Inter-American Development Bank
Banco Interamericano de Desarrollo
Banco Interamericano de desenvolvimento
Banque interámericaine de développment
AR-P1049

Country Department Southern Cone (CSC)

Non-edited draft

Competitiveness and Growth in Argentina: Appropriability, Misallocation or Disengagement?

BY

Gabriel Sánchez*
Inés Butler*

* IERAL- Fundación Mediterránea

February 2008

Competitiveness and Growth in Argentina: Appropriability, Misallocation or Disengagement?

Gabriel Sánchez and Inés Butler[♣ϕ]

February 11, 2008

[♣] IERAL-Fundación Mediterránea. Corresponding author: Gabriel Sánchez.

[ϕ] We are very grateful to Eliana Miranda, Delfina Cavanagh, Guadalupe González, Joaquín Berro-Madero and Ignacio Fernández-Dussaut for their research assistance and María Laura Alzúa for her most useful advice and suggestions on human capital and econometrics issues. Mauro Alem was a key contributor to the analysis of financial constraints.

1. Introduction

Argentina is an unfortunate example of vanished growth, as its per capita GDP in 2006 was barely 22% bigger than in 1974. During these past three decades it has experienced wild growth swings, switching from short-lived growth acceleration episodes to periods of growth stagnation or even collapse that coalesce into a flat long-run growth and a divergence from world output and productivity growth.

The questions to be answered are:

- Why has Argentina trend growth diverged from world growth rates?
- Why does it fail to sustain growth accelerations and turn them into upward shifts in growth regimes?
- What are the relative roles of capital accumulation and TFP growth for output growth in Argentina both in the medium and short runs?
- What are the most binding constraints to capital accumulation and to the economic activities that enhance productivity growth?

To this end the paper analyzes first the sources of low medium-run growth via a sources-of-growth analysis. Then it moves on to exploring how Argentina's short-run growth performances compare to the episodes of unsustained and sustained growth accelerations identified by Hausmann, Pritchett and Rodrik (2004), Solimano and Soto (2004), and Jones and Olken (2005). In so doing it uses a sources-of-growth analysis to compare the relative roles of factor accumulation, TFP growth and factor utilization during these episodes with the roles played in the typical sustained and unsustained growth episodes identified by these authors. This analysis reveals that insufficient investment and TFP growth response are also at the root of poor medium- and short-run growth performances. The paper also analyzes the behaviour in Argentina of the variables that these authors identify as companions or triggers of sustained and unsustained accelerations.

The paper continues with the identification of binding constraints to investment and to productivity enhancing activities (structural transformation towards new sophisticated export activities with high potential for technological catch-up; research and innovation; reallocation towards sector with bigger productivity growth). To this end it applies the Growth Diagnostics Methodology (GDM) proposed by Hausmann, Rodrik and Velasco (2005) (HRV), which measures the binding constraints to investment and to productivity enhancing activities via an international and intertemporal comparison of the quantities and the prices of these constraints, both in the short- and medium-runs. The rationale is that low quantities of a given constraint (like financial intermediation) could result either from low supply (in which case it would be a binding constraint) or low demand when investment is hindered by other binding constraints. In

such case, we would be able to tell if it is truly a binding constraint if its price (the real interest rate) were high.

Given that the observation of shadow prices for some of these constraints is not always feasible and/or that in the presence of complementary constraints they may not tell the true scarcity of constraining factor, we expand the HRV analysis to appraise the effect of each constraint on investment or on productivity enhancing activities via: a) sectoral and/or factorial sources-of-growth analysis, b) regression analysis that controls for other potential constraints, and which allows to undertake counterfactual analyses of the alleviation of different constraints, c) model calibration, and d) narrative analytics.

This methodology allows us to identify the most binding constraints on growth, and to classify them into the following types: a) those that bind at all times and that prevent jumping to bigger trend growth, b) those that are currently not binding but would become so if the former were alleviated. We additionally identify constraints to stable growth, the alleviation of which does not necessarily ensure bigger trend growth.

Section 2 discusses the methodological considerations. The anatomy of medium-run growth and of the short-run start-stop growth episodes is analyzed in Section 3. In Section 4 we identify the most binding constraints to investment. Section 5 analyzes the constraints to structural transformation towards new export activities with bigger catch-up potential and more stable foreign demands. The contributions of low research and innovation and of poor international technology diffusion to low TFP growth are evaluated in Section 6, which also identifies the binding constraints on these activities. Section 7 deals with unveiling the binding constraints on resource reallocation towards activities with bigger productivity growth. Section 8 concludes.

2. Methodological considerations

In order to evaluate Argentina's growth in the medium and short runs we perform a time series analysis of the levels and volatility of Argentina's growth rate and compare them to those of other relevant countries. The identification of growth accelerations and possible shifts in growth regimes is done using the metrics proposed by Hausmann, Pritchett and Rodrik (2004), Jones and Olken (2005) and Solimano and Soto (2004).

The appraisal of the relative contributions of factor accumulation and TFP growth to short and medium run growth is done via growth accounting exercises, which are compared to relevant countries.

The identification of the binding constraints to capital accumulation and to productivity enhancing activities is done via the application of the methodology proposed by Hausmann, Rodrik and Velasco (2005) (HRV). These authors propose measuring the quantities and prices of variables that are candidates for potentially binding constraints to investment. The constraint would be binding only if its supply is low and its price is high, revealing a true scarcity. This

methodology allows them to construct a decision tree for analyzing sequentially the different potential constraints to investment, and to choose which ones appear to be costlier in terms of growth. The removal of these most binding constraints would offer the biggest payoffs in terms of kick starting growth.

Figure 1 provides an illustration of the drivers of growth that can be subject to binding constraints: investment and productivity enhancing activities. The later include research and innovation and resource allocation, which comprises structural transformation towards activities with higher productivity and/or that offer bigger opportunities for technological learning (advanced manufacturing, new sophisticated exports, etc.).

Figure 2 illustrates the typical decision tree for investment proposed by HRV. We add to their approach by introducing "traffic light" indicators for different branches. A green light means that the constraint is currently not binding and it is not appraised to become binding the future. A red light indicates that it is a most binding constraint at all times. A yellow light indicates that the constraint is not binding now, but may become binding again in the future. Finally, an orange light indicates a constraint that will become immediately binding if the most binding constraints are alleviated. Figure 2 already advances the results of our research on the binding constraints to investment, which will be justified in the paper.

We expand on HRV by also introducing decision trees for identifying binding constraints to productivity enhancing allocations. Figure 3 illustrates the decision tree for research and innovation, and Figure 4 does the same for resource allocation. The traffic light colors have the same interpretation as before.

Our approach differs from HRV in that these authors appear to focus on the role of investment in a neoclassical growth model with exogenous technical change. We base our analysis instead on a Schumpeterian endogenous growth model, such as the ones proposed by Howitt (2000) and Klenow and Rodríguez-Clare (2004), in which investment in physical capital and in the accumulation of knowledge are distinct, but complementary, decision variables chosen to optimize long-run welfare. Hence there is need to consider separate trees for productivity enhancing activities.

Our methodology for identifying binding constraints starts by performing international and intertemporal comparisons of quantities and shadow prices of variables that are *a priori* deemed to be potential binding constraints. This is a useful and commonsensical approach, which nevertheless faces some important limitations. The first limitation occurs when there are complementary constraints and/or coordination externalities. In this case a required factor may appear as cheap when it is actually scarce, hence escaping its identification as a binding constraint. For instance, the supply of human capital may be low and yet this factor can be cheap because there is little demand for it as there are no modern sector activities. At the same time modern activities fail to emerge because there is not enough human capital. In the same

vein, if physical and human capitals are complementary, then if they are both scarce, their returns may still be low because of the lack of the complementary factor. The second limitation attains in the cases where it is difficult or impossible to measure the shadow prices of certain constraints.

To circumvent these limitations we will complement the HRV approach with econometric analyses of the determinants of investment and of productivity enhancing activities, together with simulations based on econometrically estimated coefficients linking potential binding constraints to investment. We also perform calibrations of existing Schumpeterian growth models based on investment and research and innovation. We undertake factorial and sectoral sources-of-growth analysis as well. This analysis is complemented with narrative analytics based on literature review and case study lessons.

3. Anatomy of medium and short run growth in Argentina

This section analyzes the medium and short-run growth performance of Argentina between 1960 and 2006, the growth fluctuations it has experienced over time, the contributions of factor accumulation and TFP growth to this performance, and the triggers of past growth cycles. This analysis involves a comparison with relevant international and regional comparators, and the identification of possible breaks in relative growth performance.

a. Medium-run growth in Argentina

Argentina shows a very poor medium run growth rate. Current per capita income is only 62% larger than in 1960, and the implied medium run growth rate is 1% per year on average (Figure 5). This poor performance has deteriorated in the past three decades, as real per capita GDP in 2006 was only 21% bigger than in 1974, implying a 0.4% average annual growth rate.

Argentina's medium run growth trajectory shows three distinct phases. The first one goes from 1960 to 1974, when the average growth rate of per worker output was 2.3%. Then there ensued the stagnation phase of 1975-1990, when the growth rate of output per worker was -0.7%. Finally, there came the mediocre growth phase of 1991-present, when the average growth rate of per worker output was 1.5% per year.

This poor growth performance was accompanied by an equally lacklustre TFP growth (see Figure 5).[1] Productivity in 2006 was only 8% bigger than in 1974 and 63% bigger than in 1960. This suggests that there has been a huge productivity slowdown since the mid-1970s.

[1] The TFP we consider in this sub-section is computed as the Solow residual, obtained subtracting capital growth and employment growth from employment growth. The labor share we use is 0.55, following what is used in Argentine national accounts. This is a conservative share. Solimano and Soto (2006) use 0.65, claiming that the shares reported in national accounts in Latin American countries fail to include now-wage compensations in their estimations. We do not adjust for capacity utilization and effective hours worked either. While these adjustments may matter in the short-run, they lose relevance in the medium and long runs. Human capital quality adjustments do not make a significant difference either (they actually make TFP growth even less impressive).

Indeed, current TFP is basically the same as it was back in 1980. The total factor productivity performance broadly accompanied the growth phases of per capita GDP.[2]

The unsatisfactory growth performance of Argentina is even less appealing when compared to international benchmarks. If we take the US as the benchmark for per worker GDP trend growth for 1960-06 (2% yearly growth rate), we observe that Argentina managed to surpass this trend during 1960-74, but had a large relative decline thereafter (see Figure 6a). As a result, Argentina's per worker GDP relative to the US per worker GDP currently is 60% smaller than it was back in 1974 (see Figure 6b). We observe a similar relative behaviour for Argentine TFP relative to the US trend for 1960-2006, that makes current Argentine TFP relative to the US be only 67% of what it was 32 years ago (see Figures 6b and 7). This divergence from world growth and technological change is contrary of what has been observed for most countries (see Klenow and Rodríguez-Clare, 2004).

This relative output decline has occurred vis-à-vis industrialized and developing countries. Table 1 shows that Argentina's per capita GDP in 1960 was 60% that of the US, and much bigger than the per capita GDPs of Japan, East Asia (excluding China), the World and Latin America. By 2006, per capita GDP had fallen to 30% relative to the US, 44% relative to Japan, 53% relative to East Asia, and had also lost very significant relative ground vis-à-vis the World and Latin America. Solimano and Soto (2004) find that the Argentine productivity slowdown since 1975 has been shared by most Latin American economies, save for Chile and the Dominican Republic. Nevertheless, Argentina's slowdown has been more pronounced, as reflected in its relative decline vis-à-vis Latin America.

b. Short run growth and collapse episodes

Within the slowdown period initiated in 1975, we distinguish four short-run growth and collapse episodes:

- The 1982-90 period, when per worker GDP fell at a -0.7% yearly rate.
- The 1991-98 cyclical recovery, when per capita GDP grew at a 3.9% rate (and per worker output at a 4.6% rate), interrupted only by the Tequila crisis of 1995.
- The 1999-2002 collapse phase, when per capita income fell 27%.
- The still ongoing 2003-2007 growth spurt, with per capita GPD growing at 7% average annual rates and per worker GDP growing at a 3% on average (however, in 2006, per capita GDP relative to the US was still 3% smaller than in 1998).

Growth also fluctuated within these short-run growth or decline episodes. Argentina has had 18 years of growth crisis (defined by Solimano and Soto, 2004, as years of negative growth) between 1960 and 2002 (almost one crisis every two years, on average). Fourteen of those crises took place between 1975 and 2002.

[2] TFP showed reasonable growth during 1960-74 (1.6% per year), substantial decline during 1975-1990 (-1.4% per annum), and reasonable growth since 1991 (1.9% per year).

There is an emerging literature on growth cycles that help to put in perspective the growth episodes of Argentina, and why they have failed to reverse the stagnation started in 1975. Hausmann, Pritchett and Rodrik (2004) (HPR), Jones and Olken (2005) (JO) and Solimano and Soto (2004) (SS) define metrics for respectively identifying unsustained and unsustained growth accelerations (HPR), regime shifts towards bigger or lower trend-growth rates (JO), and sustained growth and decline episodes (SS), and apply these metrics to the identification of such events in the world and in Latin America.

We apply the metrics defined by HPR, JO and SS for identifying growth accelerations and regime shifts to appraise the nature of Argentine short-run growth and decline episodes. This analysis reveals that Argentina has managed at times to ignite shortly-lived processes of recovery to potential trend output (as defined by the US trend growth). However, these takeoffs never became regime shifts towards bigger trend growth or sustained growth accelerations. Argentina would appear to be condemned to a slowdown trap that has made it drift farther and farther from the potential trend. The ongoing growth spurt shares some features of the observed growth take-offs, giving hope for a regime shift.

HPR define "growth accelerations" as episodes where growth: a) is bigger than 3.5 ppa during 8 years, b) accelerates on average by 2 ppa or more (relative to the previous 6 or 8 years on average). Additionally, post-growth output has to exceed the pre-episode peak. They also distinguish between sustained and unsustained accelerations. Using the HPR metric, two accelerations can be identified for Argentina: one going from 1963 to 1970, and another spanning between 1990 and 1997 for Argentina. Both were unsustained accelerations. The first episode showed slow growth before and after. The second one was preceded by the 1988-1990 collapse and followed by the collapse of 1999-2002. The current episode started in 2002-2003 appears to match the definition of HPR acceleration.[3] In order to qualify as an HPR acceleration growth would have to remain strong for the next three years. It still remains to be seen if it would qualify as a sustained acceleration.

Jones and Olken (2005) (JO) identify (upward and downward) regime shifts in trend-growth rates between 1960 and 2000.[4] They find that growth within countries is a "start-stop" process, and that regime shifts are a common phenomenon (except only for the richest countries).[5] Using the JO metric, Argentina never underwent a regime change, either up or

[3] Growth has been bigger than 3.5 ppa during the past 4 years and is expected to remain above this threshold at least for the next couple of years. The growth acceleration has been of 8.5 ppa for 2003-2006 (7% growth on average) vis-à-vis 1994-1998 (-1.6% growth on average). The pre-episode peak (in per capita terms) of 1998 is bound to be surpassed in 2007.

[4] To this end they use Bai and Perron (1998, 2003) econometric methodology.Their findings are robust to the use of more simplistic methods, such as calculating the change in growth across consecutive 10 year periods for every year in a country growth's series and defining accelerations as the year in which the growth change is biggest and decelerations as the year in which the growth decrease is greatest.

[5] Up breaks feature large jumps from mild negative growth to high positive growth. For up breaks the mean length of growth regimes is 13 years prior to the break and 17 years after that. Down breaks feature

down. This result is not surprising, as Argentina never experienced a growth acceleration that lasted close to the average 17 years associated to the JO up breaks.

SS define episodes of sustained growth as periods of at least 6 consecutive years with growth rates above 2% each year, and episodes of sustained decline as periods with negative output growth in every year during 5 consecutive years. They find that that there were eight episodes of sustained growth in Latin America during 60-02, and that Argentina is not among them. The current growth spurt initiated in 2003 is likely to qualify as a sustained growth episode, as growth rates bigger than 2% are expected in the next two years.

c. Sources of growth in Argentina

Now we look at the contributions of factor accumulation and TFP to medium-run growth and to growth cycles. To this end we do growth accounting exercises (see footnote 1), which are placed in international perspective.

Medium run

For the medium-run analysis we do not adjust capital and labor for utilization, as the incidence of adjustment washes out over the medium-run. The stylized fact is that the very poor per worker GDP growth between 1960 and 2006 was driven mostly by a very low TFP growth (it accounted for 85% of growth), with a very modest contribution of investment per worker (see Table 2).[6]

Since 1980 there has been a trend decline in capital per worker (see Figure 8), and as a result capital per worker had a negative contribution to growth during the mediocre growth era of 1991-2006, when 120% of per worker growth was explained by TFP.[7] This TFP growth was however relatively small and did not suffice to compensate for the capital shallowing that was observed during this period.[8]

Hence we need to identify the binding constraints to both low investment and to productivity enhancing activities to shed light on what factors hinder medium run growth in Argentina.[9]

Short run growth cycles

---

large declines from high positive growth to mild negative growth. For down breaks the mean regime length is 20 years before and 18 years after.

[6] The contribution of TFP is reduced to 33% of per worker output growth if we introduce growth of human capital per worker to the sources-of-growth analysis. Human capital per worker is calculated using $H = hL = exp(\phi s)L$ where $\phi = 0.085$ are the Mincerian returns to schooling estimated by Patrinos and Psacharopoulos (2002) and s are the years of schooling for the population 25 and older, obtained from Barro and Lee (2000).

[7] Even if we adjust for human capital per worker, TFP growth still explains 89% of all output growth.

[8] When we adjust for human capital per worker, TFP growth during 1991-2006 declines to 1.16% per annum.

[9] Argentina was not alone in this lacklustre investment and TFP performances. Solimano and Soto (2004) find a decline in capital accumulation in 1980-2002 in all LA countries except Chile. They also find that most of the decline in growth in Latin America during that period is associated to declining TFP.

Jones and Olken (2005) (JO) and Solimano and Soto (2004) use a sources-of-growth analysis to appraise the roles of changes in investment and TFP growth during the growth regime shifts that they identify, which helps them describe the typical anatomy of a growth regime shift. We can compare their findings with the contributions of capital accumulation and productivity to output growth during the Argentine growth cycles, in order to understand to which extent the absence of regime shifts towards bigger trend growth has been due to insufficient investment, TFP growth or both.

The main result we obtain is that during the recent growth and collapse episodes, changes in factor utilization have played a leading role, whereas TFP growth and, especially, investment, played a much lesser role than what it was observed in the growth regime transitions identified by JO and the sustained growth episodes analyzed by SS. As such, Argentina's recent growth cycles appear to be fluctuations around a low long-run growth trend driven by changes in factor utilization. It is hence crucial to understand why investment and the factors that lead to bigger TFP growth failed to pick up during the shortly lived growth spurts.

JO evaluate the share of the *change* in growth rates between regimes that is explained by *changes* in the rate of accumulation of capital per worker and the share of that is explained by *changes* in the rate of growth of TFP.[10] They find that in the short run (5 years after the regime shift) increased capital per worker accumulation explains only 7% of the jump in regime growth. The rest (83%) is TFP. Decreased capital per worker accumulation plays a bigger role during declines: 25-30% of the decline in regime growth rates. The (70-75%) rest is TFP.

We replicate JO's analysis for the case of Argentina, concentrating on the 1999-02 decline and on the 2003-06 growth spurt.[11] We find that for the 99-02 to 03-05 "growth shift", the increase in TFP growth explains 46% of the growth acceleration, while the decline in capital per worker accounts for -46% (see Table 3). Increased capital and employment utilization jointly explain 100% of the growth acceleration. This fits only partially the JO pattern of up breaks, suggesting that there is not enough TFP and even less acceleration in investment per worker, and that factor utilization still plays too big a role. When we look at the 94-98 to 99-02 downturn, we find that TFP deceleration accounts for 54% of the growth collapse, while an increased capital per worker explains -7% of the decline. Decreased capital and employment utilization explain 54% of the collapse. This finding does not fit into JO pattern either.

SS use the sources-of-growth analysis to study the contributions of employment, investment and TFP growth to aggregate output growth during their sustained growth episodes. They measure productivity as the Solow residual, without adjusting for factor utilization and for

[10] In their growth accounting analysis they adjust for the use of capital (proxied by electricity use), labor participation, and the human capital of workers.
[11] These are the periods for which we can adjust for factor utilization and human capital improvements.

human capital quality. As such, TFP reflects technical efficiency, factor allocation and quality.[12] They find that during the sustained growth episodes in Latin America, TFP growth explains between 47 and 100% of all the observed growth.[13] Capital and labor explain the rest. On the other hand, TFP collapse is the leading determinant of sustained decline episodes, as capital and labor actually grew during those episodes. The fact that SS include changes in factor utilization in the computation of TFP may bias the results towards a big role of thus measured productivity.

Our findings relative to SS are that during the unsustained growth episode of 1994-98, utilization-adjusted TFP growth explained 38% of the observed growth, while utilization-unadjusted TFP accounted for 44.5% of growth (see Table 4). Bigger capital utilization contributed 36% of the observed growth. During the 2003-05 still ongoing growth episode, utilization-adjusted TFP explains only 15% of the observed growth, while the utilization-unadjusted TFP accounts for 56% of growth. Bigger investment explains only 8% of total growth. Compared to the typical SS sustained growth episodes, the Argentine growth spurts are overly explained by factor utilization, and relatively little by TFP and investment, especially the latter.[14]

Current investment in international perspective

An international comparison of recent investment rates confirms that investment in Argentina has been relatively low (see Table 5).

While we do not have access to international data on the returns to capital, we can approximate them for Argentina as the ratio between business income and the capital stock for recent years. Figure 9 shows that the returns on capital thus computed have been significantly high during the times of economic expansion, and have not been met with a significant jump in the investment rate, suggesting that there are binding constraints to the accumulation of capital.

d. Triggers and accompanying variables of unsustained growth accelerations in Argentina

JO and HPR analyze which are the triggers of the typical growth accelerations and regime shifts (terms of trade shocks, financial liberalization, and economic reform, etc.) and the roles played by accompanying variables (increased trade and manufactures, real exchange rate, etc.). Edwards (2007) econometrically analyzes the determinants of short-run fluctuations

[12] They choose a labor share equal to 0.65, because measured labor compensation in developing countries fails to account for the income of most self-employed and family workers, who make up a large fraction of the labor force. Additionally, a high capital share implies implausibly high rates of return on capital (if capital/output ratio = 2, then $\alpha = 0.5$ implies rate of return equal to 25%! Instead $\alpha = 0.35$ implies rate of return equal to 17.5%).

[13] The median contribution of TFP is 60-75%.

[14] During the 1999-02 downturn, utilization-adjusted TFP explained 33% of the decline, while utilization-unadjusted TFP accounted for 90% of this collapse. The bulk of the collapse fell on lower factor utilization. Decreased employment accounted for 18% of the decline, while capital actually increased (-9% contribution). This fits better with SS story, but it still is the case that the leading force is factor utilization.

around long-run growth, considering the roles of terms of trade (TOT) shocks, current account reversals, and global financial shocks, and the drivers of current account reversals (current account and fiscal deficits, net international investment position, contagion probability, etc.).

We now analyze the behaviour of the triggers and accompanying variables of start-stop growth identified and quantified by HPR, JO and Edwards to shed light on why Argentina's growth spurts failed to become sustained growth accelerations or regime shifts to higher trend growth.

HPR find that sustained growth accelerations appear to be preceded by economic reform and political regime shifts towards democracy, while TOT shocks and financial liberalization only trigger unsustained growth accelerations. They also find that accelerations are correlated with increases in investment, trade and with real exchange rate accelerations. Table 6 presents the behaviour of the HPR triggers and accompanying variables in Argentina for the growth episodes of 1991-1998 and 2003-present, undertaking the same intertemporal comparisons proposed by these authors.

JO find that upward growth regime shifts are usually accompanied by increased trade and reallocation towards advanced manufacturing, which contribute to faster TFP growth, and that neither terms of trade changes nor price stabilization contribute to these shifts. Down breaks feature movements in the opposite direction (except trade), and are usually preceded by bigger price instability. The behaviour of JO accompanying variables during Argentina's recent growth accelerations is shown in Table 7.

Edwards finds that most Latin American economies during the past three decades have experienced wild growth cycles around low trend growth that are caused by the tightening and relief of fiscal and external constraints.

Our comparison of the Argentine growth episodes with those analyzed by these authors suggests that Argentina's growth spurts appear to have been short run fluctuations around a low medium-run trend caused by changes in TOT, global financial shocks and domestic adjustments to fiscal and external imbalances, i.e., that they fit better with the triggers and accompanying variables of Edwards' Latin American cycles and of HPR unsustained accelerations. None of these accelerations displayed the increases in trade and manufacturing that are associated to sustained accelerations and regime shifts.[15]

[15] Table 6 shows, using the HPR metrics, that the 1991-98 unsustained acceleration appears to have been facilitated by a TOT improvement, economic reform and financial liberalization, which more than compensated the relatively sluggish behaviour of investment (it grew less than the HPR 16% benchmark) and the RER appreciation. This growth acceleration reverted once the initial benefits of reform and trade slackened and the decline in savings associated to the RER appreciation became a binding constraint. Table 7 shows, using the JO metric, that during the 1991-1998 acceleration the trade share increased relative to the previous episode much less than the than the average 13pp increase that JO find in the immediate 5 years after the break. There was also a decline in the output share of manufacture. W also encounter that this acceleration was associated to a sharp drop in inflation, suggesting that macroeconomic stabilization had a role in the growth spurt.

The current growth spurt appears to have been triggered by a positive TOT shock and by the increase in public and private savings associated to the big RER depreciation. These alleviations of fiscal and external constraints countervailed the backlash on reform and a partial reversal in financial liberalization. Both trade and investment rose, although less than in a typical HPR acceleration or in JO up breaks. Additionally, there has not been a significant increase in manufacturing output and employment shares.[16] Cross-section regressions using the World Bank Doing Business Data Base 2006 for investment in fixed assets by 1063 firms in Argentina, shows that while more investment appears to be going to the more skill-intensive firms, these investments appear to be negatively correlated with the firms' export shares and not to be correlated with the firms' proportion of sales coming from manufactures (see Table 8).

Hence this episode still fits more into the taxonomy of unsustained accelerations, led by bigger factor utilization, and does not appear to be yet a growth regime shift. The eventual persistence of the currently observed slack on fiscal and external constraints may lead to bigger average growth, but not to bigger trend growth. The big hindrances for shifting to higher trend growth appear to be the low response of investment and, over all, the insufficient increase in trade and relocation towards productivity enhancing activities during the Argentine growth accelerations.

It is thus relevant to consider Argentina's past and current growth cycles using the framework of Edwards (2007). This author finds that growth in most Latin American countries, including Argentina, since 1960 can be described as deviations from a low trend growth, and that the fluctuations are caused by TOT shocks, international financial shocks, sudden stops, and especially by current account reversals.[17]

Edwards also finds that the probability of CA reversals is increased by current account deficits, fiscal deficits, a lower net international investment position relative to GDP, a bigger contagion probability, a negative shock to terms of trade, lagged international interest rates, fixed exchange rates, lower FDI/GDP ratios, easier monetary policy, lower international

[16] Table 6 shows, using the HPR metrics, that the ongoing growth spurt was largely triggered by a positive TOT shock and RER depreciation, and that investment and trade have grown less than the HPR benchmark, whereas there has been a partial reversal to economic reform and financial liberalization. Table 7 shows, using JO metrics, that the current spurt displays very little improvement in trade, a decline in manufacturing labor share, a very small increase in manufacturing output share and an improvement in the TOT and the RER.

[17] Edwards analyzes the determinants of short-run fluctuations around long-run growth by means of an error correction model. The long-run growth rate of each country is estimated using the coefficients obtained in a panel data regression analysis of the determinants of long run growth. He finds that deviations between long-run trend growth and actual growth get eliminated rather quickly (86% in 3 years), but much more slowly in LA. He also finds that a TOT positive shock leads to a short run acceleration of real per capita GDP. Current account reversals cause a 2% reduction in short term growth on average, and to a 3.6% decline in LA. A global financial shock, defined as a deviation of US real interest rates from long term average, leads to a short-run deceleration. The effect is two and half times bigger in LA.

reserves/total external liabilities. Latin American countries, including Argentina, have improved in most of these fronts, reducing the probability of CA reversals and growth cycles.

The data included in Table 9 confirm that Argentina's growth cycles fit well into Edwards' story. The onset of the 1991-1998 episode featured a current account reversal from a large surplus (that financed a big capital outflow) during 1988-1990, together with positive TOT and global financial shocks. The continuing presence of a large current account deficit during this period, together with a worsening fiscal deficit and a fixed exchange rate increased the probability of a new current account reversal, which finally occurred after 1999 in a context of contagion from similar reversals in neighbouring countries and negative global financial shocks. Growth resumed in 2003 after the large fiscal and external adjustments of 2001-2002, when Argentina was also favoured by positive TOT and global financial shocks.

Table 9 also shows that Argentina now combines current account and fiscal surplus, high TOT, flexible exchange rate, and increasing reserves/external liability indicators, which sizably reduce the probability of current account reversal and of new cycles of below trend growth.[18] However, it is not clear by how much avoidance of external and fiscal shocks would increase trend growth via reduced uncertainty and increased appropriability, although average growth will certainly rise.[19] There is the risk that growth stability by itself may not be sustainable if trend growth does not augment significantly, as low real wage growth would generate a continuous demand for social insurance, which may lead to fiscal and external crises.

We conclude that while the identification of possibly binding constraints to growth stability is relevant, it is even more important to identify the binding constraints to bigger trend growth, and that emphasis must be placed on the constraints to both investment and productivity enhancing activities.

4. Identification of the most binding constraints on investment

[18] Consistently with this finding, Chisari et al (2007) show that fiscal and external sustainability in Argentina has improved significantly, which would significantly reduce the probability of new external and fiscal crises.

[19] The avoidance of these negative shocks would help escaping the large accumulated output losses that are reflected in an observed growth that is lower than trend. Edwards estimates that these shocks generate large output losses: a country with trend-growth rate of 1% and 1.3 external crises per decade accumulates a per capita GDP loss of 16% after 25 years vis-à-vis a country with no crises. This means that Argentina (assuming a 1% trend-growth), with 2 crises between 1995 and 2002, may accumulate a 7% output loss over a decade, leading to an average growth rate of 0.26%. If no further crises occur, after 20 years the average growth rate would rise to 0.6%. De Gregorio and Lee (2003) analyze the BOP crises in developing economies since 1990, finding that these crises lead to a V-shaped pattern of adjustment in growth, with a quick return to potential trend growth rate. Most economies drop to the same minimum growth rate at the time of the crisis. The level of trend growth rate thus determines how deep is the short term decline in growth rate and the permanent output loss. They estimate find that the frequent BOP crises in Argentina explain 22% of the difference in average growth rates between Argentina and East Asian countries during 1960-2000, while BOP crises in Latin America account for only 6% of the growth differential relative to East Asian countries.

Figure 3 presents the HRV decision tree for identifying the most binding constraints to investment. We will explore sequentially all the branches of the tree in order to carry out this identification, as discussed in Section 2.

The main results are that the most binding constraints to investment include: a) government failures that lead to low appropriability of private returns to investment, b) coordination and information externalities which, together with an inadequate government intervention, do not allow an optimal exploitation of the opportunities for discovering modern export activities, and c) poor infrastructure. The latent binding constraints are low access to international finance and poor financial intermediation.

There are other constraints which are currently not binding, such as public savings and macroeconomic risks arising from volatility, but which may become binding again in the future as their institutional roots have not been modified. These institutional failures are currently being compensated by the exceptional export prices brought forth by the complementarity of the Argentine economy with the fast growing Asian economies.

We first explore the cost of finance branch, and then we move on the analysis of social returns, and conclude with the evaluation of appropriability issues. We modify slightly the HRV decision tree structure by including the analysis of capabilities and opportunities for structural transformation in the social returns branch. A further digression will be made when we study together the roles of capabilities for structural transformation and of coordination and information externalities, as these are complementary constraints.

4.1. The cost of finance branch

We alter slightly the proposed decision tree structure and first explore how binding a constraint the availability of domestic savings is, then continue with the analysis of the availability of access to international finance, and close the sub-section by appraising the tightness of the financial intermediation constraint.

4.1.1. Domestic savings

The main results of our analysis are that investment currently depends strongly on the availability of domestic savings, and that the latter are currently not a binding constraint to investment, as there is a significant slack between both variables. However, if investment were to overcome other binding constraints and jump up significantly, then domestic savings would become binding, unless the constraint on international finance were relieved.[20] Additionally, the institutional features that are associated with low public savings have not been addressed, leaving open the possibility of a future decline in domestic savings that makes them a binding

[20] For instance, raising the investment rate from the current 21.7% GDP requires raising domestic savings from 24% GDP to 27% GDP. The required increase in savings is bigger because of the increase in the relative price of investment following the 2002 devaluation.

constraint again. Finally, a large share of the currently high public savings is tied to high export prices, distortionary new export taxes and to a devalued currency.

Taylor (1998) shows that investment in Argentina was highly correlated with domestic savings during 1960-1990, and that savings where a highly binding constraint on investment, which was reflected in a high relative price of capital. Table 10 shows that during the 1990s this correlation became much smaller than during the previous three decades, thanks both to Argentina's own financial liberalization and to the increased financial globalization that started in the late 1980s. However, the correlation got back to close to unity since 2003, which was associated to both the Argentine debt crisis and to the large boost to domestic savings experienced since 2002 (see Table 9).[21]

Figure 10 and Table 9 show that Argentina displayed low national savings and investment rates during 1991-2006 on average, and that savings were lower than investment on average too. Low national savings appear to have been a truly binding constraint between 1991 and 2001, when we observed high positive real interest rates and current account deficits together with growing foreign indebtedness, with a growing fiscal deficit explaining a big chunk of this poor savings performance (see Table 9). This constraint was specially binding during 1999-2001 and brought down investment when foreign savings ceased to be available and forced a current account reversal. This appears to have ceased being a binding constraint after 2002, when savings were boosted by a combination of devaluation and debt restructuring, following which the country has had negative real interest rates (for depositors) and low interest rates (for creditors), together with a current account surplus and a fiscal surplus. These national savings have exceeded the desired investment (see Figure 10).

A time series regression analysis of the determinants of aggregate investment and of investment in machinery and equipment (a proxy for private investment) during 1993-2006 is presented in Annex I. Tables AI.1 and AI.2 show that the fiscal result has a positive, robust and significant effect on aggregate investment and on investment in M&E. The effect is most significant when we exclude the user cost of capital from the controls, which is consistent with a crowding out effect of fiscal deficits on investment.

The time series econometric analysis suggests that the combination of devaluation and public debt restructuring generated an increase in savings that facilitated the recovery of investment. A counterfactual analysis using the coefficients estimated in the regression presented in Column V of Table AI.1 reveals that if the fiscal result reverted to its 1993-2001 level, investment would decline from 21.7% GDP in 2006 (at 1993 prices) to 18.5% GDP (see Figure AI.1). In the case of the investment in M&E, the counterfactual effect of the rise in the

[21] Table 9 reports both the simple correlation coefficient and the estimated coefficient of a linear regression of the investment rate on the savings rate.

fiscal result is stronger, increasing the investment rate by 21% (vis-à-vis 16% in the case of aggregate investment) (see Figure AI.3).

Domestic savings were also boosted the terms of trade improvements that took place after 2001.[22] In this vein, our time series regression analysis yields a positive and significant impact of the terms of trade on investment in M&E (see Table AI.2). The terms of trade improvement also had an economically significant effect: a reversal to the 1993-01 average would lower the M&E investment rate by 1 percentage point (12%) (see Figure AI.3).

While not being currently a binding constraint, the future prospects of domestic savings are uncertain. On the one hand, public debt restructuring sizably reduced the future interest burden and financing needs (see Figure 11) which favours future public savings, and the large complementarity with fast growing Asian economies (see Figure 12) introduces the expectation of sustained high export prices. On the other hand, all the institutional features that have generated fiscal crises in the past (lack of checks and balances on the executive branch, and the combination of fiscal decentralization with overrepresentation of smaller jurisdictions, together with large dependence of local governments on central funds and a large autonomy to borrow) remain in place (see Spiller and Tommasi, 2003, and Mody and Schindler, 2004). Hence while public savings are currently supported by new distortionary taxes on financial transactions and on exports, at the same time these institutional failures are facilitating very fast pro-cyclical public spending sprees that may jeopardize future fiscal sustainability.[23] Additionally, the currently high savings rate is also highly dependent on a depreciated real exchange rate (that re-distributes income from worker/consumers to firms/savers and to the government), which is threatened by the underlying fiscal dynamics and institutional failures.

4.1.2. International finance

Our analysis reveals that inadequate access to international finance is currently a non binding constraint on investment, but mostly because of exceptionally high domestic savings together with an investment that is being kept down by other binding constraints.

During the 1990s Argentina had a relatively high correlation between investment and foreign savings, especially during 1999-2001 (see Table 10). Access to foreign savings was not a binding constraint during 1991-1998, when the country was running capital account surpluses (see Table 9). The cost of international finance (proxied by the sovereign country risk) was neither too high nor too low during this period, reaching its minimum value during the second

[22] There are two mechanisms through which external prices may feed into savings. First, the permanent income theory of consumption tells us that positive temporary shocks to the terms of trade would not be consumed, hence leading to bigger savings. Second, the combination of bigger export prices with the introduction of export taxes in 2002 generated a new source of public revenues for the central government which are not shared with the provinces and contribute to more than half of the primary public surplus.
[23] An example of the ongoing fiscal voracity is given by the expected growth in public spending by the central government in 2007, which could reach 40-50% relative to 2006.

half of 1997 (Figures 13a-c). Poor access to foreign finance became a binding constraint during 1999-2001 when capital inflows started to decline and reverted in 2001. The country risk premium stayed high during 1998-2000 and skyrocketed in 2001.

This constraint appears not to be binding at present, which displays declining capital outflows that result more likely from a low demand for international finance than from an increase in its supply. As a result the sovereign country risk has fallen significantly since the 2001-2002 debt crisis (see Table 9 and Figures 13a-c). But it is still the case that this country risk is relatively expensive, as Argentina sovereign bonds face spreads that are bigger than in Brazil and Mexico (see Figure 14). These relatively large spreads reflect the aftermath of the debt restructuring (with $20 billion non-restructured debt with private bondholders and $6 billion outstanding debt with Paris Club members still unsettled) and government policies and regulations that are unfriendly to financial capital inflows.

Additionally, Argentina has always had a very high external debt/export ratio, which made foreign financing relatively expensive (see Table 9). This ratio declined significantly after the foreign debt restructuring in 2004, but is still rather large, which puts a relatively high ceiling to the cost of international finance.

According to the 2007 Banco Central de la República Argentina (BCRA) report on private sector foreign debt, the relative importance of international finance for the private sector in Argentina has been declining steadily since 2002, when compared to GDP and exports (see Figure 15). Current private net external debt represents 0.9% of GDP. Between the end of 2001 and the end of 2006, the stock of net external private debt fell by 40%. The BCRA report reveals that this decline in the relative importance of external debt for the private sector is largely due to a large debt restructuring process that took place mostly in 2004. Argentine firms have been mostly paying back and re-financing their outstanding debts since 2002. During 2006 the Argentine private sector had access to fresh international funds amounting to 7% of their stock of external debt (28% more than in 2005). One fifth of these fresh funds resulted from issuances of corporate bonds to non-residents (twice the 2005 issuances). A large part of these new issuances were applied to pay back outstanding debt in advance, extending the maturity of the private sector debt. Almost half of the 2006 fresh funds were applied to finance imports.

Hence we get evidence that after Argentine firms, after undergoing a process of restructuring and refinancing their external debts, are seeking new international financing. This need to tap foreign financing sources is caused by both the poor domestic financial intermediation and by the recent decline in the availability of internal corporate funds, which are documented in the next section. This foreign financing is still relatively small, and its future

growth can be threatened by the persistence of factors that lead to relatively large country risk premia.[24]

We also observe that FDI has significantly reduced its participation in total investment (see Figure 16a). While part of this relative decline is due to lower FDI flows to Latin America as a whole, Figure 16b shows that Argentina's share in world FDI flows has declined much more than the Latin America's share. As a result Argentina has also reduced its participation in total flows to Latin America (see Figure 16c). This is a potentially binding constraint, as Taylor (1998) has shown that FDI together with international corporate bond equity issuance became the predominant forms of international financing since the 1990s.

Taylor (1998) documents how Argentina's financial autarky between 1910 and 1990 has been one of the largest hindrances to economic growth for this country. This autarky was caused by "unwilling foreign creditors in the 1910s and 1920s, capital controls in the 1930s and 1940s, capital price distortions in the 1950s and 1960s, and wayward monetary policies in the 1970s and 1980s" (Taylor, 1998). This author claimed that the financial liberalization in Argentina in the 1990s together with the financial globalization of that decade was going to help escape from this autarky trap. Argentina's financial liberalization has experienced a backlash since 2002, with the re-introduction of capital controls, the still unsettled debt with private and sovereign creditors and other market unfriendly interventions in financial and goods markets. Hence while international finance may not be temporarily binding in the present, it could become binding again in a not so distant future.

4.1.4. Financial intermediation

Our analysis reveals that Argentine firms are currently financially constrained and as a result have to rely mostly on internal funds to finance their investments. However, this constraint is currently not binding as firms' internal funds since the devaluation appear to have sufficed to finance the desired investment, which has been hampered thus far by other binding constraints. This yields a combination of low financial intermediation together with low interest rates and net interest margins. Nevertheless, if investment were to rise significantly in case other binding constraints were alleviated, then poor financial intermediation would become a binding constraint by itself. This prediction is reinforced by the fact that corporate profits appear to be declining in the past two years.[25]

We start our analysis of the adequacy of financial intermediation for investment by applying the HRV approach of gauging prices and quantities of this potential constraint. From a quantity

[24] We cannot gauge how expensive the new issuances are. The BCRA report only that the stock of interest generating debt has to pay a 7.9% annual interest rate, and that the implicit interest rate over the total stock of the non financial private sector external debt is 5.1%.

