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EC938 **C A Li**

TOPIC THREE: EFFECTS OF PRIVATE FDI IN DEVELOPING COUNTRIES

(Very preliminary)

Aim : Many developing countries have provided incentives (e.g. tax exemptions to attract FDI) to attract FDI. Does FDI bring considerable benefits to the host country to warrant these favourable policies?

Outline and Reading

1. **Background**

2. **Macro-level evidence**

*Borenzstein, E., Gregorio de, J. and Lee, J.-W. ,1998, How Does Foreign Direct Investment Affect Economic Growth? *Journal of International Economics*, 45 (1), pp.115-135.

*Mello de, L.R., 1997, Foreign Direct Investment in Developing Countries: A Selective Survey. *Journal of Development Studies,* 34, pp.1-34. (part on theory)

3. **Spillovers and micro-level evidence**

* Gorg, H. and Greenaway, D.,2004, Much Ado About Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment?' *World Bank Research Observer*, 19(2), pp. 171-197. (also IZA Discussion Paper 944) (part of productivity spillovers).

*Smeets, R., 2008, Collecting the Pieces of the FDI Knowledge Spillovers Puzzle, *World Bank Research Observer,* 23(2), p107-138.

* Aitken, B.J. and Harrison, A., 1999, Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela. *American Economic Review*, 89(3), pp. 605-618.

Javorcik, Smarzynska Beata, 2004, Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In search of Spillovers through Backward Linkages, American *Economic Review*, 94(3) pp.605-627

Blalock G. and P. J. Gertler, 2008) Welfare Gains from Foreign Direct Investment through Technological Transfer to Local Suppliers, *Journal of International Economics,*74 (2), pp.402-421.

4. **The determinants of FDI** (optional)

Asiedu, Elizabeth (2006). Foreign Direct Investment in Africa: The Role of Government Policy, Institutions and Political Instability. *World Economy*, 29 (1), pp. 63-77.

1. BACKGROUND

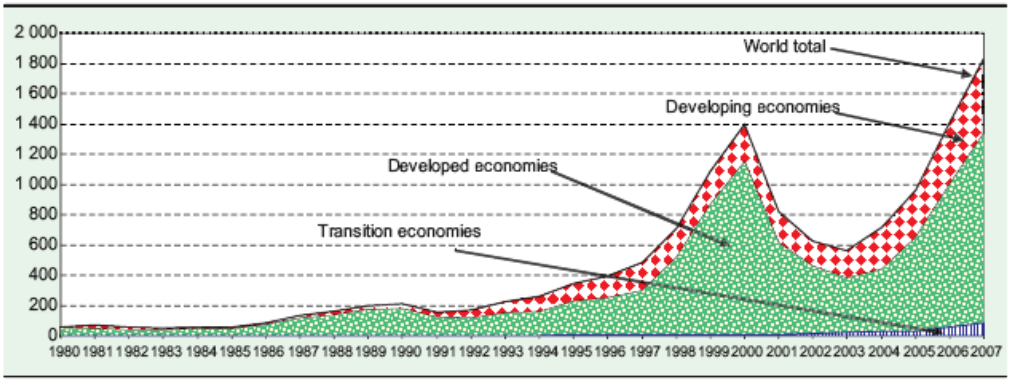
Private Foreign Direct Investment (FDI) can be defined in several ways.

- UNCTAD (World Investment Report 2008)

- FDI "as an investment involving a long-term relationship and reflecting a lasting interest and control by a resident entity in one economy (foreign direct investor or parent enterprise) in an enterprise resident in an economy other than that of the foreign direct investor…FDI implies that the investor exerts a significant degree of influence on the management of the enterprise resident in the other country…FDI has three components: equity capital, reinvested earnings and intra-company loans or intra-company debt transactions".

- Data on FDI flows are on a net basis (capital transactions´ credits less debits between direct investors and their foreign affiliates). Net increases in liabilities (FDI inward) are recorded as credits (positive sign in the balance of payments), while net increases in assets are recorded as debits (negative sign in the balance of payments). Hence, FDI flows with a negative sign indicate that at least one of the three components of FDI (equity capital, reinvested earnings or intra-company loans) is negative and not offset by positive amounts of the remaining components, implying reverse investment or disinvestment.

Figure I.1. FDI inflows: global and by groups of economies, 1980–2007
(Billions of dollars)



Source: UNCTAD FDI/TNC database (www.unctad.org/fdistatistics) and annex table B.1.

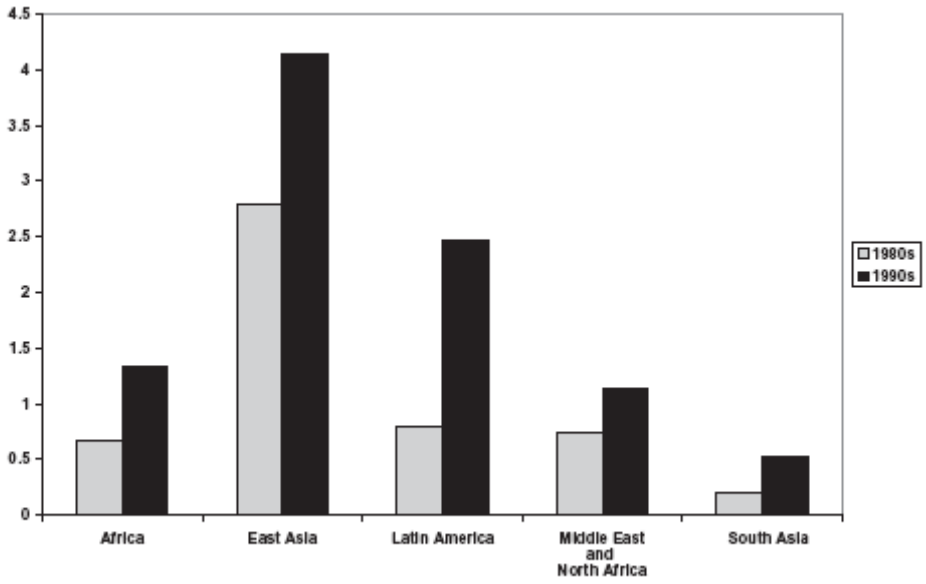


Figure 1. FDI Flows by Region (percentage of GDP)

Extracted: Seckart and Venganzones-Varoudakis, Review of Development Economics , 11(4), 607-620, 2007.
Source UNCTAD

- Researchers like De Mello Jr. define it very broadly, i.e. as a form of international inter-firm co-operation that involves equity and/or management control of foreign enterprises, quasi-investment arrangements (licensing, leasing, international production sharing etc.), joint ventures (possibly with little foreign participation) and R&D co-operation.

- For empirical studies, foreign direct investment is often measured as the level of foreign participation in the value of the company. For the IMF, FDI refers to foreign participation in excess of 10%. Anything less than that is termed portfolio investment.

- In the 1990s, capital started flowing from developing countries to developed countries. Sovereign Wealth Funds are government-owned investment funds composed of financial assets (e.g. stocks, bonds, property, currency deposits, etc) or other financial instruments. They are managed separately from the official reserves of the monetary authorities. .They have existed since 1950s but in recent year SWF have grown considerably because of current account surpluses and rapid accumulation of reserves. SWF aim to manage a financial portfolio to generate long term return. Examples: Abu Dhabi Investment Authority (United Arab Emirates), Kuwait Investment Authority, Government Pension Fund –Global Norway Fund, etc.

- Some features of world FDI activity: a) Sharp increases in world FDI activities that started after 1985. b) Increased activity and concentration of FDI. Indeed, in the 1990s, FDI has become an important sources of external finance in developing countries and FDI inflows to developing countries concentrated on a few Southeast Asian and Latin American countries. c) Developing countries have been liberalising financial markets and offered special incentives (lower taxes, subsidies for infrastructure, etc) to attract FDI in the hope of acquiring technological transfer, know-how, and in general, positive externalities.

- Two major strands of the FDI literature: a) analysis of the determinants of foreign direct investment and b) analysis of the effects of FDI on growth in the host countries. We will concentrate in the latter. As is the case with trade and growth, the relationship between FDI and growth has been analysed both at the macro and micro-level.

2. MACRO-LEVEL MODELS AND ANALYSIS

2.1. Growth Models and FDI

De Mello Jr (JDS, 1997) provides a survey of the literature on the relationship between FDI and economic growth.

The early neo-classical approach to FDI was based on capital arbitrage (capital flows result from interest rate differentials). The beneficial effects for the host country were considered to arise from a larger capital stock, increased tax revenues, increased labour income (or employment) and favourable externalities (diffusion of technology and training). Note that in the tradition of Solow and given diminishing returns to physical capital, FDI would affect only the level of income and leave long-run growth unchanged. Long run growth rates can only result from technological progress and/or population growth, which were traditionally

considered exogenous. That is, FDI will only be growth enhancing if it affects technology permanently and positively.

