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Inappropriate Pooling of Wealthy and Poor Countries in Empirical FDI Studies

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The rapid pace of foreign direct investment (FDI) and multinational firm activity has been well documented. As with trade, the freer flow of capital, including FDI, is cited by many as an important engine of growth for the world economy, perhaps especially for the world's less developed countries (LDCs). However, systematic empirical evidence for the factors that affect FDI patterns and its effect on country-level economies is in its infancy. It is only in the past decade that reasonable data on FDI activity have become available and allowed standard statistical analysis. This is particularly true with respect to LDCs.

In fact, the vast majority of empirical FDI studies do not distinguish between LDCs and developed countries (DCs) in their analysis. In many studies, data from both types of countries are often pooled into one sample, and the estimated relationships are assumed to hold equally for both types of countries. Unfortunately, these pooled coefficient estimates may significantly misrepresent the true relationships for both sets of countries if these underlying relationships are indeed different for LDCs versus DCs. Many other studies in the literature use data only for DCs, for which data are often more readily available. The results from these DC studies then do not necessarily provide information regarding LDCs' experiences with FDI. A

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Table 9.1 World FDI flows, 1982–2001

	Value at current prices (billions of US dollars)			Annual growth rate (percent)		
	1982	1990	2000	1986–90	1991–95	1996–2000
FDI inflows	59	203	1,300	23.6	20.0	40.1
FDI outflows	28	233	621	24.3	15.8	36.7

Source: United Nations (various years).

further concern is that the results are incorrectly assumed to be valid for LDCs as well. In fact, as we will discuss below, the theory often suggests that relationships should differ across these different types of countries.

This chapter examines the question of whether LDCs' experiences with FDI are systematically different from those of DCs. We do this by examining three types of empirical FDI studies using country-level data that typically do not distinguish between LDCs and DCs. We begin with the recent literature examining the factors that determine FDI location. We then turn to the relatively extensive literature examining whether FDI affects growth. Finally, we examine the issue of whether FDI negatively or positively affects (i.e., crowds out or crowds in) domestic investment.

The evidence may suggest that no significant differences exist and that pooling data across DCs and LDCs leads to correct inferences. We find the world is not that simple. In all three areas of FDI analysis we find substantial differences between LDCs and DCs that are both statistically and economically significant. In fact, in each we uncover surprising differences between our samples of LDCs and DCs that provide new perspectives on the existing literature. Thus, while our methodology is fairly straightforward—examining for structural differences in the coefficient estimates—the message we come away with is fairly powerful. It is inappropriate to assume that FDI plays the same role in LDCs as it does for DCs, and policy recommendations must, therefore, necessarily be different.

The next section gives a brief overview of worldwide patterns of FDI across LDCs and DCs over the past few decades. This is followed by our analysis of structural differences between LDCs' and DCs' behavior with the three different strands of the empirical FDI literature. A final section concludes by summarizing our results and providing some final thoughts on country-level FDI studies. In particular, we point out that controlling for these issues of pooling is not a panacea for other issues confronting cross-country empirical studies, including poor data and endogeneity issues.

Descriptive Differences in FDI Patterns for DCs Versus LDCs

FDI flows between nations have grown at a rapid pace in the past couple of decades. As table 9.1 shows, world FDI inflows reached $1.3 trillion in 2000

Table 9.2 Regional distribution of FDI inflows and outflows: Regions as a share of total, 1982–98

	Inflows						Outflows					
Region/country	**1982–87**	**1988–92**	**1993–95**	**1996**	**1997**	**1998**	**1982–87**	**1988–92**	**1993–95**	**1996**	**1997**	**1998**
Developed countries	**78.1**	**78.4**	**62.1**	**58.8**	**58.9**	**71.5**	**98.0**	**95.7**	**85.8**	**84.2**	**85.6**	**91.6**
Western Europe	31.5	47.4	36.0	32.1	29.1	36.9	55.3	59.7	47.0	53.7	50.6	62.6
European Union	28.2	43.9	34.0	30.4	27.2	35.7	47.4	50.1	42.7	47.9	46.0	59.5
Other Western Europe	3.4	3.5	2.0	1.8	1.9	1.2	7.9	9.6	4.3	5.8	4.6	3.1
United States	39.9	22.6	18.8	21.3	23.5	30.0	19.8	14.1	27.7	19.7	23.1	20.5
Japan	0.7	0.5	0.2	0.1	0.7	0.5	13.4	17.4	6.2	6.2	5.5	3.7
Other developed countries	6.0	7.9	7.1	5.3	5.6	4.1	9.5	4.5	5.2	4.6	6.4	4.9
Less developed countries	**21.8**	**21.6**	**38.0**	**41.2**	**41.1**	**28.4**	**1.9**	**4.3**	**14.2**	**15.8**	**14.4**	**8.4**
Africa	2.8	1.8	1.9	1.6	1.6	1.2	0.1	0.1	0.2	n.a.	0.3	0.1
Latin America and the Caribbean	8.9	6.7	9.8	12.9	14.7	11.1	0.4	0.3	1.2	1.9	3.3	2.4
Developing Europe	n.a.	0.1	0.1	0.3	0.2	0.2	n.a.	n.a.	0.0	n.a.	0.1	n.a.
Asia	10.1	12.1	23.0	22.9	20.6	13.2	1.4	3.8	12.7	13.6	10.0	5.6
West Asia	0.6	0.3	0.7	0.2	1.0	0.7	0.2	0.1	0.3	0.6	0.4	0.3
Central Asia	n.a.	n.a.	0.3	0.6	0.7	0.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
South, East, and Southeast Asia	9.3	11.5	21.9	22.1	18.9	12.0	1.2	3.7	12.3	13.0	9.6	5.3
The Pacific	0.2	0.2	0.1	0.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a
Central and Eastern Europe	n.a.	0.9	3.2	3.5	4.0	2.7	n.a.	n.a.	0.1	0.3	0.7	0.3
World	100	100	100	100	100	100	100	100	100	100	100	100

n.a. = not available

Source: United Nations (various years).

(United Nations 2001), and the annual worldwide growth rate since the early 1980s has been over 20 percent, with almost a 40 percent growth rate in the latter 1990s. As has been well documented, the growth of FDI has easily exceeded the already fast pace of trade growth among countries.

