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Honors Paper

Macalester College

Spring 2008

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Author: Kaitlyn Orr

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Economics Department

Honors Project

Macalester College May 2008

Spatial Patterns of Foreign Direct Investment

Do agglomeration effects explain the spatial pattern of FDI in Latin America and Asia: A spatial econometric analysis

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Spatial Patterns of Foreign Direct Investment

Kaitlyn Orr
Honor's Project
Advisor: Raymond Robertson
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Spring 2008

Abstract:

Emerging economic theory attempts to explain multinational enterprises' decisions to locate foreign direct investment in certain countries at the expense of others. Recent literature explores the reasons why FDI into a host country may depend on FDI in neighboring countries. This paper extends the previous research by employing an econometric model that measures the relationship between one country's FDI and other geographically-proximate countries' FDI. I conduct a comparative study between the emerging countries of Latin America and Asia to test whether positive agglomeration externalities exist across country borders. By studying agglomeration externalities, I address the question: does the level of FDI in a host country help explain the level of FDI in surrounding countries? I find that within Latin America, an increase in FDI in one country leads to a positive spillover effect on FDI into neighboring countries. This result supports the agglomeration effects hypothesis across borders within Latin America. Asia, however, yields inconclusive results.

*Special thanks to Professors Raymond Robertson, Gary Krueger, and Pete Ferderer for their comments and assistance in this study. Also, thanks to Birgit Muehlenhaus in Macalester's Geography Department for the GIS maps of Latin America and Asia.

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Section I. Introduction

In recent decades, multinational enterprises (MNEs) have dramatically increased their level foreign direct investment (FDI) in emerging economies. Since 1991, the growth in global FDI has averaged an impressive 17 percent annually in dollar terms (Palmade and Anayiotas 2004). An expanding body of literature highlights the importance of FDI in emerging economies because of its implications for development. For example, Guasch (2002) and Harris (2003) find a largely positive affect of FDI on productivity and long-term economic performance in developing countries. Mallampally et al. (1999) posit that FDI is important to emerging economies because it facilitates increased capital formation, technological accumulation, skills, innovative capacity, organizational and managerial practices between locations, and accessing international marketing networks. As a result, foreign direct investment potentially serves as an explanation for differences in economic growth and development between regions.

The economic benefits of FDI have encouraged developing countries to create policies aimed at attracting foreign investment and have motivated economic research exploring the determinants of FDI accumulation. Identifying the factors that affect the location of FDI can provide information to policymakers interested in overcoming obstacles that deter the accumulation of investment. This paper contributes to the existing literature by studying the spatial behavior of foreign investment in emerging economies. I extend previous research by employing existing spatial dependence econometric models for a comparative study between Latin America and Asia. Contractor (1995) found that nearly 70% of all FDI flowing into developing economies was concentrated among only a few countries in select regions, suggesting either investment herding or agglomeration externalities. Motivated by Contractor's

finding, this paper formulates an empirical model to test whether positive agglomeration externalities exist within countries and/or across country borders. By studying the effects of agglomeration externalities, I address the question: does FDI in one host country help explain FDI in neighboring countries?

The econometric technique called *spatial autoregression* estimates a 'spatial lag' coefficient that characterizes the relationship between one region's FDI and other geographically-proximate regions' FDI. By employing this technique, I compare the spatial behavior of FDI between Latin America and Asia. Spatial dependence is important because it helps explain FDI clustering within countries and regions. I perform this spatial study in order to capture the effects of agglomeration externalities. Theory suggests that agglomeration affects spatial dependence in two ways. Within a country, firm agglomeration lowers production costs as total industry output increases and attracts more investment to the host country. Across countries, positive agglomeration externalities can cross over borders and increase the level of foreign investment in neighboring countries.[1] In addition, FDI in one country can signal to investors the economic conditions of the host country and surrounding region.

Comparing Latin America and Asia allows me to study the FDI patterns in two regions comprised of emerging economies that have experienced very different development trajectories. Asia, especially the high performing East-Asian economies (HPEAs), has historically had the

[1] An example of agglomeration effects within countries is Japanese manufacturing plants in the United States, presented by Head et al. (1995). The authors posit that firms in the same industry have the propensity to cluster because proximity generates positive externalities. Examining the location choice of 751 Japanese manufacturing plants in the US since 1980, Head et al. finds empirical evidence supporting the thesis that industry-level agglomeration benefits play an important role in location decisions. In addition, Ciccone (2002) studied agglomeration effects across countries in Europe including France, German, Italy, Spain, and the UK. Empirical results found that the positive externality of labor productivity existed within the countries nearly to the extent that they exist in the US. The paper found that the estimated elasticity of labor productivity with respect to employment density is 4.5 percent with these European countries, compared to 5 percent in the US.

highest economic growth record among developing nations. Latin America has fluctuated between recession, modest growth, and stagnation. Analyzing the spatial pattern of long-term productive investment offers a partial explanation for the differing growth trajectories that these two regions have experienced. Further, the spatial dependence technique allows me to explore whether the existence of a major FDI host country (such as Singapore or Mexico) has significant FDI spillover effects into the region as a whole or whether FDI has a feedback effect that keeps it contained within the original host country. Understanding this relationship could provide an explanation for regional differences in FDI concentrations.

The paper is organized as follows. The subsequent section reviews the emerging literature on multinational enterprises' location decisions, agglomeration externalities, and spatial empirical literature regarding FDI. Sections three and four present the theoretical and empirical model. Sections five and six discuss the dataset that I use in my research and interpret my empirical findings. Finally, my paper concludes by addressing the areas in which my paper can be expanded through future research.

Section II. Literature Review

Early literature on FDI behavior focuses exclusively on the traditional macroeconomic bilateral determinants of FDI between a home and host country such as exchange rates, tax regimes, trade protection, and trade flows. More recently, institutional characteristics have been used to explain the location decisions of multinational enterprises (MNEs).[2] Despite inconsistent empirical findings, most research finds that FDI is positively linked to home-country currency

[2] Dunning (2001) notes that countries that are able to create a functioning legal system, commercial infrastructure, and viable business environment will be more likely to attract foreign direct investment. This suggests that institutional characteristics are important in determining the location decisions of FDI.

appreciation, low host-country tax rates, trade barriers, and strong host-country institutions (Froot and Sterin, 1991; Hartman, 1984; Blonigen, 2005).

Blonigen et al. (2007) note that a limitation of the traditional FDI research is the simple bilateral framework that is employed. The authors posit that the presence of agglomeration externalities may create interdependent FDI decisions across host destinations that cannot be evaluated in a two-country framework. Blonigen et al. illustrate the significance of introducing spatial interdependence as an explanation for why FDI may move into a host country based on the magnitude of FDI in geographically-proximate countries. The following three sub-sections present the relevant literature that expands on the traditional bilateral framework for studying FDI. The first sub-section traces the evolving theoretical literature regarding MNE's investment decisions. The second section presents the conflicting agglomeration effects theories in emerging economies. The final section introduces the emerging research on empirical spatial dependence.

2.1 Multinational enterprise investment decisions

Previous research presents a variety of explanations for MNE activity.[3] To begin, the literature distinguishes between different types of FDI to explain why an MNE would invest in a particular country. Mallampally et al. (1999) categorize three distinct types of FDI, including market-seeking (horizontal), resource/asset-seeking (vertical), and efficiency-seeking FDI. Market-seeking or horizontal FDI is attracted to a host country based on the market size and per capita income, market growth, access to regional and global markets, country-specific consumer

[3] Explanations of MNEs investment decisions often begin by introducing Dunning's (1993) "eclectic paradigm" that differentiates between types of FDI to provide a more precise explanation for MNE's motivations to investment in specific countries. Dunning presents a three-tired framework to account for MNE's decision-making process when deciding to invest abroad. In this model, the MNE's investment abroad is contingent upon the type of FDI activity and is based on ownership advantages, location-specific advantages, or internalization advantages. According to this theory, MNE foreign production rests of the following three determinants: i) producing abroad will allow the MNE to acquire assets that its competitors do not possess, ii) whether or not the MNE can sell or lease these assets or internalize them, iii) the exploitation of indigenous assets. Dunning's paradigm is important to keep in mind, but other literature more closely explains the reasons for FDI in emerging economies.

preferences, and the structure of the markets. The motivations behind resource or vertical FDI include accessing raw materials, low-cost unskilled labor, specialized labor, technological innovation, and physical infrastructure. Efficiency-seeking FDI is attracted to low-cost resources, transport, and communication, and to the access of membership into regional corporate networks. According to this literature, emerging economies tend to attract predominantly vertical, resource-seeking FDI (Sethi, 2003).

Blonigen et al. (2007) note that a fourth category of FDI is complex-vertical, in which multinational firms separate out a number of production activities, each of which may be in different regions. With this form of FDI having suppliers in neighboring countries or regions is likely to increase FDI to a particular host country. There may also be other forces that generate agglomeration incentives besides supplier networks, including the location of immobile resources. For example, an immobile resource (like a mine) in a neighboring country may increase FDI in a host country if the MNE wishes to simultaneously exploit the resource but remain in the host country because of factors such as infrastructure or labor. Therefore, with this type of FDI in particular we should expect FDI in a one country to have a positive effect on the level of FDI in a geographically-proximate country.

Chart 1

Literature Review Summary - MNE Literature

Author (year)	Type of FDI	Motivations	Attraction to developing countries?
Mallampally et al (1999)			
	(1) Market-seeking (horizontal)	Large market size and high per capita income, market growth, access to regional and global markets, country-specific consumer preferences, and the structure of the markets.	Low
	(2) Resource-seeking (vertical)	Access to raw materials, low-cost unskilled labor, specialized labor, technological innovation, and physical infrastructure	High
	(3) Efficiency-seeking	Access to low-cost resources, transport, and communication, and membership into regional corporate networks	Moderate
Blonigen et al (2007)			
	(4) Complex-vertical	Having supplier networks in near-by regions, proximity to immobile resources	Depends, attracted to proximate FDI

2.2 Agglomeration effects

Another vein of the literature argues that FDI activities may lead to agglomeration externalities. Dunning (1998) looks at the spatial aspects of FDI and suggests that the presence of other foreign investors in a particular country is becoming a significant factor in explaining the level of FDI. This is a sign of either a signaling effect to other firms about the country's economic condition, or an agglomeration effect by which firms benefit from being part of geographical cluster of related activities and specialized support service. Indeed, most studies explain FDI clustering as a result of agglomeration benefits. For example, Wheeler and Mody (1992) find proximity benefits from infrastructure quality, degree of industrialization, and the

existing stock of FDI. Maskell (1996) provides evidence of spatial bunching of firms engaged in related activities as a result of having access to localized support facilities, shared service centers, distribution networks, customized demand patterns, and specialized factor inputs.