If growth determinants are considered endogenous, FDI can be considered as a composite bundle of capital stocks, know-how and technology. FDI can affect growth endogenously if it generates increasing returns in production via externalities and productivity spillovers. Also, FDI can be an important source of human capital augmentation and technological change in developing economies, if it promotes the use of more advanced technologies by domestic firms and provides specific labour training and skill acquisition. Moreover, policy changes might induce permanent increases in output growth by providing incentives to host FDI.

Capital accumulation: FDI encourages the incorporation of new inputs (wider range) and technologies (productivity gains from spillovers to domestic firms) in the production process of the host country.

Technological change: FDI transfers knowledge from technological leaders to followers, promotes the use of advanced technologies by domestic firms.

Knowledge transfers: FDI can provide labour training and promote skill acquisition and diffusion, introduces new management practices and organisational arrangements, etc. These gains may take place even when FDI does not entail significant capital accumulation.

Thanks to the externality effect, the social return to investment exceeds the private rate of return. This discrepancy occurs because individual acts of private investment add to the stock of knowledge and hence, the productivity of the capital stock. Therefore, in the aggregate, the return to capital stock does not diminish although returns to single acts of investment might diminish. Property rights on innovations can reduce the extent of growth-enhancing spillovers.

a) Growth Accounting Approach

This is a conventional methodology in growth empirics and mainly involves the estimation of time-series or cross-country regressions. FDI is considered to be an additional input in an augmented production function. This is a simple way to assess the growth effects of FDI.

Assume the following production function (time-indices not included for simplicity)

$$Y = A\Phi(K, L, F, \Omega) \tag{1}$$

where Y is output, A captures technology, K is capital stock, L is labour, F refers to FDI inflows and Ω is a vector of ancillary variables.

Assume a constant returns Cobb-Douglas function and take logs and differences:

$$g_y = g_A + \zeta g_k + \psi g_f + \gamma g_\omega \tag{2}$$

where lower cases indicate per-capita; ζ , ψ and γ are the corresponding elasticities. Note that

$$g_A = g_y - \zeta g_k - \psi g_f - \gamma g_\omega \tag{3}$$

is the total factor productivity or Solow residual.

[Note: a more simple example would be $Y/L = (AK^{\alpha}L^{1-\alpha})/L \rightarrow Y/L = A(K/L)^{\alpha} \rightarrow \ln(y) = \ln(A) + \alpha\ln(k) \rightarrow g_y = g_A + \alpha g_k$]

This simple framework allows us to estimate for instance the elasticity of output with respect to capital (ζ) or FDI (ψ).

Some problems:

- FDI is a flow variable, some of the variables included in the Y equation are stock variables.
- FDI data and measurement problems.
- Omitted variables and simultaneity bias (e.g. capital stock).

Externalities

Assume that the host country production function is

$$y = A\Phi(k_d, H) = Ak_d^{\beta}H^{1-\beta} \tag{4}$$

where β is the share of domestic physical capital and A refers to the efficiency of production. Assume diminishing returns to domestic capital ($0< \beta < 1$). Total stock of knowledge H in the recipient economy is a function of per capita domestic and foreign-owned capital (FDI) respectively. Let H be of a Cobb-Douglas type

$$H = (k_d\, k_w^{\alpha})^{\eta} \tag{5}$$

where $\alpha>0$ and η ($\eta<0$ or $\eta>0$) refer to the elasticities of substitution or complementarity between foreign and domestically-owned capital. Combine (4) and (5)

$$y = Ak_d^{\beta+\eta(1-\beta)}k_w^{\alpha\eta(1-\beta)} \tag{6}$$

and take logs and time derivatives

$$g_y = g_A + [\beta + \eta(1-\beta)]g_d + [\alpha\eta(1-\beta)]g_{\omega} \tag{7}$$

This shows that besides its own effect on growth, FDI is expected to increase the elasticity of output with respect to capital by $\eta(1-\beta)>0$ if $\eta>0$. FDI thus complements domestic capital.

b) The Intertemporal Optimisation Framework

The representative agent maximises a standard concave utility function where ρ is the rate of time preference and c is private consumption

$$\text{Max} \int_{t=0}^{\infty} u(c)e^{-\rho t}dt \tag{8}$$

Subject to $\dot{k} = y - c$ and substitute y using (6):

$$\dot{k} = Ak_d^{\beta+\eta(1-\beta)}k_w^{\alpha\eta(1-\beta)} - c \qquad \text{and} \qquad k_d(0) \geq 0 \tag{9}$$

Form the Hamiltonean and assume u(c) = lnc, the optimal rate of growth of consumption is

$$\frac{\dot{c}}{c} = A[\beta + \eta(1-\beta)]k_d^{\beta+\eta(1-\beta)-1}k_w^{\alpha\eta(1-\beta)} - \rho \quad (10)$$

Assume that $\beta+\eta(1-\beta)=1$ which implies $\eta=1$, then (9) becomes

$$\frac{\dot{c}}{c} = Ak_w^{\alpha(1-\beta)} - \rho \quad (11)$$

Then, as long as $\lim_{k_w\to\infty} Ak_w^{\alpha(1-\beta)} > \rho$, the long-run growth rate depends positively on FDI. Note that long-run growth depends on the time preference, the productivity of domestic capital, and the degree of complementarity between domestic and foreign-owned capital. If $\alpha(1-\beta)=1$, then the growth rate of the capital stock and output are constant and equal to the growth rate of consumption so permanent increases in FDI lead to permanent increases in output.

c) Panel data studies

Include unobserved country effects (fixed or random). Standard model estimated for the effect of FDI on growth:

$$g_{y,h} = \alpha_h + \zeta g_{k,h} + \psi g_{f,h} + \gamma g_{\omega,h} + \varepsilon \quad (12)$$

where *h* refers to the countries in the panel, and the other variables are those in equation (2).

Some results on the effects of FDI on growth

TABLE 3

CASE STUDIES SUMMARY

	Impact of FDI on			
Study/Country/ Econometric Technique	*Output Growth*	*Domestic Investment*	*Technological Change*	*Domestic Factor Productivity*
Blomstrom *et al.* (1994), 78 Summers and Heston, OLS		Reduces the impact of fixed investment	Strong	Strong
de Mello (1996a), Selected Latin American (1970–91), IV, Granger Causality	Stronger in small open economies		Granger causes TFP growth in small open economies	
de Mello (1996b), OECD and non-OECD (1970–92), Panel Data Analysis	+ in technological laggards + in leaders	+ in technological laggards - in leaders	- in technological laggards + in leaders	
Balasubramanyam *et al.* (1996), Various (1970–85), OLS, GIVE	Stronger under export promotion			
Blomstrom and Persson (1983), Mexico (1970), OLS			Depends negatively on technological gap	
Kawai (1994) Asia, Latin America, OECD OLS	Stronger under export promotion			- for most regions examined
Kokko (1994), Mexico (1970), OLS			Depends negatively on technological gap	Evidence of spillovers
Kokko *et al.* (1996), Uruguay (1988–90), OLS				Depends on technological gap
Bielschowsky (1994), Brazil (1980s-1990s), Descriptive	Strong			Strong on labour productivity
Kholdy (1995), Various (1970-90), Granger Causality	Evidence of development thresholds			Does not Granger-cause labour productivity
Zhao (1995), China (1960-91), VAR	Strongly affected by imported technology		Strongly affected by imported technology	

Source: de Mello, 1997

2. 2. A empirical macro-level evidence on growth, FDI and human capital

Borensztein et al (JIE, 1998) examine empirically the role of FDI in the process of technology diffusion (transmission of ideas and new technologies) and on economic growth. Multinational corporations (MNCs) spend substantially in R&D and are among the most technological advanced firms; so FDI by MNCs is considered one of the channels for access to advanced technologies by LDCs. The sample consists of FDI flows from industrial countries to 69 LDC during 1970-89.

An endogenous growth model motivates the empirical work where the rate of technological progress is the main determinant of long run growth. Technological process takes place through "capital deepening" i.e. introduction of new varieties of capital goods. MNCs possess more advanced "knowledge" and are able to introduce them at lower cost. The application of this new technology requires a sufficient high stock of human capital in the host country. The stock of human capital reflects the capabilities of the host country and limits the transmission of technology.

They examine whether FDI affects growth and whether this depends on the level of host country human capital. They also examine the effect of FDI on domestic investment – namely whether FDI crowds out domestic investment. MNCs may displace domestic firms through competition in the product and financial market, but may also support them through complementarities in production and possible technology spillovers.

