INFRASTRUCTURE AND GROWTH: THE LATIN AMERICAN CASE*

Víctor J. Elías**

ABSTRACT

The main objective of this paper is to evaluate the role of infrastructure investment (ISI) in the economic growth of Latin American countries. Previous studies evaluating the role of infrastructure capital on economic growth have generally focused on industrialized countries; few have specifically addressed the case of Latin America. Due to the poor economic growth of the Latin American countries during 1980s, and the ensuing unstable recovery during 1990s, it appears both useful and opportune to address the role of infrastructure investment of future Latin American economic growth. The aim is to estimate the contribution of "hard" infrastructure to economic growth and determine how its effects are different from noninfrastructure investment.

Besides looking at the aggregate economic performance of each economy, two additional topics are presented. One refers to the effects of ISI on the productivity of the agricultural sector. The second studies the effects of ISI on the changes in regional income distribution (the so-called regional economic convergence problem).

* This work appeared previously as a special publication of the World Bank, Washington D.C., december, 1995. This project was funded from the World Bank's Research Support Budget under the sponsorship of The Economic Adviser's Unit of the Technical Department, Latin America and Caribbean Region. The design and content of the project benefited greatly from the valuable comments and suggestions of Valeriano F. Garcia. Very useful comments provided by Gregory Ingram, Simon Rottenberg, Michael Michaely, Demetris Papageorgiou, Charles Hulten, Ioannis Kessides, and Suman Bery are also acknowledged. The discussion at a seminar at the World Bank contributed to make some important improvements to the original manuscript. I appreciate greatly the research assistance provided by Ana M. Cerro, Ana G. Elías, and María de la Paz Martínez and also the excellent editing assistance of Nancy Wolfe, Fernando Losada and Kyle Kelhofer. I am particularly grateful for the valuable assistance provided by Peter Brandiss and Patricia Mendez in preparing the paper for publication. As usual, the findings, interpretations, and conclusions in this project are entirely those of the author and should not be attributed in any manner to the World Bank, to its affiliated organizations, or to the members of its Broad of Executive Directors or to the countries they represent.

** University of Tucumán and Institute of Applied Economics, Foundation of *Banco Empresario de Tucumán*.

*** Hard infrastructure are investment in irrigation, transportation, communication, energy, etc.

SINTESIS

El principal objetivo de este artículo es evaluar el rol de la inversión en infraestructura (ISI) en el crecimiento económico de los países latinoamericanos. Estudios previos acerca del rol del capital en infraestructura sobre el crecimiento económico se han basado sólo en evidencia para países desarrollados; pocos han analizado específicamente el caso de Latinoamérica. Debido al pobre crecimiento de los países latinoamericanos durante los ochenta, y a la inestable recuperación durante los noventa, es útil y oportuno analizar el rol de la inversión en infraestructura sobre el crecimiento económico futuro de Latinoamérica. El objetivo es estimar la contribución de la infraestructura "dura" (inversión en irrigación, transportes, comunicación y energía) al crecimiento económico y determinar como sus efectos son diferentes de la inversión que no es en infraestructura.

Además mirando el desempeño económico agregado de cada economía, dos temas adicionales son presentados. El primero se refiere a los efectos de ISI sobre la productividad del sector agrícola. El segundo estudia los efectos de ISI sobre los cambios en la distribución de ingreso regional (el llamado problema de convergencia regional).

INFRASTRUCTURE AND GROWTH: THE LATIN AMERICAN CASE*

Víctor J. Elías

1. INTRODUCTION

Economic growth is the result of the combination of factor accumulation and increases in productivity. In particular, accumulation of capital in the form of infrastructure investment has a number of special features, mainly an externality effect that enhances the overall growth performance of the economy. The work of Robert Lucas (1988) has renewed interest in the analysis of growth processes and their determinants; Lucas emphasizes the importance of spillovers in particular sectors, though on theoretical grounds. In an important recent contribution, De Long and Summers (1991) provide evidence in support of equipment investment being a prime determinant of productivity growth.

Appropriate infrastructure helps to increase productivity and lower production costs. The provision of infrastructure services, however, presents a number of very special characteristics. In particular, the delivery of infrastructure usually takes place in noncompetitive markets. Thus, prices often do not reflect true production costs. The recent move towards mass privatization in Latin America has opened a plethora of opportunities for market-driven, more efficient allocation of resources in infrastructure sectors. In that regard, the World Bank (1994) has recently advocated the broadening of competition and the application of standard business principles of operation in infrastructure projects.

The main objective of this paper is to empirically assess the role of infrastructure investment (ISI) in the economic growth of Latin American countries. The aim is to estimate the contribution of infrastructure to economic growth and to determine how its effects are different from noninfrastructure investment.[1]

* *Estudios de Economía*, publicación del Departamentode Economía de la Facultad de Ciencias Económicas y Administrativas de la Universidad de Chile, Vol. 23 N°2, diciembre de 1996.

[1] Following an aggregate production function approach, infrastructure could be defined as one kind of fixed capital input that could be a nonperfect substitute for other kinds of fixed capital, and therefore should be considered as a separate input. Using this definition, an interesting question to explore is whether the output-input elasticity (and from it the derived rate return) of infrastructure capital input is bigger than, equal to, or lower than the output-input elasticity of noninfrastructure capital. The hypothesis that these output-input elasticities are different can be derived from assuming that most infrastructure investment is made by the public sector, or that infrastructure investment can have some externality effect. Another possibility is that the major portion of infrastructure investment takes the form of plant investment and that its effects can therefore be different from equipment investment.

This analysis concludes by discussing the relevance of the composition of fixed capital in assessing the capital contribution to economic growth. The key issue in discussing the composition of fixed capital is the relative importance of infrastructure and noninfrastructure capital. From this analysis emerges the important question of whether infrastructure capital is growing at less or more than its optimal rate. Since both the public sector and the international financial institutions play important roles in financing infrastructure investment, this question becomes highly relevant for economic policy design.

In response to the recent revival of the debate over the appropriate amount and quality of infrastructure services needed to develop economic activities and improve income distribution, numerous empirical analyses were undertaken for specific countries and for a large number of countries. Regional comparisons within countries were also included in these studies. Infrastructure investment included mainly what is called hard infrastructure, such as irrigation, transportation, communication, and energy. In some cases both private and public (federal, local, and municipal) sources of financing were included, while in other cases, only federal public financing was considered.

Most of the empirical analysis for specific countries (mainly the industrialized ones), following the aggregate production function approach, looked into the effect on the average productivity of total capital (the gross domestic product-capital input ratio, GDP/K) of the share of infrastructure capital (ISK) with respect to total capital stock (K). For the cross-country studies of a large number of countries, the role of the share of public investment in GDP on GDP growth was also analyzed. In both kinds of empirical analyses, the role of the composition of infrastructure investment --such as transportation-- in the contribution of infrastructure capital to economic growth was also considered.

However, no definitive results have yet been obtained. In statistical terms, the results obtained for the role of infrastructure composition in total capital were not robust. The results vary from country to country, and also depend on the model specification used. In addition, these results differ from the ones obtained in ex-post evaluations of infrastructure investment projects financed by international institutions, where reasonably high rates of return were estimated (see World Bank, 1994).

The changes in the quality of services that infrastructure provides also played an important role in infrastructure contribution to economic growth. The differences in quality or efficiency across countries and over time for a given country represent factors that could warrant a more detailed study.

Other analyses (see Crain and Oakley, 1995) have taken a different road in examining the institutional determinants of public sector expenditures on infrastructure. This approach raises the issue of whether infrastructure investment

was motivated by high social rates of return or by institutional conditions. In cross-state studies for the United States, for example, such factors as gubernatorial term limitations, initiative status, and biennial versus annual budget cycles are among the institutional variables that explain, reasonably well, the differences among states in per capita public sector expenditures.

This study considers the relationship between infrastructure and growth in Latin America. Previous results for Latin American countries have shown inconsistencies among the different countries and instability in the results when minor changes are made in the regression model. This obviously creates some uncertainty for economic policy decisions in considering the amount and composition of infrastructure investment to be supported.

This paper will first analyze two different strands of evidence. One, the cross-country case, will cover twenty-one countries, looking at the average decade-long economic performance for the three decades between 1960 and 1990. The other will use time-series analysis for four countries: Argentina, Brazil, Chile, and Mexico, covering in some of the cases the period from 1900 to 1993. This two-pronged approach adds robustness to the results that will be presented.

Besides looking at the aggregate economic performance of each economy, we discuss two additional topics. One refers to the effects of infrastructure investments on the the productivity of the agricultural sector. The second strudies the effects of infrastructure on the changes in regional income distribution (the so-called regional economic convergence problem). These analyses could be useful in designing economic policies to address income distribution problems.

2. METHODOLOGICAL ISSUES

The cross-section and time-series analyses in this study are based on three different models. The first derives from an aggregate production function of the Cobb-Douglas form that relates GDP to three inputs: Labor (L), total capital stock (K), and infrastructure capital (ISK), which yields the following regression equation:

$$\ln(GDP/K)=a+b\ \ln(L/K)+c\ \ln(ISK/K)+u \qquad [1]$$

This equation can be interpreted as explaining the average productivity of total capital. The coefficient for ISK, our research target, is c, and the coefficient for total capital is $(1-a-b)$. A differential implicit rate of return to ISK could be derived from c.

In the time-series analysis the variables will vary through t (the annual time period). In order to support the final results, additional scrutiny of the time-series properties of each of the series used in the regression analysis was undertaken. In the cross-country case each variable varies according to the country and the decade used to estimate the regression model. Fixed effects due omitted variables other than variables used in Model (1), which could produce differences across countries, are also explored.

We also analyzed the role of the educational level of the labor force in economic growth, which could capture some of the cross-country differences. The value of the average level of schooling of the labor force for the initial year of each decade will be used as an additional variable in this model.

