Long-run growth and productivity changes in Uruguay: evidence from aggregate and industry level data

Casacuberta, Carlos

Universidad de la República

Gandelman, Néstor

Universidad ORT Uruguay

Soto, Raimundo

Universidad Católica de Chile

Diciembre 2006

Abstract

The economic performance of Uruguay in the last 50 years has been disappointing. Annual growth in labor productivity has been lower than the rest of the Latin American economies and well below that East Asian and OECD countries. Out of the 0.9 percent of annual growth in productivity, total factor productivity (TFP) accounts for around 45 percent, which confirms the key role TFP plays in economic growth. The paper aims to discuss the issues. Design/methodology/approach – The authors decompose the change in productivity into four sources: an utilization effect, a reallocation effect, a markup effect, and effect of technical change. Findings – In the 1985-1994 period, there is an appreciable increase in productivity levels. On the other hand, the 1995-1999 period productivity increased by a mere 0.8 percent per year. The high increase in productivity between 1985 and 1994 is explained by the relatively high and sustained technical change of Uruguayan firms as well as the relocation of inputs between and within industries. The process of relocation seems to lose momentum – or may have been completed – in the late 1990s. Research limitations/implications – This paper uses data only from the manufacturing sector. It would be desirable to include all other sectors of activity. Practical implications – A study of the contribution to growth of different determinants suggests two important conclusions. First, that government policies are at the base of growth instability. Second, that reforms have been the source of higher than predicted growth in the 1970s and 1990s, pointing to the need of deepening such reforms.

Documento de Trabajo, Nro.27, Diciembre de 2006. Universidad ORT Uruguay. Facultad de Administración y Ciencias Sociales. ISSN 1510-7477

Long-Run Growth and Productivity Changes in Uruguay:

Evidence from Aggregate and Industry Level Data

Carlos Casacuberta	Nestor Gandelman	Raimundo Soto
Universidad de la República	Universidad ORT Uruguay	Universidad Católica de Chile

Abstract

The economic performance of Uruguay in the last fifty years has been disappointing. Annual growth in labor productivity has been lower than the rest of the Latin American economies and well below that East Asian and OECD countries. Out of the 0.9% of annual growth in productivity, total factor productivity accounts for around 45%, which confirms the key role TFP plays in economic growth. We decompose the change in productivity into four sources: an utilization effect, a reallocation effect, a markup effect and effect of technical change. In the 1985-1994 period there is an appreciable increase in productivity levels. On the other hand, the 1995-1999 period productivity increased by a mere 0.8% per year. The high increase in productivity between 1985 and 1994 is explained by the relatively high and sustained technical change of Uruguayan firms as well as the relocation of inputs between and within industries. The process of relocation seems to lose momentum –or may have been completed- in the late 1990s. Finally, a study of the contribution to growth of different determinants suggests two important conclusions. First, that government policies are at the base of growth instability. Second, that reforms have been the source of higher than predicted growth in the 1970s and 1990s, pointing to the need of deepening such reforms.

The economic performance of Uruguay in the last fifty years has been disappointing. Per capita GDP in the 1955-2003 period grew at modest rates —0.4% per year— well below the growth rate of more dynamic countries in Latin America (e.g., Brazil or Mexico with 2.2% on average for the same period) and East Asia (e.g. Korea or Thailand, with annual growth rates above 4%).

Not only the rate of growth has been slow but, relative to the world economy, it has also declined steadily. In Figure 1 we plotted per-capita GDP in Uruguay relative to that in the US, which we take as the benchmark for comparison.[1] Relative per capita GDP is computed adjusting for PPP prices. It can be seen the steady decline since 1955, with only a mild recovery in the 1990s before the recession that followed Argentina's collapse in 2000.

Figure 1

[1] Relative per-capita income is defined as $R_t = \dfrac{per\ capita\ GDP\ Uruguay_t^{PPP}}{per\ capita\ GDP\ US_t}$.

This below par performance occurred while significant reforms were undertaken, several macro arrangements put in place, two severe financial crisis took place, different wage bargaining arrangements were in place, the signature of the MERCOSUR Treaty and unilateral tariff reductions, are among the most significant changes that affected the rules of the economic game and incentives of different agents, particularly in the manufacturing sector.

Section 1 of this paper documents the relative performance of the Uruguayan Economy, computes the sources of growth and reports the importance of total factor productivity to understand the evolution of total output. Section 2 decomposes the productivity change in four main sources: i) a utilization effect, reflecting the intensity with which the existing endowments of factors are used in the production process, ii) a reallocation effect, reflection to what extent factors of production are reallocated to firms that differ in their marginal productivities, iii) a markup effect that reflect the increases of input utilization across sectors that differ in market power, and iv) a residual term that may be interpreted as the effect of technical change. Finally, section 3 performs a contrafactual exercise of the impact of several policies on output growth.

1. Long-Run Growth: Relative Performance and Sources of Growth

In this section we compute the sources of growth for Uruguay in the 1955-2003 period. We decompose GDP growth into factor accumulation and changes in total factor productivity (TFP). Our measure of TFP is compared to that of the US economy, which we take as our benchmark for the technology frontier. As a reference point, the US economy is not a demanding competitor, since in this period productivity grew at lower rates than the world economy, East Asia, and Europe. Nevertheless, we use the US data to avoid the complications derived from computing capital stocks and TFP for groups of countries, for which no agreed-upon methodology on aggregation exists.

Measuring Total Factor Productivity

We measure total factor productivity (TFP) assuming that GDP is produced according to the following Cobb-Douglas production function[2]

$$GDP_t = K_t^{\alpha} H_t^{\beta} \left(A_t L_t\right)^{1-\alpha-\beta} \qquad \textbf{(1)}$$

where L_t is employment, K_t represents the services of physical capital, and H_t represents the

[2] Using this type of aggregate production function is standard in growth accounting exercises. For this particular specification sec Klenow and Rodriguez-Clare (1997).

services of human capital and are proxied by hL, where h is the average education level Parameter A_t, is the indicator of the technical efficiency in the use of factors, typically dubbed productivity index or TFP. According to this definition, TFP encompasses not only technical efficiency but also the degree of use of the stock of physical capital.

