

FDI as an Outcome of the Market for Corporate Control: Theory and Evidence*

Keith Head[†] John Ries[‡]

April 3, 2007

Abstract

Much foreign direct investment (FDI) takes the form of mergers and acquisitions (M&A). It is commonplace in finance to view acquisitions as manifestations of the market for corporate control. Following on that insight we propose a model of FDI in which headquarters bid to control overseas assets. We derive an equation for bilateral FDI stocks that resembles the recently developed fixed effects approach to modelling bilateral trade flows. We estimate the model and use its parameters to construct benchmarks for evaluating multilateral inward and outward FDI.

JEL classification: F21, F22, G34

Keywords: foreign direct investment, mergers and acquisitions, gravity, benchmark

*We appreciate the helpful suggestions of two anonymous referees, Jonathan Eaton, and workshop participants at the London School of Economics, CEPII and EIIT. We thank Thierry Mayer for providing some of the data used in this paper.

[†]Sauder School of Business, University of British Columbia, keith.head@ubc.ca

[‡]Corresponding Author: Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada. Tel: (604) 822-8493, Fax: (604) 822-8477, john.ries@ubc.ca

1 Introduction

From 1987 to 2001, about two-thirds of foreign direct investment (FDI) took the form of mergers and acquisitions (M&A) rather than new plants. While it often makes sense to think of M&A and greenfield investments as alternatives in a “buy or build” decision, this need not be the primary consideration. For example, when Renault took a one third share of Nissan, it had not been contemplating building a Renault factory in Japan. There was no intention of shifting production of Renault models to Japanese factories. Instead, Renault installed one of its star managers, Carlos Ghosn, as the Nissan CEO. He proceeded to restructure the Japanese company, restoring it to profitability. This case illustrates the way that FDI can be a manifestation of an international market for corporate control.

This paper develops a simple model of FDI where heterogeneous investors bid to obtain control rights on existing overseas assets. Unlike much of the existing theoretical literature predicting FDI, our formulation explicitly considers more than two countries. The model yields an equation for bilateral FDI that strongly resembles the gravity equation used to analyze bilateral trade in goods. The specification consists of an outward effect reflecting characteristics of the origin country, an inward effect reflecting characteristics of the destination country, and a vector of pair-specific variables reflecting monitoring costs. We estimate the model using a cross-section of 62 countries. In a second stage, we relate the estimated inward and outward fixed effects to variables predicted by the model. We then show how a formulation of the model can be aggregated to yield a simple expression for a country’s share of world FDI. We compare predicted country-level inward and outward FDI shares to actual values to see how well the model fits multilateral data and identify countries with anomalous FDI performance.

The theoretical FDI literature has traditionally focussed on greenfield investment. Important early work includes Markusen’s (1984) model of horizontal FDI and Helpman’s (1984) model of vertical FDI. Carr, Markusen, and Maskus (2001) solve a 47-equation, general equilibrium model incorporating vertical and horizontal FDI. Their computations suggest linear

FDI equations where key variables enter with interactions to capture non-linearities in the model. Bergstrand and Egger (2004) add physical capital to Markusen’s knowledge-capital model. They generate “theoretical flow data” and find the “frictionless” (no trade costs) gravity equation describes their simulated data well.

A smaller, but growing, literature considers FDI in the form of cross-border M&A. Barba Navaretti and Venables (2004) distinguish M&A from greenfield by assuming that merged firms eliminate one of the varieties and the associated fixed costs of the joining firms. In common with horizontal greenfield investment, cross-border M&A becomes more attractive relative to exporting as trade costs increase. Neary (2004) also focuses on the market structure implications of M&A but explores the implications of cost asymmetries between acquiring and target firms. In his model low cost firms from one country acquire—and then shut down—high cost firms abroad. Nocke and Yeaple (2005a) posit M&A as providing access to a foreign firm’s non-mobile capabilities. Firms choose different modes of foreign entry (export, greenfield and M&A) depending on their heterogeneous capabilities. Nocke and Yeaple (2005b) model international acquisitions as arising from a matching between heterogeneous entrepreneurs and varieties. All of these models abstract from one the main considerations of our paper: the frictions that inhibit cross-border ownership.

One natural way to model frictions affecting FDI is to assume that headquarters have imperfect information regarding assets in potential host countries. This approach has some precedents in the international finance literature. Gordon and Bovenberg (1996) stipulate that international buyers have a lower opportunity cost of capital but face information asymmetries when they purchase domestic firms. In Razin and Goldstein (2005) and Razin, Sadka, and Yuen (1998), foreign direct investors have informational advantages over portfolio investors. Mody, Razin and Sadka (2004) and Loungani, Mody, Razin and Sadka (2003) propose that foreign investors have specialized knowledge that gives them an advantage over domestic owners. However, that advantage declines with greater corporate transparency in the host country. None of the papers associate information problems with geography. One paper that explicitly considers monitoring costs that are a function of distance is Marin and Schnitzer

(2004). That paper constructs and estimates a model of the headquarters decision to use its own funds to finance direct investment (internal financing) or to rely upon loans from local or international banks.

This paper's contribution to the theory literature comes through an explicit model of monitoring in which we establish an ability versus proximity tradeoff. We build this into a highly stylized international market for corporate control. In our model, a country's likelihood of bidding successfully for assets in another country depends not only on the distance between the two countries, but also their location relative to bidders in other countries. This approach allows us to incorporate geography into an analytical expression for bilateral FDI in a multi-country world. Our model provides a set of micro-foundations for a gravity equation for FDI. Other models may provide a different set of micro-foundations for the same equation.¹ Our purpose is not to test our model against possible alternatives. Rather, we offer an analytical structure on which to base estimation of bilateral FDI.

A growing empirical literature uses the gravity equation to investigate the determinants of various types of cross-border investments. The base gravity equation relates the log of bilateral investment to the logged sizes of origin and destination economies and the log distance between them. Studies on FDI have then augmented the gravity equation with variables such as factor endowments (Eaton and Tamura, 1994), corruption and taxes (Wei, 2000), third-country competition (Eichengreen and Tong, 2005), information proxies (Loungani *et al.*, 2003), taxes and wages (Mutti and Grubert, 2004), and institutions (Bénassy-Quéré *et al.* 2007). Hijzen, Gorg, and Manchin (2005) and di Giovanni (2005) investigate the determinants of bilateral M&A transactions in a gravity setting. Portes and Rey (2005) find that gravity models also fit portfolio investment flows.

Policy is often most interested in total FDI rather than geographic origins. Our multilateral benchmarks contribute to the identification of unusually high or low FDI performance.

¹Martin and Rey (2004) derive a gravity-type model for foreign *portfolio* investment assuming risk adverse investors and iceberg transaction costs for assets. Models of horizontal FDI predict that distance costs of trade would promote investment. However, if final goods were non-traded but required inputs from home, high trade costs could lead to the negative distance effect exhibited in the gravity equation (see Grossman, Helpman, and Szeidl, 2003, for a model that admits this possibility).

The United Nations Conference on Trade and Development’s (UNCTAD) “FDI Performance Index” compares countries’ shares of world FDI to shares of world GDP. Our theory identifies biases in the UNCTAD index and our empirical implementation shows that our benchmark generally achieves a tighter fit with actual FDI.

The next section presents the model and the corresponding specifications of bilateral and multilateral FDI. Section 3 describes OECD and UNCTAD data on FDI and M&A. Here we argue that a model of FDI as a market for corporate control may represent a large share of FDI. Section 4 describes the results for bilateral FDI and M&A. We proceed in two stages. In the first stage, we use bilateral FDI for 62 OECD and partner countries to estimate origin and destination fixed effects. In the second stage, we estimate the unknown model parameters and investigate the empirical validity of the model’s predictions. Section 5 uses the estimated parameters to predict country-level aggregate foreign investment for 172 countries. Then we compare the predictions to actual country-level shares of FDI & cross-border M&A. We summarize our methods and results in the final section.

2 The model

We develop a control-based model of FDI. Jensen and Ruback (1983) motivate this approach, arguing that “the market for corporate control is best viewed as an arena in which managerial teams compete for the rights to manage corporate resources.” The model proceeds in three subsections. First, we specify the costs and benefits of controlling remote assets in a game between the headquarters of an MNE and a subsidiary. Second, we use discrete choice theory to solve for the expected amount of corporate assets in one country that will be controlled by a management team based in another country. This yields an expression for bilateral FDI stocks. Third, we specify the predictions of our model for a country’s multilateral inward and outward FDI.

2.1 The costs of remote control

We present a simple model that introduces a trade-off between the benefit of shifting control to a better owner and the costs of having that owner be remote from the target. Without monitoring, the manager of the subsidiary lacks incentives to exert effort to maximize the value of the subsidiary. Monitoring requires costs that are increasing in distance between the head office and its subsidiary.

We adapt the model from the “inspection game” described in Fudenberg and Tirole (1991, p. 17) and apply it to the case of a headquarters management team (hereafter, HQ) that must monitor the managers at an overseas subsidiary (hereafter, Sub). Sub chooses whether to work or shirk. Gross profits depend on the contributions of HQ and Sub. HQ always adds a whereas Sub adds b only when choosing to exert effort. HQ simultaneously chooses whether to *trust* Sub or *verify* whether it has worked or not.

Payoffs for Sub and HQ are shown in Table 1. HQ pays w to Sub unless HQ inspects and discovers shirking in which case Sub gets zero. Working generates gross output of $a + b$ but Sub incurs cost of effort, e . Verification costs HQ c , which we will later assume to be an increasing function of distance from HQ to Sub.

Table 1: The inspection game

		Headquarters chooses	
		Trust ($1 - y$)	Verify (y)
Subsidiary manager chooses	Shirk (x)	$w, a - w$	$0, a - c$
	Work ($1 - x$)	$w - e, a + b - w$	$w - e, a + b - w - c$

Following Fudenberg and Tirole, assume $b > w > e > c > 0$. Under these assumptions, there is no Nash equilibrium in pure strategies. If Sub expects HQ to trust, it will want to shirk since this delivers the same compensation but saves e . But if HQ expects Sub to shirk, it will want to verify, since the cost of verifying is less than the wage ($c < w$). In that case,

Sub would rather work, since $w - e > 0$.

