

Financial globalization, convergence and growth: The role of foreign direct investment*

Delfim Gomes Neto and Francisco José Veiga

Universidade do Minho and NIPE

Escola de Economia e Gestão

4710-057, Braga, Portugal

October 2009

Abstract

Using a panel dataset covering the period 1970-2004 and 96 countries, we empirically test the role of foreign direct investment on growth through diffusion of technology and innovation. Using an otherwise standard growth regression, we introduce a direct effect of foreign direct investment, which may be proxying for innovation, and an indirect effect, to capture the role of technological catch-up. We find that these two mechanisms have a positive effect on growth. Developing countries benefit relatively more, because of the catch-up effect of technology. These results are consistent with an open economy model, in which foreign direct investment affects growth through diffusion of technology and innovation.

JEL Classification: F21, F36, F43, O47

Keywords: foreign direct investment; composition of foreign capital; diffusion of technology; catch-up; convergence; growth

*We are grateful to Philippe Bacchetta, Jean Imbs, Rafael Lalive, Alexander Monge-Naranjo, Ricardo Reis, Frédéric Robert-Nicoud, Mark Wright, to seminar participants at Universidade do Minho, Université de Lausanne, Université de Cergy, Université de Genève and to participants at the 15th World Congress of the International Economic Association, and at the 2008 LACEA meeting, for very helpful comments. Delfim Gomes Neto thanks the Spanish Ministry of Education and FEDER for financial support (grant SEJ2005-03753/ECO). Francisco Veiga thanks the financial support of the Portuguese Foundation for Science and Technology (FCT) under research grant POCI/EGE/55423/2004 (partially funded by FEDER). Luísa Benta provided excellent research assistance. E-mail addresses: dneto@eeg.uminho.pt and fjveiga@eeg.uminho.pt.

1 Introduction

The ratio of International Financial Integration (stock of foreign assets and liabilities) over GDP gives an idea of the dramatic increase of Financial Globalization in the last decades. Following Lane and Milesi-Ferretti (2007), this ratio increased by a factor of 7, from 45% in 1970 to over 300% in 2004. The theory suggests that Financial Globalization would lead to a better allocation of resources, implying an increase of growth, with capital going from industrial to developing countries. But there is no conclusive and robust empirical evidence of a positive effect of Financial Globalization on growth, as stated by Kose, Prasad, Rogoff and Wei (2009) and Obstfeld (2009) after surveying this literature. Henry (2007) provides a critical reading of the literature on Financial Globalization from the perspective of the textbook theory of liberalization. He claims that the neoclassical growth model only suggests a temporary effect on growth and that the macro growth regressions are not able to capture this effect following financial integration.

There is also lack of robust empirical evidence of positive effects on growth when using measures of foreign direct investment (FDI). Given the expected benefits of FDI on innovation and diffusion of technology¹, often emphasized by policy makers, this is a surprising result. On the one hand, there is cross-country evidence of pre-conditions for the existence of a positive effect of foreign direct investment on growth. These pre-conditions are related to financial development (Alfaro, Chanda, Kalemli-Ozcan and Sayek, 2004) or to human capital (Borensztein, De Gregório and Lee, 1998). Recent research points to a positive effect of Financial Globalization on productivity², as in Bonfiglioli (2008) and Kose, Prasad and Terrones (2009). On the other hand, new evidence at the firm level points to a positive role of foreign direct investment on diffusion of technology. Javorcik (2004) stresses the importance of backward linkages from foreign direct investment to domestic suppliers, while Blalock and Gertler (2009) point out the role of FDI on catch-up.

In this paper, we test empirically the role of foreign direct investment on growth through diffusion of technology and innovation. Using an otherwise standard growth regression, we introduce a direct effect of foreign direct investment, which may be proxying for innovation, and an indirect effect, to capture the role of catch-up on productivity. We find that foreign direct investment has a positive effect on growth through these mechanisms.

To motivate and guide the empirical analysis, we present in Section 2 a small open economy model, based on Barro, Mankiw and Sala-i-Martin (1995), where only a part of the capital serves as collateral in international markets. We introduce in this model an effect of foreign direct investment on growth, through diffusion of technology and

¹See Kose, Prasad, Rogoff and Wei (2009) for an overview and references.

²On this topic also see Obstfeld (2009). In a study at the industry level, Levchenko, Rancièrè and Thoenig (2009) find a positive effect of financial integration on output, but not on productivity.

innovation. The diffusion of technology depends on the lag of technology relative to the world frontier, following the idea of Nelson and Phelps (1966)³, and also on foreign direct investment. On the one hand, the more backward a country is, the greater the room it has to absorb technology and, thus, the higher its growth rate of technology will be. On the other hand, the higher foreign direct investment is, the higher will be the capacity of absorption for a given technological gap. The idea of foreign direct investment having a positive effect in the transfer of technology is also present in Findlay (1978).

The stock of foreign direct investment is related to the control of factors of production and management by the firm⁴. Other forms of foreign capital, such as external debt, do not have these characteristics, or at best have a tenuous direct effect on transfer of technology, when compared with FDI. Thus, countries relying relatively more on foreign direct investment may have higher diffusion of technology. Moreover, FDI may stimulate research in the country and thus improve on its innovation rate.

In a small open economy growth model, there is an initial endowment of capital and the international interest rate is taken as given. It follows that an amount of foreign capital is flowing into the representative economy. With other factors held equal, countries will differ only on the composition of foreign capital (mostly FDI and external debt). Thus, in order to account for the effect of Financial Globalization on growth through diffusion of technology, we need to analyze the differences in the composition of foreign capital among countries.

We use two measures of foreign direct investment. First, the most common in macro growth regressions, the stock of foreign direct investment over GDP. Second, the stock of FDI over total foreign capital. Both measures of FDI are obtained from Lane and Milesi-Ferretti (2007). The second measure is related to the first one in a small open economy. Given the international interest rate, and using a Cobb-Douglas production function, there is a linear relationship between total physical capital and GDP and, thus, between FDI over GDP and FDI over total capital. Taking other factors as given, total capital is equal among economies and it differs only in the composition of foreign capital.

The empirical implications of our open-economy growth model are tested using system-generalized method of moments (system-GMM) estimations on a dataset comprising seven consecutive and non-overlapping 5-year periods from 1970 to 2004, and 96 countries. After controlling for initial GDP per capita, the investment share, initial education, population growth, and trade openness, we find that economies with relatively more foreign direct investment have higher catch-up and a higher direct effect on growth. Our results are robust to (1) restricting the sample to the period 1985-2004, over which financial globalization

³In their paper, Nelson and Phelps (1966) consider the lag between "best practices" and actual technology of a country. For a given lag, the technology of a country increases with human capital.

⁴Foreign direct investment gives the foreign investors a lasting interest (10% or more of the voting stock) in firms operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital.

grew considerably; (2) restricting the sample to the developing countries or to non-OPEC members; (3) controlling for macroeconomic stability and institutions; (4) considering alternative explanations for catch-up and growth, such as diffusion of technology through human capital, openness to international trade, and financial development; and, (5) to using total factor productivity instead of GDP per capita in the baseline regression.

We would like to point out three important contributions of our empirical analysis. First, we show that the inclusion of an interaction term of FDI with a proxy of initial technology is essential to capture the effect of foreign direct investment on the diffusion of technology. Failure to include this interaction term leads to omitted variable bias, which may have been a problem in previous empirical studies that do not find evidence of positive effects of FDI on growth. In fact, after including the interaction term, we also find evidence of a direct effect of FDI on growth. Second, our results clearly indicate that it is necessary to analyze the composition of foreign capital when evaluating the effects of Financial Globalization on growth. Concretely, we show that countries with a greater share of FDI on total financial liabilities tend to have higher catch-up and higher direct effect on growth. Finally, we present evidence that developing countries gain relatively more with financial globalization, when foreign capital takes mainly the form of foreign direct investment. This result is consistent with our theoretical model, in the sense that developing countries are farther away from the world's technological frontier, having greater room for catch-up.

