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Are Net FDI Flows and Reversals of Capital Flows a Result of Output Growth?*

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Abstract

Literature notes many factors as affecting capital flows, but the effects of these flows over the recipient economies and the overall effect over growth are highly debatable. This study claims that although capital flows may be required for the increase in output, other forces are causing this growth and creating the demand for capital. We construct a model in which growth requires both training of managers by firms in order to expand, representing the absorption capacity of the firms, and capital for the firms' expansion. The model shows that in early stages of development, when output is low, capital inflows are increasing with an increase in the output, but are not the cause for the output growth. However, when output is higher, an increase in the output is associated with financial outflows, since the local savings are increasing by more than the local demand for capital. We test this relationship in a large sample of countries, and manage to explain half of the variations in net FDI flows per capita using the stage of development.

KEYWORDS: capital flows, reversals, FDI, economic development, firms, growth, on-the-job training

JEL CLASSIFICATION: F21, O41, O16, F43, J24

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1 Introduction

Research regarding capital flows mentions several factors which are affecting these flows: labor costs, market size, labor availability, preferential policies, intellectual property rights and other factors (see, for example, Helpman, 1984, Markuzen, 1984, Lee and Mansfield, 1996, Gastange, Nugent and Pashamova, 1998, Billington, 1999, Cheng and Kwan, 2000, Bevan and Estrin, 2004, Javorcik, 2004, Verdier, 2008).

The effects of the capital flows over the recipient economies are debatable, with opposing arguments and findings in the literature. Effects include, among others, possible technological spillovers and productivity, but some claim that there are no spillovers (Aitken and Harrison, 1999, Javorcik, 2002, Saggi, 2002, Javorcik and Spatareanu, 2008, Bonfiglioli, 2008); positive and negative effects over local investment (Henry, 2000, Agosin and Mahcado, 2005, Barrios, Gorg and Strobl, 2005, Bonfiglioli, 2008); changes to the local wages (Lipsey, 2002, Henry and Sasson, 2008); and financial development, alongside possible financial instability (Beck, Levine and Loayza, 2000, Stiglitz, 2000, Klein and Olivei, 2008). The overall effect of FDI and capital flows on the economic growth of the recipient economy is questionable as well. Some claim that there is a positive short-run effect over growth, which leads to a long run level-effect over the output (Quinn, 1997, Stiglitz, 2000, Levine, 2001, Bekaert, Harvey, and Lundblad, 2005, Hur, Raj and Riyanto, 2006). Others find mixed or negative effects, or claim that the causal relationship between capital flows and output growth has not been proven (Rodrik, 1998, Lipsey, 2002, Prasad et al., 2003, Eichengreen and Leblang, 2003).

This study claims that although capital flows may be required for the increase in output, they are not the cause for this increase. Other forces are enabling the growth and creating the demand for capital, and capital flows are merely meeting this demand when capital is not locally available. Thus, they enable the increase in output, but do not cause it. We constructed a model in which growth requires both training of managers by firms in order to expand, representing the potential of the firms to absorb capital and utilize the production technology, and additional capital for the expansion of these firms. While the latter is the neoclassical force behind the positive effect of FDI over growth, the former is much less common. The literature dealing with firms has long acknowledged the importance of managers and the firms' need to train managers in order to expand (Coase, 1937, Penrose, 1959, Slater, 1980, Dias and McDermott, 2006), and the importance of managers to economic performance has been acknowledged as well (Lucas, 1978, Burstein and Monge-Naranjo, 2007), but training of managers by firms has rarely been aggregated into a macroeconomic model. An exception is Aharonovitz (2008), which did not include capital or capital flows that are included here, allowing for theoretical and empirical analysis of capital flows. In the model, firms are training managers in order to expand and open additional units, an expansion that also requires capital. Local supply of capital is created by local savings, and the difference between local savings and local demand for capital is bridged by capital flows. The model shows that in early stages of development, when output is low, capital inflows are increasing with an increase in the output. These inflows are required to enable the increase in output, but are not the cause or the constraint on output growth. In later stages of development, when output is higher, an increase in the output is associated with financial outflows, since the local savings are larger than the local demand for capital. On a broader perspective, treating the international supply of capital as a 'technology capital', capital that embodies new technology in it, or as international availability of capital and technology, and the local supply of managers as the potential of the economy to absorb the capital and the technology, the model emphasizes the importance of the local potential compared to the external resources.

The model predicts an inverted U-shaped relationship between capital flows used for investment and the stage of development of the economy. We tested this relationship in a large sample of countries, using net FDI per capita as the measure for capital flow and GDP per capita of an earlier year as a measurement for the stage of development. We found that indeed FDI per capita follows this pattern, increasing in earlier stages of development but decreasing and becoming negative (capital outflows) in latter stages. We managed to explain 50% of the variations in FDI using the stage of development and two control variables (latitude and capital formation at an earlier year). We tested many other control variables and found them to be insignificant.

These findings contribute to two strands of the literature. Regarding the factors affecting financial flows and the contribution of these flows to economic growth mentioned above, the model shows that although the capital is important in enabling the increase in the amount of production units, which is leading to the increase in output, it may not be the factor causing the increase. The cause may be the internal development, leading to demand for external capital. The empirical evidence, showing that the size of the flow is affected by the stage of development of a given country, supports this view. This is in line with Manova (2008), showing that sectors in need of credit are affected more than other sectors by financial liberalization. Our claim is similar, but deals with the need of the entire economy for credit, i.e., the demand for capital, which is set by the internal development of the economy.

Another strand is dealing with sudden stops and capital flow reversals (see, for example, Calvo, 1998, Kaminsky and Reinhart, 1999, Bordo et al., 2001, Hutchison and Noy, 2006, Glick, Guo and Hutchison, 2006), which are considered to cause a decrease in output. Our contribution is showing that a part of the reversals are a natural evolution of an economy from having a net external debt (net borrower) to net external assets (net creditor). The decrease in growth rate associated with the reversal may be a natural one as well. The decrease is caused by the end of a rapid catch-up of the economy with the rest of the world, leading to a mature growth rate and a slowdown in the demand for capital. When accompanied by high savings rates, it may lead an economy to become a capital creditor rather than a debtor.