[25] Additionally, while we cannot measure this effect, the poor financial intermediation may lead to lower productivity growth as many potentially profitable productivity enhancing activities that lack internal financing possibilities fail to be undertaken.

point of view, financial intermediation in Argentina would appear to be rather poor. Banking credit to the non-financial private sector and stock market capitalization are very low from an international perspective (see Tables 11 and 12). What is more, banking credit to the non-financial private sector is significantly smaller than it was during the 1990s, when it was already low by international standards (see Table 9).

However prices tell a different story. We currently observe very low (even negative) real interest rates and very low interest margins (see Table 9), signalling that access to financing does not appear currently to be a binding constraint to investment, and that the currently very low intermediation results mostly from a low demand for credit. As it was shown in Figure 9, Argentine firms' cash flows between 2003 and 2005 were historically large, helping them self-finance their investment. Instead during the 1990s Argentina faced a rather high cost of credit (large real interest rates and net interest margins), suggesting that this was a binding constraint to growth (and probably that firms' cash flows were relatively small). This was especially true for 1999-2002.

In our time series econometric analysis of the determinants of investment we find an insignificant effect of a bigger stock of credit relative to GDP on aggregate investment and on investment in M&E (see Tables AI.1 and AI.2).

In the regressions of the manufacturing industries panel there is a negative and significant association between financing and investment, which is consistent with the possibility that the large and expensive stock of debt (possibly bigger than the optimal levels of indebtedness) that manufacturing firms had accumulated in the pre-devaluation period generated very large financial costs that prevented the allocation of internal funds to the financing of investment (see Table AI.3). Under this interpretation, the devaluation and pesoification of corporate debts in 2002 (which generated a large decline in the credit/GDP ratio since 2002) may have brought forth a significant financial relief to manufacturing firms, which facilitated the self-financing of their investments in the short run.[26]

The firm level cross-sectional analysis using the WBDB Survey data shows a statistically insignificant correlation between investment and the external financing of both working capital and net fixed assets (Table AI.4).

On the other hand, all our regression analyses have shown a positive and significant effect of current sales and profits on investment, which is usually associated to financial constraints on investment. Hence we test formally for the possible existence of these financial constraints. To this end we run panel data regressions for the determinants of investment in net fixed assets using data from financial statements of public offer firms for 1990-2006. The

[26] Indeed, the corporate finance literature shows that there exist optimal debt levels and that when these levels are surpassed investment may decline, as the returns on investment would end up being used to serve debt rather than paying bigger dividends (see Bebzuck and Garegnani, 2006, and Myers, 1977).

regressors include, in addition to variables related to profit maximization, financial variables such as cash flow or leverage in the investment equation, as proposed in Fazzari, Hubbard and Petersen (1988). Based on Gilchrist and Himmelberg's (1998) set up, and assuming quadratic and persistent adjustment costs as in Love (2000), we obtain an investment equation of the following form:

$$I_{it}/ K_{it} = \beta_1 (I_{it-1}/ K_{it-1}) + \beta_2 MPK_{it} + \beta_3 (FIN_{it-1}/ K_{it-1}) + \beta_4 (LEV_{it}/ K_{it}) + f_i + d_t + \varepsilon_{it}$$

where i denotes the firm; t, the year; I, investment; K, capital stock; MPK, marginal productivity of capital; FIN, a proxy for liquidity; LEV, leverage; f, a firm-specific effect; and d, a time dummy.

The nature of capital markets imperfection can come from various sources, such as information asymmetries, costly monitoring and contract enforcement problems. Thus, in a financially constrained context, the signs of sales/K (proxying MPK) and liquidity in the equation should be positive. The sign for leverage cannot be determined a priori.[27] The proxies used for FIN, as it is standard in the literature, are cash flow or stock of liquidity (current assets minus current liabilities). We also estimate a specification that tests the interaction of MPK, FIN and LEV for different periods and also stratify by firm size to capture whether financial constraints have tightened in recent years and if they are particularly relevant for smaller firms. Macroeconomic and financial development indicators are included among the regressors to control for common shocks in the second and the third specifications. We undertake both fixed effects and GMM estimations. The results are shown in Table 13.

The results confirm the premise that firms in the sample face financing constraints, as the estimated coefficients for both the proxies for business opportunities (MPK) and liquidity (FIN) are significant and positive in each of the alternative model specifications, particularly for smaller firms in terms of assets. Another indication of financial constraints to investment is the statistical relevance of past investment in the GMM equation. The coefficient for leverage is significantly negative under the GMM estimation and under OLS for smaller firms, which is consistent with most of the previous empirical literature, indicating that very indebted firms do not get credit easily (Gallego and Loayza (2000), Devereux and Schiantarelli (1989), among others), or that very indebted firms prefer to invest less, as the resulting profits would end up in creditors hands rather than being distributed as dividends.

It is interesting to note that the coefficient on MPK is augmented in the period 2002-2006 under the GMM estimation, which suggests that firms are indeed facing more stringent financing constraints in the growing environment experienced in the last 5 years. To the

[27] It depends on whether the stock of debt is below or above the optimal level for the firm (see Myers, 1977).

contrary, the estimated coefficient of leverage in the OLS equation indicates that very indebted firms do not face binding constraints to their investment during 2002-2006, probably due to the high profitability and consequently accumulation of cash stocks during these years.

When we stratify the sample by firm size in terms of assets[28], results under both estimation methods point out that the relatively smaller firms seem constrained by insufficient liquidity (cash flows) or over-indebtedness. Larger firms rather seem to face constraints to keep their investment growing at the same rate as sales.

The results thus confirms the findings obtained using HRV's GDM approach, that Argentine firms are financially constrained, and more so in the present, but that they have been able to circumvent these constraints with the larger availability of internal funds. Financing would become even more binding if other currently binding constraints were relieved and firms tried to raise their investments above the current levels and/or if the currently large availability of internal funds were to decline.

4.2.1. Human capital

Human capital is a complementary factor of physical capital. Hence its scarcity would lower the returns to investment and discourage it. We find, using price, quantity and quality measures, as well as regression analysis, that human capital does not appear to be a binding constraint to investment.

When we focus on indicators that proxy for stocks of human capital we observe that Argentina ranks among the top in Latin America in terms of educational attainment (see Table 14). Its tertiary education attainment indicators are similar to those of Ireland and Spain and are close to those of Australia. Argentina also presents good educational quality indicators, as it has a relatively low number of students per teacher (Table 15), and its students score better than most Latin American countries in PISA tests, although these scores are still lower than in relevant OECD comparators (Table 14). We measure the "prices" of human capital as the Mincerian returns to education. Table 16 shows that these returns are lower in Argentina than in most relevant Latin American comparators, save for Uruguay.

Hence based on the HRV approach of measuring prices and quantities, human capital would not appear to be a binding constraint to investment. However, as human capital is a complementary production factor for physical capital, its low price could reflect a low demand arising from insufficient capital rather an actual abundance. To shed further light on this issue, we econometrically analyze the effect of human capital on investment at the firm level using the WBDB Survey.[29] This cross-country regression analysis shows that the coefficient for an inadequately educated labor force is negative, but statistically insignificant (see Table AI.4).

[28] Firms are stratified in two groups divided by the mean of assets in the sample.
[29] The WBDB Survey provides information on the level of obstacle faced by individual firms in finding an adequately educated labor force. This is a discrete variable that ranges from 0 (no obstacle) to 4 (very large obstacle).

Therefore, we find no evidence supporting the possibility that human capital is a binding constraint to investment.

Nevertheless it is still possible that human capital has low returns not because it is abundant, but because there has not been a structural transformation towards more sophisticated export activities that demand bigger skills, as proposed by Hausmann, Hwang and Rodrik (2005).[30]

4.2.2. Infrastructure

Infrastructure includes three main areas: transportation, communications and energy. The returns to private investment will be conditioned by the quality of infrastructure, which has a direct impact on costs of production and transportation, and even on the uncertainty regarding future costs and profits.

Our analysis shows that Argentina currently faces binding constraints to investment in the areas of generation, transportation and distribution of energy. The transportation infrastructure is not adequate either. Instead the telecommunications and information infrastructure, while lagging the developed country standards, is nevertheless ahead of most Latin American countries, although the post-devaluation sluggish investment in this sector is worrisome.

In order to appraise how binding a constraint infrastructure can be, we start by analyzing quantities and "prices" of infrastructure, comparing them both over time and across countries.

Regarding transportation infrastructure, De Ferranti et al (2002), Table 2.1, show that Argentina fares relatively well vis-à-vis other South American countries in terms of indicators such as paved roads per km^2, railroad lines per km^2, port efficiency, telephone mainlines per capita and airfreight per capita. However, South American countries fare very poorly relatively to developed countries and to middle-income European countries (see Table 2.2 in De Ferranti et al, 2002). Additionally, Argentina has significantly less paved roads per km^2 than larger surface industrialized countries such as the US (see Table 17). It does slightly better in terms of railroad lines per km^2, but the use of this transportation mean is not widespread. If we proxy the "price" of transportation by the average international transport costs (proxied by the ratio between CIF and FOB prices that the IMF proposes), De Ferranti et al (2002) show that Argentina's transportation costs are 24% smaller than the South American average, but 77% bigger than in developed countries. While a large part of these high transportation costs can be due to distance (Argentina is the Latin American country that is farthest from major markets), nevertheless its transportation costs are 63% bigger than for Uruguay, which is almost as far from major markets as Argentina, but has much more efficient ports (see De Ferranti et al, 2002). Hence transportation infrastructure appears to be "scarce" in the HRV sense. We

[30] These authors find that human capital is positively associated to their measure of export sophistication.

additionally observe that the investment/amortization ratio of public offer firms in the area of transportation services has fallen from 406% in 1998 to less than 100% since 2003, reaching a minimum 10% in 2006 (see Table 19b), giving further support to the conclusion that transportation infrastructure is currently scarce in Argentina.

As for information and telecommunications infrastructure (telephone mainlines per capita, cellular phone lines per capita, PCs per capita), Argentina does better than the South American average, but is relatively far from developed countries (see Table 18 in this paper, and Tables 2.1, 2.2 and 2.4 in De Ferranti et al, 2002).[31] Table 19 additionally shows that the cost of access to Internet broadband services (our proxy for the "price" of telecommunications infrastructure) is cheaper, or at least as cheap, than in the rest of Latin America. When we plot the different indicators of quantity and prices of ITC infrastructure for different countries, we find that Argentina has indicators that are better or equal than those expected for its level of development (see Figure 17b). Hence telecommunications infrastructure in Argentina appears as relatively abundant vis-à-vis the rest of Latin America, as suggested both by prices and quantities, although relatively scarce relative to developed countries. However, Table 19b shows that the investment/amortization ratio of public offer telecommunications firms has been below 50% since 2003, much less than the 102% observed in 1998, raising concerns about the future availability of an adequate telecommunications infrastructure.

Argentina currently faces bottlenecks both at the levels of production, transportation and distribution of energy (electricity, natural gas, liquid fuels), especially the latter which have generated shortages in the supply of energy to business firms (see Instituto Argentino de la Energía, 2006). Figure 17c illustrates the very large demand rationing for natural gas that occurs during the demand peaks. While prices of energy to manufacturing firms have been rising, Argentina still has policy distorted energy prices, which do not reflect the true scarcity of this factor and which have promoted an overuse of it. In 2004 Argentina had the cheapest electricity of the entire region, even though it has been a frequent importer from Brazil and Paraguay (see Table 20). The price distortion is reflected in the conspicuous decline in the investment/amortization ratio for public offer firms in the energy sector (see Table 19b). This is especially true for the electricity companies, whose investment/amortization ratios fell from 264% in 1998 to less than 75% since 2003.

This distorted price subsidized investment by manufacturing firms between 2003 and 2005, but the discretionary increases in this price for industrial activities since 2006, together with frequent energy rationing, has reverted the subsidy to an implicit tax. As a result, there has been a reversal in the pattern of investment across manufacturing industries. While the industries with more intensive use of energy expanded more its capacity in the 2002-06 period,

[31] Argentina significantly lags Mexico, Costa Rica and Panama in terms of safe Internet servers.

since 2006 this relation has been reversed and the restriction on energy use had become binding and industries that use energy more intensively have expanded less their capacity (see Figure 17).[32] Hence while energy infrastructure was not binding until 2005, it has become a binding constraint since then.[33]

It is difficult to test in a more formal fashion how binding a constraint infrastructure is. Making use of narrative analytics, we can highlight that infrastructure was not a binding constraint during the unsustained acceleration of 1991-98 and did not cause the 1999-2002 growth collapse. Privatizations and massive investments in this area contributed to this. However, it was a binding constraint to growth during the 1980s, when energy shortages were frequent and public utility companies were run by the government, and prices were set in a distortionary fashion using politico-economic criteria and trying to tame inflation (see Givogri, 1990). The evidence presented here suggests that infrastructure has become a binding constraint once more.

4.3. The low appropriability branch: government failures

We now move on to analyze to what extent low appropriability of private returns arising from government failures. We analyze the role of market failures on appropriability later on, when we examine the decision tree for structural transformation.

We focus first on microeconomic risks arising from ill-defined property rights, corruption, high taxes, and big transaction costs, and then consider macroeconomic risks and instability.

4.3.1. Microeconomic risks

Low appropriability may come from explicit taxes on capital and from covert and discretionary taxes on capital through contract violations (default, pesification of debts, price caps, bribery, etc.) that reduce the share of the private returns that are captured by the investor.

Taxation

Economic theory predicts that large corporate income taxes may have a negative effect on investment.[34] Tax volatility is also hurtful for investment, as it signals time inconsistent policies that punish investment after capital has been sunk in the expectation of lower taxes.

---

[32] The investment data in Figure 17 correspond to the implicit variation in installed capacity per industry, computed by comparing changes in production with changes in the use of capacity. The energy consumption data are the coefficients of energy usage by industry obtained from the 1997 Input-Output Tables.

[33] This is reflected in the shortages in the provision of natural gas and electricity to the manufacturing sector during the 2007 winter, which is likely to become recurrent at times of extreme temperatures. For instance, these shortages led to a significant manufacturing production slowdown during July 2007, when output grew only 2.3% y-o-y, much less than in the first half of 2007 (6.4%) and the second half of 2006 (8.8%). This slowdown was biggest for energy-intensive activities such as chemical products and the automobile industry.

[34] This negative effect may be partially compensated by the contribution of taxes to the provision of public goods and to fiscal solvency and sustainability, and through this channel to reduced macroeconomic instability and to bigger national savings and a lower cost of capital.

Table 21 shows that the maximum statutory corporate income tax rate is in an intermediate position relative to other relevant comparing countries.[35] However, effective corporate income tax rates can differ significantly, depending on issues such as the treatment that each country gives to depreciation deductions, valuation of inventories, the sources and cost of financing, and so on. The corporate income tax rates are 35% in Argentina (there are no lower rates for profits that are re-invested, as in Chile), but can reach much higher levels because of the fact that firms are not allowed to adjust their stocks with inflation (the tax rates over actual profits may reach up to 50%). On the other hand, many firms have been able to write off tax obligations with the big losses that they endured during the 2001-2002 crisis. Additionally, export taxes where introduced in 2002, ranging from 5% for manufactures to 40% for the exports of some natural resources. These export taxes have been varying over time in a discretionary fashion for many goods. Moreover, these taxes are set by Presidential decree, without passing through congress. This is just a small sample of how variable and unpredictable the tax burden may be. We hypothesize that tax variability and unpredictability may be particularly harmful for investment in Argentina.

Figure 18 suggests that there is a negative effect of tax volatility (computed as the conditional variance of the forecast error for the tax collection/GDP ratio, using GARCH methods) on investment. Our volatility measure captures the variance of unexpected innovations in the average tax burden, i.e., it proxies for the unforeseen discretionary changes in the average tax rate. A high volatility would signal time inconsistent tax policies that punish the sunken capital. Figure 18 further shows that tax volatility is currently lower than it was during 2002-2005, but is still bigger than it was during most of the 1990s (see Figure 18).

Our time series regressions on the determinants of aggregate investment and of investment in machinery and equipment yield negative, significant and robust effects of the volatility in the tax collection/GDP ratio on investment (see Tables AI.1 and AI.2).[36]

One limitation of this analysis is tax volatility hence measured captures not only discretionary changes in tax rates and the discretionary introduction of new taxes, but also the possibility that tax compliance is pro-cyclical and the possible changes in the tax base that are associated to drastic changes in relative prices. But it should be kept in mind that the largest tax volatility occurred during 2002-2004, even after the effects of the 2002 crisis had subsided, and that it coincided with the introduction in 2002 of export taxes (which have been changed frequently for different goods, and which recurrently represent 10% of total tax collection), financial transaction taxes (that account for 6% of total tax collection), the inability to adjust stocks by inflation, the lack of accommodation of income and wealth tax brackets to inflation,

[35] The second column in Table 21 corresponds in several occasions to the average statutory tax rate.
[36] These regressions instrument current volatility by its twice lagged value, to avoid endogeneity biases in the estimation.

and the creation of new specific taxes on energy usage by industrial firms (the revenues of which are allocated to the financing of public investment in energy infrastructure), among others. Hence the tax burden for business firms became highly unpredictable, and this is captured by our tax volatility measure.

Hence tax volatility appears to have been a binding constraint in recent times (2002-2004), but this constraint seems to have been alleviated in the present. Indeed, the counterfactual analysis also shows that a one standard deviation shock to the tax burden uncertainty would reduce the aggregate investment rate by 1.5 percentage points (7% of current investment) and the rate of investment in M&E by 0.4 percentage points (5% of current investment) (Figures AI.2 and AI.4).

However, the discretionary nature of the policymaking process in Argentina and the lack of checks and balances for the executive branch do not allow us to disregard the possibility of a return to more volatile taxation in the future in response to a weakening of the fiscal result and/or distributive tensions. We discuss this issue at bigger length at the end of this section.

Transaction costs

Large transaction costs can be a hindrance to investment (and possibly to productivity) by diverting scarce managerial and financial resources to dealing with bureaucratic requirements, and also by introducing uncertainty regarding the appropriability of the private returns to investment, as in the case of costly and uncertain contract enforcement. Additionally, high costs of starting or closing a business generate sunk costs that lower investment in the presence of uncertainty.

The World Bank Doing Business Indicators for 2006 show that starting a business in Argentina is costlier than in Brazil, Chile and the OECD countries but cheaper than in Latin America on average (see Table 22). It also takes more time than in Chile and the OECD but less than in Brazil and Latin America, and it involves a bigger number of procedures than elsewhere save Brazil.

On the other hand, in Argentina it is easier and cheaper to close a business than in the rest of Latin America, but it is significantly costlier, money and time-wise, than in the OECD countries. Enforcing contracts is cheaper than in the rest of Latin America, but much more expensive than in the OECD countries.

Finally, paying taxes in Argentina takes a substantially larger share of profits than elsewhere and more procedures than everywhere except for the Latin American average. Additionally, only in Brazil it takes longer to pay taxes.

Hence Argentina appears to be in a relatively favourable position regarding some transaction costs vis-à-vis Latin America, and in a less favourable position regarding others. It compares relatively well with East Asian countries (except in the paying taxes area), but ranks in an unfavourable position vis-à-vis the OECD countries in all these indicators.

Our cross-section regressions for firm level investment based on the WBDB Survey yield negative but statistically insignificant coefficients for most transaction cost indicators (see Table AI.4). They only yield a negative and significant statistical and economic effect on private investment of the share of managerial time that is spent in dealing with government regulations.[37]

Hence transaction costs appear as a nuisance for investment, but not as a binding constraint.

Property rights and corruption

Risks of low appropriability of private profits arising from covert capital taxes may have a large negative impact on investment. Typical examples of current government interventions that lower the appropriability of private returns to investment include price controls that vary highly by industry, region and by use of the goods (final consumption, intermediate inputs, raw materials); discretionary distortive changes in labor market regulations; reneging on contracts in the area of public utilities; large uncertainty regarding the judiciary resolution and associated cost of work-related illnesses and accidents; and the list goes on.[38] Some these risks of low appropriability may be endogenous and associated to macroeconomic instability, but others may arise from poor institutional design and may be binding constraints at all times.

Our analysis reveals that institutional failures that reduce the ability of private firms to appropriate the private returns of their endeavours are a binding constraint to investment in Argentina. This result is supported by the comparison of international indicators of institutional quality and also, although indirectly, by our econometric analyses of: a) the effects of the "regime change" that ensued the abandonment of the Convertibility regime and its associated rules and institutions, and b) the low ability of Argentine firms to pass the investment in intangible assets to a bigger market value, and the negative impact of this low pass-through on their investments in physical assets. Other authors have also found that indicators of institutional quality help explain Argentina's poor long run growth in the context of multi-country panel data regressions. Narrative analytics based on the literature of institutional development of Argentina also lend support to this hypothesis, and suggest that poor institutional design is at the root of both macroeconomic and microeconomic risks.

The application of the HRV GDM that entails measuring quantities (how low is appropriability) and prices (how costly it is in terms of investment) is not easily applicable in this case, as this constraint is mostly intangible and there is not a market for it. We approximate the study of "quantities" by looking at international indicators of institutional quality. These indicators are based on perceived property rights, which may matter more than ex-post property

[37] The average time spent in dealing with regulations is 13.7% of the managerial time. If this time were cut in half, the regressions suggest that investment would be boosted by 6%.

[38] Other discretionary interventions include setting quantitative restrictions on exports of beef, the rationing in the access to energy that had already been purchased by manufacturing firms, bank deposit freezes, and pesoification of foreign denominated assets.

rights for investment purposes. We also approximate the extent of appropriability by measuring the ability that Argentine firms have to pass their investments in intangible assets to a bigger market value.

We start by analyzing the position of Argentina in the Economic Freedom Ranking of the Heritage Foundation (see Table 23). This indicator shows that Argentina currently fares relatively poorly in most indicators, and especially so in the property rights indicator. On the other hand, Argentina performed much better in 1998, suggesting that the inability to raise investment more at that time was associated to other binding constraints. This unfavourable change in ranking is consistent with the contract violations and discretionary changes in policies and institutions during the crisis of 2001-2002 and recent years, which have included price controls, deposit freezes, pesoification of public and private debts with domestic residents, discretionary changes in severance payments, and so on.

The World Bank Governance Indicators show a similar pattern of change over time, with Argentina losing relative ground in all the indicators between 1998 and 2005 (see Table 24). It is additionally interesting to remark that Argentina has always scored very low in two indicators that are usually found to be strong predictors of growth, such as rule-of-law and control of corruption. This would support the view of some authors that argue that low appropriability arising from government failures was a binding constraint to investment even during the 1990s.[39]

We also construct a market based measure of the degree of appropriability of returns to investment in Argentina, which is based on the literature on the market valuation of R&D effort by individual firms (Cockburn and Griliches, 1988; Hall and Oriani, 2004; among others). This exercise and its results are formally explained in Annex II. Here we summarize the intuition and the main results. This literature proposes that a firm's excess market value over the replacement or book value of tangible fixed assets (Tobin's Q) is an increasing function of its investment in R&D and other intangible assets relative to its investment in tangible assets. They formally derive a regression equation that helps estimate the market valuation of a firm's investments in R&D and in other intangible assets. In this framework, a low market valuation signals a low appropriability of the social returns to this investment arising from ill-functioning intellectual property rights and other spillovers. They use data of public offer firms to estimate these valuations in several OECD countries.

In the case of Argentina we do not have separate data for capitalized R&D expenditures and other intangible assets. We only have access to the overall capitalized intangible assets of public

[39] Kydland and Zarazaga (2003) calibrate the neoclassical growth model to replicate the Argentine's growth trajectory and find that the model's predictions for investment in response to the positive productivity shocks observed during the 1990s largely exceed the observed investment rate. They attribute this underperformance of investment to the expectation of future expropriation (which finally occurred in 2002).

offer firms, which include the joint book value of trademarks, licenses, patents, R&D expenditures, advertising, etc. This includes all the "purchases" of intangible goods that are capitalized instead of being written down as expenditures because they are deemed to generate revenues in the future.[40] We cannot tell apart which part corresponds to R&D and which part to other intangible assets. We argue that the market valuation of these intangibles will be lower the bigger is the risk of low appropriability due to both government and market failures. The idea of the exercise is thus to measure the extent to which investment in intangible assets is captured by the investing firm. However, we reckon that our measurement is not able to tell apart which part of the low appropriability is due to poor IPRs and other spillovers and which part is due to government failures. We hence include the exercise to provide a joint measure of low appropriability due to government and market failures.

The exercise involves estimating the following regression equation:

(2) $$\log (q_{it}) = \lambda_t + \mu_i + \delta \log[K_{it}/A_{it}]$$

where q_{it} is firm *i*'s Tobin's Q, A_{it} is tangible capital, K_{it} is intangible capital and δ is its shadow value, λ_t is an overall market index, and μ_i a firm-specific component.[41] Using a panel of public offer firms with yearly data for 1990-2006 we estimate this equation, finding that intangible assets have a positive valuation (see Table AII.1). However, the estimated coefficient (0.014) suggests a small "elasticity" of market valuation to intangible assets. Indeed, estimations made for several EU countries by Hall and Oriani (2004) suggest that elasticities in these countries are in a range of 0.11 to 0.36. Hence appropriability of the returns on investments in intangible assets appears to be small in Argentina. We additionally estimate this elasticity for two sub-periods, 1991-2001 and 2003-2006, finding that that it is bigger and more significant during 1991-2001 than during 2003-2006. What is more, during the latter period these elasticities are not significantly different from zero and have a negative sign (see Table AII.1). This result reveals that appropriability was low before the 2001-2002 macroeconomic crisis, and even lower after that, suggesting that the expropriation shocks after the devaluation have acted as a negative appropriability shock.

Since we do no have data on "prices" of appropriability, we try to measure instead, via econometric analysis, the impact of low appropriability on investment in physical assets. This is a complicated challenge, as we do not have a panel data set that includes both investment by Argentine firms or industries and of the exogenous appropriability shocks or threats of expropriation that these firms face. Hence we rely on more indirect procedures to trace the shades of the effects of expropriation shocks on investment.

[40] Hence they are capitalized and are depreciated annually like the tangible fixed assets.
[41] The Tobin's Q is measured as measured as [(total assets -capital stock) + market capitalization]/total assets.

We start this analysis by noticing that in our time series regression analysis of the determinants of investment we cannot reject the hypothesis of structural break after the first quarter of 2002, which would support the view that there was a regime change for the behaviour of investment. Based on the changes in perceived institutional quality between 1998 and 2005-2006 that are shown in Tables 23 and 24, we tried to approximate the effects of the losses inflicted upon investors by the regime changes in 2002 by introducing a 2003-2006 dummy variable in our time series regressions that proxies for this regime change (see Annex I).[42] This exercise yields a negative, significant and robust coefficient of the 2003-2006 dummy variable (see Tables AI.1 and A1.2). This "change of regime" variable is also very significant in economic terms: holding everything else constant, the investment rate could now be up to 28% bigger than it currently is if the "regime change" had not attained (see Figures AI.1 and AI.3). While this dummy variable could be capturing a lot of different things, its effect is nevertheless consistent with the observed changes in perceived goodness of property rights, rule-of-law and other institutional quality indicators.

We also attempted to shed light on the effect of low appropriability arising from micro risks associated to government failures by running cross-section regressions of firm level investment on different indicators of low appropriability, using data from the WBDB Survey. We estimated negative coefficients for two such indicators: percent of annual sales paid as informal payment, and lack of consistency and predictability of the interpretation of laws and regulations. However, none of these estimated coefficients was statistically significant at standard levels. Hence we do not obtain strong evidence supporting our hypothesis based on this particular data set.

Next we consider the effect on investment that the estimated elasticities of market value to investment in intangible assets, our market based estimation of appropriability of returns, have on the investment in fixed assets by public offer firms (the formal analysis is detailed in Annex II). To this end we estimate how this measure of appropriability varies by economic sector (defined by industry and size), and how differences in appropriability by sector impact on sectoral investment in fixed assets.[43] This approach requires estimating first how appropriability

[42] We do not have enough observations neither for estimating separately the regression equation for both sub-periods nor for introducing interactive terms that capture changes in the coefficients of the different regressors across periods.

[43] The ability to appropriate the returns from investing in entrepreneurial assets differs by industry and/or by size, because of political economy reasons, market structure and technological reasons. These coefficients may differ because of the different mechanisms through which the rents that these assets generate can be effectively protected and appropriated by the firm (Rumelt, 1984; Villalonga, 2004). These mechanisms will include the ability to introduce barriers to entry (technology, scale, branding, patents), to lobby for favourable policies (or the ability to protect the firm from expropriation or unfavourable discretionary policies), or to avoid the diffusion of industrial secrets. As such, matters like legal system, industrial organization, firm size, technological characteristics of each industry and political economy considerations may affect appropriability differently by sector.

varies by sector, which is done by including among the regressors in equation (2) terms that interact $\log[K_{it}/A_{it}]$ with industry dummies and then with size dummies.[44]

$$(3) \qquad \log(q_{it}) = \lambda_t + \mu_i + \delta \log[K_{it}/A_{it}] + \sum_j \gamma_j D_{ij} \log[K_{it}/A_{it}]$$

where $D_{ij} = 1$ if firm i belongs to industry or size j, and zero otherwise.

The resulting estimations show that appropriability indeed differs by sector (see Tables AII.2 and AII.3). Next we construct hedonic measures of Tobin's Q for each public offer firm, which are obtained by fitting equation (3) using the observed intangible to tangible asset ratios for each firm and the sector to which it belongs, and the estimated coefficients.. These hedonic Q measures reflect the pure appropriability component of the market value of the firm, measuring both the ability to capture rents and the size of these rents (for the derivation of this estimation procedure see Villalonga, 2004).

Next we estimate the impact of the hedonic Q on investment at the firm level. To this end we substitute the firm's actual Tobin's Q for the hedonic Q measure in our panel data regressions of the determinants of investment in public offer firms in Annex I.[45] We expect to find positive and significant coefficients for our hedonic Q measures, signalling that the bigger the appropriability, the bigger the investment. We obtain the expected results, i.e., that bigger hedonic Q raise firm level investment, suggesting that appropriability of returns matters significantly for investment in Argentina (see Table AII.4). The result holds for both the hedonic Q's that are based on industry differences and on size differences, although the former have a more significant effect. Hence low appropriability is seen to bring down investment.

These results are interesting, given that if this measure of appropriability reflected only poor IPRs and other spillovers, then it should have an impact only on R&D rather than on investment in fixed assets.[46] The positive effect of this measure of appropriability on the investment in fixed assets suggests that government failures are also contributing to the observed low appropriability, which appears to be acting as a binding constraint on investment.

4.3.1.2 Macroeconomic risk and instability

Uncertainty regarding macroeconomic aggregates (GDP, inflation, real exchange rate, terms of trade, interest rates and the relative price of capital goods) may have a negative impact on investment through a variety of channels:

---

[44] We define size arbitrarily by splitting the panel into small firms (the third part of the panel that contains the smallest firms), large firms (the third part of the panel that contains the largest firms) and medium firms (the rest). If we re-define the small firms as the bottom 50% of the size distribution, medium firms as the 50%-75% interval of this distribution and large firms as the top 25% of the distribution the results do not change significantly.

[45] This analysis, based on Leahy and Whited (1996), included as regressors the firm's Tobin's Q, the volatility of the firm's stock prices (to capture uncertainty), the correlation of own stock volatility with the market volatility (to capture risk) and the firm's sales.

[46] Hall and Oriani (2004) find that capitalized R&D and intangible assets have distinct effects on market valuation (pass-through) in the EU and the US. Hence a low pass-through to market value stands for more than R&D spillovers.

- The irreversibility of investment, which introduces the value of waiting for the resolution of uncertainty about the marginal profitability of investment or the cost of capital before investing (Dixit & Pindick, 1994).
- The combination of uncertainty with credit constraints and asymmetric information (Greenwald & Stiglitz, 1990).
- Risk aversion (Appelbaum & Katz, 1986). The firms with bigger risk aversion will have lower inputs and output and lower investment.[47]

Additionally, large macroeconomic volatility is likelier to lead to bigger probabilities of contract breaches, drastic discretionary policy changes and government intervention in goods and factors markets, and large and variable taxes, i.e., to a lower appropriability of the returns to investment. Finally, it is still an open issue whether macroeconomic and external volatility leads to lower trend growth or to deviations from trend growth. Our analysis of short-run growth cycles favors the latter view.

We find direct evidence that terms-of-trade volatility appears to have been a binding constraint to investment in the past, but that this volatility is currently relatively low and does not seem to be a binding constraint. We did not find direct evidence on the negative impact of other sources of volatility, which was singled out as important for investment by other authors. In any case, most types of macroeconomic volatility are currently low.

However, the lack of institutional reform to address the ultimate politico-economic sources of volatility described in the previous section make it unclear whether macroeconomic volatility has been permanently reduced in Argentina, or if it relies only on a circumstantial agenda set by the current government, together with new distortionary taxes and exceptionally high export prices. Additionally, while Chisari et al (2007) have found that fiscal and external sustainability appear to be currently much bigger than during the 1990s, the continuation of the currently observed politically-driven public spending dynamics (primary spending is expected to grow 40-50% in 2007 vis-à-vis 2006 in nominal terms, and 20-30% in real terms) may offset the public savings generated by sovereign debt restructuring and jeopardize fiscal sustainability. The increasing need to invest in energy infrastructure by the public sector works in the same direction. The good news is that maintaining sustainability is economically feasible, although the political and institutional scope for doing so is less certain.

Hence while volatility and macro risks are currently not binding, it is a latent constraint the institutional roots of which have not yet been alleviated.

[47] One corollary is that risk averse firms will tend to choose projects that offer lower, albeit safer, returns, i.e., that have more certain returns that exceed the certainty equivalent of projects that are riskier but offer bigger returns. This could have a negative impact on investment in M&E.

Following the HRV GDM, we assess both "quantities" and "prices" of volatility and macroeconomic risks. The quantities are appraised via intertemporal and international comparisons of volatility measures, and the prices are measured through econometric estimations of the effects of volatility on investment and through the review of previous literature findings.

Argentina has shown a very large volatility in inflation and in GDP growth in the past, and it has shown a very large volatility vis-à-vis other countries as well (see Table 25 and Figure 19).[48] The same can be said of the behaviour over time of the volatilities of the real exchange rate and the terms of trade (see Figure 20).[49] Our time series regression analysis of the determinants of aggregate investment and of investment in M&E during 1993-2006 reveals that terms of trade uncertainty has a significant negative effect on investment.[50] The counterfactual analysis done in Annex I shows that a one standard deviation shock to the terms of trade volatility would reduce the aggregate investment rate by 0.75 percentage points (3% of total investment) (see Figure AI.2) and the rate of investment in M&E by 0.4 percentage points (5% of investment in M&E) (see Figure AI.4). We do not find any significant effect for the volatilities of the relative price of investment, inflation, and growth, which is also consistent with the cross-country findings of Mody and Schindler (2004). We also find that the volatility in the real exchange rate (RER) has a negative, but insignificant, effect on aggregate investment. This contrasts with Edwards (2007), who finds a significant negative effect of RER volatility on growth.[51] The low significance of the estimated coefficient for RER volatility can also be due to its multicollinearity with other controls, such as the volatility in the tax burden.

[48] Volatility in this case is measured as the within-year standard deviation of the considered variables.
[49] Volatility in this case is computed as the conditional variance of the forecast error for the tax collection/GDP ratio, using GARCH methods. This volatility measure captures the variances of unexpected innovations in the considered variables.
[50] This finding is consistent with the negative impact on growth estimated for country panels by Mody and Schindler (2004) and Edwards (2007).
[51] However, the coefficients on the volatility of the RER gain more significance (although they remain insignificant at standard levels of confidence) and become bigger in absolute value when we introduce a term that interacts this variable with the level of financial development, which is consistent with the effects proposed, and estimated for a panel of countries, by Aghion et al (2006). These authors empirically show that RER volatility matters for growth when there is a small level of financial development. They explain this result as arising from a setup in which nominal wages are preset and cannot be adjusted to variations in the exchange rate. In such case, firms' current earnings are reduced if there is an exchange rate appreciation and so is their ability to borrow in order to survive idiosyncratic liquidity shocks and thereby invest. We check for the possibility that such an interaction operates in Argentina by including in the regression equation specified in column V in Table AI.1 a term that interacts RER volatility with the credit/GDP ratio. The regression results, not shown here, are that, while still being statistically insignificant, the coefficients for RER volatility and credit/GDP are now much larger in absolute size and also have become much less insignificant. Additionally, the interactive term shows the expected positive sign. This weakly suggests that RER volatility could be hurtful at times of low financial intermediation.

Our analysis of the determinants of firm level investment for public offer firms developed in Annex I also shows that stock price volatility has a negative effect on investment (see Table AI.4). However, in this analysis we do not tell apart the sources of this volatility.

Other authors have found that macroeconomic and external volatility statistically mattered for Argentina's low long-run growth in the past, although they cannot tell apart the channels through which it operates and whether volatility affects trend growth or if its effects simply show up as an accumulation of repeated one-time income losses that accumulate over time, leading to lower average growth. De Gregorio and Lee (2003) find, using the results of their multi-country panel data regressions, that differences in inflation explain 32% of the 1960-2000 growth differential between Argentina and the East Asian countries, with a bigger frequency of past balance of payments crises explaining another 22%. According to Mody and Schindler (2004) (MS), Argentina's low average growth rate during 1960-2000 can be explained in the context of a cross-country study as resulting from its high level of fiscal volatility.[52] They argue that the sources of fiscal volatility are related to Argentina´s political arrangements that fail to provide adequate checks and balances necessary for fiscal discipline. However, fiscal volatility in Argentina, as measured by MS, appears to be declining over time and is currently below the Latin American average, hence suggesting that this is no longer an important constraint to medium run growth.

4.3.1.3. Institutions and government failures in Argentina

Given that our measurement of the "price" of poor property rights arising from government failures is rather indirect and subject to the criticism that it may also be capturing other shocks and market failures that have a negative impact on investment, we complement our analysis with a review of what other authors have previously found regarding the effect of institutions on Argentine growth and also with narrative analytics based on the literature that studies the growth-unfriendly aspects of Argentina's institutional design. This review also sheds light on the institutional roots of macroeconomic volatility.

Mody and Schindler (2004) (MS) found that Argentina fares relatively well in terms of primitive determinants of institutions, such as geography and settler mortality. However, when they analyze the determinants of past growth cycles they also find that Argentina appears distinctive in that when rapid growth periodically pushes the country ahead of its institutional capabilities, the institutions do not respond to the challenge and growth collapses. They compute the institutional gap as the residual of a regression of per capita GDP on institutional variables such as presidential form of government, majoritarian electoral rules, number of

[52] Fiscal volatility is measured as the standard deviation of the residual of a regression of growth in public spending on lagged GDP growth (two periods), lagged public spending growth, terms of trade growth, inflation and other external developments.

elections and the square number of elections, finding that Argentina has one of the largest institutional gaps.

MS do not assess through which channel institutions affect growth, and hence it is not clear whether their results reflect a negative impact of bad institutions on investment or on productivity enhancing allocations.

Della Paolera and Gallo (2003) argue that Argentina has repeatedly missed the opportunity to design the right institutions that would secure sustainable growth and insulate the society from the voracity of politicians and rent seekers. These authors argue that institutional failures in Argentina go beyond what would be predicted by the usual determinants.

Spiller and Tommasi (2003) (ST) point out that Argentina started with an early history of wars, and peace and confederation came at the expense of overrepresentation of small jurisdictions, which generated a first instance of inadequate checks and balances. These inadequate arrangements have remained over time and in recent decades the legislature, judiciary and bureaucracy have been ineffective in providing checks and balances.

According to these authors no single feature of the political system can be singled out to explain distortive policy outcomes in Argentina, which result of past historical instability, constitutional provisions and the evolution of constitutional practices which led to an amateur legislature, an ineffective judiciary and a weak bureaucracy. There are weaknesses in the bureaucracy arising from a lack of a long-term principal, leading to unclear accountabilities, a parallel bureaucracy that is installed by each new executive through the nomination of large numbers of political appointees, and a high turnover through the frequent rotation at the ministerial and secretarial levels. As a consequence, the dynamics of the political system depend on unchecked unilateral moves by the president alternating with periodic impasse in a system where provincial governors exercise considerable veto power.

The following quote from Spiller and Tommasi (2003), page 21, also quoted by Mody and Schindler (2004) illustrates well these points:

> "The practices have evolved partly out of the political instability that has tended to focus on the executive process that in a more stable process would have drifted towards the legislature. They are also the result of some explicit constitutional capabilities and constitutional lacunae, including the fact that the President is endowed with the capacity to "regulate" the laws from Congress, and the practice of issuing Decrees of Need and Urgency. The interaction of the capacity for unilateral moves, historical carryovers, and the (endogenous) lack of institutionalization of Congress and of legislative careers, has moved the center of the political scene away from the Congress and the bureaucracy towards unilateral and multilateral interactions among the National executive and provincial political elites, especially provincial governors. Given the provincial bases of party power, this has been a game of 25 0r 49 players (or more if we count the

provincial parties proper). This large number of key veto players interacting in an essentially 'institution-less' arena has led to non-cooperative outcomes and to public policies with the undesirable features described in the introduction."

These weaknesses have been further exacerbated by the transitions between military and civilian governments and the high rate of turnover of key decision makers, leading to policies that are characterized either by excess volatility or by a high degree of rigidity. In this setup, professional politicians are beholden to provincial governors, becoming amateur legislators that rarely invest in the skills and knowledge required for the effective fashioning of laws.

An important issue is to what extent the microeconomic risks are associated to economic crises (and hence would get eliminated with macroeconomic stability) or a more permanent feature of the Argentine economy that gets exacerbated at times of crisis. The analysis of institutional development suggests that an inadequate institutional design is at the root of both recurrent instability and expropriation risks. Hence in the absence of institutional reform, low appropriability arising from government failures may remain a binding constraint to bigger investment.

Inadequate institutions also lead to the possibility that even at times of more market-friendly policies and institutions the memory of past expropriations persists and leads to underinvestment. This can be easily understood as a problem of time inconsistent policies and institutions: once you have sunk capital in response to "good" policies and institutions it may pay for the sovereign to renege and capture the private rents associated to these investments.

Low appropriability associated to crisis and discretionary policy changes that alter financial contracts (such as freezing bank deposits, changing the currency of denomination of deposits and the agreed interest rates) has also hurt financial intermediation and the channelling of national savings towards financing investment.

