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Threshold Effects in the relationship between FDI and Import Productivity growth In Latin America and the Caribbean.

By

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Abstract

The theoretical literature on the impact of FDI on growth in developing countries makes strong claims about the extent of technology transfers and spillover effects from trans national corporations (TNCs) in developing countries. It is argued that apart from contributing to domestic investment, they enhance local technology capacity, and assists in innovation and technology transfer and generally strengthens the competitive environment in a host country. Such claims reflect the views of a variety of writers including Solow (1956), Romer (1993) De Mello (1997) and others, whether such transfers takes place through knowledge or through the imports of machinery and equipment.

This paper examines the impact of FDI on import productivity growth in Latin America and the Caribbean and finds strong evidence of threshold effects with respect to the level of human capital. The implication is that raising the level of domestic innovation is important for benefiting fully from FDI in the Caribbean and Latin America.

Introduction

This paper examines the impact of inward foreign direct investment on economic growth in the Caribbean and Latin America, with a view to identifying the set of policy variables that are most effective in improving the efficiency of inward foreign direct investment (FDI). This is an important issue despite the fact that a great deal of analysis has already been done on the relationship between FDI and growth. The reasons for continuing interest in this area are many, among which are the following: First, the literature on the impact of FDI on growth has been mixed despite the number of firm, country level and panel data studies on this subject(Carkovic and Levine 2005, Lipsey and Sjoholm 2004). Secondly FDI is promoted in the development literature as a major source of transfer of knowledge and technology to developing countries. Thirdly, the policy emphasis on promoting FDI with excessive incentives in both Latin America and the Caribbean raises serious issues about the impact of FDI in relation to revenue losses from concessions especially at a time of fiscal stress[1].

Fourthly, there is an emerging literature that argues that the absorptive capacity of developing countries was the single most important factor in determining how much countries benefiting from FDI. For example studies of the Indonesian manufacturing sector found that such capacity might be important if local firms are to benefit from spillovers (Blalock and Gertler, 2004;Todo and Miyamoto 2006). If this assessment was correct, then energies and resources might be better placed on building a local domestic

[1] Lipsey et al (2004) argued that while there is disagreement in the academic literature policy makers have made the judgment that FDI is valuable to their countries.

capacity to innovate which can complement FDI rather than to merely provide incentives to raise the level of FDI inflows (James 2006).

While governments of the Latin American and Caribbean region have provided fiscal incentives and implemented economic reforms intended to attract FDI inflows, the empirical evidence surrounding the impact of FDI on economic growth of the region was inconclusive. For example, Bengoa and Sanchez- Robles (2003) studied a sample of 18 Latin American countries and found a positive correlation between FDI and economic growth in countries with adequate human capital, economic stability and liberalized markets. Similar results were reported by Tondl and Fornero (2010) who examined the sectoral and spillover effects of FDI in Latin America and found that FDI in manufacturing, transport and telecommunications resulted in spillovers to nearly all other sectors. However, Porzecanski and Gallgher (2007) reviewed the literature on FDI and economic reform in Latin America and concluded that despite significant FDI inflows since the implementation of reforms, spillovers have been limited. In the case of the Caribbean, it has been argued that there is insufficient research on the role of FDI in these small island developing states (Read 2007). Two important facts however need to be borne in mind when examining the importance of FDI to the region. The first is that, with the exception of a few countries in Latin America[2], FDI may have heightened the specialization in a narrow range of primary price taking activities with very little spillover to domestic firms and activities. Secondly the Caribbean and Latin America continue to largely produce low technology manufactures and services (ECLAC 2010). For example, primary products, low technology manufactures and natural resource based

[2] The exceptions are Brazil and Mexico.

manufactures predominate. This paper employs a threshold panel data approach along the lines of Hanson (1999) to examine the relationship between FDI growth and growth in import productivity in the Caribbean and Latin America. We examine the productivity of imports rather than percapita income or some other ratio because of the fact that a majority of the economies are extremely open and the foreign exchange constraint, due to current account imbalances, is often binding. Thus improved import productivity is a way of using imports efficiently while dampening the constraint. The paper is divided into six sections, and the next section examines briefly the core literature on FDI and growth. Section three examines the theoretical formulation with informs the estimation and the threshold panel data approach. Section four describes the data set used and discusses the panel data set up while section five reports the estimation results. The last section concludes.