This paper is related to the literature on the growth effects of financial globalization, summarized in recent surveys by Kose, Prasad, Rogoff and Wei (2009), Henry (2007) and Obstfeld (2009). The results of the studies they surveyed are not conclusive in general. Our results point to a direct effect and an indirect effect of foreign direct investment on growth, through diffusion of technology.

Some authors have emphasized pre-conditions for countries having benefits with financial globalization. This is the case with foreign direct investment and its interaction with some variables. Foreign direct investment will lead to higher growth, if the country has a relatively high level of financial development (Alfaro et al., 2004) or of human capital (Borensztein et al., 1998). In general, these high levels are more common in developed countries. We find that most developing countries benefit relatively more in terms of growth because of the catch-up effect and also because of a direct effect⁵.

There is a literature on the catch-up effect using cross-country regressions. Benhabib and Spiegel (1994), directly inspired in Nelson and Phelps (1966), find evidence for a role of human capital in catch-up. Based on a Schumpeterian model, Aghion, Howitt and Mayer-Foulkes (2005) show empirically that financial development has a positive effect on convergence to the growth rate of the world technology frontier.

⁵Notice that Alfaro et al. (2004) and Borensztein et al. (1998) find a direct, but negative effect of foreign direct investment on growth.

In a calibrated version of the neoclassical growth model, Gourinchas and Jeanne (2006) estimate the welfare gains of financial integration of a small open economy, when compared to an economy in autarky. They provide estimates of growth and welfare gains for countries beginning out of the steady state. The welfare gains are small, but would improve if catch-up of the productivity was associated with the entry of foreign capital in the form of foreign direct investment. Our results, based on a growth model with a process of diffusion of technology, in which the composition of foreign capital plays a role, show that the gains in terms of annual growth vary between 0.65 percentage points for the average country and 1 percentage point for the average developing country.

The paper is organized as follows. Section 2 presents a small open economy growth model with diffusion of technology and its predictions, to motivate our empirical analysis. In Section 3 we describe the dataset and the empirical methodology. The empirical results are discussed in Section 4. Finally, concluding remarks are presented in Section 5.

2 A small open economy with diffusion of technology

With the purpose of motivating the empirical analysis, this Section presents a growth model with credit constraints, following Barro et al. (1995), where foreign direct investment affects growth through the diffusion of technology and innovation.

2.1 The small open economy

The production function is Cobb-Douglas:

$$Y = K_C^\alpha K_U^\eta (AL)^{1-\alpha-\eta}$$

with $\alpha + \eta < 1$. Y is output, L is labor, A is the level of technology. K_C is a capital that can be used as collateral in the foreign market, and K_U is another capital but that cannot be used as collateral⁶. The production function in intensive form is given by:

$$y = k_C^\alpha k_U^\eta, \tag{1}$$

where y is output per unit of effective labor and k_i ($i = C, U$) is capital per unit of effective labor.

The rental price of capitals, R_{kC} and R_{kU} , are given by

$$R_{kC} = \alpha k_C^{\alpha-1} k_U^\eta = \alpha \frac{y}{k_C} \tag{2}$$

⁶For an early model with borrowing constraints, see Cohen and Sachs (1986). These authors assume that a fraction of the capital, say k , serves as collateral. Barro et al. (1995) assume instead that there are two types of capital and that only one of the capitals serves as collateral.

$$R_{kU} = \eta k_C^\alpha k_U^{\eta-1} = \eta \frac{y}{k_U}. \quad (3)$$

The budget constraint is

$$\dot{k}_C + \dot{k}_U - \dot{d} = k_C^\alpha k_U^\eta - (\delta + n + g)(k_C + k_U) - (r^* - n - g)d - c, \quad (4)$$

where $k_{C0} > 0$, $k_{U0} > 0$ and d_0 are given. d is debt per units of effective labor, c is consumption per units of effective labor, and r^* is international real interest rate. The depreciation rate is δ , and population growth is n . The growth rate of productivity g is an endogenous variable and its behavior will be presented in the next subsection.

The economy can borrow abroad but, as stated above, only k_C serves as collateral ($d \leq k_C$).

If $k_{C0} + k_{U0} - d_0 \geq k_U^*$, the initial stocks of capitals are higher than the steady state level of the capital that can not be used as collateral and the economy goes directly to the steady state.

But with $k_{C0} + k_{U0} - d_0 < k_U^*$, the borrowing constraint is binding and $d = k_C$. For every period t , we have the rental rate of k_C equal to the international interest rate: $R_k - \delta = r^*$. Using equation (2):

$$\frac{k_C}{y} = \frac{\alpha}{r^* + \delta}. \quad (5)$$

Inserting equation (5) in equation (1), the production function is written as

$$y = B (k_U)^\varepsilon, \quad (6)$$

with $B = \left[\left(\frac{\alpha}{r^* + \delta} \right)^\alpha \right]^{\frac{1}{1-\alpha}}$ and $\varepsilon = \frac{\eta}{1-\alpha}$ ⁷.

Taking into account equations (5) and (6) and that $d = k$, the budget constraint, given by equation (4), takes now the following form:

$$\dot{k}_U = (1 - \alpha) B (k_U)^\varepsilon - (\delta + n + g) k_U - c.$$

Assuming that savings are a constant fraction of output⁸, $s(1 - \alpha) B (k_U)^\varepsilon$, we have

$$\dot{k}_U = \bar{s} (k_U)^\varepsilon - (\delta + n + g) k_U, \quad (7)$$

where $\bar{s} = s(1 - \alpha) B$.

We characterize now the steady state of this open economy with credit constraints.

⁷As $0 < \alpha + \eta < 1$, it follows that $0 < \varepsilon < \alpha + \eta < 1$. Notice that $(1 - \varepsilon) = \frac{1 - (\alpha + \eta)}{1 - \alpha} > 1 - (\alpha + \eta)$.

⁸We could also introduce consumer optimization in the model.

With $\dot{k}_U = 0$, it follows from (7) that

$$k_U^* = \left[\frac{\bar{s}}{\delta + n + g^*} \right]^{\frac{1}{1-\varepsilon}}. \quad (8)$$

where g^* is the steady state growth rate of technology, which is equal for every country and also equal to the growth rate of technology of the leader country.

Using the relation between output and the capital that can not be used as collateral, given by equation (6), we write equation (7) as a function of output:

$$\frac{\dot{y}}{y} = \varepsilon \left[\bar{s} y^{\frac{\varepsilon-1}{\varepsilon}} - (\delta + n + g) \right].$$

Defining Y_{pc} as GDP per capita, we have $\frac{\dot{y}}{y} = \frac{\dot{Y}_{pc}}{Y_{pc}} - \frac{\dot{A}}{A} = \frac{\dot{Y}_{pc}}{Y_{pc}} - g$. Taking also into account that $k_U = \left(\frac{y}{B}\right)^{1/\varepsilon}$ and $\ln k_U = \frac{1}{\varepsilon} \ln \left(\frac{y}{B}\right)$, which follow from equation (6), we linearize the equation above around the steady state to get:

$$\frac{\dot{Y}_{pc}}{Y_{pc}} = g^* - \beta (\ln y - \ln y^*) + (1 - \varepsilon) (g - g^*) \quad (9)$$

where $\beta = (1 - \varepsilon) (\delta + n + g^*)$.

The second expression on the right hand side of equation (9) captures the convergence effect on growth through capital accumulation. If $g = g^*$, there is no room for changes in productivity. But, with $g \neq g^*$ there is the possibility of an additional effect on growth, given by the third term on the right hand side of equation (9).

2.2 Diffusion of technology

Instead of a constant growth rate of technology, we assume a process of diffusion of technology. There will be a leader country with a constant growth rate of technology, but the growth rate of technology of any other country will depend on its initial level of technology.