In a mixed strategy Nash equilibrium, Sub shirks with probability x and HQ verifies with probability y . By assumption, HQ's value-added does not depend on Sub's action. Expected revenues are therefore given by $a + b(1 - x)$. HQ compensates Sub unless HQ verifies that shirking occurred (probability xy). Taking these observations into account, HQ's expected payoff is

$$v = a + b(1 - x) - cy - w(1 - xy). \quad (1)$$

Sub's expected utility is $w(1 - xy) - e(1 - x)$. The agents choose their respective probabilities taking the other's as given. The first order condition for HQ is therefore $v_y = -c + wx = 0$ and that for Sub is $v_x = -wy + e = 0$. The equilibrium mixing probabilities are therefore $x = c/w$ and $y = e/w$. Plugging these results back into HQ's payoff, we obtain

$$v = a + b(1 - c/w) - w. \quad (2)$$

Maximizing this expression with respect to w implies the contract of paying $w = \sqrt{bc}$ except when HQ verifies that shirking has occurred (and therefore pays nothing). Substituting this result back into equation (2), we see that

$$v = a + b - 2\sqrt{bc}. \quad (3)$$

The key result is that higher verification costs lower the value of the subsidiary to headquarters. This effect is magnified when Sub's effort is more valuable (high b). Put another way, if two head offices of equal potential valued-added a were bidding, the one with lower inspection costs would bid higher.

We now give the model empirical content by hypothesizing that inspection costs, c , are an increasing function of a vector of geographic and cultural distance measures denoted, \mathbf{D}_{in} . We call this the remoteness function and specify it so as to simplify the algebra of the value

equation. In particular, let

$$c_{in} = [r(\mathbf{D}_{in})/2]^2 \text{ with } r' > 0.$$

Substituting back into equation 3 in country n to a representative HQ in country i , we have

$$v_{in} = a + b - \sqrt{br}(\mathbf{D}_{in}). \quad (4)$$

This equation illustrates an *ability versus proximity trade-off*, since high values of HQ value-added a are necessary to offset the monitoring costs of a remote subsidiary. There are two other implications of the model worth noting even though we cannot test them here. First, the compensation paid to Sub is an increasing function of distance given by $w_{in} = (1/2)\sqrt{br}(\mathbf{D}_{in})$. Second, the output of the subsidiary is decreasing in distance from HQ: $a + b(1 - x) = a + b - (\sqrt{b}/2)r(\mathbf{D}_{in})$. In both relationships, the impact of remoteness is higher when Sub adds greater value, b .

The simple model captures the idea that once monitoring costs are taken into account, a high-ability headquarters may have a lower willingness to pay for a target than a less able, but more proximate headquarters. Intuitively, we would expect to find the lower valuations of remote HQs reflected in lower amounts of realized investment. The next subsection formalizes that intuition.

2.2 Bilateral ownership stocks

We endogenize the ownership outcome by modeling it as a process in which the bidder who anticipates the highest subsidiary valuation, v , makes the highest bid, and wins the stylized auction for control of a subsidiary.² Let π_{in} denote the probability that a headquarters from country i takes control of a randomly drawn target in country n . Using K_n to represent the asset value of the entire stock of targets in the host country, expected bilateral FDI stocks are

²The official definition of FDI includes minority share-holding, as long as there is a “lasting interest” involving “a significant degree of influence,” operationalized as an equity share of 10% or more. For brevity, we apply the term “control” to all FDI.

given by

$$E[F_{in}] = \pi_{in}K_n. \quad (5)$$

Unless there are a continuum of targets in country n , actual FDI will differ from expected FDI due to “lumpiness.” Since many targets are very large, realized F_{in} can be very different from the expected level. An illustration of lumpiness can be seen in Renault’s \$5.4 billion investment in Nissan in 1999. That year France’s stock of FDI in Japan jumped by a factor of 10, and Renault’s investment accounted for 95% of the net inflow. In Appendix A we specify the variance of F_{in} as a function of the number and size distribution of the targets in the host country.

To specify π_{in} , we suppose that country i has m_i headquarters, each of which have different valuations for a given target in country n . The natural way to introduce heterogeneity in the valuations is through the HQ value-added term, a , which enters equation 4 additively. For reasons stated below, we assume that the cumulative density of a takes the Gumbel (type-I extreme value) form: $\exp(-\exp(-(x-\mu)/\sigma))$. Bury (1999) points out that the maximum of m Gumbel draws is also Gumbel with the same shape parameter, σ , but the location parameter, μ , shifted up by $\sigma \ln m$. This property is useful since π_{in} depends on the maximum of the m_i bids issuing from country i . The probability that the highest bidder for a random target in country n is one of the HQs from country i equals the probability that the maximum valuation from country i exceeds the maximum valuation from any other country. Here a second feature of Gumbel heterogeneity comes in useful: it is a rare case where the distribution of the probability that a given draw is the maximum draw takes a simple analytical form. Using the results of Anderson, de Palma, and Thisse (1992, p. 39), one can then show that the π_{in} are given by the multinomial logit formula:

$$\pi_{in} = \frac{\exp[\mu_i/\sigma + \ln m_i - (\sqrt{b}/\sigma)r(\mathbf{D}_{in})]}{\sum_{\ell} \exp[\mu_{\ell}/\sigma + \ln m_{\ell} - (\sqrt{b}/\sigma)r(\mathbf{D}_{\ell n})]}. \quad (6)$$

Substituting (6) into (5), we can express expected bilateral FDI stocks as

$$E[F_{in}] = \frac{m_i \exp[\mu_i/\sigma - (\sqrt{b}/\sigma)r(\mathbf{D}_{in})]}{\sum_{\ell} m_{\ell} \exp[\mu_{\ell}/\sigma - (\sqrt{b}/\sigma)r(\mathbf{D}_{\ell n})]} K_n, \quad (7)$$

To obtain an equation that can be estimated, we need to parameterize the inspection cost function $r(\cdot)$. With the goal of linearity in parameters, let $r(\mathbf{D}_{in}) = \mathbf{D}_{in}\boldsymbol{\delta}$, where $\boldsymbol{\theta} \equiv \boldsymbol{\delta}\sqrt{b}/\sigma$ is a compound parameter that determines the FDI-impeding effect of distance. It depends positively on the distance costs of remote inspections ($\boldsymbol{\delta}$) and the value-added by a non-shirking manager (b). On the other hand, the higher the heterogeneity in bidder ability (captured with σ), the less distance inhibits FDI.

Expected F_{in} depends only on the *shares* of headquarters in each country, so we introduce $s_i^m \equiv m_i/(\sum_{\ell} m_{\ell})$ to represent a country's share of the world's bidders. Using the new notation we can specify an important factor in the bilateral FDI equation that follows from the theory. Define $B_n \equiv \sum_{\ell} s_{\ell}^m \exp[\mu_{\ell}/\sigma - \mathbf{D}_{\ell j}\boldsymbol{\theta}]$ as the "bid competition" for targets in country n . Bid competition is greater when large shares of bidders are nearby (low $\mathbf{D}_{\ell j}$) and high ability (high μ_{ℓ}). Re-expression of (7) in terms of these variables yields

$$E[F_{in}] = \exp[\mu_i/\sigma - \mathbf{D}_{in}\boldsymbol{\theta}] s_i^m K_n B_n^{-1}, \quad (8)$$

This expression resembles the gravity equation in that expected bilateral stocks are increasing in the product of origin and destination size variables (s_i^m and K_n) and decreasing in measures of bilateral distance. Higher bid competition (B_n) in n implies that a higher fraction of assets in n will be taken by rivals from other countries, thereby reducing the expected bilateral stocks of headquarters from country i .

Equation (8) specifies the country i 's expected stock of direct investment in host country n . Our static model does not predict the sequence of FDI flows involved in reaching this expected stock. Observed FDI flows include divestitures that often lead to negative bilateral investment. A model of flows requires accounting for divestitures of assets in a specification

of the adjustment costs associated with convergence to desired FDI levels.³

Additional insight into how the parameters of the model might be estimated can be had by re-expressing the right-hand side as:

$$E[F_{in}] = \exp(\underbrace{\mu_i/\sigma + \ln s_i^m}_{\text{Outward effect}} + \underbrace{\ln K_n - \ln B_n}_{\text{Inward effect}} - \mathbf{D}_{in}\boldsymbol{\theta}). \quad (9)$$

This equation shows that bilateral FDI can be separated into a origin i -specific term relating to its share of the world’s headquarters and their mean ability, a destination n -specific term relating to the share of “target” assets and the competing set of bidders (B_n).⁴ These outward and inward effects can be estimated as i - and n -specific fixed effects. Compressing the outward and inward effects into one term each, we obtain an even more compact expression for expected bilateral FDI stocks:

$$E[F_{in}] = \exp(O_i + I_n - \mathbf{D}_{in}\boldsymbol{\theta}), \quad (10)$$

where $O_i = \mu_i/\sigma + \ln s_i^m$ is the outward direct investment effect for origin i , $I_n = \ln K_n - \ln B_n$ is the inward direct investment effect for destination n . This formulation follows Eaton and Kortum (2001, 2002) and Redding and Venables (2004) who estimate trade equations with exporter and importer fixed effects. Like Eaton and Kortum (2002), we wish to explore the structural determinants of the fixed effects. First, however, we manipulate the model to achieve expressions for expected multilateral outward and inward FDI. These expressions can be used for benchmarking purposes.

³The parameter vector $\boldsymbol{\theta}$ measures how distance impedes FDI. In our static model, the amount of FDI we observe at any point in time should reflect contemporaneous distance costs. To see this, consider a reduction in distance costs that induces greater expected US investment in France. The implicit assumption of our model is that this would elicit an immediate flow of US FDI into France until the stock reached the level reflecting desired US holdings given the contemporaneous level of distance costs. In a model where stocks adjust gradually to desired levels, observed stocks in any year would reflect lagged values of θ .

⁴The origin and destination terms play an analogous role to the “multilateral resistance indexes” introduced by Anderson and van Wincoop (2003) in their specification of the gravity equation for trade.

2.3 Implications for multilateral FDI

UNCTAD calculates its FDI Performance Index as the ratio of a country’s share of world FDI to its share of world GDP. In this section, we aggregate bilateral FDI to derive predictions for multilateral FDI in the context of our model. We show that even the simplest formulation of the model—one with no distance costs—generates predictions of a country’s share of world FDI that differ from the one used by UNCTAD.