Review of the Literature

The theoretical literature suggests that FDI has multiple effects on economic growth. In the Neo classical growth model, FDI increases capital accumulation which improves productivity and fosters economic growth (Solow 1956). It is also argued that technology transfers from TNCs allow developing countries to acquire new techniques of production that contribute to higher productivity of capital and labour (De Melo 1997). FDI is also expected to contribute to economic growth through the introduction of new management ides and the promotion of competition.

The recent literature has been influenced by the endogenous growth accounting models along the lines of Romer (1986) and Lucas (1988) who emphasize endogenous technological change and knowledge spillovers. From the viewpoint of endogenous growth models, FDI promotes growth through technology transfers and spillovers that enhance productivity in the host economy. Spillovers may occur in various ways. Increased competition created by the entry of TNCs can put pressure on domestic firms to introduce improved technology. In cases where TNCs establish linkages with domestic firms, for example as suppliers, the domestic firms may need to upgrade their technology and labour force in order to meet the requirements of the TNCs. Finally, some domestic firms may choose to upgrade their technology in an attempt to imitate the TNCs. However, it is now accepted that the extent to which an economy can benefit from spillovers is dependent on the host country's absorptive capacity. Empirical studies suggest that an important determinant of absorptive capacity is human capital. Borensztein et. al. (1998) found that a given threshold level of human capital has to be available in order for the host country to take advantage of the spillovers of FDI. Studies of Indonesian manufacturing firms found a positive relationship between the research and development activities of domestic firms and their ability to benefit from spillovers (Takii 2005, Todo and Miyamota 2002, 2006). Further empirical evidence of the critical importance of absorptive capacity has been provided by Blalock and Gertler (2004) who also studied Indonesian manufacturing firms and found that the domestic firms with more educated employees were able to adopt more technology from foreign firms.

Other research highlights the importance of imported goods as channels for international knowledge diffusion (Coe and Helpman 1995). While Coe and Helpman examined total imports, the view that imports embody knowledge that can enhance productivity and growth is also supported by studies that have found a positive relationship between imported equipment and economic growth (Dulleck and Foster 2008, Mazumdar 2001, Lee 1995). While it is recognized in the literature that both FDI and imported goods can promote economic growth through positive externalities associated with technology transfer, there are no empirical studies on the impact of FDI on import productivity. This study fills a gap in the literature by examining the relationship between FDI and import productivity in developing countries.

The import productivity concept recognizes that developing countries are constrained by the deficit on the current account of the balance of payments as they and rely heavily on imports of a variety of goods for production (James 2006; Alleyne 2006; De Benedictis 1998; Lewis 1950, 1964). It could even be argued that some consumption goods can be seen as part of the production process if they are seen as incentive goods that motivate individuals to create additional income. The fundamental challenge is how to reduce the import capacity constraint (Best 1968, Levitt and Best 1969) in order to conserve the scare resource which is foreign exchange. The saving of foreign exchange due to efficiency in the use of imports is key to expanding exports through production, while at the same time lowering the constraint on the current account of the balance of payments.

Lewis (1950:1954) has pointed to the excessive and inefficient use of intermediate imports as a constraint to growth and its impact on employment.[3] If imports are used productively and are complements to domestic investment then the productivity of investment should increase and subsequently enhance growth. Imports are also a source of advanced technologies and when they are complementary to domestic investment they can have important growth effects. James (2006) argues that import productivity growth is likely to be optimized through a relatively faster growth of investment in domestic physical capital per unit of imports relative to the import intensive sector[4] and through relative faster growth in human capital. This issue is particularly important for the Caribbean economies given the limited fiscal space, high external debt and even more critically an expanding current account deficit.

Theoretical Formulation

We assume an economy producing goods along the following lines of a production function as follows:

(1) $$\mathbf{Y_t = A\phi\left(K_t^{\mu} L_t^{\alpha} H_t^{\beta} M_t^{1-\alpha-\mu}\right)}$$

Y= total output.
A=efficiency of production
K= total capital stock
L= total employed labour
H=level of human capital
M= imports of goods other than consumer goods.

[3] Lewis's proposal for import substitution
[4] Import intensive sector are those that do not employ and significant amount of domestic resources either physical or human.