They find that FDI is an important vehicle for technology transfer, contributing more to economic growth than domestic investment. The positive effect of FDI on growth is enhanced by higher levels of host country human capital. But, FDI is more productive than domestic investment only when human capital levels are above a minimum threshold. As opposed to crowding out of domestic investment, they find evidence of crowding in effects, but the results are not very robust.

The framework

The economy produces a single consumption good according to

$$Y_t = AH_t^{\alpha} K_t^{1-\alpha} \tag{1}$$

where A is the exogenous state of technology; H is human capital; K is physical capital which consists of different varieties of capital goods, each of one being denoted by x(j)

$$K = \left\{ \int_0^N x(j)^{1-\alpha} dj \right\}^{1/(1-\alpha)} \tag{2}$$

Capital accumulation takes the form of expansion of the number of varieties.

The total number of varieties of capital goods (N) produced by domestic (n) and foreign (n*) firms is

$$N = n + n^* \tag{3}$$

Each firm producing capital goods will rent capital goods out to each final good producer at the rental rate m(j). The demand for each variety of x(j) is given by the equality between the rental rate and the marginal productivity of the capital good in the production of the final good:

$$m(j) = A(1-\alpha)H^{\alpha} x(j)^{-\alpha} \tag{4}$$

Assume that the process of technological adaptation requires a fixed set-up cost F before production of the new technology takes place

$$F = F(n^*/N, N/N^*), \qquad \text{where} \quad \delta F/\delta(n^*/N)<0, \ \delta F/\delta(N/N^*)>0 \tag{5}$$

i.e. the first partial derivative captures the assumption that foreign firms facilitate the adoption of technology to produce new capital varieties. The second partial derivative captures the "catch up" technological effect in which costs increase with the number of varieties produced domestically (N) compared to those produced in more advanced countries (N*). Imitation possibilities are higher when N/N* is lower. An increase in the number of varieties can also be interpreted as an improvement of the quality of goods; while the catch up effect reflects that the cost of improving an existing capital good is smaller the lowest is its quality. So, it will be cheaper to upgrade goods of lower quality.

Once the capital good is introduced, there is a constant maintenance cost per period of time (marginal cost of production of x(j) = 1).

Profits for the producer of the new variety of capital j are

$$\Pi(j)_t = \int_t^{\infty} [m(j)x(j) - x(j)]e^{-r(t-s)}ds - F(n_t^* / N_t, N_t / N_t^*) \quad (6)$$

m(j)x(j) = total revenue at time t, x(j) = total cost at time t (marginal cost = 1), r = rate of return on capital – can be considered as a discount rate of a firm – profit in the near future will be more valuable than profit in the more distant future.

Maximisation of (6) subject to (4) yields

$$x(j) = HA^{1/\alpha}(1-\alpha)^{2/\alpha} \quad \text{[Hint: First integrate (6) and then take a derivative wrt x(j)]} \quad (7)$$

and substituting (7) into (4) gives the rental rate as a mark-up over maintenance cost

$$m(j) = 1/(1-\alpha) \quad (8)$$

Assuming free entry so Π(j)=0, substituting in (7) and (8) to (6), and solve for the optimal rate of return r

$$r = A^{1/\alpha}\alpha(1-\alpha)^{(2-\alpha)/\alpha} F(n^* / N, N / N^*)^{-1} H \quad (9)$$

The process of capital accumulation is driven by savings behaviour. Assume that individuals maximise

$$U_t \int_t^{\infty} \frac{C_s^{1-\sigma}}{1-\sigma} e^{-\rho(s-t)}ds \quad \text{where C is the consumption of a final good.} \quad (10)$$

subject to $\dot{K} = Y - C$ and K(0)>0.

Forming the Hamiltonian and solving the FOCs yields

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\sigma}(r - \rho) \quad (11)$$

(For details/explanation - see for instance Romer: Advanced Macroeconomics, ch 2-3).

In the steady state equilibrium, the rate of growth of consumption must equal the rate of growth of output.

From (9) and (11)

$$g = \frac{1}{\sigma}(A^{1/\alpha}\alpha(1-\alpha)^{(2-\alpha)/\alpha} F(n^* / N, N / N^*)^{-1} H - \rho) \quad (12)$$

The equation to be estimated is an approximation of (12)

$g = c_0+c_1(FDI)+c_2(FDIxH)+c_3(H)+c_4(Y_0)+c_5(X)$

where FDI is foreign direct investment, H is the stock of human capital, Y_0 is the initial GDP per capita and X is a set of variables often included in long-run growth studies (govt consumption, black market premium as a proxy for exchange market distortions and dummies for Latin America and Sub-Saharan Africa).

The growth rate is measured as annual rate of per capita real GDP over a decade (1970-79 and 1980-89).

FDI is defined as gross foreign direct investment originated in OECD member countries (as proportion of GDP) into LDCs because they want to capture benefits of foreign direct investment through knowledge and other spillover effects. This is analogous to the fraction of goods produced by foreign firms (n*/N).

The initial GDP captures the "catch up" effect (N/N*).

For human capital stock, they use the educational attainment and measured it by initial level of average year of the male secondary schooling constructed by Barro and Lee.

The group of X variables include govt consumption (measured by the average share of real govt consumption in real GDP), black market premium on foreign exchange, political instability, political rights, a proxy for financial development, the inflation rate and a measure of quality of institutions.

The results

The regressions are based on panel data for two decades (1970-79, 1980-89). They applied seemingly unrelated regressions equations (SURE) technique, because the disturbances of the regressions include factors that are common to all countries as well as factors that are specific to the country (i.e. equations are linked by their disturbances). Also because the set of equations has the same parameters and estimating the equation separately will waste information (see Greene). They did not report the cross sectional regression results that yield similar results as the panel data estimation. They also performed IV in the growth per capita regression to correct for endogeneity of FDI. Overall, the results were qualitatively similar to the ones obtained with SURE.

- *Effects on growth*

Table 1
FDI and per capita GDP growth: panel of two decades (1970–89)

	Regression number						
	1.1	1.2	1.3	1.4	1.5	1.6	1.7
Independent variable	Coefficient (standard error)						
Log (initial GDP)	−0.0124	−0.0126	−0.0122	−0.0100	−0.0125	0.0061	−0.0111
	(0.0040)	(0.0043)	(0.0039)	(0.0041)	(0.0041)	(0.0044)	(0.0050)
Schooling	0.0162	0.0142	0.0128	0.0078	0.0058	0.0033	0.0005
	(0.0044)	(0.0043)	(0.0045)	(0.0044)	(0.0043)	(0.0042)	(0.0005)
Government	−0.0969	−0.0870	−0.0811	−0.0818	−0.0817	−0.0668	−0.0435
consumption	(0.0339)	(0.0330)	(0.0333)	(0.0326)	(0.0323)	(0.0323)	(0.0316)
Log (1 +black	−0.0183	−0.0180	−0.0185	−0.0188	−0.0125	−0.0104	−0.0113
market premium)	(0.0055)	(0.0054)	(0.0054)	(0.0060)	(0.0052)	(0.0054)	(0.0054)
FDI	0.6590		−0.8489	−1.0190	−1.3665	−1.4628	−1.8535
	(0.4689)		(0.7203)	(0.6883)	(0.6746)	(0.6612)	(0.6759)
FDI*schooling		1.0659	1.6231	1.3891	1.6639	1.6531	1.6365
		(0.3850)	(0.6086)	(0.5715)	(0.5743)	(0.5930)	(0.6365)
Sub-Saharan				−0.0188	−0.0200	−0.0197	−0.0253
African dummy				(0.0060)	(0.0060)	(0.0064)	(0.0068)
Latin American				−0.0202	−0.0221	−0.0219	−0.0155
dummy				(0.0057)	(0.0058)	(0.0067)	(0.0070)
Assassinations					−0.0024	−0.0092	−0.0050
					(0.0124)	(0.0128)	(0.0129)
Wars					−0.0077	−0.0024	−0.0002
					(0.0050)	(0.0057)	(0.0057)
Political rights					−0.0032	−0.0023	−0.0001
(1 best, 7 worst)					(0.0014)	(0.0014)	(0.0014)
Financial						0.0011	0.0031
depth						(0.0117)	(0.0117)
Inflation						−0.0119	−0.0087
rate						(0.0090)	(0.0092)
Institutions							0.0056
(1 worst, 10 best)							(0.0019)
R^2-adjusted, individual	0.28(69)	0.32(69)	0.33(69)	0.34(69)	0.37(69)	0.32(64)	0.39(58)
periods (No. of obs.)	0.08(69)	0.10(69)	0.08(69)	0.23(69)	0.19(69)	0.21(67)	0.15(60)
Education threshold			0.52	0.73	0.82	0.89	1.13
(No. countries>threshold)			(46)	(38)	(32)	(29)	(22)

Notes: The system has 2 equations, where the dependent variables are the per capita GDP growth rates over each decade. Each equation has a different constant term (not reported)[b]. Other coefficients are constrained to be the same for all periods. Estimation is by the SUR technique. The estimation allows for different error variances in each equation and for correlation of these errors across equations. Education threshold indicates that countries with secondary schooling above this threshold will benefit positively from FDI. The number of countries that satisfy it in 1980 for each regression is in the parenthesis.