Most world FDI flows continue to be mainly among DCs, especially the "triad" of Japan, the European Union (EU), and the United States. Table 9.2 shows the regional distribution of FDI inflows and outflows from 1982 to 1998. Over the period of 1986–2000, an average of 72.5 percent of world FDI inflows was received by DCs. However, the share of world FDI activity flowing to LDCs has been rising gradually. LDCs received 37 percent of world FDI inflows over the period of 1993–98, compared to an average of 31.2 percent from 1991–92 and an average of 17.5 percent during the second half of the 1980s. At the same time, total FDI flows into LDCs are also strikingly concentrated. For instance, during the 1990s, the five largest host countries for FDI inflows are China, Brazil, Mexico, Singapore, and Indonesia, and these five countries accounted for 55 percent of FDI inflows to all LDCs in 1998. The FDI outflows from LDCs are also concentrated in certain regions.

Of course, the biggest distinction between LDCs and DCs is that although DCs have substantial amounts of two-way FDI flows, LDCs are almost exclusively recipients of FDI. A small exception to this occurs in East and Southeast Asia, especially among Association of Southeast Asian Nations (ASEAN) countries that see some two-way flows of FDI between LDCs.

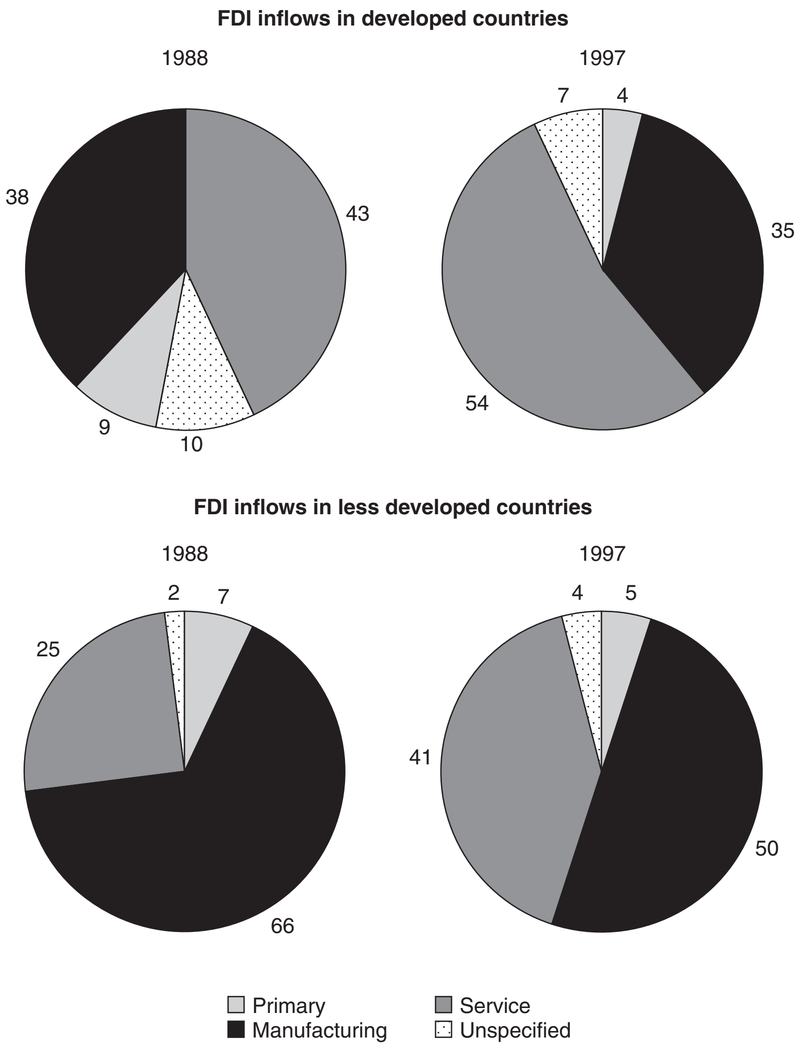
Importantly, FDI inflows are playing an increasingly important role in private capital flows to LDCs. Approximately 66.8 percent of total private capital flows to LDCs was FDI in 1998, compared with 38.5 percent in 1990.

Another interesting phenomenon in the raw numbers is the sectoral distribution of world FDI inflows (figure 9.1). The share of service FDI has been growing, while shares of manufacturing FDI and primary FDI have been declining over the past decade or so in both LDCs and DCs. However, LDCs have experienced a larger decrease in manufacturing FDI inflows and a larger increase in service FDI inflows than DCs. For DCs, the share of manufacturing FDI inflows fell from 38 percent in 1988 to 35 percent in 1997, and primary FDI inflows from 9 percent to 4 percent, while service FDI inflows went up from 43 to 54 percent. LDCs' manufacturing FDI inflows decreased from 66 percent to 50 percent, while primary FDI inflows decreased from 7 percent to 5 percent from 1988 to 1997. Service FDI inflows in LDCs increased from 25 to 41 percent of total inflows.

Estimating Determinants of FDI

In the past few decades, economists have developed ever more realistic models of FDI by multinational enterprises (MNEs). One main strand of the literature has developed models where MNEs are motivated by the desire to

Figure 9.1 Sectoral distribution of FDI inflows, 1988 and 1997 (percent)



Source: United Nations (various years).

outsource some of their activities to lower-cost countries. More specifically, such "vertical" FDI sees MNEs from DCs accessing less-skilled workers in LDCs to perform assembly operations at a lower wage. Formal models of vertical MNE activity stem back at least to Helpman (1984). An initially separate strand identified an alternative motivation for FDI: accessing markets in the presence of trade frictions such as tariffs or transportation costs. Such activity is horizontal since it predicts MNE FDI across larger economies that may be similar in all aspects and involves duplication of the entire production process (with the exception of headquarter services) across multiple countries. Formal modeling of horizontal MNE activity dates back to at least Markusen (1984). Recent work by Markusen et al. (1996) and Markusen (1997) combines both the vertical and horizontal motivations for FDI into one theoretical model, labeled the knowledge-capital model, and Carr, Markusen, and Maskus (CMM) (2001) have proposed and estimated an empirical specification that explains world FDI patterns based on it.[1]

