What determines foreign reinvestment?

A study of the choice and composition of FDI types

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Abstract: Reinvestment in subsidiaries aimed to expand foreign production represents half of the FDI projects in developed countries. However, foreign reinvestment remains largely unknown and, related policies underexploited. This paper addresses this issue by explaining the relationship between greenfield and reinvestment FDI in a framework of limited financial commitment between the headquarters (HQ) and the affiliate. The HQ may invest in new plants or reinvest in existing ones. Although an active footprint of affiliates reduces establishment costs for new-comers, high financial and transaction costs may alter the choice between both FDI types. The empirical results obtained using the gravity equation on a global dataset reveal that credit constraints and distance costs have a significant impact on the otherwise positive interaction between both FDI types.

Keywords: FDI; greenfield; reinvestment; credit constraints; FDI finance; gravity equation

JEL Classification: F20, F21, F23

1 Introduction

In recent years economists have successfully explained several varieties of foreign direct investment (FDI): greenfield (Nocke & Yeaple, 2007); mergers (Horn & Persson, 2001; Portes & Rey, 2005), acquisitions (Davies & Kristjánsdóttir, 2010; Head & Ries, 2008), foreign affiliate sales (Bergstrand & Egger, 2007; Kleinert & Toubal, 2010), and partial ownership (Fatica, 2010; Van Assche & Schwartz, 2013). These models have given theoretical substance to empirical studies that highlight the rich variety of FDI types (Hijzen, Görg, & Manchin, 2008; Hyun & Kim, 2010; Klimek, 2011; Qiu & Wang, 2011; Slangen & Hennart, 2008).

While extant literature provides a firm theoretical footing upon which to base empirical research on some FDI types, little research has yet examined reinvestment in foreign affiliates. The literature on reinvestment is not only marginal compared to other FDI types, but predominantly empirical. These studies reveal that foreign reinvestment depends largely on firm's internal factors, such as sales (Wren & Jones, 2009) and the track record of past endeavors (Chiţu, Eichengreen, & Mehl, 2012). Paniagua and Sapena (2013) show that the host's governance variables (e.g. political openness) exhort influence on greenfield but no significant effect on expansions. Gil-Pareja, Llorca-Vivero, and Paniagua (2013) study the differential effects of systemic banking crisis on greenfield and reinvestment. Subsequently, these studies fail to provide theoretical ground upon which its empirical findings rest. Apparently, there is no economic model to explain foreign reinvestment. This paper fills this gap.

Foreign reinvestment represents a significant intake of the world's FDI. The UNCTAD's 2013 *World Investment Report* distinguishes FDI's project composition among

new greenfield projects (i.e. constructing new production facilities abroad); and expansion projects (i.e. increasing production of existing facilities abroad). Together they represent 72% of the cross border economic activity abroad (the rest is mergers and acquisitions). Particularly in developed countries, nearly half the new FDI projects takes place through reinvestment to expand existing production facilities abroad (UNCTAD, 2013b, p. 24). Additionally, reinvested earnings accounted for about one third of total inward FDI income and almost the same share of FDI flows during 2005–2011. Consequently, policymakers allocate substantial resources to aftercare investment services[1] since most FDI "is in the form of re-investment or expansions by existing investors" (Loewendahl, 2001b p. 25). Settled companies require different policies to new entrants since they possess a knowledge asset through their foreign subsidiary which new-comers lack (Loewendahl, 2001b; Wells and Wint, 2000).

Despite the policy and economic interest on the different types of FDI, scholars fail to examine in full several questions related with foreign reinvestment. For example; what are its determinants?; what governs the choice and composition of FDI types (i.e. greenfield and reinvestment FDI)?; does FDI finance play a significant role? As a result, policymakers often find themselves on quicksand implementing policies without a clear understanding of the underlying mechanisms of FDI.

The seminal work of Markusen (1984) and Helpman (1984) led to general equilibrium models accounting for multinational firm's organizational and locational advantages. Mapping the theory of vertical and lateral integration of Grossman and Hart (1986) into international production, Antràs and Helpman (2004) provided a key insight on

[1] For instance, Ireland and Spain IPAs have built departments to deal exclusively with after-care investment. One illustrative example is Oregon, USA, which "focuses exclusively on after-care with existing investors as the primary mechanism to generate new investment" (Loewendahl, 2001a, p. 5).

FDI reinvestment: "headquarter services" which alleviate the transaction costs of FDI. In a scenario featuring firm heterogeneity and fixed costs to modes of international organization, "headquarter services" explain how some firms decide to internalize foreign costs and engage in FDI, even when fixed costs are especially high to prevent offshoring[2]. Affiliates profiting from these headquarter (HQ) reinvestment services internalize costs that other firms cannot. This gives these affiliates a relative advantage over other firms operating in the country. A Multinational Enterprise (MNE) that plans a new greenfield operation abroad benefits from a footprint in the host country. Empirical evidence suggests that foreign investment spills over to other firms (Blomström & Kokko, 1998). Eichengreen and Tong (2007) find evidence to support FDI creation in Asia due to FDI in China. Eichengreen, Rhee and Tong (2007) found "a tendency for China's exports to third markets to crowd out the exports of other Asian countries" (p. 220). Greenaway, Mahabir and Milner (2008) find a similar result (for trade), but in smaller order of magnitude.

However, HQ services are subject to contractual frictions due to a problem of institutional limited commitment, such as expropriations (Hart & Moore, 1994; Thomas & Worrall, 1994) or credit constraints. The ongoing global recession has brought FDI finance to the spotlight. The ability of the headquarters to finance their services towards the affiliate is crucial for FDI. For example, the quality of financial institutions is key in determining the ownership structure of international joint ventures (Van Assche & Schwartz, 2013). Recent research indicates that credit constraints may have an effect on trade (Ahn, Amiti, & Weinstein, 2011; Antràs & Foley, 2013; Ma & Cheng, 2005), FDI (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004; Alfaro & Chen, 2012; Contessi & De Pace, 2011; De

[2] Empirical evidence of FDI and intra-firm trade substitution through headquarter services has been provided by Yeaple (2006).