Dunning (1998) challenges the presence of agglomeration effects in developing countries. He posits that the low value-added activities in the least developed areas of the world are less likely to experience agglomeration benefits because their activities are not knowledge-facilitating. That is, knowledge spillovers fail to occur in emerging economies because the vertical FDI that these counties attract tend to be lower on the production chain. According to Dunning, with the exception of possible increases to the physical and human infrastructure as a result of FDI clusters, the macroeconomic environment and institutional framework of the host country tend to play a more decisive role in the investment decision than agglomerative externalities in developing countries. On the other hand, Contractor (1995) finds a large concentration of FDI in just a few developing countries supporting the agglomeration hypothesis. In addition, Sethi et al. (2003) introduce a herding theory in emerging economies in which all MNEs weigh prospective locations for their investment through traditionally identified FDI determinants and then choose the location offering the best fit with their firm strategy. Aiming not to cede the market to competitors, other MNEs rush in with their own investment, causing a clustering of economic activity in non-industrialized economies. My research hopes to clarify this debate in the literature by empirically testing the agglomeration hypothesis in the less-developed countries of Latin America and Asia.

Chart 2

Literature Review Summary - Agglomeration Effects

Author (year)	Positive agglomeration effects?	Finding
Wheeler and Mody (1992)	Yes	Proximity benefits from infrastructure quality, degree of industrialization, and the existing stock of FDI
Contractor (1995)	Yes	Evidence of a large concentration of FDI in just a few, select developing countries.
Maskell (1996)	Yes	Spatial bunching of firms engaged in related activities as a result of having access to localized support facilities, shared service centers, distribution networks, customized demand patterns, and specialized factor inputs/
Dunning (1998)	No	The macroeconomic environment and institutional framework of the host country tend to play a more decisive role in the investment decision than agglomerative externalities in developing countries.
Sethi et al. (2003)	Yes	MNEs weigh prospective locations for their investment through traditionally identified FDI determinants and then choose the location offering the best fit with their firm strategy. Aiming not to cede the market to competitors, other MNEs rush in with their own investment, causing a clustering of economic activity in non-industrialized economies.

2.3 Empirical Spatial Dependence Literature

Empirical literature examines the relationship between agglomeration benefits, the location choice of FDI, and spatial trends. In accordance with the theory discussed above, Head and Ries (1995) suggest that firms in the same industry cluster geographically because proximity generates positive agglomeration externalities. Agglomeration externalities are present when industries cluster because firm proximity adds to the attractiveness of the location due to favorable factor endowments in a particular location, technological spillover effects, specialized labor, or intermediate inputs. Using data on the location choices of Japanese manufacturing foreign direct investment in the United States and employing a conditional-logit specification,

Head and Ries's empirical evidence supports the hypothesis that industry-level agglomeration effects play a decisive role in MNE's location decisions. The authors find that not only does manufacturing conglomerate within states in the US, but that agglomeration benefits spillover state borders and attract additional investment in neighboring states as well.

Using a spatial econometric technique to examine FDI behavior and test for the presence of agglomeration externalities, Coughlin and Segev (2000) estimate a model to explain the geographic pattern of FDI location within China. Similar to Head and Ries's analysis within the United States, Coughlin and Segev hypothesize that agglomeration may lead to higher FDI levels in neighboring Chinese provinces due to spillover effects across borders. If, however, agglomeration effects do not spill over provinces, then the concentration of FDI in one province may negatively influence FDI in adjacent provinces. Using spatial autocorrelation, the empirical results confirm that one province's FDI is positively correlated with FDI in neighboring regions, exhibiting a positive spatial lag. The authors attribute the result to agglomeration economies within and across provinces.

Extending Coughlin and Segev's spatial method, Blonigen et al. (2007) use an empirical FDI model that examines US outbound FDI in predominately developed host countries in order to test for spatial correlations across countries and regions. Blonigen et al. analyze outbound FDI data from 1983 through 1998 into OECD countries. They employ a spatial autoregression specification to examine the relationship between one region's FDI and other geographically-proximate regions' FDI. The paper finds a statistically significant positive result for cross-country spatial dependence term in the model. In addition, traditional determinants of FDI are robust and statistically significant when spatial dependence terms are included in the model specification. Unfortunately, the authors find that the estimated spatial dependence term is

sensitive to the sample of countries one examines, bringing into question the robustness of the results.

Similar to Blonigen et al.'s empirical approach is Baltagi et al.'s (2007) specification. Baltagi et al. distinguishes between vertical, horizontal, and complex-vertical MNE activity and then tests for the spatial patterns that should be associated with each type of MNE activity. Using US outbound FDI for seven manufacturing industries Baltagi et al. find substantial evidence of spatial interactions. Baltagi's results are more robust and less sensitive to the country sample than Blonigen et al.'s study.

Chart 3

Literature Review Summary - Empirical Spatial Dependence

Author (year)	Method	Finding
Head and Ried (1995)	Conditional Logit	Examines the location choices of 751 Japanese manufacturing plants built in the United States since 1980 with data supporting the hypothesis that industry-level agglomeration benefits play an important role in location decisions.
Couglin and Segev (2000)	Spatial Error Model	Hypothesizes that agglomeration may lead to higher FDI levels in neighboring Chinese provinces due to spillover effects across borders. If, however, agglomeration effects do not spill over provinces, then the concentration of FDI in one province may negatively influence FDI in adjacent provinces. The empirical results confirm that one province's FDI is positively correlated with FDI in neighboring regions.
Blonigen (2007)	Spatial Autoregression (Spatial Lag)	Employs a spatial autoregression specification to examine the relationship between one region's FDI and other geographically-proximate regions' FDI. The paper finds a statistically significant positive result for cross-country spatial dependence term in the model. In addition, traditional determinants of FDI are robust and statistically significant when spatial dependence terms are included in the model specification

My research extends the literature discussed above by building upon the current spatial econometric methods and applying it to a cross-regional study of emerging economies. Drawing largely from the empirical framework of Blonigen et al., I extend the dataset to the year 2004 and apply the analysis to Latin America and Asia. By looking at only less-developed, emerging economies, I hope to provide an explanation for the different FDI growth trajectories between the developing regions of Latin America and Asia. This research aims to provide further insight into FDI behavioral patterns in developing economies.

Section III. Theoretical Model

A MNE's decision on where to invest depends upon expected profit generation, relative to alternative locations. In general, location decisions are determined by factors that affect total cost and total revenue. For the purposes of this paper, I focus on total cost. Total revenue is assumed to remain constant, relative to other countries, due to the type of FDI that is predominantly present in developing countries. Vertical and complex-vertical FDI are the most likely categories of investment to enter emerging economies. For example, a developing country is more likely to attract an assembly plant that exports a final or intermediate good to a different market than a retail plant that sells to the host market. This implies that total revenue is generated externally and irrespective of the market characteristics of the host country.

Total cost, on the other hand, is dependent upon host country characteristics, including local labor and capital costs, the relative price of natural resources, other inputs, and the presence of the existing FDI stock. This relationship is represented in lines 1-3 below:

(1) Firm X will invest in country i and not j if $\pi_i > \pi_j$

(2) $\pi_{it} = TR_{it} - TC_{it}$; *assume TR is constant across countries*

(3) $TC_{it} = f$*(local labor, capital, natural resources, inputs,* FDI_{t-1}*)*

Where π is the present value of all expected future profit, i and j are specific countries, TR is total revenue, and TC is total cost.

The existing aggregate stock of FDI (FDI_{t-1}) is relevant because of firms' propensity to agglomerate in order to reduce costs. The theory of agglomeration hypothesizes that when external economies of scale occur the firm's average costs fall as the industry's output rises, creating a propensity for firms to cluster geographically. Within less developed countries, this scenario typically happens due to specialized or developed infrastructure, natural resource abundance, and network externalities. To conceptualize, if a firm decides to locate in country X, then the next few firms will have a lower average cost if they also locate in country X due to the positive agglomeration externalities created by the previous firm(s). This pattern creates a feedback effect that is self-perpetuation and reinforcing.

This paper is concerned with the spatial dependence of FDI. Agglomeration potentially impacts spatial dependence in two ways. One the one hand, FDI in one country may lead to a higher concentration of FDI in neighboring countries to the extent that agglomeration effects spillover country borders. On the other hand, if agglomeration does not spill over borders, then FDI in one country may negatively affect the level of FDI in neighboring countries. The latter scenario occurs because the positive agglomeration externality attracts further FDI into the primary host country at the expense of FDI into neighboring countries. This relationship is represented in lines 4 and 5:

(4) If $\partial TC_{it}/\partial FDI_{t-1} < 0$, then agglomeration is present within country X

(5) If $FDI_i = f$(host variables, $\rho * W * FDI_j$) and $\rho * W * FDI > 0$, then agglomeration is present across borders

Where the subscripts i and j represent different countries and $\rho * W * FDI_j$ is the distance-weighted FDI of neighboring countries.[4] The spatial autoregression term is $\rho * W * FDI$, where W is the spatial lag weighting matrix and ρ is an estimated parameter (Anselin, 1988).

The following section introduces the distance-weighted FDI term and describes the empirical technique employed to test for the presence of agglomeration effects and spatial dependence, using a spatial autoregressive technique.

Section IV. Empirical Specification and Expected Coefficient Signs

This section models Blonigen et al.'s (2007) spatial autoregression econometric technique to examine the spatial dependence of FDI between counties. The spatial autoregression technique used in this paper characterizes the relationship between one host countries' FDI and other geographically-proximate countries' FDI, controlling for traditional determinants of investment location choice.

To estimate spatial correlation, I first employ a modified gravity model and adapt it to include variables measuring skill endowments and a spatially lagged, distance-weighted variable. A basic gravity model specification considers the traditional determinants of cross-country FDI activity and holds constant country specific characteristics, such as domestic policies and

[4] This is the notation used by Blonigen et al. (2007) and will be expanded upon in the following empirical model section.

economic condititions. A gravity model is the dominant model employed by the existing empirical literature on FDI. The relationship is represented in the general equation:

(Eq. 1) $$\mathbf{FDI = \alpha + \beta\ Host\ Variables + \rho * W * FDI + \varepsilon}$$

The host variables include gross domestic product (GDP) per capita, trade costs, the distance between the parent and the host country, a measurement for investment risk, and skilled-labor endowments. The literature predicts that countries with a higher GDP per capita will lead to higher levels of FDI. A positive coefficient is expected for this variable. The effect of trade costs on the magnitude of FDI is ambiguous, but remains an important control variable. On the one hand, if the type of foreign direct investment is vertical then the investment aims to produce in the host country and then export the final or intermediate goods out of the country to serve a different market. Vertical investment is undertaken in order to exploit cheaper production inputs. In this case, the trade cost variable is expected to be negative because if there are more barriers to trade, the exportation of the goods will be more costly and reduce the amount of FDI in the host country. On the other hand, if the FDI is largely horizontal investment then it seeks to overcome trade barriers by replacing trade with FDI and selling to the host country's domestic market. In this instance, the trade cost coefficient is expected to be positive because the FDI is import-replacing.

