ASYMMETRIES IN BILATERAL FDI FLOWS BETWEEN COUNTRY-PAIRS EXPLAINED: HETEROGENEOUS FIRM PRODUCTIVITIES

Jinzhuo Zhao Garrett[1]
Hampden-Sydney College

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Abstract

This paper constructs a monopolistic competition model with firms varying in productivity levels that generate bilateral FDI flows and a large number of zeros, as observed in the data. The investment decision by multinationals involves first determining whether productivity is high enough to overcome the fixed cost of investment and then, conditional on investing, deciding how much to invest in the destination country. Data on bilateral FDI flows between 104 countries from 1995 to 2002 is used to estimate this model employing a Heckman two-step selection procedure. Results highlight that some characteristics previously considered important for determining FDI flows in traditional OLS estimations may only matter for the selection into an FDI relationship, and in some cases, may even negatively affect FDI flows.

Keywords: Bilateral foreign direct investment, Multinationals, Intra-industry firm heterogeneity
JEL Classification: F21, F23, F1

[1] J.Z. Garrett, Department of Economics, Hampden-Sydney College, Department of Economics, Hampden Sydney, VA 23943-0868, USA. Phone: (434)223-6200. Fax: (434)223-6504. Email: jzgarrett@hsc.edu

1. Introduction

When considering the flows of bilateral FDI, every country is potentially both a recipient and a source of FDI with more than one partner. Despite the record-breaking numbers in worldwide FDI flows, a large number of country-pairs do not have FDI flows between them[2]. Even when only considering developed economies, which dominate both global inflows and outflows, nearly half of OECD countries' potential bilateral FDI pairs are not realized from over 50 percent of their FDI partners. This pattern of missing bilateral FDI is even more prevalent in other areas of the world.

In this paper, I seek to determine whether firm heterogeneity matters for understanding the aggregate pattern of multinationals' foreign direct investment activities, both theoretically and empirically – can this theory help explain the large number of missing bilateral FDI flows between country-pairs, and consequently provide an explanation as to why bilateral FDI is concentrated among few country pairs. As there are many missing entries and zeros in FDI data, it is also important to consider how to accurately evaluate a country's potential multinational enterprises' activities. These zeros and missing entries could lead to biased results when left untreated. Heterogeneous firm theory developed by Melitz (2003) presents a model with productivity differences across firms that explains the stylized facts regarding diversity among multinational firms in the same exporting industry. Empirical evidence shows that only a tiny minority of firms engage in international trade and an even smaller fraction of firms own production facilities in more than one country. In this paper, I extend the Melitz-type heterogeneous firm theory and implement a Heckman two-stage selection procedure to account for the missing entries' effect on the bilateral FDI data, theoretically and empirically.

[2] Or at least not observed.

Helpman, Melitz, and Rubinstein (2008) extend the Metliz-type firm-level export model and show important implications on aggregate trade flow patterns and trading partners. In particular, the method explains the missing trade in international bilateral trade flows without assuming symmetry between trading countries. The authors emphasize that the estimation results are biased if the zeros are excluded. The main feature of the Helpman, Melitz, and Rubinstein (2008) paper is that it improves upon the traditional gravity type estimation method to account for international trade that only includes positive trade flows.

Previously, there have been very few studies that incorporate both firm productivity differences and the analysis of zeros in FDI data. To fill this gap, I extend the Helpman, Melitz, and Rubinstein (2008) type heterogeneous firm framework to provide theoretical foundations flexible enough to explain symmetric, asymmetric, or the zeros in the bilateral FDI data. I test the model using a two-stage estimation procedure to systematically account for observed FDI flows and adjust for unobserved flows.

The paper will be organized as follows: section two provides a general overview of the relevant theoretical and empirical literature; section three sketches the baseline model; section four lays out the empirical estimation procedures; section five discusses data source; section six presents the empirical results; and section seven concludes.

2. Literature Review

There have been a large number of empirical, as well as theoretical studies on learning what makes foreign direct investment an attractive option to penetrate foreign markets, and the factors that affect the amount of FDI into the foreign market. Existing literature examines the determinants of FDI in a partial equilibrium setup, and a generation of general equilibrium models attempts to include important long-run factors that affect FDI locations and decisions.

Melitz (2003) pioneered a theoretical model that uses firm productivity differences to explain the intra-industry effects of international trade. The Melitz model provides a theoretical foundation for stylized facts that firms exhibit a range of productivity levels within an industry, and the relatively more productive firms are more likely to export, while the majority of firms do not. Helpman, Melitz, and Yeaple (2004) incorporate intra-industry heterogeneity in a Melitz type model to explaining why even fewer firms establish foreign affiliates, based on the proximity-concentration tradeoff hypothesis. Assuming the fixed costs of FDI are higher than export costs, Helpman, et. al. find empirical evidence that support the relationship between exports and FDI: the higher productivity dispersion in an industry, the higher the ratio of exports to FDI sales. Baldwin and Harrigan (2007) propose a quality-adjusted heterogeneous firm trade model to account for the number of export zeros, market size and export prices. Helpman, Melitz, and Rubinstein (2008) build a simple extension of the Melitz model, and by assuming firms are distributed on a truncated Pareto distribution, the authors are able to explain aggregate level trade asymmetry and zero trade flows. Silva and Tenreyro (2006) also emphasize on the importance of correcting for the zeros in trade flow data, and they show heteroskedasticity is quantitatively and qualitative important in the gravity equation, even after controlling for fixed effects. Silva, et. al. recommend the Poisson pseudo-maximum-likelihood estimator to correct for the heteroskedasticity bias and to deal with observations of zero values, in place of the standard log linear OLS model.

Several recent studies explicitly examine the role of fixed cost in determining FDI flows. Razin, Rubinstein, and Sadka (2004) establish a model with “lumpy” setup costs that directly affect the flow of bilateral FDI. Based on the comparative advantages that technologically advanced countries have in setting up foreign affiliates, the authors build a model that generates two-way FDI flows for North-North and North-South countries. In this model, every country is treated as a potential source for FDI flows, and instead of one FDI partner, there is a range of potential host countries for its FDI. Meanwhile, this source country could host FDI flows from several source countries. This is a unique feature, because it allows us to correctly evaluate aggregate bilateral flows, taking into consideration all possible county pairs for FDI activity, even if there is no observed data entry for flows. In fact, in the OECD dataset that Razin, Rubinstein, and Sadka (2004) employed, many country pairs indeed have zero flows between them. The authors use a Heckman selection procedure to correctly account for fixed cost of investment, and find an education-income threshold that is crucial for rich-poor country pairs to surpass, while higher host country education level will induce FDI flows, and source country education level is a predictor of the formation of source-host country pairs. Razin, Sadka, and Tong (2005) use expanded data on countries to include non-OECD countries. The model employed is one with comparative advantage as well, and they find two effects that affect bilateral FDI flows in opposite directions: with the standard marginal profitability effect, a positive productivity shock in the host country tends to increase FDI flows, but with total profitability effect, the same shock may lower the likelihood of an FDI investment to occur. This is one of the first studies that examine FDI flow data at the aggregate level, and discovers the important productivity threshold barrier that is a source of conflicting effect of productivity change on bilateral FDI flows.