The growth rate of technology in the leader country is given by

$$g^* = \frac{\dot{A}^L}{A^L},$$

where A^L represents the level of technology of the leader country.

We assume that the growth rate of technology in the small open economy is represented by

$$g = \frac{\dot{A}}{A} = \lambda * \left(\frac{A^L - A}{A} \right) + \tau. \quad (10)$$

There is catch-up to the technology of the leader. Following the idea of Nelson and Phelps (1966), this catch-up effect increases with the gap of technologies $A^L - A$: the more backward a country is, the greater the room it has to absorb technology and thus the higher its growth rate of technology will be. In addition, the catch-up effect depends positively on the technology absorption rate λ , for a given technological gap. We also represent a process of innovation by τ , with $\tau < g^*$.

Defining $a = \frac{A}{A^L}$:

$$\frac{\dot{a}}{a} = \lambda * \left(\frac{1}{a} - 1 \right) + \tau - g^* \quad (11)$$

and $g = \frac{\dot{a}}{a} + g^*$. It follows that with $\dot{a} = 0$, $g = g^*$ and

$$a^* = \frac{\lambda}{\lambda + g^* - \tau}.$$

In the steady state all countries will grow at same rate as the leader, with $g = g^*$.

Using equations (10) and (11), we get:

$$g - g^* = \frac{\dot{a}}{a} = \lambda \left(\frac{1}{a} - 1 \right) + \tau - g^* = -\lambda \ln a + \tau - g^* \quad (12)$$

where $a = A/A^L < 1$. Thus $\ln a < 0$ for countries below the technological frontier.

The parameter λ , the technology absorption rate, depends on conditions of the economy. For example, it may vary across countries because of differences in human capital, as in Nelson and Phelps (1966). Our key assumption in this respect is that λ will be a function of foreign direct investment. That is, the capacity of absorption for a given technological gap may increase with the presence of more foreign firms, $\lambda = \lambda(FDI)$. Or, in the words of Findlay (1978)⁹:

"..., other things being equal, the rate of change of technical efficiency in the backward region is an increasing function of the relative extent to which the activities of foreign firms with their superior technology pervade the local economy."

2.3 Implications of foreign direct investment on growth through diffusion of technology

The transitional dynamics of GDP per capita depends on convergence of capital to its steady state level and also on the technological catch-up. Following equations (9) and

⁹In his model, Findlay (1978) stresses the role of foreign direct investment in the diffusion of technology. Our model insert the diffusion of technology in a neoclassical growth model and derives the implications for growth regressions.

(12), we have:

$$\frac{\dot{Y}_{pc}}{Y_{pc}} = g^* + \beta (\ln y^* - \ln y) + (1 - \varepsilon) (-\lambda \ln a + \tau - g^*). \quad (13)$$

For a country below the steady state level of capital and also below the technological frontier, there will be positive effects on the growth rate of GDP per capita. We are principally interested in the second of these effects, given by the third term on the right hand side of equation (13), and how it depends on diffusion of technology through foreign direct investment.

In the model presented above, the total amount of foreign capital that enters in a country depends on the initial amount of capital in the economy, on the international interest rate and other parameters, as seen in equations (2) and (5). Financial integration can take principally the form of foreign direct investment or external debt. But only foreign direct investment has a positive effect on λ , following the intuition presented above. External debt does not play the same role in technological diffusion or, at best, has a smaller effect. For a given amount of foreign capital, increasing external debt leads to a reduction of foreign direct investment and, thus, also leads to a negative effect on λ . Notice that the model does not determine the composition of foreign capital, because each form of foreign capital is remunerated at the international interest rate. But foreign direct investment has a positive externality effect through diffusion of technology. Although a country has interest in attracting foreign direct investment, foreign investors may decide the amounts of each type of foreign capital in a specific country, taking into account other conditions in the economy and in international markets.

Following the work of Benhabib and Spiegel (1994) on the effects of human capital on technology, we assume a linear specification for the effects of foreign direct investment (FDI) on technology, where $\lambda(FDI) = \lambda * FDI$ and $\tau(FDI) = \tau * FDI$. We have:

$$g = -\lambda * FDI * \ln a + \tau * FDI.$$

It follows that there are two effects of foreign direct investment on the growth rate of technology:

$$\frac{\partial g}{\partial FDI} = \underbrace{-\lambda \ln a}_{\text{Effect 1}} + \underbrace{\tau}_{\text{Effect 2}}$$

Effect 1 and Effect 2 are as presented below.

- Effect 1: $-\lambda \ln a > 0$. The first effect is an increase in the catch-up effect, when FDI increases. The transfer of technology may increase for a given gap of technologies with relatively more FDI .
- Effect 2: $\tau > 0$. The second effect is also positive and may be associated with a

technological improvement following the increase in FDI, through innovation in the country.

We can present the effects of foreign direct investment on growth in the following proposition:

Proposition 1 *Economies with relatively more FDI have a higher catch-up and a higher direct effect on growth.*

Empirically, the first effect can be captured by an interaction term between FDI and a proxy for the initial level of technology, given by $\ln Y_0$. The second effect appears as an explanation for a direct effect of FDI on growth, although we are using an exogenous growth model. As stated above, in the steady state all economies grow at the same rate, with $g = g^*$.

We will use two measures of foreign direct investment in our empirical analysis. In line with the macro growth literature, we use the stock of foreign direct investment over GDP, $\frac{FDI}{GDP}$. This proxy is linearly related to the ratio $\frac{FDI}{k_C}$ by equation (5)¹⁰, where k_C represents total physical capital¹¹. The latter contains the initial domestic capital, foreign direct investment, and external debt. Notice that total physical capital, as well as total foreign capital, depends on parameters of the model, given initial domestic capital and equations (2) and (5). Other things equal, what determines the effects on the technology is the relative importance of foreign direct investment and external debt in a country. We can capture this effect with the composition of foreign capital. This proxy has the advantage of depending of just one dataset (Lane and Milesi-Ferretti, 2007), instead of the composition of total capital, whose calculation implies gathering data from an additional dataset (to calculate total capital, one uses the perpetual inventory method, and needs investment data from the Penn World Tables)¹².

Thus, our second measure is foreign direct investment over foreign capital, $F = \frac{FDI}{Foreign_Cap}$. Notice that external debt has a negative effect on this measure. Relatively more external debt implies relatively less foreign direct investment for a given amount of foreign capital. Thus, it also implies relatively less capacity of absorption, taking into account the technological gap.

The next Sections will empirically analyze the effects of foreign direct investment on growth.

¹⁰Using equation (5) and noticing that k_C represents physical capital: $\frac{k_C}{GDP} = \frac{\alpha}{r^* + \delta}$ and $\frac{FDI}{GDP} = \frac{FDI}{k_C} \frac{\alpha}{r^* + \delta}$.

¹¹In his model, Findlay (1978) uses the stock of foreign direct investment over capital domestically owned and he notices that this is one among other possible representations.

¹²The linear relationship between $\frac{FDI}{GDP}$ and $\frac{FDI}{k_C}$ may have empirical limitations if one considers issues related to sovereign debt and credit constraints, or if equation (5) needs adjustments to be empirically implemented, as in Caselli and Feyrer (2007).

3 Data and empirical analysis

Annual data from 1970 to 2004 was gathered for 209 countries, but missing values for several variables reduce the number of countries in the estimations to 96. The main data sources were the *Penn World Tables, Mark 6.2* (PWT) - for GDP, investment, population, trade openness, and size of government, the updated version of Barro and Lee (2000) educational attainment dataset, Lane and Milesi-Ferretti (2007)'s *External Wealth of Nations Mark II*, the updated version of the *Financial Structure Dataset* of Beck, Demirgüç-Kunt and Levine (2000), and the International Monetary Fund's *International Financial Statistics* (IFS-IMF).