The paper proceeds as follows: section 2 presents the model. Section 3 analyzes the evolution of the economy and of the capital flows based on the model. Section 4 provides empirical evidence. Section 5 concludes.

2 The Model

Assume a small open economy with a population of *N* infinitely living agents. Each agent is employed every period in the traditional sector, as a worker in the manufacturing-technological sector, or as a manager in that sector. Denote with F_t, L_t and M_t the quantities of workers in the traditional sector, workers in the technological sector and managers, such that:

$$F_t + L_t + M_t = N \qquad (1)$$

Production of a single good, that can serve as consumption or capital good, takes place in two sectors, traditional and technological. The traditional sector uses labor only and exhibits a constant marginal productivity (which is normalized to 1).

The technological sector is divided into production units (e.g. plants, firms). Each one of those production units requires a manager in order to exist and has a production function in the form of:

$$y_t = f(l_t, k_t) = A(l_t^{\alpha} k_t^{1-\alpha})^{\beta} \qquad (2)$$

where y is the output of the production unit, A represents the productivity, l is the number of employees including the manager, k is the capital and $0 < \alpha, \beta < 1$.[1] β represents the span of control problems of a single manager, such that a single manager cannot simply increase k and l and increase the output in the same proportion, but rather more managers are required in order to maintain the same productivity when increasing the size of the firm. Accordingly, although the production function of each unit is not homogeneous of degree 1, the technological sector as a whole does exhibit homogeneity of degree 1, when the production factors are managers, workers and capital. Increasing the quantity of managers, workers and capital in the same proportion leads to an identical increase in the quantity of the production units, and thus increases the output by the same proportion. Thus, managers represent a certain 'absorption capacity' for labor and capital. Capital does not depreciate. For simplicity, we assume that A=1.

Labor markets are competitive. Capital is freely flowing across countries, such that each firm in the economy can rent capital at a cost of r, and the economy as a whole can borrow (or save) capital at the same interest rate. The saving behavior of the individuals is characterized below.

Training managers is the heart of this model. An agent can become a manager only through training in an existing production unit (firm). Each period, each existing production unit (firm) is headed by a pre-trained manager and can train new

[1] An additional constraint on α and β is that $\bar{l} > 1$, see subsection 3.1.

managers, at a cost. The newly trained managers can immediately function as managers (i.e., to enable the existing production unit to open new production units under it), although the new managers and the new production units cannot train additional managers at the same period. The new managers are obliged to work at their production units in that same period, but in later periods they are free to leave and head new production units (firms), which can train new managers and thus open additional production units, or stay and head a production unit that can train new managers and open additional production units. The cost *c* of training *m* new managers in a single production unit in period *t* is denoted by:

$$c = c(m) \qquad (3)$$

where $c(0) = 0$, $c(m)$ is continuous and twice differentiable, $\frac{\partial c}{\partial m} > 0, \frac{\partial^2 c}{\partial m^2} > 0$, and $\frac{\partial c}{\partial m} \xrightarrow[m \to 0]{} 0$. These conditions resemble standard investment-cost function. The function $c(m) = Bm^2$, *B*>0, will serve as an example. The production units cannot charge managers for their training, i.e., they are paid their marginal productivity as workers, like every other worker (note that *l* includes the manager).[2]

Individuals that earn up to the wage of the traditional sector do not save, but rather consume their entire income. Individuals that earn a labor income that exceeds the wage of the traditional sector save *s* out of the excess wage. Returns to capital (*r*) are saved as well. Consumers in the economy cannot borrow for consumption purposes. Therefore, imports (and exports) are of capital goods.

In every period existing managers (i.e., all those that worked as managers in the previous period, whether they were trained in that period or before) are running

[2] A longer period in which a manager has to work for the firm, or charging a manager for his training, affect the pace of development, but not its general form. See subsection 3.1.

(and working in) the production units (firms). Each of these units decides how many managers to train (and therefore how many new units to open) and how much capital and workers to hire. The rest of the population, if there is any, works in the traditional sector. Production, consumption and savings take place, and we move to the next period.

3 Development Path

Prior to the development process all the output is stemming from the traditional sector, which yields an output of *N* per period. Assume that at period 1 one manager has been exogenously introduced to the economy. One may consider, for example, a multinational corporation which opens a plant at that economy. We analyze the development path of the economy, the evolvement of the capital stock and the capital flows.

3.1 First phase

The first phase refers to the periods in which there are still workers in the traditional sector, i.e., $F_t, > 0$. As long as there are workers in that sector, the quantity of workers in every production unit is set by equating the marginal productivity of the workers in the technological sector to 1, the marginal productivity in the traditional sector, which equals the wage (*w*=1). Capital is determined by equating its marginal productivity to its cost, *r*. The decreasing marginal productivity of both factors together ($\beta < 1$) ensures that this is achieved for a finite quantity of workers and capital, noted with $\bar{l}$ and $\bar{k}$.

For an explicit solution, one should derive (2) and solve $\frac{\partial f(l,k)}{\partial l}=1$ and $\frac{\partial f(l,k)}{\partial k}=r$, leading to $\bar{l}=\left(\frac{\beta(1-\alpha)^{\beta(1-\alpha)}\alpha^{\beta(\alpha-1)+1}}{r^{\beta(1-\alpha)}}\right)^{\left(\frac{1}{1-\beta}\right)}$ and $\bar{k}=\left(\frac{\beta\alpha^{\alpha\beta}(1-\alpha)^{(1-\alpha\beta)}}{r^{1-\alpha\beta}}\right)^{\left(\frac{1}{1-\beta}\right)}$.[3]

