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LONG-RUN DETERMINANTS OF ECONOMIC GROWTH IN SOUTH AMERICA

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Based on an annual historical database for South American countries from 1960 to 2008, we develop an empirical study to gain insight into the long-run determinants of economic growth using a two-equation framework. A system of two panel data models is estimated to identify the growth determinants and their connection with foreign direct investment. We find that economic growth is driven most strongly by physical and human capital accumulation, as well as by sectorial exports, and that institutions and policy have a substantial impact on economic growth and investment. Macroeconomic disturbances have a significant detrimental effect on long-run growth. Trade openness correlates positively with foreign investment, indicating that relatively closed countries stand to benefit most from opening up their economies. Our division of the sample into two sub-periods, 1960–1980 and 1981–2008, indicates a structural change.

JEL classification codes: F41, O54, N26
Key words: economic growth, Latin America, investment, dynamic panel data analysis

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I. Introduction

The primary purpose of this paper is to provide a quantitative assessment of the long-run determinants for South American economic growth.[1] The empirical study is based on a cross-country regression framework where economic growth is explained primarily by: (a) proximate and measurable influences, captured in the growth accounts, and (b) potential influences (i.e., institutional influences and macroeconomic distortions), which are more difficult to measure. The econometric work has two innovative features. First, it benefits from a long-term database spanning almost fifty years, which enables construction of a rich panel data set that includes a large number of growth fundamentals for the period 1960–2008.[2] Second, to test the temporal instability of the growth determinants, we divide the sample into two sub-periods: 1960–1980 and 1981–2008.

By testing the effect of foreign direct investment (FDI) on growth, our research fills a gap in the empirical literature for developing economies. The recent wave of global liberalization in South America triggered the phenomenon of investment-led growth by lowering the relative prices of traded goods and services and improving resource allocation in more open economies. To extend analysis of this concept, we must focus on the growth model developed by Baldwin and Seghezza (1996), which shows that trade openness, can affect return on investment by influencing the capital rental rate and its cost, the main factors influencing growth rates.

Our empirical approach follows this line of inquiry using a two-equation framework that relates economic growth and foreign investment. The first model estimates the effects of a group of fundamental variables with other exogenous factors of economic growth. The second model re-examines the nature of the investment-growth channel, providing empirical insight by analyzing explanatory variables that affect capital inflows in South American economies. Both models are necessary because the measure of openness sometimes fails to explain growth.

[1] Our sample covers the ten largest South American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela. In 2008, these countries had a combined population of 382 million, equivalent to 99.3% of the region's total population and almost the 99.9% of its GDP. We collected a dataset f^{or} these countries that incorporates more than 400 annual observations over the last five decades, covering a wide range of political systems, institutions, exchange rates, and historical circumstances.

[2] Choice of period was largely dictated by data availability. Great effort was made to include a large sample of the region's less developed countries—Bolivia, Ecuador, and Paraguay.

Including a measure of investment may produce a genuine effect of openness precisely by increasing investment. Finally, while a number of papers address the link between FDI and growth in developing countries, we find a small number of studies that deal explicitly with Latin America.[3]

The study produces three new findings. First, contrary to the other empirical results (De Gregorio 1992; Astorga 2010), we find that the openness indicator is directly related to FDI. Openness impacts growth via FDI. Macroeconomic stability and human capital also play a crucial role. Second, the process of de-industrialization in South America is based on the shift in production, where the share of manufacturing in exports affects growth negatively between 1981 and 2008 (see Palma 2005). Finally, we obtain solid evidence on the role of institutional factors, since contract-intensive money, constraints on executive power, and institutional quality have significant impacts on growth and FDI, which vary in both sub-periods.

The rest of this paper is structured as follows. Section II reviews the relevant economic literature and empirical evidence. Section III develops the empirical framework, explaining the econometric methodology. The main results are presented in Section IV. Section V discusses the most relevant findings and the conclusions drawn from them.

II. The determinants of long-run economic growth

This paper investigates the long-run determinants of growth and its relation to foreign direct investment (FDI) based on the endogenous growth model. As is well known, the long-run growth rate of GDP per capita equals the growth rate of technology in the Solow model extended to include technology.[4] Technology is exogenous in the Solow model. Thus, if technology is omitted, the long-run growth

[3] Bengoa and Sanchez-Robles (2003) study 18 countries during the period 1970-1999. Astorga (2010) analyzes the six largest Latin American economies over a period of 105 years. Trevino et al. (2008) describe the process of institutionalization in Latin America and its impact on organizational decision making regarding FDI.

[4] Neoclassical models of growth as well as endogenous growth models provide ground for most of the empirical work on the FDI-growth relationship. This relationship has been studied by explaining different channels: determinants of growth, determinants of FDI, role of multinational firms in host countries, and causality between the two variables (Chowdhury and Mavrotas 2005). The endogenous growth literature points out the increments in economic growth through capital formation, technology transfer, and increased level of education and knowledge in the population.

rate of GDP per capita is zero. This fact highlights the importance of endogenous growth theories, where the rate of economic growth may be determined by different factors in the long-run.

The endogenous growth literature shows that the main determinants of growth include human capital, public infrastructure, and technology diffusion. The institutional background is also crucial in understanding differences within countries. In surveying the empirical research that analyzes the different causes of growth in developed and developing countries, Temple (1999) emphasizes human capital and research, development, and other fundamental variables. Furthermore, financial globalization, combined with good macroeconomic policies and domestic governance, appears to be conducive to growth. Nonetheless, we believe that the empirical evidence available is insufficient to provide decisive conclusions on South American countries.