The indices on physical capital, labour, imports and human capital have been constructed to show increasing return to scale among all the variables since $\mu + \alpha + \beta + (1-\alpha) = 1 + \beta + \mu > 1, \mathbf{for}\ \beta > 0.$ At the same time, there are constant returns between capital, labour and imports. Rewriting (1) in terms of imports per unit of output allows the relationship to be stated as,

(2) $\mathbf{y_t} = \frac{\mathbf{Y_t}}{\mathbf{M_t}} = \mathbf{A}\phi\left(\mathbf{k_t^{\mu} l_t^{\alpha} H_t^{\beta}}\right)$, where k is capital per unit of imports and *l* is the labour force per unit of imports and H is the level of education. Thus the relationship is written in terms of output per unit of imports or import productivity. Conceptually import of capital and intermediate goods are the appropriate measure to employ in this analysis, however, consistent time series observation on these variables are unavailable for the countries of interest and as a result, total imports was employed.

We assume that the total capital stock per unit of imports, K/M is made up of domestic capital k_d and foreign capital k_f measured in units of imports and that the level of human capital H, is a function of the level of capital employed. Thus

In (3) $\mathbf{k} = \mathbf{k_d} + \mathbf{k_f}$, where $\mathbf{k} = \mathbf{K}/\mathbf{M}$, $\mathbf{k_d} = \mathbf{K_d}/\mathbf{M}$ and $\mathbf{k_f} = \mathbf{K_f}/\mathbf{M}$

And in (4) $\mathbf{H} = \left[\mathbf{k_d k_f^{\delta}}\right]^{\eta}$, where δ and η are the marginal and intertemporal elasticities of substitution between domestic capital and foreign capital goods per unit of imports. Thus there are complementarities between the two types of capital which both affect H. Given that imports are also a part of k_f the elasticity with respect to this variable may not be the true elasticity. If we substitute for k_t and H into equation (2) we get the following expression.

$$(5)\quad \mathbf{y_t} = \mathbf{A}\phi\left(\mathbf{k_f^{\mu+\delta\eta\beta}}\ \mathbf{k_d^{\mu+\eta\beta}}\ \mathbf{l^{\alpha}}\right)$$

If we rewrite (5) in an estimation context to take account of the panel nature of our data set we have.

$$(6)\quad \mathbf{y_{it}} = \mathbf{A_{it}}\mathbf{k_{f_{it}}^{\mu+\delta\eta\beta}}\ \mathbf{k_{d_{it}}^{\mu+\eta\beta}}\ \mathbf{l^{\alpha}}\boldsymbol{\varepsilon}_{\mathbf{it}}$$

Taking the log difference in equation (6) gives (7) the growth rate of income per unit of imports , y_{it} , where I is the country index and t is the period.

$$(7)\quad \Delta\mathbf{y_{it}} = \Delta A_{\mathbf{it}} + (\mu + \eta\beta)\Delta\mathbf{k_{d_{it}}} + (\mu + \delta\eta\beta)\Delta\mathbf{k_{f_{it}}} + \alpha\Delta\mathbf{l} + \Delta\boldsymbol{\varepsilon}_{\mathbf{it}}$$

We assume that $\Delta\mathbf{A_{it}}$, the growth of technology can be specified as a function of the following form.

$$(8)\quad \Delta\mathbf{A_{it}} = \gamma_0 + \gamma_1\mathbf{H_{it}} + \gamma_2\mathbf{H_{it}}\Delta\mathbf{k_{d_{it}}} + \gamma_3\mathbf{H_{it}}\Delta\mathbf{k_{f_{it}}}$$

Where the $\Delta\mathbf{A_{it}}$ depends on an exogenous technology level, γ_0, while the variables $\mathbf{H_{it}}\Delta\mathbf{k_{d_{it}}}$ **and** $\mathbf{H_{it}}\Delta\mathbf{k_{f_{it}}}$ capture spillover effects represented by the relationship between the level of human capital and changes in domestic and foreign investment per unit of imports. In this case the level of technology diffusion depends on both domestic and foreign investment. This relationship may also contain institutional variables which help or hinder the development of technical progress. Equation (8) can be modified to account for sectoral spillover effects in the relationship between the level of human capital and investment. The overall formulation after substituting equation (8) in to equation (7) is as follows;

$$(9)\quad \Delta\mathbf{y_{it}} = \gamma_0 + \gamma_1\mathbf{H_{it}} + \gamma_2\mathbf{H_{it}}\Delta\mathbf{k_{d_{it}}} + \gamma_3\mathbf{H_{it}}\Delta\mathbf{k_{f_{it}}} + \gamma_4\Delta\mathbf{k_{d_{it}}} + \gamma_5\Delta\mathbf{k_{f_{it}}} + \gamma_6\Delta\mathbf{l} + \Delta\boldsymbol{\varepsilon}_{\mathbf{it}}$$