Each period, each firm decides how many new managers to train. The profit of a firm, which is training m new managers, *excluding* the wage of the already existing manager, is:

$$\pi(m)=(m+1)(f(l,k)-w(l-1)-rk)-wm-c(m) \quad (4)$$

where w is the wage of a worker, and w=1 as long as the traditional sector exists. Note that the profit is simply the output minus the wages of the workers, the cost of capital, the wage of the newly trained managers (which are paid like workers) and the cost of training.[4] Since the labor market for pre-trained managers is competitive, the wage of the pre-trained manager, noted with $w_{M,t}$ equals the marginal product, which is the mere existence of the firm, and therefore equals the entire profit of the firm, including its new production units. Consequently, one may regard that trained manager as the owner-entrepreneur as well. Note also that since in future periods firms will have to pay the managers they are training in the current period a competitive wage, which equals their marginal product, and since all the population is equally talented, people would agree to pay the firms in order to be trained. However, we assume that firms are not allowed to pay the managers in training less than a worker's wage, and they cannot force managers to stay within the firm for more than the current period. A bounded payment or a bounded number of periods a manger is obliged to stay within

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[3] Since $\bar{l}$ includes the manager, α, β and r must satisfy $(\beta(1-\alpha)^{\beta(1-\alpha)}\alpha^{\beta(\alpha-1)+1}/r^{\beta(1-\alpha)})^{1/1-\beta}>1$.

[4] Throughout the first phase, while the traditional sector exists, the creation of a second firm (i.e., managers that were trained by the first manager and later leaving to open their own firms) does not affect the first one, and therefore, training other managers does not affect future profits in this phase. It does bring upon, eventually, the second phase's competition, but any reasonable discount factor makes it negligible for a decision taken early in the first period. Once there are many firms, each firm is small enough such that its decision does not affect future competition.

the firm leads to having more trainees every period, but still a bounded number of trainees, and thus does not affect the general form of the development process and the conclusion.[5]

Proposition 1: The technological sector exhibits constant growth rate during phase 1.

Proof: given the wage of the pre-trained manager, firms maximize the profits, (see equation (4)) over *m*. Accordingly, $\frac{\partial \pi(m)}{\partial m} = f(l,k) - wl - rk - \frac{\partial c(m)}{\partial m} = 0$. Since $k = \bar{k}, l = \bar{l}$ and *w*=1, *m* is set according to:

$$\frac{\partial c(m)}{\partial m} = f(\bar{l},\bar{k}) - \bar{l} - r\bar{k} \qquad (5)$$

which is equating the marginal cost of training one more manager to the marginal benefit – one more production unit minus the wage of its workers and the cost of its capital.[6] Since $\partial c / \partial m$ is an increasing function, (5) is achieved for a constant value of *m*, noted with $\overline{m}$; note accordingly the profits of a firm before paying the pre-trained manager with $\overline{\pi}$. Therefore, every period each firm trains $\overline{m}$ new managers and opens $\overline{m}$ new production units, such that it has $1+\overline{m}$ production units. In the following period all these $1+\overline{m}$ managers are pre-trained, and every one of them heads a firm-unit which trains $\overline{m}$ new managers and opens $\overline{m}$ new production units, etc. The output per unit is not changing, and therefore $\overline{m}$ is the growth rate of the technological sector. QED

Walras' Law of Markets allows for omitting the analysis of the equilibrium in the market for the output. Note, however, that equilibrium is easy to show. Firms have zero profits, since all the profits are paid as wage to the pre-trained manager. Payments to capital are saved as capital. Wages to workers and managers are

[5] See also Aharonovitz (2008) for a more formal analysis in an economy without capital.

[6] The optimal *m* may be a fraction, while the quantity of managers must be an integer. The interpretation here is that some firms train the integer above *m* and some the integer below, such that *m* is the average over all the firms.

consumed or saved as capital based on the decision rule mentioned above, thus the entire output is allocated. Any capital requirement above the accumulated local savings is capital inflow, while any accumulated local savings above the capital requirement turns into capital outflow, see subsection 3.3.

For the explicit example one gets

$$2B\overline{m}=\left(\frac{\beta^{\beta}(1-\alpha)^{\beta(1-\alpha)}\alpha^{\alpha\beta}}{r^{\beta(1-\alpha)}}\right)^{\left(\frac{1}{1-\beta}\right)}-\left(\frac{\beta(1-\alpha)^{\beta(1-\alpha)}\alpha^{\beta(\alpha-1)+1}}{r^{\beta(1-\alpha)}}\right)^{\left(\frac{1}{1-\beta}\right)}-r\left(\frac{\beta\alpha^{\alpha\beta}(1-\alpha)^{(1-\alpha\beta)}}{r^{1-\alpha\beta}}\right)^{\left(\frac{1}{1-\beta}\right)},$$

and $\overline{m}$ is calculated accordingly. Note that $\overline{m}$ is constant over time.

The development pace of the whole economy is different from the growth rate of the technological sector, since in the initial periods a significant portion of the country's output is stemming from the traditional sector. However, as the technological sector is expanding on the expense of the traditional one it affects the overall development pace more and more, up to the point where the traditional sector disappears. As long as there are workers in the traditional sector (i.e., $M_t\bar{l}\leq N$), the development process occurs as described above. However, from the period in which $M_t\bar{l}>N$ firms will have to hire less than $\bar{l}$. This phase of development, the second phase, is analyzed below.

3.2 Second Phase

As the traditional sector disappears, firms are hiring fewer workers per production unit, and therefore paying them a higher wage. This reflects on the profitability of the firm and accordingly on the number of production units each firm is opening and managers it is training.

Proposition 2: second phase growth rate of the quantity of production units is decreasing over time.

Proof: Since labor markets are competitive, each period, after the decision regarding m is made and M_t is set, each production unit hires $\frac{N-M_t}{M_t}$ workers, thus having $\frac{N}{M_t}$ workers including the manager, and the wage of a worker is the marginal productivity of labor. Capital is set by equating its marginal productivity to its cost (time index is omitted for clarity of presentation):

$$\frac{\partial f(l,k)}{\partial l} = \alpha\beta k^{(1-\alpha)\beta}\left(\frac{N}{M_t}\right)^{\alpha\beta-1} = w \qquad (6)$$

and $$\frac{\partial f(l,k)}{\partial k} = (1-\alpha)\beta\left(\frac{N}{M_t}\right)^{\alpha\beta} k^{(1-\alpha)\beta-1} = r \qquad (7)$$

Note the quantity of workers including the manager in the second phase with $\tilde{l}$, and the wage and capital solving (6) and (7), given M_t, with $\tilde{w}$ and $\tilde{k}$. It is easy to see that $\tilde{l}$ and $\tilde{k}$ are decreasing in *M*, and by substitution (7) to (6) that $\tilde{w}$ is increasing in *M*.