In the second analysis (cross-country) we estimate the importance of infrastructure investment behavior of the total factor productivity (TFP). Applying the sources-of-growth methodology, we measure TFP growth by using the "residual" obtained by deducting the weighted average growth rates of the labor and capital inputs from the GDP growth rate. This is a stepwise technique. The regression model in this case will be:

$$dlnTFP = a^{*} + b^{*}\ dlnISK + u^{*} \tag{2}$$

where d represents first difference, so $dlnTFP$ is the rate of growth of TFP.

We estimate Model (2) with two kinds of evidences: cross-country and time series. We analyze the relevance of changes in the composition of ISK looking at the behavior of some of its components, such as transportation and communication. In fact, this model is an extension of the sources-of-growth analysis, focusing on the determinants of some of its components. If a reasonable estimate of coefficient c in Model (1) can be obtained, one could compute the infrastructure capital contribution of growth following the sources-of-growth methodology. This feature of our analysis is appealing, since very few of the previous studies looked directly at the effects of ISK on TFP.

Our third model will look at the relevance of ISK in explaining the total rate of return to fixed capital r(K):

$$r(K) = a^{**} + b^{**}(ISK/K) + u^{**} \tag{3}$$

In this case we interpret r(K) as the aggregate economic performance indicator of the economy. Consequently, in our model, r(K) is the global result of the

efficiency of aggregate investments. To analyze the effects of ISK on economic performance, Model (3) should be more appropriate than Model (2). Also Model (3) could have fewer estimation difficulties than Model (2).

Prior to presenting the regression analysis, we will offer some descriptive discussion of our data base. For the cross-country evidences, we estimate the growth rate of infrastructure capital by defining a weighted average of the rates of growth of each of its components (transportation, irrigation, communication, and energy). The growth rate of each component is based on physical measurements of its stock. In the case of transportation, its is the sum of railroad tracks and paved roads measured in miles; for irrigation, it is the number of hectares of irrigated land; for communication, it is the number of telephones; and in the case of energy it is the Kwk of electricity generation capacity. We do this for the cross-country data, obtaining the weights for the rate of growth of each components from the relative importance of these components in the annual infrastructure investment.

In the case of the time series, the ISK is measured in value terms using the annual series on infrastructure investment and applying the permanent inventory method. In this case, an initial estimate for ISK in needed plus a rate of depreciation. To begin the time series, the initial estimate of ISK is based on the five-year average of ISI divided by the sum of the average annual growth rate of ISK and the coefficient of depreciation. The rate of depreciation was assumed to be around 0.05. Since the series are long, small departures from the exact initial value of ISK is not a serious problem because the errors are depreciated.

3. ECONOMIC GROWTH PATTERN

Before looking at the effects of infrastructure on economic growth, we discuss the growth performance and patterns in Latin America because this offers some useful insights for interpreting the econometric analysis and understanding the diversity of the growth behavior of the countries included in our sample.

Table 1 provides information on growth performance for each of the twenty-one countries included in the cross-country analysis. Its presents the annual average growth of GDP and TFP, and the average output-capital ratio for each of the three decades from 1960 to 1990.

Looking at the behavior of each country across the decades, some interesting patterns can be found. In the case of the GDP growth rate, nine countries had a negative trend (GDP growth rates declining across decades) and the remaining twelve did not have a definite trend[2]. Also notice that only two of the twenty-one

[2] With ten initially increasing and then decreasing, and with two first decreasing and then increasing.

countries, Chile and Jamaica, had a higher GDP growth rate in the 1980s than in the 1970s.

The average annual GDP growth rate for twenty-one countries was 4.8 percent in the 1960s, 4.7 percent in the 1970s, and 1.0 percent in the 1980s. The average annual growth rate for the whole period, 1960-90, was 3.5 percent. This implies a 1.1 percent annual growth rate in GDP per capita (the GDP per capita increased 47 percent in the 30-year period).

The largest variability in GDP growth rates across countries was observed during the 1970s. The 1960s and the 1980s show a similar variability even though the 1960s had a much higher average GDP growth rate than the 1980s (almost five times). For TFP, Table 1 shows a more similar pattern across countries than that observed for GDP growth rates. In this case seventeen out of twenty-one countries experienced a declining trend in the TFP growth rates over decades. The same pattern is observed for the average productivity of total capital (GDP/K ratio).

Next, we analyze the growth experiences of the four countries that will be used in the time-series analysis-Argentina, Brazil, Chile, and Mexico.

Table 2 displays a summary of the growth performance of these countries for the period 1900-93. The annual average growth rates of GDP and TFP, and the annual average rate of return to fixed capital, are presented by decade.

The GDP growth pattern of Argentina and Chile for the whole period has been quite variable between decades, as shown by Table 2. Brazil presents a positive trend for the entire period except for the last decade, and Mexico also presents a positive GDP growth trend from the 1920s until the 1980s. The TFP growth patterns of the four countries do not show any definite behavior. Argentina and Chile do not show as much fluctuation in TFP growth as in GDP growth.

The values indicated by the TFP are very important in terms of its relative contribution to GDP growth. This suggests that there is sufficient cause to investigate its determinants, of which infrastructure could be one.

The rate of return to fixed capital behaves with a positive trend in the case of Argentina; a positive trend followed by a negative one with Brazil (the change occurred in the 1950s); very low fluctuations with Chile; and a positive trend until the 1960s followed by a small negative trend for Mexico. For Argentina, there is a contrast between the smooth behavior of r(K) and the very irregular behavior observed by the GDP growth rate (which looks consistent with a very stable capital share in GDP).

4. INFRASTRUCTURE AVAILABILITY AND TRENDS

Table 3 shows estimates of infrastructure availability in Latin America for 1990[3]. The transportation component is represented by the number of miles of railroad tracks and paved roads per 1,000 persons, and also per 1,000 hectares of cultivated land. The communication component is represented by the number of telephones per 1,000 persons. The irrigation component is represented by the percentage of cultivated land that is irrigated. In the case of energy, the number of Kwh of electricity generation capacity per 1,000 persons is used.

The availability of infrastructure differs considerably, both by component and by country. However, with the exception of Paraguay's energy component, the range of variation for each infrastructure component is fairly similar -the maximum value for availability is about ten times the minimum value. From one country to another the relative range of availability for different kinds of infrastructure is also similar. But while this range of variation is similar, the pattern may not be -for example, Argentina is ranked high in energy but low in irrigation, while Ecuador is just the opposite.

The range of variation in GDP per capita between countries is much greater than the range observed for infrastructure availability. The highest GDP per capita is about eighteen times the lowest, while in infrastructure the highest availability for a given component is about ten times the lowest availability.[4]

The ISK growth rate is estimated by the weighted average of the rates of growth of each of its components (transportation, communication, irrigation and energy).[5] Each component is measured in physical units and the weights are based on the investment share of each of these components in total ISI. The estimates of these weights are based on ISI figures for some of the countries included in this study. Table 4 presents average annual rates of growth per decade for total ISK and for each of its components (with the transportation component divided into railroad tracks and paved roads).

[3] In this paper only the so-called hard components of infrastructure, such as transportation, communication, irrigation, and energy, are included. The ISI of the public and private sectors is included in most of the cases. For some countries we also analyze the importance of the local and municipal government components within the total public investment. In accordance with the methodology presented in this paper, we used the concept of infrastructure capital stock (ISK) in most parts of the analysis. In the cross-country studies we constructed ISK from the measurements of each of its components in physical units. In the time-series studies we built the ISK series from annual ISI values following the permanent inventory method.

[4] With this kind of comparison it could be useful to have some indicators of the degree of efficiency of the services provided by each infrastructure component. This would require a more detailed analysis than the one pursued here, which should be left for future inquiries.

[5] The growth patterns of ISK for the twenty-one Latin American countries are presented in Table 4.

The growth pattern of total ISK (annual average rate of growth across decades) for each of the twenty-one countries coincides with the growth pattern of GDP (which was presented in the previous section) for only twelve of those countries. For the growth pattern of TFP, coincidence is observed for only ten countries. Table 4 also reveals large differences among the growth patterns of the different infrastructure components. The growth behavior across decades was variable, and only showed a definite trend in a few cases. In the case of transportation, the decline of the railroad track component was more than compensated for by the growth of the paved roads component.

We present our time-series estimates of ISK for Argentina, Chile, and Mexico in Table 5. This table also illustrates the average annual rate of growth by decade of ISK and the average share by decade of ISK with respect to total fixed capital K for the period between 1900 and 1993. In some cases the share of transportation as a component of total infrastructure is also given. As explained above, the ISK estimates are based on the annual observations of ISI applying the permanent inventory approach.

In the case of Argentina, a very irregular growth behavior of ISK can be noted from Table 5. The ISK share of total fixed capital, K, ranged from 20 percent in the 1900s to 37 percent in the 1940s. The transportation component of ISI had a very high negative trend. In Mexico the growth of ISK was very important and the ISK share of total K had a high positive trend. For Chile, considering only the period from 1960 to 1993, there is a declining trend in the ISK share of total K, together with a fluctuating ISK growth rate.

The results presented in Tables 4 and 5 allow us to compare the behavior of ISK growth rates estimated by two different methods. The method presented in Table 4 measured each infrastructure component in physical units, and the one presented in Table 5 was derived from the annual values of ISI. The cases presented in Table 5 suggest that the ISK growth rates estimated from value units (from ISI) were lower through time than the ones based in physical terms.

Some possible explanations of these results could be either that it became cheaper through time to produce infrastructure, or that infrastructure was decreasing in quality through time (i.e. countries were building cheaper infrastructures that provides fewer services or were less durable).

The privatization policies followed by many Latin American countries changed the institutional composition of ISI, not only in terms of private and public contributions, but also within the public component itself (with an increased share coming from local governments). The institutional composition of ISI varies across countries, across infrastructure components, and through time (due to the recent privatization policy followed by many Latin American countries). In Argentina, public investments in 1988 were made mainly by the federal government (73.2%).

