FOREIGN DIRECT INVESTMENT AND SPILLOVER EFFECTS ON DOMESTIC FIRMS

by

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Abstract

The literature concerning foreign direct investment and the spillover effects on domestic firms has developed significantly over the past two decades. This report examines the historical data on foreign direct investment flows and identifies several different types of spillover effects. Earlier studies identify potential horizontal spillovers but later studies suggest that these spillovers are insignificant. Recently, vertical spillovers, especially through backward linkages, have been identified as occurring in the host country. Studies indicate that this is happening particularly in the manufacturing sector for firms relying on inputs from the services sectors that have higher levels of foreign direct investment.

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1. Introduction to Foreign Direct Investment

1.1. Basic Definitions on Foreign Direct Investment

Krugman, Obstfeld, and Melitz (2011) define foreign direct investment (FDI) as "a firm largely owned by foreign residents acquiring or expanding a subsidiary firm or factory located in the host developing country." Krugman, Obstfeld, and Melitz consider an investment to be FDI "when a (domestic) firm buys more than 10 percent of a foreign firm, or when a firm builds a new production facility abroad." Krugman, Obstfeld, and Melitz categorize FDI as a firm having at least 10 percent ownership of the foreign firm because, at this point, the investing firm is considered to have control, or decision-making power, in the foreign company. The controlling or owning firm is known as a multinational firm while the controlled firms are called the multinational affiliates.

Krugman, Obstfeld, and Melitz (2011) identify four different categories of foreign direct investment. When a multinational firm builds a new production facility or creates a new firm in a foreign country, it is known as greenfield FDI, brownfield FDI is denoted as the acquisition or merger by a multinational firm with an already existing firm. While greenfield FDI implies full ownership of the multinational affiliates, brownfield FDI can involve either full or only partial ownership of the multinational affiliates. The other two categories of foreign direct investment are horizontal FDI and vertical FDI. Horizontal foreign direct investment occurs when "the affiliate replicates the production process (that the parent firm undertakes in its domestic facilities) elsewhere in the world," while vertical foreign direct investment occurs when "the production chain is broken up, and parts of the production processes are transferred to the affiliate location" (Krugman, Obstfeld, and Melitz 2011). Both horizontal FDI and vertical FDI are driven by an attempt to reduce the costs of the multinational firms. Horizontal FDI takes

place to reduce the costs of international trade such as transportation costs, tariffs, and quota controls by having the final production facility located in the foreign country. Vertical FDI is driven by the theory of comparative advantage. A multinational firm attempts to take advantage of abundant factors of production in a foreign country by establishing a multinational affiliate capitalizing on the abundant factors with the goal of driving down input costs of making a good or providing a service (Krugman, Obstfeld, and Melitz 2011). The following table is a summary of the four categories of foreign direct investment:
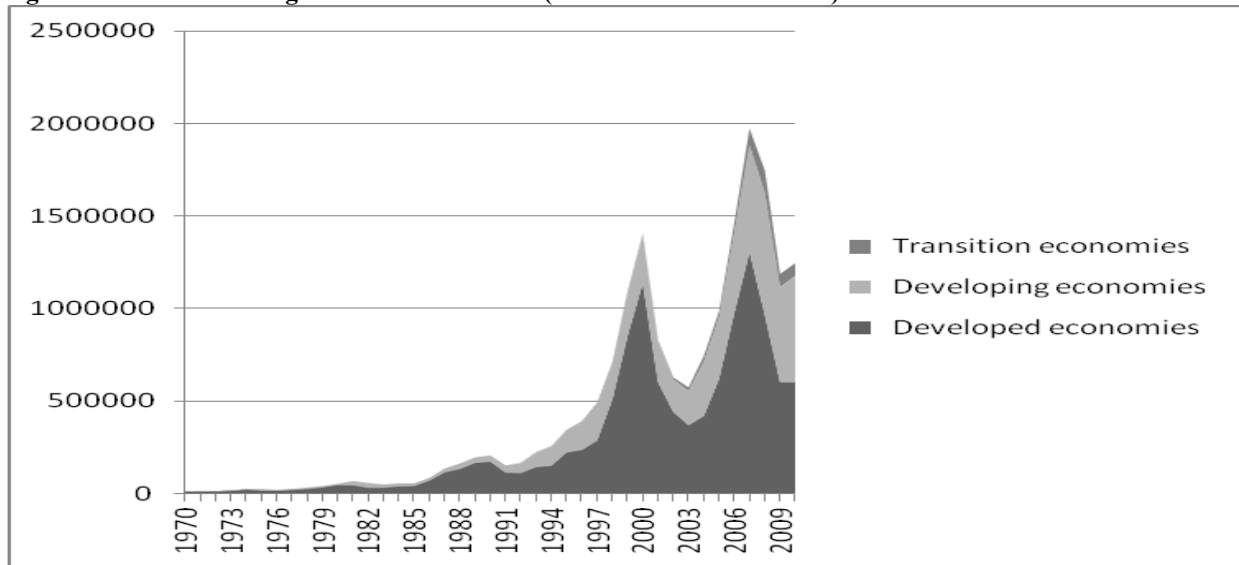
Table 1 Types of Foreign Direct Investment

Category of FDI	Summary
Greenfield	Building a new plant facility with full ownership of the multinational affiliate by the multinational firm
Brownfield	Cross-border merger or acquisition by a multinational firm
Vertical	Partial or full ownership of a plant facility to take advantage of abundant factors of production
Horizontal	Partial or full ownership of a plant facility to avoid costs associated with international trade

1.2. Foreign Direct Investment Trends over Time

Foreign direct investment flows in two direction known as inflows and outflows. Inflows refer to the amount of foreign direct investment that a foreign multinational firm invests in a domestic firm and outflows refers to the amount of FDI a domestic multinational firm invests in a foreign firm (Krugman, Obstfeld, and Melitz 2011). Beginning in the 1990s, foreign direct investment became the largest single source of external finance in developing countries, accounting for about half of all private capital and 40% of total capital flows (Aitken and Harrison 1999). Developing countries are not the only ones responsible for this recent growth of foreign direct investment; developed countries have also been major recipients of FDI. The following graph summarizes foreign direct investment growth from 1970 to 2010:

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Figure 1 Inflows of Foreign Direcct Investment (in millions of US Dollars)