Summing across bidders for a given destination country, we obtain expected worldwide (w) foreign direct investment received by country n :

$$E[F_{wn}] = \sum_{i \neq n} E[F_{in}] = K_n \sum_{i \neq n} \pi_{in} = K_n(1 - \pi_{nn}). \quad (11)$$

The summation across $i \neq n$ arises because the “F” in FDI excludes investment by domestic bidders in domestic targets (which equals $\pi_{nn}K_n$). Worldwide FDI stocks are found by summing the national inward stocks:

$$E[F_w] = \sum_n E[F_{wn}] = \sum_n (K_n - \pi_{nn}K_n) = K_w - \sum_n \pi_{nn}K_n. \quad (12)$$

The amount of total outward investment by country i is given by

$$E[F_{iw}] = \sum_{n \neq i} E[F_{in}] = \sum_{n \neq i} \pi_{in}K_n = K_i(A_i - \pi_{ii}), \quad (13)$$

where $A_i \equiv \sum_n \pi_{in}(K_n/K_i)$. A comparison of multilateral inward and outward investment for a given country i suggests an interpretation for the A_i term. Outward investment, F_{iw} , equals inward investment, F_{wi} , if and only if $A_i = 1$. Thus, A_i is a measure of the “bidder advantage” for country i when $A_i > 1$ and “bidder disadvantage” when $A_i < 1$.

The equations above result simply from adding up accounting identities. Equations (5) and (8) imply that

$$\pi_{ii} = s_i^m \exp[\mu_i/\sigma - \mathbf{D}_{ii}\boldsymbol{\theta}]B_i^{-1}$$

is the domestically owned share of domestic assets. Letting $s_i^K = K_i/K_w$ represent the share of the world's capital in country i , bidder advantage is given by

$$A_i = (s_i^m/s_i^K) \exp[\mu_i/\sigma] \sum_n \exp[-\mathbf{D}_{in}\boldsymbol{\theta}] B_n^{-1} s_n^K.$$

The inward FDI benchmark is given by the predicted value of i 's share of world inward FDI stock:

$$f_i^I = \frac{\mathbf{E}[F_{wi}]}{\mathbf{E}[F_w]} = s_i^K \frac{1 - \pi_{ii}}{1 - \tilde{H}},$$

where $\tilde{H} = \sum_n \pi_{nn} s_n^K$ is the share of the world's capital stock held by domestic controllers.

The outward FDI benchmark is given by the predicted value of i 's share of world outward FDI stock:

$$f_i^O = \frac{\mathbf{E}[F_{iw}]}{\mathbf{E}[F_w]} = s_i^K \frac{A_i - \pi_{ii}}{1 - \tilde{H}}.$$

Consider the case of no distance costs, $\boldsymbol{\theta} = 0$, and that each country's shares of bidders and targets are proportional to its GDP share, $s_i^m = s_i^K = s_i \equiv Y_i/Y_w$. Then predicted outward shares equal predicted inwards shares,

$$f_i^O = f_i^I = s_i \frac{1 - s_i}{1 - H}, \tag{14}$$

where $H \equiv \sum_i s_i^2$ is the Herfindahl concentration index for the worldwide distribution of GDP. It is interesting to compare this predicted FDI share, which we call the neutral benchmark, to the UNCTAD FDI Performance Index. Since UNCTAD scales FDI shares by GDP shares, their implicit benchmark is s_i . The neutral benchmark therefore differs from the UNCTAD benchmark because it adjusts for country size relative to the concentration index, $(1 - s_i)/(1 - H)$. FDI shares for small countries are predicted to be larger than their GDP shares. Thus, other things equal, we expect relatively high UNCTAD performance indexes for small countries. Since $H = 0.14$ in 2001, only the US ($s_i = 0.32$ in 2001) is large enough so that its share of world FDI is predicted to be less than its share of world GDP. The neutral benchmark predicts all other counties to have FDI shares greater than their GDP shares. In

2004 the UNCTAD reported that “The results show that relatively small economies such as Switzerland feature prominently on the top of the list. This suggests that these economies have highly competitive enterprises with ownership advantages that enable them to compete successfully in international markets.”⁵ The size-bias inherent to the UNCTAD benchmark raises doubts about this inference.

3 FDI and M&A

We fit our model to both FDI and M&A data. The source of the foreign direct investment statistics used in this study is the Balance of Payments that reflects cross-border flows of goods, services, and ownership claims. We obtain bilateral FDI from the Organization for Economic Cooperation and Development’s (OECD) *SourceOECD International Direct Investment Statistics database*. The original source of M&A data is Thomson Financial Securities Data Corporation who compile information on all mergers and acquisitions that involve at least a 5% change in firm equity. Multilateral FDI and M&A data are available from UNCTAD’s FDI database.⁶ Bilateral M&A transactions from 1990 to 1999 are kindly made available by di Giovanni (julian.digiovanni.ca).

For a number of reasons, cross-border M&A transactions are not a proper subset of FDI data. First, M&A data includes funds raised locally. For example, an acquisition by a foreign enterprise resident in the country of the target is recorded in the M&A statistics but not in the FDI statistics (since no cross-border flow of funds has occurred). Second, the M&A data reflect gross transactions amounts at the time of the deal and do not account for subsequent investment or divestitures. Third, the M&A values recorded at the time of the announcement or closure of the deal may not correspond exactly to the flow of investment funds.⁷

Despite these definitional differences, it is useful to observe the relationship between the two data series. We collected multilateral FDI flow and M&A data from UNCTAD’s Foreign

⁵www.geneva.ch/_FDI_performance.htm

⁶The M&A data are based on the acquirer obtaining at least a 10% stake in the target company.

⁷These definitional issues are discussed in the *World Investment Report 2000*, Chapter IV, pp.104–109.

Table 2: M&A transactions and FDI flows: Correlations and ratios for 1987–2001

	OECD		
	Members	“Partners”	Others
Number (w/ GDP data)	29	31	122
GDP shr	83.01	14.33	2.66
FDI Outward stock shr	87.42	11.39	0.82
FDI Inward stock shr	69.85	24.6	5.25
FDI Outward flow shr	90.47	8.24	0.92
FDI Inward flow shr	75.16	19.96	4.58
M&A purchase (outward) shr	93.23	4.5	1.96
M&A sale (inward) shr	89.79	8.36	1.59
M&A: FDI Outward Flow Ratio	0.71	0.38	1.49
M&A: FDI Inward Flow Ratio	0.82	0.29	0.24
Corr(FDI,M&A): Outward flows	0.89	0.52	0.62
Corr(FDI,M&A): Inward flows	0.94	0.49	0.43

Note: Ratios sum 15 years of transactions in numerator (M&A) and denominator (FDI).

Direct Investment Statistics for the period 1987–2001. We categorize the countries into three groups. The first group comprises the 29 OECD countries (Belgium and Luxembourg FDI stocks are combined by UNCTAD) that report bilateral FDI. The second group are the 31 non-OECD countries listed as “partners” in the OECD database for which we have data on bilateral FDI and GDP.⁸ The third group consists of an additional 122 countries for which UNCTAD provides multilateral data.

Table 2 displays information about GDP, FDI flows and stocks, and M&A for these groups of countries. The first seven rows reveal that the OECD countries account for the vast majority of economic activity—83% of GDP (valued at nominal 2001 exchange rates), roughly 90% of M&A, and over three-quarters of FDI. The 31 “partners” play a smaller role but their share of 1987–2001 FDI inflows as well as their 2001 shares of inward FDI stocks are 20% and 25%. This group includes China, Hong Kong, and other Asian countries that host large amounts of FDI. The remaining group has only small shares of activity.

We also cumulate 1987–2001 M&A and FDI flows and report the ratio of M&A purchases to outward flows and M&A sales to inward flows. Rows 8 and 9 indicate that M&A accounts

⁸Appendix B lists the OECD and partner countries.

for a large majority of the 29 OECD countries' investment, with M&A sales representing 82% of inward FDI and purchases of foreign assets through M&A accounting for 71% percent of outward FDI. The ratios are lower for the other groups of countries. The 1.49 ratio of purchases to outward FDI for the third group, the 122 countries with multilateral data only, reflects large M&A purchases by Bermuda and Bahrain coupled with much smaller recorded outward FDI flows. For all countries, the ratio of M&A sales to inward FDI and M&A purchases to outward FDI are 0.68 and 0.69, and these data are the basis for our statement in the introduction reporting that FDI accounts for roughly two-thirds of FDI.

The last two rows list the correlation between outward FDI and M&A purchases and inward FDI and M&A sales for the groups for the 1987–2001 period.⁹ The correlation is quite high for the OECD countries—0.94 for inward investment and 0.89 for outward investment. The correlations are around 0.5 for the other groups.

We have learned that M&A seems to characterize much of the FDI of OECD countries. Does M&A reflect the market for corporate control that we focus on in the model? Additional information sheds light on this issue. Gugler, Mueller, Yurtoglu and Zulehner (2003) calculate the share of international M&As that are horizontal, vertical, and conglomerate for the 1981–1998 period. They define horizontal mergers as those occurring between companies classified in the same four-digit industry. Vertical mergers are those for which the firms are in different 4-digit SICs and the two SICs have at least 10% of their sales/purchases with one another (based on the 1992 US input-output table). Conglomerate mergers are all others. They find that 54% of cross-border M&A mergers are conglomerate, 42% are horizontal, and only 4% are vertical. Hijzen, Gorg, and Manchin (2005) examine a slightly later period, 1990–2001, and calculate that 32% of mergers are horizontal.

Conglomerate mergers and a portion of horizontal mergers may be consistent with our model of corporate control. Conglomerate mergers occur when the investor can add value to the target's operations. The motivation for such mergers is unlikely to cause a shift in the acquirer's production in order to lower costs, the traditional focus of FDI theory. Thus,

⁹We stack M&A and FDI data for each country and each year and compute correlations. Thus, correlations contain both time series and cross-sectional variation.

we argue that these transactions are better modelled in our framework than one where trade costs and factor costs play the central role. In addition, as demonstrated by the Renault-Nissan example, some horizontal mergers are more related to adding value through better management than lowering costs by shifting production.