The hypothesis that financial globalization affects economic growth and convergence is tested by estimating dynamic panel data models for the natural log of GDP per capita on a sample composed of seven consecutive, non-overlapping, 5-year periods from 1970 to 2004 (1970-74, 1975-79, ..., 1995-99, and 2000-04). Our baseline model includes the following explanatory variables:

- *Initial GDP per capita (log)* (PWT). This is the log of GDP per capita lagged by one 5-year period. A positive coefficient, smaller than 1, is expected, indicating the existence of conditional convergence among countries;
- *Foreign Direct Investment* (Lane and Milesi-Ferretti, 2007). We hypothesize that more FDI contributes to higher steady state GDP, and thus to higher growth, which is consistent with a positive coefficient. Two measures of FDI will be used. First, the ratio of the stock of foreign direct investment liabilities to GDP, $\frac{FDI_l}{GDP}$, which is the most commonly used measure of FDI in the literature. Second, in order to consider the share of FDI in foreign capital, we use the ratio of foreign direct investment liabilities to total financial liabilities, $\frac{FDI_l}{Fin.Liab.}$;
- *Foreign Direct Investment * Initial GDP per capita*. This interaction term is used to test the hypothesis that more FDI increases catch-up of technology. Since greater catch-up means that poorer countries should grow faster, we expect a negative coefficient. The two measures of FDI referred to above will be used;
- *Investment (% GDP)* (PWT): average over the current 5-year period. A positive coefficient is expected, as greater investment shares have been shown to be positively related with economic growth (Mankiw, Romer and Weil, 1992). For a more recent discussion, see Hsieh and Klenow (2007);
- *Initial years of schooling*: secondary years of schooling of the population above 15 years old (Barro and Lee, 2000) in the first year of the 5-year period. This variable is used to control for the level of human capital, which should be positively related to economic growth. A positive coefficient is expected;

- *Population growth* (PWT): average over the current 5-year period. All else remaining the same, greater population growth leads to lower GDP per capita growth. Thus, a negative coefficient is expected;
- *Trade openness* (PWT): average over the current 5-year period. Assuming that openness to international trade is beneficial to economic growth, a positive coefficient is expected.

Descriptive statistics of these and other variables for the 96 countries considered in the baseline estimations are shown in Table 1 (the countries are listed in the Appendix).

[INSERT TABLE 1 ABOUT HERE]

Taking into account the implications derived in equation (13), we have:

$$\begin{aligned}\ln Y_{i,t} - \ln Y_{i,t-1} &= \gamma_1 \ln Y_{i,t-1} + g_{i,t} + \psi' * Z_{i,t} + \kappa_i + \mu_t + \epsilon_{i,t} \\ g_{i,t} &= \gamma_2 * FDI_{i,t} * \ln Y_{i,t-1} + \gamma_3 * FDI_{i,t}.\end{aligned}$$

where $i = 1, \dots, N$ represents countries, $t = 1, \dots, T$ is time, $\ln Y_{i,t}$ is the logarithm of real GDP per capita of country i at the end of period t , $FDI_{i,t}$ is foreign direct investment, $Z_{i,t}$ is a set of variables that may affect economic growth, κ_i are the fixed effects of country i , μ_t are period dummies, and $\epsilon_{i,t}$ is the error term. In the interaction term capturing catch-up $\ln A$ is proxied by $\ln Y$ (log of GDP per capita).

The empirical model can be summarized as follows:

$$\ln Y_{i,t} - \ln Y_{i,t-1} = \gamma_1 \ln Y_{i,t-1} + \gamma_2 * FDI_{i,t} * \ln Y_{i,t-1} + \gamma_3 * FDI_{i,t} + \psi' * Z_{i,t} + \kappa_i + \mu_t + \epsilon_{i,t} \quad (14)$$

With $\alpha = 1 + \gamma_1$, equation (14) is equivalent to:

$$\ln Y_{i,t} = \alpha \ln Y_{i,t-1} + \gamma_2 FDI_{i,t} * \ln Y_{i,t-1} + \gamma_3 FDI_{i,t} + \psi' Z_{i,t} + \kappa_i + \mu_t + \epsilon_{i,t} \quad (15)$$

OLS estimates of this linear dynamic panel data model will be inconsistent, both in the fixed and random effects settings, because the lagged value of the dependent variable would be correlated with the error term, $\epsilon_{i,t}$, even if the latter is not serially correlated¹³. Arellano and Bond (1991) developed a Generalized Method of Moments (GMM) estimator that solves this problem. Taking first differences of equation (15) removes the individual effects (κ_i) and produces an equation that is estimable by instrumental variables (where D is the first-difference operator):

¹³See Arellano and Bond (1991) and Baltagi (2008).

$$D \ln Y_{i,t} = \alpha D \ln Y_{i,t-1} + \gamma_2 D (FDI_{i,t} * \ln Y_{i,t-1}) + \gamma_3 D FDI_{i,t} + \psi' D Z_{i,t} + D \mu_t + D \epsilon_{i,t} \quad (16)$$

The valid instruments are: levels of the dependent variable, lagged two or more periods; levels of the endogenous variables, lagged two or more periods; levels of the pre-determined variables, lagged one or more periods; and the levels of the exogenous variables, current or lagged or, simply, the first differences of the exogenous variables. More moment conditions are available if the explanatory variables are uncorrelated with the individual effects. Then, the first lags of these variables can be used as instruments in the levels equation. This estimation combines the set of moment conditions available for the first-differenced equations with the additional moment conditions implied for the levels equations. If the level of an explanatory variable is correlated with the individual effects but its first-differences are not, lagged values of the first-differences can be used as instruments in the equation in levels (Arellano and Bover, 1995). Lagged differences of the dependent variable may also be valid instruments for the levels equations. According to Blundell and Bond (1998) this system-GMM estimator is preferable to that of Arellano and Bond (1991) when the dependent variable and/or the independent variables are persistent, which corresponds to our case.

4 Empirical Results

The main objective of our empirical analysis is to test the hypothesis, stated in Proposition 1, that foreign direct investment leads to faster catch-up and economic growth. Then, we check if that positive effect of FDI on growth operates through total factor productivity (TFP). The following step of the empirical analysis is to evaluate the sensitivity of the results to alternative samples and to the inclusion of regional dummies. Concretely, we estimate the models for a sample covering only the period 1985-2004, the part of the original sample for which financial globalization is greatest, for a sample of developing countries, so that we can analyze the effects of foreign direct investment in those countries, and for a sample that does not include OPEC member countries. Then, we consider alternative explanations for catch-up and growth, such as diffusion of technology through human capital, openness to international trade, and financial development. Finally, we account for the effects of macroeconomic stability and institutions on growth.

4.1 Foreign capital, convergence and growth

The results of the estimation of the empirical model described above on a sample of seven consecutive and non-overlapping 5-year periods from 1970 to 2004, using the system-GMM

methodology, are presented in Table 2¹⁴. The model of column 1 follows the traditional approach of including a proxy for the stock of FDI along with the usual control variables¹⁵. The ratio of the stock of foreign direct investment liabilities to GDP, $\frac{FDI_l}{GDP}$, is not statistically significant, which could indicate that this type of foreign capital does not affect growth. According to the discussion on diffusion of technology presented above, this specification may suffer from omitted variable bias, as it does not account for the effects of foreign capital on catch-up. That is, the model of column 1, like many similar ones found in the literature¹⁶, may be not correctly specified because it omits the interaction term of foreign capital with initial GDP (proxying for initial technology). This problem is accounted for in column 2, where $\frac{FDI_l}{GDP}$ and its interaction with initial GDP are both weakly statistically significant, providing some evidence that the stock of FDI liabilities positively affects growth and catch-up. The results concerning the control variables generally conform to our priors. Investment (%GDP) and Trade Openness have positive coefficients, and Population Growth has the expected negative coefficient. As found in several panel regressions, Initial Years of Schooling is not statistically significant.