Davies and Kristjansdottir (2010) also examine the importance of fixed cost in analyzing FDI. Using Iceland aggregate FDI inflow data, the authors adopt a Heckman two-step procedure, to account for fixed costs and their impact on the aggregate investment patterns. The authors claim that most firms are involved in very few investment projects across the world, implying a dataset with predominately zero flows. The larger firms with existing advantages, such as in size, tend to make investments, which causes a natural sample selection bias. They find that contrary to the standard OLS approach, some of the variables that were believed to affect the quantity of FDI may play the most important role in determining whether FDI occurs in the first place.

Building on literature incorporating intra-industry firm heterogeneity into models of international investments, as well as incorporating geographic selection into the structure of U.S. multinational activity across industries and countries, Yeaple (2009) presents a micro-founded model that explains the multinational activities. As an extension of Helpman, Melitz, Yeaple (2004), it focuses on heterogeneous firms serving consumers in foreign markets through exports or horizontal FDI. Important predictions from Helpman et al. (2004) are that only the most productive firms in a country engage in FDI; relatively less productive firms export; and the least productive firms only serve the domestic market. Using U.S. firm level data, Yeaple (2009) found that the more productive U.S. firms indeed own affiliates in a larger number of countries and generate most revenue sales. Yeaple (2009) is closest to this paper in the way proximity-concentration trade-offs are set up. However, using foreign affiliate sales data, Yeaple focuses on the productivity cutoff threshold, and country characteristics' effect on the extensive margin of FDI. Yeaple does not focus on "missing" FDI flows, or in the asymmetrical structure of FDI. This paper, however, addresses the causes for a large number of zeros and missing FDI flows, as well as asymmetric FDI flows, in a heterogeneous firm framework.

Recent literature illustrates the importance of incorporating fixed FDI cost and differences in firm productivity when studying the flow of FDI. This paper contributes to this rapidly growing literature in that it adopts a model that explicitly integrates both features that are found important in previous studies, and examine them empirically by using a dataset with 104 countries over an eight-year period from 1995 to 2002. A Heckman-type two-stage estimation procedure is derived from the model, and implemented to account for the effects of the fixed cost of investment, the entries in the dataset for those country-pairs with zero bilateral FDI flows, and the effects of firm productivity differences within industry.

3. A Model of Multinationals and FDI

In Helpman, Melitz, and Yeaple (2004), the authors establish a model design for U.S. multinational activities based on proximity-concentration motivations. One of the most important predictions Helpman, Melitz, and Yeaple (2004) make is that firms' inherited productivity levels will determine their mode of international involvement: produce at home, export, or invest directly abroad. More specifically, firms that do not have a high enough productivity threshold will not survive in a market, and will be eliminated; firms that overcome the productivity threshold will produce and serve the home market; firms with even higher productivity which overcome the cost of export will trade internationally; and only firms with the highest productivity levels will open foreign affiliates. Given the focus on FDI in this paper, I assume that all firms in an economy will engage in domestic production, and the decision is concentrated between export and FDI. I adopt Helpman, Melitz, and Rubinstein (2008) formulation with heterogeneous firms while allowing asymmetric FDI flows between source and host countries.

In a world with J countries, assume labor as the single factor input, and each country in the model produces a homogeneous good, *z*, with 1 worker. A continuum of differentiated products, M, are produced by firms with heterogeneous productivities, indexed by *a*. A higher *a* implies higher quantity of output per unit. The varieties produced by a firm in each country are distinctive from the rest.

Consumption: Representative consumers exhibit love of variety and consume all differentiated products in each sector. Utility is maximized given the budget constraint:

$$U_j = \left(1 - \sum_{m=1}^{M} \beta_m\right) \log z + \sum_{m=1}^{M} \frac{\beta_m}{\alpha_m} \log\left(\int_{v \in V_m} x_m(v)^{\alpha_m} dv\right), \textit{ where } j=o;\, d$$

$$\textit{Subject to: } z + \sum_m \int_{v \in V_m} p_m(v) x_m(v) dv \le Y_j$$

Origin and destination countries are denoted by *o* and *d*, respectively. β_m share of the income is spent on differentiated products in respective sector, m. The remainder, $1 - \sum_m \beta_m$, is spent on freely traded homogeneous numeraire good z. $\varepsilon = \frac{1}{1-\alpha} > 1$ is the constant elasticity of substitution across products, identical for all countries. The income of country *j*, Y_j, is equal to country j's expenditure. Let V_m denote the measure of available products in sector m, then $x_m(v)$ is consumption of variety *v* in that sector, and the elasticity of substitution in preferences across varieties in different sectors is assumed to be constant. The demand for each variety in a given sector from the maximization is: $x_m(v) = \beta_m \frac{p_m(v)^{-\varepsilon} Y_j}{P_j^{1-\varepsilon}}$, where $p_m(v)$ is the price of product *v* in sector *m*, and P_j is the country's price index: $P_j = \left[\int_{v \in V_m} p_m(v)^{1-\varepsilon} dv\right]^{1/(1-\varepsilon)}$.

Production: Productivity level, *a*, for each firm is assigned idiosyncratically, and every firm produces a unique product in the home market with labor as the only input. The more productive a firm, the higher value of output given each unit of input. The numeriaire good *z* is produced by all countries[3] with identical constant returns to scale technology and it requires one worker to produce a unit. This numeriaire sector determines wage level. Firms in the differentiated goods sectors involve in monopolistic competition and we assume these firms all serve the respective domestic economies. Facing constant elasticity of substitution preferences, firms in the monopolistically competitive market set prices at a constant markup higher than marginal cost. More specifically, if the source country's wage is w_o, then a firm with productivity a will set a price equal to: $p_m(a) = \left(\frac{1}{\alpha}\right)(aw_o)$. This price varies by firm depending on its productivity level, a, and the price is also independent of quantity produced or prices set by other firms. Given the optimal price and demand for each variety, a firm pays home wage rate w_o if it exports, but must ship $\tau_{od} > 1$ times of the merchandize to ensure that one hundred percent of the goods arrive at the destination. If a firm wishes to establish a foreign affiliate for the purpose of accessing the destination market, it can save $(\tau_{od} - 1)$ percent of cost in transporting goods to the destination, but will pay the destination market wage w_d to produce.

Firms earn revenue: $R_X^{od}(a) = \beta\alpha^{\varepsilon-1}(w_o\tau_{od})^{1-\varepsilon} Y_d P_d^{\varepsilon-1} a^{1-\varepsilon}$ if export.

Firms earn revenue: $R_I^{od}(a) = \beta\alpha^{\varepsilon-1} w_d^{1-\varepsilon} Y_d P_d^{\varepsilon-1} a^{1-\varepsilon}$ if FDI.

If a firm from the origin country chooses to open an affiliate in the destination market, it faces an additional cost of investment, F_I. It is a sunk cost that illustrates explicit expenses associated with establishing a plant in a foreign country, such as advertisement, and expenses spent on building local business relationships, etc.

Firms generate profits $\pi_X^{od}(a) = \dfrac{\beta\alpha^{\varepsilon-1}(w_o\tau_{od})^{1-\varepsilon} Y_d P_d^{\varepsilon-1} a^{1-\varepsilon}}{\varepsilon}$ from exporting.

[3] Follow Helpman, Melitz, and Yeaple (2004) set up.

Firms generate profits $\pi_I^{od}(a) = \frac{\beta\alpha^{\varepsilon-1} w_d^{1-\varepsilon} Y_d P_d^{\varepsilon-1} a^{1-\varepsilon}}{\varepsilon} - F_I$ from FDI.