Maeseneire & Claeys, 2012; Gil-Pareja et al., 2013), foreign employment (Paniagua & Sapena, 2014a), and foreign divestments (Paniagua, 2014). This suggests that the credit constraints may well affect foreign investors' decisions on whether to reinvest or establish greenfield affiliates. Unlike the extant literature on the effect of credit constraints in international economics, little research exists on the effects on FDI finance in the relative choice and composition of FDI types.

The contributions of this paper are the following: Firstly, this paper gives theoretical substance to previous empirical findings on reinvestments. Secondly, our model explains the choice and composition of FDI types (i.e. greenfield and reinvestment FDI). Our model rests upon a setup of financial contractual frictions on the MNE's corporate control (Head & Ries, 2008) due to a problem of limited commitment between headquarter and the affiliate (Antràs & Foley, 2013; Thomas & Worrall, 1994; Van Assche & Schwartz, 2013). Thirdly, this paper provides empirical evidence indicating that relative choice and composition of FDI is governed by distance and financial constraints. Using the latest empirical developments on the FDI gravity equation, we estimate the effect of foreign reinvestment on greenfield capital flows, number of projects and foreign employment on a panel dataset of 161 countries during 2003-2010.

The remainder of the paper is organized as follows. Section 2 constructs the model; section 3 describes the empirical strategy and provides facts on the data; section 4 discusses the results; section 5 makes a sensitivity analysis examining the effect of greenfield on reinvestment FDI; section 6 performs a robustness check using quantile regression and finally section 7 concludes with some implications for policy.

2 The model

To build intuition on the model, consider for example Ford Motor Inc., an American automobile manufacturer. Ford's headquarters in Detroit (USA) has an implicit contract with the plant in Valencia (Spain) to provide services (e.g., finance, technology, expertise) to be able produce the Ford Focus. In Valencia, Ford has an extensive network of international automobile parts providers. On June 2011, Ford announced its biggest reinvestment (€812 million or $1.2 billion) in the Spanish plant for 35 years (Reuters, 2011). In May 2013, the Spanish plant received 72% of the initial investment (Euro Weekly News, 2013). Moreover, the Spanish Registry for FDI accounted an 86% increase of American new foreign investment in Spain during that period (excluding Ford's). This case exemplifies that:

1) headquarter services rarely come at full compliance with the affiliate, as they might be affected by financial constraints at home and the transaction costs between the headquarters and the affiliate.

2) Reinvestment in foreign affiliates may spill over to other foreign firms.

The model considers a foreign affiliate from home country i producing and selling products in country j. The revenue obtained from the sale of a particular product $R_j = R(x_j, Y_j)$, is assumed to be a strictly increasing and concave function of the quantity sold in that country x_j, and an increasing function of the demand Y_j. The concavity in the revenue function may stem from technology, or market preferences. On the supply side, the affiliate costs f_{ij} are assumed to be a fixed cost of international production.

We assume that there is a contract in place between the HQ and the affiliate to sustain foreign production through HQ services. HQ services increase the ability of the affiliate to

increase in technological, organizational or financial capabilities. However, these services rarely come at full. When HQ services are not fully enforced, the HQ does not stand by the initial terms of the contract with the affiliate, reducing the expected revenue stream. Additionally, HQ services imply that the residual rights of control over the affiliate's operations is shifted towards the HQ home country (Antràs, 2003). In particular, the contract is enforced with probability $\gamma_i \in (0,1)$, where γ_i is an index of the financial quality at the home country i.

Reinvestment in foreign affiliates

Let the affiliate receive a fraction $\mu(\tau_{ij}) \in (0,1)$ of the services that would have been generated under no frictions. It is assumed that this fraction will depend on the transaction costs, which is an increasing function of the distance between the two markets. In countries farther apart, headquartered services are less effective. Let $ReFDI_{ij}$ be the investment needed to provide the service. Therefore the constraint of the MNE results in:

$$(1 + r_i) \cdot ReFDI_{ij} \leq \big(\gamma_i + (1 - \gamma_i)\mu(\tau_{ij})\big)(R_j) \qquad [1]$$

where r_i is the interest rate faced by the MNE to finance $ReFDI_{ij}$. Equation [1] reflects that with probability $(1 - \gamma_i)$, the headquarter is not abiding by the contract with the affiliate and revenue is shaved by $\mu(\tau_{ij})$. The profitability of headquartered services with contractual frictions is given by:

$$\pi^{ReFDI} = max\left\{\frac{\big(\gamma_i + (1 - \gamma_i)\mu(\tau_{ij})\big)}{(1 + r_i)} R_j - f_{ij}\right\} \qquad [2]$$

Reinvestments in foreign affiliates decreases in the distance between countries and in the interest rates in the home country r_i. Reinvestment increases in the financial stability at home γ_i. Furthermore, reinvestments is strictly increasing and concave function of the quantity sold in that country x_j, and an increasing function of the demand Y_j.

Greenfield FDI

Consider that the headquarters decide to engage into international production in a new facility in country j. We still assume that a contract enforces headquarter and the new affiliate. The responsibility of building the plant relies at home if the MNE has no footprint in j. In other words, the residual right of control is shifted towards the headquarters. Foreign financing costs are captured by assuming a probability γ_i that the contract is enforced, being γ_i a measure of the financial quality at home. In this case, the expected revenue will diminish by a fraction $\delta(\tau_{ij}) \in (0,1)$. This transaction costs captures the difficulties of the MNE to deal with foreign operations. Therefore the constraint of the MNE results in:

$$(1 + r_i)FDI_{ij} \leq \big(\gamma_i + (1 - \gamma_i)\delta(\tau_{ij})\big)(R_j) \qquad [3]$$

Which reads that with a probability $(1 - \gamma_i)$, the affiliate is not abiding by the contract with the headquarter in building the new plant and expected revenue is reduced by $\delta(\tau_{ij})$.