While we have M&A in mind when developing the model, in light of this information on M&A and FDI data, we feel our model can be applied to observed FDI levels. Most OECD FDI is M&A and the costs and benefits of control are likely to be important considerations for most M&A. Our model may also be able to represent greenfield investment in cases where investors bid on a fixed number of investment sites and there is heterogeneity across investors in the value they can add to the sites.

In the next section, we fit our model to 2001 bilateral FDI stocks and cumulative 1990–1999 M&A transaction values.

4 Bilateral FDI results

The recorded bilateral FDI data for 30 OECD countries and 32 non-OECD partners contains both missing data and zero values. Once we cumulate 1990–1999 M&A data collected from di Giovanni, we have 19,897 observations for 101 source countries and 198 destination countries. Only 1551 of these observations, however, are non-zero and there are no missing values: di Giovanni coded zeros for bilateral pairs with no M&A transactions. To keep the FDI and M&A samples as consistent as possible, we confine the sample to the 30 OECD members and the 32 additional “partners” listed in the OECD Direct Investment Statistics database.¹⁰

We estimate the model in two stages. In the first stage, we regress bilateral FDI stocks on outward and inward fixed effects and a vector of geographic and cultural distance measures, $\mathbf{D}_{in}\boldsymbol{\theta}$. In the second stage, we regress the estimated outward and inward effects on variables predicted by the model. Specifically, the outward effect is a function of the quality and quantity of management teams ($\mu_i/\sigma + \ln s_i^m$) whereas the inward effect depends on a country’s capital

¹⁰We thereby discard 511 observations with positive M&A data. However, M&A levels for these observations are quite small: only two exceed \$10 billion with both of those involving Bermuda as the destination country.

stock (K_n) and bid competition (B_n).

To proceed, we need to move from the expected values determined in the theory section to the actual values of FDI recorded in the OECD data set. Define $\eta_{in} = F_{in}/E[F_{in}]$ as the ratio of actual to expected bilateral FDI stocks. Using equation (10),

$$F_{in} = E[F_{in}]\eta_{in} = \exp(O_i + I_n - \mathbf{D}_{in}\boldsymbol{\theta})\eta_{in}, \quad (15)$$

Although η_{in} has an expected value of one, it can deviate from one for three main reasons. First, in the context, of the model, lumpiness of the targets leads to variance in realized FDI (see appendix A). Second, specification error is nearly unavoidable in a parsimonious model based on particular functional forms. Third, governments measure FDI imperfectly.

The \mathbf{D}_{in} vector consists of log distance and adjustments based on observed and unobserved bilateral linkages:

$$\mathbf{D}_{in} = \{\ln d_{in}, \text{Lang}_{in}, \text{ToColy}_{in}, \text{FromColy}_{in}, u_{in}\},$$

where d_{in} is the average great circle distance between the 20 largest cities in countries i and n .¹¹ Lang_{in} indicates that i and n share a common language. A prior colonial relationship is likely to be a good proxy for institutional similarity that could facilitate monitoring. We introduce directional dummy variables to indicate FDI to a former colony from its colonizer (ToColy) and FDI from a colony to its colonizer (FromColy). The distance, language, and colony variables are provided on the `cepii.fr` website. These variables have been found significant in past studies of trade (e.g. Rose, 2004). We introduce u_{in} to capture all the unobserved linkages between two countries that affect the cost of monitoring. After introducing these variables, the equation for bilateral FDI stocks becomes

$$F_{in} = \exp[O_i + I_n - \theta_1 \ln d_{in} + \theta_2 \text{Lang}_{in} + \theta_3 \text{ToColy}_{in} + \theta_4 \text{FromColy}_{in} + (\theta_5 u_{in} + \ln \eta_{in})] \quad (16)$$

¹¹We experimented with dividing distance into six categories and using category dummy variables as in Eaton and Kortum (2002) but found that the parsimonious linear-in-logs approach provides a slightly better fit. The two distance decay functions are compared graphically in files available at <http://strategy.sauder.ubc.ca/head/sup>.

The conventional method for estimating (16) is to take logs of both sides, yielding

$$\ln F_{in} = \mathbf{x}_{in}\boldsymbol{\beta} + \epsilon_{in}, \quad (17)$$

where \mathbf{x}_{in} is $[1 \times K]$ vector of explanatory variables, $\mathbf{x}_{in}\boldsymbol{\beta} \equiv O_i + I_n - \theta_1 \ln d_{in} + \theta_2 \text{Lang}_{in} + \theta_3 \text{ToColy}_{in} + \theta_4 \text{FromColy}_{in}$, and $\epsilon_{in} \equiv \theta_5 u_{in} + \ln \eta_{in}$. We can then estimate the parameters $(O_i, I_n, \theta_1 - \theta_4)$ using linear regression. Since u_{in} captures unobserved country-pair linkages, we expect ϵ_{in} to be high correlated with the reverse direction error term ϵ_{ni} . We therefore estimate (17) using pair-wise random effects (GLS).

A well-known problem with estimating (17) is the log function eliminates all the zeros. This problem is more severe for FDI and cross-border M&A than trade because of the much higher frequency of bilateral zero stocks. Eaton and Tamura (1994) introduced Tobit-type estimation methods for FDI and trade and Wei (2000) adopts the same method. Recent simulations results of Santos Silva and Tenreyro (forthcoming) find that Eaton and Tamura's method can yield highly biased estimates in the presence of heteroskedastic errors. They point out that if the variance of the error term η_{in} is a function of the covariates (such as $\ln d_{in}$), then the conditional expectation of $\ln \eta_{in}$ will not be zero and linear regression generates inconsistent parameter estimates—regardless of whether the dependent variable contains zeros.

Santos Silva and Tenreyro argue that Poisson quasi-MLE is an attractive alternative to least squares on equation (17). The K first order conditions for the Poisson QMLE are

$$\sum_i \sum_n (F_{in} - \exp(\mathbf{x}_{in}\boldsymbol{\beta})) x_{in}^k = 0 \text{ for } k = 1 \dots K, \quad (18)$$

the same first order conditions used for Poisson MLE on count data. The Poisson QMLE gives consistent $\boldsymbol{\beta}$ estimates no matter what the variance of η_{in} so long as $E[F_{in}] = \exp(\mathbf{x}_{in}\boldsymbol{\beta})$. Comparing with the least squares first order conditions,

$$\sum_i \sum_n (\ln F_{in} - \mathbf{x}_{in}\boldsymbol{\beta}) x_{in}^k = 0 \text{ for } k = 1 \dots K, \quad (19)$$

we see that the former involves level deviations of F_{in} from its expected value whereas the OLS involves log deviations. In comparing the fit of each model to the data, we therefore report diagnostics (R^2 and RMSE) in terms of both levels and logs. Another advantage of Poisson QMLE is that it can incorporate the zero FDI stocks.¹²

Table 3: Bilateral FDI regressions with fixed effects: 2001

Specification:	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GLS	GLS	GLS	PQMLE	PQMLE	PQMLE
Depvar:	ln FDI	ln FDI	ln M&A	FDI	FDI	M&A
Sample:	All*	Hi-OECD*	All	All	Hi-OECD	All
ln distance	-1.250 ^a (0.072)	-1.048 ^a (0.129)	-0.916 ^a (0.095)	-0.591 ^a (0.061)	-0.582 ^a (0.083)	-0.726 ^a (0.111)
Language	0.697 ^a (0.191)	0.611 ^b (0.257)	1.147 ^a (0.233)	0.250 ^c (0.143)	0.215 (0.163)	0.593 ^b (0.293)
To colony	1.140 ^a (0.243)	0.831 ^a (0.314)	0.897 ^a (0.315)	0.201 (0.198)	0.096 (0.258)	0.125 (0.286)
From colony	0.772 ^a (0.274)	0.426 (0.295)	-0.171 (0.452)	0.328 (0.210)	0.262 (0.242)	0.687 ^b (0.283)
No. of obs.	1278	425	944	1559	453	2465
R^2 in logs	0.795	0.835	0.603	0.729	0.782	0.494
R^2 in levels	0.609	0.661	0.669	0.898	0.903	0.884
RMSE in logs	1.466	1.215	1.765	1.795	1.481	2.094
RMSE in levels	15.419	21.075	9.739	5.008	8.841	3.207

Note: GLS regressions estimated with country-pair random effects and heteroskedasticity-robust standard errors. Poisson Quasi-MLE standard errors are robust to over/under dispersion and clustered at the country-pair level. Statistical significance at the 1%, 5% and 10% levels parentheses denoted with ^a, ^b, and ^c. * “All” comprises 30 OECD reporters and 32 partners. HI-OECD limits sample to 24 high-income countries (see data appendix).

Table 3 presents the coefficients on distance, common language, and colonial tie from the first-stage regressions.¹³ The first three columns display the GLS results and the second three columns Poisson QMLE results. Columns (1) presents GLS results for FDI stocks. In common with gravity equations estimated for bilateral trade, distance impedes international transactions while common language and colonial ties promote them. In this column, bilateral FDI is higher for countries with colonial ties regardless of whether the source country is a

¹²Wooldridge (2002, Chapter 19) provides further detail on the robustness and efficiency properties of Poisson QMLE for models with non-negative dependent variables even if they are continuous and do not follow the Poisson variance assumption.

¹³We relegate the estimated outward and inward country fixed effects to Appendix B.

colonizer or former colony. Column (2) reflects FDI results when we confine the sample to 24 high-income OECD countries as both the source and destination countries (the Czech Republic, Hungary, Mexico, Poland, Turkey, and Slovakia are excluded from the original 30 OECD countries). The logic of considering this sub-sample is that Table 2 indicates that most FDI of these countries is M&A. The results do not change much with this smaller sample except that the “From colony” variable loses statistical significance. Column (3) shows results for cumulative M&A. Compared to the results for FDI shown in column (1), the estimates are similar except that M&A from colonies is not estimated to have a statistically significant effect.

Turning to the Poisson QMLE estimates, we observe that this method tends to produce smaller coefficient estimates than corresponding GLS estimates. Santos Silva and Tenreyro (forthcoming) find smaller distance and colony Poisson QMLE estimates than OLS estimates in trade data.¹⁴ A negative distance effect is a common finding in the empirical FDI literature and does not support the view of FDI serving as a means to avoid trade costs. Both our GLS and our Poisson QMLE distance elasticities are larger than Wei (2000) and Eaton and Tamura (1994), and Loungani, Mody, Razin and Sadka (2004) find for FDI and di Giovanni and Hijzen, Gorg, and Manchin (2005) find for M&A.¹⁵ The estimates of the effect of common language are marginally significant for the full samples of countries in the FDI and M&A regressions. However, common language enters insignificantly in the high-income OECD sample. The Poisson QMLE estimates of “From Colony” are larger than the “To Colony” across specifications and samples, indicating that former colonies enjoy advantages when investing in their colonizer.