Equation (9) is the equation to be estimated and in this formulation:

$\gamma_4 = \mu + \eta\beta$, $\gamma_5 = (\mu + \delta\eta\beta)$, $\gamma_6 = \alpha$.

This relationship suggests that the growth in output per unit of intermediate imports is related to the level of human capital, the interaction between the level of human capital and the growth in domestic and foreign capital stock per unit of imports, the changes in domestic and foreign capital stock and the growth in the labour force per unit of imports. The constant γ_0 which is exogenous technical progress might also be proxied by variables picking up fixed and time effects including financial variables and variable reflecting macroeconomic uncertainty. The final formulation was the following equation as follows:

$$\Delta y_{it} = \gamma_0 + \gamma_1 H_{it} + \gamma_2 H_{it}\Delta k_{d_{it}} + \gamma_3 H_{it}\Delta k_{f_{it}} + \gamma_4 \Delta k_{d_{it}} + \gamma_5 \Delta k_{f_{it}} + \gamma_6 \Delta l + \gamma_7 \Delta m2GDP_{it} + \gamma_8 \Delta lopen_{it} + \Delta\varepsilon_{it} \quad (10)$$

Where the last two variables are the log changes in m2 to GDP ratio designed to capture some level of economic uncertainty and change in openness defined as the log ratio of exports plus imports to GDP. An important consideration in our analysis is that there may be non linearities among some of the variables of interest and the question is how to model these. One approach might be to estimate the thresholds by linear splines however the thresholds may not be known. We employ Chan's approach to estimating the threshold effects on a variety of threshold variables which is based on the original panel threshold model of Hanson (1999)

We are interested in understanding non linearities between the growth in output per unit of imports and the complementarities among the following variables $\boldsymbol{\gamma}_2\mathbf{H}_{\mathbf{it}}\Delta\mathbf{k}_{\mathbf{d}_{\mathbf{it}}}$ **and** $\boldsymbol{\gamma}_3\mathbf{H}_{\mathbf{it}}\Delta\mathbf{k}_{\mathbf{f}_{\mathbf{it}}}$ .We illustrate the threshold relationship as the interaction between the level of human capital H_{it} and the change in foreign direct investment in the case of a double threshold which is illustrated as follows:

(11) $\boldsymbol{\gamma}_2\mathbf{H}_{\mathbf{it}}\Delta\mathbf{k}_{\mathbf{f}_{\mathbf{it}}} = \boldsymbol{\gamma}_{21}\ \mathbf{I}(\mathbf{H}_{\mathbf{it}} \leq \boldsymbol{\lambda}_1) + \boldsymbol{\gamma}_{22}\mathbf{I}(\boldsymbol{\lambda}_1 < \mathbf{H}_{\mathbf{it}} \leq \boldsymbol{\lambda}_2) + \boldsymbol{\gamma}_{23}\mathbf{I}(\boldsymbol{\lambda}_2 < (\mathbf{H}_{\mathbf{it}}))$

Note that I(.) is the indicator function and λ_1 is the estimated threshold. When $\mathbf{H}_{\mathbf{it}} \leq \boldsymbol{\lambda}_1$, the coefficient γ_{21} refers to the impact of foreign direct investment on growth in regime one, or the low regime. On the other hand, when the coefficient is $> \boldsymbol{\lambda}_1$, **but** $\leq \boldsymbol{\lambda}_2$ it refers to the impact of observations in a higher regime in threshold one. The case in which $\mathbf{H}_{\mathbf{it}} > \boldsymbol{\lambda}_2$ refers to the observations at the second threshold in an even higher regime. In order to estimate the model we must estimate the threshold variable λ_1 as the variable that minimizes the concentrated sum of squares residual from a least squares regression. Assuming that the threshold variable were known then the model could be estimated by OLS, but since it is unknown then it has to be estimated along with the other parameters. Following Hanson(1999) the threshold parameter is estimated as the value that minimizes the sum of squared errors from the least squares regression. In order to determine whether the threshold is statistically significant, we are testing, in the single threshold case for example, the null hypothesis that $\boldsymbol{\gamma}_{21} = \boldsymbol{\gamma}_{22}$. Since the classical tests do not follow a normal distribution Hansen (1999) bootstrap method is used to simulate the asymptotic distribution of the likelihood ratio test of the following equation.