5. Capabilities, opportunities and incentives for structural transformation of exports

We now analyze the possibility that capital accumulation is discouraged by the lack of opportunities, capabilities or incentives to invest in new endeavours that offer bigger returns than the traditional production and export activities. This analysis cuts across different branches of the HRV decision tree for investment: the social returns branch (in what relates to capabilities for structural transformation) and the market failures branch (in what relates to coordination and information externalities which may hinder the discovery of new export activities). It also creates a bridge to our HRV decision tree for productivity enhancing activities, as structural transformation not only creates new opportunities for investment, but also relocates resources to activities that contribute to bigger TFP growth via technological catch-up and generates more attractive opportunities for research and innovation.

Hwang (2006) finds that fast growing developing countries thrive by widening the pattern of specialization towards goods that are produced initially at a relatively low quality vis-à-vis a

distant world technology frontier, hence gaining access to bigger catch-up possibilities. He finds unconditional convergence in individual product prices: the farther from the frontier the quality of a given exported good is (proxied by the relative export price vis-à-vis the frontier), the largest the subsequent growth in the export price and quality. Additionally, convergence in product quality leads to unconditional convergence in output growth. He also finds that increasing the convergence possibilities is greatly facilitated by bigger export diversification, a greater similarity with the export structure of advanced countries, and by a bigger export sophistication (as defined by Hausmann, Hwang and Rodrik, 2006). In Hwang's framework, the barriers to entry in the new activities include high local costs of R&D (required to exploit catch-up possibilities), a small market size, export-discouraging domestic and foreign trade policies, the initial domestic quality, and high discount rates.

Hausmann, Hwang and Rodrik (2005), HHR from now on, estimate that the more sophisticated the country's export basket vis-à-vis its per capita income, the larger its subsequent growth. The sophistication of the export basket is measured as the income content of the products exported by a country.[53] HHR attribute the positive growth effect of export sophistication to the associated learning economies or potential catch-up effects to rich countries productivities by specializing in similar sets of goods. However, they do not test for this effect at a microeconomic level and get the result in a black box fashion. Indeed, Hwang (2006) finds that bigger export sophistication, as measured by HHR, is less associated to bigger catch-up possibilities than a bigger export diversification and/or similarity to the exports of OECD countries. Hence the growth effect of bigger export sophistication could be capturing other growth friendly effects of exporting a rich country's export basket, such as the bigger terms-of-trade stability that is usually associated to the export of more sophisticated manufacturing goods that face a more stable world demand. In any case, both because of the move to new goods with larger convergence possibilities and/or because of bigger terms-of-trade stability, a structural transformation towards modern export activities is bound to have significant growth enhancing effects, via increased investment and productivity.

HHR argue that the acquisition of bigger export sophistication requires investing in self-discovery, which is subject to information and coordination externalities that may lead to sub-optimal investment in the absence of adequate government policies that compensate these externalities (as proposed by Hausmann and Rodrik, 2003), and is facilitated by a bigger country size and a bigger abundance of human capital, which lower the costs of experimentation in discovering the profitability of the new export activities.

[53] HHR (2005) measure of sophistication of country's export basket, EXPY, is calculated as the share weighted average of the PRODY of each component of country's export basket and where PRODY measures the productivity associated to the good, calculated as the revealed comparative advantage (RCA) weighted average of the level of income per capita of the countries that export that good.

Hausmann and Klinger (2006) further show that the discovery of new exports in modern sectors in additionally conditioned by the country's current exports and the capabilities they create for jumping to exports of more sophisticated products. These authors find that goods can be clustered in the product space in groups according to the probabilities of being exported conditioned on the goods in the same group being exported as well. They also find that being specialized in the exports of goods that are close (in terms of conditional probabilities of being exported) to other goods that have a high income content (as defined by HHR), greatly facilitates structural transformation of exports towards a more sophisticated export basket, and to bigger growth through this channel. They interpret this finding as reflecting the fact that goods that are closer may share several of the required capabilities for being produced and exported, hence facilitating the move to new exports. Additionally, a higher income content of the goods that are nearby makes structural transformation more attractive.

Our analysis will start by appraising whether lack of structural transformation is a binding constraint to growth, via the evaluation of the extent of structural transformation and its "price" (potential effect on growth if it were improved). Showing that transformation is scarce, we move on to study the potential binding constraints to the discovery and diffusion of new export activities in Argentina: insufficient capabilities, coordination and information externalities, and/or inadequate trade policies.

The anticipated conclusion is that structural transformation in Argentina is scarce, resulting in a relatively low and stagnated sophistication of its exports, and specialization in activities that appear to offer relatively little scope for technological catch-up to the world frontier. Hence structural transformation would offer large payoffs in terms of bigger investment, productivity and trend growth.

Our analysis also suggests that Argentina's accumulated capabilities and opportunities for developing more valuable export activities appear to be suitable on average. Hence this discovery process appears to be hindered by the lack of adequate government intervention to help circumvent information externalities and coordination failures. Nevertheless, the most attractive goods in terms of sophistication and technological frontier appear to be relatively far in terms of the required capabilities.

As a result, Argentina displays discoveries mostly in activities where private entrepreneurs can introduce barriers to entry (brand, technology, scale) that prevent diffusion and self-provide the required industry-specific public goods, while many socially profitable activities where introduction of barriers is not possible fail to be discovered. The ensuing protracted privately generated monopoly power allows the survival of many new exports of low value.

Domestic and foreign trade policies appear to play a smaller role in deterring structural transformation. The biggest hurdles are given by the time inconsistency of Argentine trade policies, the EU tariffs on goods with high convergence possibilities and the large import tariff

discrimination imposed across the board by Latin American and Asian countries. Asian and Latin American discrimination may become particularly hurtful since they are the most dynamic import markets for Argentina since 2002 (see Figure 12).[54] This finding suggests that the negotiations for the opening of foreign markets should consider not only the incumbent goods, but also potential new exports of high value that are within the capabilities accumulated by Argentina.

5.1. Structural transformation in Argentina

Argentina has had a lackluster growth in the sophistication of the Argentine export basket, measured as suggested by Hausmann, Hwang and Rodrik (2005) (HHR). This measure shows that the income content of Argentine exports has grown only 15% between 1975 and 2000 (see Figure 21). Argentina's current per capita income lies above its export sophistication, suggesting its current export basket will not offer a positive contribution to growth (either in the form of catching up to the technology frontier or through more stable terms of trade).

It is also remarkable that during the same time span the income contents of the exports of Brazil and Chile respectively grew 100% and 50% (see Figure 22). It appears to have been very important that the export sophistications of these countries were significantly bigger than their per capita GDPs in 1975. The sophistication of Brazilian exports increased more than this country's per capita GDP between 1975 and 2000, suggesting increasing opportunities for growth.

In the case of Argentina, export sophistication was never much bigger than its per capita GDP, which may help explain its lackluster growth performance since 1975. A similar counterfactual analysis can be made for future growth based on the current lack of sophistication of its export basket. The prospects for Argentina remain discouraging when we compare the gap between export sophistication and per capita income with other Latin American countries (see Figure 23).

If we focus on the quality upgrading of Argentine exports, proxied by the evolution of unit export prices, we first observe that while Argentina's exports rose sevenfold between 1986 and 2006, most of this growth was explained by a rise in quantity, with only a negligible contribution of changes in export value (see Figure 24). Hence Argentina does not appear to have experienced a structural change in the composition of its exports towards activities with bigger scope for quality upgrading. Table 26 further shows that there has been little quality convergence of Argentine exports to the OECD frontier between 2004 and 2005, as proxied by the evolution of relative unit export prices vis-à-vis the OECD prices for the same export baskets:

[54] The importance of the Latin American and East Asian markets for new sophisticated export activities in Argentina is confirmed by the case studies analyzed in Sánchez et al (2007).

- The relative unit price of total exports vis-à-vis the frontier declined during this period.
- This decline was driven mostly by "traditional" exports, as the unit price of new exports actually rose relative to the frontier. However, this growth was very small (0.46% per year).[55]
- As predicted by Hwang (2006), the unit price of new exports relative to the frontier was smaller than that of traditional exports.
- Next we focus on manufactures, which is where Hwang shows that quality convergence takes place, especially for industrial manufactures but also, albeit to a smaller degree, for processed foodstuff. We first observe that there has been divergence in quality in the case of processed foodstuff, both for total exports and for new exports (although less in the latter case). This is the opposite of what Hwang finds for a cross-section of countries.
- In the case of industrial manufactures there was also quality/price divergence for total exports, despite the small convergence for new industrial exports (unit prices grew 0.1% per year vis-à-vis the frontier). New industrial exports started with a lower relative price than traditional exports of industrial manufactures.

Additionally, Figure 9 in Hwang (2006), page 25, shows that in 1989-1991 Argentina had a relatively high unit price for its manufacturing exports to the United States (much bigger than the unit export prices of Malaysia, Korea, China, Dominican Republic, Brazil, Holland and Hong Kong), which helps explain its relatively low, in international perspective, per capita GDP growth during 1991-2004.

We find that Argentina's exports are relatively well diversified and that this diversification has been increasing slowly over time (see Figure 26). Hence lack of diversification cannot be the source of low catch-up possibilities. While the Herfindahl index for its exports in 2004 (2.9%) compares unfavorably to the US (0.57%), for instance, Argentina presents one of the most diversified export structures in Latin America (see Figure 2.19 in De Ferranti et al, 2002). Argentina is also much more diversified than the average in Hwang's sample of 116 countries for 1984-2000, whose Herfindahl index is 23%. Its export structure is also much more similar to the OECD structure than the average of Hwang's sample.[56]

[55] For the identification of the new exports at the 6-digit level of the Harmonized System (HS) that emerged between 1993-94 and 2003-04 we used the following criteria. These should have grown at least 300% during this period (so as to include sectors that have increase above average export growth, 154.7%, and median export growth, 263%). They must also display a minimum value of exports of US$ 10 millions in the average of 2003-04 and a maximum value of exports of US$ 1 millions in the average of 1993-94. This criterion leaves us with only 87 products that meet all our requirements (out of 4198 products at this level of disaggregation that showed positive exports in 2004).

[56] The export similarity index taxes a zero value when there is no overlap and 1 if a country has an identical distribution of export shares as the OECD. While the Hwang sample average index is 0.14, Argentina's index is 0.29.

This means that the problem lies not in the extent of diversification but in the possibility that Argentina has diversified its exports towards activities with low catch-up possibilities, which is consistent with the lack of export sophistication. This would suggest that the costs of entry in the activities with the biggest convergence possibilities have been very large, giving little private value to these new activities.

Hence, while there have been important changes in the composition of exports betweem 1993 and 2005, with a significant increase in the importance of new export activities (see Tables 27 and 28), these new exports have offered little convergence possibilities and very little improvement in export sophistication. This means that the most valuable new export activities have failed to be discovered.

Next we provide some measures of the "price" of the small structural transformation, measured as the foregone growth opportunities that are suggested by the econometric findings of HHR and Hwang (2006).

HHR estimations suggest that if the export sophistication of Argentina had been 60% bigger at the onset (so as to the replicate the ratio of export income content to per capita income of Brazil in 1975), its growth rate for 1975-2000 would have been 3 percentage points bigger than what is was observed. This finding is consistent with Hwang's estimates, which suggest that a 60% increase in the income content of Argentina's exports would bring forth a bigger catch-up space that would improve the rate of growth of export prices by 6 percentage points per year and per capita GDP growth by 2 percentage points. Additionally, Hwang's estimates also show that Argentina's catch-up space (distance between its unit export prices and those of the OECD) in 1994 predicted a 0.26% per capita GDP growth per year. Instead if Argentina's catch-up space had been similar to that of Brazil, its per capita GDP growth rate would have been 2 percentage points bigger.

5.2. Capabilities and opportunities for structural transformation

Next we analyze to what extent the lack of structural transformation is due to high costs of entry into valuable new export activities that are caused by the lack of accumulated capabilities required for these new activities.

Hausmann and Klinger (2006) (HK) found that the capability of structural transformation depends negatively on the distances between the products in which the country has a revealed comparative advantage and those products that are not being exported. These authors measure distance between two products as the minimum probability that each of these products will be exported conditional on the other being exported as well. They use these measures of distance to construct measures of "density" for each product that a country is not currently exporting, which aggregate the distances between each of these products and the goods that the country is currently exporting. These density measures capture the capabilities for structural transformation.

These authors additionally measure the attractiveness of structural transformation by evaluating the "price" of the products that are close (in the HK sense) to current exports. This price is measured by the productivity associated to the good, calculated as the revealed comparative advantage (RCA) weighted average of the income per capita of the countries that export that good. The prices and densities of the un-exported goods are aggregated into a variable called "open forest," which measures the option value of structural transformation. Intuitively, the closer and pricier the non-exported goods are, the bigger the attractiveness of, and capability for, structural transformation towards a more sophisticated export basket.

HK indeed find that the likelihood of jumping to a new export good is positively affected by the distance between the "price" of the new good and that of the current export basket (sophistication). They also find that density has a positive and significant effect on the probability of jumping to new goods (see columns 1, 3, 4 and 6 in Table 29).

We replicate HK's estimations for the individual case of Argentina, although we analyze the period 2000-2004 instead of 1985-2000 as HK did (see columns 2 and 5 in Table 29).[57]

Conditioned on the differences in time period, our estimations show that the probability of jumping to new exports depends positively on density. However, the effect of density on the probability of structural change is between two and three times bigger in the case of Argentina than in the whole sample, suggesting that proximity is a stronger determinant of discovery than it was for the average country in the HK sample. When Hausmann and Klinger (2007) re-run their panel data regressions of Table 29 including an Argentine dummy that interacts with density, they find its coefficient to be insignificant, arguing that Argentina is not an outlier in terms of discovering new products given its location in the product space. We interpret the difference between their result and ours as arising from the different time period under consideration, i.e., density appears to have become more important for Argentina now than it was before 2000.

We additionally find that in the individual case of Argentina, the productivity of the new goods has a significant but very small impact on structural change. This suggests that proximity is more important than value for discovering new goods, which is consistent with our finding of no growth in the unit prices of Argentine exports and the little growth in the sophistication of Argentine exports.

HK additionally test the effect of the open forest on the growth of the sophistication of the export basket between 1985 and 2000, controlling for the initial export sophistication and the initial GDP per capita. As predicted by their theoretical framework, the authors find that the growth of export sophistication is positively affected by the size and value of the open forest and negatively by the initial export sophistication (more sophisticated exporters have less

[57] We are very grateful to Bailey Klinger for supplying us with the required data base for this analysis.

attractive opportunities to catch up to). They also find that the value of the open forest has a stronger effect than its size on the growth of the export sophistication. The results of their regressions are reproduced in Table 30.

We now analyze how favourable for structural transformation Argentina's open forest has been and currently is. The first point to notice is that Argentina's open forest has been growing over time at rates comparable to those of Brazil and Chile (see Figure 26). Additionally, Argentina had bigger initial open forest and per capita GDP than these other two countries, which nevertheless managed to have their export sophistications increase significantly over time. Hence it does not appear that Argentina's initial open forest was an impediment for export sophistication growth. Indeed, if we use the coefficients estimated by HHR in Table 30, Argentina's initial open forest should have led to a 22-37% increase in export sophistication between 1975 and 2000 (depending on whether we use the fixed effect or the random effect estimations), much bigger than the one we actually observed (15%), and similar to those predicted by Korea using the same estimated coefficients.[58]

Argentina is not alone in its lack of ability to adequately exploit its open forest, as many Latin American countries appear to share this feature.[59]

We hence conclude that there is nothing intrinsically wrong with the Argentina's accumulated capabilities and opportunities for structural transformation, as summarized by its open forest, and that there are other more important impediments for Argentina improve the sophistication of its exports. Indeed, Argentina's open forest in 2000 was not significantly smaller than it was for China, India, Indonesia or Finland.

To shed further light on this issue, we now move from the aggregate analysis of capabilities and opportunities to the evaluation of the capability to discover the goods that are more attractive, and the attractiveness of the goods that are easier to discover. We additionally

[58] Based on their findings HK argue that Korea was able to have much bigger rates of growth of export sophistication and per capita GDP than Argentina because it had a much more valuable initial open forest. We took this argument seriously and used the coefficients from HK regressions to estimate the growth in export sophistication that Argentina and Korea should have had based on the 1985 values of open forest, per capita GDP and export sophistication. Our simulations reveal that both countries should have had basically the same rates of export sophistication growth! The reason for this result is Argentina had an initially larger per capita GDP that should have compensated for the deleterious effect of its relatively less valuable open forest, which nevertheless predicted only a slightly smaller income content growth for Argentina than for Korea. There is of course the possibility that HK's empirical implementation is not right in treating per capita GDP and open forest as perfect substitutes for export sophistication growth (they could actually enter a Leontieff production function for structural transformation).

[59] We re-estimate the impact of the open forest on the growth of export sophistication in Latin American countries between 1975 and 2000 (see Table 31). We find that the open forest actually has a negative effect on the subsequent export sophistication growth in Latin America. This effect is significant at an 11% when using fixed effects and non significant when using a random effects estimation. Additionally, the initial export sophistication has a negative impact on export sophistication growth that is significantly stronger than the one estimated by HK for the whole sample. These findings suggest that on average Latin American countries display a bias towards its current export sophistication and that there are impediments to exploit its open forest for these countries on average.

consider the recent discoveries of new goods in Argentina, and how close to the previous export basket in the product space these products were, and also how productive they are.

In order to choose the most attractive products in which Argentina still lacks a revealed comparative advantage (RCA), we rank the top 25 goods (at the 4-digit HS classification) according to three alternative criteria: productivity, strategic value and quality/price gap with the OECD (proxy for technology frontier).[60] Productivity is the income content of the good's exports, as defined by HHR. The strategic value is what the new goods would add in terms of bigger capabilities for productivity enhancing structural transformation. It is defined as what each good would add to the open forest of each country, i.e., how it would improve the option value for further transformation. In the case of unit export price gap vis-à-vis the OECD, we consider both total exports and industrial manufacture exports.

In order to choose the most feasible goods, we rank the top 25 goods that lack RCA by their density vis-à-vis the current export basket. That is, we consider the goods that are closer to the current export basket in the product space. We additionally consider all the goods that became new exports after 1993 and also the "traditional" exports (those goods which already had RCA in 1993).

For each group of goods we compute their average productivities (how much they would add or have added to income content of the export basket), their strategic value (how much they improve the option value for further transformation), their densities (how close they are to the current export basket in HK terms) and their share in total exports. We also include the unit export price gap with the OECD.

Table 32 shows the average value of "prody", "strategic value," "density," export share, and price distance to the OECD for each group and also for traditional exports (the goods with RCA before 1993).

Looking first at past structural transformation, we find that the recent discoveries have a productivity that is 50% bigger than that of traditional exports, and that they have already exploited some small convergence possibilities that they had at the onset (see Table 26). Hence higher income content than traditional exports played some role in their discoveries, but they did not contribute significantly to improve export sophistication because they represent only 18% of total exports. The density of these goods reveals that they were located at a close distance of the previous export basket in the product space, suggesting that it was relatively "cheap" (in terms of required capabilities) to develop these new exports. These new goods marginally improved the option value for further transformation, as they had a similar strategic value as prevalent export basket.

[60] In the case of goods with biggest catch-up possibilities we introduce the requirement that they export at least of $ 1 million but still lack RCA, so that their export prices are representative of actual quality gaps instead of reflecting just marginal occasional exports.

Looking at the capabilities and opportunities for further transformation, we find that the easiest products to develop, those with highest density, have little value for structural transformation and their productivity is quite below that of recent discoveries (U$S7769 versus us$9222). Additionally, they have relatively high unit export prices vis-à-vis the OECD, thus leaving little space for quality convergence. That is, the nearest products to Argentine's actual export basket add little to export sophistication and to capabilities for structural transformation.

On the other hand, the highly valuable goods that would improve export sophistication the most (the highest productivity group) have a productivity that is 3 times bigger than the recent discoveries and 4 and half time bigger than traditional exports. This set of goods has a space for quality convergence that is much bigger than the one that recent discoveries enjoyed at the onset (compare to Table 26). The discovery of this group would not improve much the open forest for Argentina. These goods lie in the product space at a bigger distance than all the other sets of goods, suggesting that Argentina has not accumulated enough capabilities (with its current exports) for discovering these high-productivity goods.

Thirdly, those products chosen due to their high strategic value for structural transformation are also far in the product space and their productivity, although higher than the average, is not as high as for the top productivity group. This high strategic value group offers a larger space for quality convergence to the frontier than traditional exports and recent discoveries.

Finally, the goods with the biggest convergence possibilities appear to be relatively far, in HK terms, from the current export basket, and have a relatively high productivity (twice as high as recent discoveries), making them relatively costly to discover.

Hence it appears to be relatively costly (in terms of distance to the current export basket) to discover the most attractive new exports.

5.3. The role of trade policies

We now analyze how domestic and foreign trade policies may have affected the pattern of past discoveries and the incentives to discover new goods that offer bigger productivity, convergence possibilities and/or have a bigger strategic value. Our prior is that domestic trade policies that change the domestic relative price in favour of import substitution will discourage the discovery of new exports in the presence of fixed costs of entry into new markets (see Das, Roberts and Tybout, 2001) and coordination and information externalities.

Discriminatory foreign trade policies reduce the expected profits of discovery, especially in the case of differentiated goods with downward sloping foreign demands, and the ability to converge to higher levels of quality if the markets for higher quality are closed.

We consider the trade barriers imposed on actual and potential Argentine exports to NAFTA members, EU members, Asian countries and Latin American countries. We analyze both the trade weighted average tariffs and the maximum tariff that each group of goods faces,

obtained from the WITS Data Base (see Table 33). The caveat must be made that this analysis misses the role played by quantitative restrictions, which can be more important than tariffs. The groups of goods considered include the top 25 goods in terms of strategic value, productivity, density and distance to the world technology frontier that still lack RCA, and also the recent discoveries and the "traditional" exports that already had RCA in 1993. We also analyze the trade weighted average and maximum domestic tariffs and export taxes that each group faces, together with the relative price of import substitution, defined as (1+ import tariff) / (1-export tax) (see Table 34).

Relatively low tariff discrimination by the NAFTA and EU members appear to have facilitated recent discoveries, as this group faces on average lower NAFTA and EU trade restrictions than any other group, although they faced relatively high tariff peaks. High tariff discrimination in East Asia and in Latin America, natural markets for new goods, is relatively large and may have conditioned the attractiveness of the new exports. Domestic trade policy did not discourage these discoveries at the onset either. This group enjoyed relatively high protection at home, although at the time of the discovery they faced no export taxes (which were introduced in 2002) which resulted in a low relative price of import substitution (1.14). Since the introduction of export taxes the relative price of import substitution rose to a high 1.23. This raises a potential problem of time inconsistency of trade policy that may discourage future discoveries.

Traditional exports face relatively low average tariff discrimination in all export markets (although they are subject to large quantitative restrictions not reported here) and domestic import tariffs but face the largest domestic export taxes.

The highest productivity goods are not discriminated by the average NAFTA and EU tariffs (although they face high tariff peaks in NAFTA), but are punished by relatively high East Asian and Latin American barriers to imports. The discovery of this group does not appear to be discouraged by domestic trade policy, as it faces a low relative price of import substitution (similar to the one enjoyed by new discoveries at the onset).

The goods with the highest strategic value face EU and NAFTA trade barriers that are neither high nor low, very high East Asian and Latin American tariffs, and an anti-export bias by the domestic trade policy that is not negligible either.

The highest density group is not discriminated by NAFTA average tariffs but faces relatively high EU tariffs and very high tariff peaks in both blocs, and is exposed to a low anti-export bias of the domestic trade policy.

Finally, the group with the biggest catch-up possibilities is exposed to low average EU and NAFTA tariffs, faces relatively high tariff peaks in both blocs, and also is subject to a non-negligible anti-export bias.

Asian and Latin American import tariffs are highly discriminatory across the board, except for the high density group and, in the case of Asia, the group with biggest scope for convergence.

Hence domestic trade policies do not appear to be too responsible for the lack of discovery of the top 25 high productivity goods, and to have some responsibility the lack of emergence of the high strategic value and high scope for quality convergence goods, and also appear to have facilitated the most recent discoveries. However, the time inconsistency of domestic trade policy may be contributing significantly to insufficient structural transformation.

NAFTA and EU tariffs appear to not to hurt the attractiveness of discovering most groups, save for the top quality distance group in the case of EU average tariffs and the NAFTA tariff peaks on the highest productivity groups. On the other hand, Asian and Latin American import tariffs discriminate strongly against the exports of all groups.

Therefore domestic and industrialized country tariffs and export taxes can explain only part of the insufficient structural transformation. A bigger contribution to lack of structural transformation appears to come from the high Asian and Latin American tariffs, since they are the most dynamic export markets for Argentina since 2002. The inclusion of attractive and feasible new exports in the negotiation of trade agreements with these blocs and avoiding time inconsistent trade policies would facilitate discovery to some extent.

5.3. The role of market failures

The findings regarding trade policies and capabilities suggest that information externalities and coordination failures are possibly a very binding constraint to structural transformation. This hypothesis is supported by the case studies of new successful export activities in Argentina undertaken by Sánchez et al (2007).[61]

Here we evaluate this hypothesis by analyzing whether the emergence of new export activities since 1993 fit more the case of widespread discovery and diffusion (in which case market failures are not very important), or the case of limited discovery and diffusion. We also consider the correlation between discovery and diffusion within each sector (if market failures matter, then sectors with high discovery should have low diffusion and *vice-versa*). Finally, we consider an extended version of Hausmann and Rodrik (2003) model of self-discovery and its predictions for the patterns of discovery, diffusion, and for the growth of the open forest and of

[61] Sánchez et al (2007) analyze a series of case studies where the emergence of new successful modern export activities in Argentina often occurs in sectors where the pioneer can capture (at least temporary) monopoly rents by introducing barriers to entry, thus compensating the knowledge externality. Additionally, where coordination failures may be important the pioneer tends to be a relatively large firm, with previous experience and scale in horizontally or vertically related activities, who can engage in vertical integration and/or self-provide the required industry-specific public goods, and self-finance this investment. This in turn leads to relatively small or slow diffusion. This suggests that there are many profitable activities that fail to be discovered because of the absence of targeted policies that facilitate experimentation (quite the opposite to Chile) and because the poor functioning of many trade related institutions unduly raises the cost of experimentation.

export sophistication in the presence of varying degrees of market failure and of cross-industry differences in the ability that private entrepreneurs have to introduce barriers to entry that compensate for the knowledge externality. These predictions are then contrasted to Argentina's actual pattern of aggregate and sectoral discovery, diffusion and export sophistication growth.

Our findings suggest that coordination and information externalities are indeed a binding constraint to structural transformation in Argentina which is not compensated by adequate government interventions. Discoveries do occur, but mostly when the pioneer can introduce by herself barriers to entry that block diffusion. As a result, many activities where the pioneer cannot introduce barriers to entry by herself and/or self-provide the required industry specific public goods fail to be discovered. Additionally, there is limited diffusion, which conspires against structural transformation.

The relevant stylized facts for discovery and diffusion in Argentina are discussed next:

- The frequency of emergence of new export activities in Argentina during the past 15 years does not appear to be small in international comparison (see Table 35).
- Most of these "discoveries" are concentrated in areas linked to natural resources, and associated to privatization and deregulation, and undertaken by large firms (Sánchez et al, 2007).[62]
- The inter-industry pattern of investment in manufacturing activities since 2002 is negatively associated to the frequency of emergence of new exports by sector (see Figure 27), suggesting a bias against investing in activities that are exposed to bigger coordination and information externalities.
- The new export activities show very little diffusion (see Table 36). The concentration of exports, proxied by the export share of the largest exporting firm, was very large at the onset, as one would expect, but that it was even larger at the end.[63] This suggests that discoveries are associated to the private introduction of protracted barriers to entry and to the internal provision of industry-specific public goods.
- There is a negative correlation between discovery and diffusion at the sectoral level, signalling that discoveries emerge more frequently when entrepreneurs can introduce barriers to entry. To see this, we compute different measures of extent of diffusion per sector and estimate their correlations with the number and the frequency of new exports

[62] Sánchez et al (2007) find that the sectors with the largest presence of new exports include activities directly linked to the exploitation of mining resources (Coke and Oil Products), industries that process agricultural resources (Food and Beverages, Tobacco Products), industrial manufactures that process natural resources (Wood and Wood Products, Manufactures of Basic Metals), and Motor Vehicles (a relatively labor intensive activity that got an initial boost from Mercosur).

[63] To measure export concentration at the product level we use Customs Office data for firm-level exports by product (which can be disaggregated up to the 8-digit level) for 1994-2004.

in those sectors, which we find to be always negative and very often statistically significant, especially regarding the number of discoveries per sector (see Table 37).[64]

These stylized facts suggest that many new modern activities fail to be discovered because of the lack of policies and institutions that deal with the appropriability problem.

Finally, in Annex III we show that the Argentine pattern of intermediate number of discoveries, very limited diffusion and low export sophistication growth and poor quality catch-up in the presence of a reasonable open forest and relatively large diversification is consistent with the lack of government intervention to compensate the coordination and information externalities, together with cross-industry differences in the ability of pioneers to introduce barriers to entry and self-provide the required public goods.

This pattern of discovery and diffusion in Argentina also suggests that capabilities for new exports are created mostly at an intra-firm level, which may prevent taking advantage of the expansion in the open forest if the monopolists on previous discoveries lack the drive or the resources to attempt further discoveries (especially if they cannot secure monopoly rights on the latter).

6. Binding constraints on research and innovation

We now move to the parallel decision tree that analyzes the binding constraints to research and innovation. This is relevant, as TFP growth in Argentina has diverged from world trend since 1975, and is responsible for a large share of the growth slowdown and the lack of upward regime shifts in trend growth.

The most recent theoretical and empirical growth literature shows that most countries appear to grow at the same long-rung growth rates, which are determined by world TFP growth, and that differences in investment and in research and innovation rates only explain differences in long-run income (Howitt, 2000; Klenow and Rodríguez-Clare, 2004). In the proposed Schumpeterian endogenous growth framework, investment in physical capital and innovation are complementary activities. Innovation in this framework is defined as all the expenditure decisions geared towards tapping the world stock of knowledge.[65] World TFP growth results from the spillovers from the research undertaken by all countries. Keller (2004) provides a summary of the compelling recent empirical evidence on the large extent of international

[64] The diffusion indicators that we compute include: a) the share of export growth explained by an increase in the number of local exporters, measured as the ratio between growth in the number of exporting firms per sector and the percentage growth in total sectoral exports (dN/dX). The larger this indicator is, the bigger the diffusion; b) the change over time in the sectoral export share of the firm which had the largest export share in 1993 (d*sharepioneer*) (if it increases, there is more concentration); c) the export share of the largest exporting firm in 2004 (*share-endleader*); d) the Herfindahl Index of concentration in the number of exporters in 2005. We compare these indicators to two indicators of discovery: the number of new exports by sector (#NE), and the number of new exports relative to the total number of exported goods by sector (%NE).

[65] Broadly defined technological research and innovation may include both R&D activities and the adaptation of technological knowledge embodied in imported capital goods to the local economy.

technology diffusion and of the mechanisms through which it occurs. Klenow and Rodríguez-Clare (2004) (KR) introduce the additional possibility that each country has its own technology frontier, which differs from the world frictionless frontier because of barriers to "engagement" (FDI, trade, capital goods imports from technologically advanced countries, communication infrastructure quality). In this framework, domestic research determines the distance between the country's long-run productivity and its own frontier. The social rate of return to innovation is smaller the closer the country is to its technology frontier.

In this framework, divergence from world TFP growth, such as the one observed in Argentina, can occur as a result of different processes. In KR's framework it can be due to transitional dynamics towards a new steady state with a bigger gap between the country's productivity and the world technology frontier, caused in turn by a decline in the steady state capital per effective worker (lower savings rate) and/or bigger capital income and R&D taxes and/or poorer ability to appropriate the social returns from innovation. KR also allow for the possibility that a country reduces its level of engagement with the world flow of ideas, leading to a lower technological frontier for the country. This in turn causes a transitional productivity slowdown (via lower research effort) until the steady-state productivity gap with the now lower frontier is restored. In this framework divergence in productivity growth is never a steady-state outcome.

The framework of Howitt (2000) allows instead for the possibility that the country fully disengages, in which case its steady-state TFP growth would depend on its own research effort, leading to divergence. However in this framework it would only pay to disengage for rich countries with large research intensity and capital per effective worker.[66] This author also permits the possibility that steady-state divergence occurs when a country does not do any research. This occurs when there are large enough R&D taxes (or small subsidies) and/or a low savings rate that reduces the long-run capital per effective worker, lowering the private returns on innovation.[67]

We will analyze how these different processes fit with Argentina's performance regarding productivity growth, innovation and investment. This will done via the calibration of KR and Howitt's models for Argentina, together with the econometric estimation of the social rates of return to innovation in Argentina using the methodology proposed by Jones and

[66] Howitt's formulation for world TFP growth assumes that each country's spillovers are diluted by world variety (population) rather than by each country's variety (population). In this setup, countries with bigger than average research intensity and capital per effective worker would be better off disengaging from the rest of the world, as their growth rates would then be higher in isolation. This would be because in isolation the rich country's growth rate depend only on its own higher than average research effort, which would have very high returns due to its large capital per effective worker, and to the fact that its research intensity would now be spread over the relatively small number of the country's own varieties instead of being spread over the number of world varieties. KR do not adopt this formulation, as it would fail to generate convergence in growth rates in steady state.

[67] A large enough interest rate and/or capital income taxes would generate the same result.

Williams (1998) and a cross-country econometric estimation of the determinants of the research effort in Argentina. This will allow us to shed light on the determinants of the productivity slowdown, and on the binding constraints to modify them.

Figure 3 presents the decision tree for research and innovation. We start by analyzing the Argentine innovation effort in an international and an intertemporal perspective, and we will also estimate the social returns to innovation, in order to gauge how "scarce" innovation is. Then we move on to the different branches that include the potentially binding constraints to research and innovation. Given that many branches interact closely with each other we will not always move sequentially exhausting the analysis of each branch separately before moving to the next. We will rather examine several of them jointly using a unified framework (model calibration).

The main findings are that low research and innovation in Argentina is a binding constraint to TFP growth. The joint decline in research intensity and in productivity relative to the world frontier during the past 30 years are explained by barriers to international technology diffusion (via capital goods imports and FDI from high knowledge countries, and adequate communications infrastructure) that have reduced the country's own technology frontier far below the world frontier at a time when technological knowledge has become more global, and by scarce human capital with adequate research skills for the business sector, together with poor IPRs. Financing does not help either, but the other binding constraints precede it in terms of importance.

6.1. The scarcity of innovation in Argentina

Argentina shows very poor indicators of innovative activity when compared to other relevant countries, either if we consider pure R&D intensity, which reaches a meagre 0.44% GDP (see Table 38), or total firm spending on innovation relative to sales.[68] Table 39, which is obtained from Lederman and Saenz (2004), further shows that Argentina experienced a very large decline in its R&D intensity since 1975-79, when it reached 0.94% GDP, which at the time compared very favourably to other countries that now overtook Argentina, such as Brazil, India, Korea, Taiwan and Ireland.[69] Nevertheless, it was always the case that a disproportionately large share of the total research effort in Argentina was undertaken by the public sector.

[68] Sánchez, Nahirñak and Ruffo (2006) find that the average amount spent on innovative activities by Argentine firms relative to sales was 1.7% in 2001, much less than in Brazil (4%). The maximum amount spent by Argentine innovative firms was 2.15% of sales, much less than the maximum amount spent in Brazil, which reached 7.8% of sales.

[69] KR show that in order for Argentina's relative TFP to fit in their calibrations the true research intensity should be three times bigger 1.21% GDP which, according to them, would include all the innovation-related expenditures that are not a direct research activity. Nevertheless, this calibrated research intensity would still be significantly smaller than the calibrated research intensities of Brazil, Chile, Colombia, Uruguay and Spain, among others (see Table A1 in Klenow and Rodríguez-Clare, 2004).

In order to gauge whether research and innovation are truly scarce, we now estimate its social rate of return (SRR) in Argentina by running a regression of TFP growth at the industry level during a certain period on the initial R&D intensity per industry. Jones and Williams (1998) show that this estimation is consistent with the true social rate of return and that the econometric estimates obtained represent a lower bound of the actual SRR, which is the sum of the two social dividends of research plus the associated capital gains.[70]

Our estimation entails running a panel data regression of TFP growth at the industry level during a certain period on the initial R&D intensity per industry. The estimations are done at the industry level to capture inter-firm spillovers. We make use of the National Innovation Survey (ENICT), which contains data on R&D and other type of innovation expenditures for a representative sample of manufacturing firms for 1992, 1996, 1998 and 2001. We compute labor productivity per industry using the data from the Monthly Industrial Survey. As we do not have access to TFP data, we run a regression of labor productivity growth during 5 years on the initial R&D intensity for each industry and on the growth of capital per worker, which is proxied by a time dummy. We run a panel data regression with T = 4, corresponding to 1992-1997, 1996-2001, 1998-2003 and 2001-2006. We distinguish between investment in R&D and investment in innovative capital goods (with embodied technological knowledge).

The results are shown in Table 40, and reveal that R&D investment thus estimated has a negligible and insignificant social rate of return (0.1-0.6%), much smaller than in the US (25-35%), which is much closer to the world technology frontier.[71]

Hence while the research intensity in Argentina is very small in international comparison, its low SRR would suggest that it is not a scarce activity, i.e., that there is little demand for it and it is not a binding constraint to growth, which does not sound very reasonable. It could rather be the case that Argentina is largely disengaged from the world flow of ideas, which leads it to have a rather low technological frontier that significantly reduces the SRR to research.

6.2. Research, investment, TFP growth and the determinants of the social rate of return to research in Argentina

In this section we focus on two sub-branches of the "low social return" branch in the research decision tree. These sub-branches are the "low engagement" branch and the "low complementary investment" branch. We will explore to which extent the diverging TFP growth

[70] The first dividend term is the productivity gain from an additional idea (the marginal effect of technological change on GDP) divided by the price of ideas (the inverse of the marginal effect of more research on technological change). The second dividend term (the effect of a bigger stock of technological knowledge on the ability to generate technological change) captures how an additional idea affects the productivity of future research. The capital gains are the rate of growth of the price of ideas.

[71] The estimations also suggest that investing in innovative capital goods has a much bigger and more significant social rate of return than investing in R&D, but that this return is still very small and statistically insignificant.

and low SRR to research in Argentina can be explained in terms of: a) a transition towards lower steady-state productivity gap resulting from a decline in the desired steady-state capital per effective worker and/or in the desired research intensity in the KR model, b) a transition to a lower technological frontier as a result of a decline in the level of engagement with the world flow of ideas, c) a steady-state autarkic TFP growth in Howitt (2000), and d) the decision not to innovate, as in Howitt's model. To this end we will calibrate the KR (2004) and Howitt (2000) models with the relevant parameter values for Argentina and see which model and particular realization of that model matches better Argentina's performance.

Transition to a lower steady-state productivity gap in KR model

The TFP of Argentina was 51% of the world TFP frontier in 2000 (see Klenow and Rodríguez-Clare, 2004). According to KR, the steady-state productivity gap in KR model is a decreasing function of: a) the country's research intensity, b) the country's steady-state capital per effective worker, c) the marginal productivity of research, and d) the ability to capture the sources of technology diffusion from abroad that do not depend on domestic research efforts.[72]

KR calibrate the world economy in their model to match the observed TFP gaps relative to the world in the world. In order to generate this match, they need to use different research intensities than those officially recorded. In the case of Argentina they require a research intensity of 1.21% GDP instead of the recorded one (0.41% GDP), which they argue as making sense because many innovation-related expenditures are not recorded as so, especially in productive activities. Their predicted gap for 2000 matches well the observed gap relative to the frictionless world technology frontier (see the first column and first row in Table 41).[73]

We provide an alternative calibration of KR model to replicate the observed TFP gap in 2000, which uses the observed research intensity and a different value for the capital income

[72] Technology in KR is given by $Y = K^{\alpha}(AhL)^{1-\alpha}$, where K is physical capital, h is human capital per worker and A is TFP. Productivity growth is given by $g_A = (\lambda s_R k + \varepsilon)(1 - a)$, where g_A is TFP growth, s_R is the research intensity (R/Y), k is output per effective worker (Y/AL), which depends positively on the amount of physical and human capital per worker, λ is a constant marginal productivity of research ε is a constant parameter that captures the sources of international technology diffusion that do not depend on domestic research efforts and a is the technology gap with the world. In KR model the country's TFP growth in steady state is the world TFP growth, and its research intensity determines only its productivity gap with the world, which is given by $a = 1 - g_A / (\lambda s_R k + \varepsilon)$.

[73] Some key parameters for this calibration are $\alpha = 0.33$ following the literature consensus, $\varepsilon = 0.015$ for which there is no empirical estimation and which is chosen freely to fit the model, and $\lambda = 0.38$, chosen to match the social rate of return to R&D implied by the model with the social rate of return estimated econometrically by (Griliches, 1992). Given that their expression of the SRR to research is non-linear, there is another, higher, value of λ that KR choose not to use on the grounds that it would yield a too high prediction of TFP for the US. They also have to compute the capital per effective worker $k = Y/AL = (K/Y)^{\alpha/(1-\alpha)}h$, where $h = e^{\varphi MYS}$, $\varphi = 0.085$ are the Mincerian returns to schooling estimated by Patrinos and Psacharopoulos (2002), and *MYS* are the mean years of schooling of the adult population, obtained from Barro and Lee (2000).

share that is consistent with the Argentine national accounts and which we used in our growth accounting exercises.[74] The predicted gap is shown in Table 41.