Selection into FDI and FDI Flows: To serve a foreign market, a firm faces proximity-concentration trade-off when choosing a mode of production. If export, the firm faces home wage rate and endures an iceberg transportation cost $\tau_{od} > 1$ in proportion to distance between two markets. Assuming investment decisions are driven by local market access, the firm could avoid the transportation cost by directly producing in the destination country, and paying foreign wage level w_d. Furthermore, assume $w_o\tau_{od} > w_d$, implying the transportation cost compared to wage differences is substantial enough between source and host countries to assume away the possibility of platform or vertical FDI. Both π_X^{od} and π_I^{od} increase with the firm's productivity index, $a^{1-\varepsilon}$. In addition, due to $w_o\tau_{od} > w_d$ assumption, π_I^{od} increases at a higher rate than π_X^{od}. Given the fixed cost of investment, for any $a = 0$, we can show that $\pi_I^{od}(0) < \pi_X^{od}(0)$. When $\pi_I^{od}(a) = \pi_X^{od}(a)$ there exists a productivity cutoff level at the margin, above which firms will find it profitable to undergo FDI, and below which firms will export. The cutoff productivity, $\tilde{a}_{od}$, is:

$$\tilde{a}_{od}^{1-\varepsilon} = \varepsilon\left[\beta\alpha^{\varepsilon-1} Y_d P_d^{\varepsilon-1} w_d^{1-\varepsilon}\right]\left[\frac{F_I}{1-\left(\frac{w_o\tau_{od}}{w_d}\right)^{1-\varepsilon}}\right].$$

Everything else equal, an increase of demand in destination country, Y_d, or a lowering of destination's wage level, will lower this cutoff – more firms with lower productivities from the origin country will be able to establish affiliates in the destination country, thus increasing the overall flow of FDI. On the other hand, if the fixed cost of opening an affiliate in the destination country increases, it will raise the cutoff productivity and fewer firms will find it profitable to take on FDI.

Suppose there are N_o number of firms in the origin country and revenue earned by firms from FDI is $R_I^{od}(a) = \beta\alpha^{\varepsilon-1} w_d^{1-\varepsilon} Y_d P_d^{\varepsilon-1} a^{1-\varepsilon}$, then the aggregate revenue for the origin country is: $R_I^{od}(a) = \beta\alpha^{\varepsilon-1} w_d^{1-\varepsilon} P_d^{\varepsilon-1} N_o V_{od}$. V_{od} is a function of the productivity cutoff derived from $\tilde{a}_{od}$, and it is positive when at least one firm is productive enough in the origin country to find it profitable in setting up affiliates in the destination country[4], thus its productivity exceeds $\tilde{a}_{od}$.

Productivity level of the firms is not observed in the data, we therefore define Z_{od}. It is the ratio of additional profits earned from FDI over the cost of FDI:

$$Z_{od} = \frac{\beta\alpha^{\varepsilon-1} Y_d P_d^{\varepsilon-1} w_d^{1-\varepsilon} \left[1 - \left(\frac{w_o \tau_{od}}{w_d} \right)^{1-\varepsilon} \right] a^{1-\varepsilon}}{\varepsilon F_I}$$

We will only observe FDI flows from the source country if at least the most productive firm finds it profitable to do so. That is, when $Z_{od} > 1$, the extra profit earned from FDI will exceed the additional cost of FDI. $Z_{od} = 1$ is true when the firm that meets the productivity threshold level $\tilde{a}_{od}$ can profitably FDI.

The relative productivity cutoff $\frac{a_{od}}{a_L}$ is monotonically decreasing in Z_{od} : $\frac{a_{od}}{a_L} = Z_H^{-\frac{1}{1-\varepsilon}}$.

This productivity cutoff relationship falls in the net profitability of the most productive firm of serving market d.

[4] Derivation for V_{od} is included in the appendix.

Let $V_{od} = \int_{a_L}^{\tilde{a}_{od}} a^{1-\varepsilon} dG(a)$, if $\tilde{a}_{od} > a_L$, 0 otherwise. The Pareto distribution of the firms is assumed to be $G(a) = \frac{a^{\kappa} - a_L^{\kappa}}{a_H^{\kappa} - a_L^{\kappa}}$, that is bounded by $a \in [a_L, a_H]$, it ensures that no firm in the source country will find it profitable to invest in the host country unless the most productive firm finds it to do so. Combine it with the definition of V_{od}, we get:

$$V_{od} = \frac{\kappa a_H^{\kappa-\varepsilon+1}}{(\kappa - \varepsilon + 1)(a_H^{\kappa} - a_L^{\kappa})} W_{od} \text{, where } W_{od} = \max\left[\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1} - 1{,}0\right]$$

If the most productive firm invests, W_{od} can be expressed in terms of the latent variable Z_{od}:

$W_{od} = Z_H^{\frac{\varepsilon+\kappa-1}{\varepsilon-1}} - 1$.

Given that there are N_j number of firms[5], the revenue that firms from the source country establishing affiliates in the destination is:

$$R_I^{od}(a) = \beta\alpha^{\varepsilon-1} w_d^{1-\varepsilon} P_d^{\varepsilon-1} N_o V_{od}$$

Note that $R_{od} = 0$ when $V_{od} = 0$, and no firm from the source country is productive enough to generate positive profits to FDI. The same also holds true if the FDI flows move in the opposite direction. This setup allows for asymmetric FDI flows: it is possible that $FDI_{od} > 0$ and $FDI_{do} > 0$, or vice versa. The flexibility of the model to allow asymmetrical FDI flow is a close estimation of the reality that we observe in FDI flows.

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[5] The number of firms in country j is indexed by N_j. Following literature, I assume the firms draw their productivity levels from a truncated Pareto Distribution, which has cumulative distribution function: $G(a) = \frac{a^{\kappa} - a_L^{\kappa}}{a_H^{\kappa} - a_L^{\kappa}}$.This distribution is truncated by an upper limit of a_H and a lower limit of a_L : $a \in [a_L, a_H]$ is a shape parameter common across countries and it determines the distribution of $G(a)$. To simplify, I assume the upper bound a_H is equal for all countries. This assumption does not result in loss of generality, because observed country-specific aggregate productivity levels will reflect the variation in a_H.

Assume the initial FDI flow is a portion, Ψ, of the actual foreign affiliate sales, then the flows will be:

$$FDI_{od} = \Psi R_{od} = \Psi \beta \alpha^{\varepsilon - 1} w_d^{1-\varepsilon} P_d^{\varepsilon - 1} N_o V_{od}$$

This configuration does not require full symmetry of FDI flows between two countries, due to the properties of V_{od} .

If no firm is productive enough in the origin country to profitably FDI, then $V_{od} = 0$, thus $R_{od} = 0$ .The same also holds true if the FDI flows move in the opposite direction between the country pair. This setup allows for asymmetric FDI flows: it is possible that the FDI flows in both directions are positive, $FDI_{od} > 0$ and $FDI_{do} > 0$, where both countries in the pair invest in each other; or the FDI flows are only positive in one direction, from the origin (*o*) to the destination (*d*) country: $FDI_{od} > 0$ and $FDI_{do} = 0$. The flexibility to allow for asymmetric FDI flows is a close modeling of what we observe in data. Furthermore, this configuration does not require full symmetry of FDI flows between two countries, due to the properties of V_{od} . This setup highlights the asymmetric FDI relationships that occur between many country pairs.