Analyzing a sample of Latin American economies for the period 1950–1985, De Gregorio (1992) finds that various openness indicators are not significantly related to GDP per capita growth and that low investment and high inflation inhibit income growth, while macroeconomic stability and human capital play a crucial role. These results suggest that instruments such as learning-by-doing, fostered by protectionist policies, may play a positive role in economic growth. Similarly, Astorga (2010) suggests that the positive correlation between openness and growth is a recent phenomenon, occurring after the 1980s in Latin America.

Other studies present trade openness as a channel, understanding income improvement as the result of increased consumption of capital goods, industrial equipment, and dissemination of ideas. Makki and Somwaru (2004) provide evidence of a positive impact of exports and FDI on economic growth in 66 developing economies, indicating that one risk of openness is the potential increase in external shocks—the distortions of terms of trade and exchange rate that produce foreign capital outflows, leading to deterioration in growth rates.

A. Foreign investment

While no consensus has been reached on the relationship between FDI and growth, there is growing acceptance of the view that FDI correlates positively to growth. This view has been bolstered by recent research in the growth theory literature, which highlights the importance of improvements in technology, efficiency, and productivity. In its simplest form, such growth occurs when a local firm improves

productivity by copying technology used by multinational affiliates. Another type of growth occurs when local firms are forced to use existing technology and resources more efficiently.

Borensztein et al. (1998) find that FDI is an important vehicle for technology transfer, one that contributes more to growth than does domestic investment. A substantial portion of growth rates in developing countries is explained by a "convergence" process on the level of technology. The authors show a robust relationship between economic growth, FDI, and human capital (i.e., education). While FDI may flow primarily to sectors with advanced technological innovation, growth rates are higher when countries achieve higher education levels.

B. Institutional framework

Good institutional quality has two principal effects: inducing higher overall investment and a sustained pace of growth, and restricting the activities of groups involved in the unlawful appropriation of resources. The empirical evidence suggests that institutional factors (rule of law, political freedom, etc.) play an important role in economic performance. For instance, resource abundance retards the process of democratization (Tsui 2011). Low institutional quality supports profit-seeking behavior in exploitation of natural resources, increasing corruption and distorting allocation of public funds. The evidence suggests that weak institutions lead to inequality and lack of constraints on rulers. On occasion, the lack of constraints on executive power in Latin America threatens FDI, resulting in high investment costs and lower ex-post returns and generally yielding low marginal returns on assets such as human capital and infrastructure (Trevino et al. 2008).

The association between institutions and capital inflows is stronger in developed countries, where political stability and property rights play a key role in attracting capital inflows.[5] Abramovitz (1986) and Borensztein et al. (1998) argue that prerequisites for countries looking to attract FDI are a sufficient level of

[5] The relationship between growth and capital inflows is partially non-causal because it largely depends on similar aspects of the political and non-political economic environment. The causality that does exist clearly runs in more than one direction, since international investors tend to search for regions that can expect rapid growth. Accordingly, neoclassical growth theory argues that an increase in investment raises the steady-state level of output per worker, while endogenous growth focuses on economies of scale and spillover effects to justify how investment promotes growth.

human capital, economic and political stability, liberalization of markets, financial globalization, and adequate infrastructure.

C. Macroeconomic volatility

Much growth literature posits that macroeconomics and political stability have a crucial effect on growth, whereas domestic political outbursts magnify the negative impacts of outward volatility. Strong and transparent government institutions thus partially mitigate the negative impact of external volatility (Easterly and Kraay 2000).

Volatile economies often have weak fiscal institutions unable to guarantee swift and appropriate response to capital outflows. Collapse of the exchange-rate leads to further depreciation of currency, increased fiscal liabilities, and rise in public debt. To complete the scenario, macroeconomic instability exacerbates the negative effects of market constraints on domestic credit, eventually curbing economic growth, and public debt overhang deters FDI (Benassy-Quere et al. 2007).

The influence of external shocks goes beyond their effect on income. Bourguignon (2004) argues that the impact of terms of trade volatility on the current account balance gives developing countries limited access to international capital.[6] Macroeconomic volatility seems especially harmful for two reasons. First, developing economies have less access to financial markets, making it difficult to diversify the risk associated with their income. Second, public services, including education and health, are directly affected by changes in government spending.

Much public finance in South American countries depends on exploitation of natural resources. When commodity prices deteriorate, the government borrows to make up a hefty and growing deficit. Gavin and Hausmann (1998) find that South American governments' revenues and expenditures correspond significantly with variations in commodity prices, especially in the cases of Argentina, Ecuador, and Venezuela.

[6] The downturn of these economies intensifies the recessionary effect of volatility due to the disruption of capital inflows from international markets. The main periods of volatility in South America were linked to external crises, high levels of external debt, and periods of inflation.

III. Modeling long-run determinants

Our econometric analysis is based on a framework of panel data regressions with cross-country data for 1960–2008. To avoid data heterogeneity caused by short-run dynamics, we opted for four-year averages (Temple 1999), giving our model a time series variation of 12 quadrennials. This approach enables us to understand the phenomenon of investment-led growth through a long-run growth model that includes physical and human accumulation, trade openness, and other variables associated with growth. Since our spatial sample is small (ten countries), it is advisable to exploit the time dimension to obtain more robust estimates by working with more degrees of freedom (Caselli et al. 1996).