To compute TFP we need to build capital series. We cumulate investment I_t, according to the perpetual inventory method, a starting value for K[3] and an annual depreciation rate, δ, of 4%:[4]

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

Computing human capital is more difficult and there are fewer alternatives. In this paper we use Pereira and Prieto's (2003) detailed analysis for the 1955-1999 period, which we complement with data from ECLAC, for the 2000-2003 period. The proxy for human capital is computed as:

$$H_t = \sum_{k=t_0}^{t}\sum_{i=1}^{6} W_i P_{ik} \qquad \textbf{(3)}$$

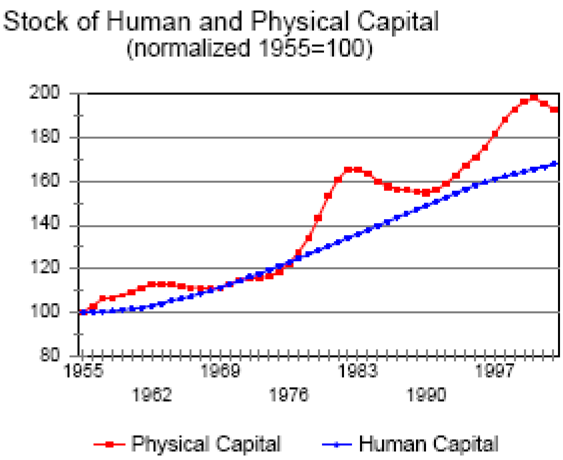
where W corresponds to the market return of education adjusting by age, gender, and other factors P_{ik} is the proportion of active workers in the labor force in each of the six categories

[3] We assume the capital-output ratio to be 2.8 in 1950, the average for the ten largest Latin American economies in the 1960-2003 period (Solimano and Soto, 2004). This assumption is inconsequential for the qualitative results of the analysis. A sensitivity analysis is presented in the appendix.
[4] A 4% depreciation rate is customary. Bucacos (1999) suggests using 8% for machinery and 2.5% for dwellings. Our assumption would imply that the capital stock in machinery is around 25% of the total stock, which is consistent with the results of Solimano and Soto (2004).

of education considered in the analysis. Hence, the measure *of H* accounts for those workers that abandon the labor force (e.g., retirement or inactivity) as well as for the eventual productivity gains derived from informal education or experience.

Figure 2 presents the evolution of the stock of human and physical capital, normalized to be 100 in 1955. It can be seen the slow but steady growth in human capital (average education levels) during the whole period; as of 2003, education levels in Uruguay rank among the highest in Latin America (ECLAC, 2004). On the contrary, physical capital exhibits important swings as a result of the high volatility of fixed capital formation.

Figure 2



To compute TFP, we need an estimate for the share of capital in GDP, α. National income accounts indicate that the share of labor compensation in GDP valued at factor prices (GDP at market prices minus indirect taxes) is small in Latin American countries relative to, say, that in the OECD countries. We choose a higher value of the labor share for growth accounting 0.7 —corresponding to $\alpha=0.3$— for two reasons. First, 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. Gollin (2002) shows that, for countries where there is sufficient data to adjust for this measurement problem, the resulting labor shares tend to be close to the value in the United States, 0.70. Second, a high capital share implies implausibly high rates of return on capita[5]. With regard to the other parameter, β, we follow Klenow and Rodriguez-Clare (1997) and assume a value of 0.28 [6] The qualitative results are largely unaffected by the choice of these parameters.

Given our choice of α and the computed capital series, we calculate our measure of TFP, as follows:

$$TFP_t = \left[\frac{GDP_t}{K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta}} \right]^{\frac{1}{1-\alpha-\chi}} \quad \textbf{(4)}$$

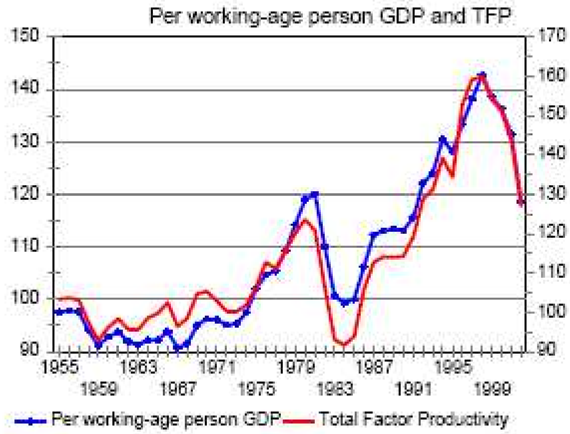
Figure 3 plots the calculated TFP against GDP per working-age person. It is convenient to use per-working age person GDP (defined as the segment of the population between 15 and 65 years of age), to avoid biases arising from demographic changes. It can be seen that there is a close correlation between both series, suggesting that if one is to discuss economic growth in Uruguay then productivity changes ought to play an important role in the analysis. Equation (4) also shows that this need not be the case as changes in human and physical capital also affect this relationship.

---

[5] With α =0.65 as suggested by national accounts and a capital/GDP ratio of 2.8 (the mean for all Latin American economies in the 1960-2002 period), in the steady state the real interest rate should be above 23% per year.

[6] The used parameters for physical and human capital do not differ from those used by Pereira and Prieto (2003) and Bucacos (1999). Appendix A shows the qualitative insensitivity of results to changes in these parameters.

Figure 3



In order to compute the contribution of factor accumulation and TFP to economic growth, we express equation (1) as:

$$\Delta Log\left(\frac{GDP_t}{L_t}\right) = \Delta Log A_t + \frac{\alpha}{1-\alpha-\beta}\Delta Log\left(\frac{K_t}{GDP_t}\right) + \frac{\beta}{1-\alpha-\beta}\Delta Log\left(\frac{H_t}{GDP_t}\right) \quad \textbf{(5)}$$

Expression (5) is a convenient way to express the growth in average productivity of labor as the result of productivity gains (the growth rate of TFP), the accumulation of physical capital (as share of GDP) and the accumulation of human capital. In order to eliminate transient phenomena, we study the long-run changes of these variables, focusing on decades rather than year-to-year variations.