Assume the amount of FDI flows is proportional to the actual foreign affiliate sales, then the flows will be:

$$FDI_{od} = \Psi R_{od} = \Psi \beta \alpha^{\varepsilon - 1} w_d^{1-\varepsilon} P_d^{\varepsilon - 1} Y_d N_o V_{od} \ .$$

4. Empirical Methodology

Multinationals make two-fold decisions regarding FDI activities: whether to invest at all and consequently how much to invest. The heterogeneous firm model in section three illustrates that the productivity threshold created by zero-profit condition determines a firm's ability to FDI. This threshold gives rise to the zeros and missing values in the FDI data. Another empirical implication of the model reflects that, not all country pairs have reciprocal direct investment relationships between each other, which is reflected in the prevalence of asymmetric investment relationships between country pairs.

We adopt a Heckman two-stage estimation process, given the two-fold decision making process of making a foreign investment. The Heckman sample selection model consists of two estimation equations. In the context of Foreign Direct Investment, it first calculates the probability of one country investing in another, and the second equation estimates an augmented gravity equation of FDI flows given that FDI flows do occur.

Stage 1: Participation Estimation. Without treating the zeros in the FDI data, it might potentially lead to biased estimation results by selection. I adopt the Heckman selection model[6], to correct this bias. In the first stage of implementing the Heckman selection process, I first estimate a Probit equation to find the probability of positive FDI flows taking place and save the inverse Mills ratio. Then this inverse Mills ratio will be included in the gravity regression of FDI in the second stage.

Conditional on observing FDI flows, the gravity equation is estimated. To derive the Probit estimation equation, I take log of the latent variable,

$$Z_{od} = \frac{\beta\alpha^{\varepsilon-1} Y_d P_d^{\varepsilon-1} w_d^{1-\varepsilon}\left[1-\left(\frac{w_o \tau_{od}}{w_d}\right)^{1-\varepsilon}\right] a^{1-\varepsilon}}{\varepsilon F_I}$$

Following Helpman, Melitz, and Rubinstein (2008), we parameterize the bilateral variable and the fixed FDI costs as follows:

Let ξ_1 be the constant term, and $\xi_d = \ln Y_d + (\varepsilon - 1)\ln P_d + (1-\varepsilon)\ln w_d + \theta_d$ reflect destination fixed effects, characterizing the FDI receiving market's country-specific fixed costs.

[6] See Heckman (1979)

Let $\xi_o = \theta_o$ be origin fixed effects, reflecting origin specific fixed costs. D_{1od} and D_{2od} are observable variables that are proxies for bilateral variable and fixed costs. ι_1 reflects random unobserved variation in variable FDI costs, and ι_2 reflects random unobserved variation in fixed FDI costs. $\eta_{od} = \iota_1 + \iota_2$ is the composite measurement error. We can rewrite the log of latent variable:

$$\ln Z_{od} = \xi_1 + \xi_o + \xi_d + \rho_1 D_{1od} + \gamma D_{2od} + \eta_{od}$$

When the FDI flows from a source to a destination country are positive, we assign value 1 to binary indicator variable, T_{od}. This occurs when the most productive firm in the source country finds it profitable to set up an affiliate in the destination country. From the latent variable Z_{od}, define:

$$T_{od} = \begin{cases} 1, \text{ if } Z_{od} > 1 \\ 0, \text{ otherwise} \end{cases}$$

To estimate the probability of $Z_{od} > 1$ is to estimate the probability of $T_{od} = 1$:

$$\Pr(T_{od} = 1) = \Pr(\ln Z_{od} > 0) = \Pr(\eta_{od} > -[\xi_1 + \xi_o + \xi_d + \rho D_{1od} + \gamma D_{2od}])$$

Assume the composite error η_{od} has a normal distribution: $\eta_{od} \sim N(0, \sigma_\eta)$, we can rewrite the probability of observing $T_{od} = 1$, conditional on the observables is:

$$\Pr(T_{od} = 1) = \Phi(\xi_1^* + \xi_o^* + \xi_d^* + \rho D_{1od}^* + \gamma D_{2od}^*) = \Phi(X_{od}\theta^*)$$

The terms with * sign have been divided by σ_η, so now η_{od}^* has a normal distribution with unit variance: $\eta_{od}^* \sim N(0,1)$. Let

$$\Phi(X_{od}\theta^*) \equiv \Phi(\xi_1^* + \xi_o^* + \xi_d^* + \rho D_{1od}^* + \gamma D_{2od}^* + \chi B_{od}^*)$$

to simplify the expression. This equation establishes the first stage Probit estimation equation in the two-step Heckman selection process. Based on the observable independent variables that are proxies for bilateral fixed and variable costs, the probability of bilateral FDI flows is estimated. As illustrated in Razin and Sadka (2007), given this type of dataset with large numbers of zeros flows, it is especially important to implement an empirical procedure that corrects them. Formally, the first stage estimation equation is:

$$\Pr(T = 1) = \Phi\left(\xi_1^* + \xi_o^* + \xi_d^* + \rho D_{1od}^* + \gamma D_{2od}^*\right)$$

This equation establishes the first stage Probit estimation equation in the two-step Heckman selection process. Based on the observable independent variables that are proxies for bilateral fixed and variable costs, the probability of bilateral FDI flows is estimated. As illustrated in Razin and Sadka (2007), it is especially important to implement an empirical procedure to correctly estimate datasets with large number of zero FDI flows.

Stage 2: FDI Flows Estimation. The intra-industry heterogeneity firm theory of FDI implies that positive FDI flows are only observed if the most productive firm in the source country surpasses the productivity threshold set by zero-profit condition between export and FDI. Thus the second stage FDI flows estimation is conditional on observing variables that determine the FDI selection process in the first stage.

Stage 2: FDI Flows Estimation Equation

Assume Ψ is a function of relative wages and transportation costs increases in trade cost τ_{od}. Explicitly, I assume the log form of Ψ is: $\Psi = \rho D_{1od} + \iota_1$, to capture the relative variable cost changes and the unobservable that affect FDI flows between country pairs. The log form of the FDI can be written as:

$$\ln(FDI_{od}) = \ln\beta + \rho\ln D_{1od} + (1-\varepsilon)\ln w_{od} + (\varepsilon - 1)\ln\alpha + (1-\varepsilon)\ln P_d + \ln Y_d + \ln N_o + \ln V_o + \iota_1$$

V_{od} is a function of W_{od} : $V_{od} = \frac{\kappa a_H^{\kappa-\varepsilon+1}}{(\kappa-\varepsilon+1)\left(a_H^{\kappa}-a_L^{\kappa}\right)} W_{od}$, and it only takes on positive values

when $W_{od} > 0$. Recall $W_{od} = \left[\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1} - 1, 0\right]$. We can rewrite the log form of FDI flows:

$$\begin{aligned}
&\ln\left(FDI_{od}\right) = \\
&\ln\beta + \rho\ln D_{1od} + (1-\varepsilon)\ln w_{od} + (\varepsilon-1)\ln\alpha + (1-\varepsilon)\ln P_d + \ln Y_d + \ln N_o \\
&+ \ln\left[\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1} - 1\right] + \iota_1
\end{aligned}$$

Let $\lambda_1 = \ln\beta + (\varepsilon-1)\ln\alpha$ be the constant intercept term, $\lambda_d = (1-\varepsilon)\ln w_d + (1-\varepsilon)\ln P_d + \ln Y_d$ be the destination fixed effect, and $\lambda_o = \ln N_o$ be the origin fixed effect. The simplified FDI flow equation is: $\ln\left(FDI_{od}\right) = \lambda_1 + \lambda_o + \lambda_d + \rho\ln D_{1od} + \ln\left[\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1} - 1\right] + \iota_1$