We estimate two dynamic panel data models using the system General Method of Moments (GMM) estimator proposed by Arellano and Bover (1995). This method allows for unobserved country-specific effects, measurement errors, estimator bias due to persistency in time series, and even endogeneity problems, not only with the lagged dependent variable but also with any other regressors (Bond et al. 2001; Arndt et al. 2010). We first test the specifications that include only the fundamental factors, such as standard regressors (physical and human capital, FDI, etc.) and trade openness. Then we move to the extended specifications that assess the role of additional factors commonly found in the literature: macroeconomic shocks, economic policy and institutions, sectorial production, and natural endowments not covered in other empirical studies (Astorga 2010; Baldwin and Seghezza 1996).

A. Specification features and database

To assess empirically the effect of the determinants of economic growth, we use the β-convergence model specification in Mankiw et al. (1992) and Barro and Sala-i-Martin (1992), where the log of real per-capita income growth (gr) depends on initial GDP level, a set of fundamental variables, and other exogenous conditioning factors. This specification also includes several variables not analyzed in studies such as Alfaro et al. (2004), among them, natural endowments, sectorial exports, and a set of institutional variables. The general growth equation thus takes the following form:

$$\ln\left(gr_{it}\right) = \alpha + \beta \ln\left(gp_{i,t-1}\right) + \sum_{f=1}^{F} \gamma_f \ln\left(x_f\right)_{i,t-1} + \sum_{e=1}^{E} \gamma_e \ln\left(x_e\right)_{i,t-1} + u_{it}, \qquad (1)$$

where $gr_{it} = gp_{it} / gp_{i,t-1}$, gp_{it} is the GDP per capita of country i over a four-year period, and $gp_{i,t\text{-}1}$ is the GDP per capita of the previous period; $x_{fi,t\text{-}1}$ is one of the F fundamental variables (FDI, gross fixed capital formation, real trade openness, the difference of life expectancy, and human capital), measured in the previous period; $x_{ei,t\text{-}1}$ are the E expansion variables—oil exports (natural endowments), manufacturing and service exports, external debt, macroeconomic shocks and institutional quality, also measured in the previous period; α and β are an intercept and the convergence coefficient, respectively; and u_{it} is the well-behaved error term.

The second equation measures the effects of the stock of human capital, GDP per capita growth rate, and a set of other variables that influence FDI, measured as a ratio to GDP. We also assess empirically the effect of exogenous shocks on FDI (Barro 1991; Astorga 2010), a factor that has been applied to other formal economic growth exercises. Following the arguments presented in the previous section, FDI is regressed on itself (lagged by one period), GDP per capita (which captures the role of the "catch-up" effect), and real openness as a policy indicator. The model also analyzes a set of expansion variables (terms of trade and real exchange rate deviations, among others). The equation to be estimated is thus:

$$\ln(fdi)_{it} = \alpha + \gamma_1 \ln(fdi)_{i,t-1} + \gamma_2 \ln\left(gp_{it} / gp_{i,t-1}\right) + \sum_{r=1}^{F} \gamma_j \ln\left(x_f\right)_{i,t-1} + \sum_{e=1}^{E} \gamma_k \ln\left(x_d\right)_{i,t-1} + v_{it}. \quad (2)$$

Our empirical study is based on over twenty growth determinants from 1960 to 2008 (see Table A1 for definitions and sources). All variables in equations (1) and (2) have been transformed into logarithms, with the exception of the macro shocks and institutional variables. Table 1 presents some descriptive statistics of the complete set of the model variables. Following De Gregorio (1992), and Astorga (2010), we use log lagged variables to avoid potential endogeneity in some of the regressors.

Our main institutional variable, the institutional quality index (*Quality*), merges data on social and political characteristics of economies and thus avoids the problems of perception effects. The data were provided by Norris (2009). Another institutional variable is institutional constraints on chief executives (*IConstraints*), which is a normalized index ranging from 0 for lowest constraints to 1 for the highest constraints, as in Bollen (1990). Contract-intensive money

(*CIM*), as a measure of security of contract and property rights, is also an institutional variable, which is expected to be positively related to income per capita (*GDPpc*) and investment (*FDI*). The real openness variable (*Openness*) is defined as imports plus exports relative to GDP in purchasing power parity in US$ (Alcalá and Ciccone 2004). In contrast to the extended Solow model, which adds human capital accumulation, we include level of secondary schooling (*School*) as the average percentage of the log of working age population with secondary education (Bernanke and Gurkaynak 2001).