While variations of a gravity model have historically been the most popular empirical framework for examining FDI activity across countries, the CMM framework is arguably the most comprehensive empirical specification we have that is grounded to some extent in theory.[2] The CMM empirical specification for the FDI from country *j* to country *i* in time period *t* is given by the following linear specification with a mean zero error term:

$$\begin{aligned} FDI_{ijt} = {} & \alpha + \beta_1 SUMGDP_{ijt} + \beta_2 GDPDIFSQ_{ijt} + \beta_3 SKDIFF_{ijt} \\ & + \beta_4 SKDGDPD_{ijt} + \beta_5 T\_COST_{it} + \beta_6 T\_COST_{jt} \\ & + \beta_7 F\_COST_{it} + \beta_8 HTSKD_{ijt} + \beta_9 DIST_{ijt} + \varepsilon_{ijt} \end{aligned} \tag{9.1}$$

FDI represents a measure of FDI activity, typically foreign affiliate sales or the stock of FDI in the host country. The first two terms on the right-hand side control for country sizes that are most connected with the horizontal MNE aspects of the model. The first, *SUMGDP*, is defined as the sum of the two countries' real GDPs, and *GDPDIFSQ* is defined as the squared difference between the two countries' real GDP. Since horizontal MNEs are most common between large countries of similar size, there is an expected positive correlation between *SUMGDP* and FDI activity and an expected negative correlation between *GDPDIFSQ* and FDI activity. The intuition is that with some positive level of trade frictions, larger and more similar sized markets better support the higher fixed costs associated with setting up production across countries (versus exporting) and lead to greater MNE activity.

The next two terms capture relative factor endowment effects and are related most to the vertical MNE aspects of the knowledge-capital model. *SKDIFF* is a measure of the skill difference between the parent and host country and is intended to proxy for relative factor abundance differences across countries. According to the CMM interpretation of the knowledge-capital model, this variable should have a positive coefficient. The fourth term *SKDGDPD*, interacts skill difference with GDP differences between

1. Yeaple (2003a) also develops a model that combines vertical and horizontal motivations for FDI, though no empirical specification has yet been proposed to test this model's implications.

2. Related work by Brainard (1997) develops and tests a model of horizontal MNE activity by US firms.

the parent and host country and is predicted by CMM to have a negative coefficient.

The last five terms on the right-hand side of equation 9.1 capture trade and investment frictions. T_COST_i is the trade cost in the host country and is expected to have a positive coefficient, since higher trade costs in the host country make exporting to that market more expensive, increasing the relative benefits from FDI. T_COST_j is the trade cost in the parent country and is expected to have a negative coefficient, since higher trade costs in the parent country make it more difficult to ship goods back to the parent country from foreign affiliates, which makes vertical FDI a less attractive option. *F_COST* is the cost of investing in the host country, which is measured by an index based on survey data of the business environment risk in a host country. As this rises, FDI should fall. *HTSKD* interacts host trade costs with the squared skill difference. Since host trade costs should matter less when FDI is vertical (i.e., skill differences are large), this carries an expected negative coefficient. Finally, *DIST* is the distance between countries. Since higher distances make both trade and control of overseas FDI more difficult, the net effect is ambiguous.

Empirical results for the CMM specification are generally good, except for a key puzzle. As shown by Blonigen, Davies, and Head (2003), the skill difference term in the CMM specification has the wrong sign and is statistically significant when the variable is properly specified. Thus, the key variable identifying vertical motivations for FDI fails and suggests that observed FDI patterns are mainly connected with horizontal motivations. This is puzzling and contrasts with recent findings by Hanson, Mataloni, and Slaughter (2003) of substantial vertical FDI, or outsourcing, by US MNEs that increases with lower wages in a destination country.

A key concern is that the CMM specification is not adequate to disentangle the vertical from the horizontal motivations for FDI from the data that pools observations of FDI activity across DCs and LDCs. CMM test their model with data on bilateral FDI activity between the United States and partner countries. This includes both observations on US outbound FDI in both DCs and LDCs and inbound FDI into the United States from other parent countries (DCs and potentially LDCs). The processes behind these various combinations of host and parent country FDI activities are likely quite different and coefficient estimates from pooled data may provide estimates that are not an accurate representation of any of these activities.

To investigate this further, we take the CMM specification and explore stability of coefficients across DCs and LDCs. We use the dataset from Blonigen and Davies (2004) on US bilateral FDI activity, which provides a more comprehensive set of data on US FDI activity than CMM. This dataset spans US FDI activity with all partner countries for which data are available for the years 1970–99. Given the critique in Blonigen, Davies, and Head (2003) we look separately at US inbound and outbound FDI, since for the inbound FDI observations the parents are always skill deficient relative to the host and vice versa for outbound FDI. Details on data sources and variable construction are in appendix 9.1.

As mentioned, an implication of CMM is that we can pool all countries and directions of FDI activity and estimate coefficient estimates that are valid for the entire sample. Alternatively, we hypothesize that the vertical motivations for MNE activity will be more evident with respect to US FDI with LDCs, in particular for outbound US FDI, where the United States is a relatively skilled country potentially searching for outsourcing destinations. For MNE activity (both inbound and outbound) between the United States and other DCs, the horizontal aspects of the model are expected to be stronger. For US inbound FDI activity from LDCs, horizontal aspects should dominate as LDCs should not be looking to source low-wage activities to the United States.[3] Thus, if anything, we should see mainly horizontal motivations governing the small amount of observed FDI by LDCs into DCs—i.e., FDI motivated by the desire to access a large market in the presence of trade frictions.

Table 9.3 provides our baseline results using data on FDI stock. Our first and third columns of results report baseline estimates for US outbound and inbound FDI between all country destinations for which data are available. The results show mixed evidence for the efficacy of these base results. The R^2 statistics are reasonably high for a sample with such cross-section variation. However, only five of the eight CMM variables in the outbound regression and only four of the eight CMM variables in the inbound regression have the expected sign. Consistent with Blonigen, Davies, and Head (2003) the skill difference term (SKDIFF) has a negative coefficient, which is exactly the opposite of what CMM would predict if vertical motivations for MNE activity exist. Instead, the coefficients suggest that FDI increases as skill differences decline, which supports a purely horizontal model of world MNE activity.

An explanation for these results is that the baseline CMM specification does not encompass the different processes that govern FDI across such heterogeneous countries. To explore this, the second and fourth columns of table 9.3 add interactions of CMM variables with a dummy variable indicating whether a country is an LDC. We classify Australia, Canada, Hong Kong, Iceland, Japan, New Zealand, Norway, Switzerland, and the European Union countries (as of 2003) as DCs. All other countries are classified as LDCs. The coefficient terms on these variables give the incremental difference in the variable's effect on FDI when the observation is connected with an LDC rather than a DC. As the results show, these interactions are extremely important. The adjusted R^2 in each equation goes up dramatically and an F-test strongly supports the inclusion of these LDC interaction terms in both the inbound and outbound equations. Many of

3. There is a potential model of LDCs having MNEs that outsource high-skilled activities to DCs, but this model has never been proposed and is arguably inconsistent with the standard models proposed by Markusen and others.