Previously, ι_1 and η_{od} are assumed to have a bivariate normal distribution, thus the standard Heckman correction procedure applies:

$$E\left[\iota_1 \middle| \bullet, T_{od} = 1\right] = E\left[\iota_1 \middle| \bullet, \eta_{od}^* > -X_{od}\theta^*\right] = \varsigma \frac{\phi\left(X_{od}\theta^*\right)}{\Phi\left(X_{od}\theta^*\right)}$$

where $\bullet$ indicates observable variables from the first stage estimation. ς is the estimation coefficient on the inverse Mills ratio, $\frac{\phi\left(X_{od}\theta^*\right)}{\Phi\left(X_{od}\theta^*\right)}$. To evaluate the conditional second stage flow equation, the productivity threshold term $\frac{a_{od}}{a_H}$ must be estimated first. Rewrite $\frac{a_{od}}{a_L} = Z_L^{-\frac{1}{1-\varepsilon}}$:

$$\frac{a_{od}}{a_L} = Z_L^{-\frac{1}{1-\varepsilon}} = \left[\exp\left(X_{od}\theta^* + \eta_{od}^*\right)\right]^{\frac{-\sigma_\eta}{(\sigma-1)}}$$

Then the term contains productivity threshold in the flow equation is:

$$\ln\left[\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1}-1\right]=\ln\left\{\left[\exp\left(X_{od}\theta^{*}+\eta^{*}_{od}\right)\right]^{\frac{\sigma_\eta(\kappa-\varepsilon+1)}{(\varepsilon-1)}}-1\right\}=\ln\left\{\exp\left[\delta\left(X_{od}\theta^{*}+\eta^{*}_{od}\right)\right]-1\right\}$$

Where $\delta\equiv\frac{\sigma_\eta(\kappa-\varepsilon+1)}{(\varepsilon-1)}$. With this substitution and the assumption that η^{*}_{od} is normally distributed,

$$E\left[\ln\left(\left(\frac{a_{od}}{a_L}\right)^{\kappa-\varepsilon+1}-1\right)\middle|\bullet, X_{od}, T_{od}=1\right]$$
$$=\int_{-X_{od}\theta^{*}}^{\infty}\ln\left(\exp\left[\delta\left(X_{od}\theta^{*}+\eta^{*}_{od}\right)\right]-1\right)d\Phi^{T}\left(\eta^{*}_{od}\right)=F\left(X_{od}\theta^{*},\delta\right)$$

where $\Phi^{T}\left(\eta^{*}_{od}\right)=\frac{\phi\left(\eta^{*}_{od}\right)}{1-\Phi\left(-X_{od}\theta^{*}\right)}$ is a truncated distribution of η^{*}_{od}.

Conditional on the observed independent variables, represented by $\bullet$, that are determinants of both stages, the estimation equation for FDI flows is:

$$E\left[\ln\left(FDI_{od}\right)\middle|\bullet, T_{od}=1\right]$$
$$=\lambda_0+\lambda_o+\lambda_d+\rho\ln D_{1od}+F\left(X_{od}\theta^{*},\delta\right)+\varsigma\frac{\phi\left(X_{od}\theta^{*}\right)}{\Phi\left(X_{od}\theta^{*}\right)}$$
$$=\lambda_0+\lambda_o+\lambda_d+\rho\ln D_{1od}+\xi THR+\zeta IMR$$

where λ_d is the destination fixed effect; λ_o is the origin fixed effect; and λ_1 is the constant intercept term, and D_{1od} is a proxy for bilateral variable cost. THR is the productivity threshold that is surpassed by the most productive firms in a country and IMR is the inverse Mills ratio constructed from the likelihood of a country directly invest in another in the first stage to capture the selection effect by multinationals. Because the non-linearity of THR, the productivity threshold term, we use maximum likelihood estimation in the second stage.

Traditionally, gravity-type equations for FDI are estimated using flows for countries that participate in FDI in at least one direction. The econometric estimation here will use unidirectional FDI flows while including fixed effects for source and host countries separately. The inclusion of these effects allow each country pair to be represented in the dataset twice: first time the FDI flows from the source country to the host, and the second time in reverse order. The first and fourth columns in Appendix 4 show results from benchmark gravity specification using ordinary least squares estimation, with country fixed effects for each unidirectional country pair.

Columns two and three in Appendix 4 present two-stage estimation results. The first stage is estimated with a Probit procedure with source, host, and year fixed effects. The predicted results are used to produce the inverse Mills ratio included as one of the explanatory variables in the second stage, as in standard Heckman procedures. In the second stage, since the term that includes the productivity threshold, ξTHR , is non-linear, we adopt a maximum likelihood estimation process.

5. Data and Empirical Methodology

5.1 Foreign Direct Investment Flows Data

Data on foreign direct investment used in this paper includes 104 countries, ranging from the highest income group to the least developed countries with some of the lowest per capita income, spanning from 1995 and 2002. During this period, FDI had experienced unprecedented increase, and reached a historical high level of flows in 2000. The data on foreign direct investment flows reflect a large portion of worldwide FDI flows.

The majority of the FDI flows in the world occur between developed economies. Developing and least developed economies receive a much smaller portion. The Organization of Economic Cooperation and Development records various types of FDI data for its member countries, but data for the rest of the world is sparse. They are usually recorded by individual national statistical agencies, and often the recording standards each country adopts are not consistent with each other. The World Investment Directory published by the United Nations Conference on Trade and Development (UNCTAD) collects and publishes a comprehensive set of direct investment data. More specifically, World Investment Directory differs from other data source in that it has detailed inflow and outflow FDI information by origin or destination country, respectively. With this data, we are able to pinpoint the bilateral investment partners not only for developed economies, but also for developing countries worldwide.

The unique inclusiveness of this dataset also leads to some issues. Despite the spike in worldwide FDI activities in year 2000, there was still a large number of country-pairs that do not invest in each other – over 90 percent of the country-pairs experienced no FDI activities over the eight-year span covered in this study. These missing FDI flows in the dataset could cause potential econometric bias if left untreated. Using the econometrics procedure modeled in this paper, we will be able to account for the many inactive entries in the FDI flow data. Previous studies such as Razin, Rubinstein and Sadka (2004, 2005) and Davies and Kristjansdottir (2010) have come closest in examining the zeros and missing entries in FDI flows, however with different emphasis on theoretical foundations and econometrics techniques.

5.2 Gravity-type Variables

Gravity-type variables have worked relatively well for FDI literature, as stated in Blonigen (2005). Adapted from empirical trade literature, gravity specification has shown success in explaining FDI flows in numerous studies. Brainard (1997), Yeaple (2008), and Fung

(2002), to name a few, have all had success in using gravity-type variables to explain FDI activities.

The gravity variables used in this paper extend beyond the basic gravity model setup, which includes GDP for both origin and destination countries and the distance between the two markets to evaluate bilateral FDI flows. Other variables are included to capture the country-specific effects for both of the FDI partners. These variables reflect cultural, geographical and historical information about both countries in the bilateral relationship. Colonial Ties variable provides information on whether the host country has ever been colonized by the source country. The hypothesis is that colonial history creates a backdrop that is shared by the source and host country pair, and should make it more likely for the source to invest in the host country. Border variable proxies indirect trading cost: if the two countries share a common border, then the cost of shipping goods from one to another will be lower. This provides incentive for higher level of trade between the two, and making foreign direct investment less likely. Religion is a composite of three religions in each country, accounting for the percentage of the population that is Protestant, Catholic, and Muslim. Although not a comprehensive measure of the religious beliefs in each country, it provides a rough measure to evaluate whether similarity in faith plays a role in investment decision-making process. The Central Intelligence Agency's World Fact Book is the source for Legal Origin variable, which is an indicator of whether the source and host countries share roots in their legal systems. Lastly, we consider if speaking the same language will have an effect on the FDI decision. The hypothesis is that language barrier can be an additional cost of investment, which might decrease both the probability of investing in the first place and the amount invested.