Table 1 presents the results of this growth-accounting exercise, which provides clues to understand the poor economic record of Uruguay in the first half of the 20th century. It can be seen that the annual growth in labor productivity—which better reflects household income and welfare— has been only 0.9% per year in the 1955-2003 period. This is a very low rate even when compared to the rest of the Latin American economies, where productivity levels grew at an average of 1.3% per year in the same period. Needless to say, these rates are well below that of East Asian countries (4.7%) and the OECD (2.4%). As mentioned, productivity in our benchmark economy, the US, grew at the same modest rate of 1.3% during most of this the period. Out of the 0.9% of annual growth in productivity in Uruguay, total factor productivity accounts for around 45%, which confirms the key role TFP plays in economic growth. Nevertheless, the share of TFP in growth in the successful economies of East Asia and Europe is usually much higher, around 60%).

Table 1

Sources of Growth in Uruguay

	Average annual growth in labor productivity (%)	Average annual growth in TFP (%)	Contribution of	
			Physical capital (%)	Human capital (%)
1955-2002	**0.9**	**0.4**	**0.3**	**0.2**
1955- 1981	**0.6** 0.0	**0.0** -	**0.3** 0.4	**0.3** 0.6
1982- 2002	**1.3** 0.1	**0.9** -	**0.3** 0.3	**0.1** 0.9
Latin America (1960-	1.3	0.0	0.7	0.6
USA (1960-85)	1.3	0.5	0.3	1.0
OECD (1960-85)	2.4	1.4	0.3	0.7
East Asia (1960-85)	4.7	2.9	0.8	1.0

Source: Own elaboration for Uruguay and Hopenhayn and Neumeyer (2004) for other countries

The evidence in Table 1 also suggests that there is a marked difference in performance before and after the early 1980s (we chose 1981 as a cutting point based on evidence by Solimano and Soto, 2004 and Hopenhayn and Neumeyer, 2004). In the 1955-1981 period, labor productivity grew very slowly (only 0.6%). At this rate, it would take over 100 years to double productivity levels and reach current US standards. The mild expansion in labor productivity was the result of physical and human capital being accumulated faster than GDP, as there was zero growth in TFP. When breaking this period into decades, nevertheless, we note that the 1960s and 1970s were different. In the 1960s the effort in accumulating physical and human capital was undone by *declining TFP* levels. The reason for the negative growth in TFP can be linked to poor macroeconomic and microeconomic policies that led to an inefficient use of resources. Among such policies were market interventions (including fixed prices, negative interest rates, etc.), tariff distortions and trade barriers, macroeconomic instability and government intervention. The 1970s, on the other hand, marked an important reversal in policies and saw the resumption of growth (see

Rottenberg, 1993). Physical and human capital expanded *pari pasu* with GDP, but economic growth was largely driven by total factor productivity which recovered at 1.1% per year. The economy expanded systematically, yet slowly, until the Debt Crises of 1982.

Surprisingly, the 1982-2003 period reproduces the previous experience, albeit with two notable differences. The first decade-1982 to 1991-was characterized by both a significant use of physical and human capital and, again, declining TFP. The second decade —1992 to 2003— was marked by a substantial recovery in fixed capital formation and TFP levels. The first difference between this decade and its counterpart of the 1970s lies in the declining contribution of human capital to GDP, itself the result of the absolute decline in employment levels. Between 1991 and 2003 employment declined by 0.6% per year. The second difference with previous history is the significant rate of growth in TFP observed in this period (2.2%). This is the only period in which TFP grew faster that the benchmark economy, at levels which are closer to those of East Asian economies.

2. Industry level Evidence of TFP Growth

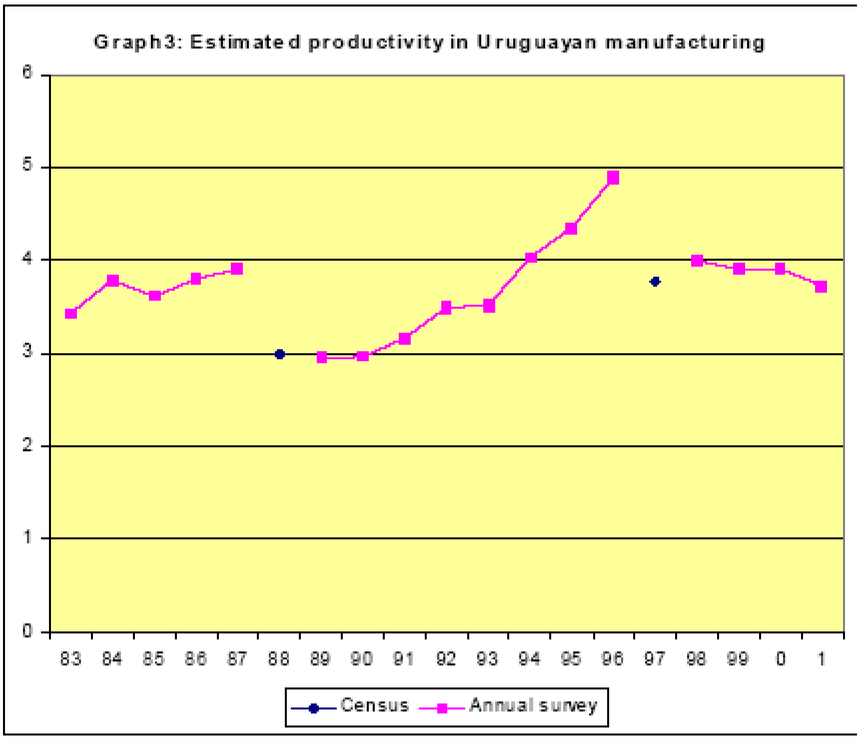
The previous section documented the significant role that TFP plays on economic growth at the aggregate level. While valuable as a description of the working of the economy, we are limited in our understanding of how producers react to macro and microeconomic shocks and policies. For example, how do producers switch resources from one industry to another as a result of changes in relative prices? How fast do producers adopt and adapt technology?