We next analyze whether the observed decline in the Argentine TFP distance vis-à-vis the frictionless world technology frontier can be a transition towards a new steady state gap caused by changes in the steady state capital per effective worker and/or in the research intensity. Between 1980 and 2000, the TFP distance to the frictionless frontier increased 13.8 percentage points (22%), capital per effective worker, as defined by KR, increased 9.9% using the KR parameter values and 5.6% using our parameter values (see footnote 65 for the definition of this variable), while the recorded research intensity fell 0.52 percentage points (56%) if we use the 1975-79 Lederman and Saenz (2005) data as being representative for 1980, and rose 0.02 percentage points (4.6%) if we take the 1980-84 as the representative data. The results are shown in the second and third rows of Table 41. We obtain that the observed widening in the TFP gap relative to the frictionless frontier cannot be explained by the change in the capital per effective worker alone, as it is revealed by the KR calibrations (first column) which maintain unchanged the 2000 research intensity, and by our calibrations using the 1980-84 research intensity (which is practically identical to the 2000 values). The model actually fits very precisely the actual gap in 1980 when we use the 1975-79 data for research intensity, which we consider to be more representative of the actual 1980 figure, given that the collapse in research intensity during 1980-84 was most likely driven by the 1982 debt crisis.

Hence we conclude that the decrease in the observed TFP relative to the world frictionless frontier was largely driven by the observed collapse in research intensity. In KR's framework, this collapse in research intensity can result from bigger capital income taxes, lower R&D subsidies and/or bigger research spillovers that reduce the appropiability of the social returns to innovation, or from a disengagement with the world flow of ideas that reduces the country's own technology frontier relative to the frictionless frontier. We will explore these possibilities, but before doing so we will analyze the predicted SRR to research that the KR model calibrations yield and contrast them to our estimated SRR.

Table 42 presents the calibrated social rates of return for 2000, using the KR parameter values and our own parameter values, which are shown to be extremely bigger than the SRR we estimated econometrically.[75] One possible reason for this wide difference is that the calibration done here assumes that Argentina's technology frontier is the frictionless world technological frontier, i.e., that it fully benefits from world technological spillovers. This leads to a very large productivity gap, which generates a large SRR to research. If instead Argentina had undergone a

[74] In order for our calibration to fit the Argentine TFP gap relative to the frictionless world technology frontier in 2000, we must assume that the parameter λ is 0.7, which is consistent with the fact that the KR calibrations admitted two possible values for this parameter.

[75] In KR's model the social rate of return along a steady state path is given by $(1 - \alpha)\lambda k(1 - a) + (\varepsilon(1 - a) - a g_A/(1 - a)) + g_L$.

disengagement process, its technology frontier could be much lower than the world frictionless frontier, hence having a relatively small gap vis-à-vis its own frontier and a low SRR. We analyze this possibility next.

The effect of disengagement on the TFP gap in KR model

By disengagement we mean any interference with the world flow of ideas that reduces the technological frontier that a country faces. At the end of this section we analyze the different channels for international technology diffusion that the literature has identified and measured, and how they have changed over time, and evaluate how Argentina has been faring on this matter. Here we analyze the effects of disengagement in the more abstract way that is presented in the KR model.

KR explore the possibility that all countries grow at the same long run growth rate, which feeds from the research intensities of all countries, but that each country has its own technology frontier, and that the spillovers it receives from other countries depend on the "distance" it has to these other countries. The distance between countries could represent all the barriers to technology transfers between them (geographical distance, linguistic barriers, barriers to trade, migration and FDI, poor communication infrastructure, etc.). The technological frontiers for all countries grow at the same steady state rate than the frictionless rate. In this formulation, the steady state relative productivity depends on the same factors as before, but now it is defined relative to the country's own frontier and not relative to the world frontier, as before. The social rate of return to innovation now depends on productivity relative to the country's own frontier, and not relative to the frictionless frontier as before.

This formulation can be used to explain Argentina's lacklustre TFP growth since 1975 as the result of a reduction in engagement (increase in the "distance" to other countries) which, despite not affecting the steady-state relative productivity vis-à-vis the own frontier and the steady-state research intensity, does reduce the country's own frontier, leading to a reduction in the relative productivity vis-à-vis the world's frictionless frontier, which is the one we observe in the data. This formulation also tells us that the measured relative productivity vis-à-vis the world's frictionless frontier underestimates the true relative productivity vis-à-vis Argentina's own frontier, thus leading to an overestimation of Argentina's true SRR to research and innovation in the calibration of the KR model.

Hence if there had been a tightening in the barriers to technology transfers after 1980 Argentina could have entered transitional dynamics towards a lower steady state technology frontier. This decline in the technology frontier would demand a transitional decline or stagnation in TFP until the new steady state is reached. The new steady state would display the same distance to the country's own technological frontier, but a bigger distance to the world frictionless frontier, which is the one we measure with the data.

Based on this, we calibrate the productivity gap relative to the own frontier that would be required to equate the calibrated SRR to research in KR model to the estimated SRR.[76] We find that the steady-state TFP relative to the own frontier would be 88.61% using the KR parameter values and 91.99% using our parameter values. This would imply that Argentina's own technology frontier is 55-57% the world frictionless frontier, and that there would be large productivity gains from increasing the level of engagement with the world flow of ideas.

Hence the apparently contradictory combination of low research intensity together with a low SRR to research and innovation can be easily reconciled if we permit a low level of engagement with the world flow of ideas.

This finding of a relatively low own technological frontier is consistent with our previous finding regarding the relatively low quality frontier, as defined by Hwang (2006), that Argentina's exports appear to have.

The effect of disengagement on steady-state TFP growth in Howitt's model:

We now consider the possibility that low TFP growth in Argentina is a steady-state outcome, to which end we will calibrate the model developed by Howitt (2000). This model allows for divergence in steady state growth rates when countries disengage fully from the world flow of ideas. In isolation the country's growth rate would depend solely on its own research intensity, its steady state capital per effective worker and the marginal productivity of research.[77] KR do not adopt this formulation, as it would fail to generate convergence in growth rates in steady state. We nevertheless explore its implications.

The calibrations made regarding the steady-state growth rates using 1980 as a starting point yield predicted steady state growth rates that range between 0.38% and 2.44% depending on the underlying parameter values, which tend to be bigger than the observed TFP growth rate for 1980-2006 (0.5% per year if we do not adjust for human capital, and 0.1% if we make this adjustment).[78] If we calibrate the predicted steady state TFP growth rates starting in 1998, the model predicts that they should be in a 0.36-1.22% range, again much bigger than the observed (utilization and human capital adjusted) TFP growth between 1998 and 2005 (-0.22%).

While some of the predicted steady-state TFP growth rates starting in 1980 would be relatively close to the observed rates between 1980 and 2006, the calibrated SRR to investment in 2000 would be in the 24-147% range which is much larger than the estimated SRR. Hence we conclude that the observed TFP slowdown cannot be explained as a steady state growth rate in isolation.

The case of no research and innovation

[76] See footnote 68 for the KR formula for the SRR to research.

[77] The steady-state TFP growth rate in isolation would be given by $g_{Ai} = \sigma\lambda k_i s_{Ri}$, where σ is a spillover parameter.

[78] For these calibrations we use the same parameter values as in the calibrations of the KR model, and add a sensitivity análisis for different arbitrary values of the spillover parameter σ ranging from 0.25 to 0.75.

Howitt (2000) generates the possibility of "club convergence" in which some countries with positive research effort converge to the same steady state productivity growth rate via technological transfers, whereas countries with nil research effort stagnate. In his model, firms in one country could fail to undertake research and innovation activities when there are large enough R&D taxes (or small subsidies) and/or a low savings rate that reduces the long-run capital per effective worker, lowering the private returns on innovation. A large enough interest rate and/or capital income taxes would generate the same result.

Argentina's recorded pure R&D effort is quite small, 0.41% GDP, and private firms participate with only 30% of the total research effort; i.e., business oriented R&D amounts to just 0.12% GDP. If we consider instead the research intensity calibrated by KR for Argentina under engagement, 1.21% GDP, privately generated research would represent only 0.36% GDP. In both cases the research effort would be very small. If we interpreted this small research effort as a case of no research and innovation à la Howitt (2000), then the declining relative productivity would result from the stagnation in local TFP while world TFP keeps growing. This possibility does not sound too farfetched, as average TFP growth rates for Argentina since 1975 are 0.2% if we do not adjust for human capital accumulation and -0.2% if we make this adjustment (computing the human capital per worker as described in footnote 66).

However, the social rate of return to R&D would be very high in Argentina if it started from nil research under engagement, while we estimate the SRR to be quite low.

Has Argentina disengaged from the world flow of ideas?

The survey of the empirical work on international technology diffusion (ITD) by Keller (2004) reveals that inward flows of foreign technological knowledge are an increasing source of domestic productivity growth.[79] While in the past technology creation and diffusion was highly concentrated on a geographic basis, there is compelling evidence that the rate at which knowledge spillovers decline with distance has fallen substantially between the mid-1970s and the 1990s (Keller, 2001a,b). This is consistent with a strong decline over time in the degree of geographic localization of technology; i.e., technological knowledge has become less country-specific recently. International technology diffusion now depends more on trade and investment integration than 30 years ago. There is an increasingly common pool of global technology, and countries that are not sufficiently integrated to world trade and investment fall behind, having access to a smaller technological frontier. This means that until the 1970s technological knowledge was more geographically localized, and TFP growth probably depended more on your own technological effort. Since then de-localization has favored those countries that became more integrated.

[79] For instance, between 1983 and 1995 the contribution of technology diffusion from G-5 countries is on average almost 90% of the total R&D effect on productivity in nine other OECD countries (Keller, 2001a).

International knowledge flows appear to be the result of deliberate activities geared towards learning and conforming to international standards via the interaction with foreigners and local efforts of technology adoption. The available empirical evidence reveals the following channels for international technology diffusion:

- Imports of capital goods with embodied technological knowledge originating in high knowledge countries (Coe, Helpman and Hoffmaister, 1997; Xu and Wang, 1999; Eaton and Kortum, 2001; Blyde, 2001).
- Inward flows of FDI from high-knowledge countries that are met with a relatively high absorptive capacity, as measured by own R&D investments (Kinoshita, 2000).
- High quality of information and telecommunications infrastructure that facilitate communication between geographically distant persons and the transmission of codified knowledge and also of some tacit knowledge as well. The telecommunications revolution has greatly reduced the role geographic distance and enhanced the importance of economic integration (the international vertical disintegration of production is an example of this).

Keller (2001b) attributes more than half of the total international knowledge flows to imports, and the rest in equal parts to FDI and communication links.[80] When all these channels are considered together with distance, Keller does not estimate a geographic localization effect anymore.

The available empirical evidence also reveals that the major determinants of successful technology diffusion from abroad include:

- The level of development. International knowledge flows from high knowledge countries have stronger effects on growth in the relatively rich than in the poorer countries (Keller, 2001d).
- The abundance and quality of human capital (Eaton and Kortum, 1996; Xu, 2000; Caselli and Coleman, 2001).[81]
- Indigenous adaptive R&D (Griffith, Redding and Van Reenen, 2000; Kinoshita, 2000).[82]

[80] This is found in an industry-level analysis of spillovers among the G-7 countries that reveals significant effects for imports, inward FDI, as well as communication links.

[81] Eaton and Kortum (1996) find that inward ITD, as measured by international patenting, is increasing in the level of a country's human capital. Xu (2000) finds that the reason why relatively rich countries benefit from hosting US multinational subsidiaries while poor countries do not as much has to do with a threshold level of human capital in the host country. Caselli and Coleman (2001) find that computer imports (a measure of inward ITD) are positively correlated with measures of human capital.

[82] Griffith, Redding and Van Reenen (2000) find that catch-up to distant technology frontiers is particularly rapid if there are substantial R&D investments in low productivity industries, and catch-up is also faster the bigger is the domestic stock of human capital.

- The pattern of specialization. There are a number of results suggesting that the strength of international technology diffusion for certain types of high-tech products could be easily two to three times bigger than for the average manufacturing good (Keller, 2004).
- Policies and institutions. Well functioning markets and an undistorted trade and FDI regime are conducive to bigger learning effects (Keller, 2004).

The empirical evidence available for Argentina suggests that the country has failed to acquire the levels of trade and FDI integration with high knowledge countries that are required to successfully tap the increasingly common global stock of technological knowledge. As the importance of geographic distance vanished since the mid-1970s and the role of integration rose in importance, Argentina did not engage enough in the world flow of ideas. Additionally, as we will show in the next sub-section, the country does not have an adequate endowment of human capital with research skills in the productive sectors and has a pattern of specialization that is biased towards goods with low catch-up possibilities (low technological frontier).

The available evidence shows that:

- Argentina has maintained a revealed inward orientation, which shows up in the form of non-growing participation in world trade and relatively low openness, and low discovery of modern activities.
    - Argentina's world trade share currently stands at 0.39% (even lower than in 1980), while at the same time countries like Brazil and Chile have been increasingly steadily their participations in global trade (see Figure 28).
    - Argentina's current trade/GDP ratio in 2004 constant PPP is 22.9%, whereas its natural openness, estimated via gravity equations, is 46.6% (see Wei, 2001).
    - The ratio of domestic to international terms of trade is no different today from what it was at the heyday of the import substitution era (see Hopenhayn and Neumeyer, 2003).[83]
- Argentina imports of capital goods relative to its GDP are below what is expected for its level of development (see Figure 29). While the average developing country, with a PPP $ 1,800 per capita GDP, shows a 5.92% capital good import/GDP ratio, Argentina, with a PPP $ 4470 per capita GDP, has a capital good/GDP ratio that reaches only 3.55%.
- While in 1995 66% of all Argentine capital goods imports came from the EU and the US, nowadays only 30% comes from those origins, while the share of imports from

[83] The domestic terms of trade are computed as the ratio between the domestic price of imported goods and the domestic price of agricultural goods (representative of export goods). The index is calculated until 2000. We do not update it, but the introduction of sizable export taxes, especially on those goods that make the largest share of exports, are likely to have maintained this bias.

Brazil rose from 10% to 32% (see Table 43). Part of this diversion was due to the formation of Mercosur in 1995 and another part to the currency devaluation in 2002.[84]

- FDI flows to Argentina are low compared to other Latin American countries (see Figures 16a-c), which is combined with low local R&D intensity.
- The indicators for ITC infrastructure are usually greater or equal than what it would be expected for its level of development, although they are far worse than those of industrialized countries (see Figure 17b).
- Price and quantity data reveal that human capital with skills for research in productive activities is scarce (see the next sub-section). There is however a relatively large reserve stock of researchers in the public sector and universities that could be adapted to the business sector needs.
- Argentina has specialized in export activities with low sophistication, as defined by HHR, and with a small frontier for technological catch-up, as defined by Hwang (2006).
- Argentina faces not only policy distortions that discourage capital good imports from high-knowledge countries and trade in general, but also distortions that affect efficient allocations in factor markets (see Sánchez and Butler, 2004).

Hence the process of unilateral trade liberalization that took place in the late 1980s appears not to have been sufficient or adequate for large ITD towards Argentina. One important feature is that it has mostly signed regional trade agreements with low-knowledge countries (like Mercosur). Another important point is that the policy and regulatory environment towards FDI shifted from unfriendly in the 1980s to friendly in the 1990s and again to unfriendly in the aftermath of the 2001-2002 crisis. This seesaw attitude towards FDI has also limited the extent of progress in the telecommunications infrastructure after all the improvements in the 1990s. What is more, while the 2002 currency devaluation appears to have been important to alleviate savings constraints, it has come at the price of raising the relative price of imported capital goods promoting a switch to imports from low cost - low knowledge countries.

6.3. Human capital

We exhaust the low social returns to innovation branch by exploring to what extent inadequate human capital may be a binding constraint to this activity. We analyze this issue following the HRV GDM, measuring quantities and prices of research related human capital in

[84] Several authors have associated these low capital good imports to high relative prices of investment goods. Eaton and Kortum (2001) find that twenty five per cent of the cross-country productivity differences among 34 more- as well as less developed countries can be attributed to differences in the relative price of equipment. In this vein, the relative price of imported equipment vis-à-vis consumption has been historically much higher in Argentina than in countries like the US. Between 1980 and 2001, the Argentine relative price of investment was between 20 and 39% bigger than in the US. The 2002 devaluation further raised this relative price in Argentina, which in 2004 was 66% bigger than in the US, while in 1950 it was 87% bigger (see Figure 30). Nevertheless, Hsieh and Klenow (2006) have shown that the absolute prices of capital goods tend to be the same in most countries, both developed and developing, and that differences in this relative price are led by differences in the prices of consumption.

an international perspective. The available evidence reveals a relative scarcity of human capital for research activities in the business sector which is reflected both in its price and quantity.

Table 44 shows that Argentina has a relatively larger participation of researchers and graduates in engineering in its labor force vis-à-vis other countries that have a bigger R&D intensity. However, only 10% of all Argentine researchers are in the business sector, whereas in countries with lower innovation-related human capital but bigger R&D intensity there is a much bigger allocation of researchers to the business sector (see Table 45).

This low allocation of researchers to production activities could reveal low demand resulting from the small participation of the business sector in research activities. However, the relatively high wages of university professors and chemical engineers vis-à-vis industrial workers in Argentina when compared to other relevant countries suggests that human capital could be a binding constraint to innovation in Argentina (see Table 46). Nevertheless the relative abundance of public sector researchers could eventually be transformed into a relative abundance of business sector researchers provided other binding constraints to innovation are alleviated first.[85] Thus far there appears to be a malfunctioning of the national innovation system that creates a wide gap between research activities in Argentina and the productive sector research needs.

6.4. Low appropiability

We now analyze jointly the roles of market and government failures that lower the appropriability of the returns to research and innovation via an ad hoc econometric analysis, which also analyzes the roles of complementary investment in physical capital and of the availability of financing. We also look, via literature review, at government failures that prevent technological upgrading via creative destruction.

We conclude that poor IPRs are a highly binding constraint to research and innovation in Argentina, and that regulatory and policy barriers to creative destruction (such as trade policies and labor market regulations) also have a deleterious effect on innovation. The potential important role of poor IPRs was also highlighted by our previous finding of a very low market valuation of intangible assets in Argentina.

Direct effect of government and market failures on research and innovation activities in Argentina

In our analysis of the link between TFP growth and research we showed that the large decline in the research intensity between the late 1970s and today is consistent with the

[85] When analyzing the emergence of biotechnology applied to human health as a successful new export activity, Sánchez et al (2007) find that one of the keys for this success was the possibility to tap into a relatively large endowment of life science researchers in the public sector and universities that was previously devoted to academic research. While their suitability for the new activities was initially conditioned by their lack of experience in commercially oriented research, these scientists could eventually adapt to commercial R&D, to which end Argentine expatriate scientists provided the required training.

divergence in productivity. We showed that this decline is consistent with a large extent with a decline in engagement. Now we explore to what extent the currently low R&D effort can be due to low appropriability. To this end we will conduct an econometric analysis that is based on KR's prediction for the determinants of research intensity in steady state.

KR's model shows that the steady state research intensity will depend negatively on capital income taxes, R&D taxes and the inability to appropriate the social returns to innovation (poor IPRs). The stock of capital per effective worker will have a positive effect on relative productivity and an ambiguous effect on the research intensity. This relationship is highly non-linear.

We take a crude approximation by running a cross-country linear regression of research intensity in 2000 on a set of regressors that include corporate income tax rates, appropriability indicators (the property rights score from the Heritage Foundation and the software piracy rate from Business Software Alliance), and the capital per effective worker. We add the market capitalization/GDP ratio to control for possible financial constraints on research.[86] The results are shown in Table 47. We obtain that software piracy rate has a significant and robust negative effect on research intensity. Property rights, as proxied by the indicator of the Heritage Foundation, have no significant effect; the sign for its coefficient is negative only when software piracy rates are excluded from the regression. Bigger corporate income taxes do not appear to have a significant effect, and their coefficient is actually positive, which is probably caused by a positive association between corporate income taxes and R&D subsidies, which we are not including among the regressors because of the lack of adequate data. The coefficient on financing has a positive coefficient but is not significantly different from zero. Bigger capital per effective per worker has a positive coefficient which is only significant when the software piracy rate is not included in the regression, which is probably due to the fact that richer countries have better IPRs.

In order to check how binding poor IPRs may be for research and innovation in Argentina we use the coefficients estimated in regression 3 in Table 47 to compute the contribution of the deviation of software piracy rates from its cross-country mean for several countries to the deviation of research in from the cross-country mean in each of those countries. The results are shown in Figure 31 and reveal that poor IPRs (in the form of large software piracy rates) explain 98% of the Argentine below average research intensity, and that these poor IPRs matter much more for its low research intensity than in other research-poor countries such as Chile and Malaysia.

[86] The countries included in the regression are Argentina, Australia, Brazil, Chile, Malaysia, the US, Austria, Belgium, Bolivia, Canada, China, Colombia, Costa Rica, Finland, France, Honduras, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Luxembourg, Madagascar, Mauritius, Mexico, Netherlands, Pakistan, Panama, Peru, Portugal, Romania, Spain, Thailand, Tunisia, Turkey, Uganda, the UK and Uruguay.

These poor IPRs and their negative effects on research and innovation in Argentina are consistent with our finding in Annex II that the elasticity of market valuation to investment in intangible assets in Argentina is dramatically lower than in industrialized countries, which suggests that the appropriability of the social return to innovation is very poor in this country.

Barriers to creative destruction

There is a vast theoretical and empirical literature on how TFP growth is largely driven by the reallocation of employment from obsolete production units to new firms that enter the market with top-of-the-line technologies when the economy is undergoing a recession (see, among others, Caballero and Hammour, 1996 and 2000, and Davis and Haltiwanger, 2001, on this subject). In this setup, factor and product market regulations and credit market imperfections that interfere with capital and labor relocation in response to shocks will have negative effects on productivity.

Previous work on labor market and productivity in the manufacturing sector in Argentina during 1991-2001 done by Sánchez and Butler (2004) shows that Argentina has relatively low rates of job reallocation and creative destruction, which hamper productivity growth by preventing the displacement of obsolete jobs by new jobs in technologically upgraded activities.[87] These authors additionally found that creative destruction was constrained by the protectionist bias of trade policies and by rigid labor markets.

6.5. Finance

Our analysis of binding constraints to investment revealed that Argentine firms are financially constrained for any kind of investment. In this vein, the National Innovation Survey (ENICT) for 1998-2001 reveals that financing was the main declared obstacle to innovation. According to this survey, financing was the main hurdle to research and innovation for 69% of all the Argentine manufacturing firms and for 75% of the small firms, while the IBGE Innovation Survey in Brazil shows that financing was the main constraint to investment for only 60% of all firms and for 60% of the small firms. This finding is reinforced by previous work by Sanguinetti (2006) on the impact of financing of R&D and innovation through FONTAR's public funding, who finds that this sort of public financing had a positive incremental impact on R&D.

7. Binding constraints to productivity enhancing resource allocation

We now move to the decision tree that analyzes the binding constraints to productivity enhancing resource allocation. This tree involves two branches. The first one considers the binding constraints to structural transformation of exports and was already analyzed in Section 5. The second one, which we explore now, deals with the constraints on resource allocation to

[87] Haltiwanger et al (2004) show that Argentina's gross reallocation of manufacturing between 1990 and 2000 was 14.1%, far smaller than in Brazil (32.1%), Chile (23.8%), Colombia (19.8%) and Mexico (27.9%), and bigger only that in Uruguay (13.8%).

activities that have bigger productivity and/or offer bigger scope for productivity growth, such as advanced manufacturing.

This is a relevant tree to explore. Hsieh and Klenow (2007) use micro data to find that the gaps in marginal products of labor and capital within narrowly defined industries in China and India are sizable relative to the US. These authors estimate that if capital and labor were reallocated such that these gaps across plants are similar to those observed in the US, manufacturing TFP gains could reach 30-45% in China and 40-50% in India. The output gains would be twice as big if physical capital accumulates to restore the original average marginal product of capital. The binding constraints that they suggest (but do not test for) include credit market distortions, and regulatory barriers to entry and to factor reallocation. Jones and Olken (2005) have also shown that upward shifts in growth regimes require substantial reallocation towards manufacturing (and especially to advanced manufacturing) in order to boost TFP growth.

7.1. Resource allocation in Argentina

In the case of Argentina, Hopenhayn and Neumeyer (2003) (HN) use a growth accounting analysis to show that one fourth of the 25% decline in per capita GDP between 1975 and 1990 can be explained by the fall in the capital/labor ratio and a labor reallocation analysis to demonstrate that 44% of the fall in output per worker is accounted for by the reallocation of labor away from tradable activities and towards non-tradable sectors with a declining output per worker. Our analysis of lack of shifts in regime growth using the metrics of Jones and Olken (2005) and of Hausmann, Pritchett and Rodrik (2004) revealed that during its unsustained growth accelerations Argentina never underwent the increase in trade and in manufacturing that are associated to upward regime shifts, and that the current growth acceleration is not different in this regard thus far. Sánchez and Butler (2004) find that intra- and inter-sectoral reallocations within the manufacturing sector contributed significantly to productivity growth during the 1990s but that reallocations were dampened by import tariffs and by labor market rigidities.

Next we update for 1993-2006 the HN analysis of the evolution of output per worker decomposing it between within sector productivity growth and between sectors reallocations, and gauge how the constraints to productivity boosting resource allocation identified by these authors have evolved during this period.

The contribution of TFP, capital per worker and factor utilization

As it was shown in Section 3, TFP growth explained 121% of the growth in output per worker (1.3%) between 1991 and 2006 when we do not adjust for factor utilization and human capital, while the declining capital per worker contributed with a negative -21% (Table 2). On the other hand, when we adjust for factor utilization and human capital TFP growth explains between 42% and 59% of per worker output growth between 1994 and 2005, depending on the sub-period (Table 4). Rising capital per worker contributes with 31% of growth during 1994-

1998 and has a negative contribution that ranges between -36% and -57% during 1999-2005. Factor utilization plays the biggest role during 1998-2005, accounting for approximately 100% of the observed per worker output growth. Hence factor utilization followed by TFP growth was the key driver of per worker output growth during this period.

Labor reallocation and output per worker

Contrary to what was observed during 1975-1990, when there was a substantial reallocation of labor towards services (see HN), the sectoral employment shares during 1993-2006 were pretty stable (see Table 47). If anything, there was a small increase in the share of services at the expense of manufactures and agriculture, hence continuing the trend of 1975-1990, albeit more weakly. Figure 31 shows that during 1993-2006, most of the total employment growth (29%) was generated by the services sector, where employment grew 36%, while employment in the other two sectors grew less than 10%. Instead during 2002-2006 there was a more dynamic behaviour of manufacturing employment, which grew 32%, that was not enough to increase it share in total employment, as employment in services still grew 30% during its period.[88]

To measure the extent of reallocation, we estimate the following index proposed by HN:

$$R_{t,t+1} = \tfrac{1}{2} \sum_i | l_{it} - l_{i,t+1} |$$

Where l_{it} is the share of total employment of sector i in period t. This index ranges from zero, when there is no reallocation, to one, when all employment moves to previously not existing sector. Table 48 shows that for the 1993-2006 period reallocation (0.075) was neither too big nor too small, as the reallocation indexes reported by HN for the 1970-1993 period range from 0.065 for 1987-1993 to 0.135 for 1970-1980. However, the reallocation index for each sub-period was rather low, ranging from 0.0207 during 1999-2001 to 0.0502 during 1993-1998. The reallocation index for the post-devaluation period is rather low (0.0407). Hence there was not much reallocation to manufactures to revert the 1975-1990 trend.

We now analyze the implications of this little reallocation of labor during 1993-2006 for the growth of output per worker. To this end we decompose the change in output per worker into its components: labor productivity growth within each sector, labor reallocation, and the interaction between both effects. The following formula is used to measure these effects between periods t and $t+n$:

$$(1/n) \ln (y_{t+n} / y_t) = (1/n) \ln (\textstyle\sum_i l_{it}\, y_{it+n} / \sum_i l_{it}\, y_{it}) + (1/n) \ln (\sum_i l_{it+n}\, y_{it} / \sum_i l_{it}\, y_{it}) +$$
$$(1/n) \ln [(\textstyle\sum_i l_{it+n}\, y_{it+n} / \sum_i l_{it+n}\, y_{it}) / (\sum_i l_{it}\, y_{it+n} / \sum_i l_{it}\, y_{it})]$$

[88] One important difference with the 1975-1990 period is that during that time employment the services sector was largely driven by public employment, whereas during 1993-2006 employment in the public administration grew only 12%.All this growth took place during 2002-2006, when government employment grew 15%.

The first term in the right hand side measures the within change, which reflects the contribution of labor productivity growth in all sectors maintaining constant the initial labor shares. If there is balanced growth, this term should account for 100% of the change in output per worker. The second term corresponds to the between change, measuring how much of the growth in output per worker is due to reallocation towards sectors with bigger or lower productivity, maintaining constant the initial productivities. The third term is an interaction effect that is negative if there is a transfer of labor to sectors with relatively low rates of growth of output per worker. This interactive effect was the dominant effect in Argentina during 1975-1990 (see HN).

Table 49 shows the results of this growth decomposition analysis. It reveals that the within component accounts for all the observed change in output per worker during 1993-2006. During this period there was a positive reallocation effect from initially low productivity primary activities to initially more productive service activities, which was offset by the negative interaction effect that arose from relocating labor from primary activities and manufacturing, which had large productivity growths (see Table 50), towards services, which had a poor productivity growth. As a result aggregate labor productivity growth was quite close to the sluggish behaviour of productivity in the services sector.

Hence there failed to attain a reallocation towards the sectors with bigger productivity growth, which contributed to yield a low growth of output per worker during 1993-2006 (0.6%). We also observe that during the post-devaluation period the within effect accounts for 77% of the observed growth in output per worker. There is also a positive contribution of reallocation from initially less productive primary activities to more productive manufacturing and service activities (38% of the observed productivity growth) which is partially offset by the continuing reallocation of labor to the low productivity growth services sector. The pre-devaluation period shows a similar pattern.

We focus next on the determinants of the lack of reallocation towards manufacturing, which had the largest initial productivity and also the fastest labor productivity growth during the period. HN explain the reallocation away from manufactures during 1975-1990 as resulting from policies and shocks that raise the cost of capital, inducing a decline in the steady state capital stock and prompting a reallocation from more productive tradable activities that have a low substitution between capital and labor towards non-traded activities.

HN report a real 97% average annual interest rate for 1983-90. This rate fell to an average 9.4% during 1994-2006, which included averages of 9.3% for 1994-1998, 18.7% for 1999-2002 and 0.2% for 2003-2006 (see Table 9). Hence the decline in the real interest rates during 1993-2006 has not sufficed to raise the attractiveness of capital intensive manufactures. The existence of financial constraints may help explain this outcome. The real exchange rate appreciation of the 1990s (see Table 9) may have contributed to the lack of reallocation towards manufactures between 1993 and 2001. However the 2002 devaluation led to a growth of

manufacturing employment that is roughly equal to the rise in employments in services. In this case it is possible that the potentially beneficial effect of the devaluation was partly offset by its effect on the relative price of investment.[89]

Finally, HN argue that the expectation of trade liberalization which would reduce the domestic relative price of manufactures deterred irreversible investments in this sector during 1975-1990. They base this argument on the observed decline in the ratio between the international terms of trade and the domestic terms of trade from a value of 149.50 in 1975-1990 to 117.52 during 1991-2000. Their argument would explain why most of the reallocation away from manufacturing occurred before the liberalization took place in the late 1980s to early 1990s. However, the domestic terms of trade have decreased significantly since the 2001-2002 crisis through the introduction of large and variable export taxes to primary exports and of a plethora of quantitative restrictions to manufacturing imports from Brazil and China, together with an increased use of countervailing measures, and yet reallocation towards manufactures has failed to materialized.

We conclude that the presence of financial constraints, together with offsetting movements in the real exchange rates and the relative price of investment, has prevented the reallocation of labor towards activities with faster productivity growth. Labor market rigidities, such as the prohibition to fire workers during 2002-2003 together with the doubling of severance payments between 2002 and 2007, among others, are likely contributors to this outcome.[90]

8. Conclusions: the Argentine growth syndrome

Argentina's growth problems involve a very low trend growth and an inability to turn its periodic growth accelerations into a sustained shift towards bigger trend growth, which has led to a divergence from world income and productivity growth during the past three decades. Both low investment and poor TFP growth arising from insufficient structural transformation and research and innovation have contributed to this outcome.

In order to adequately frame the Argentine growth syndrome and identify the most binding constraints to growth, we must first analyze the potential contributions to growth that can be derived from eliminating constraints on investment and on productivity enhancing activities and how feasible or costly it is to do so. The ideal thing would be to measure the size of the Lagrange multipliers for binding constraints on growth, which cannot be done. Instead we

[89] Figure 30 shows that the relative price of investment vis-à-vis consumption in Argentina compared to that same relative price in the US remained very stable between 1975-1990 and 1991-2001, but rose very significantly after 2002 with the devaluation.

[90] In this vein, Sánchez and Butler (2004), using a structural VAR analysis of manufacturing job flows and labor productivity, found that the more flexible labor market environment that prevailed between 1995 and 2001 facilitated reallocation within the manufacturing sector and a bigger synchronization between job creation and destruction. Hence the tightening of the labor market after 2002 is likely to have generated the opposite outcome.

undertake a heuristic approach that entails assaying how costly or feasible it would be to remove one constraint compared to how much it would contribute to bigger growth.

A disciplined way to do this identification is to set first a growth target, and then to look at the required investment rates and/or TFP growth rate. We set the target for GDP per capita growth at 4% per year, which is the one that is estimated to cut poverty rates in half after 10 years. This target rate is estimated using the methodology proposed by Bourguignon (2001).[91]

A growth accounting exercise shows that if the current investment rate (21.7% GDP at 1993 prices) and TFP growth (1.3%) were sustained, then per capita GDP would grow at 2.9% per annum. In order to rate growth to 4% per year, if TFP growth were not to improve from current levels (1.3% per year after adjusting for factor utilization), investment would be required to rise to 30% GDP (see Table 52). Domestic savings would have to rise in turn from current 23.8% GDP to 32.4% GDP (to accommodate the rise in the relative price of investment caused by the 2002 devaluation). This does not appear to be a feasible goal, given that the current level of savings (23.8% GDP in 2006 vis-à-vis 16% in 2001) was caused by the combination of large currency depreciation, sovereign debt restructuring, and the introduction of new distortionary taxes, and there is not much economic and/or social scope for further resorting to these instruments. Additionally, we cannot expect much relief from international finance. Even at times of large financial integration like the 1990s, international finance represented at most 5% GDP, which would not be enough to finance the required increase in investment. The current scenario, which includes the still unsettled debt with the Paris Club, holdouts on restructured debt, and tinkering with inflation-indexed bonds, does not appear to promising for reaching access to the required international finance.

A more feasible scenario would involve elevating TFP growth to 2% per annum, in which case the required rise in the investment rate would be only from 22% GDP to 24.2% GDP, which appears to be feasible in terms of the required increase in savings (from 23.8% GDP to 26.1% GDP), which can be more easily satisfied with a modest access to international finance (see Table 52). A final possibility is that if investment were not to rise, then TFP growth would be required to rise to 2.4% per year (see Table 52).

This leaves open the question of how to reach a 2% TFP growth (or a 2.4% TFP growth). If we plausibly assume that Argentina has already completed a transition initiated circa 1980 towards a new steady-state with a bigger productivity gap and that TFP growth has a steady-state component like the 1.3% currently observed, we have to determine what kind of improvement is required from productivity enhancing investments to add an extra 0.7% TFP growth (or 1.1%).

[91] This estimation assumes that income distribution improves during this time span, until it recovers its best level in the past 20 years (the 0.45 Gini coefficient for 1993-5).

We start with the required increase in the intensity of innovation. Calibrating the Klenow and Rodríguez-Clare (2004) model, we obtain that in order to generate the extra 0.7% TFP growth, Argentina should increase its long-run productivity by 24% over a 30 year transition period. This would in turn require raising the R&D intensity to 0.68% GDP from current 0.41% GDP (see Table 53). The respective requirements for a 2.4% TFP growth would be raising long-run productivity by 39%, and R&D intensity to 0.97%. These are relatively small and feasible improvements.

If we focused instead on improving export sophistication as the sole source of productivity growth, we can get the required improvement by using the coefficients estimated by Hausmann, Hwang and Rodrik (2005) for the impact of export sophistication on growth in their panel data regressions. To generate the required 0.7% TFP growth increase, export sophistication would have to improve between 7.6 and 49.6%, with the median estimated coefficient calling for a 15.8% improvement in export sophistication (see Table 53). The required minimum, median and maximum enhancements in export sophistication demanded to increase TFP growth by 1.1% respectively would be 12, 24.7 and 78%. The required increase in export sophistication is not too large.[92]

On the other hand, if the extra 0.7pp TFP growth were to come from improving the technology frontier of Argentine exports, as defined by Hwang (2006), using this author's estimated coefficients we would require a structural transformation of Argentine exports that is such that the unit export price relative to the OECD (the proxy for the quality/technology gap) becomes 57% instead of the current 87% (see Table 53). If the transformation were to involve only the exports of industrial manufactures, as proposed by this author, then the required increase in the quality/price gap vis-à-vis the OECD would be from the current 78.6% to 52.4%. On the other hand, if the desired increase in TFP growth were 1.1pp, then the required quality/price gaps for total exports would become 45.5% for total exports and 41.4% for industrial manufactures. This may prove to be a more challenging task, as the top 25 goods that are closest in the product space have a rather poor technology frontier (see Table 32), while goods with large technology frontiers are farther in the product space. Nevertheless, relatively small improvements (like improving the technological frontier to 71% in the case of total exports, or to 64% in the case of industrial manufactures) would provide half of the required improvement in TFP growth.

This suggests that the biggest payoffs for bigger growth come from maintaining or marginally improving the current investment rate and from undertaking relatively small, and easier to finance, improvements in productivity enhancing activities.

[92] However, it must be mentioned that such changes take some time to occur. For instance, in the case of Brazil, where export sophistication has been growing relatively fast, the income content of exports on average rose 15% every five years between 1975 and 2000.

As it was shown above, while bigger investment can contribute by itself to reaching the desired growth rate, relieving the constraints on domestic savings and international finance that would hamper required increase in investment appears to be either too costly or unfeasible because of political economy considerations. It appears more promising to aim at marginally improving current investment (from 21.7% GDP to 24.2% GDP), which would secure a 3.3% per capita growth rate, and to get the extra kick from removing binding constraints on productivity enhancing activities. Reaching this modest increase in investment rates demands preserving macroeconomic stability (so as to reduce the probability of discretionary policies and expropriation shocks), providing adequate infrastructure, and taking care of the latent constraints associated to poor financial intermediation and poor access to international finance. The removal of the more permanent sources of low appropriability that result from poor institutional design may prove very difficult.

Instead, as shown above, relatively easy to finance improvements in research and innovation may be much less costly to achieve the desired improvement in output and TFP growth rates. This small improvement in research intensity would demand policy and regulatory changes that enhance Argentina's engagement in the world flow of ideas (bigger capital good imports and FDI from high knowledge countries, better ITC infrastructure, relocating researchers from the public sector to private firms) and that improve appropriability (through better IPRs). While this strategy offers large payoffs it nevertheless demands a sizable coordination effort for the provision of the required public goods, adequate design of the programs to subsidize R&D (and information gathering), and also macroeconomic sustainability.[93]

Likewise, policies and institutions that address the coordination and information externalities that hinder the structural transformation of exports are bound to have large payoffs in terms of bigger growth. As shown above, relatively small increases in export sophistication and in the technological frontier of Argentine exports can have sizable impacts on growth.

It was also shown that even if investment were not to rise from current levels (which would still demand maintaining macroeconomic sustainability and addressing infrastructure and latent financing issues), the desired bigger growth could be achieved via improvements in technological and export innovations that are not too large and hence feasible, provided the binding constraints on these activities are alleviated.

What is more, the simultaneous removal of binding constraints on technological and export innovation would lead to bigger growth rises, lowering the demand on investment. This result should not be surprising. Since productivity enhancing activities appear to be scarcer than investment, their marginal contributions to growth should be bigger. However, the policy

[93] See Trajtenberg (2005) for a enlightening discussion of the hits and misses of the Israeli institutions and support programs for R&D, which offers important lessons for countries such as Argentina.

agenda for promoting these activities is less straightforward than removing the binding constraints on investment (infrastructure, volatility, financing), as it entails substantial information gathering, capacity building and solving coordination externalities. Hence perhaps a bigger constraint lies in the capabilities of policymakers and the time required for building these capacities.

The final conclusion is that it is not advisable to rely on alleviating constraints on only one activity, especially given their complementary natures. Each of these channels (investment and the different productivity enhancing activities) has diminishing returns when undertaken separately.[94] Hence a bit of everything is advisable, but more is required from the activities that have fallen further behind: technological and export innovation.

A complementary way to look at the Argentine growth syndrome is to consider whether the most binding constraints lie in the areas of capabilities (human capital, technological knowledge stock, past production and export experience), opportunities (value of the open forest) or of incentives (government and market failures).

Our analysis suggests that the most binding constraints lie in the area of incentives, especially in the form of government failures, and that currently microeconomic risks are what matter the most. Market failures (in the form of coordination and information externalities) also matter significantly for the structural transformation of exports. Informational asymmetries are also very important for the poor financial intermediation. Poor IPRs hurt innovation. However, government failures appear to be the common thread behind many binding and latent constraints.

Indeed we observe that microeconomic risks are currently binding barriers to FDI, to financial intermediation, to domestic investment, and to private investment in infrastructure. Past and present examples of this type of government failures include price freezes for public utilities, capital controls, bans on loan indexation, prohibitions to foreclose, asymmetric peso-ification of assets and liabilities, deposit freezes, and discretionary tax policies, to name a few.

While macroeconomic risk currently appears not to be a binding constraint, this is largely because of the combination of public debt restructuring, high export prices, political discretion and the introduction of new taxes on exports and on financial transactions the revenues of which are not shared with the provinces rather than the result of the introduction of sustainable institutional arrangements.

A poor design and functioning of institutions relevant for policy making and contract enforcement appear to be at the heart of both microeconomic and (currently subdued)

[94] Capital has the typical diminishing returns. Innovation has lower returns as we get closer to the frontier (Klenow and Rodríguez-Clare, 2004). Technological convergence at the product level becomes slower as we get closer to the frontier (Hwang, 2006). Capital accumulation and investment and complementary activities, and the steady-state productivity gap is smaller the bigger the accumulated capital per effective worker (Howitt, 2000; Klenow and Rodríguez-Clare, 2004).

macroeconomic risks. What is more, the reduction of macroeconomic risk (and of the associated changes in the rules-of-the-game) after the latest crisis has been largely attained via new microeconomic risks (like discretionary taxes, price controls, prohibitions to export certain goods, still unsettled public debt restructuring, etc.).