$M_t = M_{t-1}(1+E(m))$, where $E(m)$ is the expected number of new units per firm. Since each firm is small, it can neglect its own effect over $E(m)$ and therefore over M_t and the subsequent $\tilde{l}$, $\tilde{k}$ and $\tilde{w}$ when deciding how many new units to open. Therefore, the maximization problem faced by a firm, given the wage of the pre-trained manager, is:

$$\underset{m}{Max}\{(m+1)(f(\tilde{l},\tilde{k}) - \tilde{w}(\tilde{l}-1) - r\tilde{k}) - \tilde{w}m - c(m)\} \qquad (8)$$

Accordingly, $\frac{\partial \pi(m)}{\partial m} = f(\tilde{l},\tilde{k}) - \tilde{w}\tilde{l} - r\tilde{k} - \frac{\partial c(m)}{\partial m} = 0$ and m is set such that:

$$\frac{\partial c(m)}{\partial m} = f(\tilde{l},\tilde{k}) - \tilde{w}\tilde{l} - r\tilde{k} \qquad (9)$$

Each firm equates the marginal cost of training an additional manager to the marginal benefit. Note the solution of (9) with $\tilde{m}$. As development proceeds, marginal benefit is decreasing (since each production unit hires fewer workers and less capital, and pays a higher wage to each worker). Since $\frac{\partial c(m)}{\partial m}$ is increasing in *m*, $\tilde{m}$ is decreasing over time and development pace slows down. Note also that, as before, the economy is in general equilibrium every period. QED

For the explicit example in which $\frac{\partial c(m)}{\partial m} = 2Bm$, (9) translates to $\tilde{m} = (f(\tilde{l}, \tilde{k}) - \tilde{w}\tilde{l} - r\tilde{k})/2B$, and since $\tilde{l}$ and $\tilde{k}$ are decreasing in *M* and $\tilde{w}$ is increasing in *M*, $\tilde{m}$ decreases over time.

Development in this model ceases when $M = N$ (since $\frac{\partial c}{\partial m} \xrightarrow[m \to 0]{} 0$, equation (9) ensures a positive amount of trainees as long as $M < N$).[7] We regard the cessation of this type of development as reaching a phase that requires a new one – researching new knowledge. The country has created the full capacity for absorbing capital and improving productivity with the current production function, and future growth will depend on having a better technology (i.e., an increase of *A*).

3.3 Capital flows

The position of a country as having a net external debt (net debtor) or a net lender (creditor) of capital, alongside the capital flows in or out of the economy, is a function of the production units' demand for capital, compared to the stock of capital owned by the local agents. We focus initially on the first phase, assuming the

[7] One may also consider an assumption of mortality of the population, workers and managers, after few periods. Workers are thus born every period and firms need to train managers to replace those who died. In this case training never ceases. *M*, however, reaches a certain steady state level.

population is large enough (such that the first phase is at least two-periods long), and proceed with the analysis of the second phase.

In the first phase, the *capital requirements* of the economy (demand), noted with K_t^D, are a function of the number of units operating. Thus, in the first period, in which there is one pre-trained manager and $\overline{m}$ managers in training, there are $\overline{m}+1$ production units, each requiring $\overline{k}$ units of capital, and therefore $K_1^D=(1+\overline{m})\overline{k}$. Similarly, since throughout the first phase $\overline{k}$ and $\overline{m}$ are constant:

$$K_t^D=(1+\overline{m})^t\,\overline{k} \qquad (10)$$

The *local supply of capital*, noted with K_t^S, is stemming from the savings of the managers, who are the only ones receiving a wage higher than 1, and the interest over the savings (the rent of the capital). Since consumption and savings occur at the end of each period, savings affect the capital stock of the next period. In the first period the economy has no locally-owned capital, $K_1^S=0$. The capital of the second period is the savings of the pre-trained manager of the first period, i.e., $K_2^S=s(\overline{\pi}-1)$. The local capital stock of the third period is the savings of the pre-trained managers of the second period, plus the savings of the managers from the first period, including payments from firms for using this capital, i.e. $K_3^S=(1+\overline{m})s(\overline{\pi}-1)+s(\overline{\pi}-1)(1+r)$. Similarly:

$$K_t^S=\sum_{i=1}^{t-1}(1+\overline{m})^{i-1}s(\overline{\pi}-1)(1+r)^{t-1-i},\; t>1 \qquad (11)$$

For every *t*, local stock of capital was created in the previous periods. Thus, *i* stands for the period of creation, $(1+\overline{m})^{i-1}$ is the number of pre-trained managers saving at this period, and $(1+r)^{t-1-i}$ is the interest accumulated over these savings till period *t*.

The net position of the economy as a borrower (or a creditor) of capital, i.e., the net external debt, noted with K_t^{NP}, is, therefore:

$$K_t^{NP} = K_t^D - K_t^S \qquad (12)$$

where $K_t^{NP} > 0$ represents having net debt. Thus, $K_1^{NP} = (1+\overline{m})\overline{k}$, and:

$$K_t^{NP} = (1+\overline{m})^t \overline{k} - \sum_{i=1}^{t-1} (1+\overline{m})^{i-1} s(\overline{\pi}-1)(1+r)^{t-1-i}, t > 1 \qquad (13)$$

The expression measuring a country's net external debt during the second phase is similar to (13), but with $\tilde{m}_t$, $\tilde{k}_t$ and $\tilde{\pi}_t$ instead of $\overline{m}$, $\overline{k}$ and $\overline{\pi}$.

Proposition 3: The economy is a net borrower of capital starting from period 1 for a finite amount of periods. The economy is a net creditor of capital starting from a certain period. Thus, the economy experience capital inflows that later reverse to capital outflows.

