0,596***	0,107	0,573***

	(0,191)	(0,0774)	(0,186)
contig	0,247	-0,0244	0,309
	(0,174)	(0,104)	(0,191)
colony	0,938***	0,209***	0,696***
	(0,160)	(0,0658)	(0,222)
EU(home)	0,581**	-0,168	0,729**
	(0,234)	(0,146)	(0,281)
EU(host)	0,538***	0,0130	0,535***
	(0,119)	(0,0965)	(0,119)
gov_qual		0,428***	
		(0,136)	
emu	-0,261	2,246*	-1,882
	(1,479)	(1,215)	(1,322)
intro	-0,445*	-0,151	-0,359
	(0,254)	(0,119)	(0,274)
emuintro	0,761***	0,237	0,523*
	(0,221)	(0,157)	(0,300)
mills			-2,313
			(8,325)
$\hat{z}$			-0,590
			(5,146)
$\hat{z}^2$			0,747
			(0,932)
$\hat{z}^3$			-0,215**
			(0,0921)
Observations	30514	57871	26228
R-squared (pseudo R2 for probit)	0,672	0,247	0,678

Robust standard errors in parentheses; *** $p<0,01$, ** $p<0,05$, * $p<0,1$. Home and host countries and time dummies included.

It stems from Table 3 that the selection and heterogeneity biases are relevant for empirical assessment of OFDI determinants based on the gravity equation. High significance level of the selection variable *gov_qual* in the second column demonstrates that the quality of government in the host economy influences the location decision of foreign investors. Although the interaction term *emuintro* preserves its significance in the third column but at a mere 10 percent level and the estimated coefficient declines by 1/3 relative to its value in the first column of Table 3. Ignoring the biases in the traditional gravity equation leads to an overestimation of the "euro effect".

To gauge the time patterns of the euro effect we repeated the rolling-window regression estimates of the bias-corrected gravity equation. In the Probit equation the cl variable was replaced with the *gov_qual* indicator. Table 4 reports the results which generally support the findings set out above.

The "euro effect" was initially weak in terms of the value and significance of the interaction variable *emuintro*. Moving the estimation window forward suggests that the euro boosted OFDI during the 2002-2006 period and the global financial and fiscal crises put a break on it. In the sample embracing 2008 (column 9 in Table 4) the euro seems to deter OFDI but the coefficient is insignificant. This is in striking contrast to the results presented in Table 2, where the "euro effect" was found to be the strongest in 2008. Provided the new estimation results we have to conclude that the potency of euro in 2008 is debatable. Successively adding observations from years 2009-2012 does not affect the strength of the "euro effect", which remains significant but the values of its coefficient do not depart from low levels observed shortly after the euro's birth.

5. Conclusions

Using the difference-in-differences method and performing the traditional gravity equation regression analysis leads to an erroneous conclusion that the euro adoption stimulates outward FDI flows. Correcting the gravity equation for the sample selection and firm-heterogeneity biases reveals that the 'euro effect' was weaker or even non-existent over the entire 1985-2012 period. We investigated the trends of the strength of the impact of the euro using the rolling window regression method to show that the euro exerted significant the most powerful positive influence on the OFDI in the years 2003-2005 and 2010-2011. Its impact faded in the years 2006-2007, and the euro was insignificant shortly after its introduction and during the global financial crisis.

Moreover, we confirmed that the size of the home and host economies, the distance between the countries and their cultural proximity are important determinants of outward FDI flows from the OECD countries. These standard factors behind firms' decision to invest abroad lost their importance during the Great Recession and the fiscal crisis in Europe.

We concluded that the euro effect appeared in the OECD countries' OFDI flows but its estimated magnitude is sensitive to the estimation method and examined time period. It should not be a surprise because it seems that it is a phenomenon similar to the evolving role of the "EU effect" also highlighted in this study. Our results should be treated with caution because they are based on aggregated OFDI data. Meanwhile, as in the case of trade, the "euro effect" can be asymmetrically distributed across countries, sectors and firms.