Note that number of M&A observations in the Poisson QMLE regressions is much higher than corresponding FDI regressions—2465 M&A observations versus 1559 FDI observations. This is due to recorded zeros in the M&A regressions for observations where the OECD lists FDI as missing (recall, di Giovanni generated zeros when no M&A was observed). We find that

¹⁴Their sample is 136 countries in 1990 and they do not divide colonial ties into its two components.

¹⁵Wei, di Giovanni, and Loungani, Mody, Razin and Sadka include a variable measuring telephone linkages between bilateral pairs that explain some of the distance effects we measure.

the Poisson results are remarkably robust to the treatment of zeros and missing values—they hardly change when we turn zeros into “missings” and “missings” into zeros.

We use the full-sample as the basis for our second-stage estimations to maximize the number of estimated outward and inward effects. We consider the Poisson QMLE results to be the preferred specification for our second stage regressions. Appendix B lists the estimated first-stage fixed effects used in the second stage regressions. The number of observations is never the full 62 across specification due to missing data and other issues detailed in the appendix.

The outward effect depends on country i 's share of world bidders and the quality of the bidders, μ_i/σ . We assume the number of bidders, m_i , is proportional to population, denoted N_i , and that bidder quality can be represented by per capita GDP, denoted y_i . Thus, the outward fixed effect comprises *scale* (N_i) and *development* (y_i) effects:

$$O_i = \ln s_i^m + \mu_i/\sigma \sim \omega_1 \ln N_i + \omega_2 \ln y_i.$$

We estimate

$$\hat{O}_i = C + \omega_1 \ln N_i + \omega_2 \ln y_i + e_i$$

where \hat{O}_i is the estimated fixed effect from the first stage Poisson QMLE regression, C is a constant, and e_i is the second-stage error term. We match 2001 population and per-capita income for FDI fixed effect regressions and 1999 population and per-capita income to the M&A fixed effect regressions.¹⁶

The first two columns of Table 4 contain results for FDI and M&A. In both specifications, the coefficient on $\ln N_i$ is insignificantly different from one, indicating that, after controlling for the level of development, the number of bidders is proportional to the size of the population. The strong effect of income per capita can be interpreted as capturing the average ability effect embodied in the model as μ_i . We can also interpret the results as the number of bidders being proportional to GDP, $\ln(N_i y_i)$. In that case, the coefficients on development become

¹⁶To correct for heteroscedasticity, we weight the observations by the inverse of the standard error from the first stage (see Saxonhouse, 1976).

Table 4: Second-stage regressions: 2001

Specification:	(1)	(2)	(3)	(4)	(5)
Dep. var.:	FDI \hat{O}_i	M&A \hat{O}_i	$\ln K_n$	FDI \hat{I}_n	M&A \hat{I}_n
Scale ($\ln N$)	1.009 ^a (0.078)	1.034 ^a (0.134)	1.022 ^a (0.030)	0.812 ^a (0.096)	1.10 ^a (0.133)
Development ($\ln y$)	2.158 ^a (0.109)	2.221 ^a (0.159)	0.964 ^a (0.035)	1.279 ^a (0.150)	1.630 ^a (0.204)
Bid comp. ($\ln B$)				-0.510 (0.546)	-1.063 ^b (0.505)
N	61	51	132	60	56
R ²	0.879	0.804	0.933	0.681	0.666
RMSE	.896	1.249	.613	.971	1.242

Note: Weighted least squares regressions with ^a, ^b and ^c respectively denoting significance at the 1%, 5% and 10% levels.

1.149 and 1.187 in the FDI and M&A regressions. The two variables do a very good job of predicting the outward fixed effect, achieving an R^2 of 0.88 for outward FDI and 0.80 for M&A transactions. These second stage results tell us that $s_i^m \exp(\mu_i/\sigma)$ is roughly proportional to $N_i y_i^2$.

To examine the determinants of the inward effect, $I_n = \ln K_n - \ln \hat{B}_n$, we compute $\hat{B}_n = \sum_i N_i^{\hat{\omega}_1} y_i^{\hat{\omega}_2} \exp[\mathbf{D}_{in} \hat{\boldsymbol{\theta}}]$ using our measure of $s_i^m \exp(\mu_i/\sigma)$ and the $\boldsymbol{\theta}$ estimates. Ideally, we would regress the estimated inward effects on the host's capital stock and \hat{B}_n . Unfortunately, capital stock data for 2001 are not available.¹⁷ Column (3) portrays results of regressing the 1990 capital stock data of Easterly and Levine (2002) for 132 countries on our scale, $\ln N$, and development, $\ln y$, variables. We observed that both are significant with elasticities close to one and explain 93% of the variation in log capital stocks ($\ln K$).¹⁸

We therefore use scale and development as proxies for capital and fit the following regression to our FDI and M&A inwards effects:

$$\hat{I}_n = C + \eta_1 \ln N_n + \eta_2 \ln y_n - \ln \hat{B}_n + e_n$$

¹⁷Data on stock market capitalization is also not available for all countries.

¹⁸This data, based on the Penn World Tables 5.6, is available online at www.worldbank.org/research/growth/pdfiles/GDN/Micro%20Time%20Series.xls.

The results are displayed in columns (4) and (5). Our theoretical model predicts that the coefficients on the capital stock and bid competition will enter with unitary elasticity. Thus, given the column (3) results, the proxies for capital stock, $\ln N_n$ and $\ln y_n$, should obtain coefficients of 1.022 and .964. As can be observed, per capita income is entering more strongly than what our theory predicts. A joint test of these restrictions along with unitary elasticity for $\ln B_n$ is rejected at the 1% significance level.

Our parsimonious model posits no barriers to inward FDI other than monitoring costs as proxied by distance, common language, and colonial ties. Of course, other country characteristics will influence inward investment such as differences in institutions. Rossi and Volpin (2001) use country institution data in La Porta *et al.* (1998) and find that the presence of common law and high accounting standards and shareholder protection are associated with greater M&A. We collected data on “rule of law” as reported by the World Bank for our sample of countries and, in unreported regressions, add this variable to our inward effects regressions. It enters positively with borderline significance in the FDI and M&A regressions and lowers the coefficient on per capita income (the correlation between rule of law and per capita GDP is 0.88). With the inclusion of this variable, we now are unable to reject the unitary elasticity for the (proxied) capital stock and bid competition variables at the 10% level.¹⁹

The results of the bilateral regressions provide support for the gravity specification for FDI implied by our model of corporate control. Second-stage regressions using the estimated outward effects show a strong effect of per capita income, highlighting the importance of source country development for outward FDI. Investigation of the determinants of the inward effect reveals that the proxies for capital shares enter with the expected unit elasticity. For reasons outside the model, however, the level of development also exerts a positive influence on the inward effect. This finding suggests that the inclusion of additional variables that describe the

¹⁹Similar second-stage findings emerge when we use GLS to estimate the first-stage equation. The coefficient on $\ln N$ in the outward effect regression is within one standard of one when we use FDI as the dependent variable but is significantly below one in the M&A regressions (0.689, standard error 0.12). In the inward estimates, $\ln B$ is within one standard deviation of -1 for the M&A regressions but is significantly less than one (in absolute value) in the FDI regression (-0.268, standard error 0.19).

investment climate may capture variation in the inward effect beyond what is explained by the model-based determinants. Our derivation shows that additional host-country variables should be estimated via the two-step procedure outlined here.

5 Multilateral FDI results

In this section we show that our parsimonious, structural model conforms to the principal patterns of aggregate FDI and M&A data. To do this, we apply the model and estimates from the bilateral regressions to predict each country's shares of world outward and inward FDI in 2001 and cumulative 1987–2001 M&A flows.

Recall the specification on inward and outward shares:

$$f_i^I = \frac{\mathbf{E}[F_{wi}]}{\mathbf{E}[F_w]} = s_i^K \frac{1 - \pi_{ii}}{1 - \tilde{H}}$$

$$f_i^O = \frac{\mathbf{E}[F_{iw}]}{\mathbf{E}[F_w]} = s_i^K \frac{A_i - \pi_{ii}}{1 - \tilde{H}}$$

where $\pi_{ii} = s_i^m \exp[\mu_i/\sigma - \mathbf{D}_{ii}\boldsymbol{\theta}]B_i^{-1}$ and

$$A_i = (s_i^m/s_i^K) \exp[\mu_i/\sigma] \sum_n \exp[-\mathbf{D}_{in}\boldsymbol{\theta}]B_n^{-1}s_n^K.$$

Since a country's success at bidding for assets depends on its characteristics and geographic location as well as those of all other countries, it is necessary to use information on all countries in the world. We adhere to the theoretical structure of the model and use estimates of *unknown* model parameters from the bilateral regression.²⁰ We calculate each country's quality adjusted share of bidders as given by $s_i^m \exp[\mu_i/\sigma] \sim N_i^{\omega_1} y_i^{\omega_2}$ where ω_1 and ω_2 are estimated coefficients on $\ln N$ and $\ln y$ in the second-stage, outward effects regression. We calculate target assets as $K_n \sim N_n^{1.02} y_n^{0.96}$, and distance from other countries as $\mathbf{D}_{in}\boldsymbol{\theta}$. We compute B_n as described

²⁰This means ignoring the additional effect of per capita GDP beyond the model prediction observed in the second stage regressions on the inward effect. Thus, deviations of actual inward FDI from our benchmark will reflect rule of law and other institutional differences across countries.

Table 5: Model performance: Mean absolute deviations of actual share (percentage points) minus predicted share.

	Inward		Outward	
	levels	logs	levels	logs
Full sample (172 Inward, 146 Outward)				
UNCTAD benchmark	0.364	0.749	0.508	2.533
Neutral benchmark	0.311	0.727	0.466	2.630
Estimated benchmark	0.315	0.785	0.425	1.774
High income OECD sample (23 countries)				
UNCTAD benchmark	1.914	0.703	2.270	0.729
Neutral benchmark	1.536	0.658	1.884	0.690
Estimated benchmark	1.376	0.620	2.242	0.585

previously.

