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Economic growth in Latin America: the role of investment and other growth sources

Mario A. Gutiérrez

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Economic Development Division

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Summary

This research produced evidence about the contribution of investment and other sources to the growth process of Latin America during 1960-2002, and provided answers to the questions listed above unless from an historical perspective. The combined growth accounting and regression analysis, and used data for the six largest Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. These countries produce nearly 90 per cent of Latin America's GDP.

Alternative growth accounting methodologies were used to measure the contributions of the sources of growth to GDP growth during 1960-2002. The study also provides evidence of the effects of investments in machinery and equipment and construction structures, and the effects of private and public investment on per capita GDP growth.

The research found evidence of the primary role played by total factor productivity in explaining the difference between fast and slow growth experiences. Extending the traditional growth accounting approach did not change this conclusion. It also found that investment in machinery and equipment, and private investment were most effective in raising per capita GDP growth, but that key policy related variables, including education, were essential ingredients contributing to per capita GDP growth. Evidence of mutual causality between private investment and growth, and inconclusive evidence regarding the incidence of FDI and infrastructure on private investment were also found in this research.

Introduction

The modest recovery of Latin America after a period of stabilization and reforms that followed the 1980s debt crisis has added momentum to the interest in the factors that contribute to economic growth in the region and, in particular, about the role played by investment as a source of economic growth. Under a new outward-looking development approach growth and investment recovered during the 1990s and early 2000s from the slump of the 1980s. The recovery has been modest, however. Growth performance has not yet reached the growth rate levels observed in 1960s and 1970s and remain well below those observed Asia, Middle East, and Eastern Europe.

Disagreement persists about the role of investment in the growth process. Some authors have concluded that investment has been the main factor explaining economic growth. In a study for East Asia, Young (1994) concluded that investment was the main source of growth in the experience of the East Asian economies. Other economists have acknowledged the important role played by fixed investment but argued that productivity has been the engine that has marked the difference between fast and slow growth experiences (Blomstrom et.al. 1996; Harberger, 1996 and 1998; Klenow and Rodriguez-Clarke, 1997b. Elias (1992) produced evidence showing that total factor productivity explained about one-third of GDP growth in Latin America during 1940-85. In a more recent study, Solimano and Soto (2004) produced evidence showing that total factor productivity had the most important factor explaining the evolution of GDP growth in Latin America during 1960-2002. Some other economists have focused on specific categories of investment.

Some have emphasized the role of machinery as a main determinant of a country's economic growth (De Long and Summers, 1991 and 1993). Others have found evidence of a positive correlation between growth and private investment and the potential complementarities between private investment and public investment (Kahn and Kumar, 1997; Kahn and Reinhart, 1990; Serven and Solimano, 1992; and Greene and Villanueva, 1991). The roles played by foreign direct investment (FDI) and infrastructure as factors contributing to growth have been also documented, but the evidence is more controversial, however. The roles of FDI have been addressed by Lim (2001), Borensztein et. al (1998), and Olosfsdotter (1998). The roles of infrastructure have been addressed by Easterly and Serven eds., 2003 and Moguillansky and Bielchowsky (2000) for Latin America.

The role assigned to investment in the process of economic growth is relevant to growth theory and policy making. Should countries focus on increasing investment rates through, for example, massive investment programs in order to accelerate the pace of economic growth? What types of investments have the strongest impacts in raising growth? What is the role played by productivity? What are the roles played by economic policies as factors contributing to investment and growth? Are there reinforcing effects between investment and growth?

This study produces evidence about the contribution of investment and other sources to the growth process of Latin America during 1960-2002, and provide answers to the questions listed above unless from an historical perspective. In our research we combine growth accounting and regression analysis to reinforce our conclusions, which confirm and qualify some previous findings about the process of economic investment, growth, and productivity in Latin America during 1960-2002.

We have used data for the six largest Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. These countries produce nearly 90% of Latin America's GDP (WDI, 2004, World Bank). The selection of countries and period was also based on the availability and quality of the data. Reliable national accounts data before 1960 is either not available for many Latin American countries and the quality of disaggregated investment data by type of assets and sectors is either non existent or weak.

We examine the investment-growth process under three perspectives. First, we use alternative growth accounting methodologies to measure the contributions of the sources of growth to GDP growth during 1960-2002 (Section I). Secondly, we estimate the effects of investments in machinery and equipment and construction structures (Section II). Thirdly, we estimate the effects of private and public investment on per capita GDP growth (Section III). Our main findings are summarized in Section IV.

In our research we found that investment has played an important role in the six largest Latin American countries but that total factor productivity has made the difference between faster and slower growth experiences (across time and countries). In line with endogenous growth theory, we then explored the main factors that contributed to the productivity differences in the region. We use per capita GDP growth as a proxy for productivity growth and we found that the composition of investment and policy related factor have been main factors explaining per capita GDP growth. We found that investment in the form of machinery and equipment and private investment have been effective in boosting per capita growth, but that some key policy related variables affecting have helped to explain the difference between fast and slow growth countries and episodes during 1960-2002. We also show evidence about a reverse causality between private investment and GDP growth, which helps explain some of the virtuous and vicious cycles in Latin America, especially at times of prolonged recessions and expansions. We also examined the stability of the findings and qualified them as needed. We found that the incidence on economic growth have not only varied across the key growth determinant factors but also along the 1960-2002 period. In some sub-periods some key variables have been more relevant than in others. The main long-run trends and conclusions are not severely affected by the structural shifts, however.

I. Sources of growth: capital, labor, and total factor productivity

In this section we run an exercise on growth accounting to obtain estimates of the contribution of investment to real GDP growth for the six Latin American countries considered in our sample. The growth accounting approach has some advantages compared to the regression approach for measuring the contributions of the three broad categories of sources of growth (capital, labor, and total factor productivity) (Barro 1999, Klenow-Rodriguez 1997, Pack 1994, and Easterly 2001). The growth accounting approach overcomes three main problems present in the regression approach for measuring the growth sources: (a) the changes in capital and labor are usually endogenous to total factor productivity; (b) if the changes in capital and labor are measured with errors, the regression coefficients would be inconsistent estimates of the shares of capital and labor (this problem aggravates when the capital stock is not adjusted by "utilization" of the capital stock; (c) regression estimates usually assume no variations in factor shares and total factor productivity through time and across countries.

The growth accounting approach has also some disadvantages, however. Its main limitation stem from the use of factor prices to estimate factor contributions to real GDP growth. Deviations between factor prices and marginal products would be included in measured total factor productivity (the residual in the growth accounting). As long as we interpret total factor productivity as a broad measure of "real cost reductions", however, those deviations could be considered as correctly forming part of the residual interpreted, broadly interpreted as a measure of economy wide real cost reductions (Harberger, 1996).

A. Methodology: "Traditional Modified" and "Extended" Approaches

To obtain the growth accounting estimates for the six Latin American countries we will develop and apply two approaches. We will build a "traditional modified" approach (TMA) and an "extended" approach (EA). Under the TMA we generate capital stock series using the series on gross capital formation at constant prices of each country, a usual practice in most growth accounting exercises, but we innovate by decomposing the wage bill between the payments to "raw labor" and to "human capital". We use a proxy for the remuneration of raw labor to deflate the wage bill and obtain the two separate labor components. Through this exercise we want to determine if the conclusions about the contributions of the three basic sources of growth on economic growth are sensitive to the growth accounting methodology. We show below that enriching the traditional growth accounting framework with some strong deviations did not changed the main conclusions. The modifications and extensions that we introduce to the traditional growth accounting approach also allow us to obtain additional insights into the growth process.

In the EA we decompose the wage bill series between the raw and human capital components, as in the TMA but, in addition, we generate an alternative series of physical capital, deflating the gross capital formation series at current prices by the GDP deflator, and adjust the capital series to reflect the "utilization" of physical capital. We also use a notion of "invested" physical capital, in line with capital theory by expressing capital stock series in the same GDP basket units as GDP at constant prices: GDP units of capital are used or invested to generate GDP (both capital and GDP expressed in the same GDP basket units). In both approaches we use annual shares of labor and physical capital for each of the six countries during 1960-2002. Most growth accounting exercises use constant factor shares across time and countries, limitations that contribute to distort the derived total factor productivity series.

We start from the basic national accounts identity where output is distributed between the payments to capital and labor:

(1) $py = \rho nK + \omega nL$

Real changes are expressed as:

(2) $\Delta y = \rho \Delta K + \omega \Delta L + R$

y = real GDP
p = GDP deflator
K = real capital stock
L = employed labor force
ρn = nominal return of capital
ωn = nominal wage rate
ρ = real gross of depreciation return to capital = real net return to capital (ρr) + depreciation (δ).
ω = average wage
R = residual = total factor productivity = real cost reductions

In growth accounting it is usual to refer to the residual R as total factor productivity or "real cost reductions" (Harberger, 1998 and 1996). In terms of annual percent changes we can derive the contributions of each factor to real GDP growth and the contribution of total factor productivity (or real cost reductions to growth): R^* $(=\frac{R}{y})$:

$$(3)\ \frac{\Delta y}{y} = S_K \frac{\Delta K}{K} + S_L \frac{\Delta L}{L} + R^*$$

Growth of real GDP = contribution of capital + contribution of labor + contribution of total factor productivity.

$S_K = \frac{\rho \Delta K}{py}$ = share of capital in output

$S_L = \frac{\omega \Delta L}{py}$ = share of labor in output

The interpretation of equation (3), as the sources of growth equation (measuring the contributions of physical capital, labor, and total factor productivity to output growth) builds on the assumption that factor payments are good approximations of marginal products. Any deviations between factor payments and marginal products ($MP_K - \rho$) and ($MP_L - \omega$) would be reflected in R and R^*. These deviations stem from all types of distortions that make factor payments deviate from marginal products such as economies of scale and taxes. However, as long as these distortions raise production costs, then, they should be appropriately reflected in R^* if we interpret it as reflecting all type of real cost changes in the economy.

Equation (3) can also be derived from a Cobb-Douglas production function $y = AK^{S_K} L^{S_L}$ with: $S_K + S_L = 1$, or any production function homogeneous of degree one. But the specification of a production function is not a pre-requisite to the sources of growth equation (3).

Equation (3) represents the "traditional" growth accounting equation used in most growth accounting studies. We will now deviate from the traditional approach along two roads. We first proceed to decompose the wage bill between the component representing the payments to "raw" labor and the component representing the payments to the quality or "human capital" component. We will then proceed to generate the series of "invested" physical capital. We follow these roads based on the "two deflators" approach developed by Harberger (1998), but we also add additional extensions. We derive series of physical capital series adjusted for utilization rates. Let us first proceed to divide the wage bill between "raw" labor and "human capital." Let us define:

$L^* = \frac{\omega L}{\omega^*}$ = raw labor equivalent units of the wage bill

ω^* = wage rate of raw labor.

Then, the wage bill can be decomposed as:

$$\omega \Delta L = \omega^* \Delta L + \omega^* (\Delta L^* - \Delta L)$$

wage bill = payments to raw labor + payments to the human capital component (human capital maintenance + human capital upgrade).[1]

Our TMA growth accounting equation would be:

$$(4)\ \frac{\Delta y}{y} = SK\frac{\Delta K}{K} + \frac{\omega^{*}\Delta L}{y} + \frac{\omega^{*}(\Delta L^{*} - \Delta L)}{y} + R^{*}$$

Growth of real GDP = contribution of physical capital + direct contribution of raw labor + direct contribution of the quality improvement of the labor force (human capital) + contribution of total factor productivity (R^{*}).

An "ideal" decomposition of labor payments (into raw labor and the human capital component) should be derived by using as raw labor wage deflator the most representative wage index of unskilled labor. A proxy for this could be wage for textiles workers as mentioned by Harberger (1998), a proxy for the wage bill of low skilled workers. We examined this possibility using the International Labor Office (ILO) statistics but we found serious problems regarding the quality, time consistency, data gaps. We decided to use instead a fictitious defined low skilled wage category defining its average wage as equal to 2/3 of per capital GDP.[2] The use of annual factor shares is crucial in our work not only to better capture the contributions of capital and labor to the growth but also to obtain series for the raw labor and human capital components of the labor share.[3]

To further generate what we call the EA we further expressed the physical capital series in terms of "GDP baskets." The growth accounting interpretation of this alternative K^{*} series is better associated with capital theory: K^{*} units of capital are invested to obtain GDP with both expressed in the same units (GDP baskets). In addition, we adjust the physical capital series to reflect the notion of "utilized" physical capital a vector of "rates of utilization", which we approximate by the ratios of actual GDP to "potential" GDP. We define "potential" GDP as a centered seven-year moving average of actual GDP.[4]

K^{*} = physical capital series derived the series of fixed capital formation at current prices deflated by the GDP deflator

$$K^{*}_{inv} = K^{*}(\frac{y}{y_p})$$

Rate of utilization of capital = $RUK = (\frac{y}{y_p})$

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[1] A further decomposition of the human capital component, between the part due to human capital maintenance and the part due to human capital upgrade is given by:

$$\omega\Delta L = \omega^{*}\Delta L + \omega^{*}\frac{(L^{*} - L)\Delta L}{L} + \omega^{*}(\Delta L^{*} - \frac{L^{*}}{L}\Delta L)$$

[2] This proxy is also used by Harberger (1996). Using his words: " … those who earn 2/3 of a year's GDP are overwhelmingly poor, low skilled, and with relative low levels of human capital."

[3] The total labor share presents some important variations though time and countries. The ranges for the period 1960-2002 are: Argentina (40%-60%); Brazil (60%-80%); Chile (60%-65%); Colombia (50%-67%); Mexico (36%-60%); and Venezuela (44%-75%). Data on shares were obtained from Hoffman (2000) and Eclac/UN national account statistics. The labor share has been adjusted to include own account workers. The capital share (1-total labor share) assimilates to the national accounts concept of physical capital (which excludes land and other non-reproducible or intangible assets).

[4] A similar procedure is used in Loayza et. al. 2002 and based on the Baxter and King work on business cycles (1999).

Our EA growth accounting equation would, therefore, be expressed as:

$$(5)\ \frac{\Delta y}{y} = SK\frac{\Delta K^*}{K^*} + \frac{\omega^*\Delta L}{y} + \frac{\omega^*(\Delta L^* - \Delta L)}{y} + R^{**}$$

Growth of real GDP = contribution of 'invested" capital + direct contribution of raw labor + direct contribution of the quality improvement of the labor force (human capital) + contribution of adjusted total factor productivity (R^{**}).

The capital stock series are derived in both approaches using a perpetual inventory method and based on the following capital equation:

$$(6)\ K_{t+1} = K_t(1-\delta) + I_t(1-\delta/2)$$

I_t = gross fixed capital formation: (i) at constant prices in the TMA, and (ii) in GDP baskets in the EA.

The initial capital stock (1960) is calculated with the expression:

$$K_0 = \frac{I_0}{k+\delta}$$

This expression assumes that around the initial year (1960 in our case) capital is growing at the same pace as GDP (a steady state assumption). We take k = average annual real GDP growth during 1955-75. We take δ = 4% (similar value used in growth accounting estimates by Loayza et al 2002, and Nehru 1993). We preferred to use declining balance depreciation instead of straight line depreciation as the former assimilates better to the concept of economic depreciation (efficiency and obsolescence makes older capital stock increasingly less valuable through time). The value of initial investment I_0 is obtained running a simple regression of gross fixed capital formation against time for the period 1955-1965, taking the intercept as the value estimate for I_0.[5/6]

In summary, the characteristics of our two growth accounting methodologies would be:

(1) Traditional Modified Approach (TMA): (a) the wage bill is decomposed between the raw labor and quality (or human capital upgrade) components; and (b) the physical capital stock series, generated using the series of gross fixed capital formation at constant prices (in local currency). The TMA is basically the traditional growth accounting modified by splitting the labor contribution between a part due to raw labor and another due to its quality or human capital component.

(2) Extended Approach (EA): (a) the wage bill is decomposed between the raw labor and quality (or human capital); (b) the physical capital stock series are generated using the series of gross fixed capital formation at current prices (in local currency), deflated by the GDP deflator, and adjusted to reflect the actual utilization of physical capital.

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[5] In our capital equation (6) we use $I_t(1-\delta/2)$ instead of I_t as we are measuring capital at the beginning of each year and gross investment depreciates through the year. We assumes fixed investment depreciates at half the annual depreciation in each year. This modification has a negligible impact on the capital stock series (about 0.2 percents differences, in the annual percent changes in the capital stock series obtained using our equation against the traditional equation), however.

[6] The gross fixed capital formation series we use are in national currency units. The source are Eclac and UN Statistical Office. We updated the last seven years of the series using the most recent national account data obtained directly from the original country sources.

B. Results

We applied both growth accounting methodologies to a sample of six Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. We took the period 1960-2002. Our six countries are the largest countries of the region and produce about 90% of total Latin America's GDP (WDI, 2004, World Bank). The selection of countries and the period was based on the availability and quality of the data. Reliable national accounts data before 1960 are not available for many Latin American countries. The selected countries have longer and better quality national account series and more frequent revisions of the national account statistics than other smaller countries in the region.

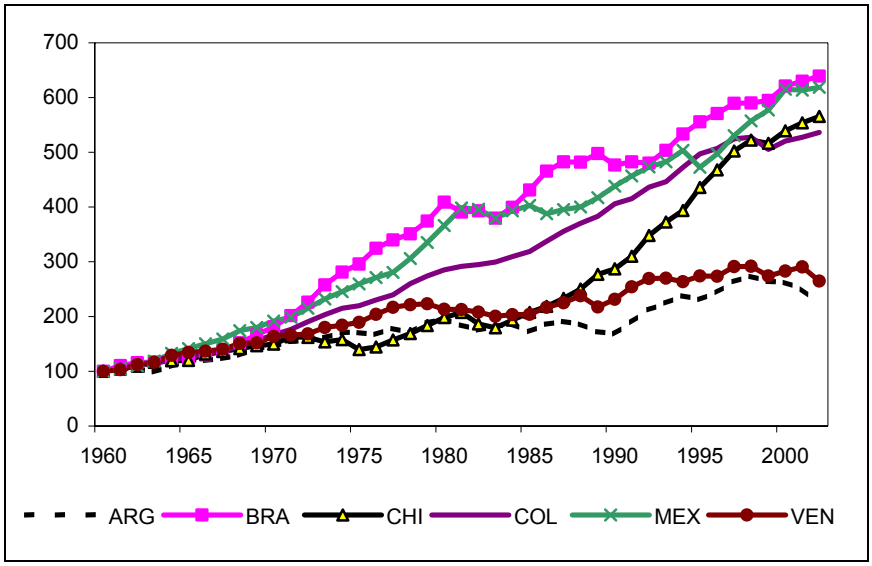
We have distinguish four broad periods in Latin America's growth experience: (1) The 1960s, representing the last "gold decade" of the import substitution industrialization (ISI) strategy combined with mixed external conditions (falling terms of trade but low real external interest rates); (2) the 1970s, representing the accelerated decay of the ISI model and mixed external conditions (improved terms of trade for oil exporters but falling terms of trade for non-oil exporters, and low real external interest rates);[7] (3) The 1980s, representing the debt crisis and lost "decade", which marks the accelerated transition from the ISI to a new export-led development strategy, a period of stabilization and reforms combined with deteriorated external conditions (falling terms of trade and higher real external interest rates, compared to the 1970s); and (4) the 1990s and early 2000s, associated with the gradual insertion of Latin America into the new globalization era: growth recovers but modestly compared to the 1960s and 1970s, adverse external conditions prevail (falling terms of trade, higher external interest rates during 1999-2000, and negative contagion from a series of shocks (Asia 1997, Russia 1998, Brazil 1999, Argentina 2001-2002). In the early 2000s the globalization experience has been subjected to growing scrutiny by economists and politicians in Washington and across the region.