Source: author using statistical information from UNCTAD FDI 2010

Historically, inflows of foreign direct investment have been focused in developed economies (Krugman, Obstfeld, and Melitz 2011). According to the United Nations Council on Trade and Development (UNCTAD), however, in 2009, the total inflows of foreign direct investment into developing economies and transitioning[1] economies surpassed that of developed countries (UNCTAD World Investment Report 2010). As the graph shows, foreign direct investment decreased across all economies in 2009. This was a result of the 2008 financial crisis that negatively impacted many of the developed economies throughout the world. As the world market began to bounce back to previous levels, foreign direct investment increased at a higher rate in developing countries as compared to developed countries (UNCTAD World Investment Report 2010). This increase of the rate of FDI inflows into developing countries is the result of the increase in FDI inflows into two different geographical areas of the world. Africa, for the

[1] Transitional Economies are defined as economies in transition from centrally planned economies to market
   economies (UNCTAD FDI 2010)

first time, became a larger market for foreign direct investment. Also, China and India continue to grow in receiving foreign direct investment, already having been the leaders among the developing countries in the inflow of FDI (UNCTAD FDI 2010). Developing countries inflows are increasing, in large part, because of greenfield foreign direct investment. Over the last five years, greenfield FDI in developing countries has accounted for over 50% of all greenfield FDI. The majority of these investments are going to East, South and Southeast Asia. This area is receiving over 26% of total greenfield foreign direct investment with much of this concentrated in China and India (UNCTAD World Investment Report 2010).

To understand the increase of foreign direct investment in developing countries, the United Nations Council on Trade and Development separates developing countries into different geographical regions. The chart of the inflows into developing countries is seen in the Appendix, taken directly from the UNCTAD website (FDI 2010). The largest inflows of foreign direct investment in developing countries are heading to Asia, more specifically East, South, and Southeast Asia. Though they are the leading recipients, these economies are the slowest growing recipients of FDI. The second leading economies for developing countries in terms of FDI inflows are the Americas, led by Brazil. Eastern European countries, though small, are beginning to attract investors, especially in the banking and financial industries. In West Asia, which includes the Middle East, governments are attempting to attract foreign direct investment by integrating infrastructure upgrade plans. Africa, though the smallest recipients of foreign direct investment compared to the other regions, is being targeted for new foreign direct investment initiatives. This is due in large part to the major increase in the services sector industries, specifically the communications sector. As there is expanded FDI in the services sector, commodity prices are also recovering in Africa, causing an increase in foreign direct investment

in the manufacturing sector, specifically in the mining industry (UNCTAD World Investment Report 2010).

While trends of the inflow of foreign direct investment have been changing over the past decade, outflow trends have remained fairly constant. Outflow of foreign direct investment comes mainly from developed countries, though developing countries do make up about twenty-five percent of all FDI outflow (UNCTAD World Investment Report 2010). Much of this outflow is a combination of greenfield investment coming from developed countries and flowing to developing economies and brownfield investment between developed countries. Of interesting note, the fastest growing flow of foreign direct investment is from developing countries to other developing countries (Krugman, Obstfeld, and Melitz 2011). The following graph summarizes these trends in outflows of foreign direct investment.

Figure 2 Outflows of Foreign Direct Investment (in Millions of US Dollars)
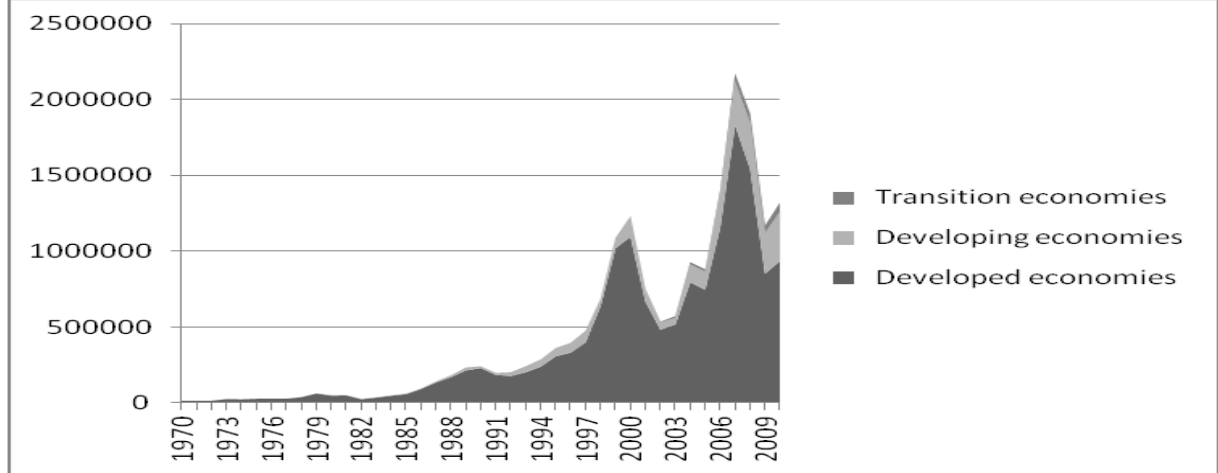
Source: Author using statistical information from UNCTAD FDI (2010)

It is important to note not only the direction of foreign direct investment but also the industry sectors that FDI is flowing into. Inflows of foreign direct investment are broken down into three major industry sectors. The first major sector is the primary sector, which includes

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agriculture and mining. The second major sector is the manufacturing sector, which includes food, chemical products, machinery, and transportation equipment. The third major sector is the services sector, which includes electricity, gas, trade, transport, communications, finance, and business services. In terms of FDI flows, the most important of these sectors is the primary sector, followed by the services sector, and finally the manufacturing sector. Of these, however, the services sector is the fastest growing sector of the three main industry sectors (UNCTAD World Investment Report 2010).

2. Foreign Direct Investment and Horizontal Spillover Effects

2.1. Definition of Horizontal Spillover Effects

Economists are not only interested in the foreign direct investment trends over time but also their effects, both the internal effects on the multination affiliates and the external on domestic firms in the recipient country. The external effects are often referred to as spillover effects. Spillovers from foreign direct investment have historically been thought to be only horizontal, intra-industry spillovers (Aitken and Harrison 1999). Beata Javorcik (2004) writes, "Spillovers from FDI take place when the entry or presence of multinational corporations increases the productivity of domestic firms in a host country and the multinationals do not fully internalize the value of these benefits." Haddad and Harrison (1993) add that if horizontal spillovers were present, "we would expect to see evidence in the form of higher productivity levels and growth rates for domestically-owned firms in sectors with a large foreign presence."