The expected returns are:

$$\pi^{GFDI} = max\left\{\frac{\big(\gamma_i + (1 - \gamma_i)\delta(\tau_{ij})\big)}{(1 + r_i)}R_j - f_{ij}\right\} \qquad [4]$$

Greenfield investments decreases in the distance between countries and in the interest rates in the home country r_i. Greenfield investments increase in the financial quality at home γ_i. Furthermore, greenfield FDI is strictly increasing and concave function of the quantity sold in that country x_j, as an increasing function of the demand Y_j.

Greenfield and Reinvestments

Consider now a scenario in which the greenfield investment is executed in a country where the headquarter is already transferring headquartered services to an established affiliate. For simplicity, we assume that the expected revenue and fixed costs from this new

facility are the same that the existing plant. In a setup where settled affiliates are locked in the host's economy (Paniagua & Sapena, 2013), the affiliate has access to local credit and providers. Therefore, the residual right of control is optimally shifted towards the existing affiliate, meaning that the responsibility of building the plant relies on the established affiliate. However, the affiliate faces local constraints that limit their expected income. For example, in the construction of the plant, the MNE might face local credit constraints, which are specially relevant for FDI. Additionally, the institutional quality (i.e. corruption, business climate) of the host is challenge to the expected revenue (Berden, Bergstrand, & Etten, 2013; Paniagua & Sapena, 2014b). This is captured by assuming a probability γ_j that the contract is enforced, being γ_j a joint measure of the financial quality at the host. In this case the expected revenue will diminish by a fraction $\mu_X \in (0,1)$. This fraction represents the extent of headquartered services that are spilled over from the established affiliate to the new plant. Since both are in the same country the reduction is not entitled to distance costs. The expected returns in this case are:

$$\pi^{GFDI} = max\left\{\frac{\left(\gamma_j + \left(1-\gamma_j\right)\mu_X\right)}{\left(1-r_j\right)} R_j - f_{ij}\right\} \qquad [5]$$

Applying the envelope theorem to expressions [3] and [5], the MNE prefers a greenfield investment over a reinvestment if and only if:

$$\frac{\left(\gamma_j + \left(1-\gamma_j\right)\mu_X\right)}{\left(1-r_j\right)} > \frac{\left(\gamma_i + (1-\gamma_i)(\tau_{ij})\right)}{(1+r_i)} \qquad [6]$$

From [6], the next conclusions follow:

Proposition. The choice and composition of FDI types (greenfield and reinvestment) is governed by the relative magnitude of the contractual frictions and exogenous financial costs. The likelihood that a greenfield investment occurs in a country with established

affiliates in expansion is increasing in the financial quality of the host country (γ_j) and in the distances between countries $\mu(\tau_{ij})$. It is decreasing in the financial quality at home (γ_i).

The relative difficulty of managing new operations abroad is alleviated by the footprint of other foreign affiliates. However, in markets close to home country *i*, pre-existing facilities are not as crucial as in markets farther away. The difficulty to raise capital for foreign projects has an important role in FDI's relative choice and composition. Credit constraints at the host amend effect that reinvestment has on greenfield FDI, which is otherwise positive. Short of local credit, the affiliate responsible for the construction of new plants will either construct less plants or smaller ones. Credit constraints at home reinforce the interaction of reinvestment and greenfield. Short of foreign credit, the HQ prefers to build new greenfield plants close to its existing affiliates rather than on new countries.

3 Data and empirical strategy

The gravity equation is widely used in empirical research and explains successfully a variety of dyadic economic interactions, such as trade, FDI, financial equities, migration, tourism, employment or commodity flows (Anderson, 2011; Bergstrand & Egger, 2011; Griffith, 2007). To have a full empirical picture of the theoretical model, the approach of this study is to examine capital FDI flows, FDI project count (i.e. extensive margin) and foreign jobs. The gravity model for FDI capital flows has a sound theoretical derivation from a general equilibrium where domestic and foreign enterprises coexist in a host country (Bergstrand & Egger, 2007; Markusen & Venables, 2000; Markusen, 2002). Researchers incorporate the extensive margin in order to reduce an over aggregation bias of capital flows (Hillberry, 2002). Recent developments in the gravity literature provide a rationale

for the creation of new investor partners through the estimation of the extensive margin (Anderson, 2011).

Since dyadic FDI data is typically characterized by numerous zeros, in line with other empirical studies (Berden et al., 2013; Bergstrand, Larch, & Yotov, 2013; Kleinert & Toubal, 2010), we use a similar non-linear specification of the FDI gravity equation. In particular, we estimate a non-linear variant of the gravity equation a Poisson pseudo-maximum likelihood (PPML) estimator similar to that proposed by Silva and Tenreyro (2006), which offers consistent estimates of data with zeros since this estimator does not require a log-linearization of the variables. In particular we estimate three equations for capital flows, number of projects and jobs:

$$\begin{bmatrix} GFDI_{ijt} \\ GN_{ijt} \\ Gjobs_{ijt} \end{bmatrix} = e^{\left(\begin{matrix}\beta_1 ln(D_{ij})+\beta_2 lang_{ij}+\beta_3 border_{ij}+\beta_4 col_{ij}+\beta_5 rel_{ij}+\beta_6 smctry_{ij}+\beta_7 BIT_{ijt}+\beta_8 FTA_{ijt} \\ +\beta_{10} CC_{ijt}+\beta_{11} DuRe_{ijt}+\beta_{12} DuRe_{ijt}*GR_{it}+\beta_{13} DuRe_{ijt}*GR_{jt}+\beta_{14} DuRe_{ijt}*\ln(D_{ij})+\delta_{jt}+\delta_{it}\end{matrix}\right)} + \varepsilon_{ijt} \quad [7]$$