We refer to our model predictions as the “estimated” benchmark which we compare to two other benchmarks. The UNCTAD benchmark predicts FDI shares equalling GDP shares, s_i , as implied by UNCTAD’s FDI Performance Index. The neutral benchmark assumes bidder and target shares are proportional to GDP and there are no distance effects. As shown earlier, in this case, FDI shares are related to GDP shares except that there is an adjustment for relative country size.

Table 5 reports mean absolute deviations of the difference between each benchmark and the actual shares for each country. We examine both level and log differences. In terms of levels, the fit of the predictions to United States data dominates the results as the US is such a dominant source and recipient of FDI, accounting for 22% of outward stocks and 21% of inward stocks in 2001. The first two columns report results for inward stocks and the second two columns for outward stocks. There are 172 countries with positive inward stocks and 146 countries with positive outward stocks. The second frame of Table 5 provides the same statistics for the sub-sample of 23 high-income OECD countries (one Belgium-Luxembourg observation).

The estimated benchmark outperforms the UNCTAD benchmark in seven out of the eight

measures. The lone exception for differences in logs of inward investment for all countries. The neutral benchmark also fits actual data better than the UNCTAD benchmark. The estimated benchmark provides a superior fit relative to the other two for outward investment, particularly when we computed deviations in terms of differences in logs. This is because our model conditions outward investment on the quality of bidders as measured by per capita GDP. However, the estimated benchmark over-predicts the United States share of outward investment—37% of world outward stocks as compared to actual outward shares of 22%. This is a consequence of the high US share of world GDP, 32%, and the importance that the estimated benchmark ascribes to high per capita income (bidder quality).

Figures 1 and 2 plot the actual inward and outward FDI against the estimated benchmark for the largest 50 countries in terms of 2001 GDP on a logarithmic scale. We identify countries with their three digit ISO codes and indicate OECD countries with solid black circles. If the estimated predictions were correct, all the points would line up on the 45-degree line. The figures reveal the fit of the model to multilateral data and identify outliers. Overall, the predictions are randomly dispersed around the 45 degree line—the slope of a regression line of actual on predicted FDI is not significantly different from one for all countries as well as the 50 shown in the figures. The “unbiasedness” of the estimated benchmark contrasts with the UNCTAD and neutral benchmarks where the slope of the line of log actual outward share on log predicted share exceeds 1.5 for the full sample. Unlike our benchmark, these other benchmarks systematically over-predict outward FDI for poor countries.

With regard to inward investment, Japan, India, and Iran under perform relative to the benchmark whereas Hong Kong, Singapore, Ireland, Belgium-Luxembourg, and the Netherlands over-perform.²¹ For outward investment, Figure 2 shows the data points well dispersed around the 45-degree line with the largest (log) deviations exhibited by small countries.

Figures 3 and 4 relate the estimated predictions to cumulated 1987–2001 M&A from Thompson for the 50 largest countries according to 1999 GDP.²² Again, the points are scat-

²¹Head and Ries (2005) provide analysis of Japan’s FDI performance over time.

²²We create the benchmarks using parameter estimates from cumulative 1900–1999 bilateral M&A and 1999 population and GDP.