For additional analytical insights we further sub-divided the four broad periods into five-year sub-periods, except for the last one (1996-2002) which contains seven years. We divided the six countries into a group of faster growth countries (FGCs) (Brazil, Chile, Colombia, and Mexico) and a group of slower growth countries (SLCs) (Argentina and Venezuela). This classification was based on the accumulated growth performance for the whole 1960-2002 period. The FGCs reached levels of real GDP by 2002 more than five times the levels in 1960 while the SGCs reached GDP levels less than three times the real GDP levels in 1960 and also developed a downward GDP trend since the mid-1990s (Figure 1).

Tables 1a and 1b summarize the results from the growth accounting exercises. Table 1a shows the result associated with the TMA exercise and table 1b show the results from applying the EA. Our first observation is about the broad results obtained under each approach. The trends and structures of the growth sources are similar under TMA (table 1a) and the EA (table 1b), which is a comforting in the sense that our main analytical observations and conclusions will not depend on the alternative methodologies used. Some relevant insights emerge from the TMA and EA, however.

[7] The 1970s is also called a period of debt-led growth as Latin America's foreign indebtedness rose significantly induced by the oil shock of 1973 and 1979, negative real interest rates, weakened commodity prices by the mid-1970s, and deteriorated economic conditions reflecting the agony of the old import substitution and state dirigisme model (see Thorp (1998)). The lending boom and "herd" related effect induced a debt led growth in the 1970s was in also seen in the 1990s, but with less systematic negative effects than in the 1980s.

Figure 1
REAL GDP GROWTH
(Index 1960 =100)



Source: World Development Indicators (WDI), World Bank.

Table 1a
TRADITIONAL MODIFIED GROWTH ACCOUNTING APPROACH (TMA) [a]

Country	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-02	1961-02
Argentina									
GDP growth	**3.99**	**4.02**	**3.12**	**2.96**	**-2.43**	**-0.33**	**6.70**	**-0.28**	**2.22**
Capital contribution	2.19	1.77	2.17	2.22	1.31	0.40	0.80	1.37	**1.53**
Share of GDP growth	54.93	44.09	69.47	75.21	54.07	119.03	11.94	482.39	68.98
Raw labor contribution	0.39	0.39	0.24	0.24	0.06	0.04	-0.06	0.28	**0.20**
Share of GDP growth	9.66	9.65	7.79	7.98	2.43	13.43	-0.97	96.85	8.83
Human capital contribution	0.44	0.50	0.30	0.25	0.05	0.04	-0.09	0.25	**0.22**
Share of GDP growth	10.96	12.56	9.75	8.41	1.94	12.22	-1.33	87.15	9.82
Total factor productivity	0.98	1.35	0.41	0.25	-3.85	-0.82	6.05	-2.18	**0.27**
Share of GDP growth	24.45	33.70	13.00	8.40	-158.44	-244.69	90.35	-766.39	12.37
Brazil									
GDP growth	**4.58**	**7.80**	**10.32**	**6.70**	**1.20**	**2.09**	**3.16**	**2.03**	**4.73**
Capital contribution	1.02	1.46	3.00	3.22	1.72	1.31	0.72	0.86	**1.66**
Share of GDP growth	22.21	18.71	29.10	48.07	143.41	62.43	22.68	42.30	35.11
Raw labor contribution	0.52	0.52	0.82	0.88	0.64	0.66	0.61	0.47	**0.64**
Share of GDP growth	11.44	6.63	7.92	13.06	53.49	31.74	19.23	23.00	13.50
Human capital contribution	1.56	1.38	1.62	1.52	1.04	1.03	0.91	0.66	**1.21**
Share of GDP growth	33.95	17.67	15.73	22.71	86.37	49.21	28.78	32.32	25.63
Total factor productivity	1.48	4.44	4.87	1.08	-2.20	-0.91	0.93	0.05	**1.22**
Share of GDP growth	32.41	56.99	47.25	16.16	-183.27	-43.38	29.31	2.39	25.76
Chile									
GDP growth	**3.69**	**4.60**	**-1.12**	**7.28**	**1.14**	**6.75**	**8.71**	**3.84**	**4.36**
Capital contribution	1.31	1.18	0.86	0.29	0.69	1.06	2.16	2.63	**1.27**
Share of GDP growth	35.49	25.72	76.76	4.00	60.31	15.64	24.80	68.59	29.19
Raw labor contribution	0.30	0.29	0.38	0.39	0.37	0.92	0.65	0.49	**0.47**
Share of GDP growth	8.11	6.25	33.90	5.33	32.11	13.63	7.49	12.76	10.85
Human capital contribution	0.57	0.57	0.80	0.81	0.72	1.69	1.11	0.79	**0.88**
Share of GDP growth	15.35	12.42	71.57	11.18	62.54	24.99	12.71	20.55	20.21
Total factor productivity	1.51	2.56	-3.17	5.79	-0.63	3.09	4.79	-0.07	**1.73**
Share of GDP growth	41.04	55.61	-282.23	79.49	-54.96	45.74	55.01	-1.89	39.75

(concluded)

Colombia									
GDP growth	**4.65**	**5.88**	**5.67**	**5.38**	**2.25**	**4.95**	**4.14**	**1.12**	**4.25**
Capital contribution	2.07	1.58	1.98	1.95	2.28	1.86	1.94	1.36	**1.88**
Share of GDP growth	44.59	26.91	34.94	36.21	101.23	37.52	46.85	121.51	44.11
Raw labor contribution	0.50	0.50	0.64	0.69	0.42	0.58	0.41	0.16	**0.49**
Share of GDP growth	10.79	8.47	11.22	12.73	18.64	11.76	9.85	14.17	11.42
Human capital contribution	1.13	1.31	1.60	1.46	0.81	0.98	0.62	0.31	**1.03**
Share of GDP growth	24.31	22.30	28.23	27.09	35.84	19.79	14.94	27.33	24.12
Total factor productivity	0.94	2.49	1.45	1.29	-1.25	1.53	1.17	-0.70	**0.87**
Share of GDP growth	20.30	42.32	25.62	23.97	-55.71	30.94	28.36	-63.01	20.35
Mexico									
GDP growth	**7.25**	**6.26**	**6.27**	**7.14**	**2.03**	**1.72**	**1.61**	**3.96**	**4.53**
Capital contribution	4.05	4.33	3.67	3.09	3.11	1.69	2.57	2.11	**3.08**
Share of GDP growth	55.91	69.14	58.55	43.27	153.01	98.12	159.59	53.35	67.94
Raw labor contribution	0.47	0.46	0.68	0.71	0.47	0.48	0.50	0.72	**0.56**
Share of GDP growth	6.54	7.33	10.83	9.91	23.09	27.69	31.26	18.28	12.40
Human capital contribution	0.79	0.86	1.43	1.53	0.78	0.51	0.40	0.65	**0.87**
Share of GDP growth	10.86	13.82	22.76	21.36	38.43	29.59	24.64	16.46	19.16
Total factor productivity	1.93	0.61	0.49	1.82	-2.33	-0.95	-1.86	0.47	**0.02**
Share of GDP growth	26.69	9.72	7.85	25.46	-114.54	-55.39	-115.49	11.91	0.51
Venezuela									
GDP growth	**6.18**	**4.02**	**2.97**	**2.54**	**-0.91**	**2.76**	**3.53**	**-0.37**	**2.59**
Capital contribution	1.80	2.09	2.12	3.68	1.36	0.76	0.94	0.62	**1.67**
Share of GDP growth	29.19	51.91	71.53	145.21	149.29	27.52	26.48	166.24	64.54
Raw labor contribution	0.62	0.62	0.89	0.95	0.48	0.48	0.72	0.48	**0.66**
Share of GDP growth	10.03	15.51	30.14	37.39	53.15	17.48	20.38	128.23	25.34
Human capital contribution	1.91	1.72	2.08	1.79	0.76	0.63	0.81	0.56	**1.28**
Share of GDP growth	30.90	42.85	69.95	70.45	83.75	22.94	22.80	149.92	49.49
Total factor productivity	1.85	-0.41	-2.13	-3.88	-3.52	0.89	1.07	-2.02	**-1.02**
Share of GDP growth	29.88	-10.27	-71.62	-153.05	-386.19	32.07	30.34	-544.39	-39.37

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

[a] Capital stock series generated using the series of gross capital formation at constant prices but unadjusted by rates of "utilization" of capital. The wage bill is decomposed between the raw labor and quality (or human capital) components. Based on GDP and gross fixed capital formation at constant prices in local currency.

Table 1b

EXTENDED GROWTH ACCOUNTING APPROACH (EA) [a]

Country	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-02	1961-02
Argentina									
GDP growth	**3.99**	**4.02**	**3.12**	**2.96**	**-2.43**	**-0.33**	**6.70**	**-0.28**	**2.22**
Capital contribution	2.47	1.50	2.19	3.47	-0.31	-0.33	1.80	0.41	**1.40**
Share of GDP growth	61.86	37.34	70.28	117.26	-12.74	-99.91	26.84	142.73	63.09
Raw labor contribution	0.39	0.39	0.24	0.24	0.06	0.04	-0.06	0.28	**0.20**
Share of GDP growth	9.66	9.64	7.79	7.98	2.43	13.43	-0.97	96.85	8.83
Human capital contribution	0.44	0.50	0.30	0.25	0.05	0.04	-0.09	0.25	**0.22**
Share of GDP growth	10.96	12.56	9.75	8.41	1.94	12.22	-1.33	87.15	9.82
Total factor productivity	0.70	1.62	0.38	-0.99	-2.23	-0.09	5.06	-1.21	**0.41**
Share of GDP growth	17.52	40.45	12.19	-33.65	-91.63	-25.74	75.45	-426.73	18.27
Brazil									
GDP growth	**4.58**	**7.80**	**10.32**	**6.70**	**1.20**	**2.09**	**3.16**	**2.03**	**4.73**
Capital contribution	0.93	1.37	3.31	4.03	1.37	1.81	1.40	1.37	**1.95**
Share of GDP growth	20.29	17.59	32.14	60.10	114.63	86.35	44.30	67.46	41.17
Raw labor contribution	0.52	0.52	0.82	0.88	0.64	0.66	0.61	0.47	**0.64**
Share of GDP growth	11.44	6.63	7.92	13.06	53.49	31.74	19.23	23.00	13.50
Human capital contribution	1.56	1.38	1.62	1.52	1.04	1.03	0.91	0.66	**1.21**
Share of GDP growth	33.95	17.67	15.73	22.71	86.37	49.21	28.78	32.32	25.63
Total factor productivity	1.57	4.53	4.56	0.28	-1.85	-1.41	0.24	-0.46	**0.93**
Share of GDP growth	34.33	58.10	44.22	4.13	-154.49	-67.30	7.69	-22.77	19.70

(concluded)

Chile									
GDP growth	**3.69**	**4.60**	**-1.12**	**7.28**	**1.14**	**6.75**	**8.71**	**3.84**	**4.36**
Capital contribution	1.13	1.75	0.62	2.52	0.08	1.57	2.78	2.82	**1.66**
Share of GDP growth	30.62	38.01	55.07	34.57	6.77	23.21	31.89	73.54	38.00
Raw labor contribution	0.30	0.29	0.38	0.39	0.37	0.92	0.65	0.49	**0.47**
Share of GDP growth	8.11	6.25	33.90	5.33	32.11	13.63	7.49	12.76	10.85
Human capital contribution	0.57	0.57	0.80	0.81	0.72	1.69	1.11	0.79	**0.88**
Share of GDP growth	15.35	12.42	71.57	11.18	62.54	24.99	12.71	20.55	20.21
Total factor productivity	1.69	1.99	-2.92	3.56	-0.02	2.58	4.18	-0.26	**1.35**
Share of GDP growth	45.91	43.32	-260.53	48.92	-1.42	38.17	47.92	-6.84	30.94
Colombia									
GDP growth	**4.65**	**5.88**	**5.67**	**5.38**	**2.25**	**4.95**	**4.14**	**1.12**	**4.25**
Capital contribution	1.85	1.64	1.61	1.99	1.76	2.30	2.32	1.66	**1.89**
Share of GDP growth	39.79	27.93	28.44	36.99	78.20	46.60	55.97	148.85	44.48
Raw labor contribution	0.50	0.50	0.64	0.69	0.42	0.58	0.41	0.16	**0.49**
Share of GDP growth	10.79	8.47	11.22	12.73	18.64	11.76	9.85	14.17	11.42
Human capital contribution	1.13	1.31	1.60	1.46	0.81	0.98	0.62	0.31	**1.03**
Share of GDP growth	24.31	22.30	28.23	27.09	35.84	19.79	14.94	27.33	24.12
Total factor productivity	1.17	2.43	1.82	1.25	-0.73	1.08	0.80	-1.01	**0.85**
Share of GDP growth	25.11	41.30	32.11	23.19	-32.69	21.85	19.24	-90.35	19.98
Mexico									
GDP growth	**7.25**	**6.26**	**6.27**	**7.14**	**2.03**	**1.72**	**1.61**	**3.96**	**4.53**
Capital contribution	3.94	4.08	3.56	3.57	3.25	1.86	1.58	3.27	**3.14**
Share of GDP growth	54.41	65.21	56.76	50.02	160.09	108.19	98.22	82.53	69.31
Raw labor contribution	0.47	0.46	0.68	0.71	0.47	0.48	0.50	0.72	**0.56**
Share of GDP growth	6.54	7.33	10.83	9.91	23.09	27.69	31.26	18.28	12.40
Human capital contribution	0.79	0.86	1.43	1.53	0.78	0.51	0.40	0.65	**0.87**
Share of GDP growth	10.86	13.82	22.76	21.36	38.43	29.59	24.64	16.46	19.16
Total factor productivity	2.04	0.85	0.61	1.34	-2.47	-1.13	-0.87	-0.68	**-0.04**
Share of GDP growth	28.19	13.65	9.65	18.71	-121.61	-65.46	-54.12	-17.27	-0.86
Venezuela									
GDP growth	**6.18**	**4.02**	**2.97**	**2.54**	**-0.91**	**2.76**	**3.53**	**-0.37**	**2.59**
Capital contribution	2.29	2.61	2.14	4.17	0.57	0.84	1.39	0.23	**1.78**
Share of GDP growth	37.05	65.04	72.05	164.18	62.82	30.47	39.43	62.95	68.78
Raw labor contribution	0.62	0.62	0.89	0.95	0.48	0.48	0.72	0.48	**0.66**
Share of GDP growth	10.03	15.51	30.14	37.39	53.15	17.48	20.38	128.23	25.34
Human capital contribution	1.91	1.72	2.08	1.79	0.76	0.63	0.81	0.56	**1.28**
Share of GDP growth	30.90	42.85	69.95	70.45	83.75	22.94	22.80	149.92	49.49
Total factor productivity	1.36	-0.94	-2.14	-4.37	-2.73	0.80	0.61	-1.64	**-1.13**
Share of GDP growth	22.01	-23.40	-72.14	-172.02	-299.71	29.12	17.39	-441.11	-43.61

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

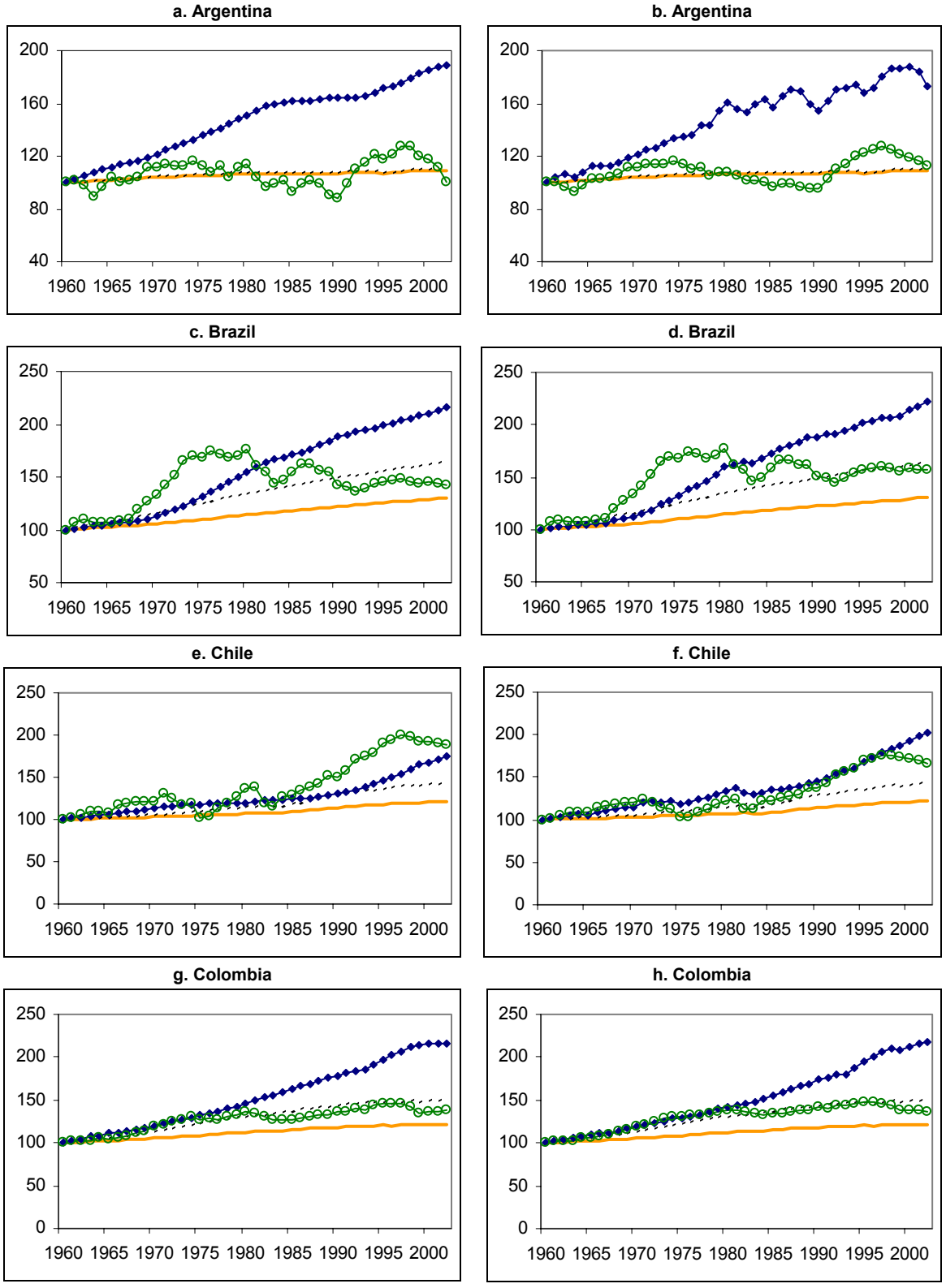
[a] Capital stock series adjusted by rates of "utilization" of capital and using the series of gross capital formation at current prices to generate the capital stock series (deflated by the DDP deflator). The wage bill is decomposed between the raw labor and quality (or human capital) components. Based on GDP at constant prices local currency and gross fixed capital formation at current prices in local currency. Source: WDI, World Bank; United Nations Statistical Office.