where $GFDI_{ijt}$ is the aggregate greenfield investment between home country *i* and host *j* in year t; GN_{ijt} is the number of projects (extensive margin); $Gjobs_{ijt}$ is the number of greenfield jobs; D_{ij} is the distance in kilometers between country pairs; col_{ij} (Colony) is set to 1 if the two countries have ever had a colonial link; $lang_{ij}$ (Common language) takes positive value if both countries share the same official language; rel_{ij} (Religion) is a composite index which measures the religious affinity between country pairs with values from zero to one; $smctry_{ij}$ (Same country) indicates if both countries where part of the same country in the past; BIT_{ij} (Bilateral investment treaty) is a dummy that takes a value of one if the country pair has a bilateral investment treaty in force; FTA_{ij} (Free Trade Agreement) is a dummy that indicates if both countries have a free trade agreement in force; CC_{ijt} (Common currency) is set to 1 if countries share a common currency or have a

fixed exchange rate. Additionally, we add fixed home and host country time-varying dummies (δ_{it} and δ_{jt}) to control for multilateral resistance (Anderson & Van Wincoop, 2003); lastly ε_{ijt} represent an stochastic error term. $DuRe_{ijt}$ is a dummy variable that is set to 1 if an affiliate from country *i* expanded its activities through reinvestment in country *j* during year *t* and 0 otherwise. $DuRe_{ijt}$ captures the net effect of reinvestment on greenfield FDI.

To detangle the predictions from our research proposition we use the interaction between the reinvestment dummy, distance and the financial constraints: With $DuRe_{ijt} * \ln(D_{ij})$ we measure the effect of distance on the relationship between FDI flavors. Our model predicts a positive coefficient.

To detangle credit constraints on a gravity framework we introduce dummy variables which capture the impact of credit availability on FDI. We use GR_{it}, for home country involved in the Great Recession and GR_{jt} for host countries. GR_{it} gives the impact of home local constraints. With GR_{jt} we disentangle the effect of local credit constraints on international investment. With $DuRe_{ijt} * GR_{it}$ we capture the effect of financial constraints at home (we expect a positive sign) and with $DuRe_{ijt} * GR_{jt}$ at the host (we expect a negative sign). The list of countries and years can be found in Laeven and Valencia (2012).

Moreover, to grasp the magnitudes involved in this relationship, we estimate the relative change of capital reinvestments on greenfield FDI, or the FDI flavor elasticity with the following equation:

$$\begin{bmatrix} GrFDI_{ijt} \\ GrN_{ijt} \\ Grjobs_{ijt} \end{bmatrix} = e^{\begin{pmatrix} \beta_1 \ln(D_{ij}) + \beta_2 lang_{ij} + \beta_3 border_{ij} + \beta_4 col_{ij} + \beta_5 rel_{ij} + \beta_6 smctry_{ij} \\ + \beta_7 BIT_{ijt} + \beta_8 FTA_{ijt} + \beta_{10} CC_{ijt} + \beta_{15} lnReFDI_{ijt} + \delta_{jt} + \delta_{it} \end{pmatrix}} + \varepsilon_{ijt} \qquad [8]$$

where $lnReFDI_{ijt}$ is the log quantity of the capital reinvestment in the expansion project. Equation [8] captures the net composition effect of an increase in reinvestments on greenfield investments.

Data Sources

Distance, common language, colony and border come from the CEPII (2011) database and control for freight, information, cultural, historic and administrative transaction costs between country pairs. Religious affinities increases the probability of economic transactions between nations with similar values and beliefs (Helble, 2007). The variable religion was introduced in the gravity equation by Helpman, Melitz, and Rubinstein (2008) as a control variable for religious affinities between trade partners. It is calculated with data from CIA World Factbook (2011) according to following formula for country each country pair: $\%Christian_i*\%Christian_j + \%Muslim_i* \%Muslim_j + \%Buddhist_i*\%Buddhist_j + \%Hindu_i*\%Hindu_j + \%Jewish_i*\%Jewish_j$. Institutional agreements such as Free Trade Agreements and Bilateral Investments Treaties reduce the uncertainty in foreign investments (Bergstrand & Egger, 2013). BIT is manually constructed with data from UNCTAD (2011). The source of FTA is Head, Mayer, and Ries (2010) complimented UNCTAD (2011) data. For a detailed description of the variables, countries and descriptive statistics, refer to Paniagua and Sapena (2013, 2014b).

4 Results and discussion

The results shown in Table 1 show that, overall, the gravity equations performs well explaining over 70% of the variation of aggregate greenfield FDI bilateral flows. Most of the variables are statistically significant with the expected signs. The first three columns show the results for the least squares estimation (OLS) benchmark estimation of equation

[7]. The next three columns (4)-(6) show results of our preferred PPML estimation of [7]. Finally, the last three columns present the results of estimating equation [8] with PPML.

Table 1 here

Focusing on the variables of interest, country pairs with reinvestment projects increase their greenfield FDI 15% on average[3]. In line the FDI spill-over hypothesis, aggregate greenfield reinvestments respond positively to reinvestment on existing affiliates. This effect is greater in foreign employment, with an average increase of 27%. The extensive margin is, however, not affected by expansion of foreign productive activity. Thus, we find that reinvestment increases the capital and labor volume of greenfield projects, but it does not attract new greenfield projects. This result is robust to a change in the estimation methodology. In the next three columns, we obtain similar coefficients with the log-linear OLS estimator.

As proposed in the model, the effect of reinvestment is more intensive for countries farther apart. The coefficient of $DuEx_{ij} * D_{ij}$ is positive and significant in all three specifications. Doubling the distance between country pairs adds approximately 1% to the effect reinvestment on greenfield FDI margins and 2% on employment[4].