Table 9.3 Exploring inappropriate pooling of countries in estimates of the knowledge-capital model in levels of the variables

Variable	Expected sign	Outbound FDI stock: Baseline estimates	Outbound FDI stock: Dummy variable interaction	Inbound FDI stock: Baseline estimates	Inbound FDI stock: Dummy variable interaction
$SUMGDP_{ij}$	+	0.04	7.85	7.28	17.52
		(2.10)	(1.70)	(1.49)	(1.58)
$GDPDIFSQ_{ij}$	–	–0.0010	–0.0010	–0.0010	–0.0020
		(0.0002)	(0.0003)	(0.0001)	(0.0002)
$SKDIFF_{ij}$	+	–1,904	–12,904	–11,927	–3,495
		(1,501)	(4,865)	(1,358)	(2,542)
$SKDGDPD_{ij}$	–	–0.001	0.72	0.56	–0.03
		(0.203)	(0.54)	(0.14)	(0.31)
T_COST_i	+	–69.15	–191.4	–2012.0	–2166.0
		(33.40)	(83.6)	(772.0)	(644.8)
T_COST_j	–	–3,406.0	–3,251.0	–50.51	–76.45
		(1,093.0)	(974.3)	(10.94)	(22.18)
F_COST_j	–	–323.2	327.3	–594.9	–898.5
		(75.3)	(132.3)	(222.8)	(563.4)
$HTSKD_{ij}$	–	1.24	7.31	7.34	–0.10
		(0.79)	(4.05)	(0.84)	(2.43)
$DIST_{ij}$	?	–2.42	–5.00	–1.34	–3.11
		(0.30)	(0.85)	(0.18)	(0.35)
LDC interactions					
$SUMGDP_{ij}$ * LDC			–12.39		–20.72
			(1.49)		(1.41)
$GDPDIFSQ_{ij}$ * LDC			0.0010		0.0010
			(0.0002)		(0.0001)
$SKDIFF_{ij}$ * LDC			12,330		2,907
			(4,877)		(2,524)
$SKDGDPD_{ij}$ * LDC			–0.60		0.08
			(0.55)		(0.31)
T_COST_i * LDC			163.9		351.7
			(84.1)		(118.3)
T_COST_j * LDC			31.01		75.20
			(154.20)		(22.19)
F_COST_j * LDC			–383.8		819.2
			(136.0)		(562.5)

(table continues next page)

Table 9.3 Exploring inappropriate pooling of countries in estimates of the knowledge-capital model in levels of the variables *(continued)*

		Outbound FDI stock		Inbound FDI stock	
Variable	**Expected sign**	**Baseline estimates**	**Dummy variable interaction**	**Baseline estimates**	**Dummy variable interaction**
$HTSKD_{ij}$ * LDC			–6.90 (4.06)		0.26 (2.43)
$DIST_{ij}$ * LDC			4.36 (0.86)		3.06 (0.35)
Observations		892	892	1,490	1,490
Adjusted R^2		0.30	0.47	0.35	0.62
F-test (p-value)		43.08 (0.000)	25.61 (0.000)	87.75 (0.000)	30.68 (0.000)

+ = positive correlation
– = negative correlation
? = ambiguous net effect
LDC = less developed country

Note: Robust standard errors are in parentheses.

the LDC interaction terms are statistically significant and in almost every instance are exactly opposite in sign to their counterpart noninteracted CMM terms. This evidence strongly suggests that a different process is governing MNE activity with LDCs that is not captured by the standard CMM model.

With respect to the skill difference puzzle, the LDC interaction with *SKDIFF* has a statistically significant positive coefficient for the outbound FDI regressions. However, the total direct effect of *SKDIFF* on US outbound FDI activity to LDCs—the sum of the coefficients on *SKDIFF* and *SKDIFF*LDC*—is negative and statistically insignificant (F = 1.12 with p-value = 0.28). This point estimate is also small in terms of economic significance, with a standard deviation change in skill difference reducing FDI stock by $1.4 million. Thus, while the inverse relationship between skill differences and FDI activity is no longer true for US outbound FDI to LDCs, there is no statistically significant evidence for a positive relationship that would be consistent with vertical motivations for FDI.[4]

As discussed in Blonigen and Davies (2004), researchers are concerned with the statistical properties of these estimators, which have been used to test the CMM model in all previous literature, because they are so skewed.

4. The total marginal effect of *SKDIFF* on FDI must also take into account the interaction terms with GDP differences. The estimated coefficients on these terms for US outbound FDI are small and statistically insignificant. At the means of the data, they yield the same qualitative comparisons of marginal effects as those reported here on only the direct marginal effects of the *SKDIFF* terms.

For example, the outbound FDI data show a mean of $10.9 billion dollars across destination countries with a standard deviation of $22.1 billion. There are many destinations with very low levels of FDI stock up to a maximum of $233.1 billion. The numbers are similarly skewed in the inbound sample as well. Not surprisingly then, a Shapiro-Wilk (1965) test easily rejects normality of the residuals and a Ramsey (1969) RESET test strongly suggests misspecification bias, even after one includes the LDC interaction terms.

Table 9.4 presents results from a log-linear model. The linear model proposed by CMM is not a structural equation derived from theory, so there is nothing inherently inconsistent with specifying a log-linear model, and this functional form transformation is often used when data are highly skewed. One issue when logging the data is dealing with negative values of the dependent variable and trade cost measures for some observations. We truncate these observations to 0.1 before taking logs although we get qualitatively similar results if we simply drop these observations. In addition, the interaction terms—*SKDGDPD* and *HTSKD*—are perfectly collinear once logged and thus are dropped from the CMM specification.

Statistically significant differences for US MNE activity between LDCs and DCs remain in the alternative log-linear model. Once again, for US outbound FDI stock we find that the vertical aspects of MNE activity show up in the *SKDIFF*LDC* variable, which has a positive coefficient. Unlike in the linear model the coefficient on this variable is statistically significant, though total skill difference effect for LDCs—the sum of the coefficients on *SKDIFF* and *SKDIFF*LDC*—is once again statistically and economically insignificant.