(12) $F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$, where S_0 is the error sum of squares obtained from estimating an equation with equation with a single threshold under the null of no threshold, while S_1 and $\hat{\sigma}^2$ are the error sum of squares and residual variance from the threshold panel model. Once the threshold value is found confidence intervals can used to determine whether the threshold value is consistent with the true value of the threshold based on an likelihood ratio(LR) test (Hanson 1999).

Bai and Perron (1998) have shown that multiple thresholds can be determined and if computed sequentially can be consistent. Thus in the case of a second threshold, the procedure is basically a three stage process as follows: In the first stage a procedure similar to that of a single threshold is employed and this yields the estimate $\hat{\gamma}_1$. After fixing this threshold parameter, the second stage estimates a second parameter $\hat{\gamma}^{w}{}_2$ minimizing the error sum of squares in (10). In the final stage the first threshold parameter is again estimated but holding fixed the second threshold parameter. The new estimates $\hat{\gamma}_1$ and $\hat{\gamma}_2^w$ have similar asymptotic distributions as in the case of a single threshold and this allows for confidence intervals to be constructed. Suppose the null of a single threshold is rejected then a further test is required to determine whether a second threshold is significant. A new bootstrap procedure which simulates the distribution of a new statistic, defined in (13) as $F_2 = \frac{S_1(\hat{\gamma}_1) - S_2^w(\gamma_2^w)}{\hat{\sigma}^2}$. Here S_1 is the error sum of squares obtained from the first stage estimate, and S_2^w is the error sum of squares obtained from the second stage and finally $\hat{\sigma}^2$ is the residual variance in the second stage of the estimation.

Description of the Data set

The objective was to employ the full complement of countries in Latin America and the Caribbean, however, due to data gaps, only data for twenty one countries could be used over the period 1980 to 2007.

Table 1: Percapita Income, Population, Land Area and Openess

	Per capita income, 2007 (Constant 2000 USD)	Population, 2007	Land Area (sq km.)	Openness, 2007
Argentina	9359.6	39490465	2736690	45.0
Barbados	11509.0	254543	430	104.8
Bolivia	1125.0	9524495	1083300	72.9
Brazil	4290.5	190119995	8459420	25.5
Chile	6077.3	16636135	743800	80.0
Colombia	2955.3	44359445	1109500	34.9
Costa Rica	5123.7	4458782	51060	102.5
Dominican Republic	3490.9	9813686	48320	66.3
Ecuador	1680.5	13341817	276840	66.8
El Salvador	2621.7	6106761	20720	74.4
Guatemala	1877.8	13353769	107160	67.9
Haiti	387.6	9720086	27560	45.6
Honduras	1410.1	7174129	111890	129.9
Jamaica	3861.5	2675800	10830	79.7
Mexico	6561.3	105280515	1943950	58.2
Panama	5228.2	3343341	74340	155.1
Paraguay	1458.8	6126643	397300	104.0
Peru	2692.2	28508481	1280000	51.1
Trinidad and Tobago	10738.0	1328216	5130	96.1
Uruguay	8060.6	3323906	175020	55.7
Venezuela, RB	5745.7	27483000	882050	54.3

Source: WDI 2009 *ratio of (exports + imports) to GDP
…..not available

The countries represent a heterogeneous group in terms of population, size, land area, per capita income and the usual measure of openness. For example, Barbados, Trinidad and Tobago and Argentina have the highest real per capita incomes for 2007 but with population of just over 250 thousand, one million and 39 million respectively. Brazil and Mexico have the highest populations of 190 million and 105 million which dwarf many other countries in the sample with significant land areas of 8 and 1.9 million sq kilometers respectively. There is also considerable variation by openness as Brazil was the least open economy and Barbados the most open.