The results show that FDI has a statistically insignificant effect on growth. But, the interaction terms for FDI and Schooling has a significantly positive coefficient. When the interaction term is added, the effect of FDI alone on growth is negative and insignificant while the interaction term is positive and significant. The values of these coefficients indicate that countries with secondary school attainment above 0.52 will benefit positively from FDI. In their sample, 46 out of 69 countries satisfy this benchmark. The black-market premium (proxy for distortions in the trade regime), the dummies for Africa and Latin America, political instability are negatively correlated with growth. The measure of financial development (M2/GDP) and the proxy for quality of institutions (Knack and Keefer's measure from the International Country Risk Guide) had also the expected signs.

- *Effects on (total fixed) investment*

Table 2
FDI and aggregate investment rates: panel of two decades (1970–89)

	Regression number					
	2.1	2.2	2.3	2.4	2.5	2.6
Independent variable	Coefficient (standard error)					
Log(initial GDP)	0.0346	0.0344	0.0356	0.0361	0.0324	0.0291
	(0.0102)	(0.0101)	(0.0105)	(0.0108)	(0.0115)	(0.0128)
Schooling	0.0197	0.0210	0.0045	0.0042	0.0007	0.0043
	(0.0109)	(0.0113)	(0.0105)	(0.0106)	(0.0106)	(0.0114)
Government	−0.1217	−0.1283	−0.1367	−0.1276	−0.1256	−0.1224
consumption	(0.0876)	(0.0887)	(0.0843)	(0.0869)	(0.0902)	(0.0905)
Log(1+black	−0.0078	−0.0080	−0.0071	−0.0072	−0.0129	−0.0083
market premium)	(0.0118)	(0.0117)	(0.0105)	(0.0010)	(0.0116)	(0.01155)
FDI	2.2944	2.8230	1.5257	1.5477	1.2641	0.7833
	(0.9919)	(1.6257)	(0.9367)	(0.9456)	(0.9367)	(0.9442)
FDI*schooling		−0.5165				
		(1.2926)				
Sub-Saharan			−0.0647	−0.0653	−0.0454	−0.0449
African dummy			(0.0172)	(0.0177)	(0.0181)	(0.0197)
Latin American			−0.0647	−0.0626	−0.0426	−0.0332
dummy			(0.0158)	(0.0166)	(0.0185)	(0.0186)
Assassinations				−0.0103	−0.0228	−0.0186
				(0.0229)	(0.0226)	(0.0222)
Wars				0.0027	0.0160	0.0166
				(0.0102)	(0.0103)	(0.0102)
Political rights				0.0006	−0.0016	−0.0006
(1 best, 7 worst)				(0.0033)	(0.0033)	(0.0034)
Financial					0.0252	0.0148
depth					(0.0249)	(0.0248)
Inflation					−0.0364	−0.0389
rate					(0.00151)	(0.0151)
Institutions						0.0111
(1 worst, 10 best)						(0.0055)
R^2-adj, individual	0.23(69)	0.22(69)	0.26(69)	0.21(69)	0.17(64)	0.17(58)
periods (No. of obs.)	0.44(69)	0.43(69)	0.55(69)	0.53(69)	0.51(67)	0.55(60)

Notes: The system has 2 equations, where the dependent variables are the average ratios of investment to GDP over each decade. See note to Table 1.

The contribution of FDI to growth could come from complementing or adding to domestic capital and/or being more productive or efficient than domestic investment. They analysed the effects of FDI on total fixed investment and the results suggest that FDI increases investment more than one for one, but the interaction FDI-Human capital was insignificant. This suggests that the complementarity between foreign and domestic investment is not sensitive to the productivity of FDI.

Note that the complementarity effect is not robust to different regression specifications. In fact, except for the baseline specification, the estimated coefficients for FDI are statistically insignificant.

To explore the possibility that FDI is more efficient than domestic investment, they regress growth on FDI controlling for aggregate investment and show that the effect of FDI on growth is significant once the interaction term for FDI and H is included. The value of the educational attainment threshold is 0.88 and is satisfied by 29 countries in the sample.

Conclusions

The effect of FDI on growth depends on the level of human capital available in the host country. There is a strong and positive interaction between FDI and the level of educational interaction (proxy for human capital). The same interaction is not significant in the case of domestic investment. They also find some evidence (not robust) of "crowding in" i.e. FDI complements domestic investment.

Caveat: the paper does not explore the effects of FDI on the level of human capital (training, etc.).

3. MICRO-EVIDENCE AND SPILLOVERS

3.1. Definition, channels, econometric specification, some evidence

a. Definition and channels

Definition (**Smeets, 2008):** "…knowledge spillovers at the firm level as knowledge created by one firm (a multinational enterprise) that is used by a second firm (a host country firm) for which the host-country firm does not (fully) compensate the multinational enterprise". Note that this definition:

- Excludes pecuniary spillovers (gains from quality increase not fully reflected in the price of the good) and competition effects (changes in market structure).
- Different than knowledge transfer i.e. intended diffusion of knowledge which creates no externality.

The literature has identified three main channels (Smeets, 2008) :

- ***Demonstration***

Imitation or reverse engineering of products and processes by host countries of the products and practices of multinationals firms. Scope depends on product/process complexity. This may also apply to managerial/organisational innovations.

- ***Worker mobility (skills acquisition)***

Multinationals will often require skilled labour and invest in training. The movement of workers from the multinational to existing host country firms or the set up new firms can lead to a productivity spillovers.

- ***Upstream and downstream linkages (inter-industry*)**

This involves spillover of knowledge from the multinational enterprise to its suppliers and customers.

Gorg and Greenaway and (2004**)** use a broader definition of knowledge spillovers, adds:

- ***Competition***

Host country firms may be under pressure to use existing technology more efficiently etc.

- ***Export spillovers***

Domestic firms can learn to export from multinationals (see Aitken, Hanson and Harrison, 1997, Barrios, Görg and Strobl, 2003 and Greenaway, Sousa and Wakelin, 2004). Exporting can require fixed costs and host country firms may benefits either from collaboration with multinationals or imitation of export practices (networks etc.).

Table 1: Spillover Channels

Driver	Sources of Productivity Gain
Imitation	• Adoption of new production methods. • Adoption of new management practices.
Competition	• Reduction in X-inefficiency. • Faster adoption of new technology.
Human Capital	• Increased productivity of complementary labour. • Tacit knowledge
Exports	• Scale economies. • Exposure to technology frontier.

Source: Greenaway and Gorg (2004)

b. Econometric specification

According to Smeets (2008), most of the econometric studies estimate models like:

$$y_{ijt} = \beta_0 + \beta_1 FDI_{ijt} + \beta_2 \mathbf{X}_{it} + \beta_3 \mathbf{Z}_{jt} + \varepsilon_{ijt} \qquad (1)$$

where β_1 is the parameter of interest (effect of FDI in firm's own sector)

y_{ijt} : productivity of firm i at time t in sector j

FDI : presence of FDI

$\mathbf{X}$: vector of firm-level control variables that affects productivity (e.g. own investment in R&D, human capital)

$\mathbf{Z}$: vector of industry control variables (e.g. market concentration)

ε : error term

Problems:
- Measure of productivity varies across studies
- Endogeneity of FDI

Demostration effect

- Most studies test a version of (1) but none of them hypothesise how demonstration effects take place.
- Most of the studies implicitly deal with demonstration effect through (horizontal or intraindustry spillover)

Worker Mobility

$$y_{ijt} = \beta_0 + \beta_1 S_{it}^M + \beta_2 \mathbf{X}_{it} + \beta_3 \mathbf{Z}_{jt} + \varepsilon_{ijt}$$

S_{it}^M measures some presence of foreign workers (workers previously employed by multinationals/ subsidiary). β_1 should be positive if there is knowledge spillovers.