In line with previous results of credit constraints on FDI (Gil-Pareja et al., 2013), the effect of credit constraints reduces the effect of reinvestment on greenfield FDI only on the extensive margin. The size of FDI projects is relatively fixed (e.g., the costs of construction of a car manufacturing plant are relatively sunk and unavoidable). Consequently, under financial turmoil, foreign investors decide to place less bets than smaller ones.

[3] Calculated as $(e^{0.148} - 1) * 100\%$.
[4] Doubling distance effect is calculated as $(2^{0.025} - 1) * 100\%$

Particularly, financial restrictions at the host country reduce the spill-over effect of reinvestment on greenfield by 25% on average. Thus, credit constraints have a double net negative effect on greenfield investment. Credit constraints make a better case for reinvestment and thus decrease the number of greenfield projects in country pairs with reinvestment projects.

The results for the estimation of the composition elasticity in equation [8] are presented in columns 7-9. For the sub-sample of country pairs with reinvestment, its quantity is the main determinant of aggregate flows and foreign jobs (column 7 and 9). An increase of 1% in capital reinvestment on foreign affiliates increases bilateral greenfield FDI flows in 0.17% and 0.1% jobs. The extensive margin remains unaffected by the quantities reinvested (column 8).

Distance costs have no effect on greenfield FDI in country pairs with positive reinvestment flows. According to the proximity-concentration tradeoff, a positive impact of distance in FDI is expected (Markusen, 2002). Daniels and von der Ruhr (2014) find that transportation costs have a positive and statistically significant relationship with FDI, suggesting a substitute relationship between FDI and trade flows. However, most of the empirical studies show a negative relationship between distance and FDI (Bergstrand & Egger, 2011). Therefore, the impact of distance on FDI accounts for more than just freight costs (i.e., reputational and governance costs), as result of limited commitment between the headquarters and affiliate. The non-significant effect of distance in greenfield FDI in countries with expanding established affiliates suggests that distance encapsulates much more than freight costs. The greenfield plant has an existing network which eases the search of credit, customers, institutional relationships. In other words, the relative difficulty

of managing new operations abroad is alleviated by the existence of facilities in host country.

5 Sensitivity analysis: Reinvestment

To check the validity of the empirical results, we perform a counterfactual test of the proposition. That is, the likelihood that reinvestment in a country with greenfield FDI is decreasing in the financial quality of the host country (γ_j) and in the distances between countries $\mu(\tau_{ij})$; and it is increasing in the financial quality at home (γ_i).

We test the effect of greenfield operations on reinvestment using the following equations:

$$\begin{bmatrix} ReFDI_{ijt} \\ ReN_{ijt} \\ Rejobs_{ijt} \end{bmatrix} = e^{\begin{pmatrix} \beta_1 ln(D_{ij})+\beta_2 lang_{ij}+\beta_3 border_{ij}+\beta_4 col_{ij}+\beta_5 rel_{ij}+\beta_6 smctry_{ij}+\beta_7 BIT_{ijt}+\beta_8 FTA_{ijt} \\ +\beta_{10} CC_{ijt}+\beta_{11} DuG_{ijt}+\beta_{12} DuG_{ijt}*GR_{it}+\beta_{13} DuG_{ijt}*GR_{jt}+\beta_{14} DuG_{ijt}*\ln(D_{ij})+\delta_{jt}+\delta_{it} \end{pmatrix}} + \varepsilon_{ijt} \qquad [9]$$

where $ReFDI_{ijt}$ is the aggregate reinvestment between home country *i* and host *j* in year t; ReN_{ijt} is the number of reinvestment projects (extensive margin); $Rejobs_{ijt}$ is the number of reinvestment jobs; DuG_{ijt} is a dummy variable that is set to 1 if an MNE from country *i* invested in a greenfield project in country *j* during year *t* and 0 otherwise; the interaction between greenfield project and distance is named $DuG_{ijt} * \ln(D_{ij})$; $DuG_{ijt} * GR_{it}$ captures the interaction of greenfield projects and financial constraints at home and financial constraints at the host are captured with $DuG_{ijt} * GR_{jt}$. The expected signs of the interactive variables are reversed.

To quantify the effect on reinvestment we use a similar equation to [8]:

$$\begin{bmatrix} ReFDI_{ijt} \\ ReN_{ijt} \\ Rejobs_{ijt} \end{bmatrix} = e^{\begin{pmatrix} \beta_1 ln(D_{ij})+\beta_2 lang_{ij}+\beta_3 border_{ij}+\beta_4 col_{ij}+\beta_5 rel_{ij}+\beta_6 smctry_{ij} \\ +\beta_7 BIT_{ijt}+\beta_8 FTA_{ijt}+\beta_{10} CC_{ijt}+\beta_{15} lnGFDI_{ijt}+\delta_{jt}+\delta_{it} \end{pmatrix}} + \varepsilon_{ijt} \qquad [10]$$

where all the variables have the same meaning as in previous equations.

The results in Table 2 show that, overall, the gravity equations performs well explaining over 60% of the variation of reinvestment FDI bilateral flows. Most of the variables are statistically significant with the expected signs. The first three columns show the results for the least squares estimation (OLS) benchmark estimation of equation [9]. The next three columns (4)-(6) show results of our preferred PPML estimation of [9]. Finally, the last three columns present the results of estimating equation [10] with PPML.

Table 2 here

As expected, the effect of distance is negative, that is MNE tend to reinvest less in faraway countries with greenfield operations in place. This result is robust for reinvestment flows and jobs in both linear and non-linear empirical specifications. However, distance has no effect on the number of reinvestments, only on their quantities. This would suggest that foreign investors place smaller reinvestment bets, rather than less bets.