The distance between the host and home country is a proxy for higher management costs, trade costs, and informational costs. Theory predicts that the further the host country is away from the home country the greater the cost and therefore the less FDI. These higher management, informational, and transportation costs are expected to reduce the level of FDI, implying a

negative sign for the distance variable. This negative relationship may be skewed, however, because of the uneven nature of US FDI. A graph of the dependent variable shows that FDI is highly concentrated in a few countries which does not appear to be highly dependent upon distance from the US. Map 1-2 shows this relationship of distance and the level of FDI by graphing the dependent variable onto regional maps in the year 1997. Within Latin America, US FDI tends to be highly concentrated in Mexico and Brazil and within Asia, FDI tends to be highly concentrated in Singapore. This relationship will be discussed further in proceeding sections.[5]

The variable for investment risk (political stability) is expected to be positively correlated with the level of FDI. That is the higher the risk, the lower level of FDI and a positive sign is expected on this coefficient. Finally, the expected sign on the skill endowment term is ambiguous and dependent on the type of FDI in the host country. If the FDI is attracted to low-skilled labor to take advantage of cheap resources, then the sign is expected to be negative. Alternatively, if the FDI is attracted to a more educated workforce because of higher returns to higher levels of human capital, then the sign is expected to be positive. FDI is traditionally expected to be attracted to low-skilled, labor abundant locations in developing countries, however literature on FDI assumes a positive correlation between the skill of the labor force and FDI because skill improves the productivity of the worker and thus increases output. This contradictory relationship makes the predicted sign of the skilled-labor variable ambiguous. Table 1 in the proceeding section summarizes the theoretically predicted signs of all the host variables.

[5] Graph 1-2 (Appendix A) also demonstrates this uneven concentration of FDI as represented by bar graphs of the dependent FDI variable from 1997-2004.

Beyond the gravity model variables, the spatial autoregression term is introduced in this model. The spatial autoregression term is the distance-weighted FDI, $\rho * W * FDI$, where W is the spatial lag weighting matrix and ρ is an estimated parameter (Anselin, 1988). This term captures the proximity and the level of FDI in one host country relative to other host countries, irrespective of the distance from the home country. The term ρ indicates the strength and sign of the spatial relationship in FDI captured by W. W is a block diagonal matrix with a dimension of N * N. Each block diagonal matrix contains a single year's observations. The W matrix is represented below.

$$W_y = \begin{bmatrix} 0 & w_y(d_{i,j}) & w_y(d_{i,k}) \\ w_y(d_{j,i}) & 0 & w_y(d_{j,k}) \\ w_y(d_{k,i}) & w_y(d_{k,j}) & 0 \end{bmatrix},$$

To clarify, $w_y(d_{i,j})$ is the shortest bilateral distance within the sample and receives a weight of one. All other distances within the sample receives a declining weights according to the equation,

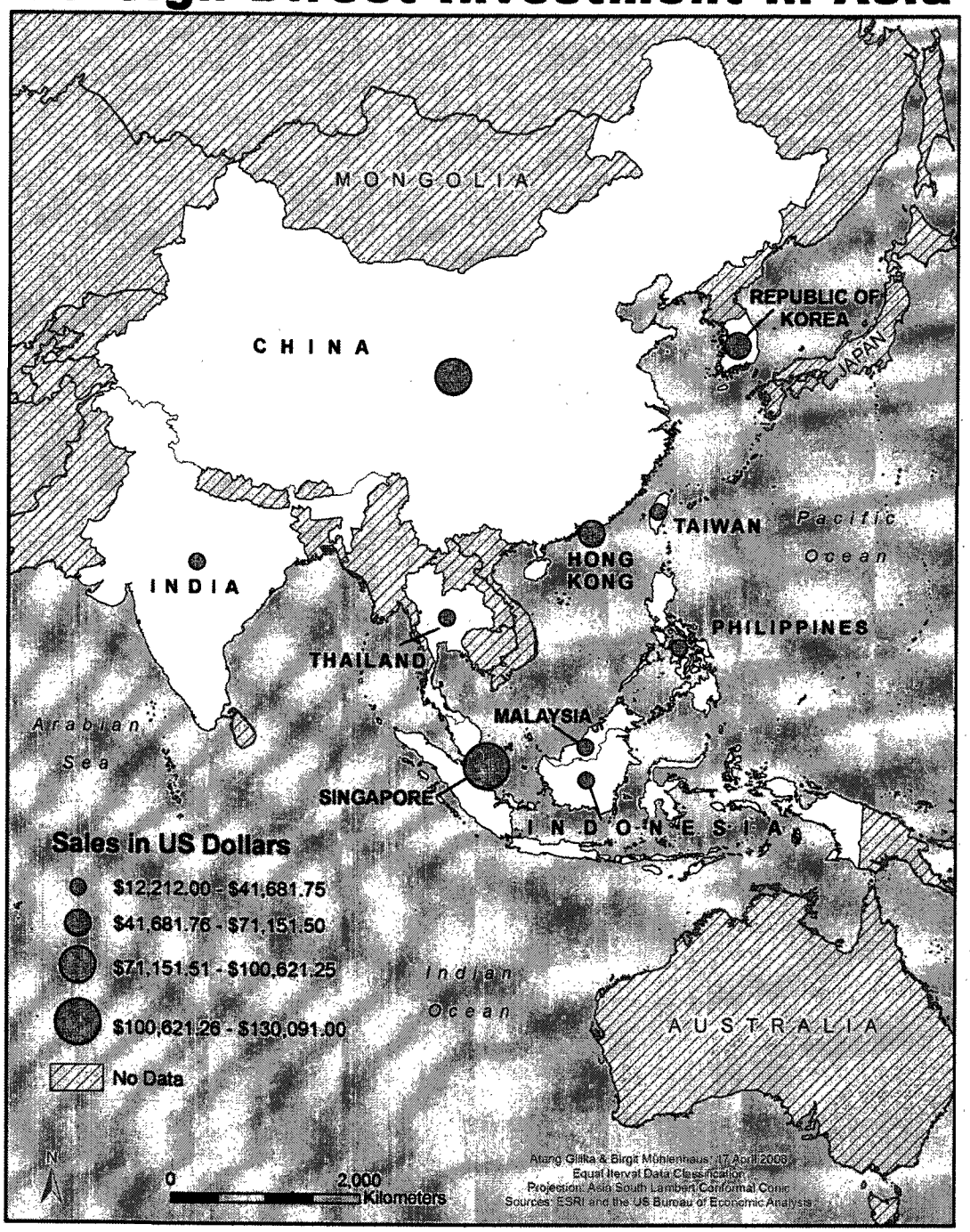
$w_y(d_{i,j})$ = shortest bilateral distance (miles) / $d_{i,j}$ (distance, miles),

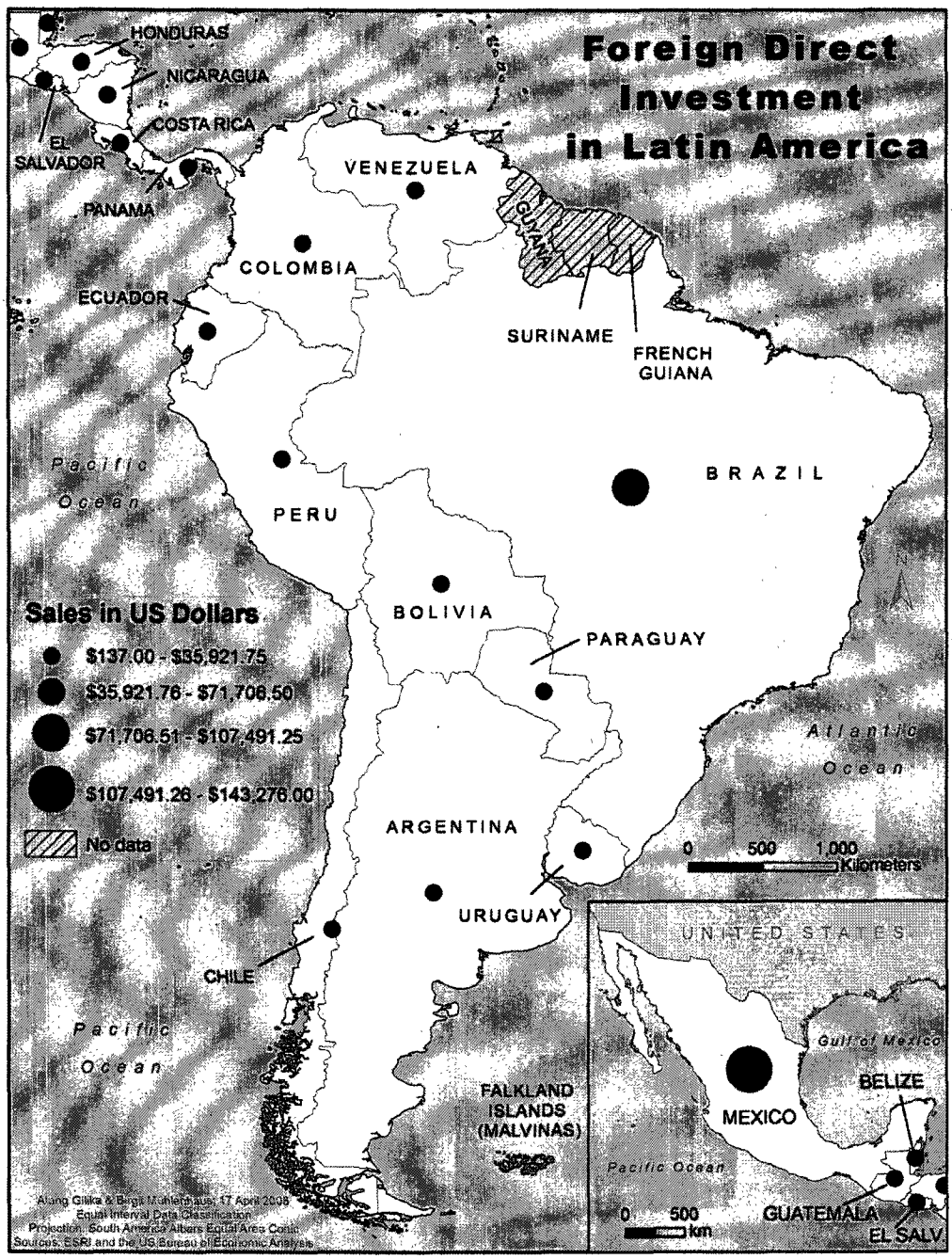
Where $i \neq j$ and $d_{i,j}$ is the distance between host countries i and j, measured between capital cities.