Economists have identified several different ways under which horizontal spillovers potentially occur. The two most likely horizontal spillovers identified are through technology diffusion from one firm to another and the formal training that a multinational firm provides its workers and that the domestic firms previously did not have access to. With the increase of foreign direct investment of a multinational firm in a sector, the domestic firms belonging to the same sector would benefit from an accumulation of technology. These spillovers from technology can affect the domestic firms in multiple different ways. New technology may be introduced to a domestic industry or existing technology may become more advanced, less expensive, and more available. These technologies would then "spillover" from the multinational firms to the domestic firms, lowering production costs (Haddad and Harrison 1993). The second major type of horizontal spillover that economists have identified is from

worker training. Economists have pointed to new and better on the job training that multinational firms provide. Workers then move on to domestic firms in the same industry and take their previous training with them, increasing the productivity at the domestic firm level (Aitken and Harrison 1999). Rodrik (1999) also identifies other potential horizontal spillovers, which include technology transfer, marketing channels, superior management, and labor training, all of which could lead to an increase in the productivity of individual domestic firms. Most studies on spillover effects focus on developing or transition economies because the potential for spillovers through these means are greater than in developed countries.

2.2. Historical Results on Horizontal Spillovers

Earlier studies on the effects of horizontal spillovers have produced mixed results. If horizontal spillovers are positive, it would be expected that there would be evidence in the form of higher productivity or increased growth rates of firms within an industry (Haddad and Harrison 1993). Aitken and Harrison (1999) identify earlier studies that point to industry booms in Bangladesh and Mauritius as evidence of positive spillover effects of foreign direct investment. A previous case study of these countries suggests that the introduction of foreign direct investment into the textile export industry generated an industry boom during the 1970s-1980s (Rhee and Belot 1989). Some recent studies, however, have failed to confirm these results. Mona Haddad and Ann Harrison (1993) examine the impact of foreign investment on firms in Morocco's manufacturing sector using data from manufacturing firms from 1985 to 1989. Haddad and Harrison conclude from this study, "There is no significant relationship between higher productivity growth in domestic firms and greater foreign presence in the sector." Brian Aitken and Ann Harrison (1999) use data from over 4,000 Venezuelan firms in an attempt to

measure the productivity effects of foreign ownership. They conclude that "on the one hand, plants with higher foreign participation exhibit positive productivity gains...On the other hand, plants which do not receive foreign investment exhibit productivity declines as a result of increasing foreign activity."

In their study on Morocco, Haddad and Harrison (1993) start with a baseline model that reflected previous case studies on foreign direct investment. They recognize that there is potentially a missing variable bias and later augment this equation to try and capture this bias. The following is the baseline model along with the explanation of the dependent variable:

$$U_{ij} = C + aDFI\_Firm_{ij} + bDFI\_Sector_j + cSIZE_{ij} + \varepsilon_{ij} \tag{1}$$

$$a_j = max\ (a_{ij}) \tag{2}$$

$$U_{ij} = (a_{ij} - a_j)/a_j \tag{3}$$

In equation 1, U_{ij} is the deviation of firm-level productivity from the sector's best practice frontier in sector j. From equation 3, U_{ij} is calculated by taking the productivity of firm i in sector j (a_{ij}) and subtracting the maximum productivity value (a_j) in the sector and dividing this difference by the maximum productivity value in the sector. The range of the deviation from the maximum productivity is between -1 and 0. Most sectors have an average of -0.1 deviations from the maximum productivity of the sector, though about ten percent of the sectors are larger than -0.3 deviations from the maximum.

Note that DFI_Firm_{ij} refers to the percentage of foreign presence within the individual firm. DFI_Sector_j refers to the share of foreign firms in the sector calculated as the percentage of total assets held by multinational firms. $Size_{ij}$ refers to the measure of the size of the firm and is

calculated by the total number of employees (Haddad and Harrison 1993). The following are the

results of the estimation of model 1:

Table 2 Haddad and Harrison Results (a)

U=	Intercept	DFI (firm)	DFI (sector)	Size of Firm	N	R-Squared
	-0.441	0.03**	0.17**	0.002**	3993	0.16
	(0.004)	(0.008)	(0.019)	(0.00001)		

**indicates significant at the 5% level

Source: Haddad and Harrison 1993

Table 2 shows that the coefficient on firm level FDI is both positive and significant. As

direct foreign investment increases 1% at the firm level, the firm's productivity grows 0.03

deviations closer to the maximum productivity level. In firms that are found in sectors within 0.1

deviations from the maximum productivity level, this would be at least a 3% growth but would

be relatively small in sectors with larger deviations. In general, firms involved in joint ventures

through foreign direct investment exhibit less deviation from the best-practice productivity levels

of the sector. Similarly, the coefficient on the foreign direct investment present in the sector is

both positive and significant. Economically speaking, as foreign direct investment increases in a

sector, productivity for an individual firm would grow 0.17 deviations closer to the maximum

value of productivity for the sector given a 1% increase in foreign direct investment across the

sector. This suggests that in sectors that have a large foreign presence, there is a smaller

deviation of all firms from the maximum productivity level of the sector. This sector coefficient

captures the horizontal spillover effects of foreign direct investment. The coefficient on the size

of the firm is positive and significant, which indicates that the larger the firm, the closer the

individual firm is to the maximum productivity value within the sector. All of this is in line with

previous studies that concluded that foreign direct investment has a significant, positive spillover effect on the domestic firms as suggested by the estimated coefficient of DFI_sector$_j$. However, Haddad and Harrison believe that there may be a missing variable bias here, so they attempt to capture the change in the productivity of the firms due to foreign direct investment. The previous regression only captures the productivity of the firm and fails to capture any growth in productivity. To examine if there is any growth in productivity due to FDI spillovers, Haddad and Harrison measure the change in total output over time, allowing them to examine marginal productivity. The new regression equation is as follows:

$$\Delta \log Y_{ijt} = C + a\Delta DFI\_Firm_{ijt} + b\Delta DFI\_Sector_{jt} + \alpha_x \Delta \log L_{ijt} + a_k \Delta \log K_{ijt} + \varepsilon_{ijt} \qquad (4)$$

In equation 4, $\Delta \log Y_{ijt}$ refers to the change of the log of value-added to a firm i in sector j at time t. ΔDFI_Firm_{ijt} refers to the percentage change of foreign direct investment present in firm i in sector j at time t and measures the impact of an increase of FDI in an individual firm on producitivity. ΔDFI_Sector_{jt} refers to the percentage change of the FDI present in sector j at time t and measures he extent to which the presence of FDI affects the productivity growth of the sector. As before, the sector coefficient represents the horizontal spillover effects of foreign direct investment. $\Delta \log L_{ijt}$ and $\Delta \log K_{ijt}$ refer to the change in the log of the value-added productivity of labor and capital, respectively, in firm i of sector j at time t. By including a control for capital and labor, Haddad and Harrison are trying to capture the increase in productivity of a sector through horizontal spillovers that are not from multinational firms

investing in highly productive industries only. This new econometric model yields the following results:

Table 3 Haddad and Harrison Results (b)

dLogY =	dLogL	dLogK	DFI (firm)	DFI (sector)	N	R^2
	0.77**	0.088**	-0.02	-0.039	11,772	0.42
	(0.009)	(0.011)	(0.023)	(0.061)		

**indicates significant at 5% level

Source: Haddad and Harrison 1993

In this case, the results are vastly different. As Table 3 shows, while the coefficients on firm and sector are negative, they are also both statistically insignificant. Haddad and Harrison also run this model with different variations of firm, a time dummy, and an industry dummy. In all of these cases, they find that the coefficient on total FDI in a sector, which captures the horizontal spillover effect, was insignificant. This causes Haddad and Harrison (1993) to conclude, "The evidence suggests that foreign investment was associated with a one-time increase in domestic firm efficiency (captured by the first regression). However, higher levels of foreign investment have not been associated with rising productivity among domestic firms (captured by the second regression equation)." Rodrik (1999) adds, "At the national level, the effect of DFI on economic growth tends to be weak, and disappears as more country characteristics are controlled for."

The case study by Aitken and Harrison (1999) in Venezuela uses a similar model as that of the augmented model of Haddad and Harrison. Aitken and Harrison also look at the effect on total output of the firm in an attempt to measure the effects of foreign direct investment. The following is the baseline regression equation for Venezuelan firms:

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$$\log Y_{ijt} = C + \beta_1 DFI\_Plant_{ijt} + \beta DFI\_Sector_{jt} + \beta_3 DFI\_Plant_{ijt}*Sector_{jt} + \beta_4 X_{ijt} \qquad (5)$$

$$+\log UNSKL_{jt} + \log SKL_{it} + \log M_{it} + \log K_{it} + D_i + D_t + \varepsilon_{ijt}$$

In equation 5, $\log Y$ is again the log of real output in firm i in sector j at time t. DFI_Plant_{ijt} refers to the percentage invested in the plant by foreign investors in firm i in sector j at time t. DFI_Sector_{jt} refers to the percentage of foreign investment across the entire sector j at time t. X_{ijt} corresponds to the number of plants owned by firm i in sector j at time t. Input factors regressed on the log of real output include unskilled labor ($\log UNSKL_{it}$), skilled labor ($\log SKL_{it}$), materials ($\log M_{it}$), capital ($\log K_{it}$), an industry level dummy (D_j) and a time dummy (D_t). Unskilled labor, skilled labor, materials, and capital are all expressed in terms of log. The time dummy controls for product differences across time and the industry level dummy controls for product differences across industries. The coefficients on these inputs are not reported in the following table but are included in the regression equation in column 1 and removed from the regression equation in column 2. This baseline model provided the following results:

Table 4 Aitken and Harrison Results

	Impact of direct foreign investment (DFI) on productivity		Impact of DFI on output		Impact of DFI on change in productivity			
	OLS with industry dummies[b]	OLS without industry dummies	Weighted least squares[c]	OLS with industry dummies and no factor inputs[d]	First differences[e] $(Y_t - Y_{t-1})$	Second differences[e] $(Y_t - Y_{t-2})$	Third differences[e] $(Y_t - Y_{t-3})$	Fourth differences[e] $(Y_t - Y_{t-4})$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign ownership in the plant (Plant_DFI)	0.105	0.158	0.142	2.176	0.003	0.018	0.042	−0.011
	(0.027)	(0.028)	(0.039)	(0.124)	(0.037)	(0.039)	(0.043)	(0.049)
Foreign ownership in the sector (Sector_DFI)	−0.267	0.058	−0.206	−1.258	−0.238	−0.302	−0.248	−0.320
	(0.061)	(0.030)	(0.155)	(0.232)	(0.067)	(0.065)	(0.071)	(0.083)
Plant_DFI * Sector_DFI	0.356	−0.212	0.314	5.003	0.262	0.420	0.384	0.658
	(0.181)	(0.189)	(0.226)	(0.810)	(0.223)	(0.246)	(0.252)	(0.288)
Number of plants	10,257	10,257	10,257	10,372	9,489	7,158	5,132	3,607
Number of observations	43,010	43,010	43,010	46,947	32,521	23,136	16,100	11,045
Hausman test[f]	38.4	—	82.9	—	—	—	—	—
R^2	0.96	0.95	0.96	0.32	0.53	0.60	0.64	0.65

Source: Aitken and Harrison 1999

As reported in column 1 in table 4, the coefficient on foreign ownership at the plant level is both positive and statistically significant. This implies that there are relatively large gains from foreign direct investment within an individual firm. The coefficient of 0.105 suggests that a 1% increase of foreign ownership in a plant would increase real output by 0.105%, which captures the productivity gains of foreign direct investment. In contrast, the coefficient on foreign ownership in the sector, though still statistically significant, is negative, which suggest that horizontal spillovers on domestic firms are negative. This suggests that as foreign direct investment increases across a sector, the domestic firms in the same sector become significantly less productive. A 1% increase of FDI across the sector suggests that there would be a 0.267%

decline in the domestic firms real output. This leads Aitken and Harrison (1999) to conclude, "Domestic plants in sectors with more foreign ownership are significantly less productive than those in sectors with a smaller foreign presence." This large decline in domestic productivity when there is an increase FDI across the sector captures the negative horizontal spillover effect. It is important to note that a negative spillover on the domestic firm does not imply a negative impact on the domestic welfare as more productive firms are entering the market, forcing less productive firms to exit the market (Melitz 2003). The coefficient on the interaction term of Plant*Sector is both positive and statistically significant. This suggests that if an individual firm is a multinational affiliate, it benefits from increased foreign direct investment in other firms within the sector as compared to domestically owned firms. Aitken and Harrison conclude, "Our finding of large, negative spillovers from foreign investment to domestic firms is in sharp contrasts with previous econometric studies, which generally found positive spillovers."