Table 4. Determinants of OFDI flows: Rolling Window Bias-Corrected Results; The Quality of Government Indicator in the Host Economy Used as the Selection Variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Variables	1985-2000	1986-2001	1987-2002	1988-2003	1989-2004	1990-2005	1991-2006	1992-2007	1993-2008	1994-2009	1995-2010	1996-2011	1997-2012
constant	-4,686	-6,867	-8,351	-9,395	-5,221	-10,89	-33,73	-7,485	56,42	-1,738	4,994	3,627	6,124
	(7,718)	(6,652)	(7,093)	(7,891)	(8,554)	(8,363)	(27,58)	(28,54)	(120,2)	(8,341)	(10,39)	(9,592)	(8,087)
GDP(home)	0,702*	0,753*	0,840**	1,069***	1,151**	1,496**	2,654*	1,045	-2,089	0,835	0,470	0,447	0,0782
	(0,361)	(0,369)	(0,346)	(0,387)	(0,462)	(0,561)	(1,522)	(1,474)	(6,003)	(0,576)	(0,512)	(0,527)	(0,565)
GDP(host)	0,702***	0,625***	0,507***	0,602***	0,634*	0,847**	1,252	0,310	-1,426	0,0729	0,00788	0,151	0,0649
	(0,0908)	(0,108)	(0,110)	(0,206)	(0,352)	(0,376)	(0,781)	(0,632)	(3,166)	(0,377)	(0,266)	(0,249)	(0,283)
dist	-0,71***	-0,75***	-0,82***	-1,1***	-1,18**	-1,39***	-2,07*	-0,84	1,47	-0,55	-0,41	-0,55**	-0,56***
	(0,175)	(0,221)	(0,254)	(0,346)	(0,493)	(0,444)	(1,116)	(0,916)	(4,246)	(0,382)	(0,255)	(0,210)	(0,204)
lang	0,606***	0,627***	0,591***	0,616***	0,607***	0,621***	0,733**	0,507*	0,0787	0,465**	0,405**	0,479**	0,505**
	(0,202)	(0,213)	(0,206)	(0,194)	(0,208)	(0,203)	(0,277)	(0,274)	(0,781)	(0,202)	(0,191)	(0,193)	(0,188)
contig	0,163	0,179	0,175	0,254	0,322	0,328	0,327*	0,337*	0,674	0,382*	0,425**	0,424**	0,430**
	(0,218)	(0,216)	(0,215)	(0,211)	(0,209)	(0,193)	(0,184)	(0,189)	(0,601)	(0,202)	(0,193)	(0,197)	(0,198)
colony	0,683**	0,704**	0,831***	1,013***	1,091**	1,264***	1,821*	0,828	-1,007	0,529	0,473*	0,504*	0,537*
	(0,250)	(0,269)	(0,259)	(0,320)	(0,397)	(0,349)	(0,892)	(0,698)	(3,271)	(0,344)	(0,264)	(0,267)	(0,269)
EU(home)	0,197	0,177	0,211	0,121	0,262	0,282	0,301	0,516	1,167	0,630***	0,897***	0,945***	0,996***
	(0,271)	(0,320)	(0,348)	(0,388)	(0,306)	(0,251)	(0,257)	(0,318)	(1,160)	(0,171)	(0,181)	(0,207)	(0,203)

EU(host)	0,413*	0,417	0,342	0,263	0,442**	0,528***	0,753*	0,391	-0,172	0,419***	0,388***	0,393***	0,386***
	(0,212)	(0,249)	(0,208)	(0,200)	(0,193)	(0,183)	(0,404)	(0,346)	(1,012)	(0,112)	(0,112)	(0,118)	(0,131)
emu	-2,572*	-1,348	1,264	2,092	-1,931	-3,056*	2,331	-1,012	-6,080	-2,765*	-1,725	-2,806	-2,102*
	(1,403)	(0,808)	(0,766)	(1,404)	(2,848)	(1,700)	(4,492)	(4,815)	(9,233)	(1,465)	(2,072)	(2,170)	(1,090)
intro	-0,0306	-0,184	-0,422	-0,575	-0,577	-0,437	-0,480	-0,419	-0,753	-0,158	-0,109	-0,278	-0,325
	(0,365)	(0,384)	(0,377)	(0,366)	(0,347)	(0,361)	(0,369)	(0,313)	(0,711)	(0,271)	(0,281)	(0,249)	(0,228)
emuintro	0,537*	0,529*	0,603**	0,734***	0,693***	0,721***	0,846**	0,599**	-0,110	0,534***	0,585***	0,567***	0,533***
	(0,295)	(0,310)	(0,288)	(0,261)	(0,247)	(0,240)	(0,323)	(0,294)	(1,252)	(0,182)	(0,174)	(0,183)	(0,173)
mills	-12,81**	-12,99**	-13,28**	-15,4***	-16,2***	-14,2**	-13,5**	-12,7**	-12,2*	-9,53	-9,1	-11,2	-9,83
	(5,500)	(5,086)	(4,979)	(5,069)	(5,019)	(5,711)	(6,091)	(5,916)	(6,422)	(6,973)	(7,962)	(7,409)	(7,483)
$\hat{z}$	-7,79**	-8,02**	-8,29**	-10,2***	-10,8***	-10,02**	-11,4**	-7,41	-0,58	-4,35	-3,53	-5,18	-4,25
	(3,500)	(3,241)	(3,124)	(3,246)	(3,305)	(3,793)	(4,727)	(4,475)	(12,78)	(4,676)	(5,144)	(4,767)	(4,846)
$\hat{z}^2$	2,011**	2,065***	2,036***	2,323***	2,358***	2,131***	2,085***	1,970***	1,884**	1,570*	1,510	1,771**	1,568*
	(0,721)	(0,650)	(0,601)	(0,624)	(0,600)	(0,647)	(0,677)	(0,656)	(0,708)	(0,796)	(0,908)	(0,848)	(0,856)
$\hat{z}^3$	-0,13**	-0,13**	-0,12***	-0,14***	-0,13***	-0,13**	-0,15***	-0,16***	-0,17***	-0,18***	-0,19**	-0,19**	-0,18**
	(0,0517)	(0,0478)	(0,0419)	(0,0405)	(0,0382)	(0,0506)	(0,0496)	(0,0482)	(0,0542)	(0,0605)	(0,0774)	(0,0757)	(0,0834)
Observations	9,812	10,374	10,964	11,656	12,571	13,435	14,470	15,506	16,496	17,255	18,122	18,924	19,653
R-squared	0,707	0,706	0,705	0,703	0,700	0,698	0,697	0,697	0,697	0,692	0,690	0,688	0,687

Robust standard errors in parentheses; *** p<0,01, ** p<0,05, * p<0,1. Home and host countries and time dummies included.

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