The empirical model explains the importance of the distance-weighted term and the control gravity model variables. One important problem exists, however. A generalized least squares estimation technique with the presence of the distance weighted term allows for

endogeneity between the error term of the dependent variable and the spatially lagged term. The endogeneity arises from the possibility that there may be a shock to global FDI that would be common in the error term with regard to the level of FDI in the host country and the level of FDI in neighboring countries (the exogenous variable). For example, a global shock in foreign direct investment (such as an increase due to an economic boom) will affect the level of FDI in a particular host country and its surrounding countries. This means that the independent variable is potentially correlated with the error term. This endogeneity problem may result in coefficient estimates that are biased or inconsistent. To control for endogeneity, I introduce the use of an instrumental variable estimation. An improved strategy is to instrument with a lagged value of the distance-weighted term. To test the robustness of the results, I also run an estimation technique with the lagged distance-weighted term. The results are discussed in Section 6.

Foreign Direct Investment in Asia

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PANAMA
VENEZUELA
GUYANA
COLOMBIA
ECUADOR
SURINAME
FRENCH GUIANA
Pacific Ocean
BRAZIL
PERU
BOLIVIA
PARAGUAY
Atlantic Ocean
ARGENTINA
URUGUAY
CHILE
Pacific Ocean
FALKLAND ISLANDS (MALVINAS)
Sales in US Dollars
$137.00 - $35,921.75
$35,921.76 - $71,706.50
$71,706.51 - $107,491.25
$107,491.26 - $143,276.00
No data
0 500 1,000 Kilometers
UNITED STATES
Gulf of Mexico
BELIZE
MEXICO
Pacific Ocean
0 500 km
GUATEMALA
EL SALV
Alung Gilika & Birgit Muhlenhaus, 17 April 2008
Equal Interval Data Classification
Projection: South America Albers Equal Area Conic
Sources: ESRI and the US Bureau of Economic Analysis

V. Summary statistics

Previous FDI literature identifies the relevant variables that motivate MNE's decisions to invest in foreign locations. The empirical model employed in this study includes the traditional home country determinants of FDI and a distance-weighted spatial interdependence term as explanatory variables. The traditional determinants of FDI are gross GDP per capita, investment risk, variables that represent trade costs, the distance from the US, and a measurement of skilled-labor endowment. The ideal dependent variable is a measurement to completely capture the FDI level within the specified host countries.

To study the trends in FDI concentrations between Latin America and Asia, I gathered a panel dataset that encompasses the period 1997 through 2004 and includes 18 countries from Latin America and 11 countries from Asia. The dependent variable is measured by annual data on US outbound FDI activity into the host country. FDI activity is proxied by sales of the US foreign affiliate companies in the host country as reported by the US Bureau of Economic Analysis.[6] This is the most reliable and feasible measure to use for the total magnitude of FDI in the host counties. According to the BEA, sales is defined as the value of goods and services sold including investment income net of returns, allowances and discounts, and excluding consumption taxes on the consumer and excise taxes on the suppliers.

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[6] Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies. US Bureau of Economic Analysis. In some of the smaller Latin American countries, data on sales was omitted by the BEA. This is because the BEA is obligated to suppress data in order to main the confidentiality of their survey respondents. That is, when only one or a few companies report FDI sales in a given country in a given year, the BEA is obliged to not publish this data. At the recommendation of Ron Davies, the missing data points were generated by using World Bank data on total FDI inflows. The World Bank data was compared to the available BEA data for a given country to interpolate the estimated level of sales for a given year and country. For example, suppose sales are on average 80% of total FDI inflows, then I assume this ratio is constant over time and use the FDI inflows data to construct a sales measure. This technique was used for certain years in Honduras, Panama, Belize, El Salvador, Guatemala and Nicaragua.

The host country FDI variables are gathered from a variety of sources. Gross domestic product per capita and the trade-cost variable are obtained from Penn World Tables (PWT).[7] GDP per capita is obtained by the PWT by adding consumption, investment, government expenditures and subtracting imports in any given year. Each is calculated in 1996 values in international dollars using a fixed base index with 1996 as the reference year. The trade cost measure is the inverse of the openness measure as reported by the PWT. The openness variable is calculated by exports plus imports divided by GDP. This variable can be interpreted by equating a higher magnitude of trade with a lower apparent cost of trade.

Investment risk is developed by the World Bank Worldwide Governance Indicators (WGI) that measures six dimensions of governance by year including political risk. The data reflect the views of governance as reported by the public sector, the private sector, NGO experts, and citizens and firm survey respondents.[8] In my specification, I choose to use the variable for Political Stability to gauge investment (institutional) risk. The sign on the coefficient is expected to be positive indicating that more stability would attract investment.

Next, the distance from the home country is measured by the distance between capital cities, measured in kilometers. The distance is taken from each host country's capital city from Washington DC. This information is easily accessible and available online. Finally, host country skilled-labor endowment is proxied by the percentage of the population over the age of 25 that has successfully completed primary school. This information is acquired from Barro-Lee's

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[7] Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. http://pwt.econ.upenn.edu/php_site/pwt_index.php

[8] Kaufmann, Daniel, Kraay, Aart, Mastruzzi, Massimo. (2007) Governance Matters VI: Aggregate and Individual Governance Indicators. The World Bank Policy Research Working Paper. It should be noted that the each country estimate has a difference margin of error because of the different samples sizes in each country. This reflects the difficulty in measuring governance using any kind of data. The author notes, however, that after taking the margins of error into account, the data can provide meaningful cross-country comparisons.

International Data on Educational Attainment.[9] The authors report the data in five year intervals from 1960-2000 and say that it is a straightforward way to show the population's attainment of skills and knowledge associated with a particular level of education.

The second component in our specification, the distance-weighted spatial interdependence term, is developed by the matrix discussed in the empirical model section. The data used in the specification is compiled by taking the distance between each host country's capital city measured in kilometers and weighting it so that each distance receives a declining weight according to its proximity to a host country (see Empirical Specification: Section IV). The data gathered provides the distance between capital cities, similar to the data used for the distance between the host country and the US.[10] Table 1 provides a list the variables in the estimation equation, their expected sign, and the summary statistics in our dataset from the years 1997-2004.[11]

[9] Barro, R., Lee, J.W., (2001) International data on educational attainment: updates and implications. Oxford Economic Papers 53 (3), 541-563.

[10] http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt

[11] I performed a Wooldridge test for autocorrelation in the panel dataset and determined that no first-order autocorrelation exists. Comparing the correlation coefficient between variables, it appears that they are all sufficiently independent with the exception of the spatial term and the distance term. The correlation coefficient on these variables was .87. This result is not surprising because the spatial term includes distances. The results are presented in Appendix D.

Table 1

Summary statistics [1]

Variables	Expected Sign	Mean	Std Dev	Min	Max
FDI FDI sales in host country (dependent variable)		28946	60399	51	301506
GDP/Cap Real GDP per capita, 1996 values in international dollars	+	8974	7085	2163	29644
Trade cost[2] Exports plus imports divided by divided by GDP	+/-	90.1	80.6	18.2	462.9
Skill[3] Percentage of population over the age of 25 that have attended primary school	+/-	42.6	11.6	16.7	63.8
Investment risk An relative index of political stability	+	-.13	.78	-2.2	.32
Distance Distance of host country from US in km	–	8050.9	4572.9	2669	16370
W*FDI Distance weighted FDI on all other countries in sample	+ if agglomeration spills over – if agglomeration is contained within countries				

Countries: Costa Rica, Guatemala, Honduras, Mexico, Panama, Belize, El Salvador, Nicaragua, China, Hong Kong, India, Indonesia, Republic of Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Notes:

1. All summary statistics are presented in the linear form.
2. The expected sign on trade cost is negative assuming that FDI entering developing countries is predominantly vertical so that higher trade costs reduces the value of FDI.
3. The expected sign on skill is negative, assuming that FDI in developing countries are seeking relatively cheaper resources.

Section VI. Empirical Results

To test the empirical model, I first run a generalized least squares estimation technique including only the traditional host variables of FDI and excluding the distance weighted term for the whole sample, the Latin American subset, and the Asian subset represented in the first column of each model. In order to explore the spatial behavior of FDI, I include the instrument variable for the spatially weighted term using fixed effects estimators to correct for time invariant country fixed effects. Country fixed effects are the preferred estimation technique for analyzing this data. Countries have fundamentally unique characteristics across the panel dataset and fixed effects control for these differences. In addition, a Hausman test between fixed effects and random effects estimators for the Latin American and Asian sample indicate that the model is best estimated using fixed effects.[12] The results of the instrumented variable (IV) technique are displayed in Column 2 of each table. Finally, to check for the robustness of the instrumented variable technique, I lag the distance-weighted term. These results are displayed in Column 3 of each table.

6.1 Full Sample

The full sample set combines the data of Latin America and Asia. The results are presented below in Table (2). Because of the distance between the two regions and heterogeneous regional characteristics, this model has limited explanatory power. Model (1) shows that in the absence of the distance-weighted variable, GDP per capita, distance, and investment risk are statistically significant. The coefficients of the variable suggest that a higher

[12] Appendix E graphs the fitted residuals of the random effects estimator and the fixed effects estimator. The graphs demonstrate that the fixed effects estimator produces more randomly and evenly distributed residuals. See Appendix F for the results of the Hausman test and the regression results for the random effects estimation.

GDP per capita, closer proximity to the US, and less investment risk correlates with more FDI. These signs are theoretically appropriate.

Column 2 and Column 3 introduce the distance-weighted term using the two different estimation techniques discussed above. Importantly, the signs and the magnitude of the coefficients are quite similar across the two models, indicating the robustness of the results. The trade costs variable remains negative. Interpretatively, this means that an increase in trade frictions decreases the level of FDI, as predicted. This result suggests that the FDI in this sample set is predominately vertical; that is, the higher the barriers to trade, the less FDI that will be attracted to a host country because it will be more costly for the MNE to export intermediate and final goods to alternative markets. Further, the skill endowment term is positive, indicating that FDI is attracted to a relatively more skilled work force in order to take advantage of the returns to higher levels of human capital.

The coefficient of the spatially-lagged term is positive and statistically significant in the IV model (.75) and the lagged model (.34). The statistically significant positive coefficient suggests that with the Latin American and Asian data combined, an increase in FDI in one host country leads to an increase in FDI in neighboring countries. Separating the data into two regional subsets provides more explanatory results.