In this setup, Argentina has restored investment to its past highs in the previous decade, but the relief of some binding constraints came at the expense of introducing new constraints that put a cap on investment and on other productivity enhancing activities. In this vein it must be remembered that institutional quality indicators worsened at the crisis aftermath, but were nevertheless quite poor before the crisis occurred.

The common feature behind past macroeconomic risks and current and past microeconomic risks is the poor institutional design and the historical failure of the legislature, judiciary and bureaucracy to provide adequate checks and balances, together with fiscal federal arrangements that make public spending highly pro-cyclical. In this setup, macroeconomic risks may remain subdued as long as export prices remain high and the policy discretion favors fiscal sustainability and macroeconomic stability. However, sizable microeconomic risk remains. Given the endogenous nature of institutions it is hard to envision a rapid elimination of microeconomic risk. The best hope is that the eventual continuation of macroeconomic stability together with continuous growth may lead to an endogenous demand of society for institutional improvements that lead to lower microeconomic risk.

This increases the need to prioritize the removal of the binding constraints on growth that are less affected by the poor institutional design, namely the coordination and information externalities and the trade policies that hinder the structural transformation of exports, the poor IPRs and lack of fiscal policies to compensate for the technological externalities that hurt innovation and improvements on the treatment of foreign capital (like settling the arrears with the Paris Club) so as to improve the attraction of FDI from more advanced countries. Trade integration agreements with advanced countries would also help, although this can only be done by Mercosur as a whole.

This is also needed because a pure reliance on low macroeconomic risk supported by discretionary policies and good international prices is risky, as these bases can easily change. Additionally, if this strategy is not helped by bigger investment in productivity enhancement activities, there will always be a risk that real wages grow relatively slowly and that the ensuing demand for social protection jeopardizes macroeconomic stability.

It is also the case that market failures that cause low appropriability also result from poor institutions. For instance, professional politicians are beholden to provincial governors, becoming amateur legislators that rarely invest in the skills and knowledge required for the effective fashioning of laws. This is reflected in the lack of long term agendas for dealing with these issues (macroeconomic instability and changes in the rules of the game certainly did not

help) and in the shortage and/or lack of clout of tenured government official that have the skills for pursuing such an agenda. However, the lack of addressing coordination and information externalities does not appear to respond to any vested interests (as opposed, for instance, to measures such as utility price freezes, time inconsistent export taxes or debt meltdown). Hence the institutional constraint for solving market failures is less binding than in the case of microeconomic risk.

One final concern is related to the issue of finance. This is currently a latent constraint that is being circumvented with a relatively large availability of firms' internal funds. However, there is evidence of a deterioration of these internal funds that can turn financing into a binding constraint, calling for the need to remove the appropriability problems that are hurting financial intermediation and access to foreign savings.

Hence low appropriability from government failures appears to be the most binding constraint, as it is also a cause of disengagement and misallocation.

Bibliography

Abel, Andrew B, "Optimal Investment Under Uncertainty," *American Economic Review* 73 (March): 228-233 (1983).

Abel, Andrew B., Avinash K. Dixit, Janice C. Eberly and Robert S. Pindyck, "Options, the Value of Capital and Investment", *Quarterly Journal of Economics* 111: 753-778 (1996)

Artopoulos, Alejandro, Daniel Friel, Sebastián García-Dastugue, and Juan Carlos Hallak.The Emergence of New Successful Export Activities in Latin America, Universidad de San Andrés, 2006.

Aghion, P., P. Bachetta, R, Ranciere y K. Rogoff (2006), "Productivity Growth and. the Exchange Rate Regime: The Role of Financial Development", NBER WP 12117, May.

Appelbaum, Elie, and Eliakim Katz, "Measures of Risk Aversion and Comparative Statics of Industry Equilibrium", *American Economic Review* 76 (1986), 524-529.

Barro, R. and J. Lee (2000), "International Data on Educational Attainment: Updates and Implications," NBER WP 7911.

Bebczuk, Ricardo y Garegnani, Lorena, "Autofinanciamiento empresario y crecimiento económico, *Banco Central de la República Argentina*, 2006.

Bourguignon, F. (2001), "The Pace of Economic Growth and Poverty Reduction," mimeo, LACEA.

Blomström, M., R.E. Lipsey y M. Zejan, "Is Fixed Investment the Key to Economic Growth?", *NBER Working Paper 4436*.

Blyde, J. (2001), "Trade and Technology Diffusion in Latin Diffusion in Latin America," IADB Working Paper

Business Software Alliance, www.bsa.org

Caballero, R.J. and Hammour, M.L. (1996), "On the timing and effieicency of cretative destruction", Quarterly Journal of Economics, 111(3), 805-852.

Caballero, R.J. and Hammour, M.L. (2000), Creative destruction and development: institutions, crisis and restructuring, Annual World Bank Conference on Development Economics, Washington, DC:

Caselli, F. and W. Coleman (2001), "Cross-country Technology Diffusion: the Case of Computers," American Economic Review Papers and Proceedings 91:328-335.

Chisari, O., E. Corso, J. Fanelli, y C. Romero (2007), "Growth Diagnostics for Argentina," mimeo, April.

Cockburn, I. and Z. Griliches (1988), "Industry Effects and Appropriability Measures in the Stock Market's Valuation of R&D and Patents," American Economic Review, American Economic Association, vol. 78(2), pages 419-23, May.

Coe, Helpman and Hoffmaister (1997), "North-South Spillovers," Economic Journal 107: 134 149.

Davis, J.; Haltiwanger, J. (2001) Sectoral job creation and destruction responses to oil price changes, Journal of Monetary Economics, 48(3), 465-512
De Ferranti, D., G. Perry, D. Lederman and W. Maloney (2002), *From Natural* , *From Natural Resources to the Knowledge Economy*, The World Bank.

De Gregorio, José and Jong-Wha Lee (2003), "Growth and Adjustment in East Asia and Latin America" Central Bank of Chile, Working Paper No.245, December.

DeLong, Bradford and Lawrence Summers, "Equipment Investment and Economic Growth", *Quarterly Journal of Economics* 106:2 (May 1991), 445-502.

DeLong, Bradford and Lawrence Summers, 1993, How Strongly Do Developing Economies Benefit from Equipment Investment?, http://www.j-bradford delong.net/Econ_Articles/Econ_Articles.html.

Demirguc-Kunt A. and V. Maksimovic (1998), "Law, Finance and Firm Growth", *Journal of Finance*, Vol. 53, 2107-2137.

Devereux, M. and F. Schiantarelli (1989), "Investment, Finacial Factors and Cash Flow: Evidence From UK Panel Data," NBER Working Papers 3116, National Bureau of Economic Research, Inc.

Dixit, Avinash and Robert S. Pindyck, "Investment Under Uncertainty"*, Princeton University Press,* Princeton, New Jersey (1994).

Eaton and Kortum (1996), "Trade in Ideas: Patenting and Productivity in the OECD," *Journal of International Economics* 40: 251-278

Eaton, J. and S. Kortum (2001), "Trade in Capital Goods," *European Economic Review* 45(7), 1195-1235

Edwards, S. (2007), "Crises and Growth: A Latin American Perspective," NBER WP 13019, April.

Elosegui, Pedro, Garegnani, Lorena, Lanteri, Luis, Lepone, Francisco y Sotes Paladino, Juan, "Estimaciones Alternativas de la Brecha del Producto para la Economía Argentina", *Banco Central de la República Argentina*, Octubre 2006.

Fazzari, Hubbard and Petersen, 1988, vol 1, Financing constraints and corporate investment, Brookings Papers on Economic Activity.

Gallego, F. and N. Loayza (2000), "Financial Structure in Chile: Macroeconomic Developments and Microeconomic Effects," Working Papers Central Bank of Chile 75, Central Bank of Chile.

Gilchrist, S. and C. Himmelberg (1998), "Investment, Fundamentals and Finance," NBER WP W6652

Givogri, C. (1990), *La Productividad del Capital en Argentina*, IERAL.

Ghosal, Vivek, and Prakash Loungani, "The Differential Impact of Uncertainty on Investment in Small and Large Business", *The Review of Economics and Statistics* 82 (2000), 338-343.

Greenwald, Bruce, and Joseph Stiglitz, "Macroeconomic Models with Equity and Credit Rationing", in R. Glenn Hubbard (Ed.), *Asymmetric Information, Corporate finance and Investment* (Chicago: University of Chicago Press, 1990), 15-42.

Griffith, R., S. Redding, and J. Van Reenen (2000), "Mapping Two Faces of R&D: Productivity Growth in a Panel of OECD Industries," mimeo, LSE, November.

Griliches, Z. (1992), "The Search for R&D Spillovers," Scandinavian Journal of Economics, 94: S29-S47.

Hall, B. and R. Oriani (2004), "Does the Market Value R&D Investment by European Firms? Evidence from a Panel of Manufacturing Firms in France, Germany, and Italy," NBER Working Papers 10408, National Bureau of Economic Research, Inc

Haltiwanger, J., A. Kugler, M. Kugler, A. Micco and C. Pagés (2004), "Effects of Tariffs and Real Exchange Rates on Job Reallocation: Evidence from Latin America," *Journal of Policy Reform* 7: 191-208.

Hartman, Richard, "The Effects of Price and Cost Uncertainty on Investment". *Journal of Economic Theory* 5 (October): 258-266 (1972).

Hausmann, R. and B. Klinger (2007), "Structural Transformation Opportunities in Argentina," mimeo.

Hausmann, R., and Klinger, B., "Structural Transformation and Patterns of Comparative Advantage in the Product Space", CID Working Paper No. 128, Center of International Development, Harvard University, August 2006.

Hausmann, R., Rodrik, D. and Velasco, A., "Growth Diagnostics," John F. Kennedy School of Government, Harvard University, March 2005.

Hausmann, R. and Rodrik, D., "Economic Development as Self-discovery," Journal of Development Economics, December 2003, Vol. 72, No. 2, pp. 603-633.

Heston, Alan, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Hopenhayn, H. and P. Neumeyer (2003), "The Argentine Great Depression: 1975-1990," unpublished mimeo.

Howitt, P. (2000), "Endogenous Growth and Cross-Country Income Differences," *American Economic Review*, September 90, pp. 829-846.

Hsieh, C. and P. Klenow (2006), "Relative Prices and Relative Prosperity," mimeo.

Hsieh, C. and P. Klenow, (2007), "Misallocation and Manufacturing TFP in China and India," mimeo.

Hwang, J. (2006), "Introduction of New Goods, Convergence and Growth," unpublished mimeo, Harvard University

Instituto Argentino de la Energía General Mosconi (2006), *Situación Energética Argentina 2006*, Buenos Aires.

Jones, B.J. and B.A. Olken (2005), "The Anatomy of Start-Stop Growth", *NBER Working Paper Series 11528*

Jones, C. and J. Williams (1998), "Measuring the Social Return to R&D," *Quarterly Journal of Economics*, pp 1119-1135, November

Keller, W. (2001a), "Geographic Localization of International Technology Diffusion," *American Economic Review*

Keller, W. (2001b), "Knowledge Spillovers at the World's Technology Frontier," CEPR WP2815

Keller, W. (2004), "International Technology Diffusion," *Journal of Economic Literature*.

Kinoshita, Y. (2000), "R&D and Technology Spillover via FDI: Innovation and Absorptive Capacity," mimeo.

Klenow, P. and Rodríguez, A., "Externalities and Growth", Handbook of Economic Growth, Volume 1A, P. Aghion and S. Durlauf, eds., 2005, 817-861 (chapter 11)

Kydland, F. and C. Zarazaga (2003), "Argentina's lost decade and subsequent recovery: hits and misses of the neoclassical growth model"

Leahy, John, and Toni Whited, "The effect of Uncertainty on Investment: Some Stylized Facts", *Journal of Money Credit and Banking* 28 (1996), 64-83.

Lederman, D. and L. Saenz (2005), "Innovation and Development around the World, 1960-2000," World Bank Policy Research Working Paper 3774, November

Love, I. (2003), "Financial Development and Financing Constraints," *The Review of Financial Studies*, 16, 765-791

Mody, A. and M. Schindler (2004), "Argentina's Growth: A Puzzle?", IMF, February.

Myers (1977), "Determinants of Corporate Borrowing", Journal of Financial Economics, Vol. 5, 147-175.

Psacharopoulos, G. and H. Patrinos (2002), "Returns to Investment in Educagtion: A Further Update," World Bank Policy Research Working Paper 2881.

Rumelt, R. (1984), "Towards a Strategic Theory of the Firm," in Lamb, B. (Ed.), *Competitive Strategic Management*, Prentice Hall, Englewood Cliffs, NJ

Sanchez, Gabriel, Hernán Ruffo, Inés Butler and Ricardo Rozemberg (2007), "The Emergence of New Successful Export Activities in Argentina: Self-Discovery, Knowledge Niches, or Barriers to Riches?," mimeo, IDB.

Sánchez, Gabriel and Inés Butler (2007), "Inversión en Argentina: Evolución reciente y perspectivas," mimeo, IDB.

Sánchez, Gabriel, Paula Nahirñak, Hernán Rufo. "La innovación en las empresas argentinas una Mirada comparativa entre países," Julio 2006, Documento de Discusión de IERAL.

Sanchez, Gabriel and Inés Butler, "Market institutions, labor market dynamics and productivity in Argentina during the 1990´s," *Journal of Policy Reform*, 2004, December

Sanguinetti, P. (2006), "Innovation and R&D Expenditures in Argentina: Evidence from a Firm Level Survey," mimeo.

Servén, Luis, "Macroeconomic Uncertainty and Private Investment in Developing Countries", *Policy Research Working Paper2035, TheWorld Bank* (1998)

Spiller and Tommasi (2003), "The institutional foundations of public policy: a transaction costs approach with application to Argentina," *Journal of Law, Economics and Organization.*

Taylor, A. (1998), "Argentina and the World Capital Market: Saving, Investment and International Capital Mobility in the Twentieth Century," *Journal of Development Economics.*

Trajtenberg, M. (2005), "Innovation Policy for Development: An Overview," mimeo, LAEBA Meeting.

Villalonga, B. (2004), "Intangible Resources, Tobin's *q*, and Sustainability of Performance Differences," *Journal of Economic Behavior & Organization*, Vol. 54, 205-230

Wei, Shang-Jin (2001) "Natural Openness and Good Government", CID Working Paper No.61, February.

World Integrated Trade Solution (WITS), World Bank, http://wits.worldbank.org.

Xu, B. (2000), "Multinational Enterprises, Technology Diffusion, and Host Country Productivity Growth," *Journal of Development Economics*, 62: 477-493

Xu, B. and J. Wang (1999), "Capital Goods Trade and R&D Spillovers in the OECD," *Canadian Journal of Economics* 32: 1258-1274

Table 1. Argentina's per capita GDP relative to other countries

	1960	2004
United States	60.3%	30.3%
Japan	169.7%	44.4%
Asian tigers	445.0%	52.8%
Latin America (20)	213.0%	151.3%
World	315.5%	133.9%

Source: PWT and WDI

Table 2. Growth Accounting for Argentina

	GDP / L	Contribution to the GDP / L growth by	
		Capital	TFP
porcentage points			
1960-2006	0.8%	0.1%	0.7%
1960-1974	2.3%	0.7%	1.6%
1975-1990	-1.3%	0.0%	-1.3%
1991-2006	1.3%	-0.3%	1.6%
% of the GPD growth			
1960-2006		14.8%	85.2%
1960-1974		30.2%	69.8%
1975-1990		-1.1%	101.1%
1991-2006		-21.0%	121.0%

Source: IERAL from Fundación Mediterránea based on Mecon

Table 3. Contribution of factor accumulation, factor utilization and TFP growth to recent changes in growth rates between growth cycles

	Growth GDP / L	Contribution				
		Capital / Labor		Labor		TFP
		Raw	Utilization	Utilzation	Human Capital	Adjusted
Porcentage Points						
2003-05 /1999-02	6.41%	-2.97%	4.12%	2.31%	-0.01%	2.96%
1999-2002 / 1994-98	-5.89%	0.41%	-2.26%	-0.90%	0.03%	-3.18%
% of GDP / L growth						
2003-05 /1999-02		-46.3%	64.2%	36.0%	-0.1%	46.1%
1999-2002 / 1994-98		-7.0%	38.4%	15.2%	-0.5%	53.9%

Source: IERAL - Fundación Mediterránea based on Mecon

Table 4. Sources of growth during recent growth episodes in Argentina

	Growth GDP	Inputs						
		Capital		Labor			TFP	
		Raw	Utilization		Utilization	Human Capital	Base	Adjusted
Variation (%)								
1994-1998	3.95%	3.17%	0.72%	1.39%	-0.22%	0.08%	1.76%	1.51%
1999-2002	-5.07%	0.97%	-4.34%	-1.73%	-1.84%	0.13%	-4.55%	-1.67%
2003-2005	8.63%	1.62%	4.87%	5.56%	2.34%	0.12%	4.83%	1.29%
Contribution to GDP								
1994-1998		36.0%	8.1%	19.5%	-3.0%	1.1%	44.5%	38.3%
1999-2002		-8.6%	38.3%	18.8%	20.0%	-1.4%	89.8%	32.9%
2003-2005		8.4%	25.2%	35.6%	15.0%	0.8%	56.0%	15.0%

	Growth GDP / L	Inputs						
		Capital / Labor		Labor			TFP	
		Raw	Utilization		Utilzatin	Human Capital	Base	Adjusted
Var promedio								
1994-1998	2.6%	1.8%	0.72%		-0.22%	0.08%	1.76%	1.51%
1999-2002	-3.3%	2.7%	-4.34%		-1.84%	0.13%	-4.55%	-1.67%
2003-2005	3.1%	-3.9%	4.87%		2.34%	0.12%	4.83%	1.29%
Contribución al PIB								
1994-1998		31.2%	12.6%		-4.7%	1.7%	68.8%	59.2%
1999-2002		-36.2%	58.1%		30.4%	-2.2%	136.2%	49.9%
2003-2005		-57.4%	70.9%		42.2%	2.2%	157.4%	42.1%

Source: IERAL - Fundación Mediterránea based on Mecon

Table 5. International comparison of investment rates

Gross capital formation as % of GDP

	2000	2001	2002	2003	2004	2005	simple average
Argentina	16	14	12	15	19	21	16
Brazil	22	21	20	20	21	21	21
Chile	22	22	22	22	21	23	22
China	33	36	38	41	43	43	39
India	24	24	26	27	31	33	28
Korea, Rep.	31	29	29	30	30	30	30
Mexico	24	21	21	21	22	22	22
Spain	26	26	27	27	28	30	27
United States	20	19	18	18	19	..	19

Source: WDI (2006)

Table 6. HPR triggers and accompanying variables during Argentina's growth spurts

		HPR		
		1991-1998	1999-2002	2003-2006
TOT	T-1 to T+1 / T-7 to T-1	99%	99%	107%
	T to T+7 / T-4 to T-1	114%	114%	113%
I/GDP	T-1 to T+1 / T-7 to T-1	-10% (-1.9pp)	-1% (-0.1pp)	-19% (-3.4pp)
	T to T+7 / T-4 to T-1	9% (1.5pp)	-19% (-3.7pp)	15% (2.4pp)
Trade/GDP	T-1 to T+1 / T-7 to T-1	28% (2.2pp)	24% (3.9pp)	-3% (-0.6pp)
	T to T+7 / T-4 to T-1	89% (7.1pp)	4% (0.7pp)	9% (1.7pp)
RER	T-1 to T+1 / T-7 to T-1	69%	91%	177%
	T to T+7 / T-4 to T-1	46%	116%	161%
Economic reform	T-1 to T+1	Yes	No	¿?
Financial liberalization	T-1 to T+1	Yes	No	¿?
Political change	T-1 to T+1	No	No	No

Source: IERAL - Fundación Mediterránea based on INDEC, Mecon and BCRA

Table 7. JO accompanying variables during Argentine short-run growth episode

		JO		
		1991-1998	1999-2002	2003-2006
Trade / GDP	T - T+5 / previous episode[6]	70% (5.6 pp)	23% (3.5 pp)	5% (0.9 pp)
	T - T+7 / previous episode	89% (7.1 pp)		
Manufacturing labor share	T - T+5 / previous episode	n.a.	-21% (-6 pp)	-9% (-2.1 pp)
	T - T+7 / previous episode	n.a.		
Manufacturing output share	T - T+5 / previous episode	-6% (-1 pp)	-11% (-2 pp)	4% (0.6 pp)
	T - T+7 / previous episode	-6% (-1.2 pp)		
I / GDP	T - T+5 / previous episode	-21% (-4.8 pp)	-16% (-3 pp)	6% (0.9 pp)
	T - T+7 / previous episode	-18% (-4.3 pp)		
Inflation	T - T+5 / previous episode	-84% (-121.9 pp)	-72% (-12.7 pp)	140% (6.9 pp)
	T - T+7 / previous episode	-88% (-127.5 pp)		
TOT	T - T+5 / previous episode	-6%	2%	10%
	T - T+7 / previous episode	-5%		
Nominal ER	T - T+5 / previous episode	3198%	157%	196%
	T - T+7 / previous episode	3211%		
RER	T - T+5 / previous episode	-37%	14%	63%
	T - T+7 / previous episode	-38%		
Per capita GDP	T - T+5 / previous episode	119%	-12%	-37%
	T - T+7 / previous episode	130%		

Source: IERAL based on Mecon, BCRA and INDEC

Table 8. Firm level investment, skill intensity, exports and manufacture

Dependent variable: investment / capital
Method of estimation: OLS. Period: 2006

	1	2	3	4
Sales / capital stock	0.0378 (14.3) ***	0.0503 (3.83) ***	0.0502 (3.83) ***	0.0378 (14.28) ***
Skill ratio	8185.3870 (6.43) ***			8209.8280 (6.51) ***
Manufacturing Sales (%)			-108.5184 (0.95)	-13.2441 (0.14)
Exports / Sales		508.4109 (0.96)		-209.3135 (1.67) *
_cons	-4139.6460 (0.11)	-13982.2800 (1.55)	870.0252 (0.06)	195.7008 (0.01)

Note: t-statistic between brackets
*** Pr(|t|)<0.01,** 0.01<Pr(|t|)<0.05 and * 0.05<Pr(|t|)<0.01
Data source: World Bank Doing Business, 2006

Table 9. Quantities and prices of potentially binding constraints to investment

	HRV						
	1991-1998		1999-2002		2003-2006		1991-2006
I/GPD	Average period	19.0%	Average period	16.0%	Average period	18.4%	18.1%
	Avg(88-90)	16.7%	1999	19.1%	2002	11.3%	
	1991	15.9%	2001	15.8%	2003	14.3%	
	1998	21.1%	2002	11.3%	last available	21.7%	
Nationl Savings/GPD (1)	Average period	16.4%	Average period	15.6%	Average period	21.4%	17.3%
	Avg(88-90)	n.a.	1999	13.6%	2002	20.1%	
	1991	n.a.	2001	14.2%	2003	19.7%	
	1998	16.1%	2002	20.1%	last available	23.7%	
Public Investment / GDP (1)	Average period	1.58%	Average period	1.16%	Average period	1.72%	1.48%
	Avg(88-90)	n.a.	1999	1.67%	2002	0.73%	
	1991	n.a.	2001	1.11%	2003	1.21%	
	1998	1.63%	2002	0.73%	last available	2.23%	
RER	Average period	1.03	Average period	1.17	Average period	1.88	1.28
	Avg(88-90)	2.32	1999	0.88	2002	2.03	
	1991	1.22	2001	0.88	2003	1.87	
	1998	0.97	2002	2.03	last available	1.85	
Current account / GDP	Average period	-3.0%	Average period	0.0%	Average period	3.8%	-0.5%
	Avg(88-90)	3.5%	1999	-4.2%	2002	8.9%	
	1991	-0.1%	2001	-1.4%	2003	6.4%	
	1998	-4.8%	2002	8.9%	last available	3.8%	
Capital account / GDP	Average period	4.9%	Average period	-1.4%	Average period	-0.5%	1.9%
	Avg(88-90)	-3.1%	1999	4.9%	2002	-11.6%	
	1991	4.0%	2001	-2.0%	2003	-2.5%	
	1998	6.1%	2002	-11.6%	last available	-2.7%	
Total external debt / Export	Average period	508.9%	Average period	619.3%	Average period	393.0%	507.5%
	Avg(88-90)	598.2%	1999	653.9%	2002	609.7%	
	1991	528.3%	2001	624.8%	2003	556.9%	
	1998	558.4%	2002	609.7%	last available	235.9%	
Fiscal result / GDP	Average period	-1.0%	Average period	-2.2%	Average period	1.7%	-0.6%
	Avg(88-90)	-3.1%	1999	-1.7%	2002	-1.5%	
	1991	-0.4%	2001	-3.2%	2003	0.5%	
	1998	-1.4%	2002	-1.5%	last available	1.8%	
Credit to non financial private sector / GDP (2)	Average period	17.5%	Average period	20.8%	Average period	8.6%	16.1%
	Avg(88-90)	n.a.	1999	23.3%	2002	15.8%	
	1991	11.2%	2001	21.3%	2003	8.4%	
	1998	21.4%	2002	15.8%	last available	9.7%	
Credit (excluding consumption) / GDP (3)	Average period	17.6%	Average period	17.8%	Average period	6.9%	13.4%
	Avg(88-90)	n.a.	1999	20.2%	2002	13.7%	
	1991	n.a.	2001	18.0%	2003	7.3%	
	1998	18.7%	2002	13.7%	last available	7.2%	
WL / GDP (1)	Average period	38.5%	Average period	39.5%	Average period	36.3%	38.3%
	Avg(88-90)	n.a.	1999	40.7%	2002	34.6%	
	1991	30.8%	2001	42.1%	2003	34.3%	
	1998	38.3%	2002	34.6%	last available	38.6%	
Real Active Interest Rate (4)	Average period	9.3	Average period	18.7	Average period	0.2	9.4
	Avg(88-90)	n.a.	1999	11.6	2002	23.9	
	1991	n.a.	2001	27.5	2003	4.3	
	1998	9.6	2002	23.9	last available	-3.5	
Net interest margin (4)	Average period	3.4	Average period	6.9	Average period	4.4	4.8
	Avg(88-90)	n.a.	1999	3.2	2002	10.9	
	1991	n.a.	2001	10.5	2003	8.7	
	1998	3.2	2002	10.9	last available	2.5	
Country Risk (5)	Average period	718.0	Average period	2160.8	Average period	3463.4	2579.4
	Avg(88-90)	n.a.	1999	718.3	2002	5713.4	
	1991	n.a.	2001	1542.6	2003	5572.4	
	1998	718.0	2002	5713.4	last available	2721.5	

(1) 1993-2005, (2) 1991-2006, (3) 1997-2006, (4) 1994-2006, (5) 1998-2006

Source: IERAL - Fundación Mediterránea based on INDEC, Mecon and BCRA

Table 10. Saving-investment relationship: Argentina, raw data

	Corr (I/Y,S/Y)	β (I/Y,S/Y)
1890 -- 1900	-0.29	-0.15
1900 -- 1910	0.43	0.70
1910 -- 1920	-0.62	-0.82
1920 -- 1930	0.79	0.43
1930 -- 1940	0.22	0.14
1940 -- 1950	0.30	0.13
1950 -- 1960	0.23	0.10
1960 -- 1970	0.94	0.94
1970 -- 1980	0.93	0.84
1980 -- 1990	0.96	1.02
1990 -- 2000	0.54	0.74
2000 -- 2006	0.72	0.66
1991 -- 2006	0.48	0.36
1991 -- 1998	0.74	0.85
1999 -- 2001	-0.66	-3.32
2003 -- 2006	0.93	1.08

Notes: Corr(I/Y,S/Y) is the correlation of I/Y and S/Y. β(I/Y,S/Y) is the OLS time series coefficient from a regression of I/Y on S/Y with a constant.
Source: IERAL - Fundación Mediterránea based on Mecon

Table 11. Domestic Credit, claims on private sector

Countries	% GDP, 2005
Argentina	**11.4%**
Colombia	**21.1%**
Brazil	**32.7%**
India	**41.2%**
United States	**57.9%**
Chile	**70.1%**
Rep. of Korea	**93.5%**
China	**112.2%**
Spain	**146.0%**

Source: IERAL - Mediterranean Fundation based on IMF (IFS)

Table 12. Stocks market valuation (% of GDP)

	2000	2001	2002	2003	2004	2005
Argentina	58.43	71.64	101.36	30.04	30.34	33.54
Brazil	58.43	36.63	26.87	46.38	54.70	59.77
Chile	79.71	82.12	70.74	117.09	123.19	118.39
Mexico	21.53	20.30	15.89	19.17	25.16	31.12
United States	154.68	137.50	106.36	130.27	139.38	136.47

Source: WDI (2006)

Table 13 Investment equation, stock exchange firms, 1990-2006.

Variable	Fixed-effects within			GMM estimation		
	(1)	(2)	(3)	(4)	(5)	(6)
MPK	0.0775***	.0954***	.0845***	0.0681***	0.0427***	0.0511***
	(9.03)	(6.4)	(5.31)	(2.87)	(3.5)	(4.63)
FIN	0.0099***	-0.0013	-0.0102	0.0120***	0.0078***	-0.0003***
	(2.5)	(-0.03)	(-1.05)	(1.36)	(0.18)	(-0.10)
LEV	0.0002	-.0203***	-0.0033	-0.0019***	-0.0012***	0.0006***
	(-0.10)	(-2.85)	(-0.34)	(-0.42)	(-0.22)	(0.41)
Inv/K (t-1)				-0.0051***	-0.0555***	-0.0633***
				(-0.10)	(-1.75)	(-0.67)
MPK*(2002-06)		-0.0173			0.0342***	
		(-1.28)			(2.96)	
FIN*(2002-06)		0.0151			0.0033***	
		(0.34)			(0.1)	
LEV*(2002-06)		0.0175***			0.0001*	
		(2.7)			(0.05)	
MPK*(asst<med)			-0.0424**			-0.0124***
			(-2.14)			(-0.78)
FIN*(asst<med)			0.0539***			0.0457***
			(4.14)			(4.34)
LEV*(asst<med)			-0.0151**			-0.0201***
			(-2.11)			(-4.11)
Country risk		0.0001***	0.0001***		0.0001***	0.0001***
		(7.31)	(7.01)		(9.68)	(10.17)
Credit/PIB		4.296***	4.081***		5.447***	5.781***
		(6.91)	(6.77)		(7.82)	(6.96)
Observations	637	610	610	509	486	486
FE R2	0.2171	0.3006	0.323			
Sargan test				0.9125	0.8129	0.7535

Table 14. Indicators of educational attainment and quality

	Adult literacy rate (%)	Survival rate to 5th grade (%)	Tertiary education GER (%)	Literacy Skills (Pisa 2000)		
				Reading	Mathematical	Scientific
Argentina	97.0	93.1	56.3	418	388	396
Brasil	88.2	…	18.2	396	334	375
Chile	95.7	99.9	37.5	410	384	415
Méjico	90.5	90.5	21.5	422	387	422
Perú	85.0	86.1	31.8	327	292	333
Uruguay	97.7	88.5	37.1	…	..	..
Latino América	89.2	88.5	25.7	…	..	..
Irlanda	…	98.8	49.9	527	503	513
Estados Unidos	…	…	81.4	504	493	499
España	…	…	58.9	493	476	491
Australia	…	…	64.6	528	533	528
China	90.9	98.0	12.7	…	..	..
India	61.3	61.4	11.4	…	..	..
Developing countries	76.4	83.3	11.3	…	..	..
World	81.7	…	23.2	…	..	..

Source: Regional EFA Global Monitoring Report 2005 & School Factors Related To Quality And Equity; Pisa 2000, OECD

Table 15.
Student/teacher ratios

	2003
Spain	13.9
United States	14.8
Argentina *	17.3
Ireland	18.7
China	21.1
Uruguay *	21.2
Brazil *	24.0
Peru *	25.1
Mexico	26.7
India	41.3
* 2002	

Source: WDI (2006)

Table 16. Mincerian returns to education

Country	Private returns to education	
	High school	Higher education
Argentina	14.2	14.9
Chile	12.9	20.7
Costa Rica	17.9	12.9
Mexico	20.1	15.7
Uruguay	10.3	12.8

Source: Psacharapoulos an Patrinos (2002)

Table 17. Transportation infrastructure indicators

	km of road per km2	km of railroad line per km2
Francia	1.81	5.40
UK	1.54	7.06
España	1.32	2.74
EEUU	0.67	1.51
Argentina	0.17	0.97
Chile	0.16	0.39
Turquía	0.08	1.11

Fuente: European Road Statistics 2005, Ministerio de Obras Públicas. Argentina 2004, Chile 2003, Resto 2002 & WDI para los datos de vías ferreas, datos a 2002

Table 18. Communication and information technology infrastructure

Country	Telephone mainlines per 100 inhabitants	Cellular phone lines per 100 inhabitants	Personal computers per 100 inhabitants	Internet international bandwith (bits per person)	Internet safe servers per 1,000,000 inhabitants
Argentina	22.8	57.3	21.9	319.2	10.8
Bolivia	7.0	26.4	8.4	51.2	2.4
Brasil	23.0	46.3	2.3	149.3	14.1
Chile	22.0	67.8	10.5	787.9	21.0
Colombia	16.8	47.9	14.8	123.8	4.2
Costa Rica	32.1	25.5	4.2	25.8	61.7
Ecuador	12.9	47.2	3.9	44.2	4.1
El Salvador	14.1	35.1	5.1	68.5	5.4
Guatemala	8.9	25.0	1.8	62.4	5.6
Honduras	6.9	17.8	1.6	2.6	4.2
México	18.2	44.3	13.1	110.1	83.7
Nicaragua	3.8	n.a.	4.6	186.0	2.1
Panamá	13.6	41.9	2.0	291.6	56.3
Paraguay	5.2	30.6	10.0	37.5	1.4
Perú	8.1	20.0	13.3	204.8	5.2
Uruguay	30.9	18.5	8.2	290.7	26.0
Venezuela	13.5	46.7	13.4	57.4	4.6
United States	68.4	67.7	76.2	n.a.	n.a.
World	19.8	34.0	3.9	n.a.	65.2

Sources: ITU, WDI

Table 19. Access cost to Internet

	US$ per month	
	Basic reach (min 64 kbps)	Medium reach (min 400kbps)
Argentina	14.6	22.7
Bolivia	39.0	95.0
Brasil	21.1	35.3
Chile	26.7	38.2
Colombia	14.0	36.2
Costa Rica	24.9	72.3
Ecuador	39.9	75.0
México	14.0	35.1
Paraguay	32.0	198.0
Perú	31.9	45.8
Uruguay	35.8	78.2

Source: IERAL - Fundación Mediterránea based on ITU

Table 19b. Investment/Amortization Ratios of Public Offer Firms

Ratio Investment / Amortization, ARGENTINA*						
Number of enterprises	Sector	2003	2004	2005	2006	Ref.: ratio 1998
5	**Agriculture and fishing**	163.3	175.7	157.6	106.4	1 227.1
7	**Food and Beverages**	43.9	94.4	137.1	116.5	211.0
3	**Commerce**	50.2	55.2	79.0	184.2	364.4
4	**Construction**	13.5	46.0	50.9	158.3	20.5
2	**Electroelectronics**	13.5	10.5	24.1	72.7	71.2
7	**Electric energy**	30.2	44.1	52.7	71.7	263.5
8	**Finanance and Insurance**	141.1	sd	51.0	194.9	sd
1	**Industrial Machinery**	878.6	68.1	10.8	145.0	66.2
5	**Non metal minerals**	10.5	25.5	48.2	105.6	238.4
5	**Paper and celulose**	219.2	300.9	433.6	513.7	235.2
11	**Petroleum and gas**	87.3	101.4	133.9	150.1	176.2
6	**Chemistry**	47.2	99.2	124.9	77.7	152.2
2	**Real State Rent**	10.6	79.1	75.9	368.6	-3 457.1
6	**Iron and steel Sector and Metallurgy**	58.4	91.3	191.9	295.9	246.6
1	**Software and data**	61.0	105.8	171.5	145.3	sd
5	**Telecommunication**	10.9	30.7	37.4	48.8	102.1
4	**Textile**	7.9	17.7	35.1	27.1	49.2
4	**Transport Services**	34.1	80.8	70.9	9.5	405.6
2	**Vehicles and parts**	9.5	20.2	47.1	62.9	100.3
3	**Others**	1.0	24.7	40.1	54.2	62.5
91	**Total**	**44.3**	**68.3**	**98.1**	**125.7**	**146.4**

(*) Public Offer Firms, Buenos Aires Stock Market

Investment: Purchase of duarable goods , Amortization: depreciation and amortization.

Souirce: IERAL - Fundacion Mediterránea, based on Economatica.

Table 20. Electricity prices for industrial firms (US$/KWh)

País	2004
Nicaragua	12.89
Guatemala	12.32
El Salvador	11.99
Panamá	9.90
Ecuador	8.71
Colombia	7.70
Perú	7.49
México	7.46
Costa Rica	7.26
Chile	5.75
Uruguay	5.18
Bolivia	5.05
Brasil	4.42
Paraguay	3.92
Honduras	3.49
Venezuela	3.17
Argentina	3.07

Source: OLADE.

Table 21. Corporate income taxes

Country	Maximum Corporate Income Tax Rate	
	1998	2007
Chile	15,0	n/a
Hong Kong	16,0	17,5
Taiwan	25,0	25,0
Singapore	26,0	20,0
Korea	28,0	n/a
Sweden	28,0	n/a
Canada	29,1	36,1
Indonesia	30,0	30,0
United Kingdom	31,0	30,0
Argentina	33,0	35,0
Brazil	33,0	34,0
China	33,0	33,0
Denmark	34,0	24,0
Mexico	34,0	29,0
Japan	34,5	30,0
India	35,0	35,0
Netherlands	35,0	29,6
United States	35,0	35,0
Australia	36,0	30,0
Poland	36,0	19,0
Italy	37,0	33,0
Belgium	40,2	34,0
France	41,7	33,3
Germany	45,0	38,3
Average	32,1	35,2

Source: American Council for Capital Formation and www.worldwide-tax.com

Table 22. Transaction costs

		Argentina	Brasil	Chile	LAC	OECD	East Asia & Pacific
Starting a business	Procedures (number)	15.0	17.0	9.0	10.2	6.2	8.2
	Duration (days)	32.0	152.0	27.0	73.3	16.6	46.3
	Cost (% GNI per capita)	12.1	9.9	9.8	48.1	5.3	42.8
Paying taxes	Payments (number)	34.0	23.0	10.0	41.3	15.3	29.8
	Time (hours)	615.0	2600.0	432.0	430.5	202.9	290.4
	Total tax rate (% profit)	116.8	71.7	26.3	49.1	47.8	42.2
Enforcing contracts	Procedures (number)	33.0	42.0	33.0	39.3	22.2	31.5
	Time (days)	520.0	616.0	480.0	641.9	351.2	477.3
	Cost (% of debt)	15.0	15.5	16.3	23.4	11.2	52.7
Closing a business	Time (years)	2.8	4.0	5.6	2.6	1.4	2.4
	Cost (% of estate)	12.0	12.0	14.5	13.6	7.1	23.2
	Recovery rate (cents on the dollar)	36.2	12.1	20.0	25.7	74.0	27.5

Source: Doing Business 2006, World Bank.

Table 23. Institutional quality indicators – Economic Freedom ranking

Country	Score	Trade	Fiscal Burden	Gov't Intervention	Monetary Policy	Foreign Investment	Banking	Wages & Prices	Property Rights	Regulation	Informal Market
2006											
Argentina	3.30	3.0	4.0	2.0	3.0	3.0	4.0	3.0	4.0	3.0	4.0
Brazil	3.08	3.5	2.8	4.0	3.0	3.0	3.0	2.0	3.0	3.0	3.5
Chile	1.88	1.5	2.3	2.5	1.0	2.0	2.0	2.0	1.0	3.0	1.5
China	3.34	3.0	3.9	3.0	1.0	4.0	4.0	3.0	4.0	4.0	3.5
Colombia	3.16	3.5	4.1	3.5	3.0	3.0	2.0	2.0	4.0	3.0	3.5
India	3.49	5.0	3.9	3.0	2.0	3.0	4.0	3.0	3.0	4.0	4.0
Korea	2.63	3.5	3.3	2.5	2.0	2.0	3.0	2.0	2.0	3.0	3.0
Spain	2.33	2.0	4.3	2.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0
United States	1.84	2.0	3.9	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.5
1998											
Argentina	2.48	3.5	4.3	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0
Brazil	3.41	4.5	2.6	3.0	5.0	3.0	3.0	3.0	3.0	3.0	4.0
Chile	2.10	2	2.5	1.5	3.0	2.0	3.0	2.0	1.0	2.0	2.0
China	3.69	5	3.9	4.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0
Colombia	3.19	3	3.9	3.0	5.0	2.0	2.0	2.0	3.0	3.0	5.0
India	3.83	5	4.3	3.0	3.0	3.0	4.0	4.0	3.0	4.0	5.0
Korea	2.35	3.5	3.5	2.5	2.0	2.0	2.0	2.0	1.0	3.0	2.0
Spain	2.45	2.5	4.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0
United States	1.94	2.5	3.9	2.0	1.0	2.0	2.0	2.0	1.0	2.0	1.0
1-1,99		**free**									
2-2,99		**mostly free**									
3-3,99		**mostly unfree**									
4-5		**repressed**									

Source: Economic freedom score, Heritage foundation, www.heritage.org

Table 24. Governance indicators

Country	Voice and Accountability						Political Stability						Government Effectiveness					
	2005			1998			2005			1998			2005			1998		
	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.
ARGENTINA	0.43	0.14	11	0.30	0.23	6	-0.26	0.21	10	0.32	0.26	6	-0.27	0.15	12	0.34	0.26	7
BRAZIL	0.36	0.14	10	0.57	0.23	7	-0.13	0.21	10	-0.52	0.25	7	-0.09	0.15	12	-0.08	0.25	8
CHILE	1.04	0.14	10	0.59	0.23	6	0.85	0.21	10	0.37	0.26	6	1.26	0.15	12	1.31	0.26	7
CHINA	-1.66	0.12	10	-1.72	0.24	5	-0.18	0.21	10	-0.11	0.26	6	-0.11	0.15	11	0.06	0.26	7
COLOMBIA	-0.32	0.12	12	-0.26	0.23	7	-1.79	0.21	10	-1.64	0.25	7	-0.09	0.15	12	-0.04	0.25	8
INDIA	0.35	0.14	10	0.18	0.24	6	-0.85	0.21	10	-0.73	0.25	7	-0.11	0.15	11	-0.18	0.25	8
SPAIN	1.12	0.16	9	1.09	0.24	6	0.38	0.21	10	0.59	0.25	7	1.40	0.16	9	1.95	0.29	7
UNITED STATES	1.19	0.16	9	1.38	0.24	6	0.06	0.21	10	0.88	0.25	7	1.59	0.16	9	1.71	0.29	7

Country	Regulatory Quality						Rule of Law						Control of Corruption					
	2005			1998			2005			1998			2005			1998		
	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.	Est.	S.E.	N.
ARGENTINA	-0.64	0.17	10	0.77	0.27	6	-0.56	0.13	15	0.06	0.18	11	-0.44	0.14	12	-0.29	0.19	10
BRAZIL	0.08	0.17	10	0.23	0.27	7	-0.41	0.13	15	-0.17	0.18	12	-0.28	0.14	11	0.03	0.19	11
CHILE	1.40	0.17	10	1.10	0.27	6	1.20	0.13	15	1.18	0.18	11	1.34	0.14	12	1.13	0.19	10
CHINA	-0.28	0.17	10	-0.11	0.27	6	-0.47	0.13	15	-0.35	0.19	10	-0.69	0.12	12	-0.20	0.17	9
COLOMBIA	0.05	0.17	10	0.43	0.27	7	-0.71	0.13	16	-0.72	0.18	12	-0.22	0.14	13	-0.67	0.19	11
INDIA	-0.34	0.17	10	-0.14	0.27	7	0.09	0.13	14	0.13	0.18	11	-0.31	0.12	12	-0.24	0.16	11
SPAIN	1.25	0.19	8	1.04	0.28	6	1.13	0.14	12	1.33	0.20	10	1.34	0.15	10	1.52	0.21	9
UNITED STATES	1.47	0.19	8	1.35	0.28	6	1.59	0.14	11	1.66	0.20	10	1.56	0.15	10	1.89	0.21	8

Source: World Bank, Governance indicators, 2006.