FDI inflows revealed variations among the countries in terms of sectoral composition but some common characteristics were also present. First some US$32 billion of FDI flowed to the sample countries, but of this amount two countries, Brazil and Mexico accounted for as much as 56.7% of the flow to Latin America and the Caribbean. This is not surprising given the size of these economies and the range of their economic sectors and activities. At the same time the average net FDI share to the region was 3.1% while the world average was 6,6%.

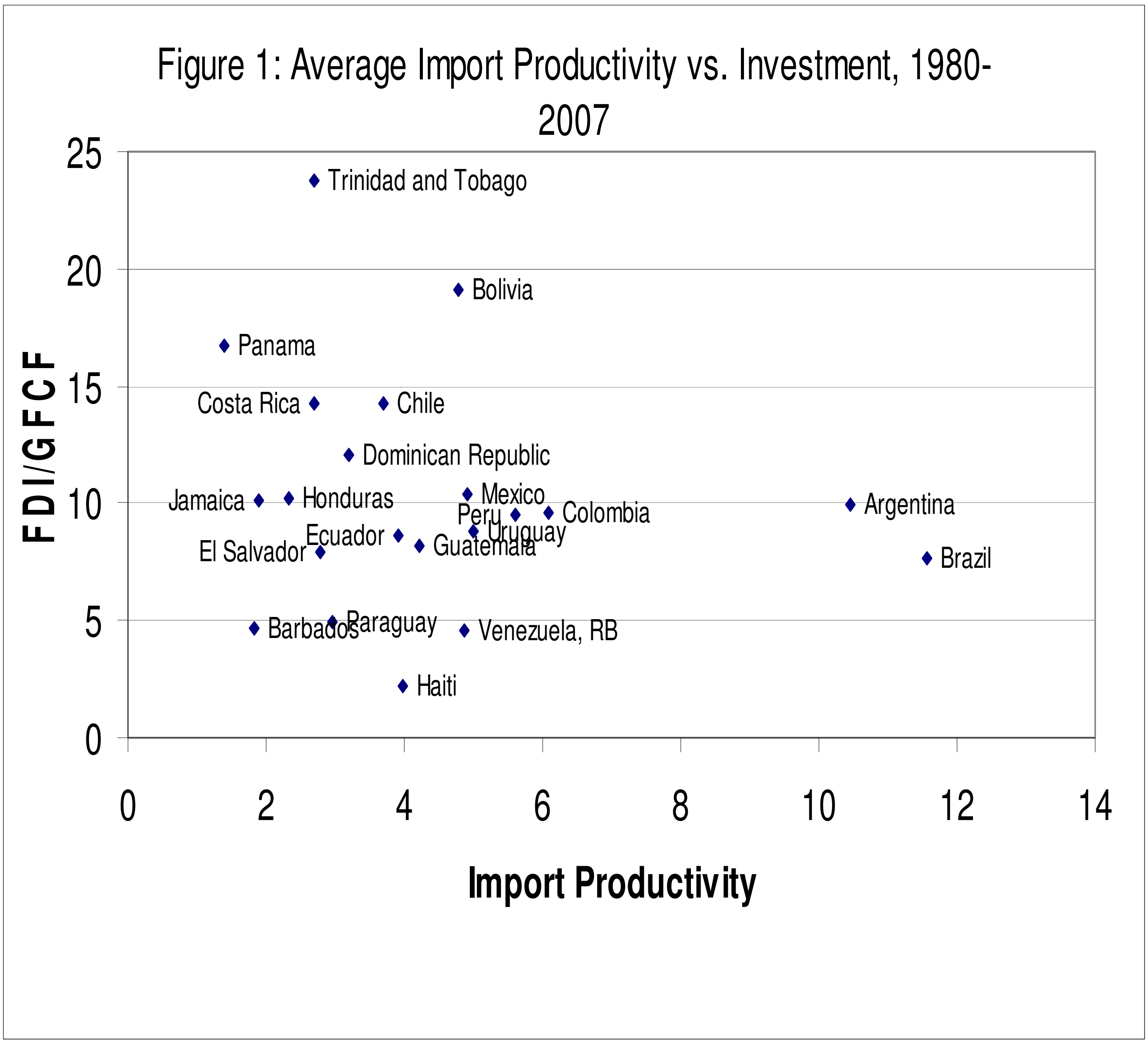
Some countries received considerable smaller shares such as Barbados, Bolivia, El Salvador and Guatemala. Countries such as Haiti, Honduras, Jamaica, Paraguy and Uruguy received less than 1% over the period.   When the FDI stock as a percentage of GDP was examined for 2008, however, the impact was much more substantial. For example, two Caribbean countries Trinidad and Jamaica, in addition to Panama had the highest shares as a percentage of GDP.