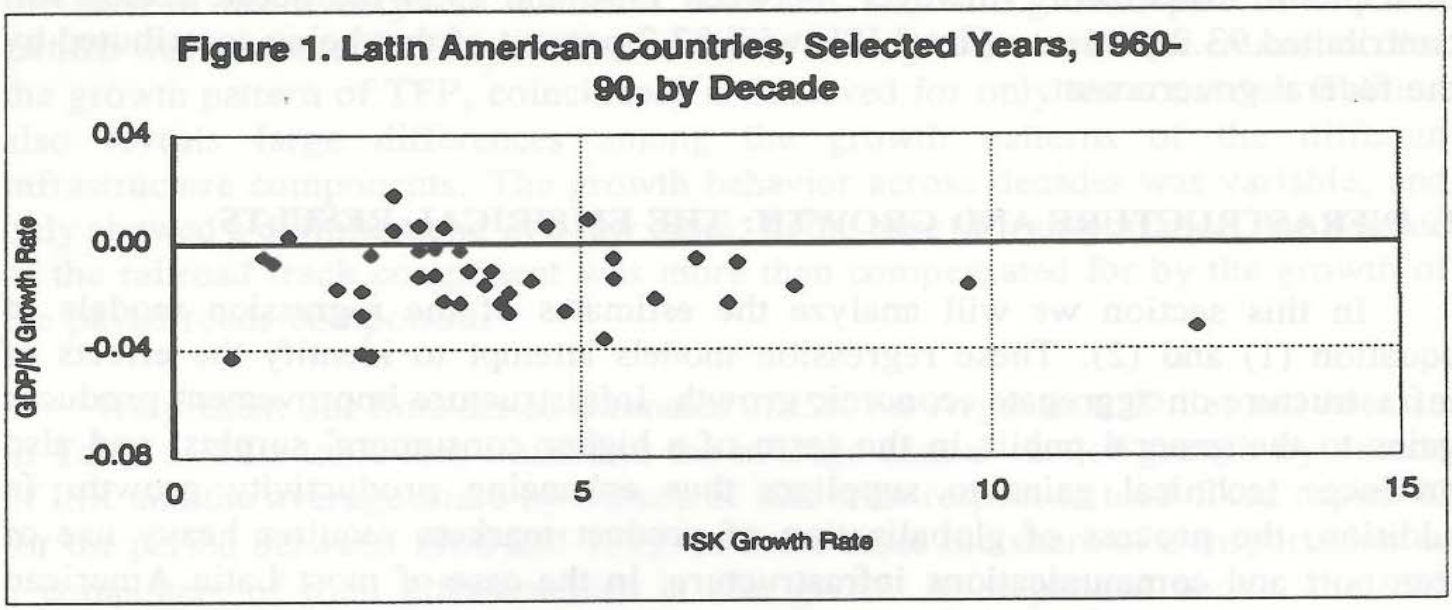
In 1993, due to privatization, the federal government made only 46.0 percent of total public investment. However, between 1990 and 1994 the public sector still contributed 93.2 percent of total ISI, with 87.2 percent of that being contributed by the federal government.

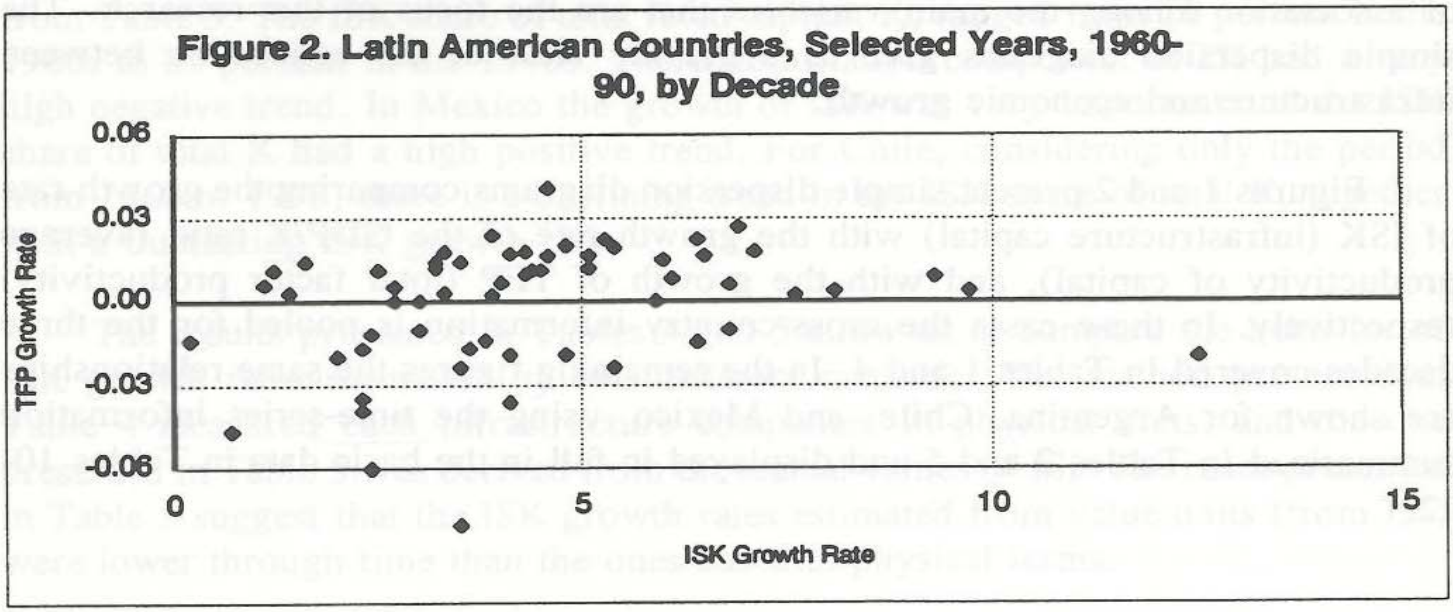
5. INFRASTRUCTURE AND GROWTH: THE EMPIRICAL RESULTS

In this section we will analyze the estimates of the regression models of equation (1) and (2). These regression models attempt to identify the effects of infrastructure on aggregate economic growth. Infrastructure improvement produces gains to the general public in the form of a higher consumers' surplus, and also produces technical gains to suppliers thus enhancing productivity growth. In addition, the process of globalization of product markets requires heavy use of transport and communications infrastructure. In the case of most Latin American countries, as we shall see below, the productivity gain effect of infrastructure, the typical externality-generating investment, seems to be sizable.

Before discussing the regression results, we should take a look at the degree of association among the main variables that are the focus of this research. The simple dispersion diagrams give us a graphic view of the connection between infrastructure and economic growth.

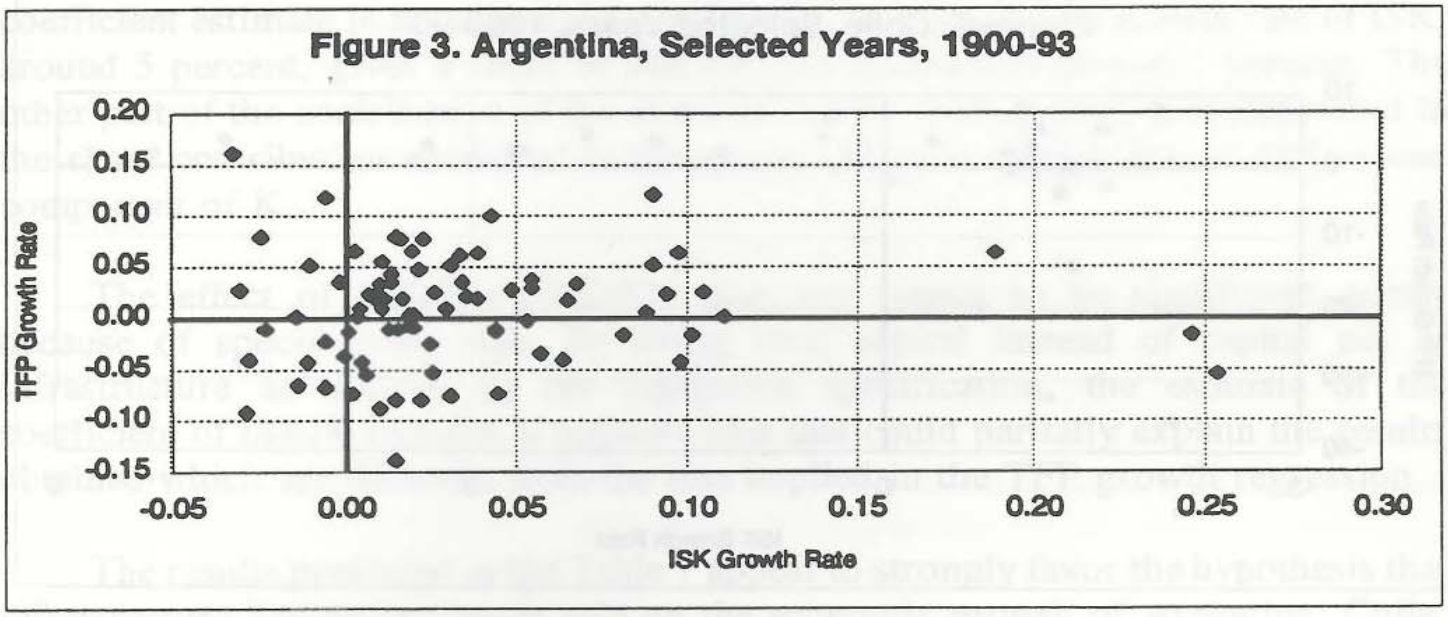
Figures 1 and 2 present simple dispersion diagrams comparing the growth rate of ISK (infrastructure capital) with the growth rate of the GDP/K ratio (average productivity of capital), and with the growth of TFP (total factor productivity) respectively. In these cases the cross-country information is pooled for the three decades covered in Tables 1 and 4. In the remaining figures the same relationships are shown for Argentina, Chile, and Mexico, using the time-series information summarized in Tables 2 and 5 and displayed in full in the basic data in Tables 10-12.