Table 9.4 displays other interesting differences with respect to US FDI patterns between LDCs and DCs. In the outbound regressions, increases in *SUMGDP* still have a positive impact on FDI activity, but the coefficient falls from 5.43 to 2.14 (5.43–3.29). This suggests that GDP growth in the LDC is not as important for the amount of US FDI it receives, which is again more consistent with a vertical MNE, rather than a horizontal MNE, story. The other significant difference is that FDI costs (as measured by an index of business environment risk in the host country) are much more important for LDC hosts than DC hosts. MNEs may be much more sensitive to changes in these risks for LDCs that are generally more risky.

In the inbound regressions, the most notable differences for LDCs concern the *SKDIFF* and *DIST* variables. First, greater skill differences have a slightly larger negative effect on FDI activity from LDCs into the United States than for DCs. This is likely because FDI from an LDC into the United States is often insignificant until a country has reached some threshold level of education or skills.[5] Second, distance does not seem to negatively affect LDC FDI into the United States, as it does for DCs.

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5. As discussed below, such education thresholds also seem important for whether *inbound* FDI increases growth in LDCs.

Table 9.4 Exploring inappropriate pooling of countries in estimates of the knowledge-capital model in logs

Variable	Expected sign	Outbound FDI stock: Baseline estimates	Outbound FDI stock: Dummy variable interaction	Inbound FDI stock: Baseline estimates	Inbound FDI stock: Dummy variable interaction
$SUMGDP_{ij}$	+	3.73 (0.82)	5.43 (0.81)	14.71 (1.28)	12.77 (1.07)
$GDPDIFSQ_{ij}$	–	–0.67 (0.31)	–1.75 (0.32)	–4.28 (0.49)	–3.11 (0.46)
$SKDIFF_{ij}$	+	–0.10 (0.13)	–0.51 (0.13)	–4.12 (0.14)	–1.57 (0.25)
T_COST_i	+	–0.07 (0.04)	–0.18 (0.02)	18.89 (5.84)	13.28 (5.05)
T_COST_j	–	1.06 (3.97)	0.41 (3.94)	–0.15 (0.04)	–0.37 (0.04)
F_COST_j	–	–2.67 (0.25)	–1.22 (0.24)	–0.83 (1.19)	–0.73 (1.30)
$DIST_{ij}$	–	–1.06 (0.11)	–0.86 (0.11)	–0.50 (0.14)	–0.95 (0.11)
LDC interactions					
$SUMGDP_{ij}$ * LDC			–3.29 (0.54)		–1.38 (1.01)
$GDPDIFSQ_{ij}$ * LDC			2.08 (0.36)		–0.11 (0.53)
$SKDIFF_{ij}$ * LDC			0.95 (0.32)		–1.56 (0.37)
T_COST_i * LDC			0.23 (0.06)		0.84 (0.98)
T_COST_j * LDC			–0.21 (1.05)		0.39 (0.07)
F_COST_j * LDC			–2.14 (0.52)		0.24 (1.80)
$DIST_{ij}$ * LDC			–0.07 (0.19)		0.83 (0.20)
Observations		892	892	1,490	1,490
Adjusted R^2		0.37	0.40	0.51	0.62
F-test (p-value)		74.87 (0.000)	85.81 (0.000)	221.57 (0.000)	388.17 (0.000)

+ = positive correlation
– = negative correlation
LDC = less developed country

Note: Robust standard errors are in parentheses.

What conclusions can we draw from these results? First, the evidence strongly suggests that the standard CMM model does not yield a comprehensive model of world MNE activity. Substantial differences in the factors that determine MNE activity between the United States and LDCs versus the United States and DCs apparently exist. This casts doubt on the CMM specification's ability to identify vertical versus horizontal MNE activity. The follow-up question is, "Where do we go from here?" Are there feasible modifications to the CMM specification that would lead to a comprehensive model or is it more fruitful to develop models that focus on DC-LDC or DC-DC FDI separately? We do not have a definitive answer, but note that our attempts to modify the CMM specification to yield residuals with nice statistical properties have been unsuccessful. These modifications (many of which are reported further in Blonigen and Davies 2004) include country fixed effects, first-difference specifications, and inclusion of short-run determinants of FDI activity, such as tax and exchange rate changes. None of these provide specifications that can pass a RESET omitted variable test or a test for normality of residuals.

Cross-country data alone may simply be insufficient to provide a full accounting of worldwide FDI patterns. For example, Yeaple (2003b) finds that interactions of an industry's relative skill intensity with a country's relative abundance of skill are important for explaining US outward FDI. Accessing low-wage countries motivates FDI most clearly for industries that are less-skilled-labor intensive. Thus, we may not be able to explain worldwide patterns of FDI based on country-level data alone. Our analysis, along with that of Yeaple (2003b) and Hanson, Mataloni, and Slaughter (2003), suggests that vertical motivations for FDI are likely more important than what is revealed by the CMM empirical specification.

FDI and Growth

One of the more important issues that economists can study is discovering which factors affect economic growth. As evidenced by the literature estimating cross-country growth equations, however, the wide variation in results across various samples and econometric methodologies calls into question our ability to definitively state which factors are important for economic growth.[6] Despite these concerns, recent studies have begun to examine whether FDI, a factor largely ignored in previous literature, has an independent impact on the economic growth of countries.

Two more well-known studies, Balasubramanyam, Salisu, and Sapsford (1996) and Borensztein, De Gregorio, and Lee (1998), examine this issue in

6. Important studies pointing to the fragility of cross-country growth results include Levine and Renelt (1992), Sala-i-Martin (1997), Islam (1995), and Lee, Pesaran, and Smith (1998).

the context of LDCs and find that FDI is positively correlated with economic growth, but only under certain conditions. Balasubramanyam, Salisu, and Sapsford (1996) find that the evidence for a positive FDI effect is strongest when the LDC is pursuing export-promotion policies, rather than import-substitution policies. Borensztein, De Gregorio, and Lee (1998) find that FDI positively affects economic growth in LDCs only after the country has a sufficient human capital threshold, as proxied by years of schooling of males over the age of 25. The studies' authority is based upon an economic hypothesis about when FDI should affect growth (and when it should not) for an LDC, which is confirmed by the empirical analysis.