Table 2: Inward FDI Stock, FDI stock as a Percentage of total Latin America and the Caribbean (LAC), FDI Stock as a Percentage of Gross Fixed Capital Formation (GFCF) and import productivity				
	FDI Stock, 2007 ($MN USD)	FDI Stock , percent of LAC total, 2007	FDI Stock, percent of GFCF	Ratio of GDP/Imports, Average for 1980-2007
Argentina	67574.0	6.0	112.0	4.9
Barbados	789.9	0.1	117.9	2.2
Bolivia	5485.0	0.5	259.0	3.2
Brazil	309668.0	27.5	127.4	8.4
Chile	99488.2	8.8	295.2	3.0
Colombia	56448.4	5.0	137.1	5.6
Costa Rica	8802.8	0.8	154.9	1.9
Dominican Republic	8253.0	0.7	110.6	2.7
Ecuador	10326.0	0.9	100.4	2.9
El Salvador	5916.3	0.5	180.2	2.1
Guatemala	4617.6	0.4	67.2	2.3
Haiti	385.6	0.0	45.7	2.9
Honduras	4223.8	0.4	112.8	1.3
Jamaica	8667.2	0.8	236.3	1.6
Mexico	272730.6	24.2	146.8	3.3
Panama	14572.2	1.3	366.5	1.3
Paraguay	2223.8	0.2	87.5	1.9
Peru	26807.7	2.4	120.0	4.5
Trinidad and Tobago	13367.9	1.2	277.3	2.6
Uruguay	6356.0	0.6	198.0	3.6
Venezuela, RB	43957.0	3.9	81.5	4.3
LAC Average	35159.7	3.1	246.8	4.4
World Average	74573.8	6.6	391.0	3.3

Sources: WIR 2009, WDI Online Database

Table 2 shows the total FDI stock, FDI stock as a share of FDI to Latin America and the Caribbean, FDI stock as a share of GFCF and import productivity

As in Table 1 when the FDI stock is examined, Brazil and Mexico account for just over 50% of FDI stock however FDI as a share of GFCF was very large for a variety of countries which suggested that FDI inflows had a considerable impact on capital formation in these countries. Among those with the highest import productivity were Brazil, Argentina, Peru and Venezuela.



Sources: WIR 2009, WDI Online Database

Figure 1 reports the relationship between the ratio of inward FDI to GDP and average import productivity growth over the period 1980-2007. The results suggest that there are two distinct group of countries, those for which import productivity was high and those for which it was low. There were a number of countries for which the FDI ratio was high but average import productivity was low and among these were Trinidad and Tobago, Panama and Bolivia. Argentina and Brazil have relatively low FDI to GFCF ratios but high average import productivity. The next section reports the estimation results.

Estimation Results

The methodology employed is a panel fixed effects approach with the sample period 1980-2007 averaged every two years to reduce the variability of FDI at the annual level. This resulted in a total of 14 observations for the 21 countries. The balanced sample was computed in Winrats 7.30 while accounting for threshold effects using Hansen(1999) method. A variety of formulations were employed to ascertain the robustness of the results and these are reported in Table 3.

In the first column the variables are reported followed by the coefficients for the various formulations. The 't' statistics are in bracket and the variables preceded by deltas are the log changes and the results are for robust errors estimation. A quadratic relation $\Delta \mathbf{k}^2_{\mathbf{d}_{it}}$, was tried for domestic investment to capture nonlinear effects but this was highly insignificant.