Table 25. Volatility of inflation

	1990-1994	1995-1999	2000-2004	2003 Q4	2004 Q4	2005 Q4
United States	0.59	0.33	0.64	0.54	0.55	0.64
Spain	0.54	0.52	0.60	0.57	0.49	0.43
China,P.R.: Mainland	5.08	3.80	0.97	1.24	1.79	1.40
Korea	1.40	1.43	1.10	0.53	0.41	0.61
India	2.66	2.26	1.71	0.63	0.63	0.54
Argentina	2 167.49	1.19	8.77	15.53	11.18	3.12
Brazil	1 273.63	471.83	2.48	3.85	4.66	0.76
Chile	3.36	1.19	0.84	0.88	1.43	1.33
Colombia	2.06	1.79	1.33	0.62	0.76	0.50

Within year standard deviations. Source: IFS, IMF

Table 26. Relative export price. Argentina to OECD

Overall and New Exports (NE)

	Total	Total without NE	NE	MOA	MOA NE	MOI	MOI NE
1994	0.866	0.871	0.817	0.853	0.808	0.854	0.779
2005	0.809	0.799	0.855	0.757	0.805	0.786	0.787

Source: IERAL - Fundación Mediterránea based on

Table 27. Participation in new exports

	1994-1993	2004-2003	Change
New exports	0.10	20.90	20.80
New exports without fuel	0.09	13.35	13.25
Fuels	0.00	7.55	7.55

Note: There are 90 new products

Table 28. Contribution of New Exports to overall export growth

2004 - 1993

	Annual growth rate	Contribution to total export´s growth
Total	9.2	
New exports	*79.76*	*34.4*
New exports without fuels	73.04	22.0
Fuels	127.84	12.4

Source: IERAL from Fundación Mediterránea based on INDEC and COMTRADE

Table 29. Determinants of acquisition of revealed comparative advantage, World and Argentina

	(1) Probit $X_{i,c,t+1}$	(1 arg) Probit $X_{i,c,t+1}$	(2) Probit $X_{i,c,t+1}$	(3) OLS $X_{i,c,t+1}$	(3 arg) OLS $X_{i,c,t+1}$	(4) OLS $X_{i,c,t+1}$
$X_{i,c,t}$	0.678	0.853	0.673	0.801	0.879	0.799
	(55.65)**	(39.50)**	(57.60)**	(110.82)**	(131.51)**	(110.78)**
$\ln density_{i,c,t}$	0.043	0.093	0.039	0.013	0.033	0.011
	(4.66)**	(3.68)**	(4.44)**	(4.28)**	(2.65)**	(4.05)**
$\ln GDPpc_{c,t}$	0.019		0.017	0.005		0.004
	(2.26)*		(3.20)*	(1.08)		(0.81)
$\ln EXPY_{c,t}$	-0.049	0.000	-0.042	-0.020	0.000	-0.017
	(5.55)**	(2.66)**	(4.88)**	(4.16)**	(2.28)*	(3.57)**
$\ln PRODY_{i,t}$	0.009	0.000	0.008	0.008	0.000	0.008
	(5.34)**	(2.44)*	(5.25)**	(7.37)**	(2.35)*	(7.23)**
$\ln RCA_{1,c,t}$			0.003			0.003
			(10.40)**			(7.88)**
Constant				0.082	0.263	0.105
				(1.37)	(3.17)**	(.)
Observations	1 172 681	6 205	1 170 478	1 175 839	6 205	1 173 635
R-squared				0.70	0.81	0.70

Standard errors are clustered by county. Year, country, and product dummies included in all estimations.
Probit coefficients are marginal effects. Absolute value of t statistics in parentheses.
* significant al 5%; ** significant at 1%
Source: IERAL from Fundación Mediterránea based on Hausmann et al. (2006)

Table 30. Open forest and export sophistication growth, whole sample, 1985-2000

	(1) FE EXPY growth	(2) RE EXPY growth	(3) FE EXPY growth	(4) RE EXPY growth
lnEXPY	-0.185	-0.059	-0.229	-0.068
	(9.36)**	(5.69)**	(10.86)**	(6.35)**
lnGDP	0.025	0.010	0.009	0.012
	(1.48)	(2.75)**	(0.53)	(3.22)**
lnopen_forest	0.027	0.016		
	(3.67)**	(4.14)**		
lnopen_forest_value			0.329	0.145
			(5.95)**	(3.51)**
lnopen_forest_size			0.006	0.010
			(0.79)	(2.38)*
Constant	1.085	0.242	-1.111	-0.865
	(5.81)**	(4.99)**	(2.53)*	(2.43)*
Obsrvations	1434	1434	1434	1434
Number of countryid	106	106	106	106
R-squared	**0.060**		**0.090**	

Table 31. Open forest and export sophistication growth, Latin America, 1975-2000

	(1) FE EXPY growth	(2) RE EXPY growth	(3) FE EXPY growth	(4) RE EXPY growth
lnEXPY	-0.588	-0.242	-0.773	-0.271
	(3.72)**	(2.53)*	(4.38)**	(2.62)**
lnGDP	0.200	0.074	0.254	0.080
	(1.33)	(1.43)	(1.71)	(1.53)
lnopen_forest	-0.141	-0.002		
	(1.60)	(0.04)		
lnopen_forest_value			0.339	0.169
			(1.39)	(0.73)
lnopen_forest_size			-0.128	-0.007
			(1.51)	(0.16)
Constant	5.278	1.546	1.934	0.192
	(4.33)**	(2.59)*	(0.97)	(0.10)
Obsrvations	66	66	66	66
Number of countryid	13	13	13	13
R-squared	**0.095**	**0.112**	**0.111**	**0.120**

Table 32. Capabilities and opportunities for structural transformation

	Prody	Strategic value	Density	Export share	Relative price OECD
Highest Strategic Value	15008,1	19369,6	0,144	2,8	0,69
Highest Density	7768,6	8490,5	0,219	0,4	0,89
Highest Prody	27211,1	13325,2	0,124	0,3	0,65
Discoveries	9222,1	13527,1	0,208	18,3	0,86
Min relative prices oecd	18712,5	14758,1	0,158	1,2	0,28
Min relative prices oecd (MOI)	18811,0	15717,7	0,148	1,3	0,29
Traditional	6076,1	13225,8	0,165	71,7	0,80

Table 33. Foreign barriers to entry, selected goods

	NAFTA Tariffs		UE Tariffs		Asia Tariffs		LAC Tariffs	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Highest Strategic Value	4.1	30.0	4.6	15.0	11.6	80.0	11.5	30.0
Highest Density	1.7	72.7	6.7	38.0	3.9	40.0	7.9	30.0
Highest Prody	2.7	43.5	4.1	17.0	8.0	30.0	9.9	27.0
Discoveries	1.2	43.5	3.6	25.0	10.0	30.0	8.9	35.0
Min relative prices oecd	3.8	38.0	13.5	34.0	4.0	25.0	10.1	70.0
Total	6.1		7.9		8.6		9.7	

Table 34. Domestic taxes on imports and exports, selected goods

	Domestic Tariffs		Export Taxes		Relative price of import
	Average	Maximum	Average	Maximum	
Highest Strategic Value	11.5	25.0	5.0	5.0	1.17
Highest Density	4.4	16.0	5.7	10.5	1.11
Highest Prody	8.4	18.0	5.1	18.9	1.14
Discoveries	14.1	35.0	7.3	25.9	1.23
Min relative prices OECD	11.2	20.0	5.0	9.8	1.17
Total	10.3	18.0	11.1	40.0	1.24

Table 35. Discoveries by country

	Discovery Count	Percent
Argentina	32	2%
Chile	31	2%
China	39	2%
Colombia	43	3%
India	24	3%
Korea, Rep	53	3%
Spain	24	1%
United States	3	0%
Indonesia	160	9%
Turquía	135	8%

Source: Klinger & Lederman, 2004, HS 6-digit.

Table 36. Concentration of new exports at the firm level

	1994	2004	Change
Numbers of firms exporting NE	412	2 245	1 833
*Major firms of each NE product represent in value (%)**			
Simple average	69.3	70.3	1.0
Weighted average	62.5	65.4	2.9
Median	74.9	78.3	3.4
In number of firms, they represent (%)	21.1	3.9	-17.2

* For each product it is selected the sole largest firm.

Table 37. Correlations between discovery and diffusion at the sectoral level

Change in	Number of new exports by sector	Frequency of emergence of new exports by sector
Exports due to increase in number of enterprises	-0.493 (95% CI: -0.831 - 0.113)	-0.213 (95% CI: -0.721 - 0.444)
Share of exports of the pioneer	-0.165 (95% CI: -0.625 - 0.379)	-0.026 (95% CI: -0.511 - 0.549)
Share of exports of the end leader	-0.094 (95% CI: -0.578 - 0.440)	-0.123 (95% CI: -0.436 - 0.613)
Herfindahl index	-0.516 (95% CI: -0.813 - -0.005)	-0.175 (95% CI: -0.646 - 0.392)

N.B.: HS 6-digit
Source: IERAL de Fundación Mediterránea

Table 38 Innovation indicators

R&D spending as % of GDP	
Countries	2004
Argentina	0.44
Brazil	0.91
Chile	0.70
Colombia (2001)	0.17
Spain	1.07
USA	2.66

Source: RICyT

Table 39. Total R&D and R&D Financed by the Productive Sector -- Selected Countries

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99
ARGENTINA R&D (% of GDP)	0.595	0.56	0.704	0.936	0.392	0.382	0.315	0.413
ARGENTINA Financed by Productive Sector (% of GDP)				0.087	0.06	0.031	0.071	0.113
BRAZIL R&D (% of GDP)			0.344	0.608	0.481	0.38	0.828	0.844
BRAZIL Financed by Productive Sector (% of GDP)			0	0.107	0.112		0.215	0.331
MEXICO R&D (% of GDP)		0.168	0.194		0.543	0.285	0.255	0.354
MEXICO Financed by Productive Sector (% of GDP)			0.016		0.007	0.01	0.043	0.068
FRANCE R&D (% of GDP)	1.49	2.039	1.778	1.704	1.99	2.235	2.375	2.239
FRANCE Financed by Productive Sector (% of GDP)	0.447	0.654	0.661	0.701	0.828	0.945	1.084	1.145
SWEDEN R&D (% of GDP)	1.18	1.27	1.463	1.735	2.361	2.835	2.965	3.663
SWEDEN Financed by Productive Sector (% of GDP)	0.664	0.701	0.799	1.018	1.421	1.717	1.833	2.36
U.S.A. R&D (% of GDP)	2.806	2.804	2.369	2.161	2.499	2.76	2.588	2.581
U.S.A. Financed by Productive Sector (% of GDP)	1.028	0.981	0.953	0.953	1.222	1.347	1.443	1.608
HUNGARY R&D (% of GDP)	1.776	1.833	2.459	2.889	2.508	2.335	1.082	0.694
HUNGARY Financed by Productive Sector (% of GDP)		0.055	0.07	0.082	1.965	1.81	0.602	0.247
INDIA R&D (% of GDP)	0.192	0.256	0.376	0.434	0.621	0.818	0.713	0.621
INDIA Financed by Productive Sector (% of GDP)		0.023	0.05	0.065	0.09	0.094	0.136	
ISRAEL R&D (% of GDP)	0.892	1.08	1.359	2.126	3.229	2.84	2.571	3.229
ISRAEL Financed by Productive Sector (% of GDP)		0.094	0.144	0.466	0.721		0.983	1.24
KOREA R&D (% of GDP)	0.24	0.366	0.357	0.529	0.833	1.692	2.098	2.565
KOREA Financed by Productive Sector (% of GDP)		0.046	0.04	0.224	0.455	1.371	1.746	1.876
PHILIPPINES R&D (% of GDP)	0.144	0.17	0.158	0.233	0.173	0.178	0.177	
PHILIPPINES Financed by Productive Sector (% of GDP)		0.028	0	0	0.027		0.004	
TAIWAN R&D (% of GDP)				0.829	0.879	1.168	1.739	1.896
TAIWAN Financed by Productive Sector (% of GDP)				0.263	0.358	0.524	0.873	1.131
MADAGASCAR R&D (% of GDP)	0.425	0.463	0.675	0.186	0.181	0.263	0.293	0.17
MADAGASCAR Financed by Productive Sector (% of GDP)		0	0					0
SOUTH AFRICA R&D (% of GDP)					0.82	0.773	0.724	
SOUTH AFRICA Financed by Productive Sector (% of GDP)					0.414	0.32	0.362	
FINLAND R&D (% of GDP)		0.713	0.849	0.978	1.321	1.737	2.136	2.764
FINLAND Financed by Productive Sector (% of GDP)		0.325	0.442	0.524	0.735	1.031	1.177	1.726
IRELAND R&D (% of GDP)	0.42	0.591	0.706	0.683	0.699	0.824	1.062	1.342
IRELAND Financed by Productive Sector (% of GDP)		0.213	0.264	0.228	0.281	0.408	0.675	0.893

Note: Annual averages, based on available data for each 5-year period.
Source: IERAL de Fundación Mediterránea based on Lederman & Saenz (2005)

Table 40. Social returns on innovation in Argentina

Dependent variable: Labor productivity growth

	Panel 1992-2001
R&D intensity	0.001
	(0.05)
Innovative capital goods	0.006
	(1.10)
Capital/labor growth	
Time dummy 1998	-0.030
	(1.73)
Time dummy 2001	-0.021
	(1.24)
Time dummy 2002	0.032
	(2.02)
Constant	0.024
	(1.85)
Observations	84
R-squared	0.16

Standard errors are clustered by county. Year, country, and product dummies included in all estimations. Probit coefficients are marginal effects. Absolute value of t statistics in parentheses.
* significant al 5%; ** significant at 1%

Source: IERAL from Fundación Mediterránea based on Hausmann et al. (June 1996)

Table 41. Calibration of TFP gap to world frontier in KR model

	Predicted TFP gap		Actual gap
	KR calibrations	Our calibrations	
2000	52.8%	50.1%	50.6%
1980 (1)	50.4%	47.5%	64.4%
1980 (2)	50.4%	68.6%	64.4%

KR calibrations: $\alpha = 0.33$, 2000 research intensity = 1980 research intensity = 1.21%, $\lambda = 0.38$

Our calibrations: $\alpha = 0.45$, 2000 research intensity = 0.41%, 1980 research intensity (1) = 0.39%, 1980 research intensity (2) = 0.94%, $\lambda = 0.7$

Table 42. Calibration of SRR to research in KR model

	Predicted SRR		Estimated SRR
	KR calibrations	Our calibrations	
2000	46.21%	99.72%	0.60%

KR calibrations: $\alpha = 0.33$

Our calibrations: $\alpha = 0.45$

Table 43. Capital goods imports by country of origin

as a % of total

	Brasil	EEUU	UE	Resto
1995	10	33	33	24
2000	24	28	22	27
2006	32	15	15	32

Source: IERAL - Fundación Mediterránea based on INDEC.

Table 44. Innovation indicators

Researchers per 1000 members of the labor force		Graduates on engineering per 1000 members of the labor	
	2004		**2004**
Argentina	3.00	Argentina (2002)	0.64
Brazil	1.55	Brazil	0.36
Chile	3.26	Chile	1.13
Colombia	0.63	Colombia (2002)	1.57
Spain (2003)	8.42	Spain (2001)	0.90
USA (1999)	13.94	USA	0.60
Source: RICyT			

Table 45. Allocation of research personnel

2004	Argentina	Brazil	Chile	Spain	Colombia	Paraguay
Government	26.4%	3.9%	3.0%	14.3%	4.6%	24.5%
Enterprises	10.0%	18.6%	60.3%	23.5%	1.3%	0.0%
Higher Education	61.3%	76.9%	32.4%	62.0%	88.4%	59.1%
Non profit private	2.4%	0.7%	4.3%	0.2%	5.7%	16.4%
Overall	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: IERAL - Fundación Mediterránea based on RICyT.

Table 47. Innovation Determinants

	1	2	3	4	5	6
Market capitalization / GDP	0.0027 (0.0044)	0.0014 (0.0038)	0.0044 (0.0035)	0.0034 (0.0033)	0.0051 (0.0037)	0.0028 (0.0041)
Corporate income taxes	4.0031 (2.8411)	3.2434 (2.4623)				2.6587 (2.5408)
Capital per effective worker	0.4906 (0.2488) *	0.1899 (0.2469)	0.1284 (0.1971)	0.1505 (0.1963)	0.4169 (0.197) **	0.1381 (0.2532)
Property rights score	-0.2397 (0.2568)		0.2537 (0.2429)		-0.1964 (0.2188)	0.2846 (0.2954)
Software piracy rate		-0.0322 (0.0115) **	-0.038 (0.0124) ***	-0.0301 (0.0099) ***		-0.0416 (0.0151) **
Constant	-0.9471 (1.3116)	1.4479 (1.4614)	2.1109 (0.9902) **	2.2143 (0.987) **	0.1194 (0.8526)	1.5989 (1.4727)

Source: IERAL - Fundación Mediterránea based on WDI, Heritage Fundation, BSA

Table 48. Sectoral Structure of Employment

	Sectoral employment			GDP / L		
	Primary	Industrial	Service	Primary	Industrial	Service
1993	9.9%	15.7%	74.3%	11 928	20 697	16 512
1998	9.7%	13.9%	76.4%	14 232	25 162	18 714
2003	9.4%	13.4%	77.2%	15 946	22 591	16 756
2006	8.4%	13.1%	78.5%	16 140	24 573	17 282

Source: IERAL - Fundación Mediterránea based on Mecon

Table 49. Employment reallocation index

Period	Index
1993-1998	0.0502
1993-2001	0.0590
1999-2001	0.0207
2003-2006	0.0407
1993-2006	0.0753

Source: IERAL - Fundación Mediterránea

Table 50. Productivity decomposition analysis

	Within	Between	Interaction
1993-1998	2.61 (95%)	0.36 (13%)	-0.23 (-8%)
1993-2001	0.73 (85%)	0.22 (26%)	-0.10 (-11%)
1999-2001	-1.22 (81%)	-0.19 (12%)	-0.10 (7%)
2003-2006	1.01 (78%)	0.48 (38%)	-0.21 (-16%)
1993-2006	0.59 (94%)	0.33 (52%)	-0.29 (-47%)

Source: IERAL - Fundación Mediterránea

Table 51. PIB /L growth, sectoral and overall

	Primary	Industrial	Service	Overall
1993-1998	19.3%	21.6%	13.3%	14.7%
1993-2001	29.2%	10.2%	5.4%	7.1%
1993-2006	35.3%	18.7%	4.7%	8.5%
1999-2001	4.6%	-5.8%	-2.9%	-3.0%
2003-2006	1.2%	8.8%	3.1%	3.9%

Source: IERAL - Fundación Mediterránea

Table 52. Investment and TFP growth requirements for 4% growth per capita

Strategy	Investment Rate	Savings Rate	TFP Growth	Factibility / desirability
Investment	30,0%	32,4%	1,3%	3
Investment + TFP	24,2%	26,1%	2,0%	1
TFP	22,0%	23,8%	2,4%	2

Table 53. Improvements in productivity enhancing activities for extra 0.7% TFP growth

	Improvement required		Required strategy	Factibility / desirability
	For extra 0.7 TFP growth	For extra 1.1 TFP growth		
Export Sophistication	16%	25%	Subsidy to self-discovery, provision of ISPG, facilitation of experimentation, pro-export policies, foreign market opening	1
Distance to technological frontier	From 78% a 52%	From 78% to 41%		
R&D + innovation	From 0.41% to 0.68% GDP	From 0.41% to 0.97% GDP	FDI and trade with high knowledge countries, ITCs, export pattern, human capital, IPRs	1

Figure 1. Drivers of growth

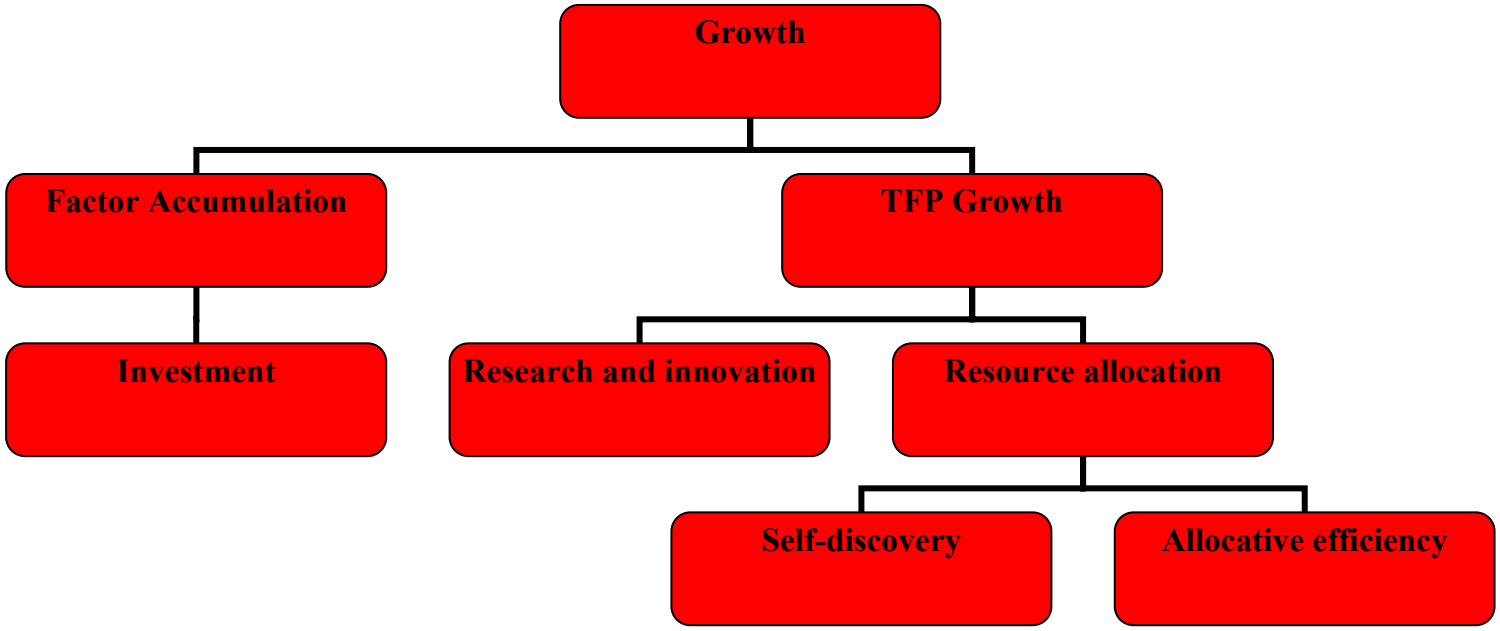


Figure 2. Decision tree for binding constraints on investment

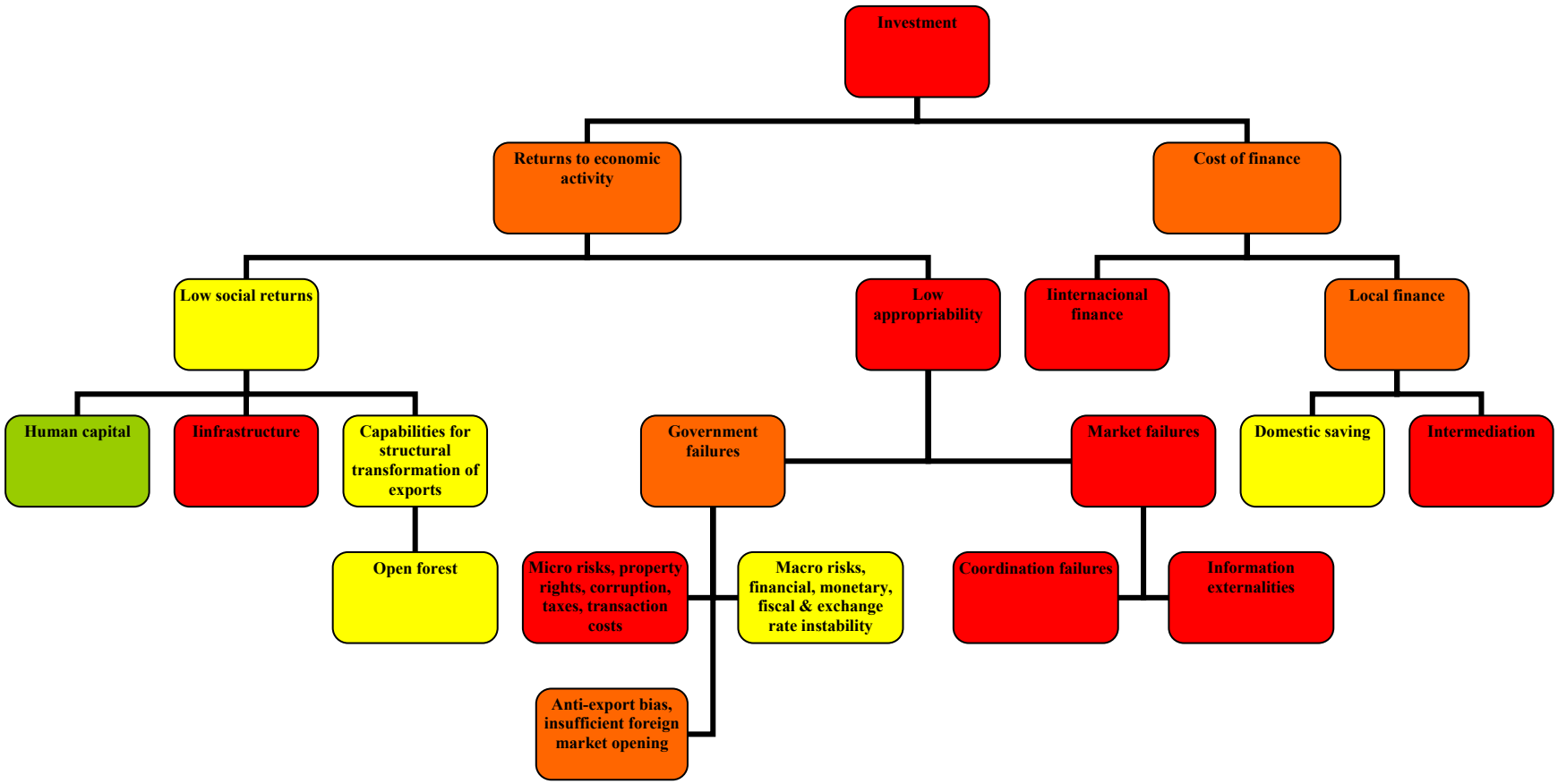


Figure 3. Decision tree for binding constraints on research and innovation

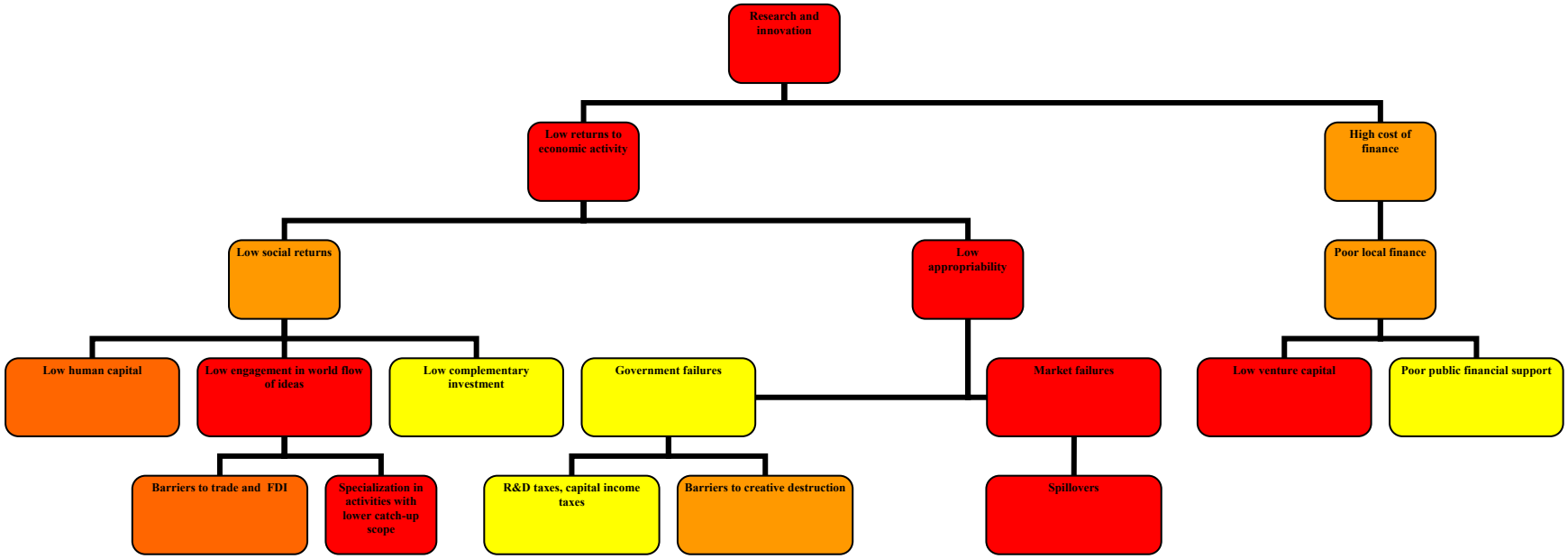


Figure 4. Decision tree for binding constraints to productivity enhancing allocations

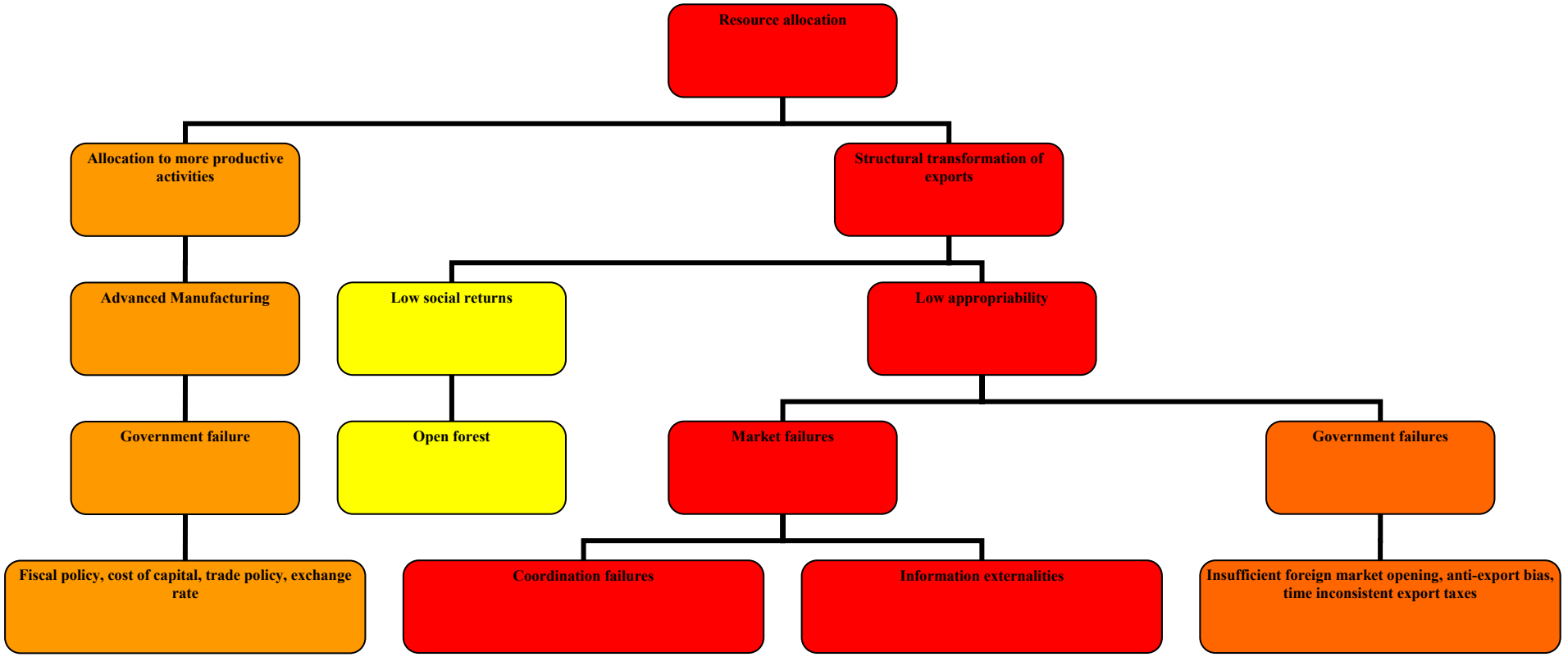
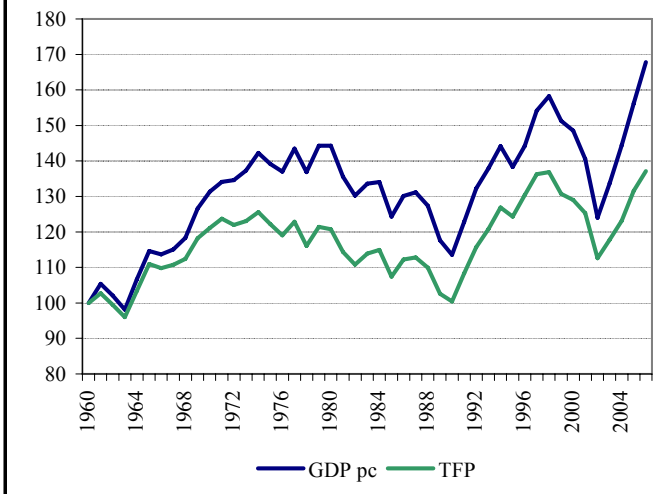


Figure 5. Per capita GDP real terms and TFP (1960 - 2006)

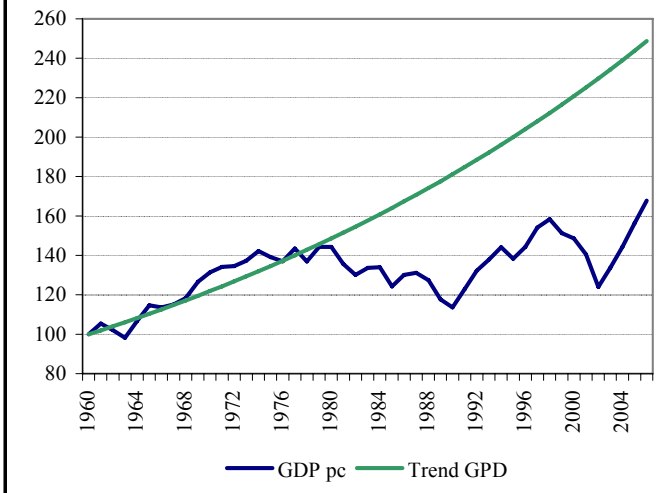
1960 = 100



Source: IERAL based on Mecon

Figure 6a. Real GDP pc and long run trend

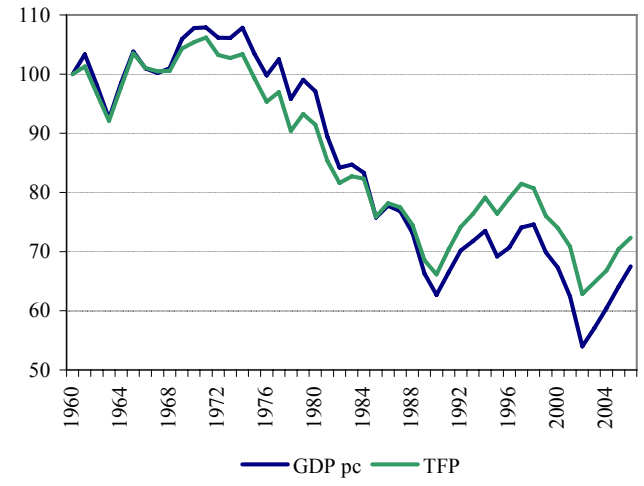
1960 = 100



Source: IERAL based on Mecon

Figure 6b. Detrended dynamics of GDP pc and TFP

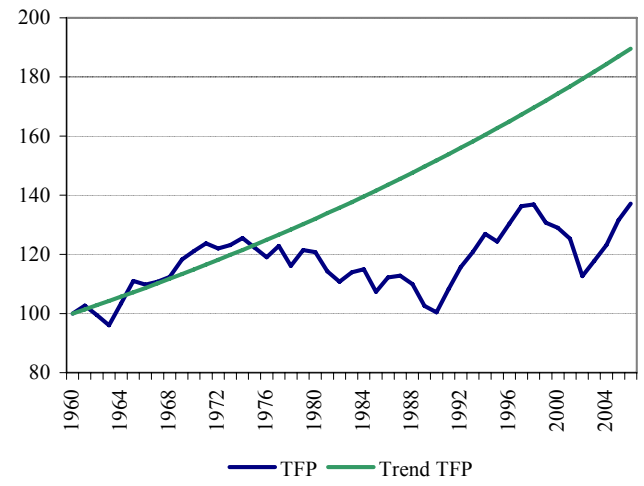
1960 = 100



Source: IERAL based on Mecon

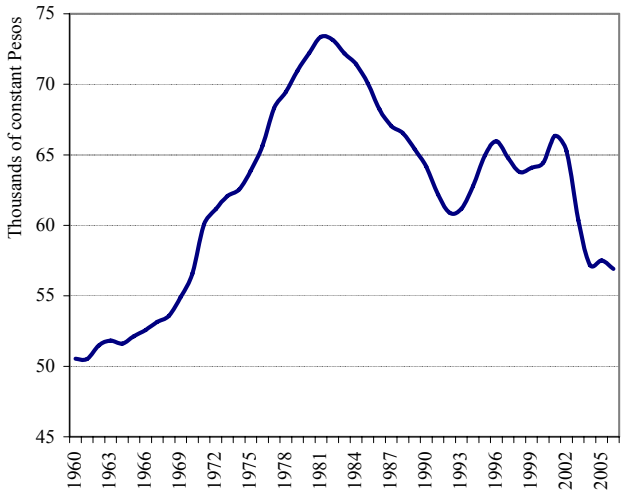
Figure 7. TFP and long run trend

1960 = 100



Source: IERAL based on Mecon

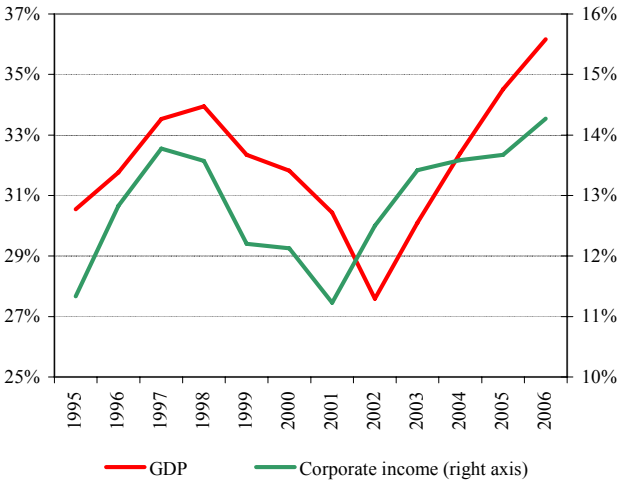
Figure 8. Capital per worker



Source: IERAL - Fundación Mediterránea based on Mecon

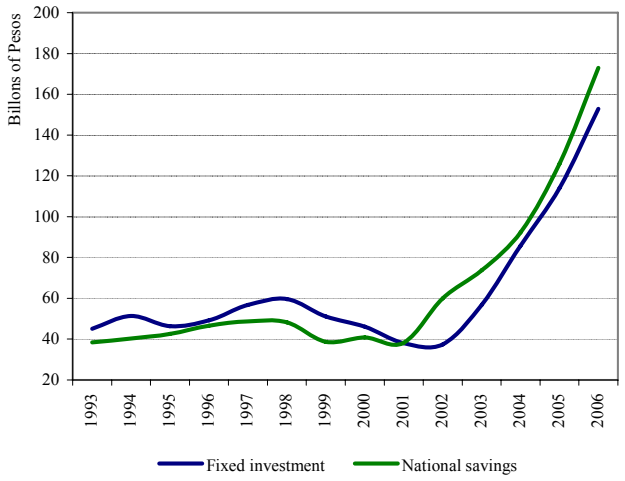
Figure 9. Returns on capital in Argentina

As a % of the capital stock



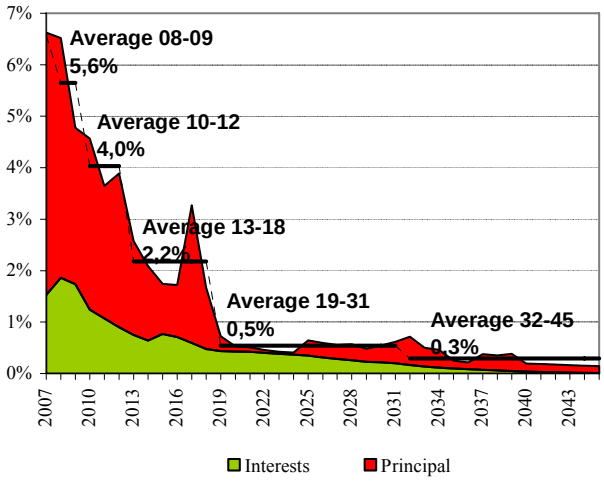
Source: IERAL from Fundación Mediterránea based on BCRA and INDEC

Figure 10. Savings and investment in Argentina



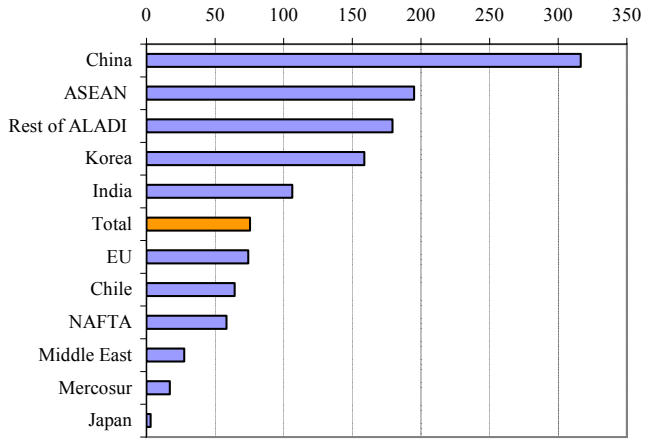
Source: IERAL from Fundación Mediterránea based on INDEC

Figure 11. Public sector financing needs



Source: IERAL from Fundación Mediterránea based on INDEC

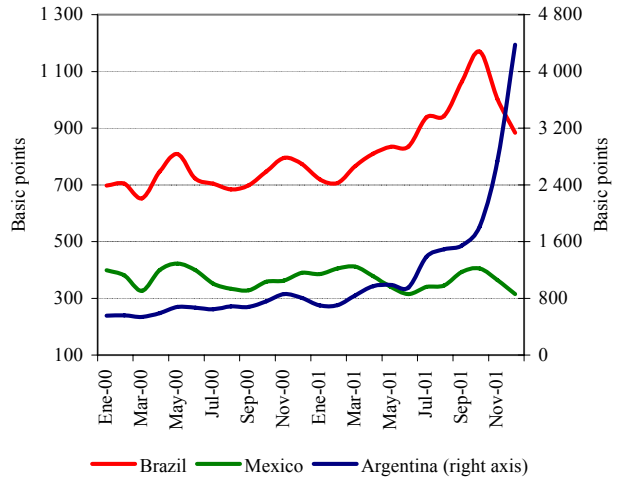
Figure 12: Argentina export growth by destination
Percentage change 2002-2006



Source: IERAL of Fundación Mediterránea based on INDEC.