Recent studies, however, have cast doubt on the effect of FDI on growth. For example, Choe (2003) performs Granger causality tests on a panel of countries from 1971 through 1995 and finds little evidence that FDI affects economic growth. What these results mean for the previous studies by Balasubramanyam, Salisu, and Sapsford (1996) and Borensztein, De Gregorio, and Lee (1998) is less clear, however, since they often find insignificance for a sample that includes both LDCs and DCs, while the Choe study focuses on LDCs. Indeed, Balasubramanyam, Salisu, and Sapsford (1996) and Borensztein, De Gregorio, and Lee (1998) motivate their empirical analysis with hypotheses that are arguably only valid for understanding the effect of FDI on LDCs. This calls into question whether the evidence of insignificance is coming from inappropriate pooling of the recent studies or inappropriate methodology of the previous LDC-only studies.

In this section, we examine whether it is appropriate to pool LDCs and DCs in growth regressions using a common cross-section (and panel) setting. The extant literature is particularly frustrating, because no common sample is used to explore these issues. Instead there seem to be many studies providing varying results from varying samples that preclude any direct comparison. In addition, a variety of alternative econometric techniques are employed. Statistical tests can at least provide evidence on preferred techniques, but the results may vary depending on the sample. An important choice, not often discussed, is frequency of the data. Given that FDI is a source of capital, theory would suggest that FDI stock is the appropriate measure of FDI for these growth regressions. However, FDI stock data are difficult to construct and often unavailable. Thus, some studies, such as Borensztein, De Gregorio, and Lee (1998) use FDI flows, but aggregate their data by decade. Other studies use annual observations of FDI flows. In constructing our sample, we use the former method because of concerns that highly variable annual FDI flows are much further away from our ideal measure of FDI stock.

Do we really think that such annual flows (or even one-year lagged flows) have a discernible effect on this year's growth rate? Yes, multiple observations of the same country seem essential to be able to control for unobserved country-specific heterogeneity. Many features of countries that are hypothesized to be important for growth seem largely time invariant, such as institutions and culture. Proxies for such important factors used in cross-sectional analysis are likely to have considerable measurement error. Thus, reducing omitted variable bias from these time-invariant factors through panel-data techniques seems essential.

With gracious help from Eduardo Borensztein and Jong-Wha Lee, we were able to obtain the data used in Borensztein, De Gregorio, and Lee (1998).[7] As mentioned above, these data are a panel of decade averages of the variables for only LDCs in the 1970s and 1980s. We then augmented their data by collecting observations for all the DCs for which we could get identical measures of the variables.[8] Linked to this common dataset from a well-known analysis in the area, we explored the effects of pooling LDCs and DCs on the estimate effects of FDI on growth, as well as sensitivity to panel-data techniques.

Columns 1 and 2 of table 9.5 provide seemingly unrelated regression (SUR) estimates of the determinants of per capita growth across countries for the two decades of data, 1970–79 and 1980–89. Like Borensztein, De Gregorio, and Lee (1998) we constrain all the coefficients equally across the two decades with the exception of the constant and, thus, report just one set of coefficient estimates. Column 1 of table 9.5 provides our base estimates, for which we use the same specification as Borensztein, De Gregorio, and Lee (1998) (column 1.6 of their table 1) but use a sample of both LDCs and DCs, not just LDCs. The estimated coefficients largely follow expected signs, and standard statistical measures suggest a decent goodness of fit. However, unlike Borensztein, De Gregorio, and Lee (1998), these estimates, which use data pooling LDCs and DCs, show much-reduced coefficient estimates on the FDI measures and no statistically significant effect of FDI on growth. Thus, pooling seems to have a substantial impact on the empirical evidence with respect to this issue.

This is confirmed in column 2 of table 9.5, where we include interactions of our variables with a dummy variable indicating our LDC countries.[9] A statistical test suggests that these interactions are jointly significant, though the most substantial impact occurs with the FDI variables. As in the previous section, the coefficients on the standard variables indicate the effects for DCs, while the effect for LDCs is the sum of the coefficients of the standard variables and their interactions with the LDC dummy variable. Thus, the coeffi-

7. We were able to gather all the data used in the Borensztein, De Gregorio, and Lee study with the exception of the data used for their institution variable. We were also able to use almost identical parameter estimates for the institution variable.

8. This added 19 additional countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, West Germany, the United Kingdom, and the United States.

9. The variables sub-Saharan African dummy, Latin American dummy, and Wars were not interacted since they are perfectly or highly collinear with an LDC dummy variable.

Table 9.5 Exploring inappropriate pooling of countries in SUR and random-effects estimates of FDI on per capita GDP growth for a panel of two decades, 1970–79 and 1980–89

Regressor	Expected sign	Seemingly unrelated regressions: Base estimates	Seemingly unrelated regressions: LDC dummy variable interaction	Random-effects estimates
Log of initial GDP	–	–0.012 (0.004)	–0.014 (0.005)	–0.011 (0.012)
School	+	0.002 (0.003)	–0.001 (0.006)	0.004 (0.012)
Government consumption	–	–0.065 (0.032)	0.178 (0.186)	–0.230 (0.650)
Log (1+black market premium)	–	–0.011 (0.005)	0.213 (0.386)	0.312 (0.880)
FDI	+	0.153 (0.687)	–0.987 (1.930)	1.959 (4.239)
FDI * School	+	–0.064 (0.389)	0.519 (0.857)	–1.217 (2.310)
Sub-Saharan African dummy	–	–0.020 (0.006)	–0.016 (0.006)	–0.020 (0.008)
Latin American dummy	–	–0.015 (0.006)	–0.018 (0.006)	–0.017 (0.008)
Assassinations	–	–0.014 (0.012)	0.214 (0.246)	–0.008 (0.501)
Wars	–	–0.001 (0.005)	–0.005 (0.005)	–0.004 (0.007)
Political rights (1 best, 7 worst)	–	–0.002 (0.001)	–0.000 (0.007)	–0.006 (0.015)
Financial depth	+	0.011 (0.009)	0.021 (0.022)	0.004 (0.056)
Inflation rate	–	–0.011 (0.008)	–0.247 (0.151)	0.015 (0.448)
LDC interactions				
Log of initial GDP * LDC	?		0.003 (0.005)	–0.002 (0.012)
School * LDC	?		0.004 (0.007)	–0.001 (0.013)
Government consumption * LDC	?		–0.252 (0.188)	0.142 (0.651)

(table continues next page)

Table 9.5 Exploring inappropriate pooling of countries in SUR and random-effects estimates of FDI on per capita GDP growth for a panel of two decades, 1970–79 and 1980–89 *(continued)*