The effect of a crisis at home has a clear negative effect on the interaction of reinvestment and greenfield FDI. Short of home credit, the MNE cannot provide in full HQ services to reinvest, especially with running greenfield operations. The effect of credit constraints is non-significant for reinvestment capital flows and foreign employment. Contrarily as expected, it has a negative effect on only on the extensive margin. However this effect is marginally significant and not robust in the OLS coefficient.

Additionally, Greenfield FDI increases reinvestment quantities and jobs. Similarly to the previous results in Table 1, the presence of greenfield FDI does not have an effect on new reinvestment FDI. This result lets us conclude that FDI's composition is governed at the intensive margin. This result suggests that the MNE's network in the host country has an effect only on the size of foreign bets (in terms of capital and labor). Other factors (e.g.

transaction costs or market size) are more important than the MNE's foreign network in the decision to undertake new projects.

The net effect of increasing greenfield FDI on foreign reinvestment is given in the last three columns of Table 2. The effect of greenfield FDI on reinvestment is higher than reinvestment on greenfield. Not only in the magnitudes of capital invested (18% vs. 16%) and jobs created (13% vs. 10%), but also on the effect on the extensive margin. For the subset of countries with both types of FDI, reinvestment had no effect on new greenfield FDI. However, increasing 1% greenfield FDI on countries with both types of investment, increases 0.11% reinvestment on average.

6 Sensitivity analysis: quantile regression

Quantile regression is popular to interpret results of skewed data like wages (Buchinsky, 1994), portfolio returns (Yu, Lu, & Stander, 2003), international trade (Dufrénot, Mignon & Tsangarides, 2010, Fidrmuc, 2009 and Figueiredo, Lima & Schaur, 2014) and FDI (Figueiredo, Paniagua, & Sapena, 2014). Standard linear regression techniques summarize the average relationship between a set of regressors and the outcome variable based on the conditional mean function $E(y|x)$, assumed to be normal and symmetrically distributed. This provides only a biased view of the relationship, especially when most of the data is concentrated at different points in the conditional distribution of the dependent variable. Quantile regression provides that capability (Koenker & Bassett, 1978; Yu et al., 2003). Additionally, quantile regression is more robust to outliers than least squares regression, and avoids assumptions about the parametric distribution of the error process (Conley & Galenson, 1998).

In particular, the FDI gravity quantile empirical equation yields in:

$$Q_\tau[ln(FDI_{ijt})|x_{ijt}] = x_{ijt}\,\beta(\tau) + v_{ij}, \qquad [11]$$

where α_{ij} are the fixed effects that affects only the location; $\beta(\tau)$, $\tau \in (0,1)$ are the parameters of interest; $v_{ij} \sim iidF_v\ (\mu, \sigma^2)$, where F_v is an unknown continuous distribution function of v_{ij}, and; x_{ijt} is the standard set of gravity control variables observed at time *t*. The estimates of the parameters are obtained minimizing the following formula:

$$\min_{\beta_q}\left[\sum_{t|FDI_{ijt}\geq x_{ijt}\beta_q} q|lnFDI_{ijt} - x_{ijt}\beta_q| + \sum_{t|FDI_{ijt}<x_{ijt}\beta_q} (1-q)|lnFDI_{ijt} - x_{ijt}\beta_q|\right] \qquad [12]$$

where q is the quantile size parameter ($0 < q < 1$).

The quantile results show in Table 3 show, in general, the expected coefficient signs. To avoid identification issues in the quantiel regression, we include the sum of Gross Domestic Product[5] as an independent regressor. These quantile results unravel an interesting effect of credit constraints. The model predicts that greenfield FDI decreasing in the financial quality at home (i.e. increasing with credit constraints). Figure 1 shows how the effect of $DuEx_{ijt} * GR_{it}$ increases in the upper quantiles. The positive effect of home credit constraints on FDI spill-overs is, therefore, concentrated in levels above the median. Since small projects are easily financed, MNEs find a way to hedge credit constraints on large projects with credit in the affiliate's host country.

Table 3 here

[5] The World Bank (2011) is the source of GDP sum, measured in constant 2000 US dollars.

7 Conclusions

This paper offers several contributions to the FDI literature. Resting upon a setup of limited financial commitment between headquarters and affiliate, our model explains the interplay of greenfield and reinvestment FDI. Results suggest that both FDI types have a positive effect on FDI capital flows, projects (extensive margin) and foreign employment. Furthermore, reinvestment alleviate the negative effect of distance on greenfield FDI. This finding is consistent with the extant proximity-concentration literature, which suggests a positive effect of distance in horizontally integrated FDI. However, this effect is counterbalanced with the negative effect credit restrictions at the host country.

This paper sheds some light on FDI's relative choice composition. Given the mutual positive interaction, one possible equilibrium of FDI types includes a symmetrical balance of reinvestment and greenfield projects. This situation would be more apparent in countries with less transaction costs (e.g. distance and financial constraints), such as developed countries.

The empirical results suggest that reinvestment in foreign facilities have an effect on the size of new FDI projects, but not on the number of them. This result provides useful to determine the best suited government's policy instruments and initiatives to promote FDI. Host countries planning to increase their FDI volumes should pay attention to established affiliates. However, policies targeted to increase FDI projects should aim at other factors, such as internal demand and credit availability.