In the model of column 3, we check the possibility that foreign capital has a positive effect on growth, regardless of whether it takes the form of FDI or external debt. We test that hypothesis by adding to the list of explanatory variables the ratio of the stock of external debt liabilities to GDP, $\frac{Debt_l}{GDP}$, and its interaction with initial GDP. If what matters for growth is just the availability of foreign capital, FDI and external debt (and their interactions) should have similar effects. The results shown in column 3 indicate that FDI and external debt have opposite effects on economic growth and catch-up. In fact, the signs of the coefficients of $\frac{Debt_l}{GDP}$ and its interaction with initial GDP suggest that a greater stock of external debt liabilities has negative effects on economic growth and catch-up. It is also worth noting that the coefficients of $\frac{FDI_l}{GDP}$ and its interaction with initial GDP are now both highly statistically significant, providing stronger evidence of a positive effects of FDI on economic growth and catch-up.

The opposite effects of FDI and external debt, shown in column 3 of Table 2, suggest that the composition of foreign capital entering a country is an important determinant of its rate of economic growth and catch-up. In fact, having both FDI and external debt in the same regression, we are estimating the effect of one type of foreign capital given the other.

¹⁴All explanatory variables except the period dummies are treated as endogenous. In order to avoid a number of instruments greater than the number of countries, only the second lags of the dependent and explanatory variables are used as instruments in the first-difference equations, and their once lagged first-differences are used in the levels equation. Two-step results using robust standard errors corrected for finite samples (using Windmeijer (2005)'s correction) are reported in all tables.

¹⁵See, among others, Edison, Levine, Ricci and Sløk (2002).

¹⁶See Edison, Klein, Ricci and Sløk (2004), Henry (2007), and Kose, Prasad, Rogoff and Wei (2009) for surveys. Henry (2007) argues that most studies do not really address the theory they set out to test, as the neoclassical growth model predicts just a temporary increase in the rate of economic growth (faster convergence to the steady state) as the result of current account liberalization.

[INSERT TABLE 2 ABOUT HERE]

Thus, in the estimation of column 1 of Table 3, the proxy for the stock of foreign direct investment liabilities was replaced with its importance in foreign capital, that is the composition of foreign liabilities, $\frac{FDI_l}{Fin.Liab.}$, with the rest of the model being equal to that of column 2 of Table 2. Since both the share of FDI in financial liabilities and its interaction with initial GDP are statistically significant, and have the expected signs, there is empirical support for the hypothesis that countries that receive relatively more FDI tend to have higher catch-up and growth. In the following estimations of Table 3, we take a deeper look at the composition of financial liabilities. Because the definition of foreign direct investment considers a position of 10% or more of the voting stock in local firms (see footnote 4), some studies also take portfolio equity into account in their proxies of FDI. The effects of the combined share of foreign direct investment and portfolio equity are analyzed in column 2, and the results still support our hypothesis. We have seen in Section 2 that external debt has a negative effect on diffusion of technology, for a given amount of foreign capital, as relatively more external debt is associated with relatively less foreign direct investment. The effects of the share of external debt are shown in column 3. These indicate that a greater weight of external debt on financial liabilities is detrimental to growth and catch-up, as the signs of the estimated coefficients are the opposite of those for the other proxies. This result is also in line with our assumptions¹⁷.

[INSERT TABLE 3 ABOUT HERE]

Overall, these results clearly support our hypothesis that economies with relatively more FDI in the composition of foreign capital have a higher catch-up (the interaction term with initial GDP is negative and statistically significant) and a higher direct effect on growth (the share of FDI on financial liabilities is positive and statistically significant). We can illustrate these effects on growth with column 1 of Table 3. Increasing the share of FDI in total liabilities, $\frac{FDI_l}{Fin.Liab.}$, by one standard deviation would lead to an annual growth rate increase of 0.65 percentage points during a five-year period. Following equation (14), the total effect on growth is measured as $(\gamma_2 * \overline{\ln Y} + \gamma_3) * \sigma_{FDI}$, where $\overline{\ln Y}$ is the mean of the log of initial GDP and σ_{FDI} is the standard deviation of the share of FDI in total liabilities. Taking also into account Table 1, it follows $[(-0.156 * 8.496 + 1.52) * 0.167] / 5 = 0.0065$.

A common concern to all empirical studies of economic growth is the possibility that most, or all, explanatory variables are endogenous. The system-GMM estimator used here controls for the potential endogeneity of all explanatory variables by using their lagged

¹⁷Results are very similar when we use the composition of International Financial Integration (IFI) - total stocks of foreign financial assets and liabilities - instead of just financial liabilities. That is, the results are robust to the inclusion of information on stocks of international financial assets. These results are not presented here, but are available upon request. Notice that foreign assets are not in general important for developing countries, but are for developed countries.

instruments in the first-difference and level equations. Additionally, it accounts for the dynamic bias that results of the inclusion of initial GDP in the regressions.

Nevertheless, the problem may not completely go away, as this estimation method assumes weak exogeneity of the explanatory variables, meaning that they can be affected by past and current growth rates but must be uncorrelated with future realizations of the error term. That is, future unanticipated shocks to GDP growth should not affect the current value of the explanatory variables. The statistical validity of this assumption is supported by the results of the Hansen test, reported at the foot of the tables, which never rejects the validity of the overidentifying restrictions. Furthermore, Difference-in-Hansen tests were used to assess the validity of the instruments of each explanatory variable individually and of subsets of instruments. Their validity was never rejected. Finally, the tests for autocorrelation of the differenced residuals, also reported at the foot of the tables, clearly reject second order autocorrelation, further supporting the validity of the instruments used.

4.2 Composition of foreign capital and productivity

Our theoretical model assumes that the positive effects of FDI on catch-up and growth operate through technological diffusion. Thus, a greater share of FDI on financial liabilities should lead to faster technological catch-up and to innovation. This implies that we should obtain similar empirical results when GDP per capita is replaced by total factor productivity (TFP) in the baseline regressions of Table 3.

The series of TFP is constructed following the Hall and Jones (1999) approach to the decomposition of output, using data from the Penn World Tables 6.2. The series on the stock of physical capital, K_i , were constructed using the perpetual inventory method as in Hall and Jones (1999). Using a macro-Mincer approach, $H_i = e^{\phi(s_i)}$ is a measure of the average human capital of workers, which is a function of the average years of schooling of the population over 25 years old, s_i , taken from Barro and Lee (2000). L_i is the number of workers (labor force in use). Finally, the factor share α is assumed to be constant across countries and equal to 1/3. With data on output, the capital stock, average human capital of workers, labor in use, and the factor share, the series of total factor productivity (TFP), can be easily constructed using the production function.¹⁸

The models of the estimations whose results are reported in Table 4 were estimated using TFP instead of GDP per capita. Since data on investment and human capital were used to construct the TFP series, these variables were excluded from the list of explanatory variables. The results obtained are very similar to those reported in Table 3, and support the hypothesis that a greater share of FDI on financial liabilities leads

¹⁸See Caselli (2005) for more detailed explanations of how the series of physical capital, average human capital, and labor are constructed. We also follow this study in assuming that the depreciation rate of physical capital is 6 per cent and that the factor share α is equal to 1/3.

to faster technological catch-up (the coefficient on the interaction term is negative and statistically significant) and innovation (the share of FDI on financial liabilities is positive and statistically significant). As found for GDP, a greater share of external debt has the opposite effects. Overall, these results are consistent with the theoretical model's assumption that FDI positively affects growth through technological diffusion.

[INSERT TABLE 4 ABOUT HERE]

4.3 Sensitivity analysis

The next steps of the empirical analysis were to check the sensitiveness of the results reported in Table 3 to sample changes and to the inclusion of regional dummies. First, we reduced the time period under analysis to 1985-2004, so that only the last 20 years, over which financial globalization grew considerably (Lane and Milesi-Ferretti, 2007), would be considered. The results reported in column 1 of Table 5 are similar to those of column 1 of Table 3.