Table 1. Descriptive statistics and model variables

Variables	Mean	Median	Maximum	Minimum	St. dev.	Kurtosis	Skewness
A. Fundamentals							
GDPpc	8.5567	8.5466	9.3839	7.5421	0.4180	-0.7739	-0.1914
Growth	0.0178	0.0178	0.0930	-0.0605	0.0291	0.4610	-0.0650
FDI	-0.0099	0.0319	2.3956	-2.3026	1.1327	-0.6700	-0.1434
GFKF	2.8949	2.8924	3.5575	1.9810	0.2911	0.5068	-0.0924
Life	4.1830	4.2166	4.3621	3.7716	0.1172	1.8317	-1.3167
School	7.0016	7.1464	10.1223	3.5242	1.2940	0.0307	0.0431
FDI×School	1.8229	1.9035	2.4417	0.1343	0.4285	3.1924	-1.5966
Openness	3.5655	3.6498	5.0551	2.1250	0.5450	0.3648	-0.3318
B. Macro shocks							
REERdep	3.0280	1.6425	74.6725	-17.8875	13.1646	9.1613	2.3621
REERdev	1,389.50	85.4675	41,239.60	19.9800	6,618.77	28.8374	5.4270
Volatility	0.0055	0.0451	1.0755	-1.4291	0.4438	0.5573	-0.3827
USrate	8.0208	7.8750	14.2500	5.0000	2.5155	0.7941	1.0496
BMP	22.6091	9.2050	199.1950	-7.4500	36.8079	9.9170	2.9387
C. Institutional variables							
Quality	19.3160	27.8750	87.9500	-73.1625	37.4264	-0.4063	-0.4961
IConstraints	0.3944	0.2500	1.0000	0.0000	0.3665	-1.1476	0.6082
CIM	0.6602	0.7050	0.9475	0.2650	0.1846	-0.9341	-0.5106
D. Other variables							
Debt	3.6232	3.6823	4.7703	2.2644	0.5513	-0.4734	-0.2482
Oil	1.3944	1.5701	4.5444	-4.3820	2.0847	-0.8325	-0.1915
Agriculture	7.1915	7.0330	9.7592	5.1378	1.1116	0.4032	0.5383
Manufacture	2.3508	2.5243	4.0128	-0.5150	1.0842	-0.5412	-0.5749
Service	3.3395	3.3538	4.3931	2.3353	0.4274	-0.2685	-0.2441
ToTrade	4.2743	4.3879	5.1406	2.6759	0.5061	1.8872	-1.2038

Notes: *** p<0.01, ** p<0.05, * p<0.1

One of the indicators of macroeconomic shocks is terms of trade volatility (*Volatility*), which has been estimated through the Kalmar filter. This model measures unobserved components of the series, optimally capturing the time-varying variances (Durbin and Koopman 2001; Cunningham and Jeffery 2007). We estimate volatility evolution of the terms of trade for each country using the following state transition model: $\Delta tr_t = \alpha_t + \beta_t \Delta tr_{t-1} + t_t + \varepsilon_t$, where *tr* is the log of terms of trade of a country, and *t* is the trend component of the series. The β_t coefficients are the transition or state vector, and they represent the volatility evolution of terms of trade. They have been restricted to a random walk, implying that shocks to coefficients are maintained indefinitely. The disturbance term ε_t is assumed not to correlate serially and contemporaneously.

Almost all coefficients for the lagged terms of trade are statistically significant, emphasizing the persistence of the volatility coefficient, particularly at the end of the period. The lagged variable's coefficients positive sign for each country thus indicate an enduring effect of variations of terms of trade in the short-run. We assume that the rate of volatility does not vary considerably within the region; increased volatility is likely to increase the intensity of recessions among South American countries.

C. Endogeneity and system GMM estimation method

Causality between FDI and economic growth could run both ways: Countries experiencing income growth may attract more market-seeking FDIs, so FDI may be influenced by innovations in the stochastic process of growth. In addition, any omitted factor that raises the return rate on capital will also increase growth rate and FDI inflows simultaneously. Such circumstances would produce a correlation between FDI and the country-specific error term, biasing the estimated coefficients.

To correct for problems of endogeneity, we estimate the model including lagged values, exploiting the advantages of our panel setting, which includes the lagged FDI ratio, human capital accumulation, trade openness, and a set of variables to account for macroeconomic shocks. We also use the system GMM estimator from Arellano and Bover (1995) and Blundell and Bond (1998), which is more efficient than the first-difference GMM estimator used in Holtz-Eakin et al. (1988) and Arellano and Bond (1991) and widely accepted as a way to address certain econometric problems in empirical growth models, such as measurement errors, omitted variables, and endogeneity.

This dynamic panel data specification instrumentalizes the right-hand-side variables in the first-difference equations, using levels of the series lagged two periods or more based on the assumption that the time-varying disturbances in the original-level equations are not serially correlated. Lagged levels of the variables are, however, only weak instruments for subsequent first differences in models, with a short number of time periods and persistent time series (Bond et al. 2001) as is the case in most growth applications. Our models also consider a small number of time periods because they are based on four-year averages (to avoid modelling cyclical dynamics) and our dependent variables (output growth and foreign direct investment) are persistent series. When these two features—persistency and small number of time series—are present in a dynamic model, the first-difference GMM estimators are seriously biased because lagged levels of the variables are only weak instruments for subsequent first differences.

The system GMM estimator uses lagged differences as instruments for the level equation, including them as additional moment conditions, which remain informative even for persistent series. Using these supplementary instrumental variables enables consistent parameter estimation in growth models that usually include endogenous right-hand-side variables, such as investment rates or foreign direct investment. We also compute the Windmeijer bias-corrected robust VCE, since non-robust results for inference on the coefficients tend to be severely biased downward (see Arellano and Bond 1991 and Windmeijer 2005 for details).

If we extend the convergence growth model (1) towards a dynamic panel data specification, as in Durlauf et al. (2006), current GDP per capita is regressed on lagged GDP per capita and other control variables as follows:

$$\ln\left(gp_{it}\right) = \left(1+\beta\right)\ln\left(gp_{i,t-1}\right) + \sum_{f=1}^{F}\gamma_f \ln\left(x_f\right)_{i,t-1} + \sum_{e=1}^{E}\gamma_e \ln\left(x_e\right)_{i,t-1} + \alpha_i + \mu_t + u_{it}, \qquad (3)$$

where α_i are the unobserved country-specific effects reflecting differences in the initial level of efficiency, while the period-specific intercepts (μ_t) capture productivity changes common to all countries. The time dummies allow for common long-run growth in GDP per capita, consistent with common technical progress (Bond et al. 2001).