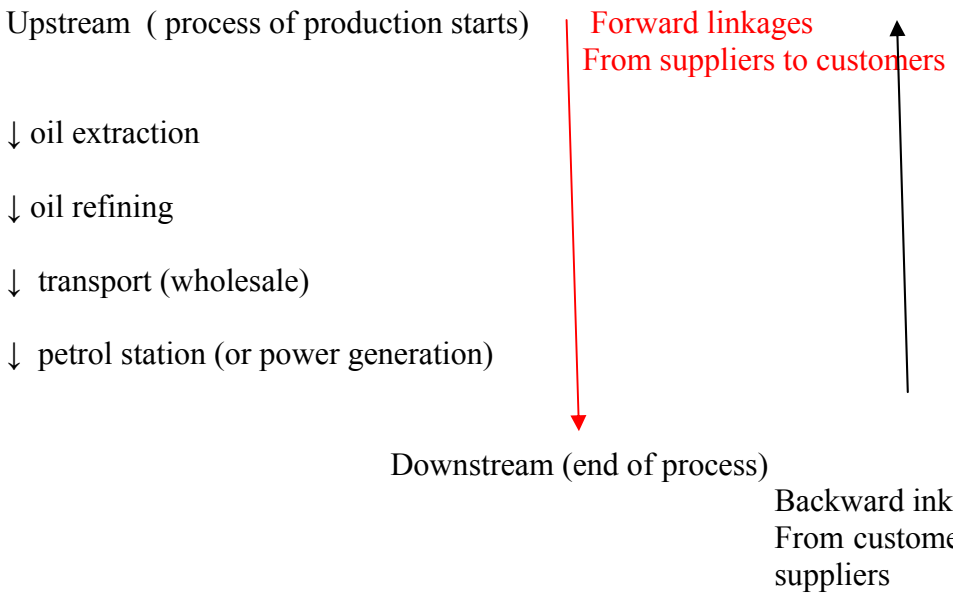
Another way is :

$$w_{ijt} = \beta_0 + \beta_1 S_{it}^M + \beta_2 \mathbf{X}_{it} + \beta_3 \mathbf{Z}_{jt} + \varepsilon_{ijt}$$

where w is (log) wages and i refers to the individual working in firm j. The underlying assumption is that wages are strongly correlated with marginal labour productivity. β_1 should be positive if there is knowledge spillovers.

Empirical studies show that hiring foreign experts increases the wage in the hiring plant; others show that having an owner trained in a multinational increase firm level productivity if the multinational operates in the same sector as the local firm.

Vertical Linkages



Forward linkages: when increased production by upstream firms provides externalities to downstream firms i.e. the effect of a change is transmitted to firms further along in the sequence of production.

Backward linkage: when increased production by downstream firms provides externalities to upstream firms i.e. changes are transmitted back to a previous stage of production

$$y_{ijt} = \beta_0 + \beta_1 FDI_{jt} + \beta_2 \sum_{k \neq j} (\alpha^0_{jkt} FDI_{kt}) + \beta_3 \sum_{k \neq j} \alpha^I_{jkt} FDI_{kt} + \beta_2 \mathbf{X}_{it} + \beta_3 \mathbf{Z}_{jt} + \varepsilon_{ijt}$$

α^0_{jkt} is the output share flowing from industry j to industry k

α^I_{jkt} is the share of input flowing from industry j to industry k

β_1 effect of FDI in firm's own sector (e.g. demonstration effect)

β_2 effect of FDI on sector k on the productivity of firm i in sector j, weighted by the share of output flowing from sector j to k (i.e. backward linkage)

β_3 captures forward linkages

Problem: Measuring knowledge transfer or knowledge spillovers?

c. What does the evidence tell us?

Most empirical studies examine effects of FDI on labour productivity or total factor productivity of domestic firms. The FDI variable is some proxy for the extent of foreign presence: the share of employment or sales in multinationals over total industry employment/sales in a given sector. So, the focus has often been on within-industry spillovers!

Greenaway and Gorg summarise the results of 40 studies on intra-industry (horizontal) spillovers. 19 find statistically significant and positive horizontal spillover effects, but in 10 of these analyses rely on cross-sectional data – possibility of endogeneity bias. Panel data would be more appropriate in a study on productivity (time dimension, firm fixed effects etc control for industry/firm-specific factors that could influence FDI decision). And thus evidence on positive horizontal spillovers is not strong. None of the panel data studies, which find evidence of positive spillovers, are done for developing countries.

Table 2: Papers on intra-industry productivity spillovers

	Author(s)	Country	Year	Data	Aggregation	Result
	Developing Countries					
1	Blomström & Persson (1983)	Mexico	1970	cs	industry	+
2	Blomström (1986)	Mexico	1970/1975	cs	industry	+
3	Blomström & Wolff (1994)	Mexico	1970/1975	cs	industry	+
4	Kokko (1994)	Mexico	1970	cs	industry	+
5	Kokko (1996)	Mexico	1970	cs	industry	+
6	Haddad & Harrison (1993)	Morocco	1985-1989	panel	micro & ind.	?
7	Kokko et al. (1996)	Uruguay	1990	cs	micro	?
8	Blomström & Sjöholm (1999)	Indonesia	1991	cs	micro	+
9	Sjöholm (1999a)	Indonesia	1980-1991	cs	micro	+
10	Sjöholm (1999b)	Indonesia	1980-1991	cs	micro	+
11	Chuang & Lin (1999)	Taiwan	1991	cs	micro	+
12	Aitken & Harrison (1999)	Venezuela	1976-1989	panel	micro	-
13	Kathuria (2000)	India	1976-1989	panel	micro	?
14	Kokko et al (2001)	Uruguay	1988	cs	micro	?
15	Kugler (2001)	Colombia	1974-1998	panel	industry	?
16	López-Córdova (2002)	Mexico	1993-1999	Panel	Micro	-,?
17	Görg and Strobl (2002c)	Ghana	1991-1997	panel	micro	+
	Transition Countries					
33	Djankov & Hoekman (2000)	Czech Republic	1993-1996	panel	micro	-
34	Kinoshita (2001)	Czech Republic	1995-1998	Panel	micro	?
35	Bosco (2001)	Hungary	1993-1997	Panel	Micro	?
36	Konings (2001)	Bulgaria	1993-1997	panel	micro	-
		Poland	1994-1997			?
		Romania	1993-1997			-
37	Damijan et al (2001)	Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia, Slovenia	1994-1998	Panel	Micro	? or -, + only for RO
38	Li et al. (2001)	China	1995	cs	industry	+
39	Smarzynska (2002)	Lithuania	1996-2000	panel	Micro	?
40	Zukowska-Gagelmann (2002)	Poland	1993-1997	panel	micro	-

Notes:

(i) Data: *CS* denotes cross-sectional data, while *panel* denotes use of combined cross-sectional time-series data in the respective analysis

(ii) Aggregation: Use of either *industry* or *micro* (i.e., firm, plant, or establishment) level data in the analysis

(iii) Result: Regression analysis finds a + positive and statistically significant, - negative and statistically significant, ? mixed results or statistically insignificant sign on the foreign presence variable for the aggregate sample.

Source: Gorg and Greenaway and (2004)

d. Why is the evidence for horizontal spillovers not stronger? What explains the neutral or negative effects?

-General: Perhaps foreign firms reduce the productivity of domestic firms through competition effects. Or perhaps there is a lag in domestic firms' learning from multinationals, which short run analyses do not pick up. Also, foreign firms may be able to protect firm specific advantages.

-What affects the speed of adoption of technology?

The extent of spillovers may depend on host country characteristics i.e. mediating factors:

- Absorptive capacity and backwardness :

Findlay (1978): relative **backwardness** and **contagion**. The larger the "technological" distance – the larger are the opportunities for imitation of technology. The extent to which activity of foreign firms pervades the local economy (upstream, downstream networks), the greater the speed of technology adoption/diffusion.

But, also possible that the larger the technology gap, the lower is the quality of technology transferred and the smaller the spillovers. This is because a larger gap can imply lower levels of infrastructure, poorer distribution networks, less human capital, which all affect the type of FDI the country can attract.

$$y_{ijt} = \beta_0 + \beta_1 FDI_{jt} AC_{it} + \beta_2 FDI_{jt} BW_{it} + \beta_3 \mathbf{X}_{it} + \beta_4 \mathbf{Z}_{jt} + \varepsilon_{ijt}$$

Where *AC* measures absorptive capacity and *BW* backwardness (both variables are not always included simultaneously). For e.g. *BW* is frontier level TFP relative to TFP of the firm; *AC* is measured as the firms' highest TFP level at time t-1 relative to the highest TFP in the firm's industry, R&D, human capital, etc.

Note that if there is a correlation between *AC* and *BW* at the industry level, then

$$\frac{dy_{ijt}}{dAC_{it}} = FDI_{jt}\left(\beta_1 + \beta_2 \frac{\delta BW_{it}}{\delta AC_{it}}\right)$$

Note that the direct effect of FDI is positive ($\beta_1>0$), an increase in *AC* will reduce *BW* so the indirect effect captured by $\beta_2 \frac{\delta BW_{it}}{\delta AC_{it}}<0$ is negative.