Proof: Period 1 obviously involves being a net borrower and thus capital inflows. Simplifying (13), the net external debt for the remaining periods of the first phase, yields $K_t^{NP} = (1+\overline{m})^t \left(\overline{k} - (1+\overline{m})^{-2} s(\overline{\pi}-1) \sum_{i=1}^{t-1} \left(\frac{1+r}{1+\overline{m}} \right)^{t-1-i} \right)$. Note that while $(1+\overline{m})^t$ affects the magnitude of the borrowing or lending, $\left(\overline{k} - (1+\overline{m})^{-2} s(\overline{\pi}-1) \sum_{i=1}^{t-1} \left(\frac{1+r}{1+\overline{m}} \right)^{t-1-i} \right)$ sets the position itself, based on the sign of the expression, as well as affecting the magnitude. While the left term of the latter expression ($\overline{k}$) is constant throughout the first phase, the right side is increasing over time. If $\overline{m} > r$ (depending on the training cost function) the right expression is bounded, and thus a small enough s can allow for $\overline{k} > (1+\overline{m})^{-2} s(\overline{\pi}-1) \sum_{i=1}^{t-1} \left(\frac{1+r}{1+\overline{m}} \right)^{t-1-i}$, such that the country is a net borrower of capital throughout the entire first phase.

Obviously, if $\sum_{i=1}^{t-1}\left(\frac{1+r}{1+\overline{m}}\right)^{t-1-i}$ and s are high enough for a certain t, the position may change into net capital creditor. If $\overline{m} < r$ and the first phase is long enough (i.e., the population is large enough), $\sum_{i=1}^{t-1}\left(\frac{1+r}{1+\overline{m}}\right)^{t-1-i}$ is increasing and unbounded, thus, there exists a t (and a population size that prolongs the first phase to at least t periods) for which $\overline{k} < (1+\overline{m})^{-2} s(\overline{\pi}-1)\sum_{i=1}^{t-1}\left(\frac{1+r}{1+\overline{m}}\right)^{t-1-i}$ and the country becomes net creditor during the first phase. Note that once the position reversed and $\overline{k} < (1+\overline{m})^{-2} s(\overline{\pi}-1)\sum_{i=1}^{t-1}\left(\frac{1+r}{1+\overline{m}}\right)^{t-1-i}$ for a certain t, it cannot reverse again, since the left hand side of this expression is constant, while the right side is increasing.

If the net capital position does not reverse during the first phase, it reverses during the second phase. During the second phase capital requirements (demand) grow at a slower pace (since $\overline{k} > \tilde{k}$ and $\overline{m} > \tilde{m}$) and eventually, once the entire population is trained, ceases to grow. K^S continues to increase unbounded (due to savings and returns to capital), and thus, according to equation (12), net external debt turns negative, and the country becomes a net creditor.

Since a net external debt (net borrowing, $K^{NP} > 0$) is created in the first period, and later the country changes to a net creditor ($K^{NP} < 0$), flows must reverse as well. Thus, once K^{NP} starts decreasing, initial capital inflow turns to a capital outflow. QED

Intuitively, the growth of the economy in the first periods, and the fact that savings join the capital stock only in following periods, are both leading to an increase in the demand for capital relative to the local supply, and thus to capital borrowing. The fact that optimal k of a firm (including its units headed by managers in training) may be higher than the savings of a single manager is enhancing the need for capital borrowing. . However, the returns to capital, which are compounded over the periods, affect in the opposite direction, and may decrease and reverse the position over time. Even if it does not do so in the first phase, once the economy enters the second phase, and growth slows and eventually ceases without any technological change, the savings increase relative to the demand, and eventually reverses the net position. Thus, the economy eventually experiences capital outflows.

We interpret the growth in the number of managers as the absorption capacity of the economy. This capacity is increasing over time, leading to a greater demand for capital. However, eventually the economy absorbs all the capital required for efficient production using the given technology, and since savings continue to increase, the capital flow must reverse. We do not regard the completion of the absorption process as the end of growth, but rather as a need to turn to an alternative source for growth, which is a technological change (i.e., an increase in A in equation (2)). This type of growth increases the required capital as well ($\tilde{k}$ itself is increasing), but since this type of growth is expected to be relatively slow, it does not reverse the outflows, but merely slows them down.[8]

Figure 1 demonstrates this process. Net external debt is positive (capital borrowing) and increasing in the beginning, but later starts decreasing and eventually turns negative (i.e., to net creditor). Once the external debt starts decreasing, capital flow changes from positive (inflows) to negative (outflows). The parameters of Figure 1 allow all these changes to occur during the first phase. Figure 2 presents the capital

[8] The rate of technical change is lower or equal to the interest rate, while savings are increasing due to the interest rate as well as due to additional savings. Therefore, capital outflows would not reverse due to this type of growth.

flows as a function of the output, showing the increase of the inflows in first stages of output growth, the reversal and the decrease in inflows, which turns negative, in latter stages of output growth.

Figure 1 here

Figure 2 here

4 Empirical Analysis

Empirical analysis validating the model explicitly requires data regarding training in a large sample of countries, which is unavailable. However, analysis of the conclusion regarding capital flow, i.e., the prediction that capital flows in during early stages of development, but flows out in latter stages, thus relating the flows to factors which are not policy, is possible.

4.1 The estimated equations

We use the lagged output, *Y*, as a measurement for the stage of development, leading us to the equation $K_t^{NP} - K_{t-1}^{NP} = a_1 Y_{t-2} + a_2 {Y_{t-2}}^2 + a_3 X + \varepsilon$, where the left hand side is the net capital flow into a given country and the right hand side includes the output, output squared and control variables (*X*), including education, quality of governance and political stability, religion, etc., of that country. Following the model, we expect a_1 to be positive and a_2 to be negative.