Looking at the results from tables 1a and 1b, we observe that physical capital appears at first sight to be the leading source of growth for all six countries in the whole 1960-2002 period. Its impact, in terms of average shares of capital contribution on GDP growth, has varied across time and countries, however (see figures 2 a through l). Further examinations of the growth process leads to the conclusion that other growth sources, and in particular, total factor productivity, have marked the difference between faster and slower growth episodes.

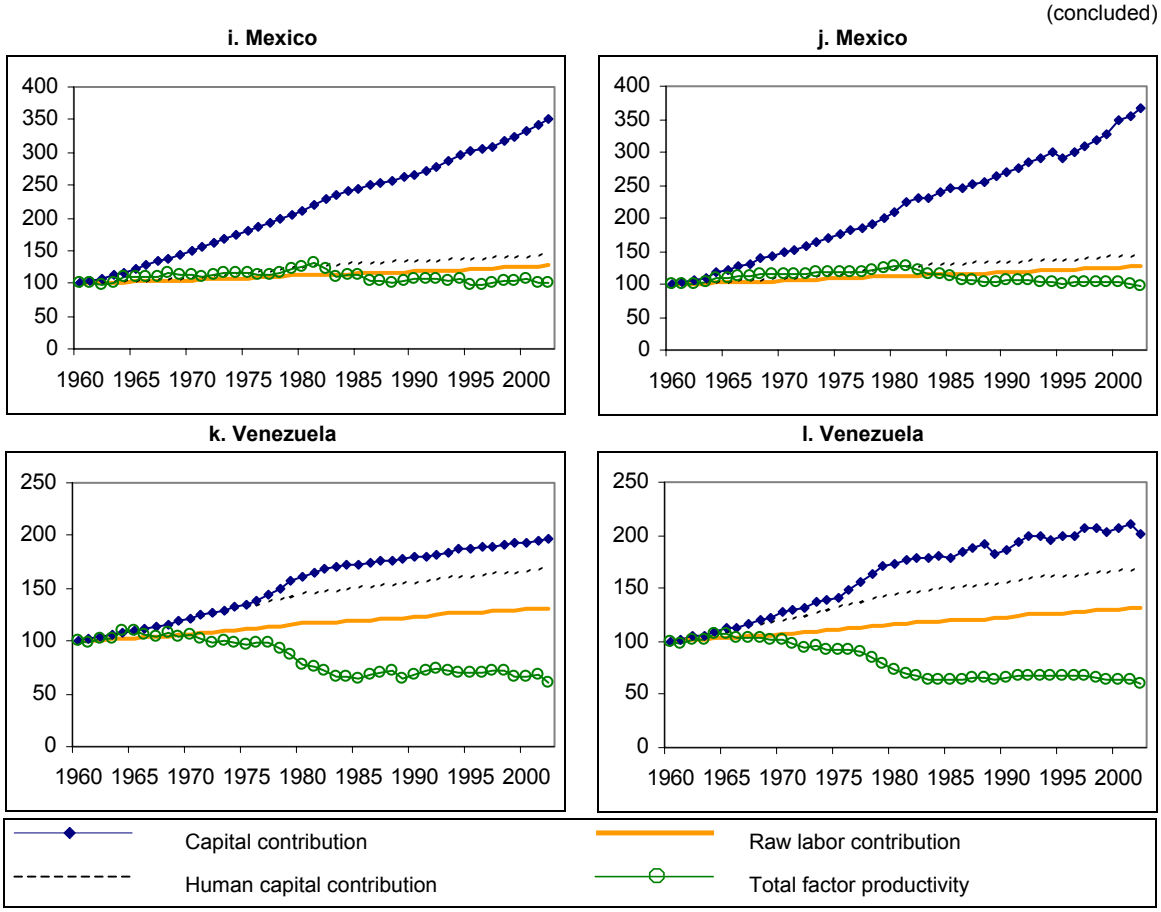
Figure 2

SOURCE OF GROWTH FOR LATIN AMERICAN COUNTRIES: TMA (LEFT) AND EA (RIGHT)

(Index 1960=100)



(concluded)



Source: World Development Indicators (WDI), World Bank.

Observation 1: Physical capital has played an important role in the growth process, but the other growth sources have made the difference between better and worse growth experiences.

Physical capital contributed with about 60%-70% to accumulated GDP growth during 1960-2002 in Argentina, Mexico, and Venezuela (one FGC and two SLCs). Growth performances did not have direct association to the physical capital contributions however. High capital contributions were associated with both high and low growth performances across countries and sub-periods. Despite having similar average shares of physical capital contribution on real GDP growth we observe that Mexico grew at an average rate about double the rates of Argentina and Venezuela on average during the whole 1960-2002 period (4.5% compared to 2.2% and 2.6%, respectively). In the case of the three other FGCs (Brazil, Chile, Colombia), real GDP growth was less dependent on physical capital. The shares of physical capital contributions on GDP growth fluctuated between 30% and 45% for these countries, about half the shares of the more capital-dependent growth countries.

Some key remarks emerged observing the differential performance of the FGCs compared to the SLCs in terms of the shares of the physical capital contributions on real GDP growth during 1960-2002.

Among the FGCs countries, Brazil was the leader in terms of average real GDP growth considering the whole 1960-2002 period (although after the 1980s its performance fell sharply). Brazil is followed by Mexico, Chile and Colombia in terms of average GDP growth during the whole 1960-2002 period. In the cases of Brazil and Mexico, the shares of physical capital contributions on real GDP growth exhibited a rising trend through the different sub-periods, reaching a peak in 1981-85 for Brazil and 1991-95 for Mexico (and declined thereafter). Real GDP

growth reached the lowest average rates in those sub-periods, however. These observations hold under the TMA and the EA. Under the EA, however, Mexico reached the peak in terms of the share of physical capital contribution on GDP growth in 1981-85 (160%), when the average real GDP growth was the third lowest of all sub-periods (2%).

In the cases of Chile and Colombia (the countries with the lowest average shares of physical capital contributions on real GDP growth) the physical capital contributions increased through the 1990s and early 2000s, but as in the other two FGCs there was a positive relationship between growth and capital contribution. Chile reached the highest share of physical capital contribution on growth in 1971-75 (69%) with the TMA and 1996-2002 (74%) with the EA, but average real GDP growth was negative in 1971-75. During 1996-2002, average real GDP growth was less than half the average rate in the peak years (1991-1995) but with a share of capital contribution on real GDP growth of near three times higher. Colombia reached the lowest average GDP growth in 1996-2002 when the capital contribution (as a share of GDP growth) was at the peak (122% with TMA and 149% with EA). Meanwhile, in the best growth years (5.9 % real GDP growth in 1966-70) the share of capital contribution on growth was the lowest of all sub-periods (about 28%).

In three of the four FGCs (Brazil, Chile, and Colombia), in the best growth years, total factor productivity was the leading source of growth, followed by physical capital or human capital, depending on the sub-period. Mexico, is the exception of the FGCs showing physical capital contributions as the main force of growth in the best growth years. However, as we indicated above, we also observe that the years Mexico had the highest physical capital contributions (as shares of GDP growth) are also the years of the lowest average GDP growth.

In the case of the SGCs the highest shares of contributions on real GDP growth coincides with the years of negative or low growth while the best growth years also coincides with the lowest shares of capital contributions on growth.

Observation 2: Labor has played a mixed role in the growth process, helping to push growth in the fastest growth countries (FGCs) but not in the slowest growth countries (SGCs). The role of the human capital component has been more important than the raw labor component.

The role of labor as a source of growth has been mixed but did not mark the difference between high growth and low growth experiences. The role of labor has been driven mostly by the human capital component, with raw labor playing a secondary role. We also observe that the share of the labor contribution on growth has been above the shares of the physical capital contribution on growth on many occasions across time and countries.

In the case of Brazil, the role of labor as a source of growth has been above the role of physical capital in all the sub-periods shown in tables 1a and 1b. Venezuela is at the top of the performers in terms of direct contributions from raw and human capital, but ranks at the bottom of the growth performers, however. As for the case of physical capital, the effectiveness of labor in stimulating growth appears to have depended on additional factors, which are being measured as total factor productivity (TFP). TFP has made the difference between high and low GDP growth experiences.

Observation 3: Total Factor Productivity (TFP) was the main source that marked the difference between better and worse growth experiences.

TFP was clearly the main source of growth in two of the FGC group, Brazil in the mid-1960s through the mid-1970s and Chile between the second half of the 1980s and first half of the 1990s. Colombia also experienced high contributions from TFP as a share of GDP growth, though they declined in the second half of the 1980s and second half of the 1990s. Mexico appears as the exception in the FGC group, with shares of contributions from TFP on growth below the shares of the contributions from physical capital. For the whole set of six countries we observe that while record high contributions from physical capital have co-existed with negative or low GDP growth. In all four

of the FGCs the shares of TFP on growth was the highest in the best and worse growth years, and above the shares of the contributions from the other growth sources (tables 1a and 1b, and figures 2c through 2j).

In the case of the SGCs the leading role of TFP is also evident. TFP has marked the difference between the high and low real GDP growth years. Argentina experienced a modest jump in TFP growth in the early 1990s, which was being reversed since 1997 in tandem with a declining trend of GDP growth. The case of Venezuela is even worse, the contribution from TFP never took off and it has been declining since the early 1970s. The poor growth performance of Venezuela has been only partly attenuated by the positive direct contributions from human capital.

Additional evidence of the key role played by TFP in the growth process of Latin America is obtained from the exercises summarized in tables 2a (for TMA) and 2b (for EA). We selected from the panel of all annual growth rates (across countries and years) the best ten and the worst ten growth rates in each of the following four decades: 1961-70, 1971-80, 1981-90, and 1991-2002. In tables 2a and 2b we show the means and medians for the average growth rates, average physical capital contributions, and average TFP contributions. We also show the difference in the means and medians between the ten highest and ten lowest growth events Last two rows) and the ratios of the differences in the means and medians between the average the contributions physical capital and real GDP growth and between the contribution from TFP and real GDP growth. These last columns show the relative incidences of physical capital and TFP in marking the difference between the ten highest and the ten lowest growth episodes.

Table 2a

HIGHS AND LOWS REAL GDP GROWTH RATES: DIFFERENTIAL IMPACTS FROM TOTAL FACTOR PRODUCTIVITY (TMA)

	GDP growth				TFP contribution				Ratio of differences			
	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02
10 highest GDP growth rates												
Mean	10.43	10.34	7.87	9.51	5.11	4.81	4.96	6.26				
Median	10.20	9.74	7.91	8.93	4.99	4.09	4.94	5.42				
10 lowest GDP growth rates												
Mean	0.45	-2.44	-6.13	-5.04	-2.95	-4.87	-8.38	-6.18				
Median	0.79	-1.42	-5.32	-4.31	-2.65	-5.37	-8.31	-5.64				
Difference in Means	9.97	12.78	14.00	14.55	8.07	9.69	13.33	12.44	0.81	0.76	0.95	0.86
Difference in Medians	9.41	11.16	13.23	13.23	7.64	9.45	13.24	11.06	0.81	0.85	1.00	0.84
	GDP growth				**Capital contribution**				**Ratio of differences**			
	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02
10 highest GDP growth rates												
Mean	10.43	10.34	7.87	9.51	1.98	2.85	0.99	1.57				
Median	10.20	9.74	7.91	8.93	1.55	2.84	0.82	1.76				
10 lowest GDP growth rates												
Mean	0.45	-2.44	-6.13	-5.04	1.84	2.04	1.61	1.57				
Median	0.79	-1.42	-5.32	-4.31	1.95	1.89	1.36	1.55				
Difference in Means	9.97	12.78	14.00	14.55	0.14	0.81	-0.62	0.00	0.01	0.06	-0.04	0.00
Difference in Medians	9.41	11.16	13.23	13.23	-0.40	0.95	-0.54	0.21	-0.04	0.08	-0.04	0.02

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

Table 2b

HIGHS AND LOWS REAL GDP GROWTH RATES: DIFFERENTIAL IMPACTS FROM TOTAL FACTOR PRODUCTIVITY AND CAPITAL (EA)

	GDP growth				TFP contribution				Ratio of differences			
	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02
10 highest GDP growth rates												
Mean	10.43	10.34	7.87	9.51	5.20	4.46	2.94	4.73				
Median	10.20	9.74	7.91	8.93	5.26	4.41	2.41	4.54				
10 lowest GDP growth rates												
Mean	0.45	-2.44	-6.13	-5.04	-1.74	-4.71	-4.45	-2.39				
Median	0.79	-1.42	-5.32	-4.31	-1.45	-4.41	-4.26	-3.33				
Difference in Means	9.97	12.78	14.00	14.55	6.94	9.16	7.39	7.12	0.70	0.72	0.53	0.49
Difference in Medians	9.41	11.16	13.23	13.23	6.71	8.82	6.67	7.87	0.71	0.79	0.50	0.59

	GDP growth				Capital contribution				Ratio of differences			
	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02	1961-70	1971-80	1981-90	1991-02
10 highest GDP growth rates												
Mean	10.43	10.34	7.87	9.51	3.78	4.56	3.01	3.78				
Median	10.20	9.74	7.91	8.93	3.92	4.46	2.90	3.75				
10 lowest GDP growth rates												
Mean	0.45	-2.44	-6.13	-5.04	0.54	0.86	-2.31	-2.22				
Median	0.79	-1.42	-5.32	-4.31	1.28	1.11	-2.42	-1.99				
Difference in Means	9.97	12.78	14.00	14.55	3.24	3.69	5.33	6.00	0.33	0.29	0.38	0.41
Difference in Medians	9.41	11.16	13.23	13.23	2.64	3.35	5.32	5.74	0.28	0.30	0.40	0.43

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

The exercise provides crucial evidence about the leading role of TFP. The results in the last columns of tables 2a and 2b show that capital TFP explains between 76% and 95% of the differences in the means in the case of the TMA and between 49% and 70% in the case of the EA. Using the medians, TFP explains between 81% and 100% of the GDP growth differences with the TMA and between 50% and 79% in the case of the EA.

Similar calculations are shown for physical capital in the lowest parts of tables 2a and 2b. The ratios of the differences of medians and means are below 8 percent and in some cases negative! in the case of TMA, and between 28% and 43% in the case of the EA, clearly much below the incidences of the TFPs.

Similar evidence about the primary role played by TFP in explaining fast growth episodes have been provided in recent research on economic growth such as Easterly (2001) and Easterly and Levine (2001) in a global analysis; Easterly and Pack (2001) for Africa; Elias (1990 and 1992) for Latin America; Harberger (1996 and 1998) for East Asia, Latin America, ad the United States and Mexican manufacturing sectors; Klenow and Rodriguez-Clarke (1997b) in a global analysis; Loayza et.al. (2004) for Latin America; and Fajnzylber and Lederman (1999) for Latin America. In a most recent study, Solimano and Soto (2004) also showed for a sample of 12 Latin American countries for the period 1960-2000 that TFP was the main determinant of GDP growth.[8]

[8] Solimano and Soto (2004) concluded that most of the evolution of GDP growth is the result of changes in the efficiency and rate of utilization in the use of capital and labor (TFP).

Despite the modifications and extensions we introduced to the traditional growth accounting methodology the main conclusion prevails in favor of the leading role played by TFP and not physical capital in "explaining" the difference between fast and slow growth experiences in Latin America. Argentina and Venezuela have performed at the bottom of the six largest Latin American, taking the whole 1960-2002 period, with modest TFP growth being a main feature of their poor growth performance. At the other extreme, Chile has experienced the fastest GDP growth on average since the 1980s, despite some weakened strength after the mid-1990s (Figure 2e and 2f), and mostly driven by total factor productivity growth. It is interesting to observe in the Chilean case that the EA assigns a lower role to TFP compared to physical capital, which in large part reflects the incidence of TFP on the return of physical capital.[9]

In the next section we examine how the composition of investment and other key factors have contributed to economic growth. We use per capita GDP growth as a proxy for aggregate for labor productivity growth.

[9] From the EA growth accounting calculations, the implicit net returns to physical capital in Chile rose from about 10% annual rate in the early 1980s to about 15% by the mid-1990s. From the mid-1990s onward, the rate declined to slightly below 10% by 2002, reflecting the negative TFP trend that developed after the mid-1990s.

II. Composition of investment between machinery and equipment and construction structures

In the previous section we provided evidence showing that physical capital played an important role in the process of economic growth in Latin America during 1960-2002, but that it was not the main factor that explained the difference between fast and slow growth experiences. We showed evidence that total factor productivity was the key force making the difference. In this section we will explore in more detail the additional ingredients that contributed to GDP growth in Latin America during 1960-2002. We use regression analysis and examine the effects on per capita GDP growth of fixed investment by type of assets and policy related variables. We use GDP per capita growth as a proxy for labor productivity growth. This approach has been followed in seminal endogenous growth estimates. See for example Barro and Lee (1994), De Long and Summers (1991 and 1993), Klenow and Rodriguez-Clarke (1997b), and Loayza et. al (2004).[10] In this section we examine the composition of fixed investment between machinery and equipment and construction structures. In the next section we analyze the composition of fixed investment between private and public investment.

[10] Solimano and Soto (1994) use the growth rates of TFPs (computed through growth accounting) for a panel of 12 Latin American countries for the period 1960-2002 as the dependent variable instead of per capita GDP growth. They showed evidence, however, of a "striking similarity" between changes of total factor productivity and per capita or per working age GDP. Both approaches should yield similar results as long as the regression estimates takes account of fixed investment as an additional control variable.

Some quantitative studies have emphasized the role of machinery investment in augmenting the role of physical capital and labor in the growth processes. Since the industrial revolution machinery investment has played a key role, directly as a production factor, and also as a mean of acquisition and transmission of technological improvements across countries and within countries. De Long and Summers (1991 and 1993) found evidence of high social returns from investments in machinery, assigning to machinery investment a primary role in boosting productivity growth (proxied by per capita GDP). They showed that high rates of machinery investment accounted for most of Japan's successful growth experience after World War II. They concluded that fast-growing countries were those with favorable supply conditions for machinery investments and that developing countries benefited as much as richer economies from the technologies embodied in machinery. Building projects are usually less effective in promoting growth because the technologies embodied in constructions structures have lower potential of being transmitted across production process. In addition, the output of the construction sector is mostly non-tradable and technologically less dynamic.

The structure of investment by type of assets matters for economic growth because the different technologies embodied in different types of investment assets are have different effects on productivity and growth. Economic policies also play a main role in affecting economy wide productivity and economic growth as they se the framework for the allocation and use of production factors and decision making by economic agents. The contributions of physical capital and labor to economic growth depend on the quality of the economic framework. Price stability has become an important factor adding to growth because of irreversible characteristics of investment makes investment decisions highly sensitive to factor affecting inflation prospects and associated uncertainty about the evolution of relative prices (see Pyndick and Solimano, 1993). The size of the government also has been shown to matter for growth because an increase of fiscal vulnerability affects economic prospects and economic stability, and because public spending could be crowding out private saving and investment. Economic instability and uncertainty about economic prospects have been shown to be main factors that have contributed to discourage investment. Schmidt-Hebbel, Serven, and Solimano (1996) concluded in a review of the literature that investment is necessary but not a sufficient condition for growth and that human capital, technological innovation, and appropriate policies are also necessary for sustained high growth. Evidence about the role of education as a factor contributing to growth has also been provided in other seminal studies (for example: Barro and Lee, 1994). Education facilitates the adoption of modern technologies embodied in new machinery and equipment and creates positive externalities (Lucas, 1988).