To answer these questions we assembled a panel of Uruguayan firms in the manufacturing sector for the 1982-2001 period. We rely on industry level observations (4 digit ISIC) provided by the manufacturing censuses (1988 and 1997) and annual surveys by the Institute Nacional de Estadistica (INE), which covers firms above 5 employees.[7] We define productivity changes as the difference in the rates of growth of value added and a suitably weighted average of capital and labor inputs. The change in total factor productivity can be decomposed into four sources. First, *the utilization effect*, reflecting the intensity with which the existing endowments of factors are used in the production process. Second, the *reallocation effect*, which reflects the ability of producers to relocate factors of production from low-productivity firms to firms where marginal productivity is higher. Third, *tbe markup effect* reflects the increase of input utilization across sectors that differ in market power. Fourth, a residual term that may be interpreted as the effect *of technical change.*[8] Figure 4 depicts the evolution of labor productivity in the sample. Discontinuities arise from the problems of the raw data described in the appendix. It can be seen the notable expansion in productivity in the 1988-1996 period, which is consistent with the TFP figures in section 1. Nevertheless, there are important differences, as the comparison of figures 3 and 4 suggest. First, the magnitude of productivity gains in the manufacturing sector are much higher than those of TFP: while the latter are in the neighborhood of 2%, the former are around 6%. Second, TFP declines notoriously after 1999, while productivity in the

[7] Assembling this data set proved very difficult, as there are changes in the survey questions, industry classification, sampled population and estimation methods. For a detailed description see the appendix.
[8] Our methodology is based on the work of Fernald and Basu (1998), and provides a comparable setup to that ofSoto and Navarro (2001) which studied the Chilean manufacturing sector in the same period.

manufacturing sector remains largely unaltered.

Figure 4



Following Fernald and Basu (1998) the decomposition of productivity defined as the difference of the growth rates of value added and a weighted average of labor and capital inputs ($dp = dv - dx^V$) is:

$$dp = (\bar{\mu}^V - 1)dx^V + du + R + dt^V \qquad \textbf{(6)}$$

where dv is the aggregate growth in value added, $\bar{\mu}^V$ is the average markup across firms, dx^V is the weighted-average growth of labor and capital inputs, du is the weighted average of utilization rates at the sector level, R represents reallocation of inputs between firms, and dt^V is the weighted average of sector technical change. [9]

To estimate this equation we rely on the estimation of a gross-output growth equation at the industry level. It relates the log difference in gross output (dy_i) to the revenue-weighted measure of growth in inputs including intermediate (dxi), a proxy for variations in capital utilization and effort ($d\mu i$), and a residual that captures technical change (dti). Formally,

$$\begin{aligned} dy_i &= \mu_i(1-s_{Mi})du + dt_i + \mu_i dx_i \\ &= \mu_i(1-s_{Mi})du + dt_i + \mu_i[s_{Ki}dK_i + s_{Li}dl_i + s_{Mi}dm_i] \end{aligned} \quad \textbf{(7)}$$

the expression in brackets shows that dx is a share weighted average of observed input growth. In addition, μ_i is a markup of price over marginal cost. Perfect competition implies μ_i equals one. The shares s_{Ki}, s_{Li} and s_{Mi} are the total cost of each input divided by gross output. The shares sum to less than one if firms make pure profits. Estimation of equation (7) is discussed in the appendix and the results of the productivity decomposition are presented in Table 2.

[9] The aggregate output measure is presented in value added terms rather than in gross terms and is obtained as a difference between gross output and materials. For details on the computation of aggregate variables see Fernald and Basu (1999).

Table 2

Decomposition of changes in productivity of manufacturing plants in Uruguay

average annual growth rates

Period	Change in observed productivity *dp*	Change in markups $(\bar{\mu}^V - 1)dx^V$	Change in labor effort and capital utilization *du*	Reallocation of inputs *R*	Residual technical change dt^V
1985-89	8.3%	-0.4%	0.1%	3.1%	5.6%
1990-94	7.2%	0.2%	-0.1%	4.1%	3.0%
1995-99	0.8%	0.9%	0.9%	1.3%	-2.3%

Source: own elaboration.

Table 2 provides evidence of the substantial dynamism of productivity in the manufacturing sector of Uruguay. In the 1985-1994 period there is an appreciable increase in productivity levels, largely the result of the relocation of inputs and technical change. Changes in labor effort and capital accumulation are minimal. On the other hand, the 1995-1999 period presents a very different situation: productivity increased by a mere 0.8%, per year, despite the substantial use of capital and labor. Relocation continues to be significant, but technical change is negative and substantial.

Observed changes in productivity in the neighborhood of 7%, as those in the 1985-1994 period, are relatively unusual. As a benchmark for comparison we use data from manufacturing plants in Chile from the study by Soto and Navarro (2001), as presented in Table 3. It can be seen that productivity levels in the 1979-1997 period grew around 5% per year, substantially less than in Uruguay, despite the fact that in this same period aggregate

TFP in Chile expanded at 3.7% per year, that is 50%, more than the Uruguayan level (2.3%). The high increase in productivity is explained by the relatively high and sustained technical change of Uruguayan firms as well as the relocation of inputs between and within industries. Relocation of inputs reflects, naturally, the combined effects of changes in relative prices as well as the initial slack in each sector. In the Chilean case, input relocation derived largely from market liberalization and trade opening, a process that was largely completed by the mid 1980s. In Uruguay, the process of relocation seems to lose momentum -or may be have been completed- in the late 1990s.

Table 3

Decomposition of changes in productivity of manufacturing plants in Chile

average annual growth rates

	Change in observed productivity dp	Change in markups $(\bar{\mu}^V - 1)dx^V$	Change in labor effort and capital du	Reallocation of inputs R	Residual technical change dt^V
Average 1979-1985	4.8%	0.3%	0.0%	3.7%	0.8%
Average 1986-1997	5.3%	1.1%	0.0%>	0.6%	3.5%

Source: Soto and Navarro (2001).

3. Economic Reforms and Long-run Growth

The previous sections document the importance of TFP in economic growth and the substantial response of plants to economic stimulus, in terms of relocating resources and adopting technology. The link between TFP growth and economic reforms is, arguably, very lose in the above description. In order to formalize more the connection between them we use the econometric results of Loayza and Soto (2002) to compute the expected change in per-capita GDP as a result of implementing selected reforms. Loayza and Soto (2002) estimate the following growth regression:

$$y_{it} - y_{it-1} = \alpha_0 y_{it-1} + \alpha_1 \left(y_{it-1} - y_{it-1}^T \right) + \beta X_{it} + \eta_i + \mu_t + \varepsilon_{it} \qquad \textbf{(8)}$$

where y is the log of per capita output, y^T represents the trend component of per-capita GDP, so that $\left(y_{it-1} - y_{it-1}^T \right)$ is the output gap at the start of the period, X is a set variables postulated as growth determinants, μ_t is a period-specific effect, η_i represents unobserved country-specific factors, and ε is the regression residual. Subscripts *i* and *t* refer to country and time period, respectively.