Since our model refers to capital flows for production purposes, as opposed to consumption purposes, we have used net FDI flows as the capital flows variable. In order to overcome the size effect, we examine the per capita variables. In order to prevent problems of causality, we have used the output and controls of years prior to that of the capital flow, such that the flow cannot be causal to output. Since annual data of capital flow is extremely volatile, we have used averages over several years. Accordingly, the first estimated equation is of the form:

$$\text{FDIpc1990\_2003}_i = a_1\text{GDPpc1989}_i + a_2\text{GDPpc1989sqr}_i + a_3\text{X}_i + \varepsilon_i \qquad (14)$$

We estimate the average FDI per capita in every country *i* (over the years 1990-2003) as a function of the GDP per capita a year before, and the squared GDP per capita a year before. We regressed many control variables (see below), and report the regressions with significant controls (FDI per capita for 1980-1989 served as a control as well). A second set of regressions includes regressions of the same structure, but for different years (FDI per capita for 1980-1989, as a function of the 1979 GDP per capita).

4.2 The data

Our point of departure is Sala-i-Martin (1997) dataset, including data of output, education, governance, etc. for 134 countries. We used the WDI (2006)[9] for the FDI data, to update some of Sala-i-Martin (1997) variables and for additional controls. Some of the education variables were taken from the Barro and Lee (1994) dataset. We were forced to omit three countries due to geopolitical changes that caused these countries not to appear on the WDI (West Germany, Taiwan and Yugoslavia). The main variables we use are GDP per capita for the years 1979 and 1989, and FDI per capita (average for the periods 1980-1989 and 1990-2003). Control variables included FDI of prior years, capital formation at 1980, latitude squared, various education variables, various output composition variables, indicators for corruption, regime, religious, etc. Table 1 provides a short description of the variables and a complete list of the control variables.

Table 1 here

[9] World Bank, 2006. World Development Indicators 2006 (CD Rom). World Bank, Washington DC.

The sample includes 131 countries. Lack of data for some countries for some of the variables restricted us to 69 to 98 observations (countries) for the various regressions. Two outliers, for which the observed FDI per capita was extremely high, were omitted from the regressions (Singapore for 1980-1989 and Ireland for 1990-2003). It should be noted that the model's prediction for these two observations is positive and relatively large (capital inflow), but falls far below the actual value.

4.3 Results

Table 2 describes regressions based on equation (14). Column (1) refers to FDI per capita for 1990-2003, as a function of GDP per capita for 1989 and GDP per capita squared. The coefficient for the first variable is positive (27.1, i.e., every $1,000 increase in GDP per capita of the baseline year increases net FDI flow by $27.1) and for the second is negative, and both are significant at 1%. The first coefficient is positive and the second is negative, therefore the regression yields the same inverted U shaped relationship between output and FDI flows predicted by the model.

Table 2 here

Column (2) adds control variables to column (1). Capital formation at a baseline year has a negative effect at low levels of capital, but since capital formation squared is positive, the effect reverses at high levels of capital. Latitude squared is negative, i.e., less capital is flowing to countries which are far from the equator. R-squared is 0.49, i.e., we are able to explain half of the variations in capital flows using these variables. We have tested many other control variables, including a measure of openness, rule of law, political rights, civil liberties, revolutions and coups, a war dummy variable, exchange rate distortion, fraction of GDP from mining, fractions of various religions, Spanish colony, life expectancy and several education variables, but they were all found to be insignificant. The only additional significant variable we found is FDI per capita of the previous decade (column (3)), with a value of 1.025, i.e., FDI inflow (or outflow) per capital for 1990-2003 is 2.5% larger than inflow (or outflow) of 1980-1989 (plus $19.5, the constant). Including this variable in the regressions of column (1) or (2) makes all the other variables insignificant.

The regressions are in line with the model. Capital inflows are positive and increasing with GDP at low levels of development, but once GDP is higher, capital outflows are occurring. Thus, the changes in output are generating the demand for capital and the capital flows, where an increase in the output in initial phases implies an increase in the economic activity and induces inflows, but starting from a certain level of output, local supply of capital may be high enough, and an increase in output implies a greater supply relative to demand, i.e., causes capital outflows. The negative sign of capital formation implies that when capital is already available (given the output), the demand for additional capital decreases. We are unable to explain the opposite sign of the capital formation squared, but this variable is not significant in all the regressions. These factors explain about half of the variations in net FDI per capita flows, and therefore diminish the importance of policy, various FDI attracting agencies, other local characteristics, etc.

The significance of the FDI of the previous decade is easy to explain. Since development is a slow process, most of the information regarding the development phase is already embedded within the past FDI variable. According to the model, besides the periods of reversal from having a net external debt to being a net creditor, in the rest of the periods inflows are increasing with GDP and outflows are increasing with GDP, thus explaining the coefficient of slightly more than 1. Moreover, past FDI already includes information regarding regime, education, latitude, corruption and other variables which are slow to change. Although most of these variables were generally insignificant in our regressions, they may still have some effect over current FDI flows, and therefore past FDI is expected to be strongly significant.

Figure 3 presents the actual values of FDI per capita and the fitted values based on the regression column (1) of table 2. Notice that the fitted values demonstrate the same pattern of reversal that is predicted by the model. Notice also the similarity between this figure to figure 2, presenting the model's prediction regarding capital flow as a function of the GDP.

Figure 3 here

As a robustness analysis we have estimated similar regressions to those of column (1) and (2) of table 2, for the years 1980-1989. Table 3 reports the results. All the coefficients are of the same sign as in table 2, and the coefficients of the GDP and GDP squared are significant at 1%. Therefore, as before, net FDI flows exhibit an inverted U-shaped behavior with regard to GDP, supporting the findings of table 2. Note, however, that the average FDI per capita and its standard deviation (see table 1) for 1980-1989 are smaller than those of 1990-2003, and so are the coefficients of GDP and GDP squared for 1980-1989 compared to 1990-2003 (in absolute values).

Table 3 here

5 Discussion

We have presented a model in which growth required increasing the absorption capacity of the firms and capital. In the model, external capital cannot create growth if there is no internal capacity. The model yielded an inverted U shaped relationship between the stage of development and net capital inflows, due to changes in the gap between demanded capital and local savings. We validated the relationship between net FDI flows and the stage of development empirically. Accordingly, this study emphasizes the importance of the internal growth forces within the economy, over external availability of capital. While financial liberalization may be required to make the external capital available, the demand for capital is not created if there are no internal forces leading to growth.