In tables 3a and 3b we provide evidence about the impact of total fixed investment, and its composition between machinery and equipment, and construction structures on per capita GDP growth. We included regression estimates for aggregate fixed investment to enrich the conclusions reached in Section I. We tested the impact on per capita GDP growth of fixed investment and its composition by type of assets combined with some key policy variables (including education). We tried with a selected number of variables that are related to economic policy making: (1) inflation (annual % change in the consumer price index), a measure of the degree of price stability and also related to consistency of macroeconomic policies; (2) trade openness (% share of trade in GDP), related to the degree of trade protection; (3) government consumption (% of GDP), related to policies that assign different roles to the size of the government sector in the economy; (4) external debt (% of GDP), related to macroeconomic policies that have conducted to different degrees of external debt exposures; (5) foreign direct investment (FDI) (% of GDP), related to policies that affect the degree capital openness and regulations affecting FDI; (6) infrastructure (per capita telephone lines), related to policies that have assigned different priorities to the development of infrastructure; and (7) education (ratio of gross secondary enrollment to the population of the same age group), related to education policies and the priorities assigned to the extension of education.

We call these variables policy related variables because they reflect or are the result of economic policies.[11]

We also included initial per capita GDP (values at initial year of each sub-period) to account for conditional convergence, which has been reported as important in other growth studies (see for example Barro and Lee, 1994; and Loayza et.al., 2004 among others). We used panel data for the six Latin American countries for the period 1960-2002 and used, for the estimates shown in table 3a, 5-year averages to reduce the effect of short-term fluctuations (we obtained 48 0bservations). We run panel regressions using OLS with country fixed effects and corrected for heterocedasticity as needed.[12] We use national accounts data at constant prices in local currency and variables expressed as shares of GDP. Appendix A contains a detailed reference to the sources and description of the variables used.

For the estimates shown in table 3b we used annual date to obtain estimates for the whole period (258 observations), but we broke also the whole period into several sub-periods in order to appreciate the stability of the coefficients derived from the whole period (long-run) estimates. The structural analysis allowed us to appreciate changes in the relevance of the explanatory variables through the different sub-periods considered. In table 3b we include the results from computing structural break tests (Chow test) for three types of breaks: (1) 1960-80/1981-1990/1991-2002; (2) 1960-80/1981-2002; and (3) 1986-90/1991-2002.

Three main sub-periods fall within the whole 42 years: (1) 1960-80: representing the gradual agony of the old import substitution industrialization strategy; (2) 1980-1990: the debt crisis, economic instability and beginning of the stabilization and reforms conducting to put in place a new outward looking and export led development strategy; and (3) 1990-2002: gradual consolidation of the outward approach. In table 3b we show in the first columns the same type of equations shown in table 3a (estimated on the base of 5-year averages and in the second column the estimates using annual data. In the rest of the columns we compute the annual equations for the breaks used to compute the Chow tests (whose results are shown in the last rows under the annual equation estimates for the whole period of each equations group). We used annual estimates to compute the structural break tests in order to have an appropriate number of degrees of freedom to assess the structural changes.

The results of the annual estimates for the whole 1960-2002 period confirm in general the results obtained using 5-year averages, which helps to reinforce the long-run trends (see the first two columns for each set of equations in table 3b). The observations stated below (Observations 4 trough 6) are based on the results shown in table 3a. We consider them as the benchmark long-rung estimates and trends. Among the policy related variables, FDI and infrastructure showed significance in the annual estimate for the whole period but did not include them in our general long-run observations as their significance disappears in the equations using 5-year averages, which we consider to be the benchmark for the long-run observations.[13] Due qualifications to each of the long-run observations and trends are drawn from the results of the structural analysis, however.

[11] High inflation episodes have been generally associated with more expansionary monetary and fiscal policies. A high share of government consumption in GDP has reflected fiscal policies that have assigned the government a more predominant role in the growth process. A higher share of trade in GDP reflects commercial policies that have reduced trade barriers. Higher shares of FDI in GDP and of infrastructure are reflecting policies that have deregulated FDI and have been more aggressive in the privatization processes (including concessions). And, changes in the coverage of secondary enrollment reflect the strength of educational policies, although as we mention in the text, existing education variables are imperfect measures of human capital formation. Measures of education levels do not account for quality or for on-the- job training factors.

[12] We applied the White's diagonal method that proves to be robust to observation specific heterocedasticity in the residuals.

[13] These observations are representative for the six countries as a whole, however. The debt crisis events of Argentina, Ecuador, and Uruguay in the 2000s (and from which Brazil was close in 1999) are indicative that policy disparities across countries continued after the 1980s making some countries more sensible than others to the different factors affecting growth.

Table 3a

GDP PER CAPITA GROWTH DETERMINANT: TOTAL INVESTMENT, MACHINERY AND EQUIPMENT, AND CONSTRUCTION STRUCTURES

Pool OLS estimates for growth of real GDP per capita (lnyt-lnyt-1)
Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela
Five-year averages: 1960-2002. Number of observations: 48

	(1)	(2)	(3)	(4)	(5)	(6)
Investment rate (% GDP)	0.0046***	0.0037**	0.004***	0.0035***		
	(2.70)	(2.43)	(3.10)	(2.69)		
Mach & Equip Rate (% GDP)					0.0074***	0.0071***
					(3.66)	(3.65)
Constructions rate (% GDP)						
Inflation (annual %)			-0.00003*	-0.00005**		
			(-1.83)	(-2.52)		
Openness (exports+imports) (% GDP)			0.0007			
			(1.63)			
Government consumption (% GDP)			-0.0034***	-0.003**		
			(-3.05)	(-2.50)		
External debt (% GDP)			-0.0005*			
			(-1.83)			
Foreign direct investment (% GDP)			-0.0037			
			(-0.95)			
Infrastr. (ln telephone lines per capita)			0.0217			
			(1.43)			
Education (ln ratio second. enroll.)			0.0007*	0.0008***		
			(1.72)	(3.01)		
Population growth (%)	-0.0129				-0.0046	
	(-1.18)				(-0.51)	
Per capita GDP (ln of value at the	-0.06***	-0.041***	-0.1331***	-0.0671***	-48***	-0.042***
beginning of each sub-period)	(-3.02)	(-3.86)	(-4.19)	(-3.62)	(-2.89)	(-4.29)
R sq	0.41	0.38	0.78	0.57	0.43	0.43
F stat	3.32	3.45	5.37	4.98	3.75	4.29

	(7)	(8)	(9)	(10)	(11)
Investment rate (% GDP)					
Mach & Equip Rate (% GDP)	0.0072***	0.0069***	0.0064***	0.0052***	0.0057***
	(3.46)	(3.44)	(3.53)	(2.80)	(3.19)
Constructions rate (% GDP)	0.0022	0.0013	0.0008		
	(1.03)	(0.68)	(0.40)		
Inflation (annual %)			-0.00005**	-0.00004	-0.00006***
			(2.50)	(-2.38)	(-3.17)
Openness (exports+imports) (% GDP)				0.0006	
				(1.20)	
Government consumption (% GDP)				-0.0022**	-0.0022**
				(-1.75)	(-1.70)
External debt (% GDP)				-0.0005*	
				(-1.85)	
Foreign direct investment (% GDP)				-0.0002	
				(-0.04)	
Infrastr. (ln telephone lines per capita)				0.0146	
				(1.06)	
Education (ln ratio second. enroll.)			0.0004*	0.0003	0.0004*
			(1.67)	(0.71)	(1.76)
Population growth (%)	-0.0097				
	(-0.87)				
Per capita GDP (ln of value at the	-0.058***	-0.043***	-0.0606***	-0.1052***	-0.0505***
beginning of each sub-period)	(-2.88)	(-4.53)	(-3.23)	(-3.83)	(-2.93)
R sq	0.45	0.44	0.55	0.76	0.58
F stat	3.51	3.8	4.54	4.78	5.15

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***). Fixed effects; Corrected for Heterocedasticity.

Table 3b

GDP PER CAPITA GROWTH DETERMINANT: TOTAL FIXED INVESTMENT, MACHINERY AND EQUIPMENT, AND CONSTRUCTIONS

Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela

1960-2002 (annual data: 258 observations; 5-year averages: 48 observations)

	(1) 1960-2002 5-year averages	(1a) 1960-2002 annual	(1b) 1960-1980 annual	(1c) 1981-1990 annual	(1d) 1991-2002 annual	(1e) 1960-1990 annual
Investment rate (% GDP)	0.0046***	0.0048***	0.0032***	0.0083**	0.0052**	0.0044***
	(2.70)	(4.76)	(2.46)	(2.37)	(2.44)	(3.92)
Mach. and equipment rate (% GDP)						
Constructions rate (% GDP)						
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption(% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)	-0.0129	-0.0088	-0.0379**	-0.0195	-0.0334	-0.0078
	(-1.18)	(-1.27)	(-2.12)	(-0.46)	(-0.64)	(-0.81)
Per capita GDP (ln of value at the beginning of each sub-period)	-0.06***	-0.0586***	-0.0609**	-0.392***	-0.2536***	-0.0659***
	(-3.02)	(-3.93)	(-2.17)	(-3.09)	(-3.74)	(-3.32)
R sq	0.41	0.2	0.19	0.32	0.43	0.2
F stat	3.32	7.81	3.33	3.07	6.04	5.39
Chow tests:						
1960-80/ 1981-90/1991-2002		20.97				
1960-80/1981-2002		14.09				
1960-90/1991-2002		2.32				

	(2) 1960-2002 5-year averages	(2a) 1960-2002 annual	(2b) 1960-1980 annual	(2c) 1981-1990 annual	(2d) 1991-2002 annual	(2e) 1960-1990 annual
Investment rate (% GDP)	0.0037**	0.0043***	0.0023*	0.0080**	0.0046**	0.0041***
	(2.43)	(4.78)	(1.85)	(2.39)	(2.37)	(3.94)
Mach. and equipment rate (% GDP)						
Constructions rate (% GDP)						
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption(% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.041***	-0.0457***	-0.0179	-0.3930	-0.2231***	-0.056***
	(-3.86)	(-5.29)	(-0.94)	(-3.09)***	(-5.10)	(-4.00)
R sq	0.38	0.19	0.15	0.32	0.42	0.19
F stat	3.45	8.67	2.92	3.52	6.81	6.09
Chow tests:						
1960-80/ 1981-90/1991-2002		5.74				
1960-80/1981-2002		1.19				
1960-90/1991-2002		2.68				

(continued)

	(3) 1960-2002 5-year averages	(3a) 1960-2002 annual	(3b) 1960-1980 annual	(3c) 1981-1990 annual	(3d) 1991-2002 annual	(3e) 1960-1990 annual
Investment rate (% GDP)	0.004***	0.0052***	0.0041***	0.0097***	0.0065***	0.0054***
	(3.10)	(5.06)	(2.72)	(3.39)	(3.29)	(3.88)
Mach. and equipment rate (% GDP)						
Constructions rate (% GDP)						
Inflation (annual %)	-0.00003*	-0.00004***	0.0002***	-0.00004***	0.0001	-0.0005***
	(-1.83)	(-4.99)	(-4.98)	(-3.90)	(0.81)	(-4.38)
Openness (exports+imports) (% GDP)	0.0007	0.0003	-0.0009	0.001	0.0016***	-0.0008
	(1.63)	(0.79)	(-0.76)	(-0.86)	-3.09	(-0.96)
Government consumption (% GDP)	-0.0034***	-0.0051***	0.0026	-0.007**	-0.0032	-0.0085***
	(-3.05)	(-3.84)	(-0.67)	(-1.77)	(-1.15)	(-2.96)
External debt (% GDP)	-0.0005*	-0.0006***	-0.0015**	-0.0002	-0.0011*	-0.0008***
	(-1.83)	(-3.28)	(-2.13)	(-0.59)	(-1.16)	(-2.79)
Foreign direct investment (% GDP)	-0.0037	-0.0048**	-0.0046	-0.0081	0.0007	-0.0076
	(-0.95)	(-2.48)	(-0.87)	(-1.24)	(0.22)	(-1.99)
Infrastructure (ln telephone lines per capita)	0.0217	0.0317**	0.0572	0.117***	0.7778	0.0443**
	(1.43)	(2.54)	(1.38)	(2.47)	(1.51)	(2.37)
Education (ln ratio second. enroll)	0.0007*	0.0012***	0.0026***	0.0031	-0.0005	0.003***
	(1.72)	(3.24)	(3.21)	(1.43)	(-1.02)	(4.05)
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.1331***	-0.1823***	-01649**	-0.4913***	-0.3834***	-0.2583***
	(-4.19)	(-6.51)	(-2.48)	(-4.88)	(-4.70)	(-5.56)
R sq	0.78	0.45	0.62	0.61	0.63	0.50
F stat	5.37	9.96	5.91	5.13	5.49	7.98
Chow tests:						
1960-80/ 1981-90/1991-2002		6.34				
1960-80/1981-2002		4.63				
1960-90/1991-2002		2.37				

	(4) 1960-2002 5-year average	(4a) 1960-2002 annual	(4b) 1960-1980 annual	(4c) 1981-1990 annual	(4d) 1991-2002 annual	(4e) 1960-1990 annual
Investment rate (% GDP)	0.0035***	0.0046***	0.0017*	0.0084***	0.0066***	0.0038***
	(2.69)	(4.90)	(1.66)	(3.16)	(3.72)	(3.61)
Mach. and equipment rate (% GDP)						
Constructions rate (% GDP)						
Inflation (annual %)	-0.00005**	-0.00004***	-0.00018***	-0.00004***	0.0002	-0.0001***
	(-2.52)	(-5.72)	(-4.27)	(-4.53)	(1.61)	(-5.82)
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)	-0.003**	-0.00401***	-0.0048	-0.0041	-0.0007	-0.0058***
	(-2.50)	(-3.84)	(-1.69)	(-1.26)	(-0.41)	(-2.96)
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)	0.0008***	0.0011***	0.0019***	0.0054***	0.0005	0.0013***
	(3.01)	(4.44)	(2.77)	(3.80)	(1.61)	(3.57)
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.0671***	-0.0896***	-0.06342**	-0.4674***	-0.2378***	-0.0994***
	(-3.62)	(-5.11)	(-2.12)	(-4.57)	(-4.48)	(-4.25)
R sq	0.57	0.3	0.31	0.55	0.54	0.3
F stat	4.98	9.99	5.01	6.1	5.88	7.47
Chow tests:						
1960-80/ 1981-90/1991-2002		7.17				
1960-80/1981-2002		2.45				
1960-90/1991-2002		1.86				

(continued)

	(5) 1960-2002 5-year averages	(5a) 1960-2002 annual	(5b) 1960-1980 annual	(5c) 1981-1990 annual	(5d) 1991-2002 annual	(5e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0074***	0.009***	0.0072***	0.0186***	0.0089***	0.0078***
	(3.66)	(6.86)	(2.82)	(4.20)	(3.15)	(4.37)
Constructions rate (% GDP)						
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)	-0.0046	-0.0019	-0.0288	-0.0355	-0.0006	-0.0001
	(-0.51)	(-0.31)	(-1.71)	(-0.84)	(-0.01)	(-0.01)
Per capita GDP (ln of value at the beginning of each sub-period)	-0.048***	-0.0546***	-0.0618**	-0.4529***	-0.1829***	-0.0576***
	(-2.89)	(-4.18)	(-2.32)	(-4.41)	(-2.76)	(-3.06)
R sq	0.43	0.23	0.2	0.42	0.43	0.2
F stat	3.75	9.19	3.51	4.78	6.04	5.35
Chow tests:						
1960-80/ 1981-90/1991-2002		6.12				
1960-80/1981-2002		1.95				
1960-90/1991-2002		1.30				

	(6) 1960-2002 5-year averages	(6a) 1960-2002 annual	(6b) 1960-1980 annual	(6c) 1981-1990 annual	(6d) 1991-2002 annual	(6e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0071***	0.0088***	0.0067**	0.0175***	0.0089***	0.0078***
	(3.65)	(6.78)	(2.62)	(4.06)	(3.10)	(4.46)
Constructions rate (% GDP)						
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.042***	-0.0519***	-0.0323	-0.4527***	-0.1824***	-0.0575***
	(-4.29)	(-6.20)	(-1.60)	(-4.43)	(-3.71)	(-4.25)
R sq	0.43	0.23	0.18	0.41	0.43	0.2
F stat	4.29	10.52	3.44	5.31	7.01	6.15
Chow tests:						
1960-80/ 1981-90/1991-2002		6.29				
1960-80/1981-2002		1.18				
1960-90/1991-2002		1.49				

(continued)

	(7) 1960-2002 5-year averages	(7a) 1960-2002 annual	(7b) 1960-1980 annual	(7c) 1981-1990 annual	(7d) 1991-2002 annual	(7e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0072***	0.0087***	0.0064**	0.0186***	0.0085***	0.0067***
	(3.46)	(6.69)	(2.37)	(4.27)	(3.31)	(3.69)
Constructions rate (% GDP)	0.0022	0.0025	0.0012	0.0002	0.0066**	0.0026
	(1.03)	(1.85)*	(0.47)	(0.04)	(2.28)	(1.46)
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)	-0.0097	-0.0078	-0.0322*	-0.0356	-0.0337	-0.0061
	(-0.87)	(-1.11)	(-1.84)	(-0.83)	(-0.66)	(-0.62)
Per capita GDP (ln of value at the beginning of each sub-period)	-0.058***	-0.0659***	-0.0645**	-0.4541***	-0.2499***	-0.0663***
	(-2.88)	(-4.54)	(-2.33)	(-3.99)	(-3.24)	(-3.33)
R sq	0.45	0.24	0.2	0.42	0.48	0.21
F stat	3.51	8.79	3.12	4.16	6.49	5.13
Chow tests:						
1960-80/ 1981-90/1991-2002		5.61				
1960-80/1981-2002		2.36				
1960-90/1991-2002		1.96				

	(8) 1960-2002 5-year averages	(8a) 1960-2002 annual	(8b) 1960-1980 annual	(8c) 1981-1990 annual	(8d) 1991-2002 annual	(8e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0069***	0.0084***	0.0072**	0.0175***	0.0082***	0.0068***
	(3.44)	(6.60)	(2.50)	(4.08)	(3.08)	(3.67)
Constructions rate (% GDP)	0.0013	0.0019	-0.0007	0.00001	0.0056**	0.0022
	(0.68)	(1.57)	(-0.30)	(0.004)	(2.21)	(1.38)
Inflation (annual %)						
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)						
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.043***	-0.0545***	-0.0328	-0.4528***	-0.216***	-0.0587***
	(-4.53)	(-6.50)	(-1.62)	(-3.93)	(-4.28)	(-4.29)
R sq	0.44	0.24	0.17	0.41	0.48	0.21
F stat	3.8	9.71	2.99	4.56	7.21	5.75
Chow tests:						
1960-80/ 1981-90/1991-2002		5.74				
1960-80/1981-2002		1.03				
1960-90/1991-2002		1.75				

(continued)

	(9) 1960-2002 5- year averages	(9a) 1960-2002 annual	(9b) 1960-1980 annual	(9c) 1981-1990 annual	(9d) 1991-2002 annual	(9e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0064***	0.0078***	0.0035	0.0164***	0.0068***	0.0063***
	(3.53)	(6.51)	(1.37)	(4.70)	(3.21)	(3.42)
Constructions rate (% GDP)	0.0008	0.0016	0.0011	0.0009	0.0064**	0.0019
	(0.40)	(1.14)	(0.51)	(0.22)	(2.29)	(0.97)
Inflation (annual %)	-0.00005**	-0.00004***	-0.0002***	-0.00003***	0.0002*	-0.00004***
	(2.50)	(-4.81)	(-4.42)	(-6.67)	(1.77)	(-4.40)
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)						
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)	0.0004*	0.0005	0.0011*	0.0053***	0.0005	0.0007
	(1.67)	(2.34)	(1.90)	(3.90)	(1.38)	(1.57)
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.0606***	-0.0839***	-0.0507*	-0.5268	-0.2392***	-0.089***
	(-3.23)	(-4.61)	(-1.75)	(-5.80)	(-3.97)	(-3.40)
R sq	0.55	0.28	0.29	0.6	0.54	0.27
F stat	4.54	8.98	4.51	7.51	5.83	6.3
Chow tests:						
1960-80/ 1981-90/1991-2002		7.94				
1960-80/1981-2002		1.72				
1960-90/1991-2002		1.52				