[INSERT TABLE 5 ABOUT HERE]

Second, we restricted the sample by considering only developing countries (from 1970 to 2004). Again, as shown in column 2, the share of FDI remains highly statistically significant. These results further strengthen our hypothesis that a greater share of FDI fosters growth and catch-up. Moreover, these results provide evidence of benefits of financial globalization for developing countries. For those countries, increasing the share of FDI in total liabilities, $\frac{FDI}{Fin.Liab.}$, by one standard deviation would lead to an annual growth rate increase of 0.99 percentage points during a five-year period¹⁹. This effect is higher than the effect found above for all countries.

Third, regional dummy variables were included, using the regions defined in the IMF's International Financial Statistics database, in order to capture eventual regional effects²⁰. None of the regional dummies turned out statistically significant, and the remaining results are similar to those of the regression of column 1 of Table 3.

Finally, we restricted the sample by excluding all current and former members of the Organization of Petroleum Exporting Countries (OPEC)²¹. In these countries FDI is related, in some extent, to the extraction of natural resources and thus the mechanism of diffusion of technology may not be at work. The results, shown in column 4, are very

¹⁹By equation (14), the total effect on growth is again measured as $(\gamma_2 * \overline{\ln Y} + \gamma_3) * \sigma_{FDI}$, where $\overline{\ln Y}$ is the mean of the log of initial GDP and σ_{FDI} is the standard deviation of the share of FDI in total liabilities. Taking into account that $\overline{\ln Y}$ and σ_{FDI} are now computed only for developing countries, it follows $[(-0.185 * 8.118 + 1.776) * 0.181] / 5 = 0.0099$.

²⁰The dummy variable for industrial countries was left out.

²¹Seven countries were excluded from the full sample of 96 listed in the Appendix: Algeria, Ecuador, Indonesia, Iran, Kuwait, United Arab Emirates, and Venezuela.

similar to those of column 1 of Table 3, meaning that our results are not driven by the inclusion of oil-producing countries in the full sample.

4.4 Alternative explanations of catch-up and growth: human capital, trade and financial development

In this subsection, we look for alternative explanations of catch-up which could drive our results based on the composition of foreign capital.

Following the idea of Nelson and Phelps (1966), Benhabib and Spiegel (1994) found a role for human capital in catch-up. In column 1 of Table 6, we add to our baseline regressions an interaction term of human capital with initial GDP. Our main results are robust to the introduction of this new term and the coefficients of human capital alone and interacted with initial GDP are not statistically significant.

[INSERT TABLE 6 ABOUT HERE]

It is possible that trade openness is the channel through which the diffusion of technology generates greater effects on growth²², instead of the relative importance of foreign direct investment. The possible role of trade openness was accounted for in the estimation of column 2, which adds an interaction term of trade openness with initial GDP to the model of column 1 of Table 3. Since the interaction of openness with initial GDP is not statistically significant, trade does not seem to affect growth through catch-up. Furthermore, the direct effect of trade openness is also not statistically significant. The results regarding the share of FDI in financial liabilities are similar to those reported in Table 3.

Several studies following Levine, Loayza and Beck (2000) have concluded that financial intermediation/development is an important determinant of economic growth. Aghion et al. (2005) provide evidence that financial development increases convergence to the growth rate of the world technology frontier in cross-country growth regressions, using an interaction term composed of proxies of financial development and initial GDP. In order to test the robustness of our results to the inclusion of a proxy for financial development and its interaction with initial GDP, we included the ratio Private Credit to GDP (taken from Beck et al., 2000) in the estimation of column 3. While this proxy and its interaction with initial GDP are never statistically significant, $\frac{FDI}{Fin.Liab.}$ and its interaction term with initial GDP remain significant, and with the expected signs. Thus, we conclude that our results are also robust to the inclusion of the most widely used proxy of financial development.

²²For a survey of the literature on international diffusion of technology, see Keller (2004).

4.5 Effects of macroeconomic stability and institutions

The final step of our empirical analysis was to control for the effects of macroeconomic stability and institutions. Macroeconomic stability is proxied by the size of government and inflation²³ as in Levine et al. (2000). As shown in column 1 of Table 7, our results are not sensitive to the inclusion of controls for macroeconomic stability. Of these, a greater government is detrimental to growth, while inflation is not statistically significant.

[INSERT TABLE 7 ABOUT HERE]

According to several authors, institutional quality affects economic growth²⁴. Furthermore, the quality of a country's institutions may also be an important determinant of its capacity to attract FDI. Thus, it is necessary to check if the empirical result that a greater share of FDI in financial liabilities leads to higher growth and catch-up is robust to the inclusion of proxies for institutions. That is done in columns 2-4 of Table 7. An efficient legal structure and secure property rights have been emphasized in the literature as crucial factors for encouraging investment, both domestic and foreign, and, consequently, economic growth²⁵. The result reported in column 2 points in the same direction, as our proxy for the *Legal Structure and Security of Property Rights*²⁶ is highly statistically significant, with the expected positive sign.

Regulations that restrict entry into markets and the free engagement in voluntary exchange reduce economic freedom and may be detrimental to economic growth. These are taken into account in column 3, where we included a proxy for the *Regulation of Credit, Labor, and Business*²⁷. The positive and highly statistically significant coefficient implies that less restrictive regulations lead to higher economic growth.

The degree of democracy may also affect economic growth (Barro, 1996). The results presented in column 4 are consistent with the view that democracy is positively related to growth, as the variable *Checks and Balances*²⁸ is statistically significant and has a positive coefficient.

Since our proxy for the composition of financial liabilities, $\frac{FDI_l}{Fin.Liab.}$, and its interaction with initial GDP are always statistically significant, with the expected signs, our conclusion that a greater share of FDI in foreign capital leads to higher diffusion of technology is robust to the inclusion of institutional variables.

²³Inflation was defined as $\log(1+Inf/100)$.

²⁴See, among others, Hall and Jones (1999), and Acemoglu, Johnson and Robinson (2001).

²⁵See, among others, La-Porta, Lopez-De-Silanes, Shleifer and Vishny (1997), and Hall and Jones (1999).

²⁶Area 2 of the *Economic Freedom of the World Index* (Gwartney and Lawson, 2007). It considers the rule of law, the security of property rights, the independence of the judiciary and the impartiality of the court system.

²⁷Area 5 of the *Economic Freedom of the World Index* (Gwartney and Lawson, 2007). Higher values of this variable correspond to greater economic freedom, that is, to smaller restrictions in credit, labor, and product markets.

²⁸We used the variable *checks* from the DPI2004 (Beck, Clarke, Groff, Keefer and Walsh, 2001).

5 Conclusion

Using as a guide an open-economy growth model with diffusion of technology, we show that foreign direct investment should affect catch-up, an effect that has not been accounted for in cross-country studies dealing with issues of financial globalization. Furthermore, FDI should also affect growth directly.

Our empirical analysis makes three main contributions to the literature. First, we show that including foreign direct investment and also its interaction with a proxy of initial technology clearly improves the results. This implies that the failure of previous studies to find robust evidence of the benefits of financial globalization on growth may in part be due to a problem of omitted variable bias, as they do not account for the effects on catch-up. Thus, foreign direct investment appears as a crucial factor for the effects of financial globalization on economic growth.

Second, we present robust empirical evidence that economies with a greater share of foreign direct investment in foreign capital have a higher catch-up effect and a higher direct effect on growth. This implies that it is also necessary to take the composition of foreign capital into account when analyzing the effects of financial globalization on economic growth.

Third, developing countries may be those gaining more with financial globalization if foreign capital takes principally the form of foreign direct investment. Since they are farther away from the technological frontier, they have greater room for catch-up and, thus, may converge faster to the frontier growth rate.