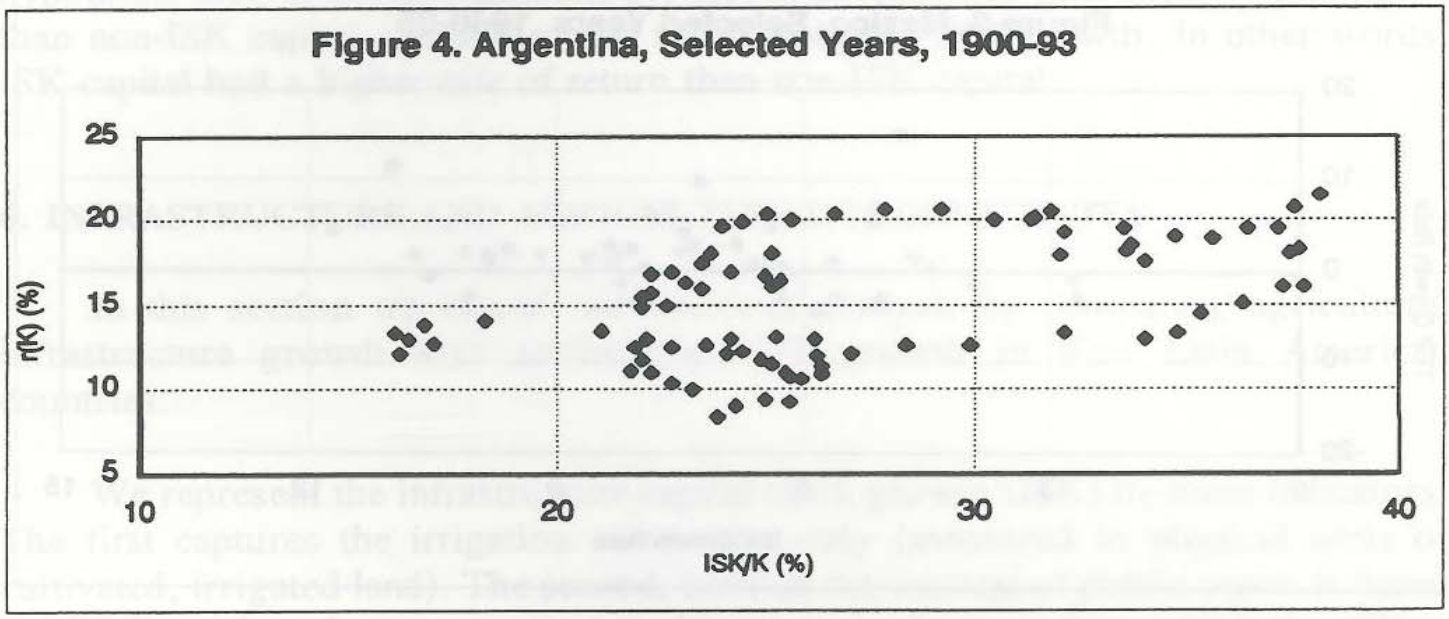




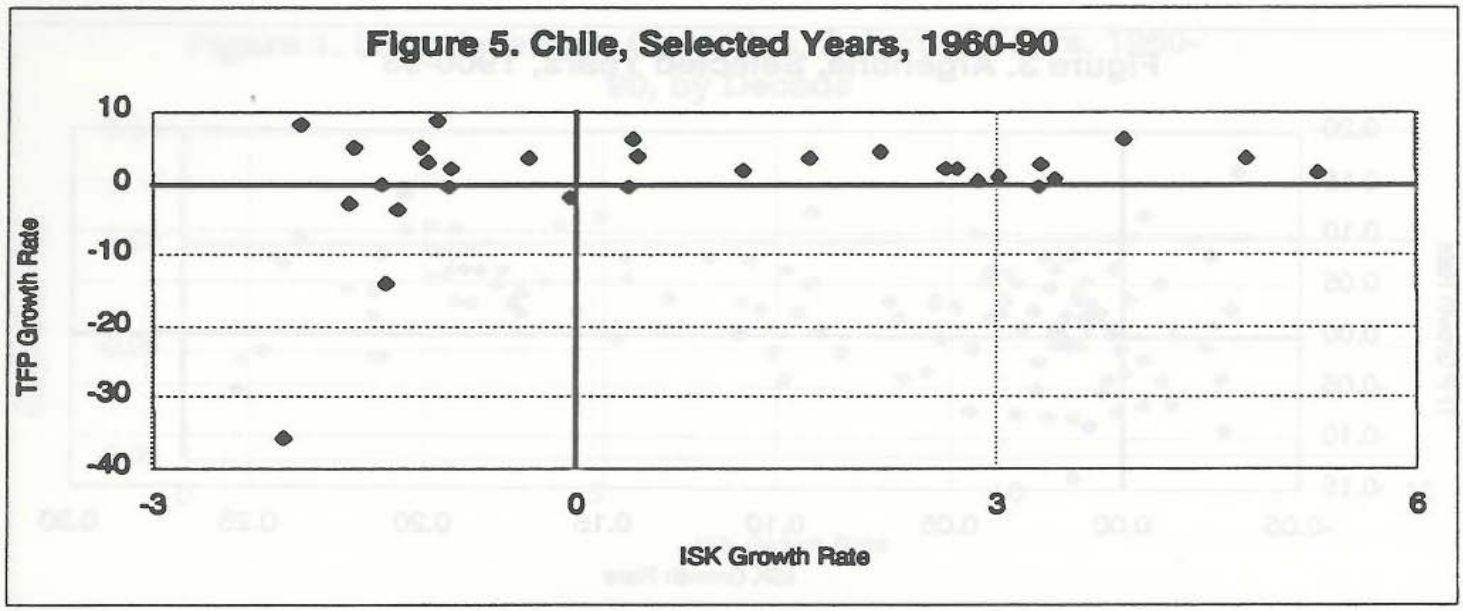
Figures 1 and 2 show a positive association between the average annual growth rates of GDP/K and ISK, and between those of TFP and ISK. This association is clearer if some points that look like outliers are excluded (such as Paraguay's data for the 1980s). The positive association is stronger between TFP and ISK growth rates than between GDP/K and ISK growth rates.

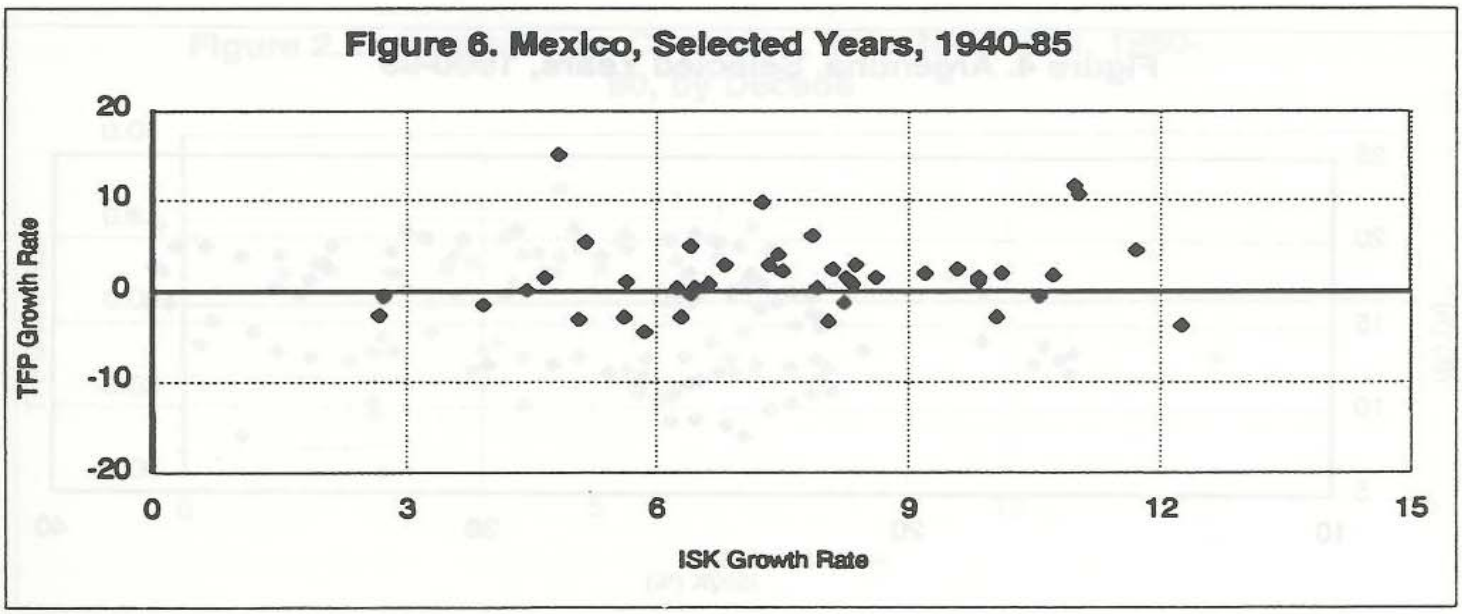
In the case of Argentina, Figures 3 and 4 show a positive association between the TFP growth rate and the ISK growth rate, and between the rate of return to capital and the ISK share of total K, respectively.





Figures 5 and 6 present the cases of Chile and Mexico. In both cases, TFP growth rate is related to ISK growth rate, showing an unclear association between these two variables. As these are simple dispersion diagrams, this could mean that a third variable could have shifted the relationship between TFP growth and ISK growth.





These simple dispersion diagrams should only be considered as a preliminary look at the data. In some cases, however, they show a clear association among the variables in play. The final word has to be given by the regression analysis. Other message sent by these figures is that the presence of some outliers should be taken into account in interpreting the regression results.

Table 6 summarizes some of the regression estimates found from pooling the twenty-one cross-country data with the average values of the relevant variables for each of the three decades from 1960 to 1990.