	(10) 1960-2002 5-year averages	(10a) 1960-2002 annual	(10b) 1960-1980 annual	(10c) 1981-1990 annual	(10d) 1991-2002 annual	(10e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0052***	0.0079***	0.0100***	0.0218***	0.0066***	0.0086***
	(2.80)	(5.71)	(3.73)	(5.36)	(2.58)	(4.29)
Constructions rate (% GDP)						
Inflation (annual %)	-0.00004**	-0.00005***	-0.0002***	-0.00004***	0.0001	-0.00006***
	(-2.38)	(-5.31)	(-4.41)	(-4.65)	(0.99)	(-4.46)
Openness (exports+imports) (% GDP)	0.0006	0.00007	-0.0016	-0.0013	0.0018***	-0.007
	(1.20)	(0.15)	(-1.32)	(-1.05)	(2.93)	(-0.81)
Government consumption (% GDP)	-0.0022**	-0.0038***	-0.0032	-0.0015	-0.0023	-0.0073***
	(-1.75)	(-2.98)	(-0.83)	(-0.53)	(-0.86)	(-2.68)
External debt (% GDP)	-0.0005*	-0.0007***	-0.0013*	0.003	-0.0015**	-0.0008***
	(-1.85)	(-3.18)	(-1.86)	(0.78)	(-2.20)	(-2.64)
Foreign direct investment (% GDP)	-0.0002	-0.0035	-0.0064	-0.0053	0.0009	76**
	(-0.04)	(-1.77)	(-1.09)	(-1.00)	(0.26)	(-2.04)
Infrastructure (ln telephone lines per capita)	0.0146	0.0291**	0.0541	0.1618	0.054	0.0383**
	(1.06)	(2.40)	(1.36)	(2.79)	(1.07)	(2.00)
Education (ln ratio second. enroll)	0.0003	0.0008**	0.0027***	0.0011	-0.0007	0.0024***
	(0.71)	(2.29)	(3.43)	(0.46)	(1.54)	(3.42)
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.1052***	-0.1553***	-0.1942***	-0.5677***	-0.278***	-0.2242***
	(-3.83)	(-6.46)	(-2.84)	(-6.62)	(-3.89)	(-5.56)
R sq	0.76	0.44	0.63	0.68	0.59	0.49
F stat	4.78	9.7	6.37	7.06	4.72	7.76
Chow tests:						
1960-80/ 1981-90/1991-2002		6.45				
1960-80/1981-2002		3.22				
1960-90/1991-2002		1.77				

(concluded)

	(11) 1960-2002 5-year averages	(11a) 1960-2002 annual	(11b) 1960-1980 annual	(11c) 1981-1990 annual	(11d) 1991-2002 annual	(11e) 1960-1990 annual
Investment rate (% GDP)						
Mach. and equipment rate (% GDP)	0.0057***	0.0074***	0.0046***	0.0168***	0.0075***	0.0067***
	(3.19)	(5.97)	(2.21)	(5.09)	(3.14)	(4.05)
Constructions rate (% GDP)						
Inflation (annual %)	-0.00006***	-0.00005***	-0.0002***	-0.0004***	-0.0002	-0.00005***
	(-3.17)	(-6.25)	(-3.87)	(-4.84)	(1.57)	(6.81)
Openness (exports+imports) (% GDP)						
Government consumption (% GDP)	-0.0022*	-0.0029***	-0.0055*	0.0004	-0.0006	-0.0054***
	(-1.70)	(-2.78)	(-1.83)	(0.13)	(-0.37)	(-2.78)
External debt (% GDP)						
Foreign direct investment (% GDP)						
Infrastructure (ln telephone lines per capita)						
Education (ln ratio second. enroll)	0.0004*	0.0006***	0.0019***	0.0053***	0.0001	0.0008**
	(1.76)	(2.75)	(2.71)	(3.86)	(0.40)	(2.21)
Population growth (%)						
Per capita GDP (ln of value at the beginning of each sub-period)	-0.0505***	-0.0677***	-0.0698**	-0.5244***	-0.1694***	-0.0758***
	(-2.93)	(-4.38)	(-2.34)	(6.41)	(-3.16)	(-3.57)
R sq	0.58	0.3	0.32	0.6	0.49	0.3
F stat	5.15	9.95	5.15	7.49	4.79	7.4
Chow tests:						
1960-80/ 1981-90/1991-2002		7.16				
1960-80/1981-2002		2.15				
1960-90/1991-2002		1.36				

Sources: World Development Indicators (WDI), World Bank and United Nations Statistical Office.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***). Fixed effects; Corrected for Heterocedasticity.

Observation 4: Key factors affecting per capita GDP growth have been: (1) investment; (2) inflation performance; (2) the size of the government; (3) the size of the external debt; and (4) education.

Confirming the findings of Section I we found that: (1) investment showed to be an important ingredient in the growth processes of Latin America during 1960-2002; (2) some key policy variables appeared also as main factors explaining per capita GDP growth during 1960-2002, and contributing to make the difference between fast and slow growth experiences; and (3) the incidence of investment and the related policy variables varied through the whole period but the long-run observations appear to hold.

Columns 1 through 4 of table 3a show the regression results for total fixed investment. We present the best four regressions after experiencing with several combinations of dependent variables.[14] From the results it seems clear the importance of fixed investment as a determinant of per capita GDP growth but other key policy related variables shoed to be also relevant in explaining per capita GDP growth. In addition to fixed investment, we found that key determinants of per capita GDP growth in Latin America during 1960-2002 were inflation, the size of government consumption, the size of the external debt in terms of GDP, and education (proxied by the ratio of secondary enrollments). We found that in the long-run (taking the whole 1960-2002 period), the most

[14] We also examined some additional variables such as the fiscal balance (% of GDP) and the current account balance (% of GDP) but the series were short, truncated, or of questionable reliability. We also, examined more disaggregated fixed investment data from the Penn World table 5.6, but the series were also truncated and we could not obtain reliable documentation explaining the data sources. National accounts data from the United Nations and national sources in Latin America does not include data for our countries on disaggregated fixed investment except for the broad categories between machinery and equipment, and construction structures.

significative policy related variables explaining per capita GDOP growth were inflation and the size of the government, however. We tried additional equations (not shown) including foreign direct investment (FDI) and infrastructure (per capita telephone lines) but their coefficients were no significant (even at the 1% level) in our long-run estimates based on 5-year averages.

We interpret the findings as indicating that fixed investment was important for growth in Latin America but other key related policy variables, mainly those that induced price stability, low external debt, reduced government, and education helped made the difference between fast and slow growth experiences. Population growth appears to have a slight negative effect and the results are showed consistency with other evidence about conditional convergence (see for example, Barro, 1993, and Loayza et. al, 2004).[15]

To examine in more detail the long-run conclusions obtained from the long-run 1960-2002 estimates we examined the stability of the respective equations and results using the breaks indicated above. This procedure seems appropriate given the structural changes and shocks experienced by Latin America through that period. The qualifications are based on the structural evidence summarized in table 3b equations: 1a through 1e; 2a through 2e; 3a through 3e, and 4a through 4e; and from the information shown in figure 3 and Appendix table B1:

(1) The impact of total fixed investment appeared significant in all of the sub-periods considered but the coefficients are higher in the 1980s and in the 1990s. The growth slump of the 1980s was to a great extent reflected also an investment slum.[16] The growth recovery during 1990-2002, though modest, appeared to have been supported by a recovery of investment and boost from investments in machinery and equipment (see below), which were stimulated by the trade reforms and privatization processes. The recovery in the 1990s was not uniform across countries, however, as can be observed in figure 3 and Appendix table B1. In the cases of Chile, Brazil, and Mexico the recovery of investment rates and GDP growth were stronger as compared to Argentina, Colombia, and Venezuela.

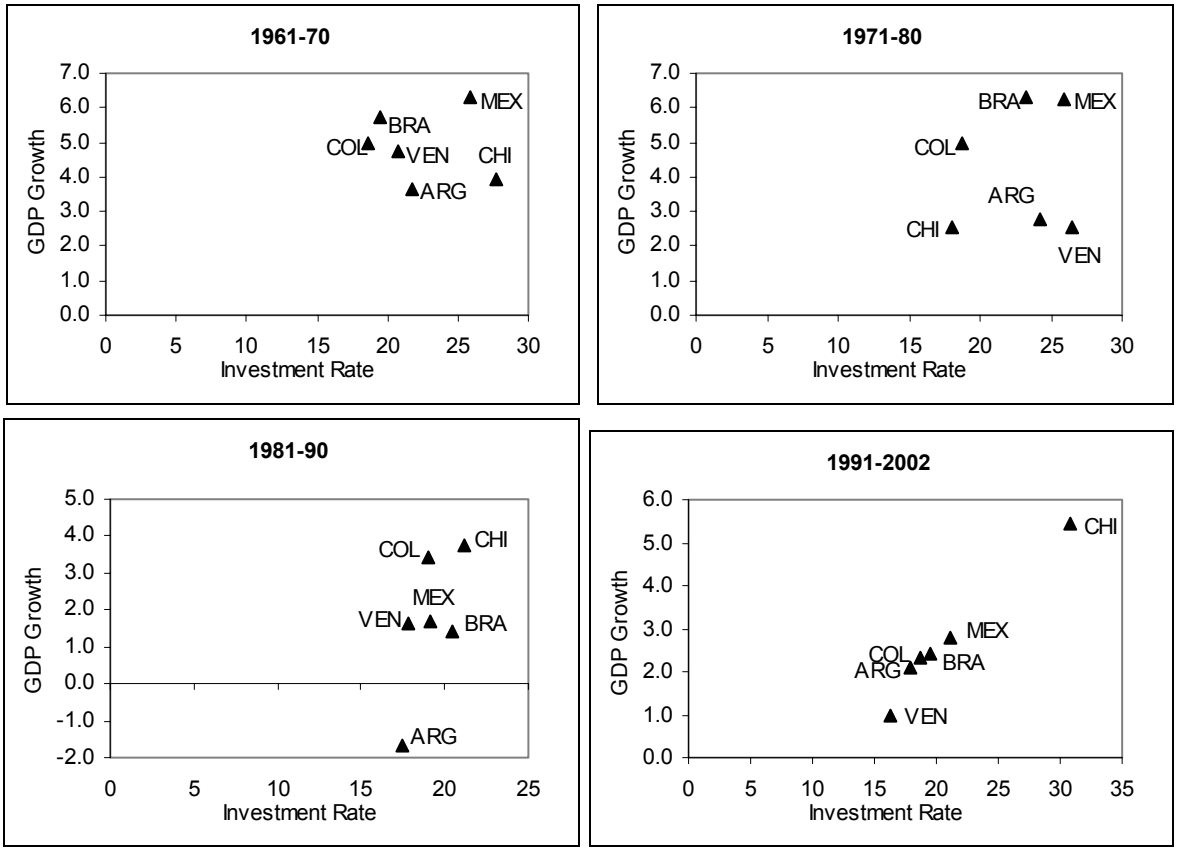
(2)The stability of the equations containing investment on per capita GDP growth is confirmed half of the twelve Chow Test F values shown for the group of equations 1 through 4. When adding policy related variables the stability of the estimates is confirmed also for half of the six Chow test F values (with a 5% rejection area). Fixed investment showed to be significant in all the equations 1a through 4d. The significance of the policy related variables varied throughout the 1960-2002 period, however (equations 3a through 4e). The Chow structural break test shows structural stability for 1960-90/1991/2002 break and it fails to accept stability including the 1980s as a separate break. We interpret these results as indication that the 1980s deviate from the long-term pattern observed and that this decade constitutes a special case for the drawing of general observations drawn for the whole 1960-2002 period.

(3)Specific observations about the influence of the policy related variables through the period are: (a) inflation appears significant before the 1990s; (b) trade "openness" become significant in the 1990s; (b) external debt appears significant before the 1980 and after the 1980s; (c) government consumption show significance before 1990s; (d) FDI shows significance in the annual equation for the whole period and also before the 1990s; (e) infrastructure also shows significance in the annual equation for the whole period and before the 1990s; and (f) education loses significance after the 1990s.

[15] Per capita GDP growth in the right side of the equations has been computed as the first difference in natural log terms between consecutive periods (ln yt- ln yt-1). Thus, a 3% rate is measured as 0.03. This is relevant for an appropriate interpretation of the estimated coefficients and the derived elasticities.

[16] Serven and Solimano (1992b) also remarked the investment slump during the 1980s and the slow recovery during the early 1990s as a factor contributing to the slow growth recovery after the 1980s.

Figure 3
GDP GROWTH AND TOTAL INVESTMENT RATES
(Constant prices, WDI)



Source: World Development Indicators (WDI), World Bank.

Observation 5: The contribution of Investment in Machinery and Equipment to per capita GDP growth is higher than the contribution from investment in construction structures. Combined with some key policy related variables, inflation, the share of government consumption in GDP, the size of external debt in terms of GDP, and education, per capita GDP growth is better explained overall.

In table 3a we also show OLS regressions for per capita GDP growth on fixed investment separated between machinery and equipment, construction structures, and we included as control variables the same policy related variables that we used for the total investment equation estimates (we also used country fixed effects and corrected for heterocedasticity as needed). This procedure allows us to compare across similar equations the robustness of the estimates. From the results, shown in table 3a, we found that when fixed investment is in the form of machinery and equipment the impact of growth is higher as compared to overall investment (see equations 1 through 4 compared to equations 5 through 11). The regression coefficients of machinery and equipment are higher than those for total fixed investment for equations that included the same additional explanatory variables.

We found that investments in construction structures played a non-significant role as a factor explaining per capita GDP growth when considering the whole 1960-2002 period (see regressions 7,8, and 9 in table 3a). The primary role of machinery investments as a source of growth has been supported by the empirical evidence provided by De Long and Summers (1991 and 1993). The social returns of machinery investments are higher than investments in construction structures because machinery (and equipment) investments embody new technologies that are more

dynamically updated and spread through different activities and sectors. Construction structures last longer and the direct and indirect impact on production processes is subject to higher inflexibility than machinery and equipment. In addition, imported machinery provides an effective vehicle to acquire modern technologies.

When combined with other key policy related variables the explanatory power of the estimated equations increased. The policy variables that showed to matter the most when combined with machinery and equipment in the long-run equation benchmarks were inflation and government consumption (see equations 9, 10, and 11). The significance of education declined when combined with machinery and equipment, however. As new machinery and equipment is combined with upgraded labor, the impact of education could be captured by machinery and equipment investment.

The effect of machinery and equipment and construction structures has varied across time, however.

(1) Investments in machinery and equipment showed to be very significant as a factor explaining per capita GDP growth in all the sub-periods considered along 1960-2002 (see equations 4a through 11e). The sizes of the coefficients of machinery and equipment rise in the 1980s and thereafter as compared to the previous years. The growth slump of the 1980s was reflected in lower shares of machinery and equipment investments (see figure 4 and Appendix table B2). The shares of machinery and equipment (as percent of GDP) recovered after the 1980s to about the levels observed in the 1960s and 1970s triggering also a recovery of per capita GDP, though at a pace below the 1960s and 1970s. Mexico led the countries with higher shares of machinery and equipment in the 1960s, and Brazil and Venezuela led in the 1970s, likely reflecting the more advanced stage of import substitution of reached in these countries.

    The shares of machinery and equipment in GDP shrank across countries in the 1980s except in the case of Chile which managed to increase the share of machinery and equipment investment. Chile also led the six countries in terms of machinery and equipment investments (in terms of GDP) in the 1980s and 1990s (including the early 2000s). Despite the modest recovery after the 1980s, machinery and equipment were more effective as a factor contributing to growth (as indicated by the increase in the size of the coefficients observed in equations 4d, 6d, 7d, 8d, 9d, 10d, and 11d, compared to the estimates for other sub-periods). It is likely that under the new outward looking development model the trade reforms and associated trade liberalization increased the productivity of machinery and equipment through new technologies acquired through imports.

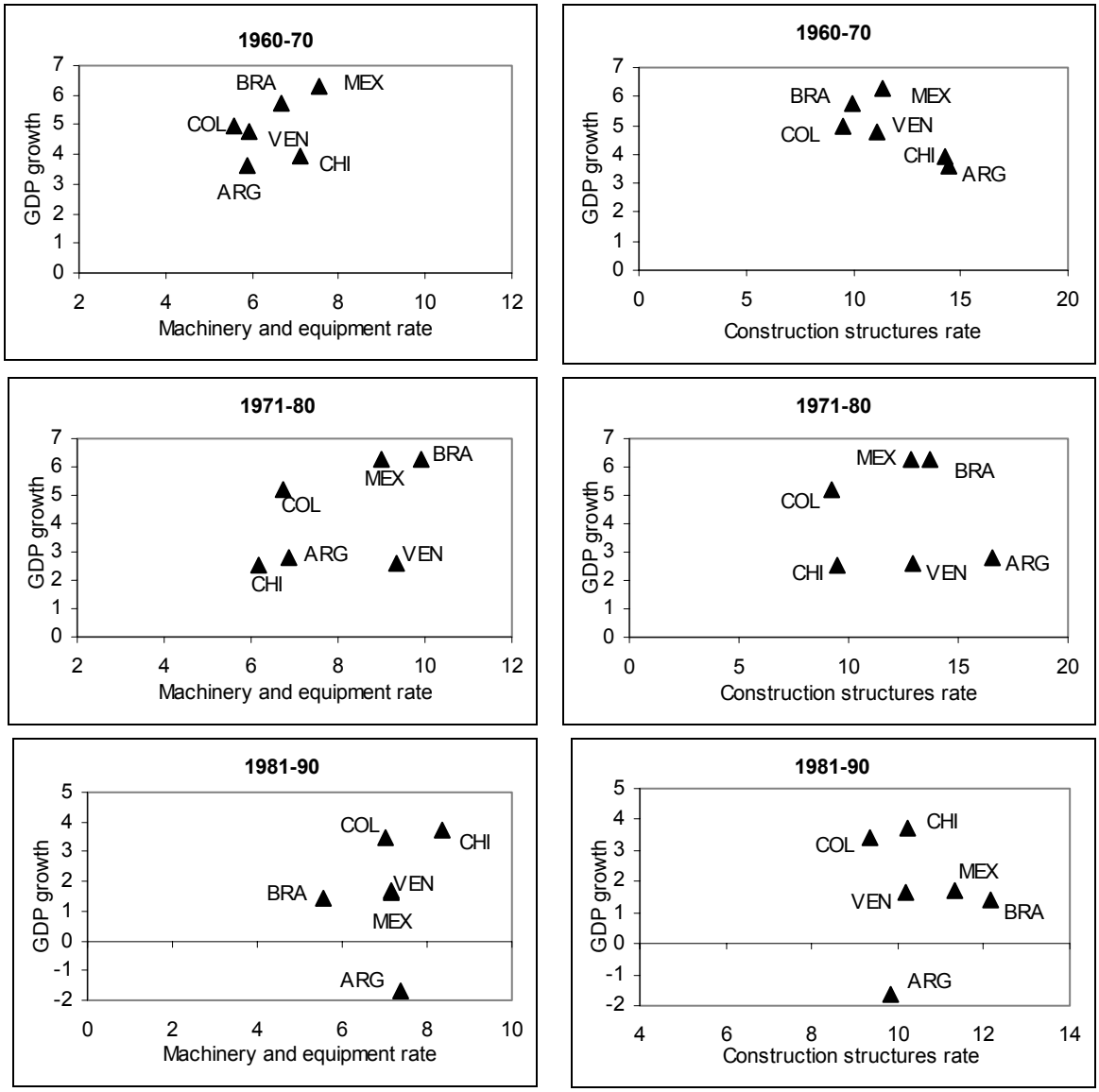
(2) Although, investment in construction structures showed little significance (t-values) as a factor contributing to per capita GDP growth during 1960-2002, a slightly positive impact appeared to develop after the 1980s (see equations 8d, 9d, and 10d). However, the shares of investment in construction structures in GDP on average moved only slightly higher after the 1980s while per capita GDP moved from negative growth rates to positive growth rates. In other words, construction structures did not play a leading role as a growth factor either in the 1980s or in 1990s (and early 2000s), though in the latter the social return of investment in construction structures as measured by the equation coefficients increased (see also figure 4). It is likely that the increase return of construction structures emerged in part as a result of the reduced role of subsidized housing constructions during the period of outward orientation and more reduced role of state participation.