One simple way out of the problem is to measure AC=1/BW so an increase in BW implies a proportional decrease in AC and vice versa.

- Regional Dimensions

Domestic firms located near multinationals may be more likely to benefit than other firms.

- Regional Effects

$$y_{irt} = \beta_0 + \beta_1 FDI_{rt} + \beta_2[\mathbf{w}_{rs}\mathbf{FDI}_{st}] + \beta_3 \mathbf{X}_{it} + \beta_4 \mathbf{Z}_{rt} + \varepsilon_{irt}$$

Where r and s indicate regions. $\mathbf{w}$ is a matrix of weights that incorporate distance between region r and s , $\mathbf{Z}$ captures region specific characteristics (e.g. region size relative to GDP). If knowledge spillovers are spatially bounded, we would expect β_1 to be positive and β_2 to be insignificant

- Importance of vertical spillovers:

If multinationals prevent transmission of knowledge to domestic competitors in the same industry, it is possible that they increase efficiency of suppliers or customers through input-output linkages (see Blalock G. and P. J.Gertler, 2008 for Indonesia).

3. 2. Evidence on intra-industry spillovers: Aitken and Harrison (1999)

The study examines a) the extent to which joint ventures or wholly owned foreign subsidiaries (i.e. foreign firms) exhibit higher level of productivity than their domestic counterpart and b) the evidence of technological spillovers to domestically owned firms from foreign firms.

The framework

- Multinationals in the manufacturing sector possess non tangible assets (technological know-how, marketing and managerial skills, etc). These assets are gained through experience and can be transferred, at a cost, to subsidiaries that are located in the host country. Then, it is expected that foreign ownership would increase a firm's productivity.

- Domestic firms might also benefit from: experienced workers leaving the foreign firm and working for domestic firms; exposure to new products, new techniques or receive technical support from upstream or downstream foreign firms. Moreover, foreign firms can be a source of demand for domestic inputs and help train employers. In these cases, the presence of foreign firms will increase productivity of domestic firms.

- Foreign firms can also reduce productivity of domestic firms especially in the short run. New foreign firm entrants to the market with lower marginal costs will have an incentive to increase production relative to their domestic counterpart. If so, foreign firms will draw demand from domestic firms who will have to spread their fixed cost over a smaller market and will experience an increase in their unit cost of production.

- Note that the positive effects of foreign firms might shift down the average cost curve of domestic firms AC_0 to AC_1; but the increased foreign firm competition might force domestic firms to move up their AC_1 average cost curve. The net effect for the domestic firm might be an increase in the overall cost of production.

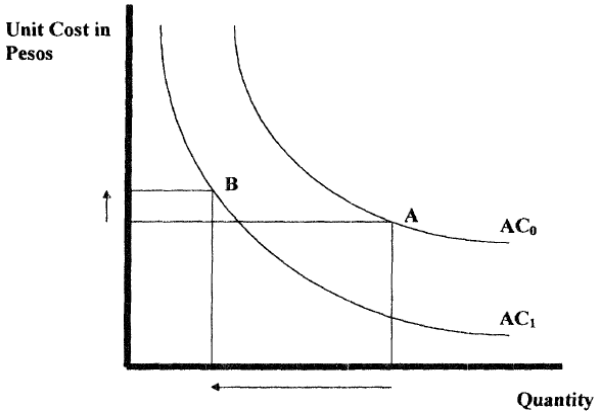


FIGURE 1. OUTPUT RESPONSE OF DOMESTIC FIRMS TO FOREIGN ENTRANTS

The equation estimated is

$$Y_{ijt} = \beta_o + \beta_1 DFI\_Plant_{ijt} + \beta_2 DFI\_Sector_{jt} + \beta_3 DFI\_Plant_{ijt} * DFI\_Sector_{jt} + \beta_4 X_{ijt} + \varepsilon_{ijt}$$

where Y_{ijt} is the (log) of output for plant i in sector j at time t, X_{ijt} are (log) inputs for production (skill labour, unskilled labour, capital), DFI_Plant_{ijt} is the share of equity participation at the plant level (which ranges from 0 to 100) and DFI_Sector_{jt} measures the presence of foreign ownership in the industry (proxied for by foreign equity participation averaged over all plants in the sector, weighted by each plant's share in sectoral employment). If positive spillovers are present, the estimated coefficient of DFI_Sector_{jt} would be positive. The measure is

$$DFI\_Sector_{jt} = \frac{\sum_i FS_{ijt} * Employment_{ijt}}{\sum_i Employment_{ijt}}$$

where FS is the share of plant equity held by foreigners. The interaction term DFI_Plant_{ijt} $*DFI\_Sector_{jt}$ examines whether the spillover effects of FDI vary according to the extent of foreign equity participation in the firm. If the estimated coefficient is positive, then joint ventures benefit from the presence of other foreign firms in the sector.

Data

Annual Encuesta Industrial from Venezuela (Venezuela's National Statistical Bureau) from 1976-1989 except for 1980 – plant-level data for the Venezuelan manufacturing sector.

Technique

OLS with and without industry dummies; also Weighted Least Squares (weight = share of each plant in total annual industry output) to control for firm size; OLS using first, second, third and fourth (log) output differences to control for plant level fixed effects (and unobservable fixed characteristics).

Results

a. Baseline regressions:

OLS (heteroskedasticity corrected):

- $\hat{\beta}_1$ is significantly positive suggesting productivity gains form foreign equity participation.
- $\hat{\beta}_2$ is significantly negative i.e. domestic plants in sectors with more foreign presence are less productive than those with a smaller foreign presence. This suggests a negative impact of foreign investment on the scale of domestically owned production – negative spillover?
- $\hat{\beta}_3$ is significantly positive suggesting that plants with a level of higher foreign equity participation, experience positive productivity spillovers from FDI within the sector.

Note that when the same regression is performed without industry dummies, $\hat{\beta}_2$ becomes significantly positive. This positive association is caused by failure to control for specific industry effects and neglects the fact that FDI tends to favour more productive sectors.

WLS: The results are qualitatively similar to OLS, but the chi square test suggests significant differences between the OLS and WLS estimates (column1 and 3). Therefore, it is possible that the magnitude of spillovers vary systematically across plants according to size.

Difference in Productivity over time: $\hat{\beta}_1$ becomes small and insignificant while $\hat{\beta}_2$ increases in magnitude and remains significantly negative as the lag increases. $\hat{\beta}_3$ remains positive and significant. These results suggest that joint ventures benefit from FDI, but that whether spillovers from FDI in the sector are positive depends on the extent of foreign equity ownership. Firms with a larger share of foreign equity participation experience positive spillovers.

TABLE 1—IMPACT OF FOREIGN OWNERSHIP ON TOTAL FACTOR PRODUCTIVITY: REGRESSING LOG OUTPUT AT THE PLANT LEVEL ON INPUTS AND THE SHARE OF FOREIGN OWNERSHIP AT THE PLANT AND SECTOR LEVELS[a]

	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

[a] All specifications include annual time dummies. All standard errors (denoted in parentheses) are corrected for heteroskedasticity. Unless otherwise specified, other independent variables (not reported here) include log materials, log skilled labor, log unskilled labor, and log capital stock. *Plant_DFI* is percentage of equity capital owned by foreigners. *Sector_DFI* is employment-weighted percentage of equity which is foreign owned at the four-digit ISIC level.

[b] Industry dummies defined at the four-digit ISIC level.

[c] Weights are the share of each plant in total annual industry output. Industry dummies are also included.

[d] Excludes the other independent variables described in note a above.

[e] Coefficients are estimated from a regression of changes in (log) output regressed on changes in (log) materials, skilled labor, unskilled labor, capital stock, changes in foreign investment at the plant and sector level, and annual time dummies.

[f] In column (2), tests for equality of coefficients between ordinary least squares (OLS) and OLS with industry dummies. In column (3), tests for equality of coefficients (excluding the time dummies) between specifications in columns (2) and (3). Bootstrapping routine used to calculate variance-covariance matrix difference for test of OLS versus weighted least squares (WLS). For details, see John Dinardo et al. (1996). In column (2), the critical 5-percent value for the $\chi^2(19) = 30.1$. In column (3), the critical 5-percent value for the $\chi^2(7) = 14.1$. A higher value indicates rejection of the test.

Source: Aitken and Harrison (1999)

b. Regional regressions

Are FDI spillovers greater if foreign firms are located closer? To control for this regional dimension, the authors include both local and regional share variables in the same regression. Regional foreign presence is measured as the share of employment in industry j in region s employed by foreign firms ($Local\_Sector\_DFI_{jst}$).