Figure 13a. Country risk Argentina, Brazil and Mexico

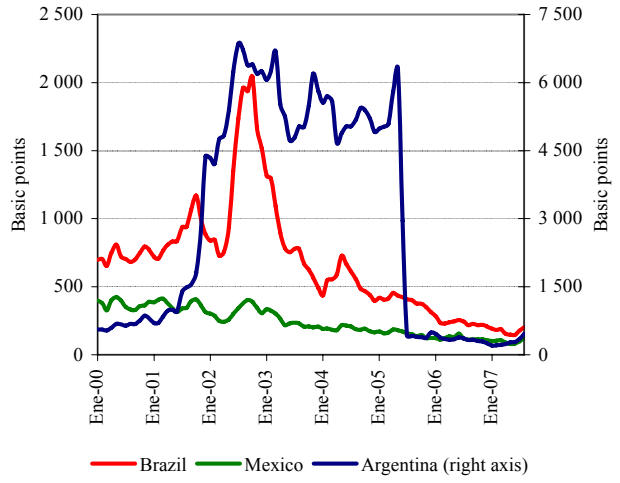
January 2000 - Dicember 2001



Source: IERAL - Fundación Mediterránea based Ambitoweb.com

Figure 13b. Country risk Argentina, Brazil and Mexico

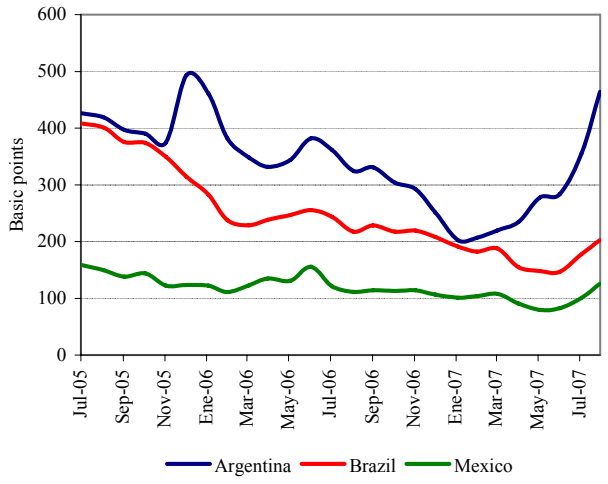
January 2000 - August 2007



Source: IERAL - Fundación Mediterránea based Ambitoweb.com

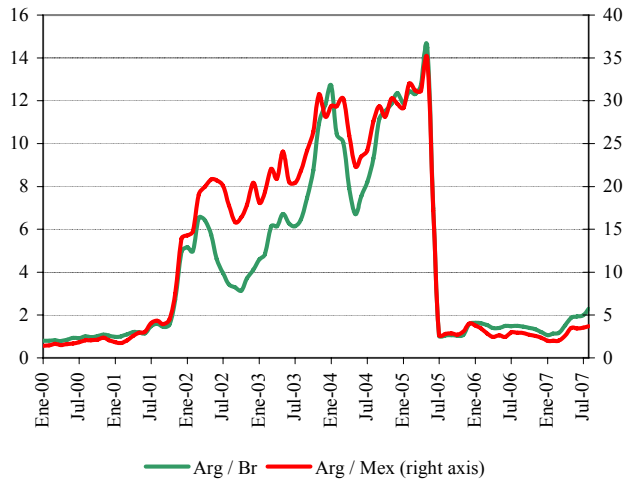
Figure 13c. Country risk Argentina, Brazil and Mexico

July 2005 - August 2007



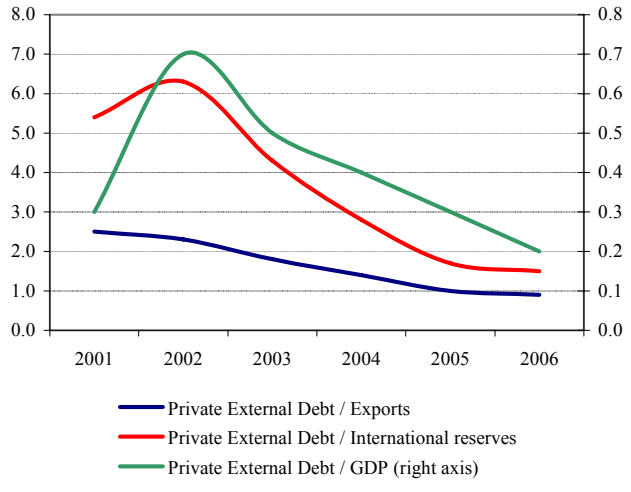
Source: IERAL - Fundación Mediterránea based Ambitoweb.com

Figure 14. Comparative county risk



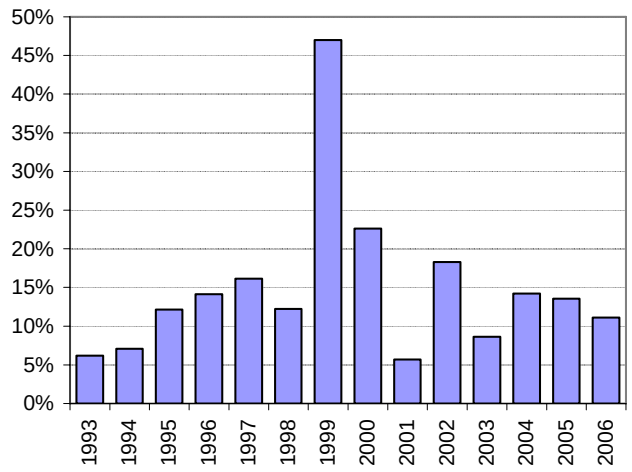
Source: IERAL - Fundación Mediterránea based on Ambitoweb.com

Figure 15. External Private Debt



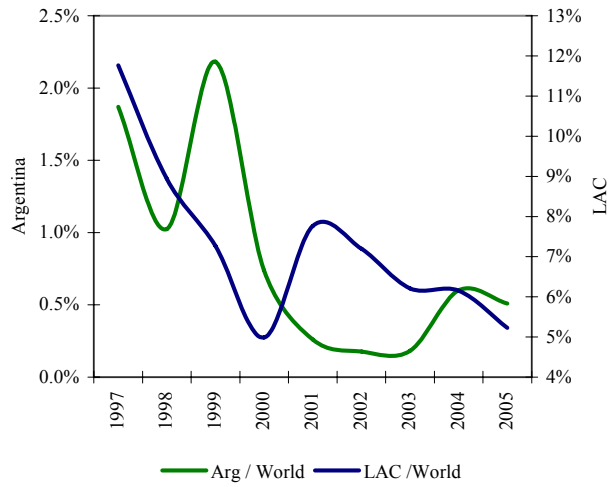
Source: IERAL - Fundación Mediterránea based on Mecon

Figure 16a. FDI in Argentina relative to total investment



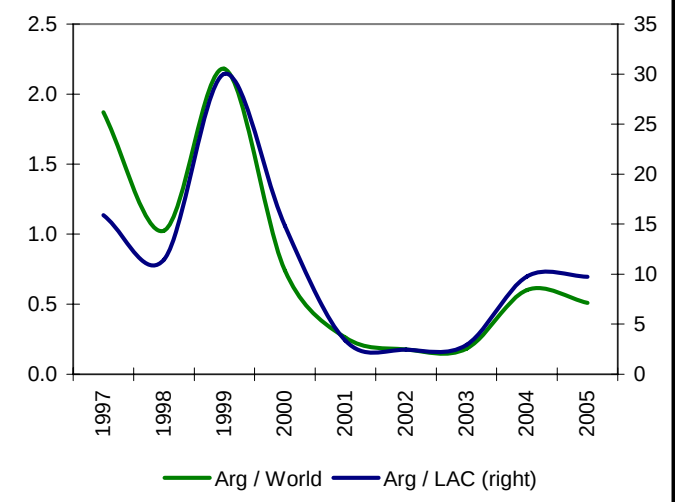
Source: IERAL - Fundación Mediterránea based on Mecon and BCRA

Figure 16b. Participations of Argentina and Latin America in FDI flows to the World



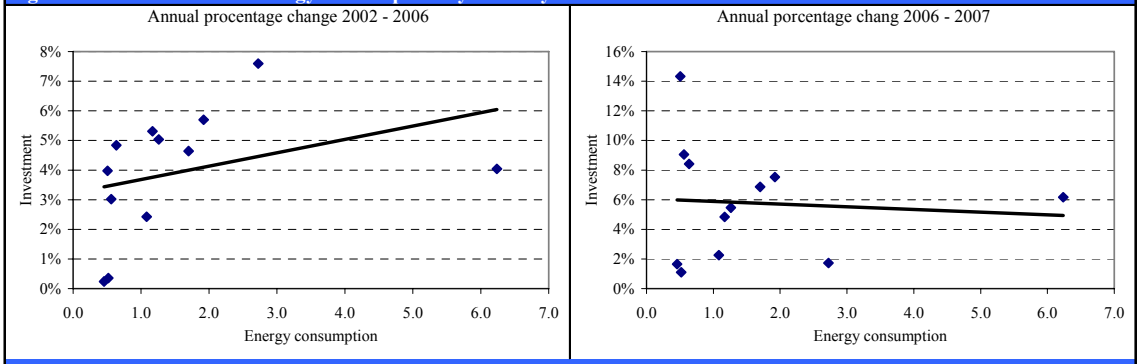
Source: IERAL - Fundación Mediterránea based on Mecon

Figure 16c. Argentina's participation in FDI flows to the World and to Latin America



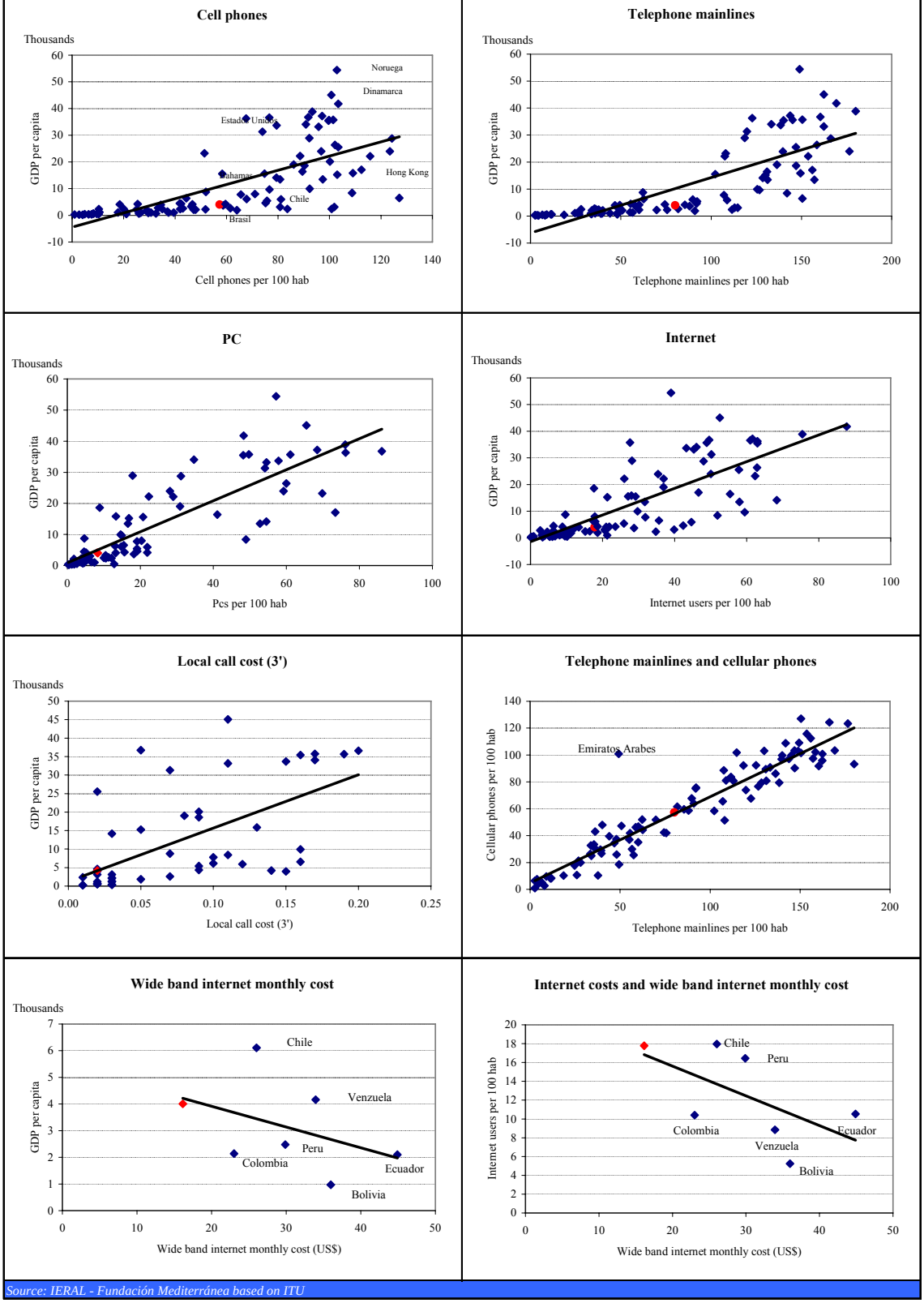
Source: IERAL - Fundación Mediterránea based on Mecon

Figure 17. Investment and energy consumption by industry



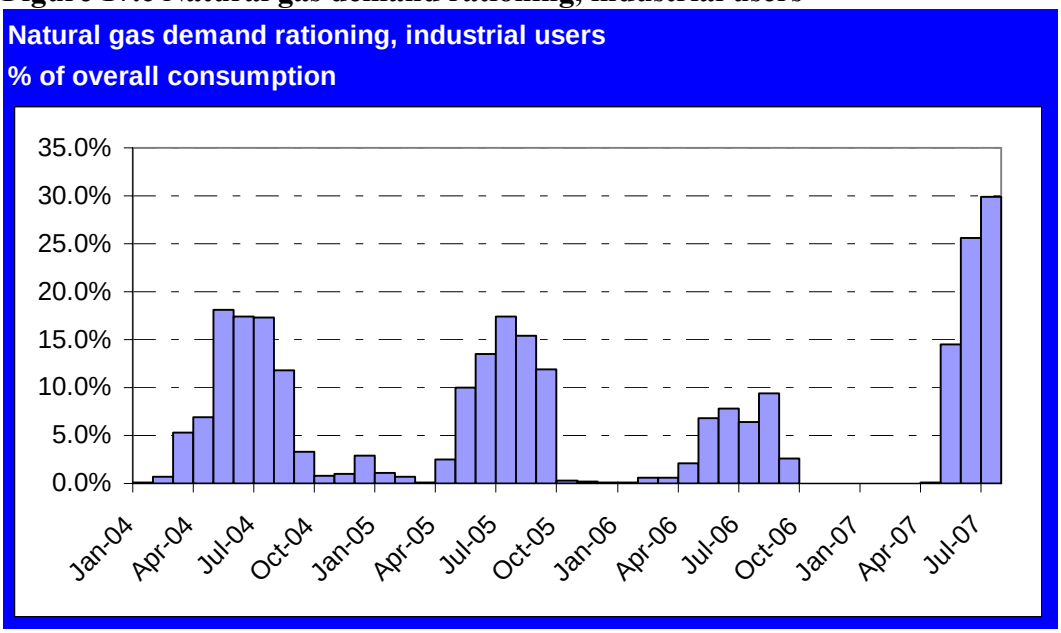
Source: IERAL - Fundación Mediterránea based on MIPAr-97 and INDEC

Figure 17b.



Source: IERAL - Fundación Mediterránea based on ITU

Figure 17.c Natural gas demand rationing, industrial users



Source: RG Consultores

Figure 17d. Natural gas demand rationing for electricity production

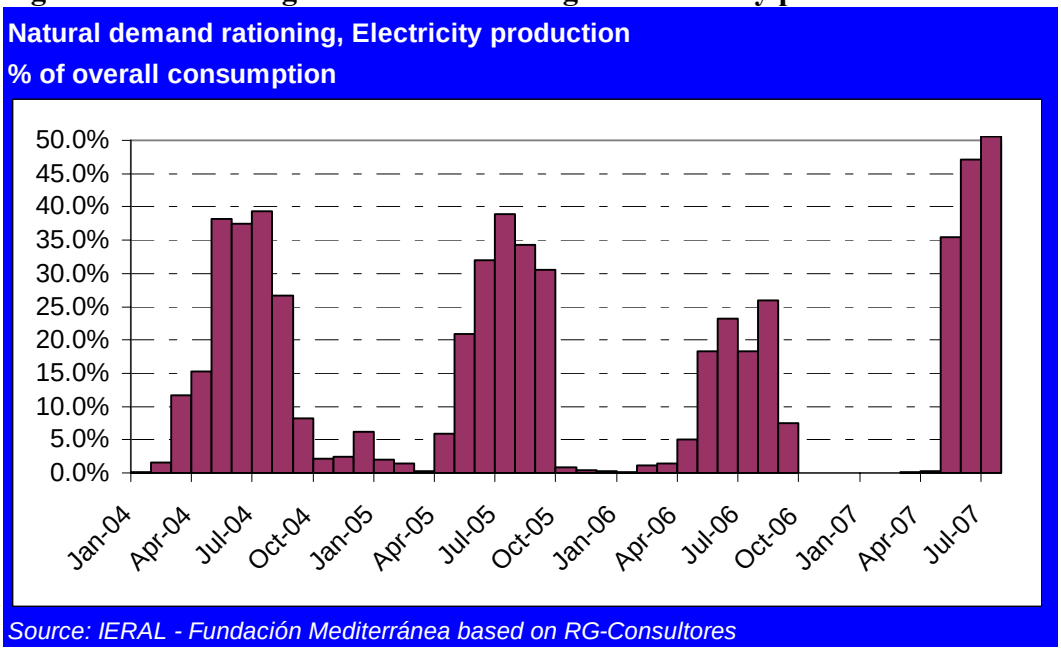
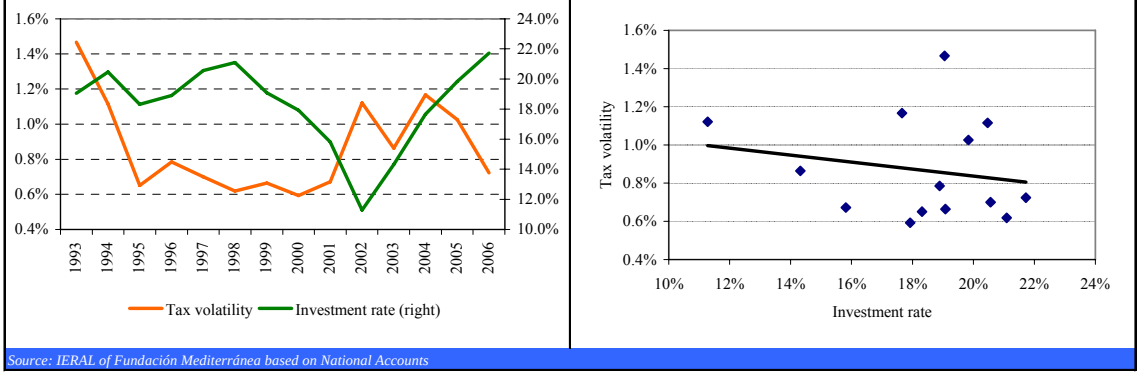
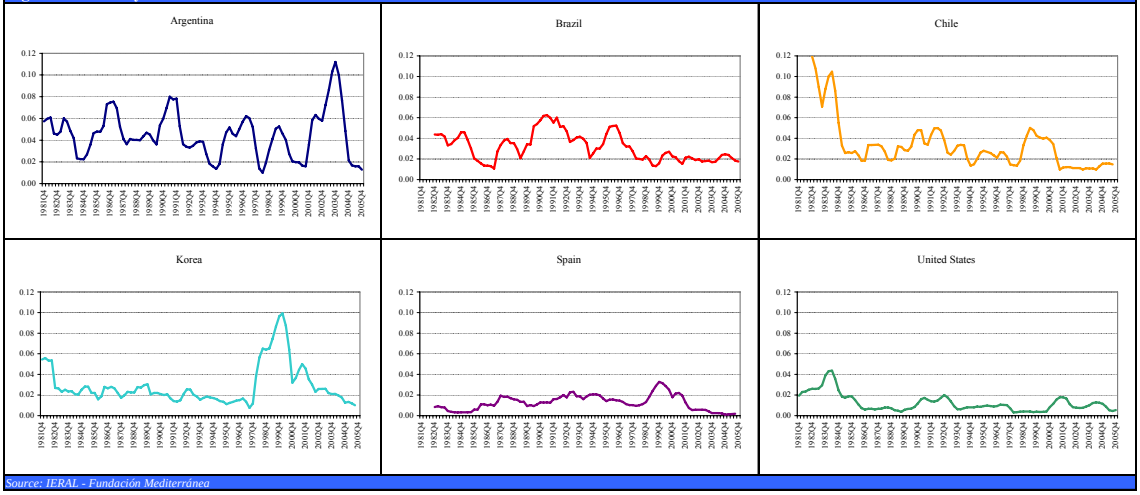


Figure 18. Tax volatility and investment in Argentina



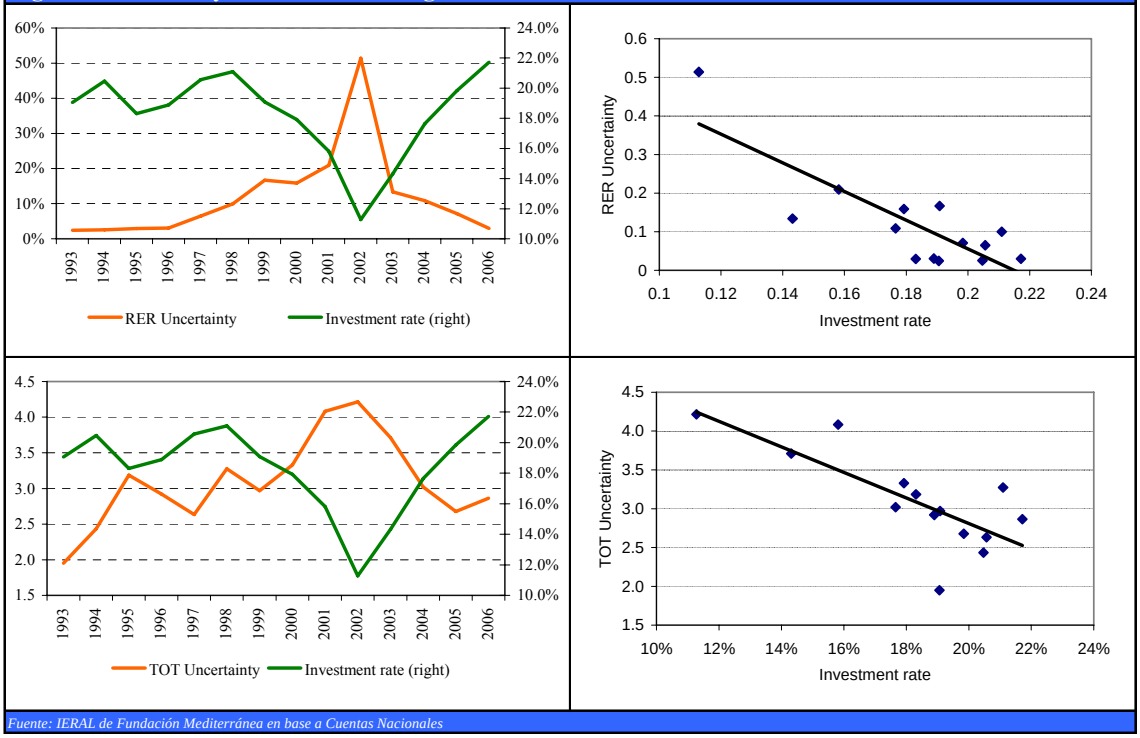
Source: IERAL of Fundación Mediterránea based on National Accounts

Figure 7. Volatility of GDP



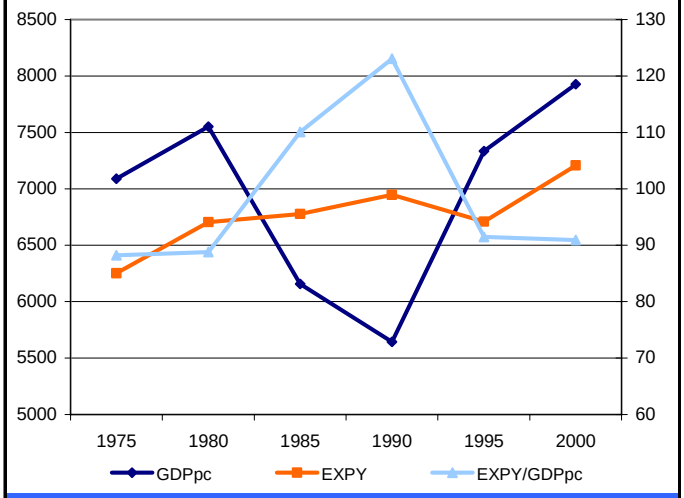
Source: IERAL - Fundación Mediterránea

Figure 20. Volatility of the real exchange rate and the terms of trade



Fuente: IERAL de Fundación Mediterránea en base a Cuentas Nacionales

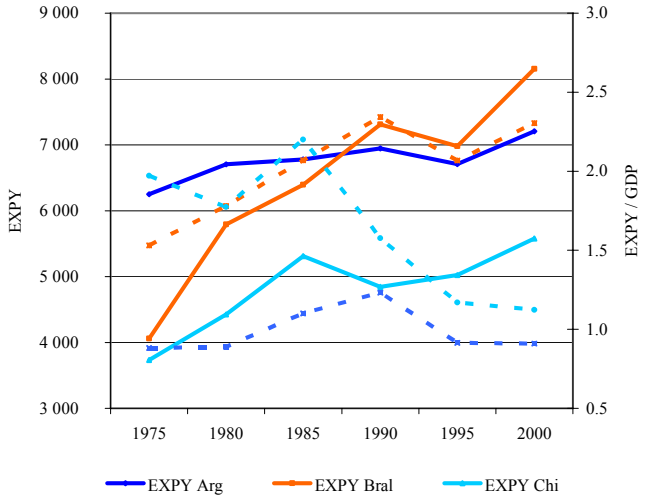
Figure 21. Argentina's export sophistication



Source: IERAL-Fundación Mediterránea.

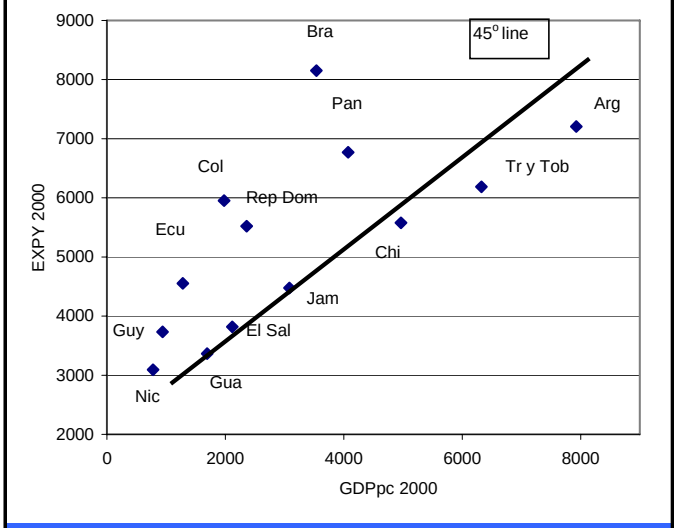
Figure 22. Export sophistication relative to per capita GDP – Selected countries

1975 - 2000



Source: IERAL-Fundación Mediterránea.

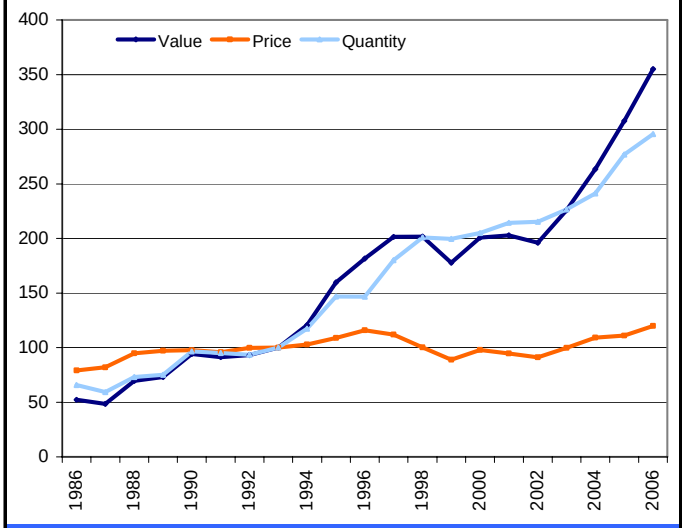
Figure 23. Export sophistication and per capita GDP – Latin America



Source: IERAL-Fundación Mediterránea.

Figure 24. Exports dynamics 1986-2006

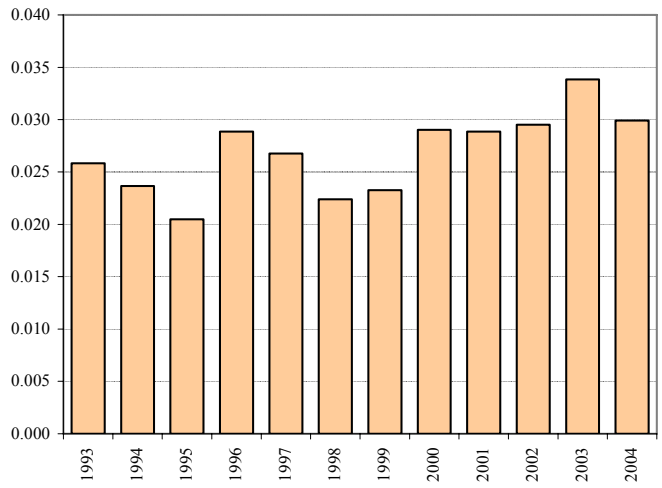
Index Base 100 = 1993



Source: IERAL-Fundación Mediterránea based on INDEC.

Figure 25. Herfindahl – Hirschmann Index for Argentine exports

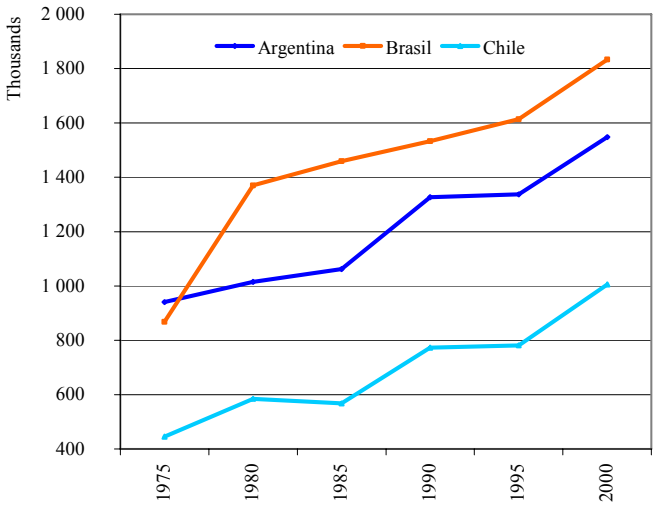
Exports at 6-digit level, 1993-2004



Source: IERAL-Fundación Mediterránea based on INDEC.

Figure 26. Open forest Dynamics in Argentina, Brazil and Chile

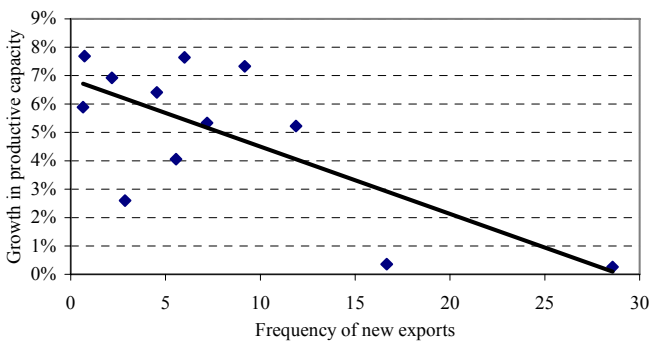
1975 - 2000



Source: IERAL-Fundación Mediterránea.

Figure 27. Industry level investment and frequency of new exports by sector

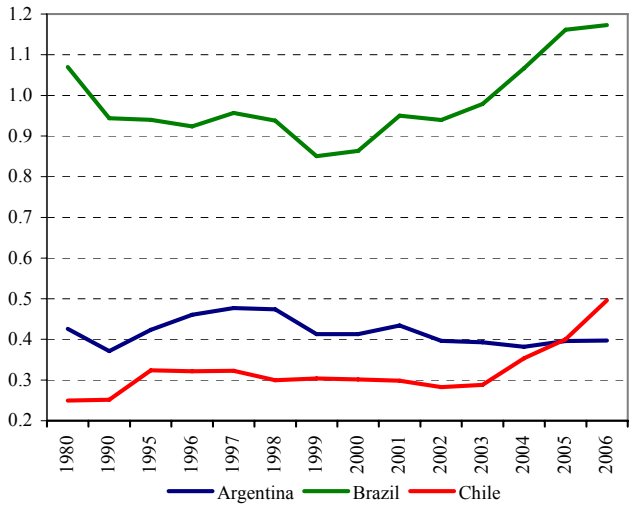
Average annual variation 2002 - 2006



* estimated from capacity utilization

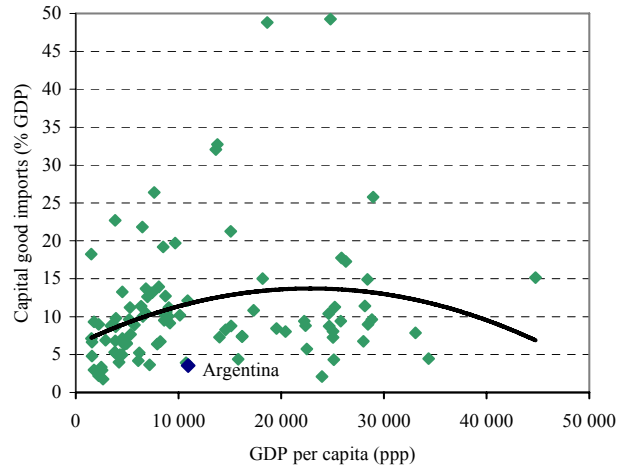
Source: IERAL de Fundación Mediterránea based on Mecon

Figure 28. Participation in international trade



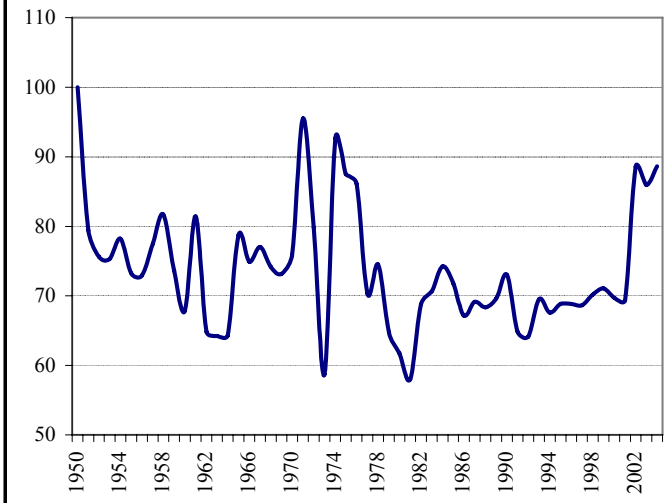
Source: IERAL de Fundación Mediterránea based on IFS

Figure 29. Capital good imports and economic development



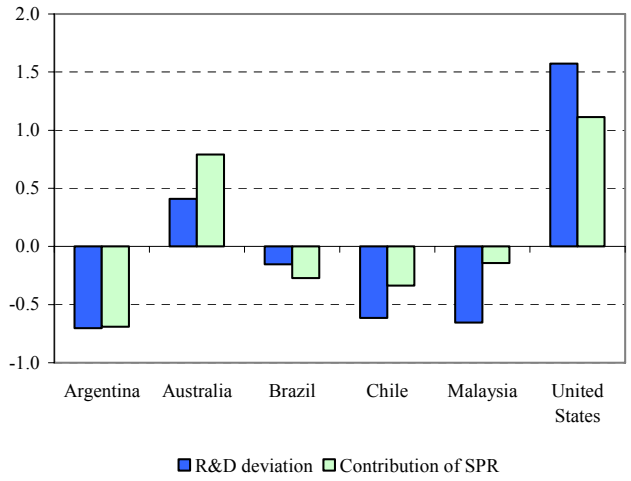
Source: IERAL de Fundación Mediterránea based on PWT 6.2WITS

Figure 30. Relative price of investment in Argentina vis-a-vis the US



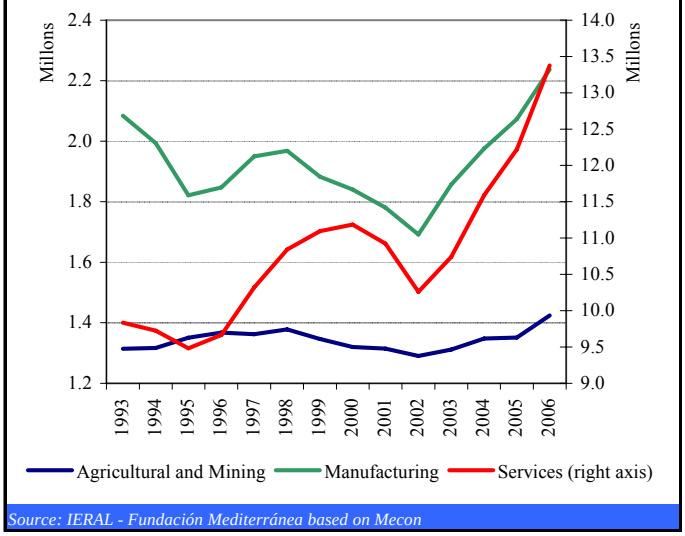
Source: IERAL-Fundación Mediterránea based on PWT 6.2

Figure 31. Cross country deviation from average R&D and contribution of Software Piracy Rates (SPR)



Source: IERAL-Fundación Mediterránea

Figure 32. Employment by Sector



Source: IERAL - Fundación Mediterránea based on Mecon

Annex AI. An econometric analysis of the constraints on investment

In this annex we evaluate the reduced form relationship between investment and its possible constraints in Argentina. We work with reduced forms because it is very difficult to build a unique structural model that incorporates all the investment theories as special cases. Besides, even if it were possible, the statistical evidence would be fragile with respect to the assumptions used to derive the estimable equation from the model.