(3) Specific observations about the influence of the policy related variables are in general similar to the equations for total fixed investment: (a) inflation loses significance after the 1980s; (b) trade "openness" become significant in the 1990s; (b) external debt appears significant before the 1980s and after the 1990s; (c) government consumption show significance before the 1990s; (d) FDI shows significance in the annual equation for the whole period and before the 1990s; (e) infrastructure shows significance in the annual equation for the whole period and before the 1990s; and (f) education shows significance before the 1990s. The replacement of total fixed investment by machinery and equipment investment changed somewhat the relative relevance of the different policy related variables but the overall lung-run trends and structural qualifications remain almost the same.

Figure 4

GDP GROWTH, MACHINERY AND EQUIPMENT, AND CONSTRUCTION RATES

(Constant prices, WDI)



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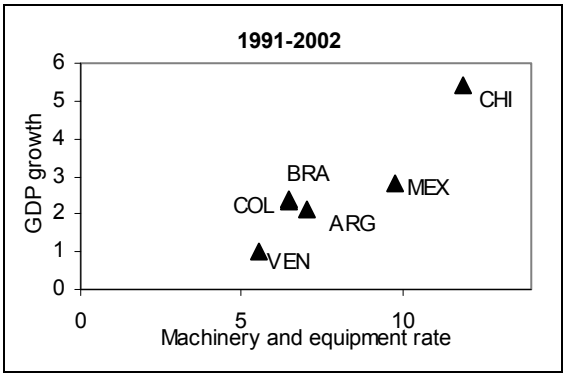
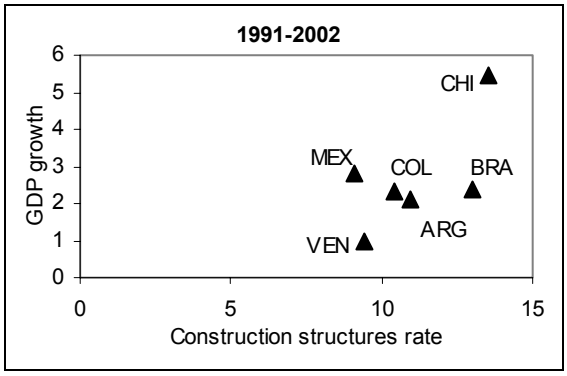




Source: World Development Indicators (WDI), World Bank.

Observation 6: Human Capital as measured by secondary education appeared to be a key factor contributing to productivity growth, but lost significance after the 1980s.

Education appeared as a significative variable in most of the long-run equations that contained total fixed investment or machinery and equipment plus other key policy related variables. In three of the five equations in which education was included its coefficient was significative at least at the 10% level (see equations 3, 4, 9, and 11 in table 3a). The effect of education on growth loses some significance when ruining with machinery and equipment investment instead of total investment (equation 10 compared to equation 3). As newer machinery and equipment requires increased training skills, part of the education effect could be being captured by investments in machinery and equipment. This is, however, and hypothesis that would require further testing the educational requirements associated to the different types and vintages of machinery and equipment.

The three countries with the lowest secondary enrollment ratios in 2001 were Venezuela (66%), Colombia (70%) and Mexico (73%). The other three countries had ratios above 80%: Chile (85%), Argentina (97%) and Brazil (100%). Although the largest potential for additional growth by raising secondary enrollment is stronger for the three countries having the lowest secondary enrolment ratios (Colombia, Mexico, and Venezuela), the potential impact of education applies to all countries as well if we interpret the indicator of education as a proxy for a broader measure of human capital. Data on education (WDI, 2002and Barro and Lee, 2003) provide indicators of education with a span of five years only and the data is not adjusted for quality, however. The quality component should add strength to the educational stock and therefore to the impact on growth, which becomes evident from the increasing demand for new skills to innovate in more efficient and competitive production processes and for adopting newer technologies incorporated in new machinery and equipment.[17]

Observations about the stability of the relationship between education and per capita GDP growth during 1960-2002 are also relevant. We have found evidence showing that secondary education was an important factor contributing to per capita GDP growth during the 1960s and 1970s but its role gradually lost force in the 1980s and further in the 1990s and 2000s (equations 3a through 3e; 4a through 4e; 9a through 9e; 10a through 10e; and 11a through 11e):

[17] We use the data on gross enrollments in secondary education from the WDI 2004, measured as the ratios of total secondary school enrollment to the population of secondary age group. See also Appendix A for description of variables and sources. Series measuring the quality of secondary education should add insights to the impact of education on growth. This is a line of statistical development that would enrich future research on economic growth.

(1) Education appeared to be more significant in explaining per capita GDP growth in the 1960s and 1970s (see equations 3b, 4b, 9b, 10b, and 11b). In the 1980s education appeared significant in the equations that included the most significant policy related variables: inflation and government consumption (these are the two variables that showed high significance in most of the equations in table 3b). When adding other policy related variables (in addition to inflation and government consumption) education loses significance in the 1980s (see equations 3c and 10c). This period was subject to many disturbances, however, induced by debt restructuring and adjustment programs, which make it difficult to interpret the declining significance of education during the 1980s.

(2) What appeared interesting in the estimates, however, was the lost of significance of education as an explanatory variable during 1991-2002 (see equations 3d, 4d, 9d, 10d, and 11d). To some extent the modernization of investment, especially of machinery and equipment, could be capturing the use of additional educational skills, but most importantly, it may be reflecting the declining role of secondary enrollments as they reaches near the 100% of the population of secondary age. Our education variable measures the ratio of secondary enrollment (ration to the population of secondary age). As most of the population of secondary age becomes enrolled the room for additional enrollments narrows. This is telling us that in the 1960s and 1970s the role of increasing the coverage of secondary education was very relevant for economic growth, but that this effect has gradually eroded. This does not mean, however, that education is not longer relevant. It means that other ways of expanding education are becoming increasingly more relevant such as improving on the quality of education and the supply of new forms of human capital formation. The evidence suggests that new impetus should be given to education as a force of growth, that first generation educational policies should be gradually replaced by a second generation of education policies increasingly focus on strengthening the effectiveness educational stock. Quality seems to be at the center of the international experiences with second generation educational policies (the importance given to education in the Asian countries is an example of the second generation type of education).

III. Composition of investment between private and public sector investment

In this section we examine the incidence of the sectoral composition of investment on per capita GDP growth. We disaggregated fixed investment between private and public sector investment and obtained estimates for the role played by private and public investment in the process of economic growth. As for the decomposition of investment between machinery and equipment and construction structures, some previous evidence have also been found regarding the effects of private and public investment on economic growth (see for example: Easterly and Rebelo 1993; Greene and Villanueva, 1991; Khan and Reinhart, 1990, and Schmidt-Hebbel, Serven, and Solimano, 1996a). In the literature seems to be consensus that these two components of investment may have a differential impact on growth depending of the context in which they take place and if public investment becomes a complement or substitute of private investment.

Public investment that complements private investment appears to increase investment productivity and economic growth. Public investment in education and infrastructure show strong complementarities to private investment and have positive effects on economic growth. Public investment may on the other side become a substitute of private investment and reduce aggregate investment returns and economic growth. Public investment may crowd out private investment by using scarce resources and adversely affect growth through the implementation of investment projects of low or negative

social returns. Thus, academics and policy makers have been increasingly aware that it is not only the level of total of investment that matters, but also its composition between private and public investment.

Evidence of the impact of private and public investment on growth has important practical implications. It shows the need to rationalize public investment budgets and allocate public resources to projects that offer the highest social rates of return, seek opportunities for complementarities with private investment, and find room for counter-cyclical investment policies, when the macroeconomic framework permits. The implications for public investment policy are especially relevant for macroeconomic policy also if, as we show below, private investment and growth present mutually causality, opening the possibilities for the creation of virtuous and vicious cycles. In this section we show evidence for our six Latin American countries during the whole 1960-2002 that private investment has had a positive impact on per capita GDP growth, that public investment has had (on average for the whole period and six countries) a non-significant effect on growth, and that the combination of private investment with other key policy variables helps further increase per capita GDP growth. The evidence leads us to draw our next observation regarding the investment-growth process in Latin America during 1960-2002:

Observation 7: The contribution of Private investment to growth has been positive and strong. The contribution of Public investment has not been very significative. Price stability appeared as a leading policy related factor adding to per capita GDP growth.

In table 4a and 4b we show a selected number of OLS estimated equations for per capita GDP growth against private investment, public investment, and a selected set of key policy variables. In table 4a we show our benchmark long-run estimates and in table 4b the estimates used for the structural break analysis. As for regressions in tables 3a and 3b we also used country fixed effects and corrected for heterocedasticity as needed. As in the previous estimates, per capita GDP growth has been approximated by the first differences of the natural logs of per capita GDP. However, for the private-public investment estimates shown in table 4a we used data for the period 1970-2002 at current prices in local currencies and we used 3-year averages (instead of the 1960-2002 period and 5-year averages used in the previous long-run estimates).

Table 4a

GDP PER CAPITA GROWTH DETERMINANTS: PRIVATE AND PUBLIC INVESTMENT

Pool OLS Estimates for Growth of Real GDP per capita
Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela.
Three-year averages: 1970-2002. Number of observations: 62

	(1)	(2)	(3)	(4)	(5)
Private investment (% GDP)	0.0032	0.00417*	0.0042*	0.0038*	0.0036*
	(1.62)	(1.82)	(1.95)	(1.75)	(1.77)
Public investment (% GDP)		0.0024	0.0024	0.0017	0.0022
		(0.92)	(0.91)	(0.63)	(0.88)
Inflation (annual %)			-0.00002***	-0.00002***	-0.00003**
			-2.70	(2.60)	-2.46
Government consumption (% GDP)					-0.0030**
					(-2.28)
External debt (% GDP)				-0.0290	
				(-0.93)	
Per capita GDP (ln of value at	-0.0004***	-0.0004***	-0.0004***	-0.0044***	-0.0005***
each sub-period)	(-3.01)	-3.32	(-3.23)	(-2.94)	(73.46)
R sq	0.24	0.26	0.34	0.36	0.41
F stat	2.44	2.34	2.78	2.62	3.20

Source: World Development Indicators (WDI), World Bank.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***).
Fixed effects; Corrected for Heterocedasticity.

The only available series of investment divided between private and public investment are those compiled by the IFC and the WDI. The series are available for the period 1970 onward and are at current prices only. We found that the data for our six selected Latin American countries were the best of Latin American countries. Data on public investment of other countries did not either cover public enterprises or the series had a short history. We preferred to avoid mixing weak data with good data despite sacrificing the number of observations. Data from United Nations on national accounts contain longer historic series but for the central and general governments only, which exclude the public enterprises.

We reduced the averages of the variables from 5-year to 3-year in order to compensate for the shortage of the estimation period. As for the estimates in tables 3a and 3b we also obtained in this case similar results for the whole 1970-2002 period when using 3-year averages (62 observations) and annual data (178 observations), which help to reinforce the main conclusions contained in Observation 7, and which is based on the benchmark log-run estimates of table 4a. As for our previous observations, due qualifications are drawn from the structural break analysis based on the results shown in table 4b, however.

Table 4b

GDP PER CAPITA GROWTH DETERMINANTS: PRIVATE AND PUBLIC INVESTMENT

Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela

1970-2002 (annual data: 177; 3-year averages: 62)

	(1) 1970-2002 3-year averages	(1a) 1970-2002 annual	(1b) 1970-1980 annual	(1c) 1981-1992 annual	(1d) 1993-2002 annual	(1e) 1981-2002 annual	(1f) 1970-1992 annual
Private investment (% GDP)	0.0032	0.0034***	0.0104***	0.0033	0.0109***	0.0052***	0.0036*
	(1.62)	(2.50)	(3.57)	(0.94)	(5.01)	(2.55)	(1.73)
Per capita GDP (ln of value at	-0.0004***	0.0017**	-0.0014	0.0011	-0.0001	0.0006	0.0018
beginning of each sub-period)	(-3.01)	(1.93)	(-1.01)	(0.64)	(-0.83)	(0.51)	(1.72)
R sq	0.24	0.15	0.37	0.12	0.43	0.18	0.12
F stat	2.44	30.93	25.57	8.59	38.10	26.24	15.55
Chow tests:							
1970-80/1981-92/1993-2002		4.36					
1970-80/1981-2002		3.13					
1970-91/1992-2002		1.58					

	(2) 1970-2002 3-year averages	(2a) 1970-2002 annual	(2b) 1970-1980 annual	(2c) 1981-1992 annual	(2d) 1993-2002 annual	(2e) 1981-2002 annual	(2f) 1970-1992 annual
Private investment (% GDP)	0.00417*	0.0037**	0.0100***	0.0030	0.0139***	0.0047**	0.0035*
	(1.82)	(2.41)	(4.08)	(0.82)	(5.85)	(2.09)	(1.62)
Public investment (% GDP)	0.0024	0.0008	-0.0073*	-0.0033	0.0120**	-0.0011	-0.0006
	(0.92)	(0.48)	(-1.90)	(-0.79)	(2.04)	(-0.38)	(-0.23)
Per capita GDP (ln of value at	-0.0004***	0.0014	-0.0025	0.0013	-0.0028**	0.0005	0.0018*
beginning of each sub-period)	-3.32	(1.63)	(-1.76)	(0.75)	(-2.41)	(0.44)	(1.74)
R sq	0.26	0.15	0.44	0.13	0.51	0.17	0.12
F stat	2.34	14.03	16.69	4.63	23.01	11.36	7.74
Chow tests:							
1970-80/1981-92/1993-2002		4.86					
1970-80/1981-2002		3.10					
1970-91/1992-2002		1.65					

(continued)

	(3) 1970-2002 3-year averages	(3a) 1970-2002 annual	(3b) 1970-1980 annual	(3c) 1981-1992 annual	(3d) 1993-2002 annual	(3e) 1981-2002 annual	(3f) 1970-1992 annual
Private investment (% GDP)	0.0042*	0.0042***	0.0108***	0.0030	0.0138***	0.0046**	0.0044**
	(1.95)	(2.85)	(5.51)	(0.81)	(5.62)	(2.09)	(2.14)
Public investment (% GDP)	0.0024	0.0006	0.0044*	-0.0036	0.0111*	-0.0006	-0.0013
	(0.91)	(0.36)	(1.49)	(-0.89)	(1.74)	(-0.20)	(-0.54)
Inflation (annual %)	-0.00002***	-0.00002***	-0.0003***	-0.00003***	0.00001	-0.00001*	-0.00003***
	-2.70	(-2.52)	(-6.17)	(-3.41)	(1.37)	(-1.83)	(-4.49)
Per capita GDP (ln of value at	-0.0004***	0.0003	-0.0056***	0.0009	-0.0027**	0.0003	0.0002
beginning of each sub-period)	(-3.23)	(0.31)	(-3.58)	(0.52)	(-2.27)	(0.22)	(0.15)
R sq	0.34	0.18	0.73	0.21	0.51	0.19	0.21
F stat	2.78	11.01	28.19	5.15	15.32	(8.72)	(8.94)
Chow tests:							
1970-80/1981-92/1993-2002		5.38					
1970-80/1981-2002		2.99					
1970-91/1992-2002		2.33					

	(4) 1970-2002 3-year averages	(4a) 1970-2002 annual	(4b) 1970-1980 annual	(4c) 1981-1992 annual	(4d) 1993-2002 annual	(4e) 1981-2002 annual	(4f) 1970-1992 annual
Private investment (% GDP)	0.0038*	0.0039**	0.0116***	0.0017	0.0121***	0.0041	0.0050
	(1.75)	(2.66)	(8.64)	(0.40)	(5.41)	(1.60)	(2.36)***
Public investment (% GDP)	0.0017	-0.00009	0.0052*	-0.0042	0.0137**	-0.0005	-0.0032
	(0.63)	(-0.05)	(1.81)	(-1.07)	(2.27)	(-0.19)	(-1.26)
Inflation (annual %)	-0.00002***	-0.00002**	-0.0003***	-0.00003***	0.000008	-0.00002	-0.00003
	(2.60)	(-2.44)	(-8.37)	(-3.62)	(1.29)	(-1.84)*	(-4.21)***
External debt (% GDP)	-0.0290	-0.0414*	-0.0874**	-0.0565	-0.1081**	-0.0168	-0.0667
	(-0.93)	(-1.83)	(-2.45)	(-1.47)	(-2.63)	(-0.63)	(-2.60)***
Per capita GDP (ln of value at	-0.0044***	0.0001	-0.0057***	0.0009	-0.0031**	0.0003	-0.0003
beginning of each sub-period)	(-2.94)	(0.10)	(-4.36)	(0.55)	(-2.80)	(0.24)	-(0.26)
R sq	0.36	0.20	0.76	0.23	0.55	0.19	0.26
F stat	2.62	9.40	24.39	4.38	13.37	6.58	8.81
Chow tests:							
1970-80/1981-92/1993-2002		5.25					
1970-80/1981-2002		2.49					
1970-91/1992-2002		2.80					

(concluded)

	(5) 1970-2002 3-year averages	(5a) 1970-2002 annual	(5b) 1970-1980 annual	(5c) 1981-1992 annual	(5d) 1993-2002 annual	(5e) 1981-2002 annual	(5f) 1970-1992 annual
Private investment (% GDP)	0.0036*	0.0044***	0.0108	0.0049	0.0136***	0.0054***	0.0052***
	(1.77)	(3.13)	(5.32)	(1.27)	(5.34)	(2.51)	(2.62)
Public investment (% GDP)	0.0022	0.0011	0.0051	-0.0007	0.0110	0.0007	-0.0007
	(0.88)	(0.62)	(1.65)	(-0.19)	(1.71)	(0.25)	(-0.27)
Inflation (annual %)	-0.00003**	-0.00002**	-0.0003***	-0.00003**	0.000009	-0.00002*	-0.00003***
	-2.46	(-2.31)	(-6.04)	(-2.44)	(1.30)	-1.80	-4.49
Governm. consumption (%GDP)	-0.0030**	-0.0019*	-0.0028	-0.0033	-0.0005	-0.0020	-0.0020
	(-2.28)	(-1.69)	(-0.96)	(-0.93)	(-0.28)	-1.51	-0.92
External debt (% GDP)							
Per capita GDP (ln of value at	-0.0005***	0.0002	-0.0055***	0.0003	-0.0027**	0.0001	-0.000003
beginning of each sub-period)	(73.46)	(0.22)	(-3.35)	(0.18)	(-2.23)	0.05	0.002
R sq	0.41	0.21	0.73	0.29	0.51	0.23	0.26
F stat	3.20	9.56	20.30	5.20	11.25	7.94	8.01
Chow tests:							
1970-80/1981-92/1993-2002		5.37					
1970-80/1981-2002		2.87					
1970-91/1992-2002		2.32					

Source: World Development Indicators (WDI), World Bank.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***). Fixed effects; Corrected for Heterocedasticity.