Applying OLS with and without industry dummies and with and without regional controls, and "within estimates" (subtracts from each variable its plant-specific mean over time) they found little evidence of spillovers from local foreign investment. Moreover, the estimated coefficient of the interaction between $(Plant\_DFI)*(Local\_Sector\_DFI_{jst})$ is negatively significant suggesting that foreign plants do not benefit from the local presence of foreign firms i.e. suggests competition at the local level. But note that:

- the coefficient on *Sector_DFI* over all regions is (significantly) negative
- the estimated coefficient of $(Plant\_DFI)*(Sector\_DFI_{jst})$ is (significantly) positive i.e. positive spillover from foreign firm to joint ventures at countrywide level.

TABLE 2—EFFECTS OF FOREIGN OWNERSHIP IN THE REGION ON TOTAL FACTOR PRODUCTIVITY: REGRESSING LOG OUTPUT AT THE PLANT LEVEL ON INPUTS AND THE SHARE OF FOREIGN OWNERSHIP AT THE PLANT LEVEL, THE SECTOR LEVEL, AND THE LOCAL LEVEL[a]

	OLS with industry dummies[b]		Within estimates[c]	
	(1) No regional controls	(2) With regional controls[d]	(3) No regional controls	(4) With regional controls[d]
Foreign ownership in the plant (*Plant_DFI*)	0.161	0.154	0.063	0.067
	(0.030)	(0.031)	(0.039)	(0.040)
Foreign ownership in the sector and region (*Local_Sector_DFI*)	0.068	0.015	0.035	0.040
	(0.023)	(0.024)	(0.032)	(0.034)
Plant_DFI * *Local_Sector_DFI*	−0.357	−0.271	−0.165	−0.189
	(0.066)	(0.068)	(0.077)	(0.080)
Foreign ownership in the sector over all regions (*Sector_DFI*)	−0.290	−0.289	−0.317	−0.304
	(0.062)	(0.063)	(0.055)	(0.057)
Plant_DFI * *Sector_DFI*	0.694	0.685	0.418	0.415
	(0.190)	(0.197)	(0.206)	(0.215)
Number of observations	43,010	41,333	43,010	41,333
Number of plants	10,257	10,190	10,257	10,190
R^2	0.96	0.96	0.98	0.98

[a] All specifications include annual time dummies. All standard errors (denoted in parentheses) are corrected for heteroskedasticity. Unless otherwise specified, other independent variables (not reported here) include log materials, log skilled labor, log unskilled labor, and log capital stock. *Plant_DFI* is percentage of equity owned by foreigners. *Sector_DFI* is employment-weighted percentage of equity which is foreign owned at the four-digit ISIC level.

[b] Industry dummies defined at the four-digit ISIC level.

[c] Estimated by subtracting from each variable its plant specific mean over all years.

[d] Regional controls include the real skilled wage and energy prices.

c. Small (less than 50 employees) versus large plants (more than 49 employees)

OLS and "within" regressions show that the effects vary depending on plant size. The own-plant effect is robust only for small firms and the spillover effect captured by *Sector_FDI* is negative, but much larger for small plants than large plants (small firms are faced with a larger "market-stealing" effect).

TABLE 3—IMPACT OF FOREIGN OWNERSHIP BY PLANT SIZE: REGRESSING LOG OUTPUT AT THE PLANT LEVEL ON INPUTS AND THE SHARE OF FOREIGN OWNERSHIP AT THE PLANT LEVEL, THE SECTOR LEVEL, AND THE LOCAL LEVEL[a]

	Small plants (less than or equal to 49 employees)				Large plant (greater than 49 employees)			
	(1) OLS	(2) Within[b]	(3) OLS	(4) Within[b]	(5) OLS[c]	(6) Within[b,c]	(7) OLS[c]	(8) Within[b,c]
Foreign ownership in the plant (*Plant_DFI*)	0.104	0.100	0.167	0.182	0.121	−0.018	0.174	−0.123
	(0.052)	(0.055)	(0.065)	(0.084)	(0.031)	(0.049)	(0.036)	(0.073)
Foreign ownership in the sector and region (*Local_Sector_DFI*)	—	—	0.061	0.072	—	—	−0.020	0.196
			(0.035)	(0.058)			(0.032)	(0.218)
Plant_DFI * *Local_Sector_DFI*	—	—	−0.395	−0.359	—	—	−0.203	−0.285
			(0.138)	(0.170)			(0.080)	(0.247)
Foreign ownership in the sector over all regions) (*Sector_DFI*)	−0.349	−0.340	−0.366	−0.363	−0.127	−0.214	−0.128	−0.180
	(0.074)	(0.074)	(0.076)	(0.093)	(0.105)	(0.111)	(0.113)	(0.173)
Plant_DFI * *Sector_DFI*	1.184	0.046	1.475	0.559	0.351	0.411	0.590	1.033
	(0.595)	(0.564)	(0.584)	(0.837)	(0.205)	(0.279)	(0.225)	(0.372)
Number of observations	29,179	29,179	28,069	28,069	13,831	13,831	13,264	13,264
Number of plants	7,620	7,620	7,563	7,563	2,637	2,637	2,627	2,627
R^2	0.90	0.96	0.90	0.94	0.90	0.94	0.90	0.96

[a] Industry dummies included in all OLS specifications. All standard errors (denoted in parentheses) are corrected for heteroskedasticity. Unless otherwise specified, other independent variables (not reported here) include log materials, log skilled labor, log unskilled labor, and log capital stock. *Plant_DFI* is percentage of equity owned by foreigners. *Sector_DFI* is employment-weighted percentage of equity which is foreign owned at the four-digit ISIC level.

[b] Estimated by subtracting from each variable its plant-specific mean over all years.

[c] Regional controls include the real skilled wage and energy prices.

Overall Effects of Foreign Investment

On the one hand, firms with higher foreign participation have positive productivity gains; but on the other hand, plants that do not receive foreign investment suffer productivity declines as a result of increased foreign activity within the industry. To determine the net effect, the authors use the estimated coefficients of the different regression specifications and the actual values of *Plant_DFI*, *Sector_FDI* and *Local_Sector_FDI* and get the net effect of DFI in each plant. Then, they sum the effects across all firms, weighted by the value of the firm's production to derive the net effect on Venezuelan manufacturing for each year. Averaging the net effects over all years, the effect is small and positive if the WLS is used for the calculation; but negative when the OLS or within plant estimates are used.

TABLE 4—NET IMPACT OF FOREIGN OWNERSHIP ON TOTAL FACTOR PRODUCTIVITY IN THE ECONOMY: WEIGHTED REGRESSION OF OUTPUT AT THE PLANT LEVEL ON INPUTS AND THE SHARE OF FOREIGN OWNERSHIP AT THE PLANT AND SECTOR LEVELS[a]

	National effects only		National and regional effects		
	OLS[b] (1)	Weighted least squares[c] (2)	OLS[d] (3)	Within: Small plants[e] (4)	Within: Large plants[f] (5)
Foreign ownership in the plant (*Plant_DFI*)	0.105	0.142	0.154	0.182	−0.123
	(0.027)	(0.039)	(0.031)	(0.084)	(0.073)
Foreign ownership in the sector and region (*Local_Sector_DFI*)	—	—	0.015	0.072	0.196
			(0.024)	(0.058)	(0.218)
Plant_DFI * *Local_Sector_DFI*	—	—	−0.271	−0.359	−0.295
			(0.068)	(0.170)	(0.247)
Foreign ownership in the sector over all regions (*Sector_DFI*)	−0.267	−0.206	−0.289	−0.363	−0.180
	(0.061)	(0.155)	(0.063)	(0.093)	(0.173)
Plant_DFI * *Sector_DFI*	0.356	0.314	0.685	0.559	1.033
	(0.181)	(0.226)	(0.197)	(0.837)	(0.372)
Net impact of DFI[g]	−0.0068	0.0004	−0.0072	−0.0100	−0.0043
Number of observations	43,010	43,010	41,333	28,069	13,264

[a] All specifications include annual time dummies. All standard errors (denoted in parentheses) are corrected for heteroskedasticity. Unless otherwise specified, other independent variables (not reported here) include log materials, log skilled labor, log unskilled labor, and log capital stock. *Plant_DFI* is percent of equity owned by foreigners. *Sector_DFI* is employment-weighted percent of equity which is foreign owned at the four-digit ISIC level.

[b] Coefficients are taken from the first column of Table 1.

[c] Coefficients are taken from the third column of Table 1. Weighted by the plant's share of total employment.

[d] Coefficients are taken from the second column of Table 2.

[e] Coefficients are taken from the fourth column of Table 3.

[f] Coefficients are taken from the eighth column of Table 3.

[g] The net impact of DFI is calculated by multiplying the coefficients in the first five rows by their actual values and then adding them together for each plant. We then sum this net effect across all plants, weighted by each plant's share of employment. The reported net effect is the average across all years.