		Seemingly unrelated regressions		
Regressor	**Expected sign**	**Base estimates**	**LDC dummy variable interaction**	**Random-effects estimates**
Log (1+black market premium) * LDC	?		–0.222 (0.386)	–0.324 (0.880)
FDI * LDC	?		–2.370 (2.242)	–4.111 (4.459)
FDI * School * LDC	?		3.339 (1.391)	4.053 (2.678)
Assassinations * LDC	?		–0.222 (0.246)	0.071 (0.502)
Political rights (1 best, 7 worst) * LDC	?		–0.003 (0.007)	0.003 (0.015)
Financial depth * LDC	?		–0.017 (0.024)	0.002 (0.058)
Inflation rate * LDC	?		0.237 (0.152)	–0.032 (0.448)
Observations		160	160	146
R^2—1970–79		0.28	0.39	
R^2—1980–89		0.35	0.40	
Goodness of fit—χ^2 (p-value)		70.59 (0.000)	101.92 (0.000)	62.98 (0.000)

+ = positive correlation
– = negative correlation
? = ambiguous net effect
LDC = less developed country
SUR = seemingly unrelated regressions

Note: Standard errors in parentheses.

cients for LDCs on FDI and *FDI*School* are –3.357 and 3.858, respectively. Both of these combined coefficients are statistically significant at the 1 percent significance level and suggest the same pattern found by Borensztein, De Gregorio, and Lee (1998). In particular, FDI has a significant impact on per capita growth only after education levels in the LDC are at a high enough threshold level. As is clear, no such relationship exists for the DCs, and pooling the data (as in column 1) obscures this important relationship.

The SUR estimates do not control for unobserved heterogeneity across countries. Given the two time periods (1970–79 and 1980–89), panel-data techniques can be applied to control for such heterogeneity, eliminating this potential source of omitted variable bias. Column 3 of table 9.5 provides random-effects estimates of the data using a specification that includes the LDC interactions.[10] In this setting, exploiting the panel nature of data does not have a substantial effect on inferences, especially with respect to the FDI variables. As with the SUR estimates, there are no statistically significant effects of FDI with respect to DCs, but there are the same types of effects of FDI for LDCs. The combined effects of FDI and *FDI*School* for LDCs are –2.152 and 2.836 with probability values of 0.12 and 0.04, respectively. The threshold level of schooling before the effect of FDI becomes positive is now 0.76, which is much closer to the Borensztein, De Gregorio, Lee (1998) estimates.

In summary, the evidence in this section suggests that inappropriate pooling of DCs with LDCs, not the introduction of panel techniques, is responsible for estimating insignificant effects of FDI with respect to per capita GDP growth. The persuasive arguments for the effects of FDI, however, have been made with LDCs in mind. That is precisely where the evidence suggests that FDI does indeed affect growth, conditioned on a sufficient level of human capital.

FDI and Domestic Investment: Crowding In or Out?

An issue related to the FDI growth question is whether FDI crowds out domestic investment or crowds it in. When foreign firms enter a country, local investors' decisions will be affected. On the one hand, FDI can crowd out domestic investment if foreign firms finance their investment by borrowing in the host country, thus increasing the host country's interest rate. Harrison and McMillan (2003) find just such evidence using a microlevel database of firms in Côte d'Ivoire. On the other hand, an increase in foreign investment can lead to an increase in domestic investment if FDI stimulates new domestic investment through forward or backward production linkages.

Borensztein, De Gregorio, and Lee (1998) use their data to explore this hypothesis. In particular, they use the same regressor matrix to explain a country's total investment as a share of GDP as they use in the growth equations. As they explain, since FDI is included in total investment, evidence of crowding in would require a coefficient greater than 1. Table 9.6 provides estimates of this hypothesis using the same pattern of specifications as in

10. With only two periods and limited observations, multicollinearity issues prevent us from estimating a fixed-effects model with this specification.

Table 9.6 Exploring inappropriate pooling of countries in SUR and random-effects estimates of FDI on aggregate investment rates for a panel of two decades, 1970–79 and 1980–89

Regressor	Expected sign	Seemingly unrelated regressions: Base estimates	Seemingly unrelated regressions: LDC dummy variable interaction	Random-effects estimates
Log of initial GDP	+	0.039 (0.010)	0.040 (0.014)	0.042 (0.025)
School	+	–0.005 (0.007)	–0.008 (0.009)	–0.023 (0.019)
Government consumption	–	–0.208 (0.089)	–0.493 (0.411)	–0.495 (0.990)
Log (1+black market premium)	–	–0.001 (0.011)	–0.536 (1.017)	–1.038 (2.060)
FDI	+	–0.081 (0.753)	–2.136 (1.487)	–1.739 (2.901)
Sub-Saharan Africa dummy	–	–0.046 (0.019)	–0.043 (0.018)	–0.056 (0.021)
Latin America dummy	–	–0.044 (0.016)	–0.037 (0.017)	–0.032 (0.021)
Assassinations	–	–0.029 (0.022)	–0.219 (0.573)	–0.483 (1.039)
Wars	–	0.012 (0.011)	0.013 (0.011)	0.004 (0.014)
Political rights (1 best, 7 worst)	–	0.001 (0.003)	–0.008 (0.015)	0.004 (0.034)
Financial depth	+	0.054 (0.022)	0.044 (0.052)	0.026 (0.108)
Inflation rate	–	–0.032 (0.015)	0.487 (0.350)	0.202 (0.979)
LDC interactions				
Log of Initial GDP * LDC	?		–0.009 (0.012)	–0.015 (0.024)
School * LDC	?		0.017 (0.013)	0.021 (0.023)
Government consumption * LDC	?		0.333 (0.420)	0.360 (0.994)

(table continues next page)

Table 9.6 Exploring inappropriate pooling of countries in SUR and random-effects estimates of FDI on aggregate investment rates for a panel of two decades, 1970–79 and 1980–89 *(continued)*

Regressor	Expected sign	Seemingly unrelated regressions: Base estimates	Seemingly unrelated regressions: LDC dummy variable interaction	Random-effects estimates
Log (1+black market premium) * LDC	?		0.534 (1.017)	1.032 (2.060)
FDI * LDC	?		4.284 (1.816)	4.163 (3.223)
Assassinations * LDC	?		0.188 (0.574)	0.457 (1.040)
Political rights (1 best, 7 worst) * LDC	?		0.008 (0.015)	–0.003 (0.034)
Financial depth * LDC	?		0.003 (0.059)	0.006 (0.114)
Inflation rate * LDC	?		–0.520 (0.350)	–0.250 (0.979)
Observations		160	160	146
R^2—1970–79		0.51	0.54	
R^2—1980–89		0.70	0.75	
Goodness of fit—χ^2 (p-value)		193.25 (0.000)	242.16 (0.000)	140.25 (0.000)

+ = positive correlation
– = negative correlation
? = ambiguous net effect
LDC = less developed country
SUR = seemingly unrelated regressions

Note: Standard errors in parentheses.

table 9.5. Column 1 provides the base specification of SUR estimates for a sample of pooled LDCs and DCs, column 2 adds LDC interactions, and column 3 provides random-effects estimates with LDC interactions.[11] The only alteration to the specification is omission of the *FDI*School* variable, since Borensztein, De Gregorio, and Lee (1998) did not find this interaction to be significant.