The results in the table show a positive effect of ISK growth on TFP growth (the t-test for this kind of regression looks reasonably high). The value of 0.19 (its coefficient estimate in the regression) multiplied by the average growth rate of ISK, around 5 percent, gives a share of ISK on TFP growth of around 1 percent. The other part of the contribution of the share of ISK to GDP growth is incorporated in the share contribution attributed to the growth of total capital (K), as ISK is one component of K.

The effect of ISK/K on GDP/K does not appear to be significant, partly because of specification bias. By using total capital instead of capital net of infrastructure as deflator in the regression specification, the estimate of the coefficient of ISK/K includes a negative bias that could partially explain the results obtained which are different from the one implied in the TFP growth regression.

The results presented in the Table 7 appear to strongly favor the hypothesis that infrastructure had an important role on the economic growth of Argentina, Chile, and Mexico. Mexico presents the stronger case in favor of infrastructure importance.

The effects of ISK growth, captured through the TFP growth, support the hypothesis that, in order to estimate the ISK contribution to growth, a weight higher than non-ISK capital should be used to multiply the ISK growth. In other words, ISK capital had a higher rate of return than non-ISK capital.

6. INFRASTRUCTURE AND AGRICULTURAL PRODUCTIVITY

In this section we extend our previous analysis by comparing agricultural infrastructure growth with agricultural TFP growth in nine Latin American countries.

We represent the infrastructure capital stock growth (ISK) by three indicators. The first captures the irrigation component only (measured in physical units of cultivated, irrigated land). The second, built on the concept of public input, is based on the flow of total government expenditures on agriculture from which the ISK is constructed (using the permanent inventory approach). The third is the total ISK already presented in the cross-country analysis above. Table 8 presents the average annual growth rates of output, total inputs, TFP, and the three definitions of ISK, for the four decades of the period 1950-90.

The behavior of TFP in agriculture, presented in Table 8, is positively related to the different indicators of ISK growth (aggregate for the whole economy and specific to agriculture, as in the case of irrigation). In this case we are covering a smaller sample of countries than in the previous section. These results also suggest the need to pursue further research to determine the effect of infrastructure on

productivity in different economic sectors, and to relate those results to the results obtained for the whole economy.

7. INFRASTRUCTURE AND REGIONAL INCOME DISTRIBUTION

One important potential effect of infrastructure investment is its contribution to the improvement of regional income distribution. Some of the infrastructure components (the so-called soft ones) have a direct impact. Others (the so-called hard ones) reveal their effects through production channels.

One of the implications of the empirical studies of neoclassical growth models is the appearance of regional economic convergence. It is expected that, under some conditions, regions with lower per capita income experience higher growth rates than regions with higher per capita income. Infrastructure availability for each region could be one of these conditions.

Since regional income data are available for only a few countries in Latin America, we were able to collect regional income information only for Argentina, Brazil, Chile, Mexico, and Peru. Table 9 presents the standard deviation of the logarithm of the income per capita across states or regions through time.

The existence of convergence can be assessed through the behavior of this standard deviation which measures income inequality across regions. In the growth literature this is called sigma convergence. If sigma increases, so does income inequality, and vice versa. The fact that sigma is calculated from the logarithm of the income per capita makes its value comparable across countries and through time.

Argentina initially experienced a pattern of nonconvergence, with sigma increasing from 0.308 in 1884 to 0.374 in 1953. But in 1985 sigma decreased to 0.334, suggesting that some convergence was going on among the provinces. Brazil and Chile both show nonconvergence, while Mexico and Peru show convergence. The data availability for different periods for each of the countries included in Table 9 makes it difficult to find a common pattern among them.

The behavior of the regional income convergence (represented by the so-called sigma convergence) can be associated to the behavior of the ISK growth. In the case of Mexico, there is clearly a more negative association with ISK growth (infrastructure increases convergence, a decrease of the standard deviation).

REFERENCES

BERNDT, ERNEST R. and BENGT HANSSON (1991): "Measuring the Contribution of Public Infrastructure Capital in Sweden," Working Paper No. 3842, National Bureau of Economic Research, Cambridge.

CRAIN, W. MARK and LISA K. OAKLEY (1995): "The Politics of Infrastructure," *The Journal of Law and Economics*, pp. 1-17.

DE LONG, BRADFORD and LAWRENCE SUMMERS (1991): "Equipment Investment and Economic Growth," *Quarterly Journal of Economics*, Vol. 106.

ELÍAS, VICTOR J. (1993): "The Role of Factor Productivity on Economic Growth," *Estudios de Economía*, Department of Economics, Universidad de Chile.

_____ (1992): *Sources of Growth: A Study of Seven Latin American Economies*, San Francisco: ICS Press.

_____ (1985): "Government Expenditures in Agriculture and Agricultural Growth in Latin American Countries," Research Report, Washington, D.C.: International Food Policy Research Institute.

JORGENSON, DALE W. (1991): "Fragile Statistical Foundations: The Macroeconomics of Public Infrastructure Investment - A Comment on Hulten and Schwab," Harvard University, xerolith.

LUCAS, ROBERT (1988): "On the Mechanics of Economic Development," *Journal of Monetary Economics*, Vol. 22.

STURM, JAN E. and JAKOB DE HAAN (1995): "Is Public Expenditure Really Productive? New evidence for the USA and The Netherlands," *Economic Modelling*, January, pp. 60-72.

WORLD BANK (1994): *World Development* Report *1994*, Washington, D.C.

YOUNG, ALWYN (1995): "The Tyranny of Numbers," *Quarterly Journal of Economics*, Vol. 110.

APPENDIX OF TABLES

TABLE 1
AVERAGE ANNUAL GROWTH RATES OF GDP AND TFP, AND AVERAGE GDP/K
(output-capital ratio)

Countries	*GDP growth (percent)*				*TFP growth (percent)*				*GDP/K (avg. annual capital productivity)*		
	60s	*70s*	*80s*	*60-90*	*60s*	*70s*	*80s*	*60-90*	*60s*	*70s*	*80s*
Argentina	4.2	2.6	-1.2	1.9	1.4	0.0	-2.0	-0.2	43	38	32
Bolivia	4.4	3.9	0.1	2.8	1.1	0.2	-1.2	0.0	30	27	26
Brazil	6.1	8.2	1.5	5.3	1.8	2.7	-1.4	1.0	44	41	35
Chile	4.2	2.5	2.8	3.2	1.2	0.3	0.5	0.7	40	41	43
Colombia	5.1	5.3	3.4	4.6	1.6	1.6	0.0	1.1	43	47	56
Costa Rica	5.9	5.5	2.4	4.6	1.1	0.2	0.7	0.1	65	55	44
Dominican R.	5.6	6.6	1.7	4.7	1.6	0.4	2.2	0.1	69	59	41
Ecuador	4.4	8.9	2.1	5.1	0.6	4.1	-1.0	1.2	29	31	33
El Salvador	5.5	3.2	0.1	2.9	1.0	-1.0	-1.7	-0.6	79	63	48
Guatemala	5.4	5.5	0.9	3.9	1.6	1.4	-1.7	0.4	54	53	48
Haiti	0.2	4.2	-1.0	1.2	-1.4	0.0	-3.9	-1.8	115	93	61
Honduras	4.7	5.4	2.0	4.0	0.9	1.1	-1.5	0.2	56	52	49
Jamaica	4.4	-1.0	2.0	1.8	2.4	-3.5	0.6	-0.2	24	20	19
Mexico	6.9	6.4	1.6	5.0	2.0	1.1	-1.9	0.4	54	47	39
Nicaragua	6.5	0.3	-1.6	1.8	1.5	-3.6	-4.7	-2.2	99	76	49
Panama	7.7	5.4	0.5	4.5	2.2	0.3	-2.4	0.1	61	49	39
Paraguay	4.2	8.4	2.8	5.1	0.4	1.9	-2.0	0.1	71	62	45
Peru	5.1	3.5	-0.8	2.6	1.7	0.0	-3.5	-0.6	37	36	30
T&T	4.1	6.0	-3.7	2.1	1.4	1.2	-6.0	-1.1	71	63	41
Uruguay	1.4	2.9	-0.2	1.4	0.8	1.8	-8.0	0.6	33	35	34
Venezuela	5.0	2.7	0.7	2.8	1.8	-2.4	-1.9	-0.8	37	35	27

Sources: World Bank data set (unpublished).

Notes: The TFP growth rates were estimated by the GDP growth minus the sum of 0.60 times the labor input growth rate plus 0.40 times the capital input growth rate. The labor input is approximated by the population between 15 and 64 years of age.

TABLE 2
ANNUAL AVERAGE GROWTH RATE OF GDP AND TFP, AND THE RATE OF RETURN
(output-capital ratio)

Countries	GDP growth (percent)				TFP growth (percent)				Rate of return to fixed capital, r(K)			
	Arg	Bra	Chi	Mex	Arg	Bra	Chi	Mex	Arg	Bra	Chi	Mex
1900-10	7.0	4.5	3.6	3.1	1.5	1.2	1.1	---	12.7	20.3	19.0	---
1910-20	1.6	3.9	1.1	0.7	-0.9	1.5	-0.5	---	10.1	20.8	17.2	---
1920-30	4.6	4.2	3.9	0.6	1.3	1.1	1.7	-1.9	12.3	21.3	16.6	11.3
1930-40	1.9	5.0	1.9	3.8	0.6	3.3	0.6	2.3	12.4	25.7	17.8	11.8
1940-50	4.4	5.7	3.4	5.9	3.2	2.5	1.8	3.9	18.0	31.8	19.0	19.2
1950-60	3.0	6.5	3.4	5.9	1.3	2.1	0.5	2.3	19.1	28.6	18.6	25.1
1960-70	4.2	6.1	4.2	6.9	1.4	1.8	1.2	2.0	19.7	22.6	18.0	25.7
1970-80	2.6	8.2	2.5	6.4	0.0	2.7	0.3	1.1	18.7	19.4	18.9	23.9
1980-90	-1.2	1.5	2.8	1.6	-2.0	-1.4	0.5	-1.9	15.9	16.4	20.5	20.0
1990-93	7.0	0.1	7.8	3.2	---	---	---	---	18.7	---	---	18.2

Notes: Arg-Argentina, Bra-Brazil, Chi-Chile, Mex-Mexico.