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Figure 1. GR coefficients by quantile

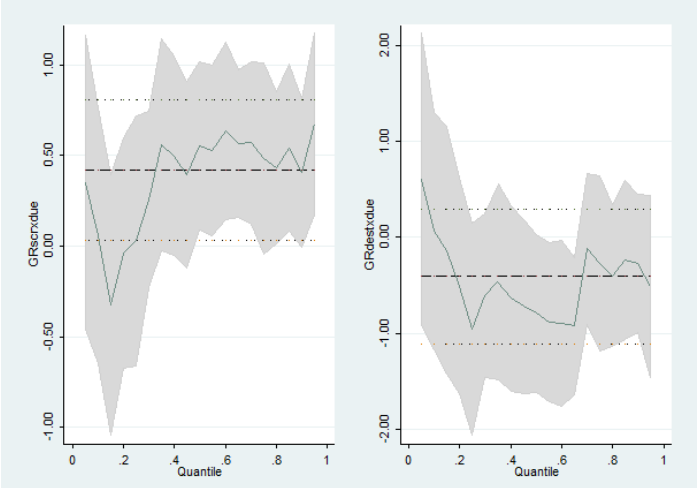

Table 1 Results (Greenfield)

	(1) FDI flows	(2) Extensive Margin	(3) Jobs	(4) FDI flows	(5) Extensive Margin	(6) Jobs	(7) FDI flows	(8) Extensive Margin	(9) Jobs
$\ln(D_{ij})$	-0.202***	-0.073****	-0.221***	-0.427**	-0.328***	-0.398***	-0.343	0.402**	-0.207
	(0.03)	(0.01)	(0.0327)	(0.03)	(0.03)	(0.04)	(0.22)	(0.18)	(0.25)
col_{ij}	0.388***	0.142***	0.320***	0.537***	0.559***	0.471***	-0.399	0.219	0.648
	(0.07)	(0.02)	(0.0749)	(0.05)	(0.06)	(0.07)	(0.46)	(0.87)	(1.04)
$lang_{ij}$	0.375***	0.089***	0.343***	0.472***	0.426***	0.673***	-0.489	0.517	1.651**
	(0.06)	(0.02)	(0.06)	(0.05)	(0.06)	(0.07)	(0.05)	(0.79)	(0.72)
$smctry_{ij}$	0.175	0.002	0.196	0.130	-0.007	-0.084	-0.604	0.427	-1.923**
	(0.15)	(0.04)	(0.14)	(0.09)	(0.09)	(0.16)	(0.81)	(0.58)	(0.86)
$border_{ij}$	0.125	0.070**	0.215***	0.024	0.928	0.132	0.065	0.273	0.132
	(0.0768)	(0.02)	(0.07)	(0.06)	(0.06)	(0.08)	(0.48)	(0.48)	(0.08)
rel_{ij}	0.226*	0.094**	0.168*	0.383***	0.213***	0.128	0.683	0.213***	0.128
	(0.119)	(0.03)	(0.10)	(0.12)	(0.10)	(0.11)	(0.84)	(0.10)	(0.11)
$comcurr_{ijt}$	0.012	-0.005	0.048	0.051	-0.005	-0.041	0.122	0.381	0.571
	(0.04)	(0.01)	(0.03)	(0.03)	(0.03)	(0.04)	(0.31)	(0.41)	(0.38)
FTA_{ijt}	0.0813	-0.016	0.048	0.030	0.100**	0.218***	-0.085	0.453	0.387
	(0.06)	(0.01)	(0.05)	(0.05)	(0.04)	(0.07)	(0.46)	(0.33)	(0.53)
BIT_{ijt}	-0.152***	-0.083***	-0.147***	-0.107**	-0.158***	-0.090*	0.368	-0.132	-0.560**
	(0.05)	(0.01)	(0.04)	(0.05)	(0.04)	(0.0)	(0.40)	(0.21)	(0.25)
$DuRe_{ijt}$	0.146*	0.027	0.054	0.148**	0.113	0.240**			
	(0.08)	(0.03)	(0.07)	(0.07)	(0.09)	(0.09)			
$DuRe_{ijt} * GR_{it}$	-0.117	-0.022	-0.152	0.174	-0.101	-0.339			
	(0.221)	(0.09)	(0.23)	(0.14)	(0.21)	(0.22)			
$DuRe_{ijt} * GR_{jt}$	-0.384	-0.167***	0.003	-0.115	-0.282**	0.278			
	(0.32)	(0.05)	(0.33)	(0.26)	(0.12)	(0.31)			
$DuRe_{ijt} * \ln(D_{ij})$	0.019**	0.00353	0.007	0.018**	0.014*	0.025**			
	(0.01)	(0.003)	(0.01)	(0.01)	(0.01)	(0.01)			
$lnReFDI_{ijt}$							0.168**	0.048	0.100*
							(0.08)	(0.09)	(0.06)
Observations	8877	8877	8877	27423	27143	27122	846	848	852
R^2	0.452	0.492	0.423	0.70	0.68	0.68	0.95	0.80	0.96
Estimation	OLS	OLS	OLS	PPML	PPML	PPML	PPML	PPML	PPML

Robust Standard errors in parentheses, Year*Country dummies
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2. Sensitivity Analysis (Reinvestment)