Table 2

Spatial Analysis of US FDI—Full Sample Set

Variables			
Models	(1)[1]	(2)[2]	(3)[3]
Ln(GDP/Cap)	1.93***	1.99***	1.74***
Ln(Trade cost)	-0.15	-0.37*	-0.12
Ln(Skill)	.79	1.12**	0.85*
Ln(Investment risk)	0.24***	.04	.37**
Ln(Distance)	2.01***	0.63	DROPPED
Ln(W*FDI)		.75**	.34**
Constant	-29.79***	-22.80***	-14.81**
Country Dummies	No	Yes	No
Observations	196	196	196
R-sq	29.01%	98.88%[+]	46.16%
Coefficients	XTReg	IVReg	FE

1. Random effects GLS regression, excluding distance-weighted FDI.
2. Instrumental variables (2SLS) regression, country fixed-effects.
3. Fixed-effects (within) regression.

\+ High R-sq value due to the inclusion of country dummy variables to control for time invariant country fixed effects.

6.2 Asian subset

Separating Asian and Latin American countries into two distinct matrices allows for a direct comparison between regions. Table (3) below contains results for the Asian countries. Within Asia, Column (1) shows that without the spatially lagged term, GDP per capital, skill endowment and, and investment risk are positive and significant, consistent with the full model. The trade cost variable is slightly positive in Model (1) but slightly negative when including the distance-weighted term. In each case the coefficient has a large standard error, signifying that the type of FDI that Asia attracts may not be predominately vertical. Rather it is likely that Asia attracts a combination of vertical and horizontal FDI and the effect of each is somewhat canceled out by the other. This is a reasonable possibility considering the large market size of certain Asian countries. Fung et al. (2004) posits that some high trade barriers do induce horizontal FDI into Southeast and East Asian countries.

Employing the IV and lagged estimators yield quite similar results. The coefficient on GDP per capita and the skill endowment term is positive and statistically significant.. The positive and statistically significant coefficient suggests that FDI entering into to Asia over time is largely attracted to more affluent countries and to more skill-intensive populations. Next, the investment risk variable remains positive across all three models. The distance term also is negative, demonstrating the importance of informational, trade, and managerial costs associated with distance.

Most importantly, the coefficient on the distance-weighted term is positive, small, and has a large standard error. The large standard error leads to inconclusive results. The data suggests that within Asia a spatial effect of FDI does not necessarily occur. This means that FDI into one country does relate necessarily relate to higher levels of FDI in neighboring countries.

The inconclusive result over time could be due to the size of the countries in the sample. For example, China is so large that even if agglomeration effects occurred within provinces due to economies of scale, an agglomeration effect occurring in the country does not have the opportunity to spill over into neighboring countries in the short-run. To check for the robustness of this result, the Asian sample is tested again with the exclusion of China. The coefficients and signs on all of the variables remain consistent with the original Asian sample set. This confirms the robustness of the data, but the spatial effect remains inconclusive because of the statistical insignificance on the distance-weighted term.[13]

[13] See Appendix B for Table 5 that includes the empirical results of the robustness check.

Table 3

Spatial Analysis of US FDI—Asia Subset

Variables			
Models	(1)[1]	(2)[2]	(3)[3]
Ln(GDP/Cap)	1.90***	2.47***	2.57***
Ln(Trade cost)	0.06	-.08	-0.03
Ln(Skill)	1.19***	0.75***	0.75**
Ln(Investment risk)	0.39***	.29**	0.31**
Ln(Distance)	-1.63	DROPPED	DROPPED
Ln(W*FDI)		0.20	0.09
Constant	3.06	-15.29***	-17.34***
Country Dummies	No	Yes	No
Observations	70	70	70
R-Sq	76.07%	98.92%	91.38%
Coefficients	XTReg	IVReg	FE

1. Random-effects GLS regression, excluding distance-weighted term.
2. Instrumental variables (2SLS) regression, country fixed-effects.
3. Fixed-effects (within) regression, lagged W*FDI.

6.3 Agglomeration effects in Latin America

Table 4 contains the empirical results of the Latin American subset. Without the distance weighted term, GDP per capita and investment risk are positive and significant. Trade cost is significantly negative indicative of a large presence of vertical FDI within Latin America. Distance is negative and insignificant and skill endowment is positive. These results are largely similar to the results found in the Asian sample and the full sample with a few differences in standard errors among select variables. For example, the positive coefficient on the skill endowment term suggests that, in contrast to Asia, Latin America receives predominately FDI that is motivated by a higher skilled labor force. As mentioned, the bulk of the FDI is in Mexico and Brazil and these workers are relatively more skilled than in other Latin American countries that have less industry and, consequently, receive less FDI. It may also be that US is close to Latin American countries so that US MNE's need less of a cost advantage for production and can therefore engage in more skill-intensive processes.

Again, the coefficients remain rather consistent across the IV and lagged model. The one exception is the sign on the investment risk variable. From model two to model three, the coefficient changes from negative to positive. The positive result in model two is theoretically unexpected, however, it is accompanied by a large standard error. This may indicate that the effect of the investment risk variable is not large within the model.

The distance-weighted term is significant at the one percent confidence level and has a strong positive coefficient of 1.07 in Model (2) and .77 in Model (3) and is significant at the one percent confidence interval. The positive coefficient of the spatially weighted terms indicates that spatial dependence is present within countries in Latin America employing a time-invariant country fixed effects estimation technique. The data, thus, lends evidence to agglomeration

effects across countries over time. This means that as one host country experiences more FDI, its neighbors will experience more FDI as well.

This finding has interesting implications. It provides evidence that FDI follows behavioral patterns and that these patterns have predictive power for where FDI is likely to locate. In the theoretical section of this paper, two hypotheses were proposed regarding the effects of agglomeration. The first suggests that as FDI clusters within a host country, the average total cost of output falls given external economies of scale. This would suggest the presence of positive agglomeration externalities within countries and would detract further investment from clustering in neighboring countries. Agglomeration effects within countries are represented by a negative coefficient on the distance-weighted FDI term. The second hypothesis suggests that as FDI clusters within a host country, the average total cost of output falls for firms in neighboring countries due to distribution networks, immobile resources, knowledge spillovers, and the like. Agglomeration effects across borders are represented by an increase in FDI in a host country leading to an increase in FDI in geographically-proximate countries over time. Across border agglomeration is seen in a positive coefficient on the distance-weighted FDI term with the fixed effects estimator. Column (3) provides evidence of agglomeration across borders within Latin America.

To sum, the data suggest there are differences in the spatial relationship between Latin America and Asia. To begin, the foreign direct investment in Latin America tends to be more highly concentrated in two dominant countries (Mexico and Brazil) than Asia. Asia does have a higher concentration of FDI in Singapore, China, and Hong Kong but is much more evenly distributed than Latin America. FDI accumulating in one country contributes to the accumulation of FDI in neighboring countries in Latin America but not necessarily in Asia. Importantly, the

data suggests that the accumulation of FDI in one country does not detract from FDI in neighboring counties among both regions. These results lend evidence to the idea that regional characteristics and spatial effects play a role in the spatial behavior of investment. Foreign direct investment does seem to be attracted to itself, but on a regional level due to positive spillover externalities.

Table 4

Spatial Analysis of US FDI—Latin America Subset

Variables			
Models	(1)[1]	(2)[2]	(3)[2]
Ln(GDP/Cap)	1.92***	0.96	1.38**
Ln(Trade cost)	-0.52**	-0.31	-0.39
Ln(Skill)	1.75	0.91	0.90
Ln(Investment risk)	0.42***	-0.04	0.24*
Ln(Distance)	-0.43	DROPPED	DROPPED
Ln(W*FDI)		1.07**	0.77**
Constant	-10.39	-17.90*	-13.40**
Country Dummies	No	Yes	No
Observations	126	126	126
R-Sq	22.47%	98.30%	28.73%
Coefficients	XTReg	IVReg	FE

1. Random-effects GLS regression, excluding distance-weighted term.
2. Instrumental variables (2SLS) regression, country fixed effects.
3. Fixed-effects (within) regression, lagged W*FDI.

Section VIII. Conclusion and further research

This paper attempts to study the locational behavior of FDI in emerging economies. For ease of comparison, I do a regional study of Latin America and Asia. By using a spatial econometric technique, I attempt to answer the question: does FDI in one host country help explain FDI in neighboring countries? Within Latin America I found that an increase in FDI in a host country, leads to an increase in FDI in neighboring countries. Asia yielded inconclusive results.

Due to its growth in the past two decades, FDI has become a significant source of financing for emerging economies. Relative to portfolio investment, its long-term commitment to the host country means that is a potential driver for real economic growth. It has the potential to increase productivity and capital-deepening, encourage technological advancement, augment the skill level of the workforce, and spur the development prospects of the host country (Mallampally et al., 1999). FDI's importance to development and understanding international finance justifies an in-depth investigation of its behavioral patterns.

The motivations for FDI are broad. MNE's choose the location choice of their foreign affiliate based on firm-level, managerial decisions. In this paper, I take a macro approach to study general trends. A more precise measure of MNE's investment decision behavior would be to look at firm-level data. Because of US privacy protections, this data is not currently available to the public. Further research may explore this question on the firm level provided that the data becomes available. In addition, further research may explore the spatial effect in Asia, controlling for the size and heterogeneity of MNE operations in Asia.