To try and explain why these results are vastly different, Aitken and Harrison rerun this regression equation without the industry dummies and other factor inputs (column 2) because this specification is the closest specification to the previous cross-section studies. These results show that without the industry dummies, the coefficient on sector foreign direct investment, which captures the horizontal spillover effects, is positive and statistically significant, which would be in agreement with previous studies. These findings lead Aitken and Harrison (1999) to conclude, "If we fail to control for the fact that foreign investment is attracted to more productive sectors, we conclude that spillovers from foreign ownership are positive; once we introduce controls for industry-specific differences, however, we find evidence of negative spillovers on domestic productivity."

Rodrik (1999) comments on both of these case studies and concludes, "Once again, the hard evidence is sobering. Systematic plant-level studies from countries such as Morocco and Venezuela find little in the way of positive spillovers." At the beginning of their study, Aitken and Harrison (1999) posited that economists had the causality of foreign direct investment backwards and that multinational firms were actually investing in already productive sectors, not causing sectors to become more productive. Rodrik (1999) agrees, "Much, if not most, of the correlation between the presence of DFI and superior performance seems to be driven by reverse causality: multinational enterprises tend to locate in the more productive and profitable economies (and niches there of)."

3. Foreign Direct Investment and Vertical Spillover Effects

3.1 Definition of Vertical Spillover Effects

Aitken and Harrison (1999) conclude that any technology or training transfers that resulted in increased productivity of domestic firms from foreign direct investment were cancelled out by a decrease in market share and increase in costs for the domestic firm. This explains the insignificant, or potentially negative, horizontal spillovers of foreign direct investment. While multiple studies following the Aitken and Harrison's, such as Jozef Konings 2001 analysis of FDI transfers in Bulgaria, Romania, and Poland, and Simeon Djankov and Bernard Hoekman's 2000 analysis of the Czech Republic, agree with this conclusion. Javorcik (2004) suggests that researchers had been looking for spillovers in the wrong place and that "spillovers from FDI are more likely to be vertical than horizontal in nature." Javorcik identifies that these vertical spillovers can be either backward or forward in nature.

Potential backward linkages from FDI occur in upstream sectors of the economy through contact between the multinational firms and their intermediate input suppliers. Upstream sector spillovers may take place through direct knowledge transfers, a higher requirement for product quality which provides incentives for domestic suppliers to upgrade their own production facilities, a requirement for a more reliable delivery of products, or an increase of demand for the intermediate input, allowing for better scales of economy by the domestic firm. Though multinational firms have reason to protect their technology from same-sector competitors, which discourages any horizontal spillovers from occurring, backward spillovers from technology transfers benefit both the domestic suppliers and the multination firm, which potentially receives a higher quality or less expensive product (Javorcik 2004).

Potential forward linkages from FDI occur in downstream sectors through the provision of inputs by multinational firms to domestic firms. Downstream sectors may then have access to previously unavailable inputs or inputs that are more technologically advanced, less expensive, or accompanied by complementary services supplied by multinational firms. While multinational firms may not have the same incentives to interact with upstream industries as they have with downstream industries, there is no reason to rule out the possibility of forward spillover effects through technology sharing as there are with horizontal spillovers, creating at least the potential for FDI spillovers being created through forward linkages (Javorcik 2004).

3.2 Evidence for Vertical Spillovers

Javorcik (2004) examines whether vertical spillovers occur, either through backward or forward linkages, by examining firm-level data from Lithuania covering the periods of 1996 to 2000. Javorcik chooses Lithuania because (i) it is among the top ten in cumulative foreign direct investment inflows per capita, (ii) as a transition economy, Lithuania is well-endowed in skilled labor, making it particularly attractive case to study the possibility of spillover effects, (iii) as a transition economy, Lithuania has contact with multiple multinational firms but not the large presence or saturation of multinational firms in any particular sector, potentially allowing for a more manageable way of capturing the effect of multinational firms entering the economy and (iv) the Lithuanian Statistical Office, which collected the data used, was ranked the second highest in quality and reliability among all the transition economies.

The following is the baseline model along with the proxy equations of the independent variables:

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$$\ln Y_{ijrt} = \alpha + \beta_1 \ln K_{ijrt} + \beta_2 \ln L_{ijrt} + \beta_3 \ln M_{ijrt} + \beta_4 \text{ForeignShare}_{ijrt} + \beta_5 \text{Horizontal}_{jt} \quad (6)$$

$$+ \beta_6 \text{Backward}_{jt} + \beta_7 \text{Forward}_{jt} + \alpha_t + \alpha_r + \alpha_j + \varepsilon_{ijrt}$$

$$\text{Horizontal}_{jt} = [\Sigma_\iota \; \text{ForeignShare}_{it} * Y_{it}] / \Sigma \; Y_{it} \quad (7)$$

$$\text{Backward}_{jt} = \Sigma_\kappa \; \alpha_{jk} \; \text{Horizontal}_{kt} \quad (8)$$

$$\text{Forward}_{jt} = \sigma_{jm}[[\Sigma \iota \; \text{ForeignShare}_{it} * (Y_{it} - X_{it})]/[\Sigma \; (Y_{it} - X_{it})]] \quad (9)$$

In equation 6, $\ln Y_{ijrt}$ is the log of real output measure for firm i in sector j in region r at time t. K_{ijrt} measures the amount of capital used in the production process by firm i. L_{ijrt} measures the amount of labor used in the production process by firm i. M_{ijrt} is the measure of the value of material inputs. ForeignShare$_{ijrt}$ is the measure of the total equity owned by foreign investors in firm i. Horizontal$_{jt}$ is calculated by equation 7 and captures the weighted share of foreign presence in sector j at time t. Backward$_{jt}$ is calculated by equation 8 and captures the weighted share of foreign presence in the industries that are being supplied by sector j where α_{jk} is the proportion of sector j's output supplied to sector k $(j{\neq}k)$. Forward$_{jt}$ is calculated by equation 9 and is the weighted share of foreign output in upstream sectors where σ_{jm} is the share of inputs purchased by industry j from industry m $(j{\neq}m)$. In this baseline equation, Javorcik does not include a measure for a change in demand over time. She will later augment the equation to attempt to capture this effect and then again to test whether there is a larger effect in backward linkages from partially owned firms as compared to fully owned firms. Javorcik also runs this baseline specification model using a one-year lag of the Horizontal, Backward, and Forward proxies "since knowledge externalities from foreign presence may take time to manifest

themselves (Javorcik 2004)." Javorcik recognizes that endogeneity can occur as output can affect the inputs used. To control for this, Javorcik uses the Olley-Pekes method to account for this. The following are the results of the baseline model and the lagged model for the spillover effects:

Table 5 Javorcik Results

Coefficient	Column 1 Non-lagged Spillover Proxies	Column 2 Lagged Spillover Proxies
Foreign Share	0.0025*** (0.0002)	0.0025*** (0.003)
Backward	0.0105** (0.0048)	0.0173*** (0.0060)
Forward	-0.0030 (0.0024)	-0.0029) (0.0040)
Horizontal	0.0029** (0.0013)	0.0038* (0.0021)
Intercept (includes lnK, lnL, lnM)	5.2323*** (0.0805)	5.1599*** (0.1108)
Number of Observations	11,630	8,214
R^2	0.93	0.93

*,**,***: Significant at 10%, 5%, and 1% respectively

Source: Javorcik 2004

In agreement with all of the previous studies on foreign direct investment, FDI has a positive and statistically significant effect on the real output of the Lithuanian firm. The multinational affiliate tends to be more productive than the domestically owned Lithuanian firm. The coefficient on backward linkages is also positive and is statistically significant at the 5% level in column 1 and at the 1% level in column two. Column 1 suggests that, as the percentage of foreign ownership that is present in a downstream sector increases by 1%, the suppliers real output increases by just over 1%. In column 2, when using lagged values of explanatory variables, the effect almost doubles. Now, an increase of 1% correlates with a 1.7% increase in the real output of the suppliers to that industry sector. The coefficient on forward linkages, though negative, is statistically insignificant. This suggests that foreign presence in a sector does not have a significant impact on the real output of downstream producers. The coefficient on the horizontal proxy is also positive and significant in column 1 at the 5% level and in column 2 at the 10% level. This is in contrast to previous studies. However, the baseline model does not include a control for determining whether FDI increases productivity of domestic firms or high-productivity sectors attract more FDI, which the Aitken and Harrison (1999) study show is needed to obtain unbiased estimates of horizontal spillover effects.

The problem is that the dummies in equation 6 (α_t, α_r, and α_j) do not capture the change over time specifically due to technology transfers. Without this control, there may be a missing variable bias in the spillover effects in horizontal domestic firms or in the downstream sector due to economies of scale. To capture this, Javorcik augments the baseline model by including a variable that captures a change in the demand of intermediate goods over time. When this specification is included, the coefficient on forward linkages is still statistically insignificant. Of interesting note, the augmented equation produces a coefficient on foreign share that is still

positive but is not statistically significant. This, coupled with the positive and statistically significant coefficient on the demand proxy, suggests that, just as Aitken and Harrison (1999) had previously concluded, "foreign share is positively correlated with productivity levels but not with growth rates, suggesting that foreign firms may be investing in the most productive domestic enterprises" (Javorcik 2004). Backward linkages are both positive and statistically significant after this augmentation, suggesting that there are positive spillovers from foreign direct investment that previous studies had missed. The coefficient on forward linkages is again not statistically significant, suggesting that there are no spillovers from foreign direct investment into upstream sectors of the domestic economy. The coefficient on the horizontal spillover effect after the augmentation is not statistically significant suggesting that there are no horizontal spillover effects from foreign direct investment. Javorcik concludes that outside of these backward linkages, "there is little evidence of spillovers taking place through other channels" (Javorcik 2004).

Javorcik (2004) also wants to consider whether backward linkages associated with partially owned foreign affiliates leads to greater spillovers than linkages associated with fully owned foreign affiliates. She hypothesizes that a partially owned affiliate will have greater reliance on domestic sources for intermediate inputs and thus having a larger spillover effect into the upstream sectors. A similar equation to the baseline model is used, with the addition of the demand proxy, but the backward linkage variable is split into two separate variables, backward partial ownership and backward full ownership. The results of this regression show that partial ownership of a firm has a positive and statistically significant effect on the real output of an upstream firm while there appears to be no backward linkages present in a fully foreign owned firm as the coefficient is not statistically significant. This provides support to the hypotheses that

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there are greater spillover effects through backward linkages in partially owned affiliates as compared to fully owned affiliates. Interestingly, in this new regression, forward linkages in downstream sectors appear to have a negative impact, as the coefficient on forward linkages is both negative and statistically significant (Javorcik 2004).

These results suggest that a possible shift in economic policy towards FDI may be desirable. Countries should be encouraging brownfield FDI through mergers, creating more partially foreign owned firms, while not encouraging greenfield FDI and brownfield FDI through acquisition, as these would create fully owned affiliates. Greenfield foreign direct investment and brownfield foreign direct investment through acquisition would appear to have no backward spillover effects and would have negative forward linkages. Brownfield foreign direct investment through mergers, however, appears to have positive backward spillovers which, depending on the magnitude could offset the negative forward spillover effects.

3.3 Supporting Evidence for Vertical Spillovers

Bitzer, Geishecker, and Gorg (2008) also consider the potential relationship between foreign direct investment and vertical spillovers. This study examines data across seventeen countries and eight sectors in an attempt to verify whether Javorcik's findings generalize to other countries. As in Javorcik's study (2004), Bitzer, Geishecker, and Gorg regress the log of real output on the log of input factors of production, the level of FDI within the sector, capturing the horizontal spillover effect, the level of FDI present in upstream industries, which captures the spillover effects through backward linkages, and the level of FDI present in downstream industries, which captures the spillover effect through forward linkages. The departure from Javorcik is that they include a country specific industry fixed effect as part of the equation. An

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augmented equation from this baseline model includes an interaction effect between the country specific fixed effect and spillovers from backward linkages. This interaction effect allows a comparison of spillover effects in developing economies, transition economies, and developed economies within the data set.

In general, the results of the Bitzer, Geishecker, and Gorg (2008) confirm those of the Javorcik's study, concluding that there are significant backward effects from foreign direct investment in upstream industries. Of interesting note is that this study found that while spillovers occur through backward linkages in both transition economies and developed economies countries, the effect is much larger in transition economies. In poor developing economies, however, there does not appear to be a statistically significant relationship with spillovers from backward linkages.

3.4 Service Sector Spillovers from Foreign Direct Investment

A recent study on the effects of liberalization in the service sector by Jens Arnold, Beata Javorcik, and Aaditya Matto (2011) suggests that potential spillovers from foreign direct investment are not found across all sectors of the economy but are concentrated in the services sector industries. This paper uses firm-level data from the Czech Republic and it suggests that there is a positive association between the liberalization in the services sector through foreign direct investment and the productivity of the manufacturing firms that use these service inputs. These effects could be described as positive forward spillover effects in the language adopted by Javorcik (2004). Liberalization of the service sector can take place through the abolition of monopolies, the privatization of state-owned enterprises or the elimination of barriers to entry, allowing for new providers, both domestic and foreign, to enter the market.