The left-hand side of the equation is the growth rate of per capita output in a given period. On the right-hand side, the regression equation includes the level of per capita output at the start of the period (to account for transitional convergence) and a set of explanatory variables measured during the same period. The inclusion of the output gap as an explanatory variable allows us to control for cyclical output movements and thus to differentiate between transitional convergence and cyclical reversion. The time-specific effect μ_t, allows us to control for international conditions that change over time and affect the growth performance of all countries in the sample. The term η_i, accounts for unobserved country-specific factors that both drive growth and are potentially correlated with the explanatory variables.

Loayza and Soto (2002) study several determinants of economic growth, which they divide into five groups: transitional convergence, cyclical reversion, structural policies and institutions, stabilization policies, and external conditions. Transitional convergence is proxied by the initial level of real per capita GDP. Cyclical reversion —which correspond to the effect of the business cycle on short run growth is accounted for by using the output gap at the start of each period. Structural policies and institutions are considered when including human-capital formation, financial depth, international trade openness, government burden, infrastructure, and governance. Stabilization policies comprise monetary instability (average inflation), output instability (standard deviation of the output gap), real exchange rate overvaluation, and an indicator of banking crises. Finally, external shocks are also accounted for by including terms-of-trade shocks and period-specific shifts common to all countries in the sample.[10]

Table 4 presents the results of forecasting per-capita GDP growth in developed economies, East Asian countries, and Uruguay. It can be seen that the econometric model predicts quite accurately the growth rates in developed economies, despite the marked variation in these rates. On the contrary, the model under predicts the growth rate in East Asian economies, notably in the 1970s and 1980s. With respect to Uruguay, the model over predicts growth in the 1960s and 1980s —the two periods we identify in section 1 as those where TFP declined- and under predicts growth in the 1970s and 1990s. Since these forecasts include the growth effects of cyclical fluctuations, over prediction cannot be the result of the economy recuperating from a previous recession. In addition, note that actual growth is much more volatile than predicted by the model, which points to policies and foreign shocks as the main source for growth instability (structural factors evolve usually slowly on time).

[10] The details on the estimation and the parameters are in the appendix.

Table 4

Actual and Forecast per-capita GDP growth

based on the econometric model of Loayza and Soto (2002)

Period	Developed Economies		East Asian Economies		Uruguay	
	Forecast	Actual	Forecast	Actual	Forecast	Actual
1961-1970	4.20	4.26	4.17	4.23	2.33	0.40
1971-1980	2.13	2.76	3.29	5.35	1.47	2.60
1981-1990	2.00	1.99	2.64	4.56	0.41	-0.67
1991-2000	1.86	1.89	2.47	3.17	1.41	2.64

Source: own elaboration based on the results by Loavza and Soto (2002).
Note: Developed economics include Australia, Austria, Belgium, Canada, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Sweden, Switzerland, and United States. East Asian countries include Hong Kong, China, Indonesia, Korea, Mauritius, Malaysia, Philippines, Singapore, Thailand, and Taiwan.

According to this panel-data model, hence, the growth performance of Uruguay is somewhat puzzling. Nevertheless, a study of the contribution to growth of the different determinants suggests two important conclusions. First, that government policies are at the base of growth instability. Second, that reforms have been the source of higher-than-predicted growth in the 1970s and 1990s, pointing to the need of deepening such reforms.

In Table 5 we show the contribution of policies to growth changes in Uruguay by decade. In the first row we report the actual change in per capita GDP (e.g., the rate of growth in the 1970s was 2.2 percentage points higher than that of the 1960s). It can be seen the beneficial impact on GDP growth of the continuous expansion in infrastructure, education, and governance. They have a combined impact of around 0.7 percentage points and suggest the need of further expanding the coverage and quality of these public services.

Table 5

Contribution of Structural and Stabilization Policies to Changes in Per capita GDP Growth

	1970s vs.1960s	1980s vs.1970s	1990s vs.1980s
Actual Change in Per Capita	2.2%	-3.3%	3.3%
Policy Indicators			
• Infrastructure	0.2	0.3	0.5
• Education	0.5	0.3	0.3
• Governance	0.0	0.0	-0.1
• Financial Depth	0.1	0.7	-0.2
• Trade Openness	0.3	0.2	0.4
• Government Burden	0.0	0.0	0.2
• Price Instability	-0.1	0.0	0.1
• Output Instability	-0.1	-0.5	0.5
• Real Exchange Rate	-0.1	0.1	-0.2
• Banking Crisis	-0.3	-1.2	1.4

Source: Own elaboration based on Loayza and Soto (2004).

Other structural indicators also reveal the importance of reforms in Uruguay. The timid yet systematic increase in foreign trade volumes have had a positive impact on GDP growth of around 0.3 percentage point per year. Financial intermediation, on the other, is also a significant contributor to GDP growth, although in the last decade the decline of credit to GDP from 36% to 24% reduced growth by around 0.2 percentage points per year.

Finally, the negative effect of instability on economic growth -and the beneficial impact of stabilization policies— is clearly depicted in the last rows of Table 5. The four indicators suggest that Uruguay paid a high welfare cost in the 1970s and 1980s as a result of high inflation, real exchange rate overvaluation, and especially banking crises. It is also noteworthy that out of the expansion of 3.3 percentage points in the 1990s when compared to the 1980s, more than 50% is directly related to stabilization policies.

The last exercise that we perform using the econometric model of Loayza and Soto (2002) is the study of counterfactual policies. Here we ask what would happen to growth in Uruguay if the structural indicators were comparable to those in developed economies. Certainly, one cannot expect Uruguay to implement all policies in the short to medium run, nor that reforms would impact on GDP growth exactly as they operate on developed economies. There are too many idiosyncratic elements to reforms that may inhibit or empower growth processes. Nevertheless, counterfactuals provide reference points to what would be the benefits for Uruguay of deepening reforms.

In table 6 we summarize the 1995-2000 levels of the main policy determinants of growth. It can be seen that there is ample space for deepening reforms in areas such as the financial sector —where intermediation is notoriously low—, trade opening, education and infrastructure. With regards to the latter, improvements in infrastructure and expansion in education levels could provide a source of sustained growth for Uruguay. Note, however, that these are crude indicators, as they tell us nothing about the quality of services or human capital. Additional productivity gains could result from improving the quality and availability infrastructure, as well as preparing students to better match labor market requirements.