Before applying the proper system GMM procedure, we time difference our models for growth and FDI, as is common in dynamic GMM estimators, to eliminate the cross-section fixed effects (α_i):

$$\Delta \ln\left(gp_{it}\right) = \left(\mu_t - \mu_{t-1}\right) + \left(1+\beta\right)\Delta \ln\left(gp_{i,t-1}\right) + \sum_{f=1}^{F} \gamma_f \Delta \ln\left(x_f\right)_{i,t-1} + \sum_{e=1}^{E} \gamma_e \Delta \ln\left(x_e\right)_{i,t-1} + \Delta u_{it}, \quad (4)$$

$$\Delta \ln(fdi)_{it} = \left(\mu_t - \mu_{t-1}\right) + \gamma_1 \Delta \ln(fdi)_{i,t-1} + \gamma_2 \Delta \ln\left(gr_{it}\right) + \sum_{r=1}^{F} \gamma_j \Delta \ln\left(x_f\right)_{i,t-1} + \sum_{e=1}^{E} \gamma_k \Delta \ln\left(x_d\right)_{i,t-1} + \Delta v_{it} \cdot \quad (5)$$

This estimator requires that there be no autocorrelation in the idiosyncratic errors (u_{it}, v_{it}). When the idiosyncratic errors are independently and identically distributed (i.i.d.), the first-difference errors (Δu_{it}, Δv_{it}) are first-order serially correlated. Further, serial correlation in the first-difference errors at an order higher than 1 is not allowed, since it would imply that the moment conditions used in the model are not valid. We thus calculate the Arellano–Bond test for first- and second-order autocorrelation in the first-difference errors of the specified models. We also compute the Sargan test derived by Arellano and Bond (1991), which contrasts the null hypothesis that the overidentifying restrictions are valid. Rejecting this null hypothesis would indicate a need to reconsider either our model or our instruments.

D. Analysis of structural change

We can compare the results for the total period with those in the two sub-periods, to assess the coefficients' sensitivity. We are especially interested in the potential impact (on the regression coefficients) caused by the debt crisis of the early 1980s, as well as the beginning of the pro-market reforms in the mid-1980s and 1990s. To what extent might the final estimates for income growth and FDI be influenced by structural changes?

The Chow breakpoint test is a well-known method for determining stability of regression coefficients over different time sub-periods.[7] When applied to the full model of equations (4) and (5), the test demonstrates a structural change in the early 1980s for both equations. The results confirm bias in the estimates for these models, shown in the last section of Table 2.

To test for significant changes in the regression coefficients, we apply a switching regressions solution, dividing the complete data set into two subsamples:

[7] This is a Wald F test of the null hypothesis that the coefficients are the same in all sub-periods.

1960–1980 and 1981–2008. Table 3 shows the results. Comparison of the estimates for the two sub-periods reveals significant changes in the coefficients. For example, variables in the global regressions become insignificant in the sub-periods, and vice versa.

IV. Results of the panel data model

This section presents the empirical findings of the econometric approach discussed in the previous section. These nested specifications include only the variables that were significant in each regression. Table 2 gives a preliminary analysis of the effects of the fundamental and extension variables for both models, growth and FDI, respectively. Table 3 presents the coefficient estimates obtained for the two sub-periods using the equations on income growth and FDI. Most of the estimates have the correct sign and are statistically significant. The Arellano-Bond serial autocorrelation test also obtains the expected outcomes in all cases: they are significant for the first order but no longer significant for the second order. The Sargan specification test always accepts the null hypothesis of validity of the overidentifying restrictions, indicating good specification of both model and instruments. The estimates of the coefficients on initial income lie comfortably above the corresponding Within Groups (fixed effects) estimate and below the corresponding OLS level estimates.

A. Specifications for the overall period

The system GMM estimation results reported in Table 2 are consistent with the growth literature. The coefficient estimates of equations (4) and (5) in the fundamental specifications (Table 2, columns 1 and 3) embed not only the direct impact of fundamental variables (investment and capital accumulation) on economic growth and foreign direct investment but also other variables (life expectancy, real openness, schooling).

In the economic growth equation (4), the coefficient of lagged per capita income $b = 1 + \beta$ is positive and significant but smaller than one. Therefore, the β-convergence coefficient $\beta = 1–b$ has a negative sign, reflecting conditional convergence in South America. In the fundamental estimation, the associated speed of convergence is 3.2%, higher than the 2% usually found in the convergence literature, with a half-life of 21 years. At this rate, South American countries will

nearly achieve convergence in almost 40 years. The rate of convergence accelerates significantly, however, as much as 3.9% for some extension variables in column (2) (Table 2), shortening the half-life to 18 years.

These results are similar to those of other empirical studies. Our rate of convergence of 3.9%, for example, is similar to the results of Barrientos (2007), who examines eight large Latin American countries over two different sub-periods and obtains a convergence speed of 4.4% for 1931-1974 and 3.7% for 1974-2005. The presence of conditional convergence means that countries did not share a steady state and that convergence occurred after controlling for each country's unobserved characteristics.

Human capital variables *Life* (Table 2, column 1), and *School* (column 2) are statistically significant at only 10%. Life expectancy (*Life*) reflects convergence with international standards of health, most likely revealing other key factors contributing to long-term growth, such as the population's education and structural and institutional changes. The effect of secondary schooling (*School*) indicates a direct positive association of growth with human capital. Equation (4) adds an interaction term constructed as the product of FDI and secondary schooling (*FDI*×*School*). To ensure that this additional variable does not proxy for FDI, we include the variable in the regression independently. We thus find that the estimate is significant at 5% in the extended specification only, implying another marginal effect of FDI on growth via secondary schooling. The higher productivity of FDI thus holds only when the host country has a minimum threshold stock of human capital. This finding is consistent with the study conducted by Borensztein et al. (1998).