Sources: Víctor J. Elías (1992, see references). Andre Hoffman, "International Estimates of Capital: 1950-1989; Comparison of Latin America and the USA," Research Memorandum No. 509, Institute of Economic Research, University of Groningen, The Netherlands, Oct. 1992.

TABLE 3
INFRASTRUCTURE AVAILABILITY IN LATIN AMERICAN COUNTRIES, 1990

Countries	Transportation (miles of railway and paved road per 1,000 people	per 1,000 ha. cult. land)	Communication (telephones per 1,000 people)	Irrigation (percent of cultivated land)	Energy (Kwh elec. gen. cap. per 1,000 people)
Argentina	1.75	1.93	93	6.4	518.7
Bolivia	0.43	4.64	25	5.0	96.7
Brazil	0.74	2.53	61	3.8	343.2
Chile	0.87	9.07	63	24.1	301.0
Colombia	0.25	1.96	72	13.0	279.1
Costa Rica	1.22	1.22	88	41.4	291.0
Dominican R.	1.34	8.91	47	18.7	—
Ecuador	0.41	2.66	45	32.1	150.1
El Salvador	0.28	2.63	23	20.5	138.2
Guatemala	0.30	2.05	20	5.6	72.7
Haiti	—	—	—	—	—
Honduras	0.39	1.30	16	5.5	54.3
Jamaica	0.57	6.62	44	16.4	304.6
Mexico	0.79	3.96	63	21.0	343.6
Nicaragua	0.31	1.10	12	7.6	101.4
Panama	0.65	3.68	86	6.8	399.5
Paragusy	0.47	0.97	25	3.0	1275.6
Peru	0.28	3.45	25	35.3	186.4
T&T	—	—	—	—	—
Uruguay	2.56	5.68	134	7.1	541.5
Venezuela	0.82	8.74	74	10.6	920.6

Sources: World Development Report 1994, The World Bank, Washington, D.C., 1994. Economic Commision for Latin America, Statistical Yearbook for Latin American and the Caribbean, 1993, Santiago, Chile.

TABLE 4
ANNUAL AVERAGE GROWTH RATES OF ISK AND ITS COMPONENTS
(percent)

Countries	ISK total			Railroad tracks			Paved roads			Telephones			Irrigation			Elec. gen. cap.		
	1960s	1970s	1980s	1960s	1970s	1980s	1960s	1970s	1980s	1960s	1970s	1980s	1960s	1970s	1980s	1960s	1970s	1980s
Argentina	3.5	3.0	2.0	-1.0	-1.6	0.5	3.9	4.6	0.9	---	2.3	5.1	3.0	2.1	0.6	6.8	6.0	3.6
Bolivia	4.5	3.9	2.4	3.6	-0.6	0.4	5.2	3.0	2.4	---	---	2.6	1.2	5.8	1.7	6.2	6.2	4.2
Brazil	7.1	6.9	3.8	-1.8	-1.1	-2.6	14.8	5.6	6.4	---	13.4	7.2	5.5	7.2	5.4	8.9	11.5	4.7
Chile	5.1	1.4	2.7	-0.2	-2.7	2.4	11.0	2.9	1.1	---	3.4	9.0	1.0	0.6	0.1	6.5	3.2	3.3
Colombia	6.5	5.1	2.7	0.8	-0.1	-0.5	7.2	7.2	-1.5	---	4.6	8.4	1.1	4.8	2.7	10.3	7.8	6.3
Costa Rica	2.5	7.6	4.0	-0.7	3.4	-2.2	---	5.6	8.7	---	11.6	6.0	0.0	8.9	6.8	8.4	10.2	3.7
Dominican R.	4.6	9.7	5.3	0.0	8.1	10.9	2.0	10.6	---	---	---	11.6	1.4	2.8	3.2	11.7	11.5	4.1
Ecuador	6.8	4.6	3.0	-1.5	-0.3	0.0	15.0	4.0	4.0	---	5.2	8.0	0.7	1.0	0.6	9.9	10.4	4.0
El Salvador	4.3	6.8	2.3	0.0	-0.3	1.1	2.1	2.8	0.9	---	6.5	5.2	1.2	18.6	0.9	10.7	9.4	4.0
Guatemala	5.1	3.2	3.6	-3.4	1.0	2.1	6.2	2.0	2.0	---	---	7.0	6.4	2.0	1.4	10.0	6.1	5.9
Haiti	0.2	5.9	2.3	-7.2	7.5	0.7	2.2	0.6	0.7	---	---	9.0	---	1.6	---	4.4	10.9	2.4
Honduras	9.3	1.2	6.4	-1.8	-14.9	16.6	22.6	7.5	3.3	---	---	10.8	3.8	1.6	0.9	10.4	10.2	2.2
Jamaica	3.9	2.3	1.1	0.0	-1.2	1.5	0.0	---	---	---	2.5	6.6	1.0	3.2	0.6	11.1	6.0	0.1
Mexico	4.8	4.4	4.1	0.5	-2.0	2.8	5.2	4.6	2.1	---	6.8	7.6	2.0	3.4	3.9	9.2	8.8	5.6
Nicaragua	6.0	4.1	0.7	0.0	-1.5	-0.4	7.1	2.7	---	---	4.1	4.3	9.3	7.2	0.6	8.0	7.7	1.0
Panama	6.4	3.3	3.5	0.0	-2.9	7.3	9.8	3.4	1.0	---	---	5.5	4.0	3.4	1.4	9.8	7.9	2.9
Paraguay	8.1	5.4	12.5	0.0	0.0	0.0	12.4	6.4	7.1	---	9.1	8.6	3.3	4.1	1.1	13.4	8.1	32.9
Peru	4.1	3.0	2.3	-1.4	-0.6	1.8	1.9	2.6	1.8	---	4.8	5.8	9.5	0.5	0.8	7.2	6.7	2.6
T&T	1.6	3.2	2.4	-7.2	0.0	0.0	-0.9	---	---	---	0.9	14.7	---	3.4	0.5	10.0	8.5	2.7
Uruguay	6.1	3.3	3.5	-0.1	0.1	-0.1	15.1	5.0	---	---	2.7	6.6	7.6	4.3	4.3	3.3	4.1	7.3
Venezuela	4.3	5.4	4.8	-4.6	-0.5	4.7	8.2	2.4	1.4	---	8.3	5.7	3.0	6.9	2.8	8.9	10.3	8.2

Sources: Table 3.

Notes: The TFP growth rates were estimated by the GDP growth minus the sum of 0.60 times the labor input growth rate plus 0.40 times the capital input growth rate. The labor input is approximated by the population between 15 and 64 years of age.

TABLE 5
INFRASTRUCTURE CAPITAL AND INVESTMENT, SELECTED STATISTICS, 1900-93

	Average annual growth of total infrastructure capital- **ISK** (percent)			Infrastructure capital as share of total fixed capital- **ISK/K** (percent)			Transp. as share of total infra. investment- **ISIT/ISI** (percent)
Decade	Argentina	Chile	Mexico	Argentina	Chile	Mexico	Argentina
1900-10	12.0	---	---	20.1	---	---	91.4
1910-20	0.7	---	---	24.5	---	---	56.8
1920-30	5.1	---	2.8	23.5	---	11.2	60.0
1930-40	3.7	---	3.8	29.7	---	13.0	65.9
1940-50	1.9	---	8.2	36.9	---	22.0	70.3
1950-60	2.1	---	7.0	34.2	---	32.9	62.5
1960-70	1.7	3.4	9.4	30.8	18.9	42.7	---
1970-80	2.1	-0.4	6.8	24.5	15.7	42.6	29.9
1980-90	0.6	-0.5	3.3	23.3	12.3	45.4	23.5
1990-93	---	2.4	---	25.3	---	42.4	---

TABLE 6
REGRESSION ESTIMATES FROM DATA POOLING 21 LATIN AMERICAN CROSS-COUNTRY OBSERVATIONS WITH AVERAGES FOR THREE DECADES
(data presented in Tables 1 and 4)

	Dependent variable	
	GDP/K growth rate	*TFP growth rate*
Constant	-0.96	-0.89
	(-3.05)	(-1.68)
dln (L/K)	0.17	
	(1.47)	
dln (ISK/K)	0.06	0.19
	(0.47)	(1.69)
R-squared	0.08	0.05
n (obs.)	63	63

Note: t-values within parenthesis under aech coefficient.

TABLE 7
REGRESSION ESTIMATES OF THE DIFFERENT MODELS OBTAINED IN TIME-SERIES REGRESSION MADE FOR ARGENTINA, CHILE, AND MEXICO

	Argentina (dependent variable)						*Chile (dependent variable)*				*Mexico (dependent variable)*		
Variables	*ln(GDP/K)*	*ln(GDP/K)*	*dln(GDP/K)*	*dln(GDP/K)*	*lnTFP*	*r(K)*	*ln(GDP/K)*	*dln(GDP/K)*	*dln(GDP/K)*	*lnTFP*	*ln(GDP/K)*	*dln(GDP/K)*	*lnTFP*
Constant	-3.28	-4.26	0.52	0.83	2.10	6.92	0.00	0.90	1.58	-0.21	0.49	-0.82	-1.39
	(-7.99)	(-5.11)	(0.89)	(1.05)	(10.56)	(4.21)	(0.00)	(0.56)	(1.30)	(-0.13)	(18.68)	(-1.11)	(-0.84)
ln(L/K)	-0.14	-0.70					0.25				0.50		
	(-1.91)	(-1.68)					(2.39)				(12.58)		
ln(ISK/K)	0.59	1.23					-0.21				0.71		
	(9.04)	(2.54)					(-3.52)				(46.58)		
dln(L/K)			0.46	-0.17				0.15				0.15	
			(2.17)	(-.42)				(0.59)				(1.17)	
dln(ISK/K)			0.14	0.93				0.14				0.80	
			(1.08)	(2.24)				(0.26)				(5.24)	
ISK/K						0.30							
						(5.07)							
lnISK					0.28				0.36				
					(14.49)				(2.58)				
dlnISK										0.97			0.43
										(1.48)			(1.85)
Rsquared	0.52	0.71	0.09	0.22	0.72	0.24	0.31	0.02	0.19	0.07	0.97	0.42	0.06
DW	0.12	0.31	1.81	1.99	0.14	0.07	0.85	1.74	1.09	2.07	0.33	2.22	1.99
n	84	39	82	38	84	84	31	30	31	30	65	64	60
Period		1944-85		1944-85									

Note: t-value within parenthesis under each coefficient.