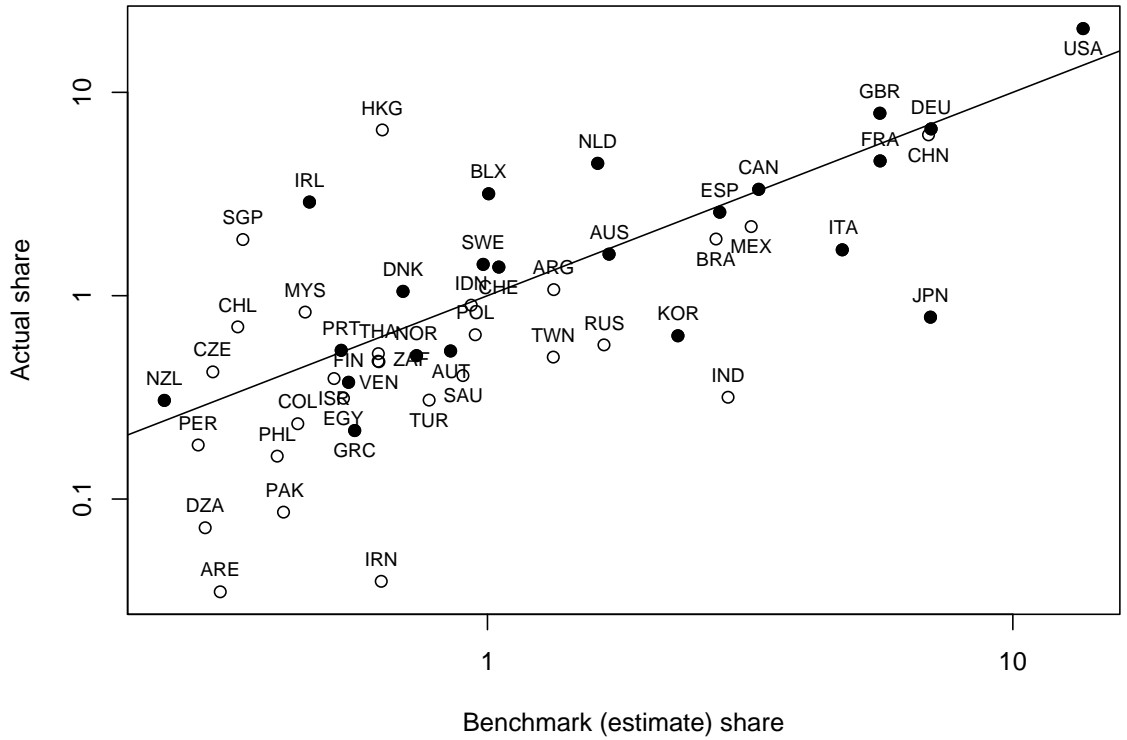


Figure 1: Inward FDI Model Performance, Largest 50 Countries

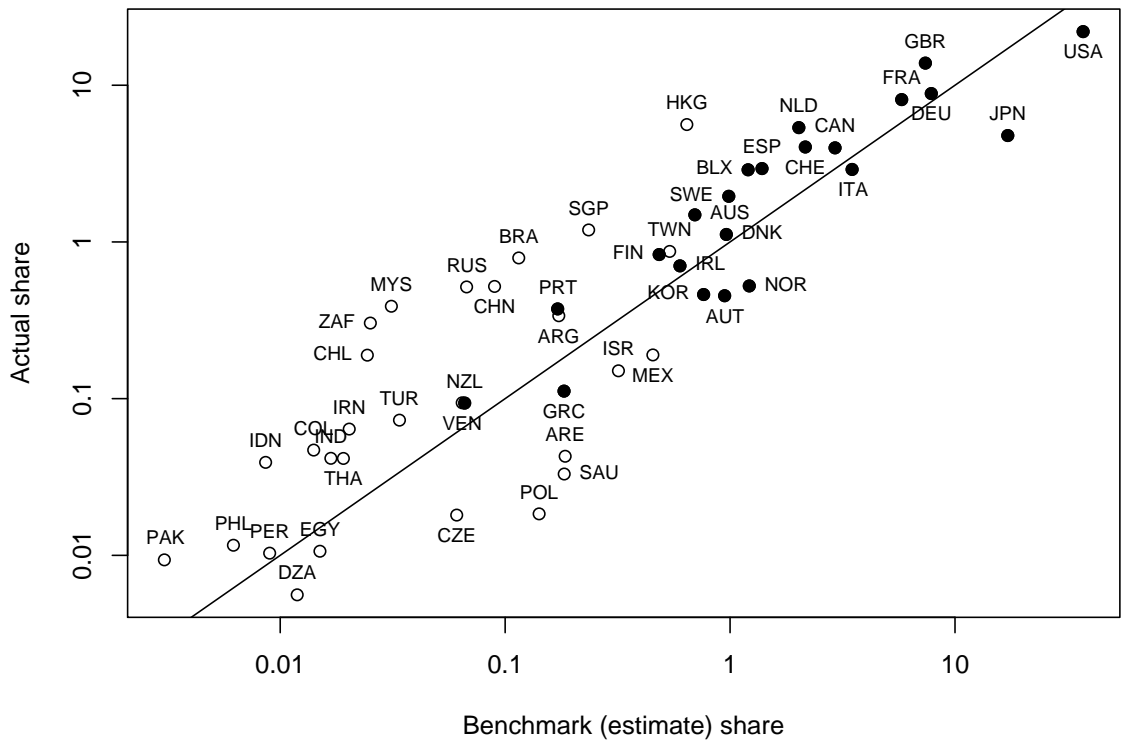


Figure 2: Outward FDI Performance, Largest 50 Countries

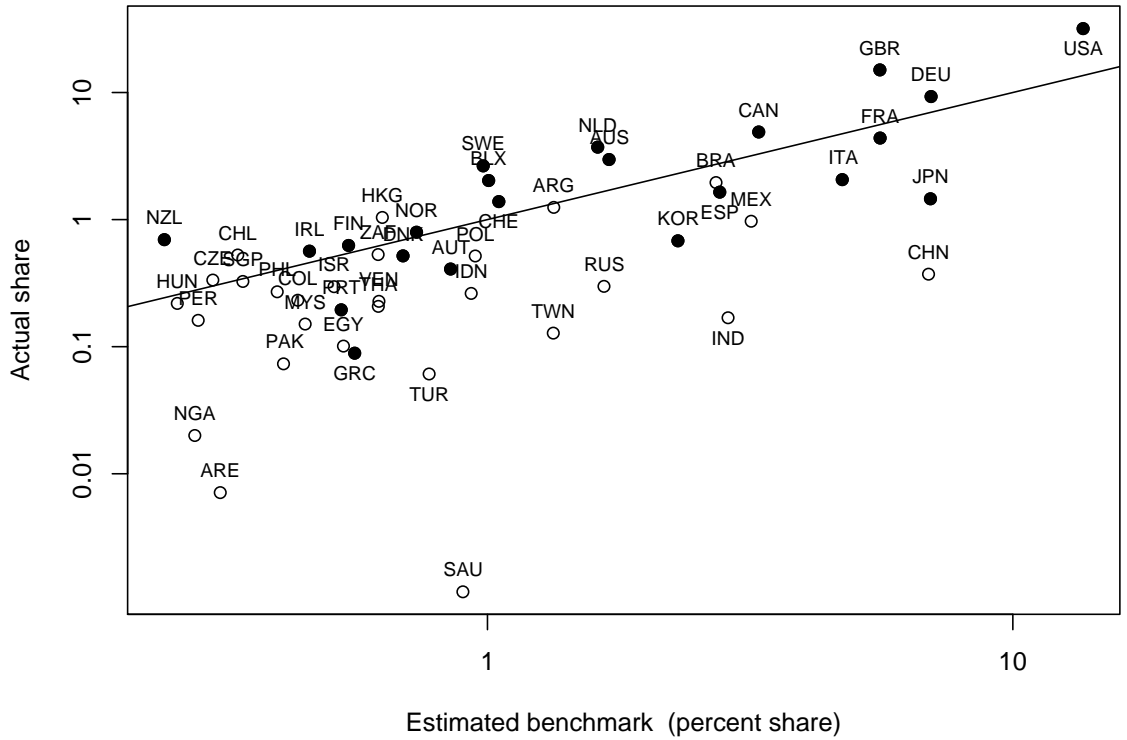


Figure 3: Inward (Sales) M&A Model Performance, Largest 50 Countries

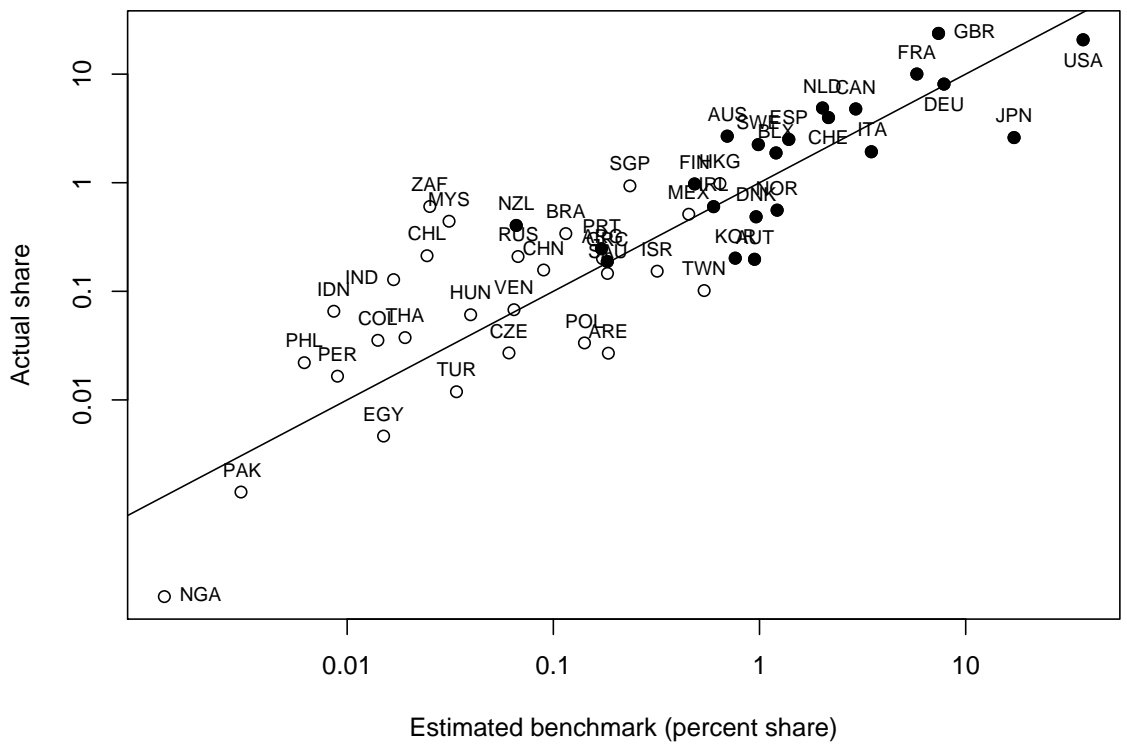


Figure 4: Outward (Purchases) M&A Performance, Largest 50 Countries

tered randomly around the 45-degree line, with the slope of line relating actual shares to predicted shares being insignificantly different from one (1.07 for inward M&A and 0.90 for outward M&A). The pictures identify Saudi Arabia, India and China as selling fewer assets than predicted. Among OECD countries, Great Britain and the Netherlands purchase more assets than predicted while Japan and the United States purchase too few.

6 Conclusion

We develop a model explaining foreign direct investment based on an international market for corporate control. After controlling for geographic and cultural distance effects between bilateral partners, FDI depends on origin-country effects (outward effects) and destination-country effects (inward effects). The latter includes a “bid competition” term that reflects characteristics of competing countries. Our model highlights the importance of taking into account the influence of third-country effects in bilateral estimation, thus echoing the insight of Anderson and van Wincoop (2003) for the application of the gravity equation to bilateral trade.

We use bilateral FDI data for 30 OECD countries and 32 partner countries to estimate the unknown parameters and test predictions of the model. We find that proxies for countries’ shares of bidders and targets enter as predicted. Moreover, we find that the level of development of the source country exerts a strong, positive influence on outward FDI.

Applying our model and estimates from bilateral regressions, we calculate predicted inward and outward shares of world FDI for all countries in 2001 and compare them to actual values. We find that the model fits the data fairly well. Indeed, the good fit even for countries where M&A is relatively unimportant suggests that an analytical derivation of a gravity equation for greenfield investment with frictions would be a helpful complement to this model.

Our empirical model of bilateral FDI intentionally uses a very small number of explanatory variables that we can incorporate within a structural model. We do this partly to investigate how well a parsimonious model can account for the global pattern of FDI and also to facilitate

calculation of the multilateral benchmarks for the largest set of countries and periods. One can use the structural model as a baseline to identify deviations and then introduce additional covariates to improve the fit or evaluate the impact of policies on FDI.

References

- Anderson, J.E., van Wincoop, E., 2003, "Gravity With Gravitas: A Solution to the Border Puzzle", *American Economic Review*, 93(1): 170-192.
- Anderson, S., De Palma, A. Thisse, J-F. (1992), *Discrete Choice Theory of Product Differentiation* (MIT Press, Cambridge).
- Axtell, R.L., 2001, "Zipf Distribution of U.S. Firm Sizes," *Science* 293, 1818-1820.
- Barba Navaretti, G. Venables, A.J. 2004, *Multinational firms in the world economy*, Princeton University Press, New Jersey.
- Bénassy-Quéré A., M. Coupet, and T. Mayer, 2007, "Institutional Determinants of Foreign Direct Investment", *World Economy*.
- Bergstrand, J.H., Egger, P., 2004, "A Knowledge-and-Physical-Capital Model of International Trade, Foreign Direct Investment, and Outsourcing: Part I, Developed Countries," Notre Dame University manuscript.
- Carr, D., Markusen, J.R., Maskus, K.E., 2001, "Estimating the Knowledge-Capital Model of the Multinational Enterprise." *American Economic Review* 91(3), 693-708.
- Bury, K., 1999, *Statistical Distributions in Engineering*, Cambridge University Press.
- di Giovanni, J., 2005, "What Drives Capital Flows? The Case of Cross-Border M&A Activity and Financial Deepening," *Journal of International Economics* 65, 127-149.
- Grossman, G.M., Helpman, E., Szeidl, A., 2003, "Optimal Integration Strategies for the Multinational Firm" NBER Working Paper No. 10189.
- Eaton, J., Kortum, S., 2002, "Technology, Geography, and Trade," *Econometrica* 70(5), 1741-1779.
- Eaton, J., Kortum, S., 2001, "Trade in Capital Goods," *European Economic Review* 45, 1195-1235.
- Eaton, J., Tamura, A., 1994, Bilateralism and Regionalism in Japanese and U.S. Trade and Direct Foreign Investment Patterns. *J. Japanese Int. Economies* 8, 478-510.
- Eichengreen, B., Tong, H., 2005, "Is China's FDI Coming at the Expense of Other Countries?," UC Berkeley manuscript.

- Easterly, W., Levine, R., 2002, "It's Not Factor Accumulation: Stylized Facts and Growth Models" *The World Bank Economic Review*, VOL. 15, NO. 2, 177-219.
- Fudenberg, D., Tirole, J. 1991, *Game Theory*, Boston: MIT Press.
- Gordon, R.H., Bovenberg, A.L., 1996, "Why is capital so immobile internationally? Possible explanations and implications for capital income taxation" *American Economic Review* 86(5), 1057-1075.
- Gugler, K., Mueller, D.C., Yurtoglu, B.B., Zulehner, C., 2003, "The Effects of Mergers: An International Comparison", *International Journal of Industrial Organization*, 21, pp. 625-653.
- Head, K., Ries, J., 2005, "Judging Japan's FDI: The verdict from a dartboard model," *Journal of the Japanese and International Economies* 19, 215-232.
- Helpman, E., 1984, A Simple Theory of Trade with Multinational Corporations. *J. Polit. Economy* 92, 451-471.
- Hijzen, A., Gorg, H., Manchin, M., 2005, "Cross-Border Mergers and Acquisitions and the Role of Trade Costs," manuscript.
- Jensen, M.C., Ruback, R.S., 1983, The market for corporate control: The scientific evidence. *J. Finan. Econ.* 11, 5-50.
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1998, "Law and finance," *Journal of Political Economy* 101, 678-709.
- Loungani, P., Mody, A., Razin, A., Sadka, E., 2003, "The Role of Information in Driving FDI: Theory and Evidence," *Scottish Journal of Political Economy* 49, pp.546-543.
- Marin, D., Schnitzer, M., 2004, "Global versus Local: The Financing of Foreign Direct Investment," University of Munich, Department of Economics, manuscript
- Markusen, J., 1984, Multinationals, Multi-Plant Economies, and the Gains from Trade. *J. Int. Econ.* 16, 205-226.
- Martin, P., Rey, H., 2004, "Financial super-markets: size matters for asset trade," *Journal of International Economics* 64, 335-361.
- Mody, A., Razin, A., Sadka, E., 2004, "The Role of Information in Driving FDI Flows: Host-Country Transparency and Source Country Specialization," NBER Working Paper 9662.
- Mutti, J., Grubert, H., 2004, "Empirical Asymmetries in Foreign Direct Investment and Taxation," *Journal of International Economics* 62, 337-358.
- Naldi, M., 2003, "Concentration indices and Zipf's law," *Economics Letters* 78, 329-334.
- Neary, J.P., 2004, "Cross-Border Mergers as Instruments of Comparative Advantage," University College Dublin manuscript.