The regressions of income growth with respect to time dummies also show positive and significant coefficients in the extended model of income growth (column 2). Since these time dummies in the system GMM estimation are defined as inter-quadrennial first differences (equation 4), positive values indicate an increasing contribution of technological change to income per capita in South American countries.

In the regression for FDI, the coefficient representing the accelerator principle or GDP per capita growth (*Growth*) has a positive impact on FDI (Table 2, column 3). The extension model results (column 4) show that real openness (*Openness*) has a positive sign in FDI inflows and is significant at 5%.

The results for the extension specifications include other important socioeconomic variables that attempt to capture new effects associated with income growth and FDI, such as macroeconomic shocks. The variable real exchange rate

depreciation (*REERdep*) shows a negative impact on both income growth and FDI. Although the *REERdep* varies to absorb different shocks or inflows in the current account that will be reflected in economic growth, changes to consolidate the fiscal policy (reduction in public investment) also cause REER depreciation, negatively affecting foreign investors' perception. The pervasive effects found for REER deviations on FDI (*REERdev*) agree with Makki and Somwaru (2004), who indicate that a process of economic opening in developing countries raises the odds of macroeconomic shocks under exchange rate deviations.

A favorable institutional framework is important for economic growth. This is especially important for constraints on executive power (*IConstraints*), which have a direct effect on growth.[8] Contract-intensive money (*CIM*) also has a positive effect on growth. It assumes that the benefit of higher growth rates in South America is greater under a more efficient, accountable, honest government, since the presence of solid institutions influences growth and attracts capital inflows (see Table 2, column 2).

External debt (*Debt*) is another explanatory variable with a statistically significant negative impact on South American economies. The hypothesis indicates that accumulated debt acts as a tax on future output, discouraging private investment plans and usually requiring government efforts with negative effects on production and income. Warner (1992) argues that the reasons for output decline in heavily indebted developing countries include declining export prices, high world interest rates, and sluggish growth.

The export sector's low diversification in South American economies is a key obstacle to sustainable growth rates. Fuel and mineral exports represent approximately 37% of total exports in our sample, and agricultural and manufacturing exports 25%. We thus introduce sectorial exports to determine whether sectorial development has significant effects on income growth. Agricultural production (*Agriculture*) shows a negative effect on income growth. Given changes in sectorial production, we assume that loss in the agricultural sector's impact on economic growth is due to the increasing role of manufacturing and oil production. Manufacturing exports (*Manufacture*) have a direct positive

[8] The use of twelve quadrennials in our panel data model allows the proxy for institutions to change over time. This lets us analyze the changes in the institutional variables on growth and obtain complementary results.

impact on FDI, significant at 10%. This result may be due to the imports-substitution industrialization policy (ISI, hereafter), which attracted high levels of investment before the 1980s and played a concrete role in developing the manufacturing sector.

Terms of trade (*ToTrade*) impact FDI negatively (see Table 2, column 4), due possibly to South America's dependence on commodity exports. It is plausible that high raw material prices boost the negative effect of macroeconomic disturbances on the investors' position, as does the decline in relative prices on traded goods. A theoretical description in Bhagwati and Srinivasan (1978) argues that terms of trade may worsen the entrance of capital inflows. The effect on FDI thus depends strongly on the country's trade policy (import substitution or export promotion) and the sectorial structure of exports (manufactured exports and raw material exports).

Table 2. Determinants of GDP per capita growth and FDI

Variables	Growth		FDI	
	(1)	(2)	(3)	(4)
	Fundamentals	Extension	Fundamentals	Extension
GDPpc (-1)	0.87056***	0.84301***	-	-
FDI (-1)	0.03293***	0.01598**	0.38200***	0.21815***
Growth	-	-	10.6485***	7.70919**
GFKF (-1)	0.20405***	0.17679***	-	-
Life (-1)	0.26962*	-	-	-
School (-1)	-	0.02956*	-	-
FDI×School (-1)	0.10363***	0.06201**	-	-
Openness (-1)	-	-	-	0.82550**
REERdep (-1)		-0.00172**		-0.00622*
REERdev (-1)		-		-0.00003***
USrate (-1)		-		-
Quality (-1)		0.00050**		-
IConstraints (-1)		0.05961**		-
CIM (-1)		0.24089***		-
Debt		-0.05561***		-
Agriculture (-1)		-0.07380**		-
Manufacture (-1)		-		0.11043*
ToTrade (-1)		-		-1.00472***
Chow-Wald test (structural change in 1980)	105.64***	42.67***	19.48***	11.37***
Annual convergence rate	3.24%	3.92%	-	-
Half-life (years)	21	18	-	-
Sargan test of overidentifying restrictions	58.21	52.23	69.42	70.74
Arellano-Bond test (no autocorrelation)				
First order	-2.4775**	-2.7648***	-2.7382***	-2.8853***
Second order	-0.7025	-1.3608	-0.7593	-1.5085
Initial income coefficients (fixed effects; OLS)	(0.84; 0.94)	(0. 80; 0.89)	(0.35; 0.52)	(0.19; 0.42)
Observations (10 countries × 12)	120	120	120	120

Notes: Panel setting: quadrennial frequency. Estimation method: System GMM, dynamic panel data model. Eleven time dummies are not reported; they go from a time dummy for 2nd – 1st quadrennial to a time dummy for 12th – 11th quadrennial. *** p<0.01, ** p<0.05, * p<0.1

B. Economic growth and investment over different sub-periods

Given the foregoing evidence in favor of dividing growth and FDI determinants into two sub-periods, some results presented for the overall period in Table 2 may be biased.