With regards to structural policies that are usually under direct control of the government, there is a significant shortage of financial credit to the private sector. The Uruguayan level —26% of GDP in the 1996-2000 period- is very low for international standards, and more importantly, has declined steadily since the 1970s. Developed economies reached around 80% of GDP in the 1990s, while East Asian economies reached around 100%. By 1995 Chile had already reached 70% of GDP.

Likewise, opening the economy seems to provide a sensible way to expand per capita GDP at faster rates. Again, Uruguay seems to be moving in the right direction, yet rather slowly. Trade volumes —net of idiosyncratic characteristics— are around 65% of GDP, while those of developed economies is more or less the double. East Asian economies, which have based the successful growth strategy on exports, traded around 220% of GDP in the 1990s. Chile has also turned in that direction and now trade is around 125% of GDP.

Finally, stabilization policies can also play a significant role. While the benefits of controlling inflation may be insignificant, those of reducing output variability seem to be quite important. Developed economies exhibit business cycles that are around 1/4 in size when compared to those in Uruguay (but it should be noted that the data *excludes* the 2002 crisis). However, it may be very difficult to achieve stability on this area as large fluctuations may be just a characteristic of development. In fact. East Asian economies and Chile exhibit similar levels to those of Uruguay in the 1990s.

Table 6

Counterfactual Scenarios for per-capita GDP growth in Uruguay

	Uruguay average 1996-2000	Developed Economies average	Effect on per Capita Growth Rates
Education Index	86.7	115.2	0.5%
Infrastructure Index	231.0	533.0	0.6%
Governance Index	1.2	16.2	-0.3%
Financial Credit (% PIB)	26.2	79.7	0.7%
Trade Openness (% PIB)	64.0	134.2	0.7%
Gov. Consumption (%	12.9	18.5	-0.6%
Inflation (%)	16.2	1.8	0.1%
Output Instability	2.2	0.6	0.4%
RER Overvaluation (%)	18.2	12.5	0.0%
Banking Crises (freq.)	0.0	4.8	-0.1 %

Source: Own elaboration based on Loayza and Soto (2004).

References

Bucacos, Elizabeth (1999): "Fuentes del Crecimiento Económico en Uruguay: 1968-1998", Revista de Economía, Segunda Epoca, 6(2):39-71.

Casacuberta, C., G. Fachola, and N. Gandelman, (2004) The Impact of Trade Liberalization on Employment, Capital and Productivity Dynamics: Evidence from the Uruguayan Manufacturing Sector, *Journal of Policy Reform*, 7 (4).

Cassoni, A. (1999): "Conciliación de la información proveniente de la Encuesta Industrial proveniente de las muestras de 1978 y de 1988". Documento de trabajo No. 9, Departamento de Economía de la Facultad de Ciencias Sociales, Universidad de la República, Montevideo.

Fernald, John G. and Susanto Basu (1999): "Why Is Productivity Procyclical? Why Do We Care?" Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 638, June.

Hopenhayn, Hugo and Pablo Andres Neumeyer (2004): "Latin America in the 20th Century: Stagnation and then Collapse", mimeo, Universidad di Tella.

Klenow, Peter and Andres Rodriguez-Clare (1997): "The Neoclassical Revival in Growth Economics: FIas It Gone Too Far?" *NBER Macroeconomics Annual*'1997', B. Bernanke and J. Rotemberg ed., Cambridge, MA: MIT Press, 73-102.

Loayza, Norman and Raimundo Soto (2002): "The Sources of Economic Growth: An Overview", Chapter 1 in *Economic Growth: Sources, Trends, and Cycles*, N. Loayza and R. Soto (eds), Banco Central de Chile.

Piccardo, Susana and Ferre, Z. (2002): "Indicadores de precios para deflactar insumos de la industria Manufacturera". Documento de trabajo No. 17, 2002, Departamento de

Economía de la Facultad de Ciencias Sociales, Universidad de la República, Montevideo.

Prieto and Pereira (2003): "Crecimiento y Capital Humano en Uruguay: 1940-1999", mimeo, Universidad de la República.

Rottenberg, Simon (1993): *The Political Economy of Poverty, Equity, and Growth: Costa Rica and Uruguay*, A World Bank Comparative Study, The World Bank, Oxford University Press.

Solimano, Andres and Raimundo Soto (2004): "Economic Growth in Latin America in the Late 20th Century: Evidence and Interpretation", mimeo, ECLAC.

Soto, Raimundo and Lucas Navarro (2001): "Procyclical productivity: evidence from an emerging economy", Banco Central de Chile, Documentos de Trabajo , N° 109 Octubre.

Appendix

Appendix Table 1

Sensitivity Analysis for the Sources of Growth in Uruguay

	Average annual growth in labor	Average annual growth in physical capital	Average annual growth in human capital	Average annual growth in TFP (%)
	Basic parameterization			
1955-2003	0.9	0.3	0.2	0.4
1955-1981	0.6	0.3	0.3	0
1982-2003	1.3	0.3	0.1	0.9
	Increasing capital share in production function a from 0.3 to 0.4			
1955-2003	0.9	0.6	0.3	0
1955-1981	0.6	0.6	0.5	-0.4
1982-2003	1.3	0.6	0.1	0.6
	Increasing annual depreciation rates 8 from 4% to 6%			
1955-2003	0.9	0	0.2	0.7
1955-1981	0.6	-0.1	0.3	0.4
1982-2003	1.3	0.1	0.1	1.1
	Increasing initial capital-output ratio from 2.8 to 3.0			
1955-2003	0.9	0.3	0.2	0.4
1955-1981	0.6	0.2	0.3	0.1
1982-2003	1.3	0.3	0.1	0.9

The Construction of the Manufacturing Firms Database

The construction of the database was a difficult task. We took care to link the different samples in order to represent a comparable subset of the population of manufacturing firms. Along the 1982- 2001 period, the results refer to those establishments with more than five employees. Since 1997 the classification system changed form ISIC rev. 2 to ISIC rev 3. Hence we reclassified the observations prior to 1987 and estimated the contributions of the corresponding 4 digit ISIC 2 to the 3 digit sectors containing them in the cases where a one to one allocation was not feasible. The most daunting task was to take care for the swings in the estimation of total employment and in the industry variables that took place each time a major sample revision took place (1988 and 1997).