Our long-run estimates for the period 1970-2002 shown in table 4a show that private investment was a main driving force of per capita GDP growth, with public investment playing a negligible role. We also found evidence that the inflation was also very significant in explaining per capita GDP growth (see equations 3,4, and 5). The coefficients appeared all significant at the 1% level and improved the explanatory power of the equations when combined with private investment (see the Rsqs. and the F values). We also found that conditional convergence appeared significative in theses estimates (we included in this case as a dependent variable the initial per capita GDP at the beginning of each 3-year sub-period).

These estimates could be interpret as showing evidence of some existing inefficiencies in the management of government finances of the six largest countries of the region when considering the whole 1970-2002 period. The results also help to understand the importance of appropriate economic policies as additional ingredients of the growth processes. Government consumption showed low significance in the long-run equations (but no significance in the sub-periods; see below). External debt was not significative as well as other variables not explicitly shown (openness, FDI, and infrastructure). Education did not show significance in this exercise. Reasons for this result could include: (1) the shorter period used in this case (1970-2002 compared to 1960-2002 in the previous datasets); (2) that private investment maybe capturing some highly correlated impacts from other policy variables; and (3) that progress on increasing the ratio of secondary enrollments increasingly eroded through the 1960-2002 as the ratios were getting closer to 100% (some evidence of this was shown earlier).

The countries that have promoted private investment and have reinforced price stability, reducing the associated vulnerabilities and uncertainties caused by high inflation, have enjoyed faster per capita GDP growth. Chile, Colombia, and Mexico have performed better while Argentina and Venezuela on the other side have suffered from stronger price instabilities during 1970-2002,

discouraging both private investment and economic growth. Price instabilities increase the exposure to vicious cycles and reduce the leverage for counter-cyclical fiscal policies.

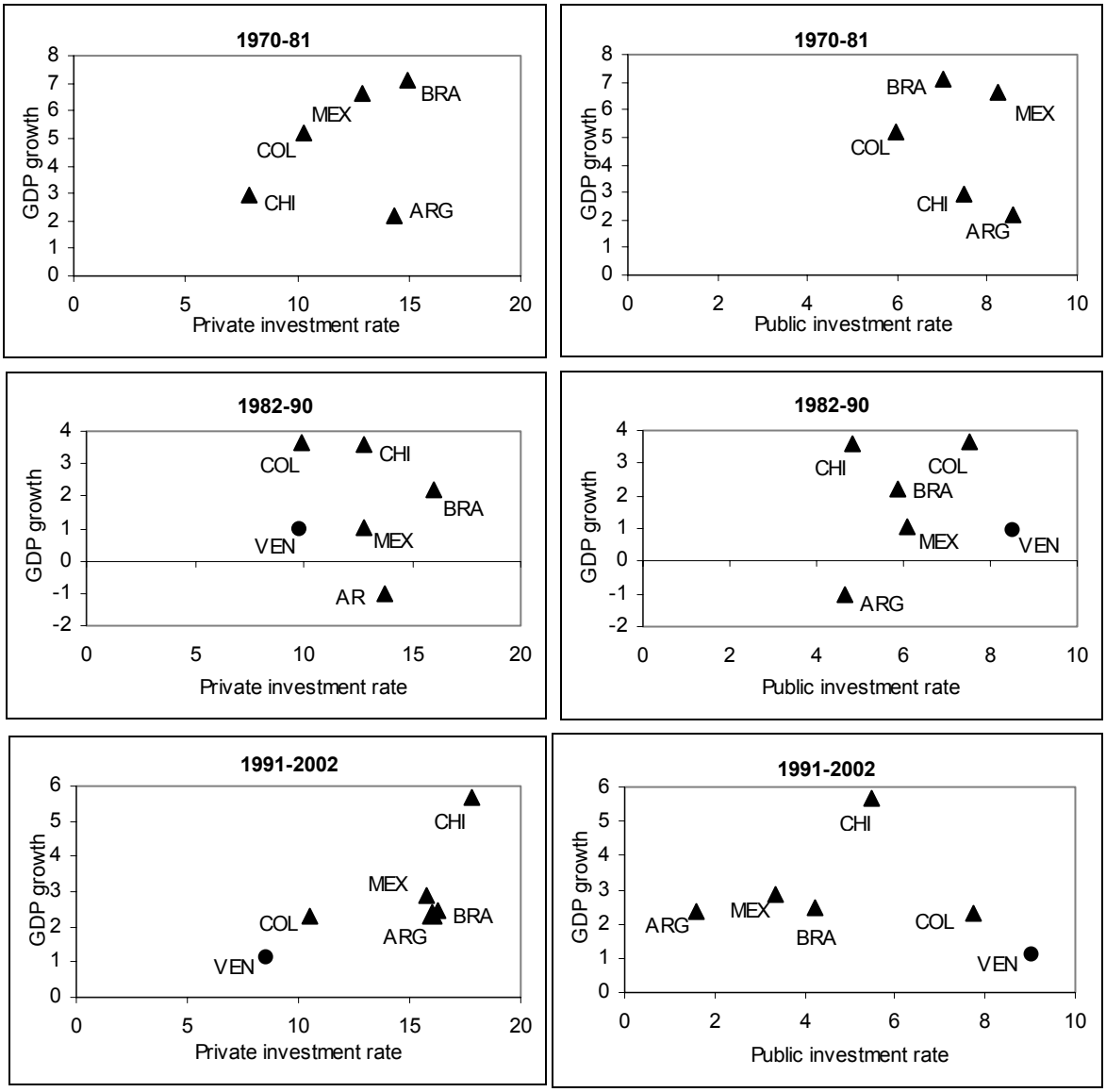
Some qualifications regarding the stability of our long-run estimates are the following (see table 4b):

(1) The structural tests show stability of the estimates when breaking the period into 1970-80/1981-2002 and 1970-91/1992-2002, but not when including the 1980s as a separate break (see last rows of equations 1a, 2a, 3a, 4a, and 5a). As for the estimates for total investment and the composition of investment between machinery and equipment and construction structures, the 1980s appeared to be "different" as compared to the global period and rest of sub-periods. This should not be strange given the series of domestic and external shocks suffered by Latin American countries in the 1980s. In particular, the spread of debt restructurings, stabilization, and reforms combined with lack of external financing and negative per capita GDP growth made that period significantly different to the others. The estimates show that in the 1980s neither private nor public investment seemed were leading factors contributing to the decline of per capita GDP growth. Inflation showed to be the main explanatory variable of growth performance in the 1980s. The results seem consistent with previous estimates and also considering that Latin American countries entered a phase of strong monetary adjustment to cut inflationary expectations and re-establish domestic equilibrium. Stabilization was assigned priority in the 19980s while structural reforms acquired an increasing role during the 1990s. After the 1980s, we observe higher shares of private investment in GDP along with a recovery of economic growth, though economic growth in the 1990s was on average below the rates observed in the 1970s, except for the case of Chile (see figure 5 and Appendix table B3).

(2) In the case of public investment, we observe some dissimilar incidence within the 1970-2002 period. The contribution of public investment to per capita GDP growth acquired significance only in the 1990s. In the 1970s and 1980s public investment appeared not significative. It is likely the fiscal reforms and rationalization of public budgets in the second half of the 1980s and first half of the 1990s strengthened the complementarities between public and private investment and, thus, its significance as a factor contributing to per capita GDP growth. We also observe in the 1990s an increasing dispersion in the shares of public investment across the six countries (see figure 5). Colombia and Venezuela reported the highest shares of public investment in GDP but also performed the poorest in terms of economic growth. Chile' economic growth was the highest with an average share of public investment in GDP near 6 percent, more that 2 percentage points below that of Colombia and 4 percentage points below that of Venezuela. This tells us that the contribution of public investment to economic growth is more country specific and that aggregate conclusions could be misleading. In the case of Chile public investment did not appear to have been a major constraint on economic growth.

(3) Some specific observations about the influence of the policy related variables emerge from the structural analysis: (a) inflation loses significance after the 1980s; (b) government consumption did not show significance in any of the sub-periods used for the structural tests; (c) external debt appears significant before the 1980s and after the 1990s. the non-significance of government consumption when combined with private investment help to strengthen the evidence of the reduced direct role of the government in contributing to per capita GDP growth, though country specific exceptions could also apply.

Figure 5
GDP GROWTH AND PRIVATE AND PUBLIC INVESTMENT RATES
(Current prices)



Source: World Development Indicators (WDI), World Bank.

Observation 8: Private Investment and economic growth show mutual causality, inducing virtuous and vicious cycles between private investment and economic growth.

Table 5a shows a series of estimates for private investment rate (% of GDP; based on data at current prices) during 1970-2002. We follow the same statistical approach applied in the previous estimates (panel OLS estimations with fixed country effects). From the larger set of equation trials we selected the best five equations (in terms of explanatory powers and economic and statistical significances of the control variables). In table 5b we show the annual estimates for the whole period and the sub-periods used to qualify the long run estimates. Similar results are obtained for the annual equation and the equations using the 3-year averages for the whole 1970-2002 period (our benchmark long-run equation) (178 and 62 observations, respectively, reinforcing the conclusion stated as Observation 8. Some additional results are provided from the structural break analysis based on the estimates shown in table 5b.

Table 5a

PRIVATE INVESTMENT DETERMINANTS

Pool OLS Estimates for Growth of Real GDP per capita
Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela
Three-year averages: 1970-2002. Number of observations: 62

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Public investment rate (% GDP)	-0.2363*	-0.2330**	-0.2035				
	(-1.83)	(-2.14)	(-1.52)				
Per capita GDP growth (%)		26.43***	34.04***	26.50***	35.42***		
		(3.07)	(3.31)	(3.044)	(3.70)		
Foreign direct investment (% GDP)	0.9010***	0.9608***		1.0758***		1.014***	
	(4.29)	(5.71)		(6.79)		(4.94)	
Infrastr. (telephone lines per capita)			2.5217***		2.8867***		2.2830***
			(3.49)		(4.88)		(3.61)
R sq	0.65	0.71	0.67	0.71	0.67	0.65	0.57
F stat	14.05	16.26	13.11	19.02	15.80	17.01	12.23

Source: World Development Indicators (WDI), World Bank.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***). Fixed effects; Corrected for Heterocedasticity.

Table 5b

PRIVATE INVESTMENT DETERMINANTS

Sample: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela
Annual data: 1970-2002 against: 1970-80; 1981-1992; and 1993-2002

	(1) 1970-2002 3-year averages	(1a) 1970-2002 annual	(1b) 1970-1980 annual	(1c) 1981-1992 annual	(1d) 1993-2002 annual	(1e) 1981-2002 annual	(1f) 1970-1992 annual
Public investment rate (% GDP)	-0.2363*	-0.2993***	-0.2265	-0.1171	-0.6502*	-0.2855***	-0.2354**
	(-1.83)	(-3.55)	(-1.15)	(-0.92)	(-2.81)	(-2.59)	(-2.19)
Foreign direct investment (% GDP)	0.9010***	0.6275***	0.2312	0.3598	-0.0643	0.3362**	0.8300***
	(4.29)	(4.19)	(0.28)	(0.74)	(-0.53)	(2.23)	(2.55)
Infrastr. (telephone lines per capita)							
R sq	0.65	0.51	0.65	0.50	0.77	0.57	0.50
F stat	14.05	177.06	90.15	60.86	154.43	152.21	114.07
Chow tests:							
1970-80/1981-92/1993-2002		9.70					
1970-80/1981-2002		5.17					
1970-92/1993-2002		6.23					

	(2) 1970-2002 3-year averages	(2a) 1970-2002 annual	(2b) 1970-1980 annual	(2c) 1981-1992 annual	(2d) 1993-2002 annual	(2e) 1981-2002 annual	(2f) 1970-1992 annual
Public investment rate (% GDP)	-0.2330**	-0.2856***	-0.0298	-0.0792	-0.7223**	-0.2437***	-0.2254**
	(-2.14)	(-3.72)	(-0.18)	(-0.60)	(-2.85)	(-2.38)	(-2.21)
Per capita GDP growth (%)	26.43***	17.34***	25.13***	8.98	29.81***	16.06***	11.24**
	(3.07)	(3.49)	(3.19)	(1.42)	(4.79)	(2.99)	(2.13)
Foreign direct investment (% GDP)	0.9608***	0.6230***	0.2743	0.2360	0.0081	0.3336***	0.7377***
	(5.71)	(4.66)	(0.42)	(0.46)	(0.09)	(2.48)	(2.38)
Infrastr. (telephone lines per capita)							
R sq	0.71	0.55	0.72	0.52	0.85	0.61	0.52
F stat	16.26	105.36	60.72	32.02	122.87	88.06	62.31
Chow tests:							
1970-80/1981-92/1993-2002		10.32					
1970-80/1981-2002		5.10					
1970-92/1993-2002		5.90					

(continued)

	(3) 1970-2002 3-year averages	(3a) 1970-2002 annual	(3b) 1970-1980 annual	(3c) 1981-1992 annual	(3d) 1993-2002 annual	(3e) 1981-2002 annual	(3f) 1970-1992 annual
Public investment rate (% GDP)	-0.2035	-0.1672**	-0.1293	0.0554	-0.6957***	-0.1249	-0.1803**
	(-1.52)	(-2.20)	(-0.57)	(0.45)	(-3.05)	(-1.20)	(-2.00)
Per capita GDP growth (%)	34.04***	21.39***	23.98***	5.39	24.70***	15.25***	15.72***
	(3.31)	(4.44)	(3.02)	(0.87)	(4.40)	(3.09)	(2.94)
Infrastr. (telephone lines per capita)	2.5217***	2.5421***	1.2122	3.5042***	-2.6842***	2.1942***	2.2310***
	(3.49)	(6.39)	(0.88)	(2.32)	(-2.39)	(3.80)	(3.56)
R sq	0.67	0.59	0.72	0.55	0.86	0.64	0.53
F stat	13.11	122.54	61.18	36.18	139.77	101.23	64.83
Chow tests:							
1970-80/1981-92/1993-2002		9.52					
1970-80/1981-2002		4.69					
1970-92/1993-2002		4.71					

	(4) 1970-2002 3-year averages	(4a) 1970-2002 annual	(4b) 1970-1980 annual	(4c) 1981-1992 annual	(4d) 1993-2002 annual	(4e) 1981-2002 annual	(4f) 1970-1992 annual
Per capita GDP growth (%)	26.50***	18.07***	25.50***	9.34	30.79***	17.81***	11.60**
	(3.044)	(3.64)	(3.46)	1.54	(4.34)	(3.51)	(2.16)
Foreign direct investment (% GDP)	1.0758***	0.7473***	0.3019	0.2063	0.0754	0.4041***	0.8383***
	(6.79)	(5.53)	(0.46)	(0.42)	(0.64)	(3.03)	(2.76)
R sq	0.71	0.55	0.72	0.51	0.80	0.61	0.50
F stat	19.02	209.75	123.93	64.73	200.34	187.88	117.00
Chow tests:							
1970-80/1981-92/1993-2002		11.74					
1970-80/1981-2002		6.76					
1970-92/1993-2002		6.15					

	(5) 1970-2002 3-year averages	(5a) 1970-2002 annual	(5b) 1970-1980 annual	(5c) 1981-1992 annual	(5d) 1993-2002 annual	(5e) 1981-2002 annual	(5f) 1970-1992 annual
Per capita GDP growth (%)	35.42***	23.13***	25.85***	5.40	29.86***	17.33***	16.54***
	(3.70)	(4.79)	(3.47)	(0.87)	(4.07)	(3.59)	(3.04)
Foreign direct investment (% GDP)							
Infrastr. (telephone lines per capita)	2.8867***	2.7964***	0.7591	3.3653***	-0.3993	2.3360***	2.5422***
	(4.88)	(8.32)	(0.74)	(2.32)	(-0.32)	(4.69)	(3.93)
R sq	0.67	0.60	0.72	0.55	0.80	0.65	0.52
F stat	15.8	259.52	123.29	73.37	199.28	221.32	125.20
Chow tests:							
1970-80/1981-92/1993-2002		8.96					
1970-80/1981-2002		5.62					
1970-92/1993-2002		3.70					

	(6) 1970-2002 3-year averages	(6a) 1970-2002 annual	(6b) 1970-1980 annual	(6c) 1981-1992 annual	(6d) 1993-2002 annual	(6e) 1981-2002 annual	(6f) 1970-1992 annual
Foreign direct investment (% GDP)	1.014***	0.7556***	0.4584	0.3225	0.0449	0.4204***	0.9384***
	(4.94)	(4.96)	(0.57)	(0.68)	(0.29)	(2.78)	(2.92)
R sq	0.65	0.50	0.64	0.50	0.71	0.57	0.48
F stat	17.01	28.94	17.63	10.18	20.81	26.07	17.73
Chow tests:							
1970-80/1981-92/1993-2002		10.64					
1970-80/1981-2002		6.53					
1970-92/1993-2002		6.33					

(concluded)

	(7) 1970-2002 3-year averages	(7a) 1970-2002 annual	(7b) 1970-1980 annual	(7c) 1981-1992 annual	(7d) 1993-2002 annual	(7e) 1981-2002 annual	(7f) 1970-1992 annual
Infrastr. (telephone lines per capita)	2.2830***	2.5677***	0.9204	3.8529***	-2.0325	2.4198***	2.2747***
	(3.61)	(6.69)	(0.86)	(2.88)	(-1.47)	(4.35)	(3.39)
R sq	0.57	0.52	0.64	0.54	0.72	0.61	0.47
F stat	12.23	31.65	17.34	12.15	22.19	30.83	17.00
Chow tests:							
1970-80/1981-92/1993-2002		10.75					
1970-80/1981-2002		7.33					
1970-92/1993-2002		4.90					

Source: World Development Indicators (WDI), World Bank.

Note: t-statistics in parenthesis; Asterisks mean: statistical significance at the 10% level (*), 5% level (**), and 1% level (***). Fixed effects; Corrected for Heterocedasticity.

From the results of table 5a we observe that per capita GDP growth appeared as a positive and very significative factor contributing to the private investment rates (at the 1% level) (equations 2 through 5). Combined with Observation 7 the estimates show a mutual causality between private investment and growth, which opens the room for virtuous and vicious cycles. An increase (decline) of private investment induces an acceleration of per capita GDP growth, and an acceleration (decline) of per capita GDP growth induces an increase of private investment. This mutual causality between investment and growth has been addressed in some previous studies.

Serven and Solimano (1992a and 1992b) found a positive correlated cyclical interaction between private investment and growth in the context of the 1980s and early 1990s. They mentioned the possibility of using public investment to attenuate the mutual reinforcing phase of both private investment and economic growth at times of economic contraction, and supporting growth stability factors to stimulate private investment and induce a virtuous cycle of recovery and growth. They remarked that growth recoveries took longer when, in the declining phase of the cycles, public investment was cut excessively and when uncertainty about the policy framework delayed the recovery of growth and private investment. We agree with these findings but we would stress that our evidence showed that public investment was not a key constraint on economic growth and that the use of counter cyclical public investment policies would depend on the existence of an appropriate policy framework.