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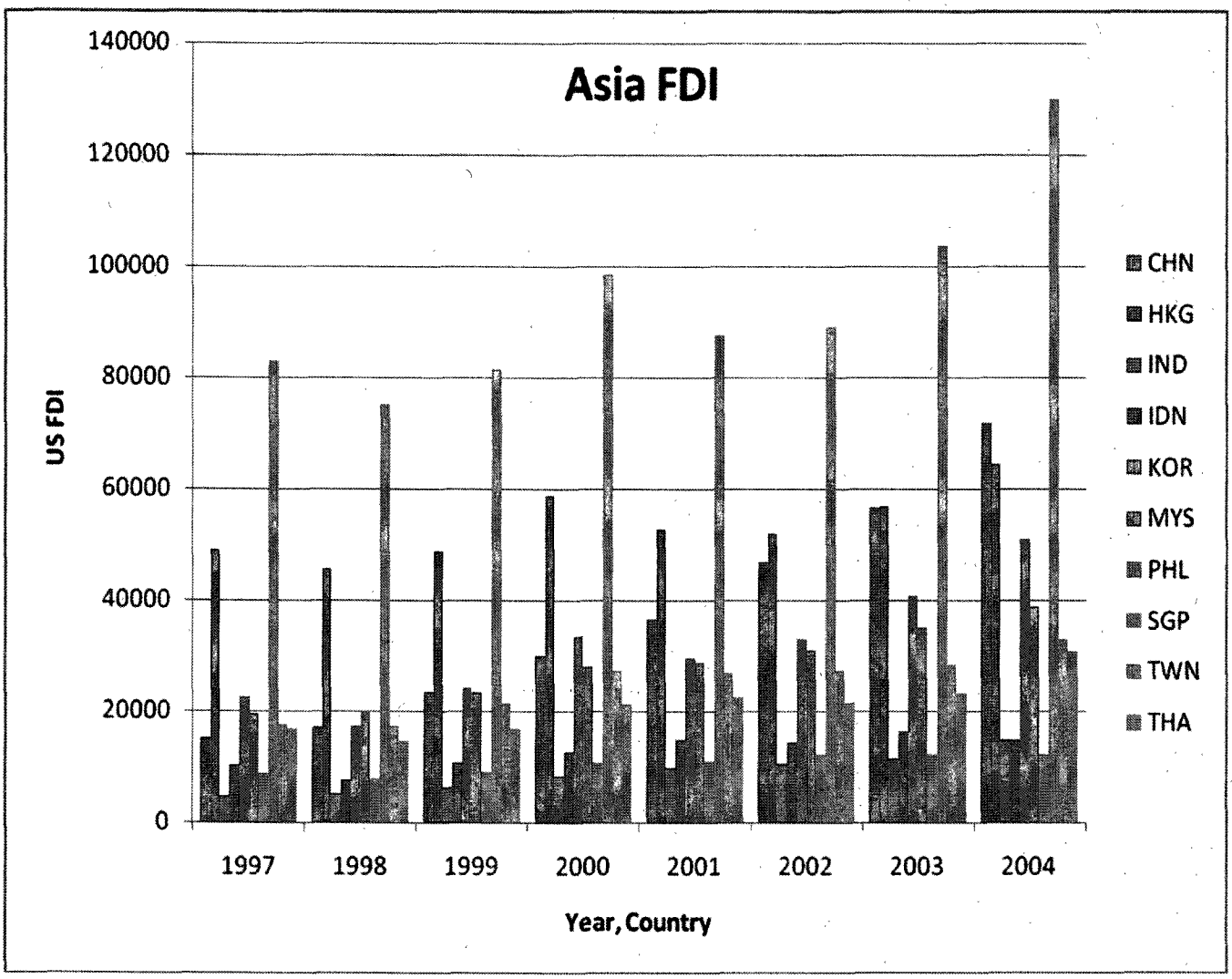
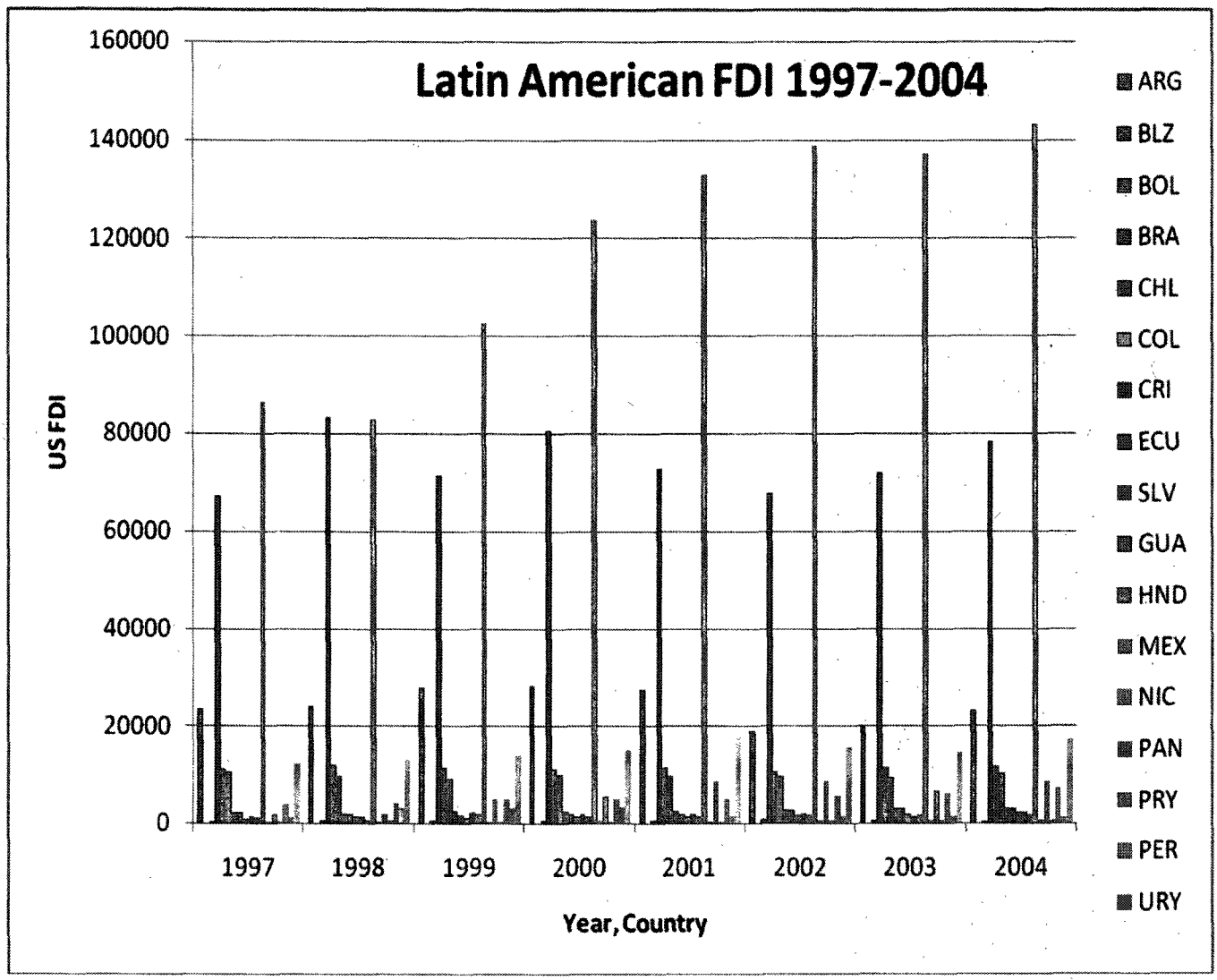
Appendix A: Graph of the dependent variable, FDI

Graph 1-A: Asia subset: US FDI



Graph 2-A: Latin America subset: US FDI



Appendix B: Robustness check, Asian subset excluding China

Table 5

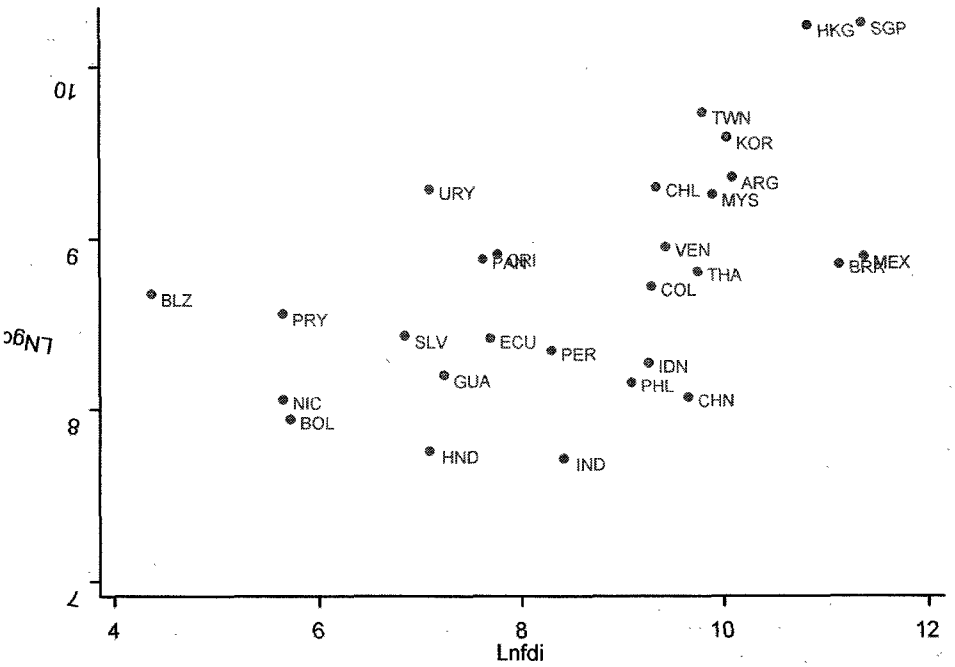
Spatial Analysis of US FDI—Asia Subset—Without China

Variables			
Models	(1)[1]	(2)[2]	(3)[3]
Ln(GDP/Cap)	1.24***	2.18***	2.38***
Ln(Trade cost)	-0.18	-0.18	-0.12
Ln(Skill)	0.86**	0.72***	0.73**
Ln(Investment risk)	0.44***	.29*	0.32***
Ln(Distance)	1.38	DROPPED	DROPPED
Ln(W*FDI)		0.25	0.11
Constant	-17.40	-16.11***	-15.57***
Country Dummies	No	Yes	No
Observations	63	63	63
R-Sq	81.38%	99.04%	88.17%
Coefficients	XTReg	IVReg	FE

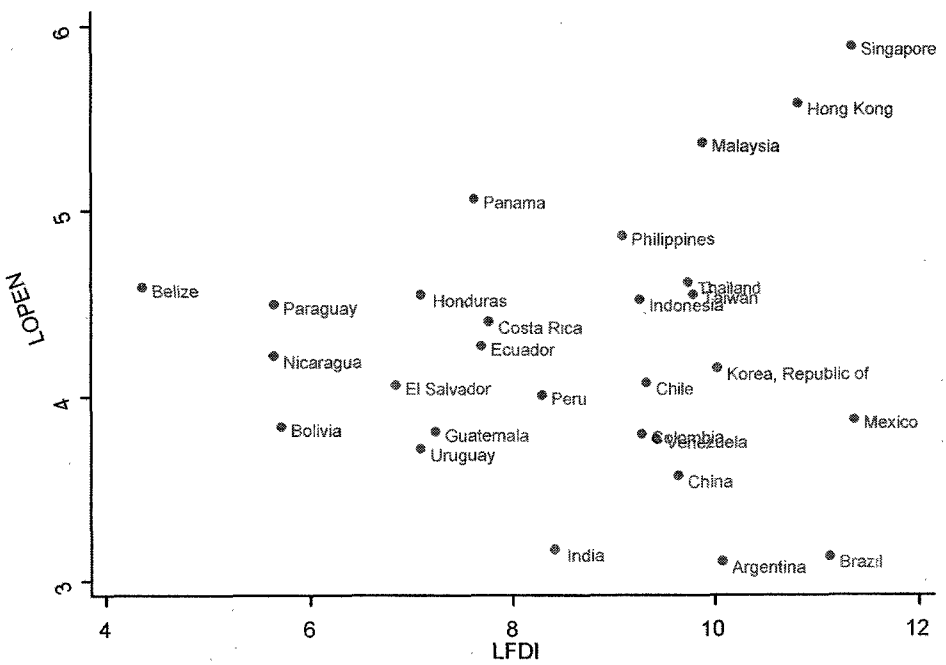
1. Random-effects GLS regression, excluding distance-weighted term.
2. Instrumental variables (2SLS) regression, country fixed-effects.
3. Fixed-effects (within) regression, lagged W*FDI.