We conduct this econometric analysis at four levels. First, we undertake a time series analysis of the determinants of aggregate investment. This reduced form analysis has the disadvantage of not allowing controlling whether the explanatory variables are having a direct impact on investment, or if they are affecting it through their effects on savings. But it does offer the advantage of allowing to appraise the effect of changes over time in these variables, and to undertake a counterfactual analysis of changes in the constraints to investment.

Next we estimate the determinants of investment in a panel of manufacturing industries. This analysis complements the previous one and allows attenuating the problem of simultaneity between savings and investment in regressions based in reduced-forms. It also allows controlling for the effect of inter-industry heterogeneity on investment.

The third exercise involves estimating the determinants of investment in a panel of public offer firms, which also permits avoiding the savings-investment simultaneity issue. This estimation allows capturing more precisely the impact of determinants of investment that operate at a microeconomic level, such as uncertainty and expected profitability (Tobin's Q). It also offers the advantage of including firms in manufactures, services, the financial sector and some primary activities. However, as the panel includes only public offer firms some results may not extend to the whole universe of firms, especially the SMEs.

These first three exercises replicate the analysis undertaken by Sánchez and Butler (2007), and expand it by including new variables and interactive terms that test for specific channels through which financing can affect investment, and by distinguishing between aggregate investment and investment in machinery and equipment.

The fourth exercise entails running a cross-section analysis of the correlation of investment at the firm level in 2006 with its potential constraints, using data the World Bank Doing Business Survey. The cross-section nature of the analysis makes it difficult to draw conclusions regarding the direction of causality, as we cannot use adequate instruments, but the correlations obtained can be very informative in the light of the results obtained in the previous exercises. Additionally, this analysis allows evaluating the possible effects of variables that are binding constraints at the firm level, such as transaction costs, human capital, several measures of appropriability, and access to financing, among others.

We next present the design of the different estimations, and then show their results in Tables AI.1 through AI.4 and the results of counterfactual analyses of changes in some of the potentially binding constraints in Figures AI.1 through A1.4.

AI.1. Time series analysis

This regression analysis is based on quarterly data for the 1993-2006 period. The dependent variable is total aggregate investment, obtained from National Accounts. We would ideally work with private investment, but this variable is available only on a yearly basis, rendering too few observations for an accurate estimation. In order to approximate private investment we also use as an explanatory variable the investment in machinery and equipment, which is undertaken mostly by the private sector. In so doing we are missing the determinants of investment in residential construction. The analysis remains valid in that investment in machinery and equipment (M&E) has been estimated by De Long and Summers (1993, 1998) to have a significantly positive and bigger contribution to TFP than the other types of investment.

The regressors include the following variables that our GDM analysis suggests that matter for investment in the short and medium runs:

- Variables that proxy for current demand and profitability and internal funds: GDP, price of investment relative to GDP, user cost of capital, unit labor cost.
- Variables that proxy for national savings and macroeconomic sustainability: fiscal result/GDP.
- Financing: banking credit to non financial private sector / GDP.
- Terms of trade.
- Multilateral real exchange rate
- Output gap (computed using a Hodrick-Prescott filter).
- Uncertainty, measured as the conditional variances of the forecast errors for the relative price of investment, inflation, terms trade, and the real exchange rate. These variances are obtained from the estimation of a first order autoregressive GARCH for each of these variables.
- Appropriability arising from government failures, proxied by tax volatility which is measured as the conditional variances of the forecast errors for the tax collection/GDP ratio.
- Lagged investment

This analysis is based on Servén (1998), who estimates a similar empirical equation for investment when analyzing the impact of uncertainty on private investment in a panel of developing countries and in individual time series. In order to deal with the potential endogeneity of the regressors, we use the twice lagged values of the explanatory variables as instruments (see Servén, 1998).

The results are shown in Table AI.1 for aggregate investment and in Table 24 for investment in durable production equipment. The method of estimation is OLS, and the

regression equation uses logs for the variables that are not computed as ratios. A Chow test does not allow rejecting the null hypothesis of a structural break after the first quarter of 2002. Hence we include a 2002 dummy variable (to capture the disruptive effects of that year crisis that go beyond those contained in our explanatory variables) and a 2003-2006 dummy that controls for a possible regime change in the behaviour of investment. Ideally we would like to allow for time dummies to interact with the coefficients of the explanatory variables, or to estimate separate regressions before and after the break, but we do not have enough degrees of freedom to do so.

AI.2. Manufacturing industries panel

We undertake a panel data regression for investment at the manufacturing industry level, which includes quarterly data for 2003-2006, and uses the implicit change in installed capacity as proxy for investment.[95] The regressors include variables that proxy for current profits and internal funds (output, industry hourly wages and sectoral wholesale prices (IPIM)), leverage (sectoral credit/gross value of production), and the extent of labor informality in the industry (to capture issues of appropriability via unfair competition and issues of access to credit).

The results are shown in Table AI.3. The estimation controls for fixed effects at the industry level.

AI.3. Panel of public offer firms

The panel has annual data for 1990-2006. The information used comes from the firms' balance sheets. The dependent variable is the variation in net fixed assets (normalized by the capital stock). The regressors include the Tobin's Q (measured as total assets -capital stock + market capitalization)/total assets), idiosyncratic uncertainty (stock price variability within each year), risk (correlation between the firm's stock price variability and the market variability), and sales. The specification of the regression equation comes from Leahy and Whited (1996). The regression includes firm fixed effects and time dummies to capture the impact of aggregate shocks. The results are shown in Table AI.4.

AI.4. Cross-section of firms

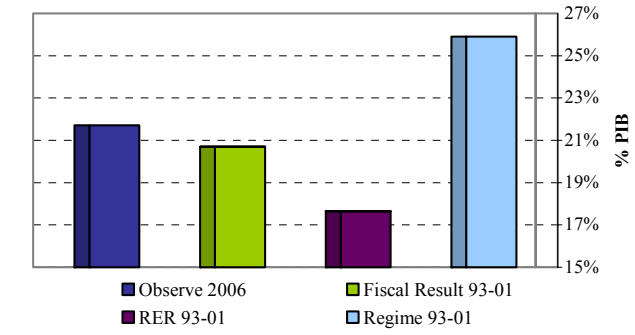
The data set includes 1063 firms from twelve sectors, for the year 2006, obtained from the World Bank Doing Business Survey. The regressions are done using OLS, with the error terms corrected for heteroskedasticity using White's methodology. The dependent variable is the investment in fixed assets normalized by the stock of fixed assets (valued at their replacement cost). The regressors include variables that measure current profits (sales/capital stock), access to financing (share of working capital that is financed with external funds, share of investment in next fixed assets that is financed with external funds), human capital (degree of obstacle

[95] The implicit change in installed capacity is computed as the difference between the percentage change in production and the percentage change in the use of installed capacity. Both variables are obtained from the Monthly Industrial Survey of INDEC.

posed by an inadequately educated labor force), appropriability of returns (informal payments to government officials/sales, income loss due to crime, consistency in interpretation of laws and regulations). The results are shown in Table AI.5.

Figure AI.1. Counterfactual analysis for aggregate investment of reversals in fiscal result, RER and "regime"

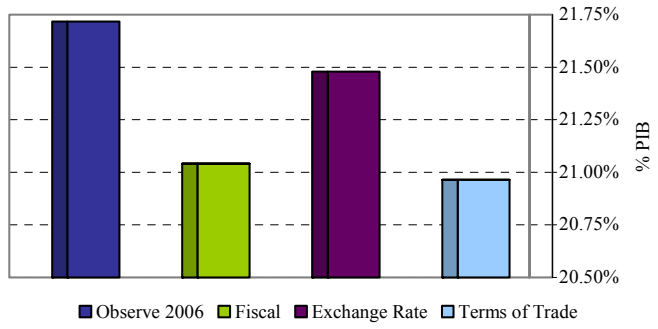
Reversion to 93-01 values for:



Source: IERAL - Fundación Mediterránea

Figure AI.2. Counterfactual analysis for aggregate investment of increases in volatility

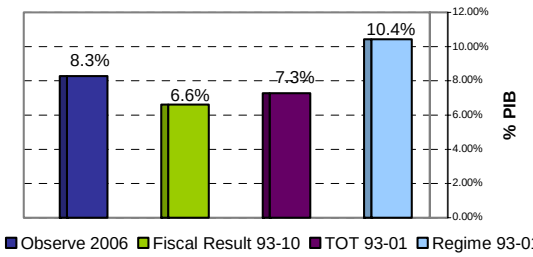
One standard deviaton shock on uncertainty:



Source: IERAL - Fundación Mediterránea

Figure AI.3. Counterfactual analysis for investment in M&E of reversals in fiscal result, RER and "regime"

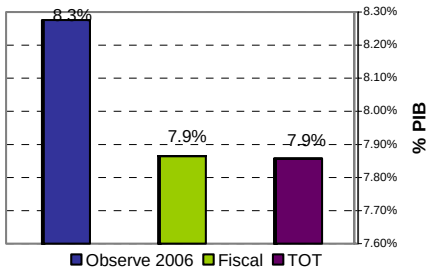
Reversion to 93-01 values



Source: IERAL - Fundación Mediterránea

Figure AI.4. Counterfactual analysis for investment in M&E of increases in volatility

One standard deviation increase in uncertainty:



Source: IERAL - Fundación Mediterránea

Table AI.1. Time series econometric analysis of agreggate investment, 1993-2006

	I	II	III	IV	V	VI	VII
Investment (-1) (LN)	0.4404	0.3848	0.3737	0.4815	0.3545	0.474	0.3379
	(5.6602) **	(4.0504) **	(3.9508) **	(6.321) **	(4.026) **	(7.2645) **	(4.123) **
GDP (LN)	0.9948	0.9472	0.8522	0.708	0.8725	0.8113	0.8756
	(2.6082) **	(2.4538) **	(2.1595) **	(1.8324) *	(2.1802) **	(2.0381) **	(2.3522) **
Investment price to GDP price (LN)	-0.1785	-0.0782	-0.2909	0.3319	-0.4213	0.256	-0.5331
	(-0.4007)	(-0.1678)	(-0.5313)	(0.64)	(-0.7302)	(0.4867)	(-0.984)
user cost of capital	-0.0009	-0.0008	-0.0008	-0.0008	-0.0008	-0.0008	
	(-1.5618)	(-1.3763)	(-1.446)	(-1.5547)	(-1.3882)	(-1.5199)	
unit labor cost	-0.0009	-0.0006	-0.0004	-0.0002			
	(-0.8476)	(-0.495)	(-0.3565)	(-0.145)			
Fiscal balance	3.1194	4.4863	4.5751		4.7855		4.6765
	(1.7527) *	(1.9799) *	(2.1128) **		(2.173) **		(2.2994) **
Credit	-0.0127	-0.0053	-0.0002	-0.0163	0.0034	-0.0158	0.0028
	(-2.964) **	(-0.6747)	(-0.0137)	(-1.6204)	(0.3271)	(-1.8746) *	(0.2919)
GDP gap	0.2341	0.4083	0.5508	0.98	0.5357	0.7689	0.7064
	(0.3157)	(0.5573)	(0.7737)	(1.5758)	(0.7361)	(1.1804)	(1.0814)
Fiscal uncertainty	-10.9563	-11.6753	-11.0916	-6.7881	-9.9979	-5.7478	-9.604
	(-2.3597) **	(-2.4058) **	(-2.2162) **	(-1.695) *	(-2.1303) **	(-1.5079)	(-2.2043) **
RER uncertainty	-0.0677	-0.0197	-0.0668	-0.0583	-0.0733	-0.0552	-0.1853
	(-0.508)	(-0.1329)	(-0.4323)	(-0.3848)	(-0.4762)	(-0.3712)	(-1.3652)
TT uncertainty	-0.045	-0.0491	-0.0514	-0.0427	-0.051	-0.0441	-0.0537
	(-2.05) **	(-2.1331) **	(-2.3297) **	(-2.2042) **	(-2.2542) **	(-2.2135) **	(-2.5484) **
dummy 2002	-0.2279	-0.1977	-0.2558	-0.1589	-0.278	-0.1669	-0.2179
	(-3.3053) **	(-2.7796) **	(-2.1824) **	(-1.3378)	(-2.2454) **	(-1.3738)	(-2.2242) **
dummy 2003-06	-0.2789	-0.2647	-0.2549	-0.2109	-0.2367	-0.2012	-0.2265
	(-4.1206) **	(-3.7269) **	(-3.4947) **	(-3.3657) **	(-4.8917) **	(-4.6796) **	(-4.9881) **
TT (LN)		0.4593	0.4574	0.0045	0.4926	-0.0181	0.4175
		(1.1257)	(1.1362)	(0.0152)	(1.2623)	(-0.0692)	(1.1379)
RER (LN)			0.145	-0.0501	0.225	-0.0422	0.208
			(0.5564)	(-0.1832)	(0.9355)	(-0.1642)	(0.9515)
C	-4.906	-6.4635	-4.2935	-4.2036	-4.0306	-4.9885	-3.0281
	(-1.2819)	(-1.5106)	(-0.8028)	(-0.7247)	(-0.7497)	(-0.8564)	(-0.6062)
R-squared	0.9805	0.9798	0.9806	0.9823	0.9799	0.9814	0.9824
Adjusted R-squared	**0.9732**	**0.9714**	**0.9718**	**0.9754**	**0.9717**	**0.9749**	**0.9759**
Sample	1994:2 2006:2	1994:2 2006:2	1994:2 2006:2	1993:4 2006:2	1994:2 2006:2	1993:4 2006:2	1994:2 2006:2
Included observations	49	49	49	51	49	51	49

Variable description and sources

Investment, GDP	constant prices 1993, National Accounts
Investment, GDP (prices)	National Accounts
User cost of capital	IERAL based on Jorgenson, BCRA and INDEC
Unit labor cost	IERAL based on INDEC
Fiscal balance	Fiscal Results as percentage GDP, National Accounts, AFIP
Credit	Credit (pirvat + public) as percentage of GDP, BCRA; National Accounts
GDP gap	Potential GDP to observed GDP. IERAL based onNational Accounts
Fiscal uncertainty	Fiscal uncertainty, measured as conditional variance of innovations
RER uncertainty	RER uncertainty, measured as conditional variance of innovations
TT uncertainty	TOT uncertainty, measured as conditional variance of innovations
TT	INDEC
RER	Real Exchange Rate. IERAL based on BCRA, INDEC.

Source: IERAL - Fundación Mediterránea

Table AI.2. Time series econometric analysis of investment in M&E, 1993-2006

	I	II	III	IV	V	VI	VII
Investment in Equipment (-1)	0.493 (5.4073) **	0.3603 (2.7089) **	0.3955 (3.3402) **	0.5475 (5.6229) **	0.3634 (3.6604) **	0.5204 (6.9128) **	0.2914 (2.7993) **
GPD (LN)	1.0314 (1.9677) *	1.277 (2.1418) **	0.937 (1.4164)	0.8125 (1.1585)	1.0857 (1.6962) *	0.9853 (1.4937)	1.7926 (2.8387) **
Investment in equipment price to GDP price (LN)	0.054 (0.1965)	0.2255 (0.7209)	0.1902 (0.4573)	0.3139 (0.7346)	0.2603 (0.6449)	0.3507 (0.8665)	0.6512 (1.9048) *
user cost of capital	-0.0019 (-2.3976) **	-0.0018 (-2.0935) **	-0.0014 (-1.5905)	-0.0014 (-1.4955)	-0.0014 (-1.4294)	-0.0015 (-1.5909)	
unit labor cost	-0.0012 (-0.6219)	0.0008 (0.3171)	-0.0007 (-0.3631)	-0.0007 (-0.3964)			
Fiscal balance	3.5827 (1.8391) *	6.3015 (2.2332) **	5.9176 (2.3726) **		6.5538 (2.425) **		7.0598 (2.5787) **
Credit	-0.0145 (-2.2079) **	0.003 (0.2194)	0.0011 (0.0645)	-0.0215 (-1.411)	0.0043 (0.2642)	-0.0187 (-1.3394)	-0.0042 (-0.2712)
GDP gap	0.3803 (0.4597)	0.3632 (0.3981)	0.9023 (1.0836)	1.0965 (1.2889)	0.7623 (0.8724)	0.852 (0.9754)	0.0921 (0.1002)
Fiscal uncertainty	-14.033 (-2.1456) **	-13.5184 (-1.8902) *	-16.1373 (-2.4842) **	-10.0596 (-1.6697)	-15.9806 (-2.4153) **	-8.9891 (-1.5404)	-20.5099 (-3.1991) **
RER uncertainty	-0.029 (-0.1434)	0.1456 (0.5615)	-0.028 (-0.1365)	-0.0977 (-0.5282)	0.0271 (0.1583)	-0.0544 (-0.3451)	-0.0479 (-0.2784)
TT uncertainty	-0.0621 (-2.2053) **	-0.0726 (-2.2803) **	-0.0741 (-2.7024) **	-0.0668 (-2.489) **	-0.0745 (-2.6817) **	-0.0686 (-2.5733) **	-0.0941 (-3.1869) **
dummy 2002	-0.3367 (-3.7971) **	-0.2727 (-2.5397) **	-0.2909 (-1.4906)	-0.2234 (-1.117)	-0.2603 (-1.2728)	-0.2305 (-1.1499)	-0.0494 (-0.3707)
dummy 2003-06	-0.3784 (-3.5126) **	-0.2993 (-2.3115) **	-0.3478 (-3.1778) **	-0.2979 (-3.039) **	-0.3215 (-4.7414) **	-0.2649 (-4.2968) **	-0.3223 (-4.6023) **
TT (LN)		0.9666 (1.4812)	0.7561 (1.3279)	-0.1202 (-0.3016)	0.9631 (1.8222) *	-0.0529 (-0.1744)	0.9446 (1.7623) *
RER (LN)			0.0178 (0.0437)	-0.1192 (-0.28)	-0.0132 (-0.0312)	-0.1088 (-0.2557)	-0.4649 (-1.3801)
C	-7.2851 (-1.12)	-14.8387 (-1.6923) *	-9.5876 (-0.9959)	-5.6931 (-0.5774)	-12.5432 (-1.4184)	-8.1932 (-0.9346)	-22.0908 (-2.6673) **
R-squared	0.9788	0.9745	0.9796	0.9781	0.978	0.9779	0.9767
Adjusted R-squared	**0.971**	**0.964**	**0.9704**	**0.9696**	**0.969**	**0.9701**	**0.9681**
Sample	1994:2 2006:2	1994:2 2006:2	1994:2 2006:2	1993:4 2006:2	1994:2 2006:2	1993:4 2006:2	1994:2 2006:2
Included observations	49	49	49	51	49	51	49

Variable description and sources	
Investment in Equipment	constant prices 1993, National Accounts
GDP	constant prices 1993, National Accounts
Investment in Equipment price	National Accounts
GDP price	National Accounts
user cost of capital	IERAL based on Jorgenson, BCRA and INDEC
unit labor cost	IERAL based on INDEC
Fiscal balance	National Accounts, AFIP
Credit	Credit (pirvat + public) as percentage of GDP, BCRA; National Accounts
GDP gap	Potential GDP to observed GDP. IERAL based onNational Accounts
Fiscal uncertainty	measured as conditional variance of innovations
RER uncertainty	measured as conditional variance of innovations
TT uncertainty	measured as conditional variance of innovations
TT	TOT. INDEC
RER	Real Exchange Rate. IERAL based on BCRA, INDEC.
dummy 2002	takes value 1 for 1st and 2nd quarter 2002, 0 otherwise
dummy 2003-06	takes value 1 after 2003, 0 otherwise.

Source: IERAL - Fundación Mediterránea

Table AI.3. Panel data analysis of investment in manufacturing industries, 2002-2006

Prices	0.042 (2,03)**
Prod Output	0.920 (44,63)**
Credit (% Value Added)	-0.003 (-2,77)**
Hourly wage	-0.274 (-1,45)
Employment in SME (% total employment)	1.714 (0,79)
Informal Employment (% of total employment)	-9.914 (-2,20)**
constant	2.908 (1,14)
R-squared within	0.9455
R-squared between	0.8876
R-squared overall	0.9319
Sample	2003-2006
Number of Observations	156
Variable description and sources Prices: base 100 - 1993. INDEC Prod output: INDEC Hourly wage: EPH. Emplyoment in SME: EPH Informal employment: EPH	

Source: IERAL de Fundación Mediterránea

Table AI.4. Panel data analysis of investment by public offer firms, 1990-2006

	I	II	III
Stock volatility	-0.170 (-2,64)**	-0.153 (-2,42)**	-0.158 (-2,23)**
Correlation with market volatility	0.004 (0,26)	0.004 (0,28)	-0.006 (-0,30)
Tobin's q	0.045 (2,23)**		0.055 (2,46)**
Sales			
Cash Flow		0.001 (0,71)	0.001 (0,39)
R-squared within	0.1120	0.1153	0.1360
R-squared between	0.0527	0.0180	0.0566
R-squared overall	0.0953	0.0882	0.1151
Sample	1990-2006	1990-2006	1990-2006
Number of Observations	673	582	525

Description	
Stock volatility	coefficient of variation of the daily quotation of shares. Economática
Correlation with market volatility	coefficient of correlation: daily quotation of shares-Merval. Economática
Tobin's q	Tobin's q= (total assets -capital stock+market capitalization)/total assets. Economática
Sales	firm's sales= operational incomes. Economática
Cash Flow	operational cash flow=net income-dividends paid+depreciation and amortization. Economática

Source: IERAL - Fundación Mediterránea

Table AI.5. Cross-section analysis of firm level investment, WBDB Survey 2006

Financing	1	2	3	4	5	6	6 b	7
Working capital	443.227 (1.10)		459.131 (1.12)	391.666 (0.77)	473.023 (1.12)	485.567 (1.15)	472.022 (1.12)	518.901 (1.17)
Sales (% Assets)	0.050 (3.84)***	0.050 (3.82)***	0.050 (3.84)***	0.051 (3.67)***	0.050 (3.84)***	0.050 (3.85)***	0.050 (3.84)***	0.050 (3.84)**
Fixed Asset		209.274 (0.89)						
j2(1)			-378.969 (1.70)*					-264.609 (1.55)
j7a(2)				-1283.145 (0.75)				
j1a(3)					-2305.223 (1.42)			-1911.126 (1.28)
l30b(4)						-8506.577 (1.54)	-1507.623 (0.39)	-8009.530 (1.51)
Constant	-21261.430 (1.61)	-21150.270 (1.15)	-16264.630 (1.40)	31900.960 (0.65)	-22716.380 (1.64)	-3312.330 (0.25)	-2025.571 (0.15)	-2078.392 (0.15)
Observations	646	440	646	484	646	646	646	646
R- squared	0.7252	0.7247	0.7253	0.7619	0.7254	0.7258	0.7258	0.7260

(1) Percentage senior management time dealing with regulations
(2) Percent of annual sales paid as informal payment
(3) Interpretations of laws and regulations are consistent and predictable
(4) Human capital adequacy
Absolute value of t statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: IERAL de Fundación Mediterranea with World Bank, Doing Business database

Annex II. Market based analysis of the appropriability of the private returns on investment and its impact on firm level investment

We now analyze market value based measures of appropriability (which do not distinguish between government and market failures) and their impact on investment at different points in time. The idea is that to the extent that appropriability of private returns is low, this should be reflected in a low market value of assets, which should in turn have a negative effect on investment.

To this end we measure the ability that firms in different sectors (defined by size and industry) have for passing on their investments in intangible assets to their market values, and use these indicators as proxies for the appropriability of the returns on investment by sector. Then we econometrically appraise the impact of these appropriability indicators on the investments of firms in each sector.

We borrow from the literature on the market valuation of R&D effort by individual firms (Cockburn and Griliches, 1988; Hall and Oriani, 2004; among others). This literature proposes that under rational stock markets the market value of a firm *i* at time *t* is given by:

(1) $$V_{it} = e^{(\lambda_t + \mu_i)} [A_{it} + \delta K_{it}]$$

where A is tangible capital, K is intangible capital and δ is its shadow value, while $e^{(\lambda_t + \mu_i)}$ is the average multiplier of market value relative to the replacement cost of total assets, which is made of an overall market index, λ_t, and a firm-specific component μ_i. Dividing expression (1) by A and taking logarithms we obtain:

(2) $$\log (q_{it}) = \lambda_t + \mu_i + \delta K_{it}/A_{it}$$

where q_{it} is firm *i*'s Tobin's Q. This is a regression equation in which K is a vector of variables representing the firm's intangible assets. These assets include the joint book value of trademarks, licenses, patents, R&D expenditures, advertising, etc. This includes all the "purchases" of intangible goods that are capitalized instead of being written down as expenditures because they are deemed to generate revenues in the future. Hence they are capitalized and are depreciated annually like the tangible fixed assets. To the extent that the valuation of such intangible assets and ability to appropriate their returns varies by sector the estimated δ need not be identical across firms, sizes or industries. This framework proposes that negative appropriability shocks will be reflected in the market value of firms in general, and in the valuation of their intangibles (entrepreneurial assets), rather than in their book values.

Using this framework, Hall and Oriani (2004) find that the intangible assets have robust and significant positive effect on the firms' Qs, which is stronger than the effect of the stock of R&D, in the U.S., the U.K., France, Germany and Italy.

We also analyze an alternative formulation where the value of the firm is given by:

(3) $$V_{it} = e^{(\lambda_t + \mu_i)} A_{it}^{1-\delta} K_{it}^{\delta}$$

Where the value of the firm results from the interaction between the multiplier and a geometric average of the books values of tangible and intangible assets, and where δ now represents the elasticity of the value of the firm to intangibles.

Dividing by A and taking logs we obtain:

(4) $$\log (q_{it}) = \lambda_t + \mu_i + \delta \log[K_{it}/A_{it}]$$

Using a panel of public offer firms with yearly data for 1990-2006, we first estimate equation (2) and find that it does not yield any significant results. Hence we estimate equation (4), finding that intangible assets have a positive valuation that persists even after including sales among the controls (as it is done by Hall and Oriani, 2004) (see Table AII.1).

The estimated coefficient (0.014) suggests a small "elasticity" of market valuation to intangible assets. Indeed, estimations made for several EU countries by Hall and Oriani (2004) suggest that elasticities in these countries are in a range of 1.7 to 10. We thus get a first market value-based indicator that appropriability was relatively low in Argentina during 1990-2006.

We next appraise whether there are changes in this indicator of appropriability before and after the 2002 devaluation, i.e., if the crisis brought forth a negative appropriability shock. There are still not well developed structural break tests for panel data and thus cannot estimate if there are structural changes in the elasticity of market value to intangible assets. While unable to test for this break, we still proceed to estimate equation (4) for two sub-periods, 1991-2001 and 2003-2006 (we exclude 2002 because of the large economic and contractual distress observed that year), and compare the estimated elasticities (see Table AII.1). These regressions yield elasticities that are bigger and more significant during 1991-2001 than during 2003-2006. What is more, during the latter period these elasticities become are not significantly different from zero and have a negative sign.

We now want to assess to which extent this low appropriability is reflected in lower investment. To this end we will construct hedonic measures of Tobin's Q that reflect the pure appropriability component of the market value of the firm, and use these measures as regressors in an investment equation instead of the actual Tobin Q of the firm. In order to do so, we hypothesize that the ability to appropriate the returns from investing in entrepreneurial assets differs by industry and/or by size, because of political economy reasons (and possibly because of market structure and technological reasons as well). Then we can estimate appropriability coefficients by industry and size and apply them to construct the hedonic Tobin's Q measures.

We hence re-estimate equation (4), first including among the regressors terms that interact industry dummies with $\delta \log[K_{it}/A_{it}]$, and then terms that interact size dummies with $\delta \log[K_{it}/A_{it}]$.[96] This analysis reveals that there are significant differences across sectors in their

[96] We define size arbitrarily by splitting the panel into small firms (the third part of the panel that contains the smallest firms), large firms (the third part of the panel that contains the largest firms) and medium firms (the rest). If we re-define the small firms as the bottom 50% of the size distribution, medium firms

abilities to appropriate the returns of their investments in intangible assets (see Tables AII.2 and AII.3).

We will not be able to tell apart which factor is driving the differences in appropriability by sector. Instead we proceed to estimate the impact of these differences in appropriability parameters on the investments of firms in different industries. To this end we first construct measures of a "hedonic Q", as the values of Q predicted from the estimation of the appropriability equations that include industry and size dummies. These estimates measure both the ability to capture rents and the size of these rents. We then run an econometric estimation of the impact of the hedonic Q on investment at the firm level. This analysis builds on the estimations made in Annex I of the determinants of investment at the firm level using a panel of public offer firms, which included as regressors the firm's Tobin's Q, the volatility of the firm's stock prices, the correlation of own stock volatility with the market volatility and the firm's sales. We run the same regression substituting the firm's Q by our measure of a hedonic Q. Table AII.4 presents the results (standard errors are bootstrapped).

We obtain the expected results, i.e., that bigger hedonic Q raise firm level investment. What is more, the hedonic Q has a much bigger coefficient than the regular Tobin Q, suggesting that appropriability of returns matters significantly for investment in Argentina. The result holds both the hedonic Q's that are based on industry differences and on size differences, although the former have a more significant effect.

A caveat must be made regarding the representativeness of the data. The panel includes 109 public offer firms, which are divided into 21 industrial categories that include manufacturing, service, public utilities, agricultural and natural resource based activities. These firms, the sizes of which range from US$ 0,6 millions to US$ 7,1 billions (average 2004-2006), with an average of US$ 500 millions and a median of US$ 112 millions. It is likely that they are exposed to smaller appropriability problems than the relatively smaller and less formal non-public offer firms, as they have more financial and managerial resources to cope with covert capital taxes than the latter.

---

as the 50%-75% interval of this distribution and large firms as the top 25% of the distribution the results do not change significantly.

Table AII.1. Basic market value regression for investment in intangible assets, 1990-2006

		1991-2001	2003-2006
		I	III
ln (intangible assets/fixed assets)	0.014 (0,006)**	0.017 (0,007)**	-0.004 (0,012)
Constant	0.376 (0,046)**	0.529 (0,064)**	0.293 (0,053)**
R-squared within	0.3152	0.4681	0,1476
R-squared between	0.0089	0.0147	0,0186
R-squared overall	0.1492	0.1923	0,0279
Sample	1990-2006	1991-2001	2003-2006
Number of Observations	646	427	165
** Significant at 5%			

Source: IERAL - Fundación Mediterránea

Table AII.2. Market valuation of intangibles by industry, 1990-2006

	I
ln (intangible assets/fixed assets)	0.049 (0,021)**
Sectoral LN(intangible assets / fixed assets):	
Agriculture and fishing	-0.002 (0,034)
Food and drinks	-0.066 (0,039)*
Commerce	-0.012 (0,047)
Construction	-0.014 (0,035)
Electronic	-0.067 (0,036)*
Electric energy	-0.024 (0,031)
Finance and insurance	-0.061 (0,032)*
Industrial machinery	-0.271 (0,264)
Not metallic minerals	-0.089 (0,039)**
Paper and cellulose	-0.028 (0,060)
Petroleum and gas	-0.049 (0,026)*
Chemical	-0.044 (0,026)*
Real state rents	-0.027 (0,031)
Iron and steel industry and Metallurgy	0.032 (0,032)
Software and data	-0.160 (0,066)**
Tobacco	(dropped)
Telecommunications	-0.083 (0,036)**
Textile	-0.064 (0,063)
Services of transportation	0.215 (0,455)
Vehicles and pieces	-0.014 (0,031)
Constant	0,378 (0,049)
R-squared within	0.3521
R-squared between	0.0229
R-squared overall	0.0597
Sample	1990-2006
Number of Observations	646

** significant at 5%

Source: IERAL - Fundación Mediterránea

Table AII.3. Market valuation of intangibles by firm size

	I
laik	0.029 (0,009)**
laik medium firm	-0.025 (0,016)
laik large firm	-0.047 (0,014)**
R-squared within	0.3502
R-squared between	0.0988
R-squared overall	0.2455
Sample	1990-2006
Number of Observations	566
Description	
laik: ln (intangible assets/fixed assets)	
** significant at 5%	

Source: IERAL - Fundación Mediterránea

Table AII.4. The effect of appropriability on investment at the firm level, 1990-2006

	I	II	III
Stock volatility	-0.149 (0,060)**	-0.152 (0,063)**	-0.130 (0,066)**
Correlation with market volatility	0.009 (0,015)	0.014 (0,021)	0.016 (0,019)
Tobin's Q	0.040 (0,019)**	-	-
hedonic Q	-	0,727 (0,286)**	0.262 (0,169)
Firm's sales	0.017 (0,002)**	0.018 (0,009)**	0.019 (0,009)**
R-squared within	0.2247	0.2465	0.2545
R-squared between	0.2258	0.2953	0.3002
R-squared overall	0.2246	0.2471	0.2454
Sample	1990-2006	1990-2006	1990-2006
* Significant at 10%			
** Significant at 5%			

Source: IERAL - Fundación Mediterránea

II: Hedonic Q constructed using industry dummies

III: Hedonic Q constructed using size dummies

8.3.1. A formal analysis of information externalities and the pattern of discovery and diffusion

We adapt Hausmann and Rodrik (2003) model of self-discovery to understand the dynamics of discovery and diffusion of new export activities in cases where there are different degrees of adoption of policies to compensate for the knowledge externality and when some firms may have the ability to generate private monopolies that offset this externality.

We focus on four scenarios: a) the social optimum, b) a decentralized equilibrium with low promotion of discovery, c) a decentralized equilibrium with a large promotion of discovery, and d) a decentralized equilibrium with low promotion of discovery and some privately generated monopolies.

The goal is to generate predictions for discovery and diffusion and their contributions to the sophistication of exports, changes in export prices, evolution of the open forest and export growth (both aggregate and in new activities) in each of these scenarios, and then contrast these predictions with the actual behaviour of these variables in Argentina.

Conceptual framework

We consider a case where entrepreneurs sink costs to discover foreign demand and/or local costs.[97] The most attractive discoveries are those that fetch a bigger foreign price $p_i(q_i)$ at any given level of output q_i, or that alternatively offer a bigger productivity a la HHR or a bigger value from catch-up to the frontier (measured as the distance between the initial domestic price and quality and that observed in the frontier, as proposed by Hwang, 2006).[98] All new exported goods are ex-ante symmetric, with $p_i(q_i)$ (or the value of discovery) having a uniform distribution. We assume that pioneers face downward sloping demands abroad.

Let us consider how the decentralized equilibrium would look. In this setup, entrepreneurs will invest in experimentation only if the expected value and monopoly period following the discovery are large enough to cover the costs of experimentation. Goods are ex-ante symmetrical in terms of the expected foreign demand, value or convergence possibilities, and hence no good will be targeted by more than one entrepreneur (otherwise they would have to split demand).

Following the experimentation by m entrepreneurs, k experiments reveal themselves as profitable. After a time T of monopoly, there is free entry. In such case, there would be imitation of the new exports until profits are equated in all these activities. Diffusion would be bigger in the most valuable activities. The marginal discoveries may be abandoned if there is a

[97] A large share of the case studies on the emergence of new successful export activities in Latin America undertaken by Sánchez et al (2007) and by Artopoulos et al (2007) suggest that demand uncertainty is probably more relevant than the discovery of local costs of production.

[98] Sánchez et al (2007) analyze the case of the emergence of exports of biotechnology applied to human health in Argentina, finding that the pioneer had targeted the sector largely because it offered big catch-up possibilities to the frontier.

rise in the costs of production as resources are mobilized from traditional activities. Hence in this setup, there need not be complete specialization in the most attractive new export activity, although the export volume and growth will be bigger in this sector.

The case of low T

In this framework, as T goes down there will be less experimentation, a lower number of discoveries and smaller expected maximum value, productivity or convergence possibilities. The ensuing export diversification and sophistication (EXPY) growth, and the improvement in catch-up possibilities, would be small. Diffusion would proceed fast towards the successful new exports, but would be limited in scope because of the relatively small number of discoveries that can be targeted and the expected small foreign demand or value that they would meet, which would be saturated with relatively few new entrants. The expected final EXPY and ability to converge would be small. There would be relatively little structural change, and the open forest would change little and few strategic goods would be discovered.

In this case new exports would contribute relatively little to overall export growth. The expected productivity of new exports would also be relatively small and we would not see significant convergence to frontier quality and prices.

The case of high T

On the other hand, as T rises for all new exports there is more experimentation, a bigger number of discoveries and a bigger expected maximum value, productivity and convergence possibilities. There is bigger export sophistication than in the case of low T, but EXPY and convergence possibilities are not maximized (although the maximum expected value of the discovery is now bigger, during the period of monopoly many "inefficient" new exporters are operating, bringing down the average productivity and convergence possibilities of the new exports). Diffusion would be delayed, giving rise to a distinct source of inefficiency. When T finally arrives, free entry leads to diffusion in all sectors until profits are equated in all the attractive sectors, the number of which will be bigger than when T is small. The final EXPY and convergence space would be bigger, because of the bigger productivities and/or quality gaps with the frontier, the larger number of surviving discoveries and the bigger delayed diffusion to each of them. There would be bigger specialization in new export activities (vis-à-vis the traditional activities) and the open forest may not improve, as the good opportunities are already discovered. Diversification would shift from small at the onset to big at the middle and then back to small at the end.

In this scenario, following free entry and new exports would contribute significantly to overall export growth. The expected productivity and convergence possibilities of new exports would be relatively big, especially after free entry. We should thus observe a relatively fast growth in export prices after a while.

Social optimum

The social optimum with imperfect information would entail promoting a sufficiently large number of experiments to maximize the expected p_i, productivity, value and/or convergence possibilities conditional on the number of experiments. Then free entry would be permitted into the most attractive sectors, dissipating monopoly rents. In such case there is fast diffusion into a relatively large set of valuable new export activities, and the EXPY and convergence capacity are maximized.

There is a large contribution from new exports to total export growth and a fast growth of export prices. The value of the open forest may not improve, as the most profitable opportunities are already exploited.

Low T and some private monopolies

Let us now consider what would happen if, starting from a low T decentralized equilibrium, some firms are endowed with the ability to introduce barriers to entry in certain sectors that allows them to extend their monopolies (possibly up to infinity) following a successful discovery of foreign demand, productivity, value and/or convergence possibilities to the frontier. Given this protracted monopoly period, these firms would require lower ex-post profits to amortize the sunk costs of experimentation. Hence they would be more naturally inclined to experiment.

In this case there could be experimentation both by monopolists and by non-monopolists (firms in sectors with a low T). When T elapses for the non-monopolists, there is free entry into the competitive new exports until profits are equated in all of them and there are no more arbitrage opportunities.

Let us compare now this equilibrium with the one that would attain in the *absence* of privately generated monopolies. Experimentation by non-monopolists will now be smaller because imitators will all concentrate on a smaller set of new activities to target once the low T elapses, driving down profits very fast in these few competitive discoveries that can fall prey to imitation. Now that there is more experimentation, the expected maximum productivity and convergence possibilities will be bigger than in the absence of private monopolists. We do not know whether EXPY and the average catch-up possibility will be bigger, as there could increase the number of monopolists that thrive in goods of little productivity and convergence possibilities. The open forest could improve if the new monopolists include goods with strategic value. Diffusion will certainly be smaller. Specialization in modern activities will be bigger than in the competitive low T equilibrium, although the individual exports of each of them may be smaller.

Compared to the low T competitive equilibrium, the contribution of new exports to overall export growth would be more important, albeit hampered by low diffusion. However, the growth of exports and export prices would be smaller than in the social optimum and in the competitive high T equilibrium. Quality convergence would be faster than in the low T

competitive equilibrium, but smaller than in the social optimum or the high T competitive equilibrium. In this scenario there would be a relatively large export diversification.

Correlation between discovery and diffusion at the sectoral level

Departing from the basic HR assumptions, we assume that entrepreneurs prefer to experiment in discovery in activities where they have some previously accumulated capabilities, and that this accumulation of capabilities occurs within industries.[99]

Our conceptual framework would predict that if the country is characterized by a low T (policy-uncompensated information externalities) and by varying numbers of privately generated monopolies in different industries, we should observe the following. In those sectors with few monopolists there should be fewer discoveries, but more diffusion. Instead in those sectors with more monopolists we should observe more discoveries but less diffusion. Hence we should have a negative correlation between discovery and diffusion at the sectoral level.

Testable predictions:

The following table summarizes the expected outcomes in the different scenarios:

	Social optimum	Low T	High T	Low T – some monopolists
Number of experiments & discoveries	Optimally large	Very small	Sub-optimally large	Intermediate
Diffusion	Fast and widespread	Fast but small	Initially slow, finally widespread	Small, as there are very few competitive discoveries
Maximum expected productivity	Maximized	Very small	Very high	Intermediate
EXPY growth	Maximized	Small	Medium at first, fast after free entry	Low
Average export price growth	Maximized	Small	Medium at first, fast after free entry	Low
Open Forest growth	Large	Small	Large at first, then reduced	Intermediate
Export diversification	Slightly improved	Small increase	Increases and then falls after free entry	Improves
Contribution of discoveries to overall export growth	Maximized	Low	Large, especially at the end	Medium to low
Correlation b/t discovery and diffusion at sectoral level	Very high and immediate	High	Low at the beginning. Fast in the end.	Negative and large

Discovery and diffusion in Argentina

We now show that Argentina's stylized facts fit into the predictions for the "low T – some monopolists" scenario. Let us recall that these stylized facts are:

- A low to medium number of discoveries since 1994.

[99] This role of intra-industry and intra-firm accumulated capabilities in the choice of new export was revealed in the cases studied by Sánchez et al (2007). The product space in Hausmann and Klinger (2006) also shows a positive correlation between proximity and sectoral affiliation.

- There is a low diffusion in new export activities.
- Low export sophistication growth.
- Divergence from the frontier in quality/unit export prices for total exports, and only very small convergence in new exports of industrial manufactures.
- Reasonable open forest growth.
- New exports explain an intermediate share of total export growth.
- There is a wide disparity in the frequency of emergence of new exports by sector (see Sánchez et al, 2007).
- Export diversification in Argentina is relatively large.
- There is a negative correlation between discovery and diffusion at the sectoral level.