5.3 Regional Trade Agreements (RTA)

Data for Regional Trade Agreement is obtained from World Trade Organization's official website. According to World Trade Organization regulations, the types of agreements included are Free Trade Agreements (FTA), Customs Unions (CU), Economic Integration Agreements (EIA), and Preferential Trade Agreements (PTA). The purpose of the Regional Trade Agreements (RTA) is to enhance and strengthen existing links between countries involved, and to create an open and stable environment for foreign companies, while enhancing domestic firms' competitiveness in the global market. Regional Trade Agreement variable takes comprehensive coverage of any direct bilateral trading bloc or indirect bilateral trade relationship established through a unilateral trading bloc setup. Any country-pair that belongs to the same trading agreement may experience increased trade levels due to preferential terms stated in the agreement. This could lead to decreased probability of setting up foreign affiliates in each other's country. If the benefit of export given the bilateral trade relationship is greater than the cost, then trade is a substitute for foreign direct investment. However, if a decision to setup foreign affiliates is established, it is unclear as to whether being in a regional trade agreement will promote foreign direct investment flows. If the final destination for goods produced at foreign affiliates is the home country, then FTA should promote more cross border investments. On the other hand, if the affiliates were setup to penetrate local market, closer trade ties may not have any effect on the investment flows, or even have negative effects, since the substitutability may decrease the scale of the investment, because of easy alternatives to export.

5.4 Currency Union

There have been extensive studies in the FDI literature on the relationship between the exchange rate and the flow of FDI[7]. Various theoretical models are built to illustrate this linkage. However, as mentioned in Blonigen (2005), "the modeling is much stronger than empirical work". In this paper, I opt to use an alternative measure to account for the effect of currency on FDI flows – currency union.

In the international trade literature, rich empirical evidence shows that currency union has a significant and positive effect on trade flows. Rose (2004) uses a gravity model and finds evidence that two countries with a common currency trade substantially more than comparable countries with their own currencies. This result holds true even after taking a spectrum of other considerations into account.

In Baldwin and Di Nino (2006), the authors incorporate the heterogeneous firm theory and focus on extensive margin of trade and being a member of the Euro Zone. The authors argue that in addition to increasing the volume of already existing varieties, the Euro stimulates export of new varieties of goods. Moreover, Baldwin and Di Nino (2006) not only provide a gravity-type estimation model, they take into consideration of the presence of censored export/import values. That is, similar to the analysis in this paper, Baldwin and Di Nino (2006) employ estimation techniques that account for the censored nature in the bilateral trade dataset, and they find evidence that the Euro has a positive effect on trade overall.

The effect of currency union on the flow of FDI may be more ambiguous than its effect on trade. The encouragement of trade by being in the same currency union may reduce the incentive for multinationals to directly invest abroad. On the other hand, being in the same currency union may indicate less exchange risk an investor would undertake, thus increasing both the likelihood and the amount invested.

[7] See Blonigen (1997)

5.5 Institutional Variables

The quality of institution is shown to be an important determinant of FDI activity. The institutional variable is especially important for less-developed countries, because poor institutional setup in a country could have severe adverse effects on the amount of foreign direct investment. If the investors must face political uncertainty, and poor legal protection of their assets, the likelihood of making the investment will be lower. Eichengreen and Tong (2007) include time-varying measure of institution quality, and they find that for those countries with lower political risk, there are higher levels of FDI flows. Furthermore, for any market to function smoothly, the existence of corruption and poor quality of institutions will increase the cost of doing business, thus diminishing FDI activities. Low quality of institutions will often lead to poor infrastructure, a necessary component to ensure profitability of any multinational investor.

Institutional data used in this study is extracted from the International Country Risk Guide (ICRG), which is an index comprised of twenty-two categories that measure a country's political, financial and economic risk. The two measurements of political risk as proxies of institutional quality in a country are level of corruption and law and order. Corruption variable assesses the corruption level within the political system, and the higher corruption points reflect a lower risk level. Law and Order is a composite of the assessment on the strength and impartiality of the legal system (law) and the assessment of popular observance of the law (order). It is also measured that a higher degree of law and order reflects a better judicial system.

6. Estimation Results

6.1 Benchmark vs. 2-Stage Results – All Countries

Traditional estimations evaluate FDI flows that take place in at least one direction. In this dataset, every country is represented once as a source country and another time as the host country. The first column of Appendix 4 shows these results. The closer the geographical distance between a pair of FDI countries, the higher FDI is. Sharing the same religion, legal origin, colonial ties, and being in the same Regional Trade Agreement will promote FDI flows. These results are found to be robust after including variables such as corruption and law and order that measure institutional environment. Both measures are obtained from the ICRG database and the higher the measure, the better institutional environment a country has. While the results stay similar to the previous set up, the results show that better institutional environment has a positive effect on the flow of FDI.

In the two-stage estimation, after running the Probit estimation in the first stage, we use the predicted probability of FDI from the Probit estimation in the second stage. This predicted probability is used to construct the term that corrects for the selection bias and unobserved heterogeneous firm bias. The term that captures the selection bias, $IMR = \frac{\phi\left(X_{od}\theta^{*}\right)}{\Phi\left(X_{od}\theta^{*}\right)}$ follows the same method as in the Heckman selection process, while the term that captures the unobserved heterogeneous firm bias, $\ln\left\{\exp\left[\delta\left(X_{od}\theta^{*}+\eta_{od}^{*}\right)\right]-1\right\}$, reflects the impact of frictions on FDI and country characteristics on the proportion of firms that FDI. The theoretical model suggests that variables that affect the *fixed cost* of FDI should be included in the first stage, but not in the second stage, in which the variables included should impact *the variable cost* of FDI decision.

This suggests a natural exclusion variable for the second stage estimation. Following Helpman, Melitz, and Rubinstein (2008), we also use the religion variable as the exclusion variable.

The two-stage estimation results are reported in columns 2, 3, 5, and 6 of Appendix 4 for all countries under consideration. The coefficients for the Inverse Mills Ratio and the term correcting heterogeneous firm bias are precisely estimated. The remaining results also show that by including the two bias-correcting terms, it reveals results masked by the benchmark estimation. Without correcting for selection and heterogeneous firm bias, the distance term is over-estimated by three folds, and so is the effect of colonial relations. Although being in the same regional trade agreement will help two countries forming an FDI relationship, the regional trade agreement (RTA) is found to have a negative impact on FDI flows, opposite to benchmark predictions. Other variables, such as currency union, common language, and border that were not found to be statistically significant indeed positively affect FDI flows, after correctly accounting for selection bias and heterogeneous firm bias.

6.2 Bilateral FDI : OECD vs. Asian Economies

To explain whether productivity heterogeneity will help explain the difference between FDI flows from developed countries and from developing economies, we take a closer look at two different country groups: OECD countries and Asian countries.