Table 3:Panel Fixed Effects, Regression Results

Independent variables	Dependent Variable, log Change in Import productivity			
	Δy_{it}	Δy_{it}	Δy_{it}	Δy_{it}
Δl	.377(9.27)	.382(9.96)	.37(9.42)	.379(9.58)
$\Delta k_{f_{it}}$	.033(2.16)	-.09(-1.04)	-	-
$\Delta k_{f_{it}} * H_{it}$	-	-	-.07(-1.67)	-.08(-1.74)
$\Delta k_{d_{it}}$	.253(1.93)	.232(1.74)	.257(1.89)	.288(4.19)
$\Delta k^2_{d_{it}}$	-.097(-.41)	-0.08(-0.39)	-0.10(-0.44)	-
$\Delta k_{d_{it}} * H_{it}$	.115(.280)	.213(.495)	.11(0.26)	-
$H_{it} \leq \lambda_1$	-	-0.25(-3.09)	-0.12(-4.33)	-.126(8.59)
$H_{it} > \lambda_1$		0.12(1.39)		
$\lambda_1 < H_{ij} \leq \lambda_2$	-	-	0.036(2.56)	.038(2.35)
$\lambda_2 < H_{ij}$	-	-	.061(2.52)	.06(2.88)
thresh 1	-	.0228(1 st pctile)	.0228(1 st pctile)	.0228(1 st pctile)
thresh 2	-	-	.2278(99th pctile)	.2278(99th pctile)
H_{it}	-	0.38(1.92)	-	
$\Delta m2gdp$	-.099(3.08)	-0.09(-3.01)	-0.09(-2.67)	-.09(-2.70)
$\Delta lopen$	.006(2.71)	.003(0.99)	.006(2.78)	.004(3.50)
$\bar{R}^2$	0.39	0.39	.394	.395

All variables except the last three are divided by imports.

The first formulation assumed no threshold effects and labour and FDI were significant at the 5% level, while domestic investment was almost significant at this level. In addition, the change in the ratio of ratio of m2 to GDP was significant and negative while the change in the level of openness (Δlopen) was positive and significant.

In the second formulation, a threshold value was found at the 1 percentile of the sample with a value of 0.022 years of education. The change in the labour force is positively and significantly related to import productivity growth, but it was insignificant for FDI. Domestic investment is not significant at the usual 5% level but the coefficient was positive, while the human capital variable[5], H was almost significant at that level. The change in the ratio of ratio of m2 to GDP was significant and negative while the change in the level of openness (Δlopen) was not.

The threshold value was highly significant and negative, which suggested that at relatively low levels of tertiary education, FDI does no promote import productivity growth. The coefficient for the threshold value beyond 0.0228 was insignificant but positive. The adjusted $\overline{\mathbf{R}}^2$ of 43% and the findings are in line with the study by Dulleck and Foster (2008) in relation to the impact of imported capital goods on growth.

In the third formulation, two threshold values were found with the second threshold at .2278 years of education reported at the 99th percentile of the sample. In addition the results show that the threshold effects are confirmed at low levels of education as negative but positive and highly significant at higher levels of education. In the final formulation, the coefficients $\Delta \mathbf{k}^2_{\mathbf{d}_{it}}$ and $\Delta k_{f_{it}} * H_{it}$ were restricted to be zero and the hypothesis was accepted at the 5% level of significance. As a result these coefficients were dropped. The final results show even stronger effects for the threshold values suggesting that human capital variable has a strong impact on the efficacy and

[5] The average number of years of tertiary education.

importance of FDI in raising import productivity growth. In addition the change in the ratio of ratio of m2 to GDP was negative and significant while the change in openness was positive and highly significant.

Conclusions

This paper found that changes in inwards FDI had a positive effect on import productivity growth in Latin America and the Caribbean due to the influence of the level of human capital on FDI. The results however vary by the level of human capital development, thus at low levels of human capital development inward FDI was found to have negative impacts on import productivity growth. These so called, threshold effects were found to be highly significant.

A variety of reasons have been offered to explain the negative impact of change in FDI on growth. One explanation was that higher levels of FDI may lead to inequality which may negatively impact growth when human capital development is low. On the other had it may be that highly sophisticated FDI flows is unproductive in countries that do not have the capacity to absorb such investment, or take advantage of the technologies they embody and at the same time there is likely to be limited technology spillover to other sectors and industries outside of FDI activities. It may also be that such technologies crowd out local domestic activity and firms that are unable to compete thus lowering overall growth.

The overall results suggest that there can be positive effects between changes in FDI and import productivity growth if there is a certain level of human capital. These results support the findings of Bengoa and Sanchez Robles (2003) that the impact of FDI on economic growth in Latin America depends on the availability of adequate human capital. The implication is that more focus should be placed on a faster investment in human capital rather than the current focus of excessive incentive to raise the level of foreign direct investment.

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