The results presented in this study have implications that contribute to the policy debate on the benefits of financial globalization. Showing the positive effects of foreign direct investment on economic growth through diffusion of technology, these results are consistent with policies of attracting this form of foreign capital to developing countries. They also imply that governments should pay close attention to the composition of foreign capital entering their countries. Concretely, more foreign capital may not necessarily be better for diffusion of technology and growth, namely if it consists of relatively more external debt. In order to better reap the benefits of financial globalization, developing countries should envisage to attract more foreign direct investment and increase its weight in their foreign financial liabilities.

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Table 1 – Descriptive Statistics

Variable	Obs.	Mean	St. Dev.	Min.	Max.	Source
<i>GDP per capita (log)</i>	636	8.609	1.122	6.014	10.736	PWT
<i>Initial GDP per capita (log)</i>	662	8.496	1.094	6.014	10.736	PWT
<i>Investment (%GDP)</i>	679	16.329	8.948	1.024	91.964	PWT
<i>Initial Years of Schooling</i>	567	1.611	1.197	0.027	5.742	BL
<i>Population Growth</i>	686	0.094	0.070	-0.281	0.732	PWT
<i>Trade Openness</i>	679	70.084	48.337	7.558	387.423	PWT
<i>Government (%GDP)</i>	679	20.579	8.726	3.230	67.428	PWT
<i>Inflation (log)</i>	624	0.175	0.388	-0.056	4.178	IFS-IMF
<i>FDI₁ / GDP</i>	666	0.181	0.242	0.000	2.519	LMF
<i>FDI₁ / Fin.Liabilities</i>	667	0.209	0.167	0.000	0.897	LMF
<i>(Equity₁ + FDI₁) / Fin.Liabilities</i>	656	0.244	0.181	0.000	0.897	LMF
<i>Debt₁ / GDP</i>	668	0.735	1.228	0.149	16.177	LMF
<i>Debt₁ / Fin.Liabilities</i>	668	0.756	0.181	0.102	1.000	LMF
<i>Private Credit / GDP</i>	575	0.426	0.371	0.000	2.067	BDKL
<i>Legal Structure and Security of Property Rights</i>	540	5.518	1.891	1.271	9.363	GL
<i>Regulation of Credit, Labor and Business Checks and Balances</i>	560	5.560	1.008	2.724	8.648	GL
	570	2.815	1.657	1.000	12.000	DPI

Sources: BDKL: Beck, Demirgüç-Kunt and Levine (2000), updated until 2005; BL: Barro and Lee (2000), updated until 2000; DPI: Database of Political Institutions (Beck, et al., 2001); FH: Freedom House; GL: Gwartney and Lawson (2006); IFS-IMF: International Financial Statistics - International Monetary Fund; LMF: Lane and Milesi-Ferretti (2007); PWT: Penn World Tables (Mark 6.2).

Notes: Sample of consecutive, non-overlapping, 5-year periods from 1970 to 2004, comprising the 96 countries considered in the baseline regressions (listed in the Appendix). The suffix '*1*' means that only stocks of financial liabilities are considered. '*Fin.Liabilities*' stands for total stocks of financial liabilities.

Table 2 – Financial Globalization and Growth

	(1)	(2)	(3)
<i>Initial GDP per capita (log)</i>	0.977*** (26.13)	0.987*** (24.85)	0.990*** (35.02)
<i>Investment (%GDP)</i>	0.00502** (2.144)	0.00419** (2.228)	0.00378** (2.438)
<i>Initial Years of Schooling</i>	0.00337 (0.106)	0.0193 (0.580)	0.00681 (0.218)
<i>Population Growth</i>	-0.742** (-2.156)	-0.691** (-2.126)	-0.648** (-2.306)
<i>Trade Openness</i>	0.001000* (1.786)	0.000733* (1.655)	0.000895** (2.059)
$\frac{FDI_l}{GDP}$	-0.0864 (-1.361)	1.325* (1.802)	1.280*** (2.855)
$\frac{FDI_l}{GDP} * Initial\ GDP$		-0.138* (-1.914)	-0.136*** (-3.132)
$\frac{Debt_l}{GDP}$			-0.162* (-1.744)
$\frac{Debt_l}{GDP} * Initial\ GDP$			0.0159* (1.651)
# Observations	596	596	595
# Countries	96	96	96
Hansen test (p-value)	0.380	0.415	0.861
AR1 test (p-value)	0.00154	0.00156	0.00123
AR2 test (p-value)	0.531	0.540	0.604

Sources: See Table 1.

Notes: - System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods.
- Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix.
- The dependent variable is the natural log of GDP per capita.
- In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
- Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction).
- T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 3 – Composition of Foreign Capital and Growth

	(1)	(2)	(3)
	$\frac{FDI_l}{Fin.Liab.}$	$\frac{FDI_l + Equity_l}{Fin.Liabilities}$	$\frac{Debt_l}{Fin.Liab.}$
<i>Initial GDP per capita (log)</i>	0.980*** (31.69)	0.993*** (30.98)	0.833*** (12.94)
<i>Investment (%GDP)</i>	0.00557*** (3.055)	0.00614*** (3.028)	0.00540*** (2.725)
<i>Initial Years of Schooling</i>	0.0119 (0.513)	0.00381 (0.188)	0.00681 (0.297)
<i>Population Growth</i>	-0.937** (-2.310)	-0.876** (-2.565)	-0.797** (-2.529)
<i>Trade Openness</i>	0.000717 (1.525)	0.000628 (1.639)	0.000594 (1.600)
<i>Composition of Liabilities</i>	1.520** (2.272)	1.850*** (3.748)	-1.637*** (-2.946)
<i>Composition of Liabilities * Initial GDP</i>	-0.156** (-1.964)	-0.193*** (-3.337)	0.169*** (2.627)
# Observations	594	584	594
# Countries	96	96	96
Hansen test (p-value)	0.452	0.534	0.442
AR1 test (p-value)	0.00237	0.00269	0.00217
AR2 test (p-value)	0.863	0.763	0.699

Sources: See Table 1.

- Notes:
- System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods.
 - Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix.
 - The dependent variable is the natural log of GDP per capita.
 - The proxy for the Composition of Financial Liabilities used is indicated below the respective column number.
 - In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
 - Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction).
 - T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 4 – Composition of Foreign Capital and TFP

	(1)	(2)	(3)
	$\frac{FDI_l}{Fin.Liab.}$	$\frac{FDI_l + Equity_l}{Fin.Liabilities}$	$\frac{Debt_l}{Fin.Liab.}$
<i>Initial TFP (log)</i>	0.997*** (31.31)	0.981*** (29.13)	0.752*** (8.659)
<i>Population Growth</i>	-1.363*** (-3.148)	-1.194*** (-3.306)	-1.413*** (-3.340)
<i>Trade Openness</i>	0.00182*** (4.162)	0.00141*** (3.452)	0.00146*** (3.475)
<i>Composition of Liabilities</i>	3.702*** (3.258)	1.902* (1.850)	-2.262** (-2.248)
<i>Composition of Liabilities * Initial TFP</i>	-0.406*** (-3.291)	-0.189* (-1.695)	0.222** (2.015)
# Observations	588	575	588
# Countries	96	96	96
Hansen test (p-value)	0.146	0.228	0.175
AR1 test (p-value)	0.000796	0.000214	0.000498
AR2 test (p-value)	0.414	0.537	0.555

Sources: See Table 1.