For both OECD and Asian countries as source, the coefficients on inverse Mills ratio are precisely estimated. Thus it is important correct for selection bias, regardless of the level of economic development level of source countries. Though the magnitude is smaller for Asian economies, we find evidence for both country groups as source countries and it is important to correct for firm productivity heterogeneity, as the coefficients on the non-linear terms are precisely estimated. While it is important to correct for firm heterogeneity for Asian host countries, it does not seem to play an important role for OECD destination countries, despite the source of FDI.

7. Concluding Comments

This paper uses a heterogeneous intra-industry firm model as a theoretical foundation to explain the aggregate level of FDI flows. This extension of the heterogeneous firm theory cannot only help to explain positive FDI flows in both directions in a country pair, but it also explains unidirectional FDI flows, as well as zero investment flows. The Heckman-type selection procedure is adopted in the empirical analysis, which allows us to not only analyze information about observable FDI flows, similar to existing studies, but it also allows us to use the zeros and unobserved flows and determine what role they play in the aggregate outcome that we observe. We find that it is important to correct for selection and heterogeneous firm biases, and this result holds for developed OECD and Asian source countries, though firm heterogeneity does not appear to be important for OECD destination countries.

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Appendix 1: Country List

OECD Countries		
Australia*	Austria*	Belgium-Luxemburg*
Canada*	Denmark*	Finland*
France *	Germany*	Greece*
Hungary	Iceland*	Ireland*
Italy*	Japan*	Netherlands*
New Zealand*	Norway*	Poland
Portugal*	Spain*	Sweden*
Switzerland*	Turkey	United Kingdom*
United States*		
Asian Countries		
Bangladesh	China	Hong Kong*
India	Indonesia	Malaysia
Pakistan	Philippines	Singapore*
South Korea*	Sri Lanka	Taiwan*
Thailand	Vietnam	
Latin American Countries		
Argentina	Bahamas	Barbados
Belize	Bermuda*	Bolivia
Brazil	Cayman Islands	Chile
Colombia	Costa Rica	Cuba
Dominican Republic	Ecuador	Guatemala
Guyana	Haiti	Honduras
Jamaica	Mexico	Netherlands Antilles
Nicaragua	Panama	Peru
Saint Kitts and Nevis	Suriname	Uruguay
Venezuela		
African Countries		
Algeria	Angola	Benin
Burkina Faso	Burundi	Cameroon
Central African Republic	Chad	Comoros
Congo, Republic of	Cote d’Ivoire	Djibouti
Equatorial Guinea	Ethiopia	Gabon
Gambia	Ghana	Guinea
Guinea-Bissau	Kenya	Liberia
Malawi	Mali	Mauritania
Mauritius	Niger	Nigeria
Rwanda	Senegal	Seychelles
Sierra Leone	Somalia	Sudan
Togo	Tunisia	Uganda
Zambia		

* denotes advanced economies by IMF classification.

Appendix 2: Data Definition and Source

Variables	Definition	Data Source
Per capita GDP	Per capita GDP (in 2000 US$)	World Development Indicator
Population	Population	World Development Indicator
Distance	Great circle distance between source and host countries	
GDP	Gross Domestic Product (in 2000 US$)	World Development Indicator
FDI	Foreign direct investment inflows	SourceOECD, UNCTAD FDI/TNC, Hattari & Rajan (2008)
Law & Order	Judicial quality and crime rate	ICRG database
Corruption	Corruption level	ICRG database
Colonial Ties	=1 if the host country was ever colonized by the source country; =0 otherwise	CIA World Factbook
RTA	=1 if the country pair belongs to a common regional trade agreement; =0 otherwise	World Trade Organization
Border	=1 if the country pair shares a common border; =0 otherwise	CIA World Factbook
Religion	Composition of different religions[8]	CIA World Factbook
Language	=1 if the country pair shares a common language; =0 otherwise	CIA World Factbook
Legal System	=1 if the country pair share the same legal origin; =0 otherwise	CIA World Factbook
WTO	=1 if the country is a member of the WTO; =0 otherwise	Rose (2004), WTO
Island	=1 if one of the countries in the pair is an island =0 otherwise	CIA World Factbook
Land locked	=1 if one of the countries in the pair is landlocked =0 otherwise	CIA World Factbook
Currency Union	=1 if the pair belongs to the same currency union =0 otherwise	Rose (2000), WTO

[8] (% Protestants in source country × % Protestants in host country) + (% Catholics in source country × % Catholics in host country) + (% Muslims in source country × % Muslims in host country)

Appendix 3: A list of Regional Trade Agreements (RTA) and Customs Unions

RTA Name	Type	Date of Entry Into Force
ASEAN Free Trade Area (AFTA)	FTA	Jan 28, 1992
Asia Pacific Trade Agreement (APTA)	PTA	Jun 17, 1976
Australia – New Zealand (ANZCERTA)	FTA	Jan 1, 1983
Canada – Chile	FTA & EIA	Jul 5, 1997
CARICOM	CU	Aug 1, 1973
Chile – Mexico	FTA & EIA	Aug 1, 1999
Common Market for Eastern and Southern Africa (COMESA)	FTA	Dec 8, 1994
Costa Rica – Mexico	FTA & EIA	Jan 1, 1995
East African Community (EAC)	CU	Jul 7, 2000
EC – Iceland	FTA	Apr 1, 1973
EC – Mexico	FTA & EIA	Jul 1, 2000
EC – Norway	FTA	Jul 1, 1973
EC – Switzerland – Liechtenstein	FTA	Jan 1, 1973
EC – Tunisia	FTA	Mar 1, 1998
EC – Turkey	CU	Jan 1, 1996
EC Treaty (15) Enlargement	CU & EIA	Jan 1, 1995
Economic and Monetary Community of Central Africa (CEMAC)	CU	Jun 24, 1999
Economic Community of West African States (ECOWAS)	PTA	Jul 24, 1993
EFTA – Mexico	FTA & EIA	Jul 1, 2001
EFTA – Turkey	FTA	Apr 1, 1992
EFTA (Stockholm Convention)	FTA	May 3, 1960
European Economic Area (EEA)	EIA	Jan 1, 1994
Global System of Trade Preferences among Developing Countries (GSTP)	PTA	Apr 19, 1989
Guatemala – Mexico	FTA & EIA	Mar 15, 2001
Honduras – Mexico	FTA & EIA	Jun 1, 2001
India – Sri Lanka	FTA	Dec 15, 2001
Latin American Integration Association (LAIA)	PTA	Mar 18, 1981
MERCOSUR	CU	Nov 29, 1991
Mexico – Nicaragua	FTA & EIA	Jul 1, 1998
New Zealand – Singapore	FTA & EIA	Jan 1, 2001
North American Free Trade Agreement (NAFTA)	FTA & EIA	Jan 1, 1994
Portocol on Trade Negotiations (PTN)	PTA	Feb 11, 1973
South Asian Preferential Trade Arrangement (SAPTA)	PTA	Dec 7, 1995
South Pacific Regional Trade and Economic Cooperation Agreement (SPARTECA)	PTA	Jan 1, 1981
West African Economic and Monetary Union (WAEMU)	CU	Jan 1, 2000

(Source: World Trade Organization, http://rtais.wto.org/UI/PublicAllRTAList.aspx)