11. Unlike the growth specification in the previous section, we were able to estimate a fixed-effect specification, but a Hausman test suggested that the random-effects specification was more appropriate.

We discover a very similar story to that of the FDI growth hypothesis above. When we pool the data across both types of countries, we get a coefficient on the FDI variable that is very close to 0. When we allow LDC interactions in our SUR specification we get substantial differences between the effects of FDI on total investment rates for DCs (coefficient of –2.136) versus for LDCs (–2.136 + 4.284 = 2.148). The difference between these coefficients is statistically different at the 1 percent significance level and clearly suggests that FDI is much less likely to crowd out domestic investment in LDCs than in DCs. This is consistent with the notion that technology spillovers, as well as backward and forward production linkages, are more common with FDI into LDCs. While the effect of FDI on total investment is statistically different from 0 for LDCs, we cannot rule out that it takes the value of 1. Therefore, our tests do not necessarily support a "crowding-in" effect from FDI, which is consistent with the evidence found by Borensztein, De Gregorio, and Lee (1998).

In related work, Wang (2003) examines the crowding-out/-in hypothesis using annual data on FDI flows across a panel of Organization for Economic Cooperation and Development (OECD) and non-OECD countries. She also investigates lagged values of these FDI flows on domestic investment to control for endogeneity concerns. Wang's analysis provides even stronger evidence that FDI crowds in domestic investment for non-OECD (or LDC) countries than that presented here. Likewise, she finds that no such effect exists for OECD countries.

In summary, there is evidence that pooling LDCs and DCs when examining the crowding-in/-out hypothesis effect on domestic investment is inappropriate. The evidence to date suggests that FDI is much less likely to crowd out (more likely to crowd in) domestic investment for LDCs than DCs. Pooling the data is likely to obscure this potentially important relationship.

Conclusion

This study has found a variety of scenarios involving FDI in which pooling rich and poor countries in an empirical analysis leads to incorrect inferences. While these empirical analyses are often based on theories that are purportedly comprehensive representations of the entire distribution of the world's economies, the data clearly tell us that FDI in LDCs and DCs follows very different processes. We have shown this with respect to three areas of recent research interest. First, the underlying factors that determine the level of FDI activity vary systematically across LDCs and DCs in a way that is not captured by current empirical models of FDI. Second, the effect of FDI on economic growth is one that is apparently supported only for LDCs, not DCs, in the aggregate data. Third, the evidence suggests that FDI is much less likely to crowd out (more likely to crowd in) domestic investment for LDCs than DCs.

Our results must be seen as illustrative of the issue of inappropriate pooling, not a definitive statement about the exact relationship between the variables we examine. The importance of the issues of FDI patterns and its effects on host countries is matched by relatively poor data at the country level. It is not surprising that results can be found to be sensitive to a wide variety of alternative specifications when the data only includes observations in the hundreds and involve measurement issues with most of the variables. Indeed, the answer is not likely to be found in throwing ever-more sophisticated estimation techniques (particularly ones for which only asymptotic properties are known) at the data. Pooling is not a fancy econometric issue or technique, but even it is not innocuous. Pooling is often a way to increase observation size and, hence, efficiency. Thus, our recommendation to treat LDCs and DCs separately in these studies affects this margin. However, as we have shown, this margin seems to have an even larger impact on inferences than other issues (such as controlling for cross-country heterogeneity through panel data techniques).[12] Rather than despair, it is our hope that continued work on these issues from both microeconomic studies and country-level approaches will ultimately provide consensus views on these important issues involving FDI.

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12. A related issue is whether even finer distinctions between samples of countries could be made and would be useful to examine—such as very poor LDCs versus newly industrializing LDCs. It would not be surprising to find that estimates in these studies are structurally different as well, though the finer detail runs into the issue of having sufficient observations for estimation.

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Appendix 9.1
Data Sources and Construction

For Analysis in the Third Section

These data are documented in detailed fashion in Blonigen and Davies (2004). Data on FDI stocks for nonfinancial sectors come from official statistics of the US Bureau of Economic Administration. These are publicly available at www.bea.doc.gov/bea/di1.htm. We convert these FDI stock data into millions of 1996 US dollars. Our GDP (both total and per capita in real terms) and trade openness measures are those from version 6.1 of the Penn World Tables, which are available online at pwt.econ.upenn.edu. For a detailed discussion of these measures, see Summers and Heston (1991). Our education variable is the mean years of education for adults over age 25. These data comes from the Barro-Lee dataset, which is available at www.worldbank.org/research/growth/ddbarle2.htm. Details on these data are given by Barro and Lee (1996). Distance was measured as the distance between capital cities as reported by the Bali Online Corporation. This distance calculator can be found at www.indo.com. For our measure of investment costs, we use the composite score compiled by Business Environment Risk Intelligence, S.A. (BERI). This composite includes measures of political risk, financial risk, and other economic indicators and ranges between 0 and 100, with higher numbers associated with a higher degree of openness. To compare these estimates to previously used measures of investment barriers, we define Investment Barriers as 100 minus the BERI's composite score. The data for these analyses are available from the authors upon request.

For Analysis in the Fourth and Fifth Sections

All variables in these sections of the chapter come from the identical sources and are constructed identically to those described in Borensztein, De Gregorio, and Lee (1998), with the exception of FDI data for developed countries. We obtained data on decade average flows of FDI into our developed countries from the 2001 OECD publication *International Direct Investment Statistics Yearbook, 1980–2000* (columns 1 and 2 of table 2, 13). We combined this with *International Financial Statistics* data on nominal GDP to get decade averages of FDI as a share of GDP. The data for these analyses are available from the authors upon request.