The policy conclusion is straightforward. Capital is required for growth, but it is flowing when the economy is growing, not causing it to grow. Therefore, policies and agencies aimed at directly increasing the flow would have little effect on the growth. Instead, countries should focus on policies aimed at creating internal growth, and the capital flows would follow. Such policies may include education and training, better legal environment for operation and expansion of firms, tax incentives for new enterprises, proper infrastructure, etc. The positive externalities of training, i.e., the fact that firms consider only the period in which a manager works for the firm, while the economy is enjoying the manager's ability for the remaining periods, is enhancing the gains from such policies even more. While this study is not trying to identify policies that foster growth, it does suggest that such policies do not include directly targeting FDI, although a successful policy would lead a low-income country to experience FDI inflow. Obviously, we do not claim that current account liberalization is not necessary. It is required, in order to allow for the occurrence of these capital inflows, once local demand is created. A similar conclusion is relevant regarding capital flow reversals. A reversal may simply be a signal of maturity of an economy, leading to a slowdown in demand relative to the supply of capital, and in such a case, there is no need for any counter-policy directly targeting the outflow, but rather for a policy fostering other growth factors.

The cessation of growth when training is completed and the exclusion of technological change from the model require some explanation. Since most of the discussion regarding FDI, sudden stops and capital flows involves developing countries, in which growth is stemming from adopting existing technologies, we chose to abstain from technological change. Thus, the model generates the path of capital flows for countries catching up with the developed world. Once this catch-up is completed, the growth of a developed country requires technological progress, which increases the local demand for capital, but not enough in order to generate capital inflow. Therefore, it does not affect the policy conclusion mentioned above. Including it, alongside other extensions, such as a research sector and mortality of the agents, may prove useful in improving the model's prediction regarding the long-run capital flows of the developed countries.

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Figure 1 – Net External Debt and Net Capital Flows over Time

Plotted for $f(l,k)=(l^{0.6}k^{0.4})^{0.9}$, $c(m)=2m^2$, r=0.1, s=0.2, and N>62,261

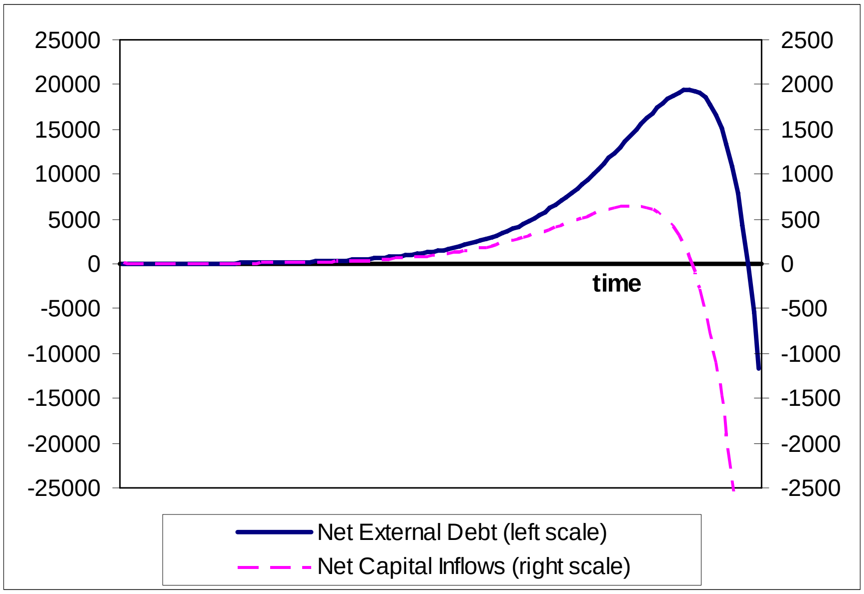

Figure 2 – Net Capital Flows and Output

Plotted for $f(l,k) = (l^{0.6}k^{0.4})^{0.9}$, $c(m) = 2m^2$, r=0.1, s=0.2, and N>62,261