Notes: - System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods.
- Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix.
- The dependent variable is the natural log of TFP.
- The proxy for the Composition of Financial Liabilities used is indicated below the respective column number.
- In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
- Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction).
- T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 5 – Sensitivity Analysis

	(1)	(2)	(3)	(4)
	1985-2004	Developing Countries	Regional Dummies	Non-OPEC
<i>Initial GDP per capita (log)</i>	0.938*** (32.35)	0.933*** (23.05)	1.001*** (24.79)	0.963*** (27.74)
<i>Investment (%GDP)</i>	0.00705*** (2.953)	0.00612** (2.296)	0.00496*** (2.948)	0.00587*** (3.468)
<i>Initial Years of Schooling</i>	0.0414* (1.721)	0.0494 (1.473)	-0.0111 (-0.418)	0.0120 (0.407)
<i>Population Growth</i>	-1.500*** (-4.443)	-0.794* (-1.929)	-0.729** (-2.253)	-1.456*** (-4.303)
<i>Trade Openness</i>	0.000362 (0.804)	0.000800* (1.766)	0.000701 (1.378)	0.000706* (1.678)
<i>Africa</i>			-0.0293 (-0.403)	
<i>Asia</i>			0.0651 (1.059)	
<i>Eastern Europe</i>			0.0282 (0.521)	
<i>Latin America</i>			-0.0141 (-0.321)	
<i>Middle East</i>			0.0110 (0.175)	
$\frac{FDI_l}{Fin.Liabilities}$	2.010** (2.031)	1.776*** (3.078)	1.658*** (2.777)	1.546** (2.406)
$\frac{FDI_l}{Fin.Liabilities} * Initial\ GDP$	-0.212* (-1.886)	-0.185*** (-2.631)	-0.181** (-1.964)	-0.156** (-3.337)
# Observations	337	441	594	555
# Countries	95	74	96	89
Hansen test (p-value)	0.353	0.990	0.596	0.606
AR1 test (p-value)	0.0312	0.00682	0.00190	0.0118
AR2 test (p-value)	0.612	0.783	0.612	0.529

Sources: See Table 1.

- Notes:
- System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods. Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix. Seven of these countries are excluded in Column 4, since they are current or former members of OPEC: Algeria, Ecuador, Indonesia, Iran, Kuwait, United Arab Emirates, and Venezuela.
 - The dependent variable is the natural log of GDP per capita.
 - In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
 - Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction). T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 6 – Controlling for Other Channels of Technological Diffusion

	(1) Human Capital	(2) Trade	(3) Financial Development
<i>Initial GDP per capita (log)</i>	0.990*** (26.52)	1.016*** (35.11)	1.016*** (14.16)
<i>Investment (% GDP)</i>	0.00591*** (3.391)	0.00494*** (2.797)	0.00617** (2.048)
<i>Initial Years of Schooling</i>	0.0352 (0.281)	0.00181 (0.0751)	0.00559 (0.0887)
<i>Initial Years of Schooling. * Initial GDP</i>	-0.00293 (-0.220)		
<i>Population Growth</i>	-0.761* (-1.935)	-0.802** (-2.111)	-1.265** (-1.995)
<i>Trade Openness</i>	0.000767 (1.358)	0.00357 (1.092)	0.00103* (1.825)
<i>Trade Openness * Initial GDP</i>		-0.000314 (-0.949)	
<i>Private Credit</i>			0.355 (0.467)
<i>PrivateCredit * Initial GDP</i>			-0.0412 (-0.520)
<i>FDI_liab / Fin.Liabilities</i>	1.552*** (2.688)	1.400* (1.957)	3.228** (2.048)
<i>(FDI_liab/Fin.Liabilities) * Initial GDP</i>	-0.165** (-2.337)	-0.143* (-1.766)	-0.354* (-1.902)
# Observations	594	594	521
# Countries	96	96	92
Hansen test (p-value)	0.604	0.531	0.506
AR1 test (p-value)	0.00231	0.00230	0.0143
AR2 test (p-value)	0.667	0.751	0.906

Sources: See Table 1.

- Notes:
- System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods.
 - Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix.
 - The dependent variable is the natural log of GDP per capita.
 - In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
 - Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction).
 - T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 7 – Controlling for Macroeconomic Stability and Institutions

	(1)	(2)	(3)	(4)
<i>Initial GDP per capita (log)</i>	0.973*** (42.79)	0.931*** (26.86)	0.960*** (28.91)	0.973*** (25.81)
<i>Investment (% GDP)</i>	0.00481*** (2.962)	0.00649*** (2.676)	0.00578*** (2.821)	0.00509* (1.778)
<i>Initial Years of Schooling</i>	0.0116 (0.515)	0.0118 (0.525)	0.0161 (0.477)	0.0211 (0.721)
<i>Population Growth</i>	-1.105*** (-3.654)	-1.194*** (-3.365)	-1.615*** (-4.445)	-0.668* (-1.852)
<i>Trade Openness</i>	0.000853* (1.957)	0.000393 (1.276)	0.000662** (2.054)	0.000944 (1.418)
<i>Government (%GDP)</i>	-0.00411* (-1.943)			
<i>Inflation (log)</i>	-0.0218 (-1.510)			
<i>Legal Structure and Security of Property Rights</i>		0.0338*** (2.740)		
<i>Regulation of Credit, Labor, and Business</i>			0.0379*** (2.654)	
<i>Checks and Balances</i>				0.0258*** (2.808)
<i>FDI_liab / Fin.Liabilities</i>	1.662* (1.844)	2.733*** (2.866)	2.999*** (3.181)	1.907** (2.040)
<i>(FDI_liab / Fin.Liabilities) * Initial GDP</i>	-0.185* (-1.744)	-0.296*** (-2.665)	-0.332*** (-3.038)	-0.197* (-1.831)
# Observations	561	489	507	509
# Countries	94	91	91	95
Hansen test (p-value)	0.910	0.612	0.686	0.324
AR1 test (p-value)	0.00387	0.000103	0.0239	0.00850
AR2 test (p-value)	0.813	0.664	0.508	0.383

Sources: See Table 1.

Notes: - System-GMM estimations for dynamic panel-data models, including a constant and time dummies for 5-year periods.
- Sample composed of non-overlapping 5-year periods from 1970 to 2004 (1970-74, 1975-99, ..., 1995-99, and 2000-04). The 96 countries considered are listed in the Appendix.
- The dependent variable is the natural log of GDP per capita.
- In each estimation, the second lag of the dependent and of the explanatory variables (all treated as endogenous) were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation.
- Two-step results using robust standard errors corrected for finite samples (using Windmeijer's, 2005, correction).
- T-statistics are in parenthesis. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Appendix

The 96 countries considered in the estimations of Tables 2 and 3

ALGERIA	HAITI	PARAGUAY
ARGENTINA	HONDURAS	PERU
AUSTRALIA	HONG KONG	PHILIPPINES
AUSTRIA	HUNGARY	POLAND
BAHRAIN	ICELAND	PORTUGAL
BANGLADESH	INDIA	RWANDA
BELGIUM	INDONESIA	SENEGAL
BENIN	IRAN	SINGAPORE
BOLIVIA	IRELAND	SOUTH AFRICA
BOTSWANA	ISRAEL	SPAIN
BRAZIL	ITALY	SRI LANKA
CAMEROON	JAMAICA	SUDAN
CANADA	JAPAN	SWAZILAND
CHILE	JORDAN	SWEDEN
CHINA	KENYA	SWITZERLAND
COLOMBIA	KOREA	SYRIAN ARAB REPUBLIC
CONGO, DEM.REP.	KUWAIT	TAIWAN
CONGO, REPUBLIC OF	MALAWI	TANZANIA
COSTA RICA	MALAYSIA	THAILAND
CYPRUS	MALI	TOGO
DENMARK	MAURITIUS	TRINIDAD AND TOBAGO
DOMINICAN REPUBLIC	MEXICO	TUNISIA
ECUADOR	MOZAMBIQUE	TURKEY
EGYPT	NEPAL	UGANDA
EL SALVADOR	NETHERLANDS	UNITED ARAB EMIRATES
FIJI	NEW ZEALAND	UNITED KINGDOM
FINLAND	NICARAGUA	UNITED STATES
FRANCE	NIGER	URUGUAY
GERMANY	NORWAY	VENEZUELA
GHANA	PAKISTAN	YEMEN
GREECE	PANAMA	ZAMBIA
GUATEMALA	PAPUA NEW GUINEA	ZIMBABWE