We find, for example, that FDI has a positive, significant effect on growth in the second sub-period only (1981-2008). Similarly, secondary schooling (*School*) is positively and significantly related to income growth only in the first sub-period (1961-1980), as is the interaction variable *FDI×School*. The results in Table 3, column 4, clearly indicate that FDI has a direct impact on growth in the second sub-period, as its coefficient is significant at 0.4%. Investment (*GFKF*) boosts economic growth in both sub-periods.

In the FDI equations (Table 3, columns 5-8), the coefficient representing the accelerator principle (*Growth*) is significant in the second sub-period only.

Macroeconomic *volatility* affects both income growth and foreign investment negatively in the two sub-periods (Table 3, columns 2, 4, 6 and 8). This harmful effect confirms the importance of predictability of changes in relative prices for economic decisions. The U.S. interest rate (*USrate*) has an expected and significant negative sign in the FDI equation in the second sub-period (1981-2008). The Black Market Premium (*BMP*), a measure of market distortions, impacts growth negatively during the first sub-period (1960-1980).

The continuous process of institutional change in South America has a substantial impact on income growth, an effect more noticeable after the debt crises and under democratic regimes. Credibility of financial institutions (*CIM*) has a positive effect on income growth and FDI, even though it is only significant in the second sub-period for growth. Improvements in the reliability of financial institutions may be seen as a proxy institutional variable, since it reflects seriousness of economic management and business development (Apergis et al. 2007). Institutional *quality* has a negative effect on FDI (Table 3, column 4) in the 1961-1980 sub-period. The institutional instability that began 1960-1970 may have made policies subject to future review, a source of uncertainty to investors.

Manufacturing exports (*Manufacture*) are significant in the second period only, with a negative impact on income growth (Table 3, column 4), a result that agrees with the findings of Palma (2005). It could be said that ISI strategy, while successful in developing infrastructure and industry, did not produce an efficient manufacturing sector, making many industries vulnerable to foreign competition, especially after the debt crisis. It may be instructive to associate the previous results for manufacturing exports with a process of de-industrialization based on the slowdown in productivity growth in the mid-1970s, probably caused by "mistaken and wrong" policy decisions (throughout the 1980s) that over-intensified de-industrialization processes and damaged long-term growth prospects (Palma 2005). If we turn to sectorial exports in the FDI equation, the coefficients for oil export (*Oil*) show a negative effect in the first sub-period but a positive effect in the second (Table 3, columns 6-8, respectively). Service exports (*Service*) are also significant in the first sub-period (column 6).

Part of South America's economy is driven by commodity exports with a relatively underdeveloped industrial base, as exploitation of natural resources is one cause of growth differences in the region. Table 3 shows a positive impact of oil exports (*Oil*) on FDI in the second sub-period (1981-2008), but in the first sub-period it is negative. The external debt (*Debt*) estimate shows a negative effect on FDI during the same sub-period (Table 3, columns 6 and 8).

Table 3. Determinants of GDP per capita growth and FDI in sub-periods

Variables	*Growth*				*FDI*			
	Sub-period 1961 – 1980		Sub-period 1981 – 2008		Sub-period 1961 – 1980		Sub-period 1981 – 2008	
	(1) Fund.	(2) Extension	(3) Fund.	(4) Extension	(5) Fund.	(6) Extension	(7) Fund.	(8) Extension
GDPpc (-1)	0.74902***	0.72706***	0.86747***	0.85058***	-	-	-	-
FDI (-1)	-	-	0.04022**	0.03051**	1.28976***	0.46572**	0.40586*	0.33101*
Growth (-1)	-	-	-	-	-	-	12.2453***	11.9657***
GFKF (-1)	0.26677***	0.22564***	0.19253**	0.34082***	-	-	-	-
School (-1)	0.07937**	-	-	-	-	-	-	-
FDI×School (-1)	0.10014**	-	-	-	-	-	-	-
REERdep (-1)	-	-0.00500***	-	-	-	-0.01658***	-	-
REERdev (-1)	-	-0.00001***	-	-0.00003**	-	-	-	-
Volatility (-1)	-	-0.04292**	-	-0.04591**	-	-	-	-
USrate (-1)	-	-	-	-	-	-	-	-0.18236***
BMP (-1)	-	-0.00117***	-	-	-	-	-	-
Quality (-1)	-	-	-	-	-	-0.01517***	-	-
CIM (-1)	-	-	-	0.64790***	-	1.82881***	-	2.70069**
Debt (-1)	-	-	-	-	-	-0.52060*	-	-
Oil (-1)	-	-	-	-	-	-0.35775***	-	0.13001*
Manufacture (-1)	-	-	-	-0.01907**	-	-	-	-
Service (-1)	-	-	-	-	-	1.19769*	-	-
Annual convergence rate:	6.27%	6.82%	3.31%	3.74%	-	-	-	-
Half-life (years):	11	10	21	19	-	-	-	-
Sargan test, overident. restrict:	2.76	3.52	28.72*	16.98	6.86	2.87	13.64	14.14
Arellano-Bond test (no autocorrelation in first-difference errors):								
First order	-1.9437**	-2.3432**	-2.6141***	-2.2575**	-1.2732	-1.6724*	-2.2575**	-2.1275**
Second order	0.8177	-0.7545	-1.1293	0.5314	-0.6394	0.0013	0.5314	1.0899
Initial income coefficients (fixed effects; OLS)	(0.54; 0.89)	(0.64; 0.96)	(0.77; 1.02)	(0.82; 0.96)	(0.52; 0.71)	(0.46; 0.61)	(-0.04; 0.41)	(-0.05; 0.35)
Observations	50	50	70	70	50	50	70	70