The Czech Republic is an ideal case study because all these types of liberalization in different services sectors have recently taken place recently. In 2000, the Telecommunications Act abolished an existing monopoly in the fixed line telecommunications sector. In 1998, four major state-owned banks were privatized the electric and gas sectors was privatized in 2002. All three measures of liberalization allowed for new parties, both foreign and domestic, to provide services to the public in the Czech Republic.

To examine whether there is a link between the services sector and the manufacturing sector, Arnold, Javorcik and Matto (2011) regress total factor productivity of manufacturing sector on its reliance on the services sector, the state of liberalization in the services sectors used, and other indicators of openness in the market, such as the presence of foreign direct investment and the presence of tariffs. They first establish a baseline model that tests the natural log of total factor productivity of a manufacturing firm on different aspects of services input linkages, upstream manufacturing input linkages, and same sector effects while also including a fixed firm effect to remove influences specific to a firm or industry. They then augment the study to include a regional dummy that removes the influences that are specific to regions of operations. The following is the baseline model:

$$\textbf{lnTFP}_{\textbf{it}} = \boldsymbol{\alpha}_{\textbf{i}} + \boldsymbol{\beta}\,\textbf{services\_linkage}_{\textbf{jt-1}} + \textbf{X}_{\textbf{jt-1}}\boldsymbol{\pi} \;+\; \boldsymbol{\sigma}_{\textbf{t}} + \boldsymbol{\eta}_{\textbf{it}} \qquad\qquad \textbf{(10)}$$

In equation 10, lnTFP_{it} is the log of total factor productivity of a manufacturing firm i operating at time t. α_i refers to the firm fixed effect of firm i. Services_linkage$_{jt\text{-}1}$ corresponds to the backward linkages of the services sector with the manufacturing firm i. Services linkages include the level of FDI presence in the service sector inputs, the level of concentration of the

individual sector, and the level of privatization of the services sector. The effects of services sector liberalization are lagged one year as the effects may take time to materialize. X_{jt-1} refers to the manufacturing input linkages effects on manufacturing firm i and includes the level of FDI presence in the upstream manufacturing sector and tariff levels in the upstream manufacturing sector and is also lagged one year from time t. σ_t refers to the level of competition from imports in the same sector of the manufacturing firm while η_{it} refers to the level of FDI present in the same sector at time t. This baseline model yielded the following results when all services input linkages are included:

Table 6 Arnold, Javorcik, and Mattoo Results

Services Input Linkages	FDI	6.194*** (2.286)
	Concentration	2.456 (3.358)
	Privatization	11.402 (7.853)
Manufacturing Input Linkages	FDI	0.009 (0.559)
	MFN tariff	-0.211 (0.152)
Within Sector Effects	FDI	0.047 (0.223)
	MFN tariff	0.117 (0.078)
Number of Observations		7155
R^2		0.067

 *** Significant at the 1% level

Source: Arnold, Javorcik, and Mattoo (2011)

The results of equation 10 yield interesting results. The coefficients on privatization and concentration from the services sector input are not statistically significant. Of important note, however, is that the coefficient on the level of foreign direct investment present in services sector which provide inputs to manufacturing firm is statistically significant at the 1% level and is also positive, suggesting that when FDI is more prevalent among service sector providers, the

downstream manufacturing firms' productivity levels tend to be higher, implying a positive vertical spillover effect through backward linkages. A one standard deviation increase in the level of FDI in the services sector would lead to a 6.194% increase in the total factor productivity of the downstream manufacturing firm. The coefficients on same-sector FDI levels and tariff controls are not statistically significant. Likewise, the coefficients on FDI levels and tariff levels in manufacturing inputs are not significantly significant.

The augmented equation that controls for regional influences produces similar results. Again, the coefficient on foreign direct investment in the services sector is both positive and statistically significant. This suggests that manufacturing firms benefit from foreign presence in the services sector inputs no matter the region. Similar to the baseline equation, the levels of foreign direct investment present in the upstream manufacturing sector and within the sector, as well as the coefficients on privatization and concentration levels, are not statistically significant. However, in both of the upstream manufacturing linkages and within the sector, tariffs present are statistically significant. In the case of upstream manufacturing sectors, the coefficient on tariffs is negative, suggesting that as tariffs on manufacturing inputs increases, total factor productivity for the downstream manufacturing firm declines. As the tariffs on same sector manufacturing increase, which in effect blocks competition, total factor productivity for the manufacturing firm increases. These results cause Arnold, Javorcik and Mattoo (2011) to conclude, "we find evidence suggesting that opening services sectors to foreign providers is a key channel through which services reforms affect downstream productivity in manufacturing." This suggests that the spillovers present from forward linkages through foreign direct investment as identified by Javorcik (2004) are positive when the upstream firm is in the services sector but not in the manufacturing sector.

It is also important to note that in this study, Arnold, Javorcik, and Mattoo (2011) did not include instruments for foreign direct investment. They avoid a missing variable bias by controlling for time and industry dummies. Anything that does not vary by time is dropped from the regression data. To control for a potential bias from industry to industry the change in output is used instead of total output. The issue of endogeneity from firm level spillovers is avoided in this case by measuring the sector differences in foreign direct investment in the input sectors instead of changes in any individual firm's foreign direct investment in the services sector inputs.

4. Conclusion

4.1 Other Potential Foreign Direct Investment Influences

Because of the growing literature supporting positive effects in foreign direct investment in developing countries, many other studies are focusing on the correlation of FDI with other facts besides spillover effects on domestic firms in both developing and developed countries. This includes the effects of FDI on migrant workers, wage inequality, and employment effects. These studies suggest that there are other positive effects outside of the direct spillover effects on domestic firms, suggesting policies should encourage an increase in both inflow and outflow in foreign direct investment.

Javorcik, Ozden, Spatareanu and Neagu (2011) find that foreign direct investment and migrant workers share a strong correlation. Countries that are linked through migrant networks also tend to have strong partnership of foreign direct investment flows. There is a particularly strong correlation between the host country of migrant workers and outflows of foreign direct investment to the migrant workers' country of origin. This suggests that as a country receives migrant workers, their foreign networks increase, which tends to increase the outflow of foreign direct investment.