Appendix 4. Benchmark vs. 2-Stage Estimation Results – All Countries

	All Countries to All Countries			All Countries to All Countries		
	Benchmark	First Stage	Second Stage	Benchmark	First Stage	Second Stage
Distance^^	-0.758***	-0.459***	-0.293***	-0.763***	-0.460***	-0.254***
	(0.0580)	(0.0291)	(0.0762)	(0.0581)	(0.0295)	(0.0759)
Currency Union	0.226	-0.477***	0.644***	0.205	-0.463***	0.513***
	(0.147)	(0.108)	(0.151)	(0.148)	(0.110)	(0.152)
Common Language	0.00822	-0.0339	0.539***	0.00601	-0.0389	0.588***
	(0.117)	(0.0612)	(0.121)	(0.117)	(0.0624)	(0.119)
Legal System	0.296***	0.194***	0.0409	0.285***	0.196***	0.0555
	(0.0824)	(0.0449)	(0.103)	(0.0825)	(0.0458)	(0.101)
Religion	0.943***	0.391***		0.952***	0.391***	
	(0.232)	(0.111)		(0.232)	(0.112)	
Border	0.134	-0.193	0.601***	0.132	-0.189	0.601***
	(0.154)	(0.135)	(0.199)	(0.155)	(0.135)	(0.191)
Colonial	0.947***	0.549***	0.335**	0.969***	0.550***	0.267
	(0.164)	(0.0951)	(0.168)	(0.165)	(0.0985)	(0.172)
RTA	0.385***	0.303***	-0.331**	0.387***	0.312***	-0.298**
	(0.114)	(0.0530)	(0.144)	(0.113)	(0.0534)	(0.141)
Source GDP^^^	0.785	-0.155	0.313	0.769	-0.139	0.335*
	(0.601)	(0.211)	(0.195)	(0.591)	(0.212)	(0.184)
Host GDP^^^	0.901	-0.771***	0.261***	0.716	-0.997***	0.224***
	(0.688)	(0.247)	(0.0367)	(0.674)	(0.265)	(0.0357)
Corruption (H)^				0.0669*	0.182***	0.00745
				(0.0405)	(0.0253)	(0.0324)
Law & Order (H)^				0.236***	-0.0419	0.203***
				(0.0501)	(0.0317)	(0.0303)
Inverse Mills Ratio			-0.266**			-0.327***
			(0.119)			(0.116)
Productivity Threshold			1.136***			1.012***
			(0.173)			(0.171)
R-squared	0.703			0.705		
Pseudo R-squared		0.5977			0.587	
Clustered pairs	1556	8918	1556	1515	7655	1515
Observations	4,538	62,426	4,538	4,497	53,585	4,497

Robust standard errors in parentheses. Source, host, and year fixed effects included.

*** p<0.01, ** p<0.05, * p<0.1

^ lagged value, ^^natural log, ^^^lagged natural log

Appendix 5. Benchmark vs. 2-Stage Estimation Results – OECD and Asian Countries as Source

	OECD to All Countries			Asia to All Countries		
	Benchmark	First Stage	Second Stage	Benchmark	First Stage	Second Stage
Distance	-0.649***	-0.217***	-0.353***	-1.106***	-0.526***	-0.922***
	(0.0723)	(0.0493)	(0.0800)	(0.193)	(0.119)	(0.203)
Currency Union	0.234*	-0.373***	0.470***			
	(0.139)	(0.121)	(0.155)			
Common Language	0.0899	-0.116	0.846***	-0.0336	0.119	0.196
	(0.132)	(0.0788)	(0.161)	(0.262)	(0.144)	(0.257)
Legal System	0.447***	0.257***	0.237*	0.0136	0.0357	-0.322
	(0.0916)	(0.0614)	(0.126)	(0.170)	(0.100)	(0.229)
Religion	0.801***	0.295**		0.398	0.534	
	(0.275)	(0.149)		(0.461)	(0.358)	
Border	0.238	-0.171	0.766***	-0.364	-0.555*	-0.171
	(0.183)	(0.163)	(0.228)	(0.394)	(0.316)	(0.364)
Colonial	0.813***	0.487***	0.301	1.120***	1.210***	0.730***
	(0.185)	(0.106)	(0.218)	(0.230)	(0.272)	(0.254)
RTA	0.424***	0.232**	-0.119	0.349	-0.162	-0.677***
	(0.157)	(0.108)	(0.183)	(0.262)	(0.157)	(0.244)
Source GDP	1.555*	0.283	0.352*	0.766	0.861	0.478
	(0.835)	(0.518)	(0.194)	(0.924)	(0.681)	(1.096)
Host GDP	1.453*	-0.652**	0.331***	-1.811*	0.315	0.337***
	(0.799)	(0.270)	(0.0504)	(0.925)	(0.897)	(0.0718)
Inverse Mills Ratio			-0.306**			0.866***
			(0.151)			(0.174)
Productivity Threshold			0.559**			7.09e-05***
			(0.222)			(4.94e-07)
R-squared	0.729			0.659		
Pseudo R-squared		0.542			0.456	
Clustered Source-Host Pairs	970	2450	970	317	728	317
Observations	3,222	17,150	3,222	1,031	5,096	1,031

Robust standard errors in parentheses. Source, host, and year fixed effects included.
*** p<0.01, ** p<0.05, * p<0.1
^lagged, ^^natural log, ^^^ lagged natural log

Appendix 6. Benchmark vs. 2-Stage Estimations – OCED and Asia Intra-group Results

	OECD to OECD			Asia to Asia		
	Benchmark	First Stage	Second Stage	Benchmark	First Stage	Second Stage
Distance	-0.549***	-0.110	-0.505***	-1.025***	-0.707***	-1.758***
	(0.118)	(0.0718)	(0.109)	(0.231)	(0.149)	(0.359)
Currency Union	0.101	-0.188	0.126			
	(0.137)	(0.134)	(0.165)			
Common Language	0.0758	-0.00478	0.855***	-0.477	-0.596**	-0.281
	(0.169)	(0.125)	(0.220)	(0.458)	(0.282)	(0.445)
Legal System	0.682***	0.434***	0.455***	-0.169	-0.0647	-0.667*
	(0.117)	(0.0981)	(0.173)	(0.255)	(0.169)	(0.364)
Religion	1.002***	0.376		-0.177	-1.153	
	(0.357)	(0.236)		(1.116)	(1.221)	
Border	0.235	-0.112	0.494**	-0.124	-0.564	-0.287
	(0.195)	(0.169)	(0.233)	(0.370)	(0.348)	(0.405)
Colonial	0.332	0.311	0.225	1.563**	3.244***	0.149
	(0.225)	(0.231)	(0.286)	(0.675)	(0.795)	(0.597)
RTA	0.697***	0.798***	-0.0661	1.032*	-0.564**	-1.573***
	(0.227)	(0.160)	(0.295)	(0.589)	(0.285)	(0.361)
Source GDP	-0.777	1.597**	0.674***	1.811	0.590	2.068
	(0.939)	(0.785)	(0.254)	(1.408)	(1.359)	(1.767)
Host GDP	4.142***	-1.833**	0.605***	-2.439**	3.097**	0.503***
	(1.374)	(0.769)	(0.0594)	(1.143)	(1.244)	(0.0875)
Inverse Mills Ratio			0.454**			1.784***
			(0.225)			(0.277)
Productivity Threshold			0.350			0.000116***
			(0.378)			(1.96e-06)
R-squared	0.735			0.738		
Pseudo R-squared		0.35			0.446	
Clustered Source-Host Pairs	470	600	470	136	182	136
Observations	2,045	4,200	2,045	528	1,274	528

Robust standard errors in parentheses. Source, host, and year fixed effects included.
*** p<0.01, ** p<0.05, * p<0.1
^lagged, ^^natural log, ^^^ lagged natural log