Notes: Panel setting: quadrennial frequency. Estimation method: System GMM, dynamic panel data model. Time dummies are not reported; they go from 2nd – 1st quadrennial to 5th – 4th quadrennial, for the 1961-1980 sub-period, and 7th – 6th quadrennial, for the 1981-2008 sub-period. *** p<0.01, ** p<0.05, * p<0.1

V. Conclusions

Our paper enriches empirical research on South America's long-term economic growth by using a two-equation dynamic panel model that includes the small regional economies. Any conclusion drawn from an empirical exercise like this one must be tentative and suggestive.

The historical evidence suggests valuable lessons for South American growth. First, physical and human capital accumulation are necessary conditions for boosting long-term growth. Economic growth is stimulated in conjunction with foreign investment by higher levels of secondary education. The profitable effects of growth via FDI come through higher efficiencies from a combination of advanced management skills and technology spillovers. On the other hand, we find that trade openness is directly related to FDI. Second, macroeconomic disturbances represent a drag on both investment and economic growth. We confirm that the region is still vulnerable to fiscal imbalances, currency distortions, external debt, and terms of trade volatility. In this context, changes in the U.S. interest rate directly affect FDI, and real exchange rate deviations are negatively associated with investment decisions and income growth. Finally, favorable political institutions are an important factor for income growth, since they stimulate productivity as well as attraction of capital. Both institutional quality and constraints on executive power have a positive impact on growth. Political and institutional structure also affect foreign investment. Rule of law and the financial institutions credibility indicator (contract-intensive money) raise the attractiveness of South America for overseas investors.

In explaining the results for the export sector, we propose a de-industrialization process in part of the region resulting from radical trade and financial liberalization in the context of economic reforms that did not focus on deep institutional changes. These results indicate that manufacturing development is not positively associated with growth. At the same time, manufacturing and service exports indicate that they attract FDI inflows, but only in the first sub-period (1961-1980), whereas oil exports show a positive effect on FDI in the second sub-period only (1981-2008).

Identifying such common factors within a large and diverse region improves our understanding of South America's growth determinants.

Appendix

Table A1. Data definitions and sources

Variable	Definition	Sources
A. Fundamentals		
GDPpc	Log GDP per capita: ratio of GDP at 1990 prices and total population.	Penn
Growth	Inter-quadrennial growth of log GDP per capita.	Penn
FDI	Log foreign direct investment as a percentage of GDP.	WDI, IFS line 78BDDZF; UM
GFKF	Log gross fixed capital formation: value of additions to less disposals of fixed assets as a percentage of GDP.	WDI
Life	Difference of the log life expectancy.	1960-1969: Mitchell (1993), 1970-2006: UNESCO (2008c).
School	Average percentage of the log of working age population with secondary education.	Bernanke & Gurkaynak (2001)
FDI×School	The product of log FDI and log secondary schooling.	Borensztein et al. (1998)
Openness	Log real trade openness: imports plus exports relative to GDP in purchasing power parity (PPP).	Alcalá and Ciccone (2004)
B. Macro shocks		
REERdep	Bilateral real effective exchange rate depreciation: $[(XRAT_{t-1}/ XRAT_t)-1]*100$; a decline means real depreciation.	WDI
REERdev	Standard deviation of bilateral real effective exchange rates.	WDI
Volatility	Terms of trade volatility estimated through the Kalman filter considering terms of trade in logs.	WDI and country central banks
USrate	US interest rate (lending rate)	WDI, IFS line 60P.ZF.
BMP	Black Market Premium: the percentage difference between the black market rate and the pegged official exchange rate.	World Currency Yearbook 1996, 2011.
C. Institutional variables		
Quality	Institutional quality: varies from 0 (lowest level) to 10 (highest level).	Norris (2009)
IConstraints	Institutionalized constraints on chief executives. Since the original variable (Constraints) ranges from 1 (highest constraints) to 7 (lowest constraints), we use a simple transformation to construct a normalized index., ranging from 0 for lowest constraints to 1 for the highest constraints (Bollen 1990), as follows: IConstraints =(7–Constraints)/6.	Polity IV
CIM	Contract-Intensive Money: M2 - money outside the banking system)/M2.	IFS (line 59MB.ZF – line 54A.ZK)/ line 59MB.ZF
D. Other variables		
Debt	Log total external debt stock as a percentage of GDP.	WDI
Oil	Log percentage of oil exports over total exports.	WDI
Agriculture	Log percentage of agricultural production over total GDP.	WDI
Manufacture	Log percentage of manufacturing exports over total exports.	WDI
Service	Log percentage of services and other goods exports over total exports.	WDI
ToTrade	Terms of trade: log ratio of prices of export goods to import goods.	WDI

Notes: The data sources are: Penn World Table, Version 8.1. (Penn); World Development Indicators, World Bank (WDI); International Monetary Fund - International Financial Statistics (IFS); "Foreign Investment in Latin America during the Twentieth Century," Economic History Services, University of Michigan (UM).

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