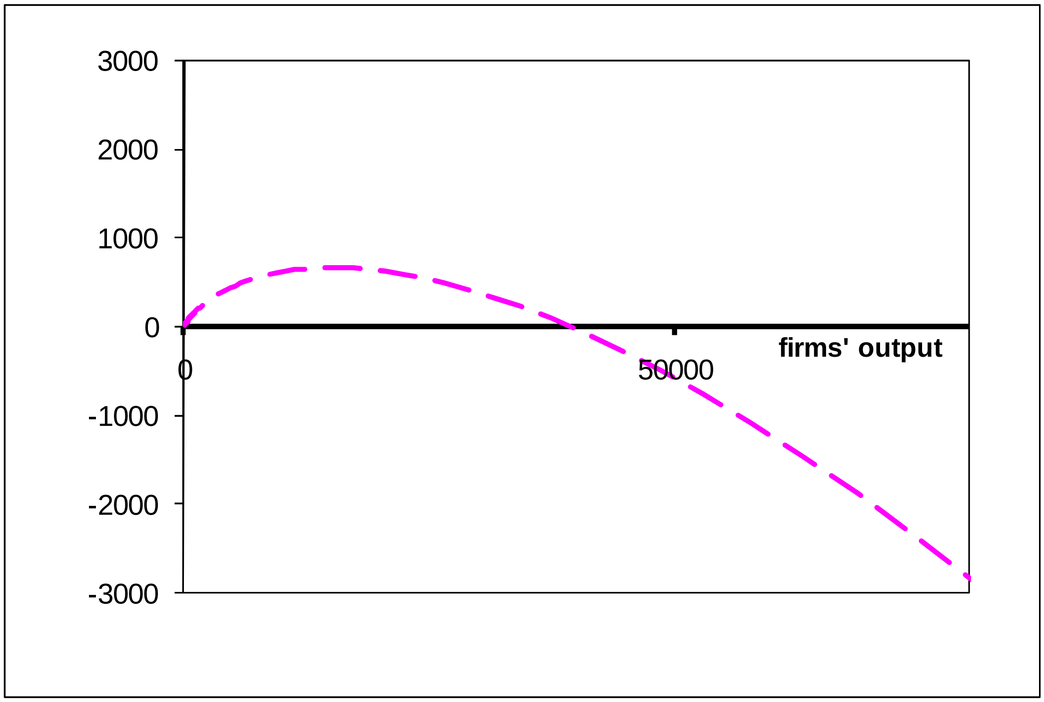

Figure 3 – FDI per capita and Output per Capita

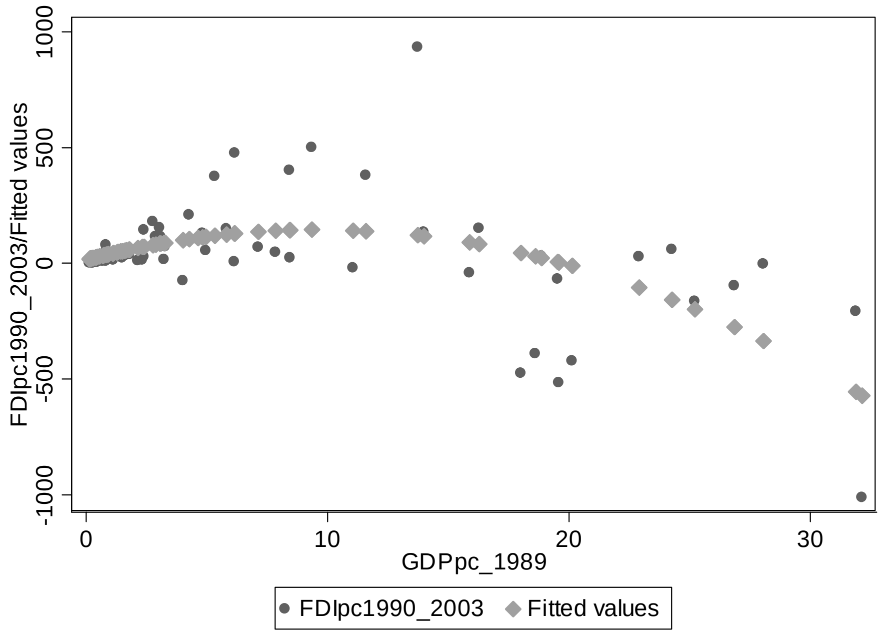

Table 1 – Variables

Variable	Description	Source	Mean	Standard Dev.
FDIpc1980_1989	Average of Foreign Direct Investment, net (constant 2000 US $) divided by total population for 1980-1989.	WDI 2006	21.5	127.6
FDIpc1990_2003	Average of Foreign Direct Investment, net (constant 2000 US $) divided by total population for 1990-2003.	WDI 2006	49.4	279.2
GDPpc1979	GDP per capita (thousands of constant 2000 US $), 1979.	WDI 2006	5.5	7.6
GDPpc1989	GDP per capita (thousands of constant 2000 US $), 1989.	WDI 2006	5.7	8.1
GDPpc1979sqr	GDPpc1979 squared.	WDI 2006	87.1	206.5
GDPpc1989sqr	GDPpc1989 squared.	WDI 2006	98.2	211.7
CapitalForm1980	Gross fixed capital formation (gross domestic fixed investment) of 1980, % of GDP.	WDI 2006	25.2	8.4
CapitalForm1980sqr	CapitalForm1980 squared.	WDI 2006	702.3	451.5
Latitudesqr	Absolute latitude, squared.	Sala-i-Martin (1997)	751.7	924.2
Additional controls	Domestic savings rate (1980), Domestic savings rate (1990), Life expectancy (1980)	WDI 2006	-	-
Additional controls	Absolute latitude, Latin America dummy, Sub-Saharan Africa dummy, Fraction Protestants, Fraction Catholics, Fraction Confucians, Fraction Muslims, Fraction Buddhists, Former Spanish colony, Rule of law, Political rights, Civil liberty, Degree of capitalism, Revolutions and coups, War dummy, Fraction GDP from Mining, Fraction of primary products in total exports, Black Market Premium (standard deviation), Exchange rate distortion, Years open (a measure of openness for 1950-1990), Life expectancy (1960), Primary schooling (1960).	Sala-i-Martin (1997)	-	-
Additional controls	Average schooling years (adults, 1975), Average schooling years (adults, 1980), Male primary school completed (1975), Male primary school completed (1980), Male secondary school attained (1975), Male secondary school attained (1980).	Barro Lee (1994)	-	-

Table 2 – FDI Regression Analysis

Dependent Variable: FDIpc1990_2003

	(1)	(2)	(3)
GDPpc1989	27.086 (3.13)**	36.417 (4.00)**	
GDPpc1989sqr	-1.411 (4.43)**	-1.486 (5.03)**	
CapitalForm1980		-21.742 (2.04)*	
CapitalForm1980sqr		0.537 (2.65)**	
Latitudesqr		-0.079 (2.49)*	
FDIpc1980_1989			1.025 (9.18)**
Constant	15.110 (0.45)	203.370 (1.56)	19.517 (1.17)
R-square	0.32	0.49	0.56
Observations	76	75	69

The absolute values of the t-statistics appear in parentheses.

* Significant at 5%.

** Significant at 1%.

Table 3 – FDI Regression Analysis

Dependent Variable: FDIpc1980_1989

	(1)	(2)
GDPpc1979	10.979 (2.91)**	18.308 (4.28)**
GDPpc1979sqr	-0.735 (4.15)**	-0.887 (4.90)**
CapitalForm1980		-2.726 (0.57)
CapitalForm1980sqr		0.086 (0.99)
Latitudesqr		-0.039 (3.53)**
Constant	5.447 (0.49)	21.333 (0.35)
R-square	0.24	0.36
Observations	98	97

The absolute values of the t-statistics appear in parentheses.
* Significant at 5%.
** Significant at 1%.