Most of the problems arise from the survey referring to a fixed sample space given by all firms registered at the three Economic Censuses performed respectively in 1978, 1988 and 1997. Only since 1999 care was taken to yearly incorporate newborn firms from a social security register database. Hence the sample deteriorated as time passed since the updates of the sample framework at the Censuses, leading to serious estimation errors.

The survey is based on stratified sampling. Probability of extraction is one for establishments with more than 100 employees. The total estimates in these strata are the sum of the sample observations. In the smaller size ranges, probability of extraction is proportional to size, i.e. the share of the establishment in the census employment of the stratum, and estimated values are obtained by multiplying sampled observation values by the inverse of the probability of extraction and then averaged to obtain the estimated totals for each size stratum. The sample size in the smaller range is taken to be enough to cover a fixed fraction of the census employment of the strata.

The crude data were almost unusable in their primary state, and each of the sector time series presented dramatic discrete jumps of a very sizeable magnitude. For instance, the total 1988 census figures show that that year's Survey figures for employment misrepresented the total in almost 50,000 jobs (about 30% of total manufacturing employment). So we undertook a process of smoothing each individual time series, linking the data provided by each particular source: Annual manufacturing survey from 1982 to 1987 and 1989 to 1996, 1988 and 1997 Economic Censuses, and Annual Economic Activity survey from 1998 to 2001. We based our method in prior work by Cassoni (1999) that proposed a smoothing method based on geometrically distributing the difference in the growth of the survey series and the average growth revealed by the Census observations, along all the years between the change of sample points.

The rationale for doing so is based on the fact that the fixed sample criterion of the INE causes the data to misrepresent the sampled population. We have the 1988 and 1997 observations for each industry both by the corresponding census and the Survey and that was the starting point to the comparison. We also had to provide the capital stock figures, based on the two census measurements, and then carrying back and forward the estimation by adding the estimated investment and trying several alternative assumptions about depreciation. Investment figures, though recorded by the INE, were not provided and had to be estimated using microdata for the 1982-1988 years, using a weighted establishment estimator for the industry totals constructed following the INE methodology used for the rest of the published series. We deflated inputs using the 4 digit special indexes provided by Piccardo and Ferre (2002), and the Manufacturing wholesale index for each industry's output.

Estimating the industry productivity decomposition

Estimation of equation (7) would require an index of capital utilization. Abbott et al (1998) and Fernald and Basu (1999) suggest to use as a proxy the growth rate in hours worked. Hence, we estimate:

$$dy_i = c + \mu_i dx_i + adh_i + dt_i \qquad \textbf{(9)}$$

where *dh* is the growth rate in employment or hours worked. The estimated regressions are reported in Table A1. This equation allows us to compute an appropriate measure of technical changer, as a residual. Shares of the different inputs were obtained as the average use of inputs in the whole period of analysis. To compute the share of capital in each sector it was necessary to compute a series of the required payments for unit of capital and estimate the user cost for each unit of capital.

After estimating equation (9) we calculated the sum of the group-specific constant and the residual of each equation as the measure of technical change in the gross-output production function. These results were inserted in the following aggregation equation to decompose aggregate productivity into a technological component plus various non-technological components, including the effects of markups and reallocation of inputs:

$$dv = \overline{\mu}^{V} dx^{V} + du + R + dt^{V} \qquad \textbf{(10)}$$

where *dv* is the aggregate growth in value added, $\overline{\mu}^{V}$ is the average markup across firms, dx^{V} is the weighted-average growth of inputs, *du* is a weighted-average of utilization rates at the sector level, *R* represents reallocation of inputs among firms, and dt^{V} is the weighted average of sector technical changes.[11]

[11] The aggregate output measure is presented in value added terms rather than in gross terms and is obtained as a difference between gross output and materials. For details on the computation of aggregate variables see Fernald and Basu (1999).

Expressing productivity growth as $dp = dv - dx^V$, equation (10) becomes

$$dp = \left(\overline{\mu}^V - 1\right)dx^V + du + R + dt^V \qquad \textbf{(11)}$$

Equation (11) shows that aggregate growth in total measured factor productivity is a combination of the growth of inputs in sectors with different markups, the change in labor effort and capital utilization, the effect of input reallocation, and technical change, respectively.

Table A1

Econometric Results for Equation 7

	A	B	C	D
Constant	0.003 (0.008)	0.005 (0.008)	0.009 (0.008)	-0.001 (0.008)
dh_i	-0.076 (0.023)***	-0.066 (0.024)***	-0.083 (0.023)***	-0.051 (0.024)**
m1	1,089 (0.135)***	1.272 (0.808)	0.402 (0.335)	0.454 (0.141)***
m2	0.720 (0.164)***	0.870 (0.337)**	0.259 (0.295)	1.271 (0.298)***
m3	0.339 (0.290)	-0.006 (0.222)	1.345 -1.209	1.500 (0.339)***
m4	0.865 (0.273)***	1.386 (0.521)***	0.222 (0.266)	1.406 (0.468)***
m5	1.212 (0.328)***	1.003 (0.404)**	0.468 (0.299)	0.353 (0.282)
m6	1.611 (0.388)***	1.551 (0.372)***	0.121 (0.321)	0.112 (0.564)
m7	-1.299 -1.516	0.855 (0.244)***	0.765 (0.393)*	0.142 (0.168)
m8	0.245 (0.181)	0.748 (0.264)***	1.367 (0.344)***	0.444 (0.155)***
m9	0.418 (0.370)	1.080 (0.197)***	0.652 (0.205)***	1.112 (0.162)***
m10	0.925 (0.281)***	1.144 (0.342)***	0.215 (0.387)	0.912 (0.221)***
m11	0.107 (0.254)	1.923 -2.838	1.256 (0.332)***	
ml2	0.223 (0.144)	4.515 -4.258	0.351 (0.293)	
ml3	1.955 –1,630	0.520 (0.362)	1.571 (0.336)***	
ml4		0.538 (0.465)	1.390 (0.258)***	
ml5		0.252 (0.249)	1.223 -1.341	
ml6		-0.535 -1.868	1.394 (0.358)***	
ml7		-0.519 (0.718)	0.755 (0.493)	
Observations	813	813	813	813
R-squared	0.16	0.13	0.14	0.15