- Nocke, V., Yeaple, S. 2005a, "Mergers and the Composition of International Commerce," University of Pennsylvania manuscript.
- Nocke, V., Yeaple, S., 2005b, "An Assignment Theory of Foreign Direct Investment," NBER Working paper 11003.
- Organization for Economic Cooperation and Development (OECD), 2002, *SourceOECD International Direct Investment Statistics database*, www.oecd.org
- Portes, R., Rey, H., 2005, "The Determinants of Cross-Border Equity Flows," *Journal of International Economics* 65, 269-296.
- Razin, A., Sadka, E., Yuen, C-W. 1998, "A pecking order of capital inflows and international tax principles" *Journal of International Economics* 44, 45-68.
- Razin, A., Goldstein, I., 2005, "An information-based trade off between foreign direct investment and foreign portfolio investment," NBER Working Paper 11757.
- Redding, S., Venables, A.J., 2004, "Economic geography and international inequality," *Journal of International Economics* 62(1), 53-82.
- Rose, A.K., 2004, "Do We Really Know that the WTO Increases Trade?," *American Economic Review* 94(1), 98-114.
- Rossi, S., Volpin, P., 2003, "CrossCountry Determinants of Mergers and Acquisitions," London Business School manuscript.
- Saxonhouse, G.R., 1976, Estimated Parameters as Dependent Variables, *American Economic Review* 66(1), 178-183.
- Santos Silva, J.M.C. Tenreyro, S., "The Log of Gravity," *Review of Economics and Statistics*, forthcoming.
- United Nations Conference on Trade and Development (UNCTAD), 2000, *World Investment Report 2000: Cross-border Mergers and Acquisitions and Development*, New York.
- United Nations Conference on Trade and Development (UNCTAD), 2000, *FDI Database*, stats.unctad.org/fdi.
- Wei, S-J., 2000, "How Taxing is Corruption on International Investors," *Review of Economics and Statistics* 1, 1-11.
- Wooldridge, J.M., 2002, *Econometric Analysis of Cross Section and Panel Data*, MIT Press: Cambridge.

Appendix A: Variance in FDI due to lumpiness

Suppressing the *in* country subscripts, let subscript τ indicate a particular target in country n . Let z_τ be a binary variable that takes the value of 1 if a headquarters from i has acquired target τ and zero otherwise. The expectation of z is the probability of it being equal to one: $E[z_\tau] = \pi$. The actual share of foreign-owned assets can then be expressed as $F/K = \sum_\tau^T z_\tau K_\tau$, where there are T targets and K_τ is the size of target τ and $K = \sum_\tau^T K_\tau$. The expected value of F/K is π . The variance of F/K is given by

$$\text{Var}\left(\frac{\sum_\tau^T z_\tau K_\tau}{K}\right) = \sum_\tau^T \text{Var}[z_\tau(K_\tau/K)] = \pi(1 - \pi) \sum_\tau^T (K_\tau/K)^2 = \pi(1 - \pi)H,$$

where H is called the Herfindahl concentration index for capital. Thus, FDI variance is increasing in the concentration of capital in the destination country. If all firms were the same size, $K_\tau = k$, then $H = 1/T$ and the variance of F/K goes to zero as the number of firms, T , becomes large. Actual firm size distributions are highly skewed. Axtell (2001) finds that the US firm size distribution is Pareto with a shape parameter near one (Zipf's Law). Equation (10) of Naldi (2003) shows that these assumptions imply

$$H = \frac{\sum_{\tau=1}^T \tau^{-2}}{(\sum_{\tau=1}^T \tau^{-1})^2}.$$

Evaluating this expression we find that $H = 0.06$ for $T = 100$, $H = 0.03$ for $T = 1000$, and $H = 0.02$ for $T = 5000$. Because the firm size distribution is highly skewed, F_{in}/K_n does not converge quickly on π_{in} and therefore “lumpiness” would appear to be an important source of variance in FDI stocks.

Appendix B: Data

*Source*OECD International Direct Investment Statistics database contains data on FDI inward and outward positions. We use these data to compile as complete a file of bilateral FDI stocks in 2001 as possible. We mainly use source-country reports to measure the stock of FDI of country i into country n . When country i does not report a positive stock and the inward stock reported by n is positive, then we use this inward stock instead.

Table 6 lists the 62 countries that constitute the bilateral data set. We list the inward and outward effects estimated in the first-stage FDI and M&A regressions (US normalized to 0). Netherlands Antilles has missing GDP data so the number of observations for second-stage regressions, shown in Table 4, never equals 62. The 51 outward M&A observations are a result of no M&A data for Algeria, Netherlands Antilles, Kuwait, Libya, Luxembourg,

and Taiwan plus our decision to drop the five countries for which we estimated fixed effects even though all bilateral M&A purchases were recorded as zero—United Arab Emirates, Iran, Slovenia, Iceland, and Cost Rica. We do not report the estimated fixed effects for these latter countries but they are much larger in absolute value than those for countries with some positive FDI purchases (estimates of less than -25). When we include these five countries, the standard error increases dramatically. Kuwait had only zero levels of bilateral inward FDI and we exclude it in the second-stage inward FDI regression. Inward M&A regressions have 56 observations because of missing GDP data for Netherlands Antilles, no M&A data for Kuwait, Luxembourg, and Taiwan and dropping Libya and Iran because they received no inward FDI.

Table 6: Bilateral FDI countries

ISO	Country	FDI		M&A	
		Outward	Inward	Outward	Inward
High-Income OECD					
AUS	Australia	-2.8	-2.7	-2.7	-2.2
AUT	Austria	-4.8	-4.5	-5.7	-5.2
BEL	Belgium	-3.3	-2.8	-4.3	-4.3
CAN	Canada	-2.8	-2.6	-2.9	-3.2
DNK	Denmark	-4.1	-4.6	-4.8	-5.1
FIN	Finland	-3.8	-4.7	-4.1	-4.4
FRA	France	-2	-2.8	-1.6	-3
DEU	Germany	-1.9	-2.7	-1.6	-1.9
GRC	Greece	-6.8	-5.7	-5.2	-6.5
ISL	Iceland	-8.1	-8.3	.	-11.4
IRL	Ireland	-4.9	-3.5	-5.3	-5.8
ITA	Italy	-3	-3.5	-3	-3.7
JPN	Japan	-1.7	-2.8	-2.1	-3
LUX	Luxembourg	-6.2	-4.1	.	.
NLD	Netherlands	-2.4	-1.8	-2.4	-3.3
NZL	New Zealand	-5.4	-4.4	-4.8	-3.8
NOR	Norway	-4.1	-4.5	-4.5	-4.4
PRT	Portugal	-4.9	-4.7	-4.6	-5.4
ESP	Spain	-4.4	-3.4	-2.7	-4
SWE	Sweden	-3.2	-3.5	-2.9	-2.9
CHE	Switzerland	-2.9	-3.1	-2.7	-4.5
TUR	Turkey	-6.4	-5.4	-7.4	-7.1
GBR	United Kingdom	-1.6	-1.9	-0.7	-2
USA	United States	0	0	0	0
Other OECD					
CZE	Czech Republic	-8.6	-5.2	-8.5	-5.7
HUN	Hungary	-7.9	-4.8	-9.4	-5.4
KOR	Korea, South	-4.3	-4.1	-4.8	-3.9
MEX	Mexico	-5.6	-3.4	-4.7	-3.9
POL	Poland	-8.2	-4.4	-9	-5
SVK	Slovakia	-8.6	-6.3	-7.8	-8.5
Partners					
DZA	Algeria	-8.3	-8.2	.	-10.7
ARG	Argentina	-6.3	-3.6	-5.4	-2.6
BRA	Brazil	-6.3	-2.9	-6.3	-2.6
BGR	Bulgaria	-11	-6.7	-14	-7.1
CHL	Chile	-8.6	-4.1	-6.6	-3.8
CHN	China	-6.7	-3.6	-6.6	-5.1
COL	Colombia	-8.9	-5.5	-12.1	-4.9
CRI	Costa Rica	-9.1	-7.1	.	-8.6
EGY	Egypt	-8.4	-5.5	-10.5	-6.7

ISO	Country	FDI		M&A	
		Outward	Inward	Outward	Inward
Partners (cont'd)					
HKG	Hong Kong	-4.7	-3.3	-3.8	-4.2
IND	India	-7.4	-5.1	-8.1	-6.1
IDN	Indonesia	-7.4	-4	-5.5	-4.5
IRN	Iran	-5.9	-7.2	.	.
ISR	Israel	-5.7	-5.4	-5.6	-5.1
KWT	Kuwait	-4.3	.	.	.
LBY	Libya	-8.7	-8	.	.
MYS	Malaysia	-5.1	-4.2	-3.7	-5.5
MAR	Morocco	-7.9	-6.4	-9.5	-7.4
ANT	Netherlands Antilles	-3.9	-4.6	.	-7.9
PAN	Panama	-6.5	-6	-11.5	-6.7
PHL	Philippines	-9.3	-4.9	-9.5	-4.9
ROM	Romania	-9.6	-6.3	-11.8	-6.4
RUS	Russian Federation	-5.4	-5.3	-7.3	-6.1
SAU	Saudi Arabia	-6.4	-5.9	-4.8	-9.6
SGP	Singapore	-4.4	-2.9	-4.2	-5
SVN	Slovenia	-8.7	-7	.	-9.3
ZAF	South Africa	-5.7	-4.7	-3.7	-4.7
TWN	Taiwan	-5.5	-4.4	.	.
THA	Thailand	-8.3	-4.3	-7.2	-5
UKR	Ukraine	-10.4	-7.3	-10.4	-8.8
ARE	United Arab Emirates	-6.1	-6.3	.	-8.6
VEN	Venezuela	-5.8	-4.7	-6.1	-5