	(1) FDI flows	(2) Extensive Margin	(3) Jobs	(4) FDI flows	(5) Extensive Margin	(6) Jobs	(7) FDI flows	(8) Extensive Margin	(9) Jobs
$\ln(D_{ij})$	0.288	-0.00473	-0.413**	0.0267	-0.184***	0.143	-0.101	-0.135***	-0.133
	(0.195)	(0.0231)	(0.184)	(0.101)	(0.0507)	(0.108)	(0.109)	(0.0446)	(0.113)
col_{ij}	-0.0586	0.131*	0.140	0.323**	0.449***	0.188	0.0595	0.256**	-0.0440
	(0.318)	(0.0720)	(0.255)	(0.142)	(0.0886)	(0.160)	(0.159)	(0.102)	(0.171)
$lang_{ij}$	0.0346	0.103**	0.291	0.203	0.347***	0.573***	0.139	0.315***	0.538***
	(0.193)	(0.0481)	(0.177)	(0.127)	(0.0791)	(0.149)	(0.163)	(0.101)	(0.170)
$smctry_{ij}$	-0.975*	-0.0982	-0.967*	-0.231	0.0966	-0.345	-0.106	0.397**	-0.205
	(0.586)	(0.102)	(0.504)	(0.273)	(0.147)	(0.303)	(0.352)	(0.189)	(0.351)
$border_{ij}$	0.113	0.0178	0.538**	0.224	0.118	0.514**	0.148	-0.0370	0.374
	(0.316)	(0.0570)	(0.273)	(0.166)	(0.0943)	(0.214)	(0.211)	(0.114)	(0.263)
rel_{ij}	0.113	0.0178	0.538**	0.224	0.118	0.514**	0.148	-0.0370	0.374
	(0.316)	(0.0570)	(0.273)	(0.166)	(0.0943)	(0.214)	(0.211)	(0.114)	(0.263)
$comcurr_{ijt}$	-0.160	-0.154	-0.974	-0.978**	-0.112	-1.155**	-1.335***	-0.163	-1.328**
	(0.674)	(0.146)	(0.659)	(0.380)	(0.288)	(0.537)	(0.479)	(0.335)	(0.640)
FTA_{ijt}	-0.160	-0.154	-0.974	-0.978**	-0.112	-1.155**	-1.335***	-0.163	-1.328**
	(0.674)	(0.146)	(0.659)	(0.380)	(0.288)	(0.537)	(0.479)	(0.335)	(0.640)
BIT_{ijt}	-0.104	-0.0347	-0.118	-0.318***	-0.182***	-0.213*	-0.334***	-0.192***	-0.0912
	(0.155)	(0.0287)	(0.147)	(0.107)	(0.0546)	(0.109)	(0.125)	(0.0658)	(0.130)
DuG_{ijt}	4.274**	0.771***	5.930***	2.510***	0.359	3.716***			
	(1.768)	(0.243)	(1.528)	(0.903)	(0.435)	(0.947)			
$DuG_{ijt} * GR_{it}$	-0.227	0.246	1.166*	-0.811**	-0.479	-0.980*			
	(0.831)	(0.225)	(0.641)	(0.385)	(0.319)	(0.580)			
$DuG_{ijt} * GR_{jt}$	0.202	-0.00771	-0.194	0.0904	-0.140	-0.517*			
	(0.559)	(0.0987)	(0.511)	(0.370)	(0.217)	(0.309)			
$DuG_{ijt} * \ln(D_{ij})$	-0.469**	-0.0919***	-0.632***	-0.178*	0.0231	-0.287***			
	(0.200)	(0.0281)	(0.174)	(0.103)	(0.0506)	(0.108)			
$lnGFDI_{ijt}$							0.185***	0.106***	0.130***
							(0.0432)	(0.0191)	(0.0439)
Observations	1836	1836	1836	5792	5735	5714	2401	2345	2346
R^2	0.534	0.409	0.574	0.583	0.541	0.660	0.678	0.670	0.707
Estimation	OLS	OLS	OLS	PPML	PPML	PPML	PPML	PPML	PPML

Robust Standard errors in parentheses, Year*Country dummies

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3. Quantile Regression results (Greenfield)

	(1) Q(0.10)	(2) Q(0.25)	(3) Q(0.50)	(4) Q(0.75)	(5) Q(0.90)
$\ln(GDP_{it} * GDP_{jt})$	0.227***	0.251***	0.252***	0.244***	0.235***
	(0.0135)	(0.0127)	(0.00897)	(0.0121)	(0.0116)
$\ln(D_{ij})$	-0.342***	-0.271***	-0.207***	-0.221***	-0.204***
	(0.0500)	(0.0448)	(0.0280)	(0.0315)	(0.0252)
col_{ij}	0.412***	0.605***	0.532***	0.423***	0.334***
	(0.138)	(0.124)	(0.0803)	(0.0926)	(0.0764)
$lang_{ij}$	0.443***	0.351***	0.237***	0.111	0.151***
	(0.102)	(0.0912)	(0.0590)	(0.0679)	(0.0556)
$smctry_{ij}$	0.0956	-0.00948	0.0860	0.307*	0.331**
	(0.241)	(0.217)	(0.138)	(0.161)	(0.133)
$border_{ij}$	-0.188	0.162	0.290***	0.118	-0.00146
	(0.147)	(0.131)	(0.0830)	(0.0956)	(0.0775)
rel_{ij}	-0.0387	-0.0120	0.0855	0.0283	-0.0172
	(0.124)	(0.110)	(0.0690)	(0.0781)	(0.0638)
$comcurr_{ijt}$	-0.0325	0.0889	0.00120	0.0422	0.00287
	(0.0770)	(0.0697)	(0.0446)	(0.0514)	(0.0420)
FTA_{ijt}	0.0824	-0.0724	-0.122**	-0.164***	-0.205***
	(0.0925)	(0.0838)	(0.0523)	(0.0589)	(0.0475)
BIT_{ijt}	0.0717	0.125*	0.126***	0.0746	0.0969**
	(0.0739)	(0.0670)	(0.0425)	(0.0487)	(0.0398)
$DuRe_{ijt}$	0.282**	0.144	0.225***	0.187**	0.310***
	(0.142)	(0.129)	(0.0823)	(0.0942)	(0.0757)
$DuRe_{ijt} * GR_{it}$	0.0542	0.0300	0.551**	0.483*	0.403*
	(0.360)	(0.352)	(0.237)	(0.269)	(0.208)
$DuRe_{ijt} * GR_{jt}$	0.0631	-0.957*	-0.789*	-0.269	-0.271
	(0.631)	(0.565)	(0.419)	(0.466)	(0.366)
$DuRe_{ijt} * \ln(D_{ij})$	0.0356**	0.0226	0.0283***	0.0234**	0.0393***
	(0.0166)	(0.0153)	(0.01000)	(0.0112)	(0.00892)
Observations	8877	8877	8877	8877	8877

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$