Figini and Gorg (2011) analyze the effect of the inflow of foreign direct investment on wage inequality. The results of the study have interesting results. In developed countries receiving foreign direct investment, there is evidence of a nonlinear connection between FDI and wage inequality. As FDI inflows initially increases in a developed country, wage inequality tends to increase as well but then diminishes as foreign direct investment continues to increase. In developing economies receiving foreign direct investment, they find evidence of a negative linear relationship between FDI and wage inequality. As foreign direct investment increases,

wage inequality in developing economies tends to diminish. Figini and Gorg hypothesize that these results have to do with education levels found in the host country. Developing countries potentially gain from foreign direct investment as the incoming multinational firm trains unskilled workers.

Federico and Minerva (2008) investigate the effect of foreign direct investment on employment growth in Italy. While previous studies had focused on the effects of foreign direct investment inflows on the domestic firms in the host country, this study focuses on the effects of the outflow of foreign direct investment on the domestic firms in the investing country. This study is largely in response to many who feared that jobs were being moved overseas by multinational firms. This study finds that the opposite was true. Employment growth in local areas investing more abroad appears to be stronger than the industry average. Even in the case of small plants, which are presumably not directly involved in foreign activities, their employment does not seem to be negatively affected by FDI generated from their local area and industry.

5.2 Summary of Literature on Foreign Direct Investment

The literature on foreign direct investment has increased with the rise of foreign direct investment flows over the past three decades. Economists originally believed that foreign direct investment had a positive spillover effect on domestic firm but studies such as those by Haddad and Harrison (1993) and Aitken and Harrison (1999) challenge this assumption, finding that horizontal spillovers are either not present or potentially negative. Javorcik (2004) then suggests that there are still positive spillover effects present, but that they occur through vertical linkages rather than horizontally. Her study suggests that positive effects exist through backward linkages in the upstream sector industries. These results are later supported by evidence from data collected across multiple countries by Bitzer, Geishecker, and Gorg (2008). A recent study

by Jens, Javorcik, and Matto (2011) suggests that these vertical spillover effects occur in manufacturing firms using services sector inputs with high level of foreign direct investment but that these spillovers do not necessarily occur from other manufacturing sectors supplying inputs and with a significant presence of FDI. As a result of these recent studies showing positive effects of foreign direct investment, many other studies have searched for other influences of foreign direct investment, such as those by Javorcik, Ozden, Spatareanu and Neagu (2011), Figini and Gorg (2011), and Federico and Minerva (2008), most of which find that increases in foreign direct investment inflows and outflows tend to have different effects that go beyond the spillover effects on domestic firms.

Appendix A - APPENDIX

Figure 3 Inflows of Foreign Direct Investment in Developing Economies (in Millions of US Dollars)
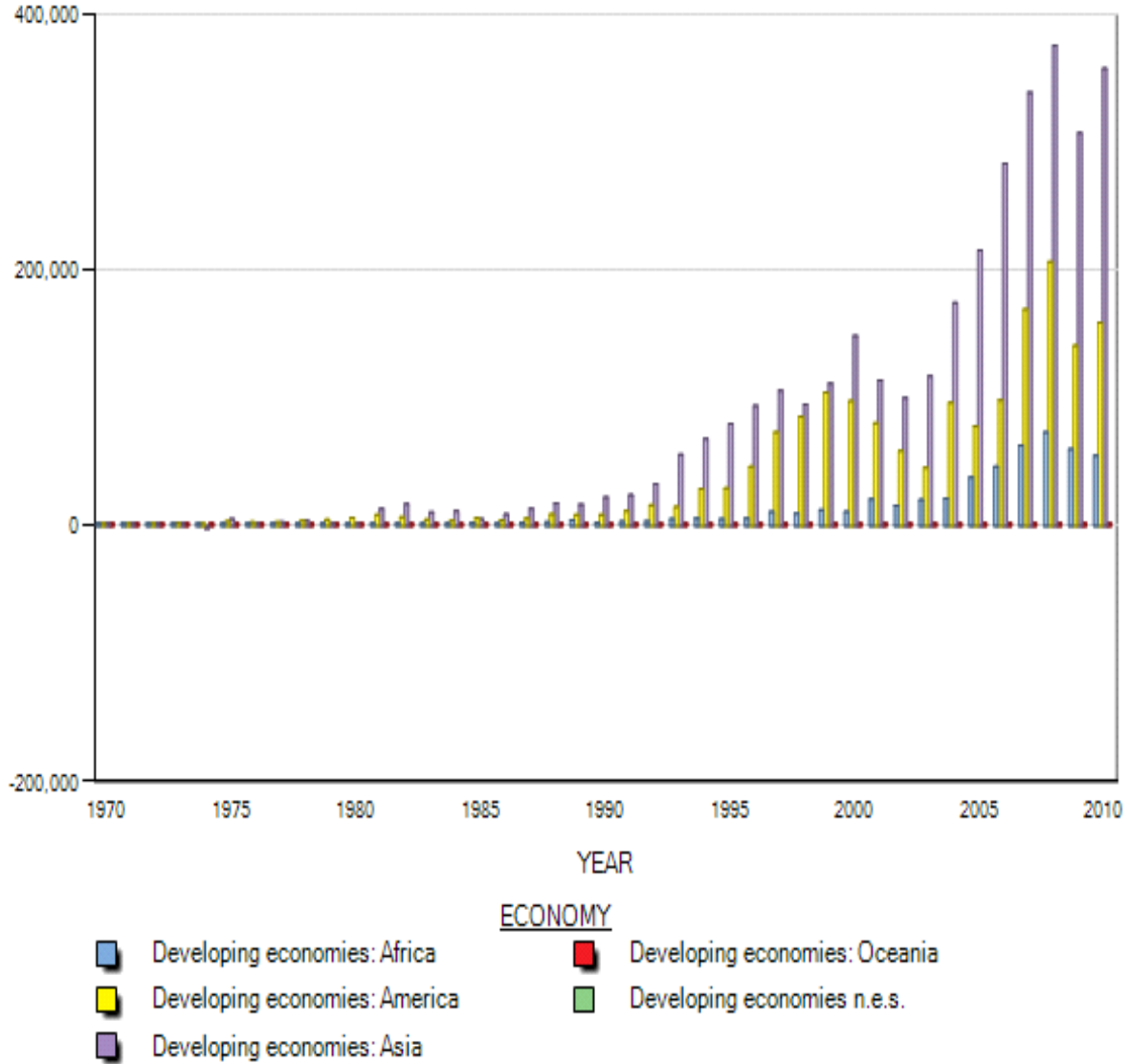
Source: UNCTAD FDI 2010)

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