Conclusions

Foreign equity participation is positively correlated with plant productivity ("own plant effect") only in the case of small firms. However, the effect of spillovers from joint ventures to plants with no foreign investment is negative. The net effect of foreign investment on the Venezuelan manufacturing sector seems to be small, so the gains seem to be internalised by joint ventures. No evidence of productivity spillovers from foreign firms to purely domestically owned firms.

Remarks

Javorcik (AER 2004) adds to the understanding of externalities generated by FDI in the host country by using firm level data over 1996-2000 from Lithuania to analyse FDI spillovers on the productivity of domestic firms. The paper is motivated by the fact that most of the studies have failed to find a significant effect or found a negative effect of horizontal spillovers (i.e. the effect of MNCs has on domestic firms in the same sector) like in the case of Aitken and Harrison for

Venezuela. Instead, the paper examines whether the productivity of domestic firms is correlated with the presence of multinationals operating in the same sector (horizontal spillover), upstream sectors (forward spillover i.e. from supplier to buyer) and in downstream sectors (backward spillover i.e. from buyer to supplier). Domestic firms might benefit from improved and/or less costly intermediate inputs produced by multinational in upstream sectors. In terms of backward spillovers taking place between foreign firms and their local suppliers, benefits can arise through a) direct knowledge transfer from the foreign firm to its local supplier, b) higher requirement for product quality and on time delivery introduced by multinationals which provides incentives to local suppliers to "upgrade", c) multinational demand for intermediate products allow local suppliers to reap the benefits of economies of scale.
The estimation results show the presence of positive productivity spillovers taking place through backward linkages in Lithuania. No evidence of horizontal and upstream.

Recently, **Blalock G. and P. J. Gertler** (JIE 2008) study technological benefits to local Indonesian firms through vertical backward linkages. They found strong evidence of productivity gains, larger competition and lower prices among local firms that supply to foreign firms.

4. DETERMINANTS OF FDI (Asiedu, 2006)

General perception: FDI in Sub-Saharan Africa (SSA) driven by natural resources and market size. This is supported by data: Angola, Nigeria and South Africa from 2000 to 2002 absorbed about 65 per cent of FDI flows to the region.

This suggests: FDI is determined by an uncontrollable factor, and policies can play little role and most SSA countries will receive little FDI because of small market size or less resources. FDI in natural resource intensive industries may not lead to positive spillovers.

Asiedu examines the following questions: What are the determinants of FDI to SSA? Can small countries or countries with little natural resources attract FDI? How important are natural resources and market size vis-à-vis government policy and host country's institutions in attracting FDI to SSA?

Study looks at the effects of natural resources, market size, physical infrastructure, human capital, the host country's investment policies, the reliability of the host country's legal system, corruption and political instability on FDI flows. It uses a panel dataset for 22 countries in SSA between 1984-2000. Literature on FDI to Africa is surprisingly scarce.

Dependent variable is ratio of net FDI flows to GDP (source: World Bank).

Estimates country fixed effects model:

$$(FDI/GDP)_{it} = \alpha + \beta_1 NATEXP_{it} + \beta_2 GDP_{it} + \theta(\text{Policy Variables})_{it} + \gamma(\text{Institutional Variables})_{it} + \mu(\text{Political Risk Variables})_{it} + \varepsilon_{it}$$

i refers to country and NATEXP to the share of oil and minerals in total exports.

Main results:

Countries with more natural resources or larger markets (GDP) attract more FDI.
But, good infrastructure, an educated labour force, macroeconomic stability, openness to FDI, an efficient legal system, less corruption and political stability also promote FDI.

A decline in corruption from the level of Nigeria to that of South Africa has the same positive effect on FDI as increasing the share of fuels and minerals in total exports (NATEXP) by about 34.84 per cent.

Also, an improvement in the host country's FDI policy from that of Nigeria to that of South Africa has the same positive effect on FDI as increasing NATEXP 23.01 per cent.

A similar change in corruption and rule of law will have the same effect as increasing GDP by 0.37 per cent and 0.25 per cent, respectively.

Also, an increase in the literacy rate from the level of Nigeria to that of South Africa would raise FDI by same amount as raising NATEXP by as much as 91.8%.

Therefore, the results suggest that countries that have small markets or countries that lack natural resources can attract FDI by improving investment policy and institutions.

Table 4
Fixed effects estimation:
Results using the human capital variable (LITERACY)

The dependent variable is 100*FDI/GDP

Variables	(1)	(2)	(3)
Intercept	-56.472** (0.010)	-66.890*** (0.003)	-59.686*** (0.006)
Market size =Lag of [Log (GDP)]	2.335** (0.024)	2.821*** (0.007)	2.484** (0.017)
Natural resources = Share of fuel & minerals in exports (%)	0.025** (0.049)	0.027** (0.032)	0.027** (0.031)
Policy variables:			
Human capital = Literacy rate (%)	0.064*** 0.009)	0.060** (0.014)	0.061** (0.012)
Macroeconomic instability = Lag (inflation rate)	-0.013** (0.011)	-0.012** (0.014)	-0.012** (0.019)
FDI policy = Lag (Openness to FDI)	0.197** (0.015)	0.169** (0.035)	0.173** (0.031)
Institutional variables:			
Lag (Corruption)	-0.357** (0.037)	-0.384** (0.024)	-0.338** (0.048)
Effectiveness of the rule of law	0.499*** (0.000)	0.497*** (0.000)	0.513*** (0.000)
Political risk variables			
Lag (No. of coups)	-1.201*** (0.009)		
No. of riots		-0.231** (0.010)	
No. of assassinations			-0.626*** (0.008)
R^2	0.492	0.491	0.494
No. of countries	21	21	21
No. of observations	137	137	137

Notes: P-values are in parenthesis and ***, **, and * denote significance at 0.01, 0.05 and 0.10 levels respectively.

Source: Asiedu (2005)

Table 5
Fixed effects estimation results using the infrastructure variable (INFRAC)

The dependent variable is 100*FDI/GDP

Variable	(1)	(2)	(3)
Intercept	-44.881** (0.039)	-58.408*** (0.009)	-48.567** (0.026)
Market size =Lag of [Log (GDP)]	1.830* (0.070)	2.462** (0.017)	1.998** (0.048)
Natural resources = Share of fuel and minerals in exports (%)	0.035** (0.015)	0.036** (0.011)	0.037*** (0.009)
Policy variables:			
Infrastructure = Lag of (log [phones per 1000 population])	1.526*** (0.002)	1.325*** (0.006)	1.469*** (0.002)
Macroeconomic instability = Lag (inflation rate)	-0.013** (0.016)	-0.013** (0.024)	-0.012** (0.03)
FDI policy: Lag (openness to FDI)	0.225** (0.011)	0.191** (0.030)	0.197** (0.024)
Institutional variables:			
Lag (corruption)	-0.474** (0.015)	-0.486** (0.014)	-0.45** (0.021)
Effectiveness of the rule of law	0.528*** (0.000)	0.533*** (0.000)	0.545*** (0.000)
Political risk variables			
Lag (no. of coups)	-1.380*** (0.008)		
No. of riots		-0.215** (0.034)	
No. of assassinations			-0.688** (0.010)
R^2	0.453	0.439	0.451
No. of countries	22	22	22
No. of observations	140	140	140

Notes: P-values are in parenthesis and ***, **, and * denote significance at 0.01, 0.05 and 0.10 levels respectively.

Source: Asiedu (2005)

Table 6
Estimated equivalent effect of a change in the policy and institutional variables vis-à-vis NATEXP and GDP for the regressions using LITERACY and COUPS (column 1 of Table 4)

	Nigeria	South Africa	Estimated coefficient[a]	Equivalent effect on NATEXP (%)[b]	Equivalent effect on GDP (%)[c]
Institutional variables					
Corruption	4	1.56	0.357	34.84	0.37
Rule of law	1.67	3.28	0.499	32.14	0.34
Policy variables					
Openness to FDI	4.69	7.61	0.197	23.01	0.25
Literacy rate (%)	48.04	83.90	0.064	91.80	0.98
Inflation rate	15.44	7.61	0.013	4.07	0.04

Notes: [a] These are the absolute values of the estimated coefficients from Column 1 of Table 4.

[b] The equivalent effect of a change in corruption from the level of Nigeria to that of South Africa is given by (4-1.56)*.357/.025, where 0.025 is the estimated coefficient of NATEXP (column 1 of Table 4).

[c] The equivalent effect of a change in corruption from the level of Nigeria to that of South Africa is given by (4-1.56)*.357/2.335, where 2.335 is the estimated coefficient of GDP (column 1 of Table 4).

Source: Asiedu (2005)