Appendix C: Variable Scatter Plots, 1997 base year

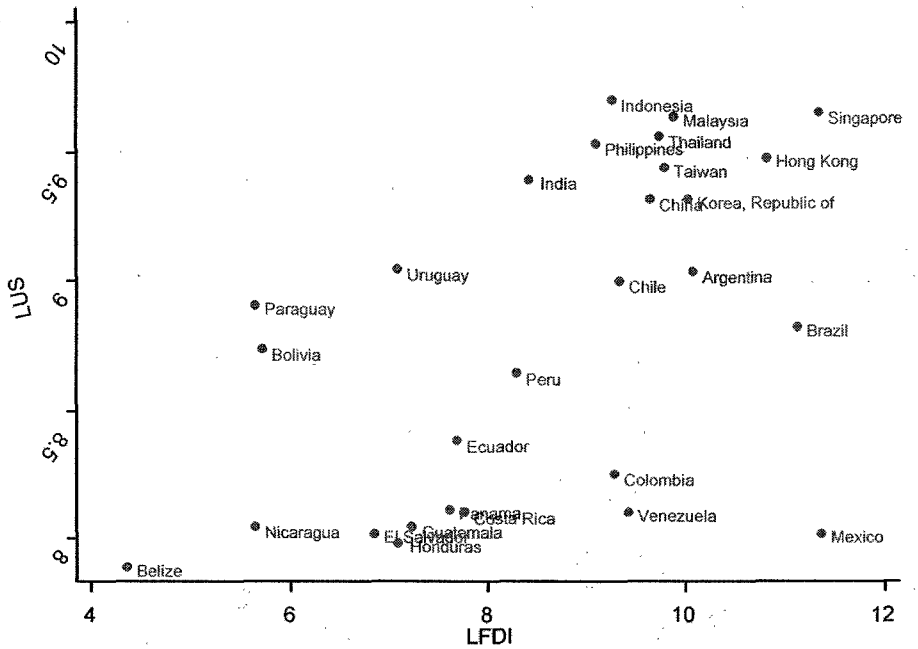
Variable 1: FDI,GDP (x-axis,y-axis)



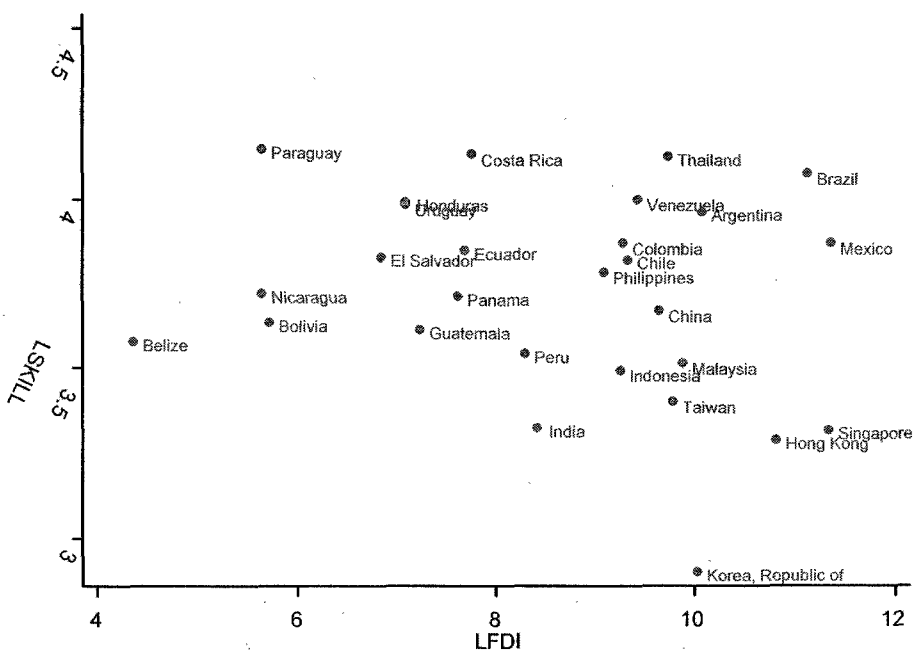
Variable 2: FDI, Trade cost (x-axis,y-axis)



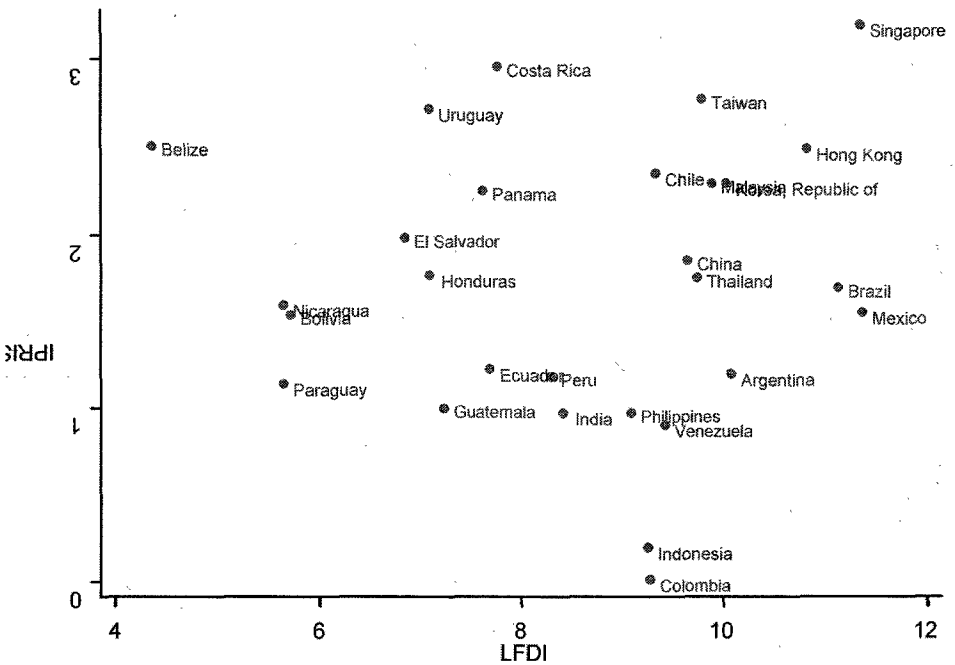
Variable 3: FDI, Distance (x-axis,y-axis)



Variable 4: FDI, Skill endowment (x-axis,y-axis)



Variable 5: FDI, Investment risk (x-axis,y-axis)



Appendix D: Data Tests

Test for multi collinearity

Correlation

	lfdi	lgdp	lopen	lskill	lirisk	lus	lwfdi
lfdi	1.0000						
lgdp	0.5994	1.0000					
lopen	-0.0006	0.3092	1.0000				
lskill	-0.2971	-0.4204	-0.2472	1.0000			
lirisk	0.1173	0.4369	0.2515	-0.1616	1.0000		
lus	0.5448	0.4013	0.1831	-0.4282	0.1254	1.0000	
lwfdi	0.4561	0.3185	0.2664	-0.5309	0.1215	0.8664	1.0000

Note: No severe *collinearity*

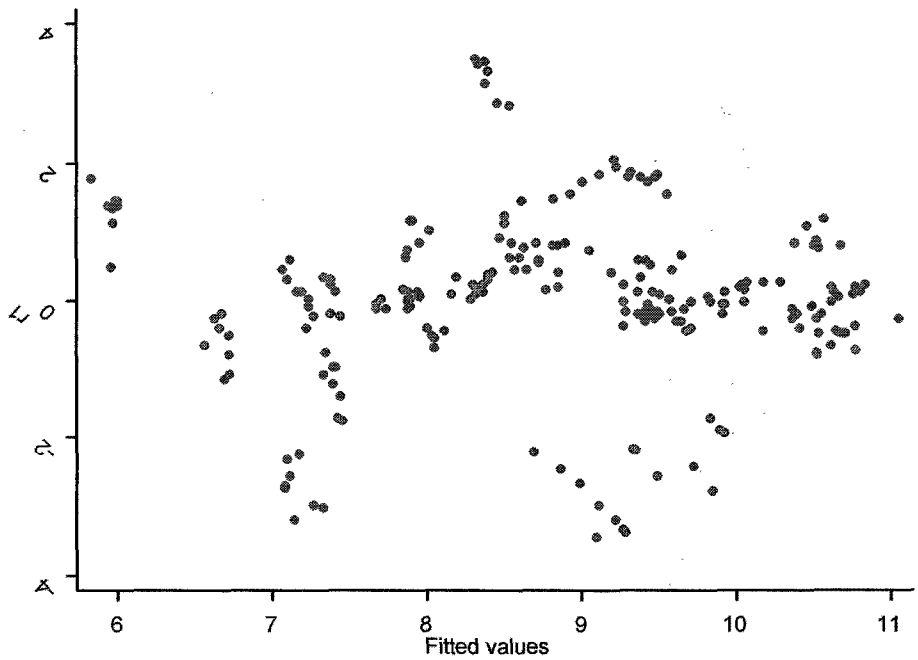
Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation

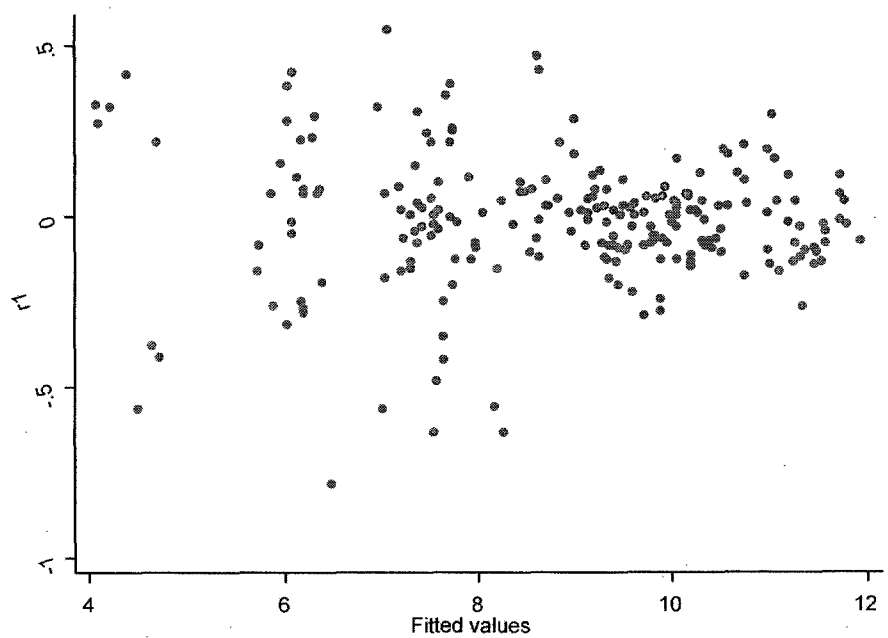
F(1, 28) = 4.933
Prob > F = 0.0346

Appendix E: Residuals

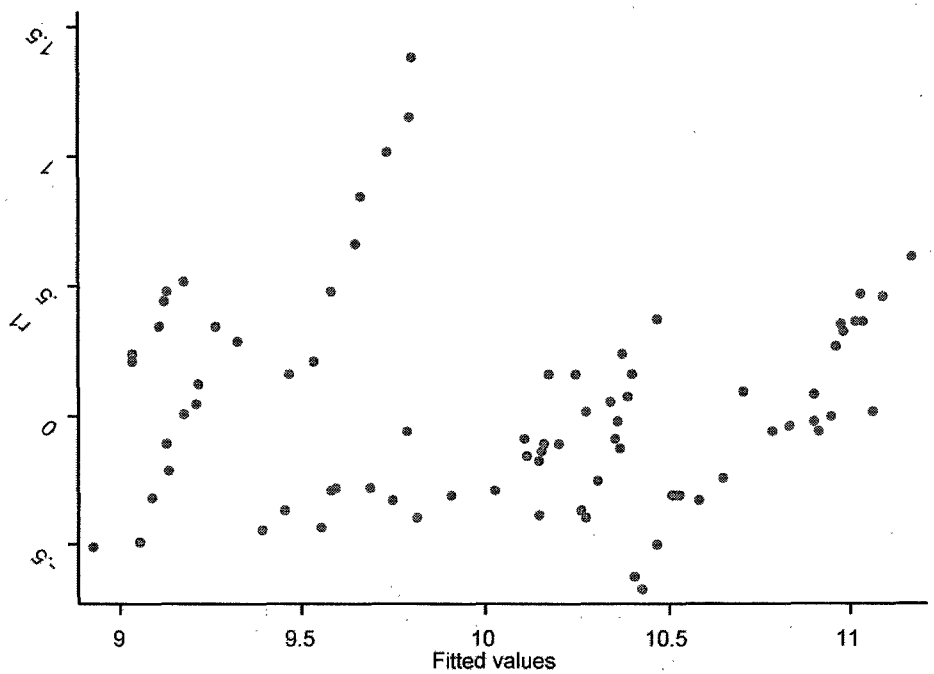
1-A: Full model sample, random effects



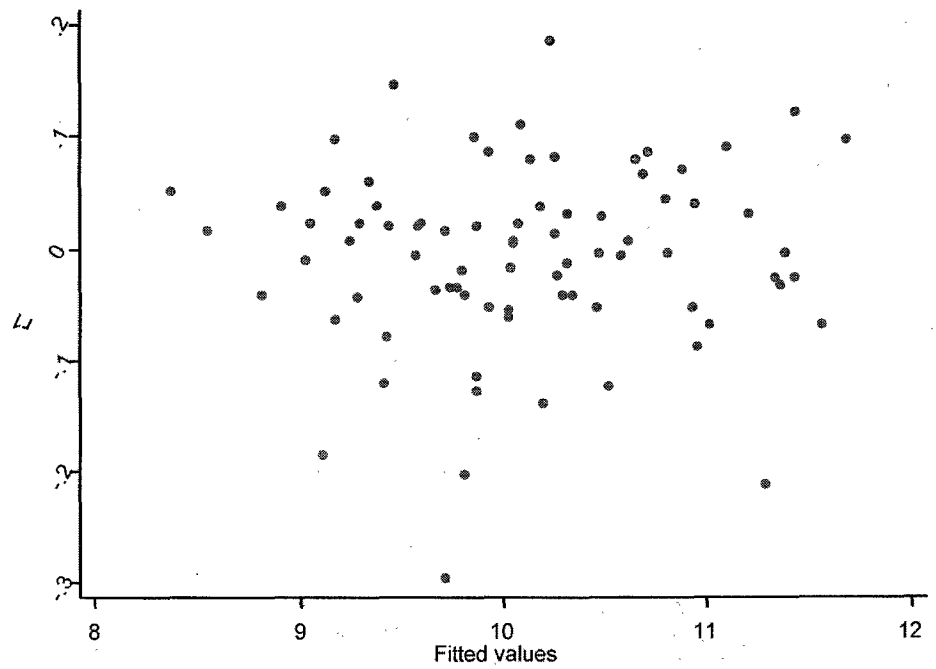
1-B: Full model sample, fixed effects



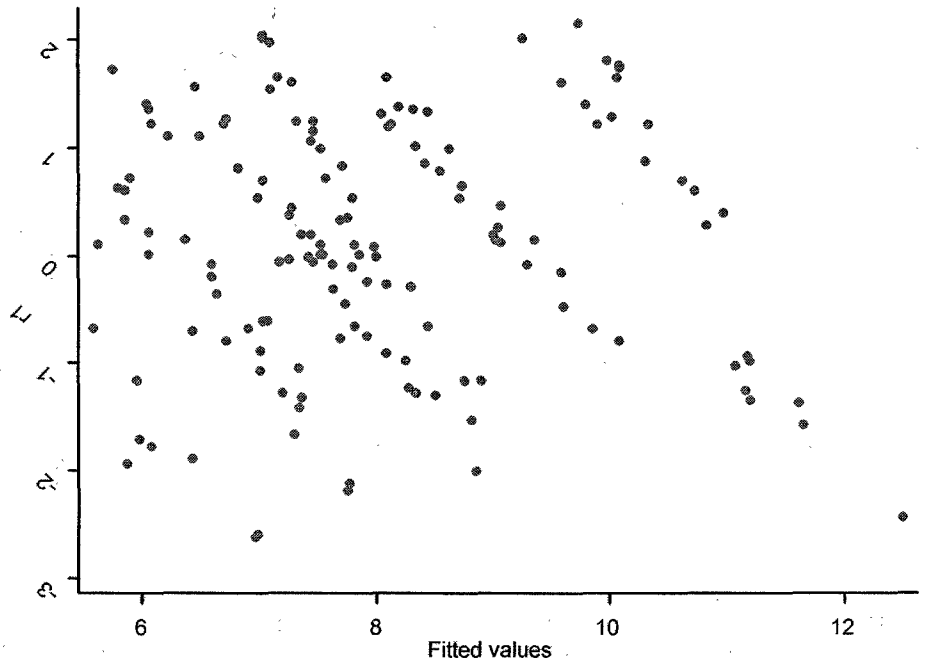
2-A: Asia sample, random effects



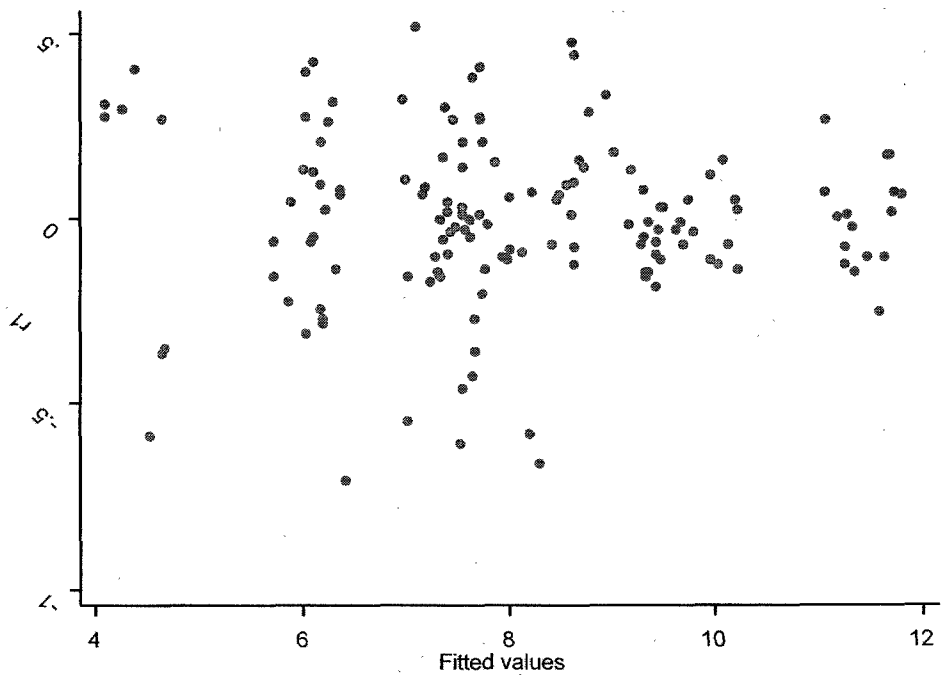
2-B: Asia sample, fixed effects



3-A: Latin America sample, random effects



3-B: Latin America sample, fixed effects



Appendix F: Hausman Results

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 136.90
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Reject null hypothesis, use fixed effects

Table 6

Spatial Analysis of US FDI—Random Effects, Instrumented variable

Variables			
Models	(Full)[1]	(Asia)[2]	(Latin America)[2]
Ln(GDP/Cap)	1.85***	1.65***	1.56**
Ln(Trade cost)	-0.41**	-.16	-0.60***
Ln(Skill)	0.61	0.95***	1.33
Ln(Investment risk)	-0.61***	.06	0.12
Ln(Distance)	-0.75**	-1.20	-0.66
Ln(W*FDI)	0.44	0.69***	0.69***
Constant	-17.74	-3.44	-9.86
Country Dummies	No	No	No
Observations	196	70	126
R-Sq	49.79%	89.51%	27.23%
Coefficients	IVReg	IVReg	IVReg

The coefficients differ somewhat from the fixed effects estimation technique. As discussed above, the Hausman test and theory suggests the fixed effects is the preferred estimator to draw results from this regional study.