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%
Notes: m1 trough m18 are the estimated μ coefficients for different sets of industries
Industries in regression A: 1512 1514 1520 1531 1533 1543 1544 1549 1551 1552 1553 1554 1600
Industries in regression B: 1720 1721 1722 1723 1729 1730 1810 1911 1912 1920 2010 2021 2101 2102 2109 2211 2212
Industries in regression C: 2411 2412 2413 2421 2422 2423 2424 2511 2519 2520 2610 2691 2692 2699 2700 2710 2720
Industries in regression D: 2811 2890 2910 2920 2930 3000 3100 3590 3610 3691

Long run growth model

Loayza and Soto (2002) estimate the following growth regression:

$$y_{it} - y_{it-1} = \alpha_0 y_{it-1} + \alpha_1 \left(y_{it-1} - y_{it-1}^T\right) + \beta X_{it} + \eta_i + \mu_t + \varepsilon_{it} \qquad \textbf{(12)}$$

where y is the log of per capita output, y^T represents the trend component of per-capita GDP, so that $\left(y_{it-1} - y_{it-1}^T\right)$ is the output gap at the start of the period, X is a set variables postulated as growth determinants, μ_t is a period-specific effect, η_i represents unobserved country-specific factors, and ε is the regression residual. Subscripts *i* and *t* refer to country and time period, respectively.

A large variety of economic and social variables can be proposed as determinants of economic growth. The variables that have received the most attention in the academic literature and in policy circles can be divided into five groups: transitional convergence, cyclical reversion, structural policies and institutions, stabilization policies, and external conditions.

Transitional convergence: An important implications of most growth models is that the growth rate depends on the initial position of the economy. The "conditional convergence" hypothesis maintains that, ceteris paribus, poor countries should grow faster than rich ones because of decreasing returns to scale in production. To control for the initial position of the economy, it is customary to include the initial level of real per capita GDP in the set of explanatory variables.

Cyclical reversion: When working with relatively short time periods (five-year averages) cyclical effects are bound to play a role. The output gap[12] at the start of each period is included as a growth determinant to control for the business cycle.

Structural policies and institutions-. The endogenous growth literature maintains that public policies and institutions affect economic growth. The first area of structural policies is human capital formation, which can counteract the forces of diminishing returns in other accumulable factors of production—such as physical capital—to sustain long-run growth. Moreover, human capital serve as a complement to other factors such as physical capital and natural resources, determine the rate of technological innovations in countries that produce technology, and facilitate technological absorption in countries that imitate it. The measure of education and human capital is the rate of gross secondary school enrollment. The second policy is financial depth. Well-functioning financial systems promote long-run growth through different channels: they facilitate risk diversification by trading, pooling, and hedging financial instruments; help identify profitable investment projects and mobilize savings to them; and help monitor firm managers and exert corporate controls, thereby

---

[12] Measured as the difference between potential and actual GDP. The Baxter-King filter is used to compute potential GDP for each country in the sample.

reducing inefficient investment. To measure financial depth Loayza and Soto use the ratio of private domestic credit supplied by private financial institutions to GDP. The third area of economic policy is international trade openness, measured by trade volume over GDP. Trade leads to higher specialization and, thus to gains in total factor productivity (TFP); it expands potential markets and allows domestic firms to take advantage of economies of scale; it diffuses technological innovations and improved managerial practices; it tends to lessen anticompetitive practices of domestic firms; and it inhibits rent-seeking activities that are mostly unproductive. The fourth area is related to the government burden measured by the ratio of government consumption to GDP. The fifth area of policy involves the availability of public services and infrastructure, which is proxied by the number of main telephone lines per capita. Finally, the last area is governance, which comprises several aspects of the institutional quality of government, including the respect for civil and political rights, bureaucratic efficiency, absence of corruption, enforcement of contractual agreements, and prevalence of law and order. The proxy for governance is the first principal component of four indicators reported by Political Risk Services in their publication International Country Risk Guide (ICRG).

Stabilization policies: With regards to stabilization policies, Soto and Loayza (2002) control first for fiscal and monetary policies, including lack of price stability (proxied by the average inflation rate); the cyclical volatility of GDP, which reflects the lack of output stability and is measured by the standard deviation of the output gap for the corresponding country and period. In addition, they include external imbalances and the risk of balanceof-payments crises. This factor is measured by an index of real exchange rate overvaluation, which is constructed following the methodology in Dollar (1992). Real exchange rate overvaluation captures the impact of monetary and exchange rate policies that distort the allocation of resources between the exporting and domestic sectors. The last area concerns the occurrence of systemic banking crises and serves to account for the deleterious effect of financial turmoil on economic activity, particularly over short and medium horizons. The occurrence of banking crises is measured by the fraction of years that a country undergoes a systemic banking crisis in the corresponding period.

External conditions: These are taken into account by including the terms-of-trade shocks affecting each country individually and a period-specific shift affecting all countries in the sample. Terms-of-trade shocks capture changes in both the international demand for a country's exports and the cost of production and consumption inputs. The period-specific shifts (or time dummy variables) summarize the prevalent global conditions at a given period of time and reflect worldwide recessions and booms, changes in the allocation and cost of international capital flows, and technological innovations.

The econometric model uses cross-country, time-series panel data. The sample contains seventy- eight countries representing all major world regions. The regression analysis is conducted using averages of five-year periods. Each country has a minimum of three and a maximum of eight non-overlapping five-year observations spanning the years 1960-1999. The total number of observations is 350 and the estimation technique is the generalized method-of moments (GMM) estimator. Results are presented in table below.

Appendix Table 3

Determinants of Economic Growth: Panel Regression Analysis

Initial per capita GDP	-0.0176 (-3.80)		Initial output gap	-0.2371 (-8.52)
Education levels	0.0172 (6.70)		Financial depth	0.0066 (4.28
Trade Openness	0.0096 (3.14		Government burden	-0.0154 (-3.18)
Public Infrastructure	0.0071 (2.71)		Governance	0.0012 (2.02)
Price Instability	-0.0048 (-1.89)		Cyclical Volatility	-0.2771 (-3.76)
Real Exchange Rate Overvaluation	-0.0061 (-3.90)		Systemic Banking Crises	-0.0289 (-7.42)
Terms of Trade Shocks	0.0720 (4.98)		Intercept	0.1216 (2.79