Our evidence suggests that the "package" of policies matters a lot for economic growth as well as investment (especially policies reinforcing price stability), and that the effectiveness of public investment is crucial. As shown in figure 5 for the case of Venezuela during 1991-2002, high public investment did not guarantee an acceleration of economic growth. In equations 1 through 3 of table 5a, we found a negative correlation between private and public investment for the whole 1970-2002 period, indicating that public investment as crowded out rather than crowding private investment during 1970-2002.

We also found that other key factors contributing to private investment during the whole 1970-2002 were foreign direct investment (FDI) and infrastructure (equations 4 through 7). These results could be implying that government policies that have encouraged privatization sales and concessions have been effective in promoting private investment (and economic growth). The significance of FDI and infrastructure seem inconclusive, however, when adding the structural qualifications (see below).

A further exploration within the whole 1970-2002 period adds relevant qualifications to the "long run" 1970-2002 benchmark estimates:

(1) The structural break tests (Chow tests) show a clear instability in the coefficients obtained in our long run 1970-2002 estimates. In the last columns of table 5b we show the Chow tests for three different breaks (1970-80/1981-92/1993-2002; 1970-80/1981-2002; and 1970-92/1993-2002) under the annual estimates equations corresponding to each set of similar equations. The results conduct in all cases to the rejection of the null hypothesis of stability of the coefficients through 1970-2002. These results could be expected taking into consideration the shorter period considered and the structural changes that have affected both the incentives and the composition of private and public investment. Liberalization of capital flows, privatization, and the rationalization of public budgets have become major structural factors affecting private investment incentives through the 1970-2002 years not only for the whole region but also with different emphasis across countries in the region.

In the 1970s FDI was highly restricted in most Latin American countries and most infrastructure investment was public. This situation gradually changed in the 1980s amid a process of strong fiscal and monetary adjustments. In the 1990s, FDI became gradually welcome in most countries, infrastructure policies relayed increasingly in the participation of the private sector, and public investment was seen increasingly as adopting a role of a complement rather than a substitute for private investment. Progress on privatization and public sector reforms have also varied across countries. Chile and Mexico have been ahead in implementing the reforms affecting capital flows and the public sector. Argentina, Brazil, and Venezuela have remained behind in improving their the public finances.

(2) The instability of the estimates shown in the structural Chow implies that our "long run" observation about the specific form of the mutual causality between private investment and per capita GDP growth appears to hold except for the 1980s.

(3) The estimates in table 5b confirm the negative correlation between public and private investment through the various sub-periods show in table 5b (equations 1a through 3f), implying that public investment has been more a substitute rather than a complement to private investment.

(4) The estimates show that FDI, and infrastructure showed as main forces driving the slump of private investment during 1981-2002 but were not main factors contributing to private investment in the 1970s (see equations 1e, 2e, 3e, 4e, 5e, 6e, and 7e, compared to equations 1b, 2b, 3b, 4b, 5b, 6b, and 7b). The 1970s was still a decade under the previous import substitution model for most countries in Latin America with an important participation of the state in the economy, which is likely to have contributed to make infrastructure investment and FDI less significative in encouraging private investment, though this conclusion is tentative given the instability of the equations through the different breaks. For the 1990s we found a non-siginificative correlation between FDI and private investment (equations 2d, 4d, and 6d). We also found an instable correlation between infrastructure (telephone lines per capita) and private investment, and a negative correlation during the 1990s. (equation 3d, 5d, and 7d).

The interpretation of the results for FDI could lead to the conclusion that FDI did not contributed directly to private investment. It could have contributed indirectly through the attraction of new technologies, though specific research could allow the drawing of more precise conclusions regarding the interactions between FDI and private investment in Latin America**.**

Specific research on this subject is contained for example in the wok of and Lim (2001), Borensztein, de Gregorio, and Lee (1998), Olofsdotter (1998).[18]

The same applies to the association between infrastructure and private investment given the sensitivity of the association.. In a case study about investment and reforms in Latin America Moguillansky and Bielschowsky (2000) provided a detailed structural analysis of the incidence of infrastructure investments on economic growth for eight Latin American countries during 1960-2000. Calderón and Servén also studied the role of infrastructure in Latin America during 1980-2001.[19] Although not included in table 5b a separate estimate of the equation for the private investment rate against per capita GDP growth and our infrastructure proxy for the period 1991-2002 instead of 1993-2002 (i.e an equation of type 5) yielded a strong and positive coefficients for both per capita GDP growth and infrastructure as factors explaining private investment (significative at the 1% level).

[18] Lim provides a survey showing that the literature provides substantial support for positive spillovers from FDI but that there is no consensus on the causality from FDI to economic growth. Borensztein et al, found that the level of human capital helps to determine the ability to adopt foreign technologies and that FDI may crowd out domestic investment. Olofsdotter found evidence showing that the beneficiary effects of FDI depends on institutional capability, which varies across countries.

[19] Moguillansky and Bielschowsky studied eight countries: Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, and Peru. They analyzed the effects of the structural reforms on investment decisions in the 1990s, covering macroeconomic, sectoral and microeconomic aspects and found that weak institutions and regulations have limited the benefits from the privatization of investments in infrastructure (including the concessions). Calderón and Servén show that Latin America lags behind the international norm in terms of infrastructure quantity and quality and that infrastructure investment has fallen in Latin America during, induced by the retrenchment of public investment and the limited response of the private sector. They also remark considerable disparities across countries.

IV. Conclusions

In our research we obtained evidence about the contribution of investment to economic in Latin America during the period 1960-2002 based on a sample of six Latin America countries (Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela), representing the region's aggregate trends. These six countries are the larges of the region and produce about 90% of total Latin America's GDP (WDI, 2004, World Bank). The selection of countries was also guided by the availability and reliability of the data we required. We divided the whole 1960-2002 period into several sub-periods and disaggregated fixed investment by type assets (machinery and equipment, and construction structures), and also by sectoral origin between private and public investment. In Section I, we examined the contribution of physical capital to Latin America's economic growth. In Section II, we examined the contributions of machinery and equipment, and construction structures and in, Section III, the contribution of private and public investment to per capita GDP growth to per capita GDP growth. A shorter period was used in Section III (1970-2002 against 1960-2002) given the availability ad reliability of the data on private and public investment.

The growth accounting exercises of Section I provided evidence of the primary role played by total factor productivity in explaining the difference between fast and slow growth experiences, with physical playing a secondary role on the growth process of the six largest Latin American countries during 1960-2002. Extending the traditional growth accounting approach through the incorporation of additional elements (adjusting physical capital by its rate of utilization,

expressing physical capital in terms of GDP basket units, and decomposing labor between its raw and human capital components) did not change the evidence found in other growth accounting studies regarding the key role played by total factor productivity in driving economic growth. From the evidence we concluded that aggregate fixed investment "per se" did not explain the difference between fast growth countries and slow growth countries and that total factor productivity made the difference. Total factor productivity reflects all types of cost reductions raising the efficiency in the use of production factors, including those induced by the composition of investment and the macroeconomic framework.

In Section II we found that fixed investment was significant in explaining per capita GDP growth during 1960-2002, but that key policy related variables were also main factors contributing to growth, helping to mark the difference between fast and slow growth experiences. We found that main policy related variables contributing to growth were: inflation, trade openness, external debt, the size of the, and education. Inflation, a proxy for price stability, showed the most consistent significance during 1960-2002, however.

We found that machinery and equipment was the main part of fixed investment contributing to per capita GDP growth, with the role of construction structures playing a secondary role. The stability analysis confirmed the significances of total fixed investment and also of machinery and equipment investment as factors contributing to per capita GDP growth. Although, investment in construction structures showed little significance (t-values) as a factor contributing to per capita GDP growth during 1960-2002, a slight positive impact developed after the 1980s.

We also have found that secondary education was an important force contributing to per capita GDP growth during the 1960s and 1970s but its role declined in the 1980s and further in the 1990s and 2000s, as the coverage of secondary education increased. The evidence suggest that education policies should incorporate new forms of expanding the human capital stock, mainly through efforts to improve the quality of all type of education and other training that facilitates a dynamic adoption of new technologies.

In Section III, we examined evidence about the influence of investment on per capita GDP growth from a sectoral perspective, during 1970-2002. We decomposed fixed investment between private and public investment. A shorter period was used in this case given the availability and reliability of the data.. As for the estimates in section II, we obtained estimates for the whole period and supported the conclusions with qualifications drawn from a structural break analysis. We found that the contribution of private investment to growth was positive and strong, that the contribution of public investment was not significative, and that inflation was also the main key variable contributing to per capita GDP growth that showed systematic and consistent significance. We found that public investment was not a key constraint on economic growth. As for the implications drawn from of section II, the structural tests showed the 1980s a "atypical" compared to the rest of the years.

We also found a mutual causality between growth and private investment, which helps to understand the formation of vicious and virtuous cycles in Latin America. A contraction (increase) of private investment induces a reduction (increase) of per capita GDP growth, which in turn, induces a contraction (increase) of private investment. Per capita GDP growth showed consistent significance as a main factor explaining private investment rates during 1970-2002. The evidence also indicates that a pre-condition for the use of active counter cyclical public investment policies would be the prevalence of a stable macroeconomic framework (mainly price stability). Finally, we did not find general conclusive evidence about the incidence of FDI and infrastructure on private investment or growth in Latin America. Specific case by case observations seem required to appreciate the influence of FDI and infrastructure.

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Appendix

Appendix A
Data sources

Variable	Description	Source
GDP	Current and constant prices local currency units	World Development Indicators (WDI). World Bank
Potential GDP	Seven year centered average of GDP at constant prices	WDI and own calculations
GDP Deflator	Index of GDP current prices/GDP constant prices	WDI
Gross fixed capital formation	Current and constant prices	WDI, United Nations Statistical Office
Factor shares	Annual labor and capital shares in national income. Capital shares excludes land and other assets not part of the national accounts concept of fixed capital formation	Economic Commission for Latin America (ECLAC), United Nations Statistical Office
Capital stock	Fixed Capital derived from the series of gross fixed capital formation at constant prices (K) and at current prices (K*)	WDI and own calculations
Labor	Employment series	Eclac, United Nations Statistical Office
GDP growth	lnGDPt-lnGDP-1 (data at constant prices local currency)	WDI
Total investment rates	% of GDP at constant and current prices (data in local currency)	WDI and national sources (data for 2002-2002)
Machinery and equipment, and construction rates.	% of GDP at constant and current prices (data in local currency)	WDI and national sources (data for 2002-2002)
Private and public investment rates.	% of GDP at constant and current prices (data in local currency)	WDI and national sources (data for 2002-2002)
Inflation	% annual change in the consumer price index	WDI
Openness (exports+imports)	% ratio of exports+ imports on GDP	WDI
Government consumption	% share of government consumption on GDP	WDI and N. Loayza database
External debt	% ratio of external debt on GDP, at average market exchange rate.	WDI
Foreign Direct Investment	% ratio of FDI on GDP, at average market exchange rate.	WDI
Infrastr. (ln telephone lines per capita)	Ln of average annual per capita telephone lines	WDI and N. Loayza database
Education (ln ratio second. enroll.)	Ln of the ratio of secondary enrollment calculated over secondary school age group.	WDI and own calculations
Population growth	Annual % rate	WDI

Appendix B

Table B1

GDP GROWTH AND INVESTMENT RATES [a]

Country	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-02
Argentina								
GDP growth	4.0	4.0	3.1	3.0	-2.4	-0.3	6.7	-0.3
GDP per capita growth	2.4	2.5	1.4	1.4	-3.9	-1.6	5.5	-1.2
Investment rate (current LCU)	22.3	22.4	24.1	28.1	20.6	17.0	17.7	16.8
Investment rate (constant LCU)	21.7	21.9	23.3	25.1	18.7	16.2	18.1	17.8
Brazil								
GDP growth	4.6	7.8	10.3	6.7	1.2	2.1	3.2	2.0
GDP per capita growth	1.5	5.0	7.7	4.2	-0.9	0.3	1.6	0.7
Investment rate (current LCU)	19.8	19.7	23.6	22.9	19.2	21.8	20.8	21.0
Investment rate (constant LCU)	19.3	19.7	23.6	22.9	19.2	21.8	21.2	18.4
Chile								
GDP growth	3.7	4.6	-1.1	7.3	1.1	6.8	8.7	3.8
GDP per capita growth	1.2	2.5	-2.8	5.7	-0.4	5.0	7.0	2.5
Investment rate (current LCU)	17.4	18.7	16.8	19.2	14.9	22.8	24.6	24.2
Investment rate (constant LCU)	33.7	21.7	18.5	17.5	18.7	23.7	29.9	31.5
Columbia								
GDP growth	4.7	5.9	5.7	5.4	2.2	4.9	4.1	1.1
GDP per capita growth	1.6	2.9	3.2	3.0	0.1	2.9	2.1	-0.7
Investment rate (current LCU)	18.5	20.2	18.7	18.4	19.8	18.9	21.1	17.1
Investment rate (constant LCU)	18.5	18.9	18.8	18.6	20.2	17.8	20.7	17.2
Mexico								
GDP growth	7.2	6.3	6.3	7.1	2.0	1.7	1.6	4.0
GDP per capita growth	4.0	2.9	3.0	4.3	-0.2	-0.2	-0.2	2.5
Investment rate (current LCU)	18.3	20.3	21.8	24.4	22.4	21.3	21.8	23.2
Investment rate (constant LCU)	24.7	27.2	26.4	26.5	21.0	17.3	20.0	22.0
Venezuela								
GDP growth	6.2	4.0	3.0	2.5	-0.9	2.8	3.5	-0.4
GDP per capita growth	2.4	0.7	-0.5	-0.9	-3.4	0.1	1.2	-2.3
Investment rate (current LCU)	22.7	27.8	31.1	36.5	20.1	19.3	18.7	18.8
Investment rate (constant LCU)	19.5	21.9	23.2	29.9	19.6	15.9	16.2	16.3

Source: World Development Indicators (WDI), World Bank.

[a] Total investment rates: Data correspond to total gross capital formation.

Table B2

MACHINERY AND EQUIPMENT AND CONSTRUCTION SHARES

Percent of GDP

Country	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-02	1961-02
Argentina									
Total Investment	19.94	20.70	22.15	24.72	18.46	15.95	18.23	17.81	19.65
Mach and Equip	5.93	5.82	6.44	7.26	7.62	7.13	7.13	6.99	6.80
Constructions	14.01	14.88	15.70	17.45	10.84	8.81	11.10	10.81	12.85
Brazil									
Total Investment	15.31	17.96	23.52	23.71	18.31	17.17	17.41	19.30	19.09
Mach and Equip	5.96	7.41	10.27	9.53	5.70	5.45	3.33	7.01	7.13
Constructions	9.35	10.55	13.25	14.17	12.62	11.72	14.08	12.29	11.97
Chile									
Total Investment	22.37	20.30	16.26	15.03	15.87	21.24	26.46	24.64	20.48
Mach and Equip	7.16	7.04	5.39	6.96	6.35	10.33	14.85	9.76	8.54
Constructions	15.21	13.26	10.87	8.07	9.52	10.91	11.61	14.88	11.94
Colombia									
Total Investment	14.47	15.74	16.08	15.89	17.24	15.49	18.28	15.82	15.74
Mach and Equip	5.52	5.66	6.50	6.98	7.34	6.66	7.26	5.87	6.31
Constructions	8.95	10.08	9.58	8.91	9.90	8.83	11.02	9.96	9.43
Mexico									
Total Investment	17.50	20.37	21.46	22.25	20.03	16.95	18.58	19.07	19.50
Mach and Equip	6.99	8.12	8.82	9.20	7.71	6.62	9.39	10.00	8.43
Constructions	10.52	12.24	12.63	13.05	12.32	10.32	9.20	9.07	11.07
Venezuela									
Total Investment	16.12	18.02	17.91	26.60	19.03	15.66	16.18	14.12	17.77
Mach and Equip	5.48	6.39	7.23	11.50	8.09	6.24	6.02	5.21	8.27
Constructions	10.64	11.63	10.68	15.11	10.94	9.42	10.15	8.91	9.50

Source: ECLAC/UN Statistical Office, and national Sources (1990-2002).

Notes: Averages of annual shares. Shares are on the basis of data in local currency at constant prices.

Table B3

PRIVATE AND PUBLIC INVESTMENT RATES

Percent of GDP

Country	1970-72	1973-75	1976-78	1979-81	1982-84	1985-87	1988-90	1991-93	1994-96	1997-99	2000-02	1970-2002
Argentina												
Total Investment	20.9	21.1	26.1	23.6	20.9	18.2	16.1	16.8	18.7	19.0	14.0	19.6
Private Investment	12.8	13.4	14.5	16.7	15.4	13.8	12.0	15.2	17.0	17.1	13.1	14.6
Public Investment	8.1	7.7	11.6	6.8	5.4	4.4	4.1	1.6	1.7	1.9	0.9	5.1
Brazil												
Total Investment	19.6	22.9	21.9	23.6	20.6	20.4	24.7	19.9	20.1	19.4	21.0	21.3
Private Investment	13.8	16.3	14.3	15.4	14.5	14.7	18.9	14.6	16.0	16.2	19.1	15.8
Public Investment	5.8	6.6	7.5	8.2	6.1	5.7	5.8	5.3	4.2	3.3	1.9	5.5
Chile												
Total Investment	14.4	14.3	15.0	17.7	12.9	17.8	22.2	22.4	24.0	24.0	22.0	18.8
Private Investment	6.8	4.3	7.9	12.4	7.8	13.6	17.0	16.9	19.2	18.0	16.6	12.8
Public Investment	7.5	10.0	7.1	5.3	5.1	4.2	5.2	5.6	4.8	6.0	5.3	6.0
Colombia												
Total Investment	17.2	15.8	15.3	16.6	18.1	17.0	17.1	16.3	22.4	17.3	14.3	17.2
Private Investment	11.3	10.5	9.4	10.0	9.2	10.1	10.4	9.2	14.7	8.8	6.9	10.2
Public Investment	6.0	5.3	5.9	6.6	8.9	6.9	6.7	7.1	7.7	8.5	7.4	7.0
Mexico												
Total Investment	18.8	20.2	20.6	25.0	19.5	19.1	17.9	19.0	17.8	20.5	19.1	19.8
Private Investment	13.1	12.1	12.5	13.9	11.7	12.9	13.6	15.1	13.9	17.9	16.2	13.9
Public Investment	5.8	8.0	8.1	11.1	7.8	6.2	4.3	3.9	3.9	2.6	2.9	5.9
Venezuela												
Total Investment	na	na	na	na	16.0	19.6	17.9	19.8	16.6	17.9	15.4	17.8
Private Investment	na	na	na	na	10.5	11.4	8.1	8.5	7.4	9.6	9.4	9.2
Public Investment	na	na	na	na	5.5	8.3	9.8	11.3	9.2	8.2	6.0	8.6

Source: World Development Indicators (2004) and International Finance Corporation (IFC) (2001): Trends in Private Investment in Developing Countries: Statistics for 1970-2000 and the Impact on Private Investment of Corruption and the Quality of Public Investment, Discussion Paper 44, Washington DC

Notes: Simple averages of annual shares. Shares are on the basis of data in local currency at current prices.

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