TABLE 8
AVERAGE ANNUAL GROWTH RATES OF OUTPUT, TOTAL INPUTS, TFP, AND INFRA CAPITAL FOR AGRICULTURE IN LATIN AMERICAN COUNTRIES, 1950-1990, BY DECADE

Countries	*Variebles and decades*					
	Output	Total inputs	TFP	ISK1	ISK2	ISK3
			1950-1960			
Argentina	1.60	1.94	-0.34	0.04		
Bolivia						
Brazil	4.40	1.91	2.49	1.36		
Chile	1.80	4.33	-2.53	1.55	0.98	
Colombia	3.30	1.00	2.30	8.35	0.86	
Costa Rica						
Mexico	4.40	1.20	3.20	7.13	0.53	
Peru	2.00	0.96	1.04	0.53		
Venezuela	5.40	3.00	2.40	2.87		
			1960-1970			
Argentina	2.30	1.81	0.49	3.01	2.27	3.50
Bolivia	1.60		1.18	12.16	4.46	
Brazil	4.40	1.53	2.87	5.54	3.17	7.13
Chile	2.10	1.04	1.06	1.04	7.39	5.06
Colombia	3.50	2.48	1.02	1.13	1.44	5.62
Costa Rica	5.70	2.39	3.31	0.00	3.35	2.52
Mexico	3.80	0.54	3.26	1.99	5.29	4.80
Peru	3.20	1.07	2.13	9.48	4.72	4.11
Venezuela	5.30	3.20	2.10	2.98	5.89	4.34
			1970-1980			
Argentina	2.50	1.41	1.09	2.12	1.89	3.03
Bolivia	5.10	5.76	10.97	3.88		
Brazil	4.90		7.23	6.08	6.92	
Chile	1.90	0.14	1.76	0.62	5.34	1.43
Colombia	5.10	3.26	1.84	4.81	2.91	5.10
Costa Rica	2.80	1.36	1.44	8.90	9.72	7.59
Mexico	3.00			3.35	9.38	4.41
Peru	0.90	1.49	-0.59	0.48	6.82	3.00
Venezuela	4.00	3.00	1.00	6.94	8.70	5.39
			1980-1990			
Argentina	1.20			0.61		2.01
Bolivia	1.80			1.66		2.40
Brazil	2.60			5.37		3.81
Chile	5.60			0.08		2.71
Colombia	3.20			2.66		2.88
Costa Rica	3.50			6.81		4.00
Mexico	0.60			3.93		4.11
Peru	1.70			0.83		2.29
Venezuela	2.60			2.77		4.83

TABLE 9
STANDARD DEVIATION OF THE LOGARITHM OF THE PER CAPITA INCOME ACROSS STATES OR REGIONS FOR SOME LATIN AMERICAN COUNTRIES

Countries	*Years*	*Standard deviation*
Argentina	1884	0.308
	1953	0.374
	1985	0.334
Brazil	1939	0.507
	1980	0.577
Chile	1960	0.423
	1992	0.474
Mexico	1930	0.597
	1950	0.506
Peru	1970	0.399
	1989	0.367

Source : Regional income accounts.

TABLE 10
BASIC DATA USED FOR TIME-SERIES REGRESSIONS: ARGENTINA, 1900-93

Year	GDP *per capita* *1992 dollars*	ISI *(millons of 1992 dollars)*	ISK *(millons of 1992 dollars)*	TFP	ISK/K *(percent)*	r(K)	IST/ISI *(percent)*
1900	1,921	169	3,831	100.0	17.0	12.7	89.9
1901	2,024	300	3,963	103.7	16.4	12.9	93.8
1902	1,929	276	4,065	98.3	16.2	12.1	93.3
1903	2,152	356	4,242	108.7	16.1	13.3	85.4
1904	2,327	623	4,678	115.9	16.8	13.8	92.3
1905	2,557	1,178	5,651	123.7	18.3	14.1	92.2
1906	2,581	1,821	7,223	121.7	21.1	13.4	93.1
1907	2,511	2,395	9,300	115.2	24.1	12.1	93.9
1908	2,614	1,434	10,325	118.3	24.5	12.2	91.8
1909	2,610	1,559	11,430	116.4	24.9	11.7	88.7
1910	2,662	1,845	12,772	116.5	25.2	11.4	86.1
1911	2,585	1,868	14,087	111.6	25.6	10.7	86.7
1912	2,668	1,333	14,792	114.8	25.5	11.0	76.1
1913	2,560	1,628	15,769	110.2	25.9	10.6	70.5
1914	2,227	934	16,009	96.1	25.6	9.2	65.8
1915	2,187	338	15,643	95.2	25.0	9.3	58.3
1916	2,084	263	15,217	91.5	24.3	9.0	43.2
1917	1,882	242	14,790	83.4	23.9	8.3	33.7
1918	2,189	180	14,319	98.1	23.3	10.0	30.6
1919	2,229	203	13,892	100.9	22.8	10.4	17.4
1920	2,340	471	13,752	106.3	22.3	11.0	45.9
1921	2,339	651	13,798	106.4	21.8	11.1	53.6
1922	2,452	1,040	14,231	112.1	22.1	11.7	81.2
1923	2,627	1,186	14,790	119.4	21.9	12.4	60.7
1924	2,734	1,474	15,614	124.1	22.2	12.9	63.1
1925	2,643	1,604	16,531	119.8	22.8	12.4	51.0
1926	2,693	1,846	17,649	121.9	23.6	12.6	43.2
1927	2,803	2,018	18,891	126.3	24.2	12.9	56.4
1928	2,893	2,705	20,764	129.2	25.3	13.1	74.3
1929	2,945	2,833	22,684	130.0	26.2	12.9	73.0
1930	2,751	2,031	23,717	120.9	26.3	11.9	70.8
1931	2,503	1,286	23,959	110.7	26.4	11.0	50.2
1932	2,374	788	23,693	106.2	26.4	10.8	14.7
1933	2,442	1,001	23,652	110.1	26.4	11.3	44.8
1934	2,592	1,845	24,456	117.3	27.1	12.1	79.9
1935	2,661	2,442	25,822	120.9	28.4	12.6	82.2
1936	2,640	2,543	27,229	120.6	29.9	12.6	80.8
1937	2,782	3,770	29,801	127.0	32.1	13.3	87.3
1938	2,743	3,846	32,335	124.8	34.0	13.0	75.9
1939	2,803	2,593	33,506	127.7	34.8	13.3	72.4
1940	2,804	2,146	34,177	128.3	35.3	14.5	62.1
1941	2,903	2,395	35,069	131.8	36.3	15.1	70.1
1942	2,887	2,023	35,549	137.7	37.2	16.0	78.9
1943	2,821	1,608	35,593	136.0	37.7	16.1	75.2
1944	3,087	1,370	35,397	153.3	37.6	18.3	79.0
1945	2,937	1,357	35,196	149.9	37.4	18.1	69.9
1946	3,145	2,132	35,780	162.3	37.1	19.5	76.1
1947	3,432	4,962	39,167	183.3	38.1	21.5	64.3
1948	3,539	3,487	40,931	181.4	37.5	20.8	67.4
1949	3,403	2,070	41,200	171.7	36.4	19.5	59.9

TABLE 10
BASIC DATA USED FOR TIME-SERIES REGRESSIONS: ARGENTINA, 1900-93

Year	GDP *per capita* *1992 dollars*	ISI *(millons of 1992 dollars)*	ISK *(millons of 1992 dollars)*	TFP	ISK/K *(percent)*	r(K)	IST/ISI *(percent)*
1950	3,354	1,801	41,188	165.6	35.6	18.9	50.8
1951	3,371	2,260	41,636	167.1	34.7	19.0	55.5
1952	3,078	1,928	41,732	155.3	34.0	17.6	60.6
1953	3,180	2,266	42,162	160.7	33.6	18.2	67.4
1954	3,260	2,557	42,864	164.0	33.7	18.6	64.8
1955	3,330	2,827	43,805	172.1	33.5	19.5	75.7
1956	3,372			173.3		19.5	
1957	3,486			178.3		20.0	
1958	3,642			184.4		20.5	
1959	3,359			170.0		18.9	
1960	3,574			178.2		19.5	
1961	3,774			184.7		19.7	
1962	3,661			177.1		18.7	
1963	3,524		54,196	169.9	32.0	17.9	
1964	3,832	3,649	55,460	184.0	32.1	19.3	
1965	4,125	3,541	56,561	196.7	31.8	20.5	
1966	4,126	3,361	57,433	194.8	31.4	20.1	
1967	4,220	4,228	59,134	196.7	31.3	20.0	
1968	4,372	3,144	59,676	200.8	30.4	20.0	
1969	4,718	3,286	60,337	212.6	29.2	20.7	
1970	4,957	3,224	60,906	218.0	27.9	20.6	31.6
1971	5,060	3,391	61,617	222.5	26.7	20.4	31.3
1972	5,080	3,504	62,410	220.3	25.7	20.0	37.0
1973	5,180	3,594	63,258	228.3	25.1	20.4	37.9
1974	5,369	3,981	64,456	226.8	24.5	19.9	32.0
1975	5,249	4,080	65,700	227.4	24.0	19.7	17.1
1976	5,163	4,342	67,151	210.2	23.7	18.0	31.6
1977	5,405	5,994	70,190	207.6	23.5	17.4	25.1
1978	5,147	5,296	72,398	192.6	23.5	15.9	25.4
1979	5,421	4,291	73,503	208.8	22.8	16.9	29.7
1980	5,412	4,713	74,982	207.1	22.3	16.8	26.2
1981	4,983	4,327	76,100	191.4	22.1	15.4	22.1
1982	4,653	3,812	76,477	183.5	22.1	14.8	21.1
1983	4,718	3,913	77,025	188.1	22.1	15.4	23.9
1984	4,768	3,733	77,369	190.0	22.3	15.7	33.3
1985	4,490	2,979	76,944	177.5	22.7	15.0	27.0
1986	4,677	3,625	77,184	189.9	23.1	16.3	23.1
1987	4,706	6,437	80,224	193.6	24.2	16.9	13.6
1988	4,517	5,520	82,215	188.8	25.0	16.7	16.4
1989	4,252	2,513	81,110	177.0	25.2	16.0	28.7
1990	4,210	2,394	79,935	177.2	25.4	16.4	21.2
1991	4,388	1,583	78,001	192.3	25.2	18.1	17.8
1992				206.9		19.6	
1993				217.4		20.8	

TABLE 11
BASIC DATA USED FOR TIME-SERIES REGRESSIONS: MEXICO, 1900-93

Year	GDP (millions of 1950 dollars)	GDP per capita (1950 dollars)	ISI (millions of 1950 dollars)	ISK (millions of 1950 dollars)	ISKT (millions of 1950 dollars)	Irrigation (thousand hectares)	Energy Gen. Cap. (1,000 kW)	Railroad Tracks (km)	Paved Roads (km)	Telephone (1,000 units)	ISKT/ ISK	ISK/K (percent)
1900	9,891	727										
1901	10,741	781										
1902	9,975	717										
1903	11,092	789										
1904	11,287	794										
1905	12,460	868										
1906	12,319	848										
1907	13,042	889										
1908	13,022	878										
1909	13,405	894										
1910	13,524	892					110					
1911												
1912												
1913												
1914												
1915												
1916												
1917												
1918												
1919												
1920							120					
1921	14,560	1,016							241			
1922	14,899	1,023										
1923	15,411	1,041										
1924	15,159	1,008										
1925	16,102	1,054	309.4	4,656	3,632						78.0	11.1
1926	17,335	1,116	443.4	4,867	3,785						77.8	11.3
1927	16,932	1,073	366.0	4,990	3,867						77.5	11.3
1928	17,240	1,075	373.6	5,114	3,946				241		77.2	11.3
1929	16,666	1,023	369.8	5,228	4,021				289		76.9	11.3
1930	15,538	939	388.7	5,356	4,123	20	510		541		77.0	11.4
1931	16,106	956	395.7	5,484	4,222	37			620		77.0	11.7
1932	13,494	788	339.5	5,550	4,267	58			645		76.9	12.2
1933	14,943	857	369.6	5,643	4,332	131			683		76.8	12.5
1934	15,927	898	403.3	5,764	4,424	149			1,183		76.8	12.7
1935	17,039	945	563.8	6,040	4,586	160			1,559		75.9	13.1
1936	18,491	1,008	651.2	6,389	4,832	180			2,007		75.6	13.6
1937	19,120	1,024	627.5	6,697	5,049	189	629		2,316		75.4	13.7
1938	19,473	1,025	607.4	6,970	5,221	201	629		3,004		74.9	14.3
1939	22,300	1,154	725.9	7,347	5,410	222	680		3,755		73.6	14.9
1940	22,600	1,150	878.8	7,859	5,600	267	681		4,781	180	71.3	15.5
1941	24,800	1,228	957.4	8,243	5,856	306	681		5,420	181	71.0	16.4
1942	26,300	1,267	1,195.9	9,198	6,341	446	682		6,082	191	68.9	18.5
1943	27,500	1,290	1,213.7	9,952	6,849	528	680		6,910	200	68.8	20.2
1944	29,700	1,356	1,144.6	10,600	7,082	597	709		7,683	207	67.8	21.5
1945	30,500	1,355	1,327.1	11,397	7,572	624	720		8,163	216	66.4	23.0
1946	32,300	1,396	1,563.4	12,391	8,022	816	893		8,614	224	64.7	24.4
1947	33,500	1,409	1,683.8	13,455	8,497	937	957		9,071	240	63.2	25.5
1948	35,000	1,433	1,845.3	14,627	8,884	1,041	1,040		10,562	254	60.7	26.7
1949	37,100	1,478	2,140.0	16,036	9,274	1,123	1,097		12,059	272	57.8	28.2

TABLE 11
BASIC DATA USED FOR TIME-SERIES REGRESSIONS: MEXICO, 1900-93

Year	GDP (millions of 1950 dollars)	GDP per capita (1950 dollars)	ISI (millions of 1950 dollars)	ISK (millions of 1950 dollars)	ISKT (millions of 1950 dollars)	Irrigation (thousand hectares)	Energy Gen. Cap. (1,000 kW)	Railroad Tracks (km)	Paved Roads (km)	Telephone (1,000 units)	ISKT/ ISK	ISK/K (percent)
1950	40,577	1,573	2,672.0	17,906	9,890	1,187	1,235	23,329	13,585	285	55.2	30.4
1951	43,621	1,641	2,287.1	19,298	10,333	1,242	1,400	23,397	14,980	305	53.5	30.6
1952	45,366	1,656	2,550.5	20,884	10,888	1,442	1,572	23,301	16,032	317	52.1	31.2
1953	45,618	1,615	2,439.3	22,279	11,368	1,584	1,701	23,283	16,945	335	51.0	32.0
1954	50,391	1,731	3,033.4	24,198	11,867	1,746	1,850	23,370	17,607	354	49.0	33.3
1955	54,767	1,825	2,813.0	25,801	12,177	1,908	1,930	23,425	18,528	365	47.2	33.9
1956	58,214	1,882	2,787.2	27,298	12,516	2,086	2,069	23,383	19,568	391	45.8	33.7
1957	62,708	1,967	3,291.2	29,225	12,976	2,165	2,270	23,383	21,516	422	44.4	34.1
1958	66,177	2,013	3,465.8	31,229	13,506	2,190	2,560	23,457	23,459	453	43.2	34.7
1959	68,119	2,011	3,614.8	33,238	14,146	2,221	2,879	23,293	24,816	491	42.6	35.3
1960	73,482	2,104	4,427.1	36,046	14,767	2,262	3,021	23,369	27,331	532	41.0	36.4
1961	76,038	2,101	5,419.0	39,663	15,329	2,305	3,275	23,487	28,937	569	38.6	38.1
1962	79,691	2,129	5,553.1	43,233	14,701	2,342	3,564	23,501	29,717	618	34.0	39.7
1963	84,700	2,187	7,051.5	48,122	15,588	2,403	4,243	23,793	31,477	664	32.4	41.8
1964	93,200	2,327	8,378.7	54,096	16,509	2,440	4,892	23,618	33,186	730	30.5	43.8
1965	98,200	2,370	6,270.5	57,662	17,321	2,479	5,311	23,672	34,431	828	30.0	43.7
1966	105,600	2,464	7,341.1	62,119	17,849	2,542	5,707	23,826	36,122	932	28.7	44.0
1967	112,400	2,535	9,712.6	68,726	19,220	2,599	5,801	23,977	37,355	1,050	28.0	45.2
1968	120,400	2,625	10,549.3	75,839	20,728	2,699	6,381	24,129	38,861	1,182	27.3	46.3
1969	129,100	2,721	11,623.6	83,671	22,248	2,782	6,894	24,120	40,374	1,334	26.6	47.4
1970	137,954	2,726	7,960.0	87,447			7,495	24,468	42,754	1,549		46.0
1971	142,691	2,725	7,848.0	90,923								44.9
1972	153,074	2,824	8,878.0	95,255								43.9
1973	164,717	2,983	9,718.0	100,210								42.7
1974	174,450	3,071	10,293.0	105,493								41.4
1975	181,585	3,106	11,621.0	111,839								40.5
1976	185,423	3,083	12,052.0	118,299								40.1
1977	191,476	3,094	14,935.0	127,319								40.8
1978	205,467	3,227	19,519.0	140,472								42.2
1979	221,866	3,387	22,630.0	156,079								43.2
1980	238,299	3,536	24,306.0	172,581								43.7
1981	257,223	3,725	31,124.0	195,076								44.8
1982	255,813	3,614	26,093.0	211,415								45.8
1983	246,760	3,401	16,286.0	217,130								46.0
1984	255,534	3,440	16,865.0	223,139								46.2
1985	262,094	3,447	17,298.0	229,280								46.1
1986	251,726	3,236	16,362.0	234,178								46.3
1987	256,663	3,227	13,346.0	235,815								45.8
1988	259,751	3,194	12,988.0	237,012								45.2
1989	268,223	3,228	12,875.0	238,036								44.5
1990	280,847	3,308	13,762.0	239,896								43.6
1991	291,023	3,354	13,387.0	241,288								42.5
1992	299,117	3,374	12,563.0	241,787								41.0
1993	300,501	3,317	NA	NA								

TABLE 12
BASIC DATA USED FOR TIME-SERIES REGRESSIONS: CHILE, 1960-93

Year	GDP (million 1993 dollars)	GDP per capita (1993 dollars)	TFP	ISI (million 1993 dollars)	ISK (million 1993 dollars)	K (million 1993 dollars)	L (thousand persons)
1960	15,864	2,084	100.0	300	5,075	25,280	2,494
1961	16,845	2,160	102.2	390	5,211	26,672	2,549
1962	17,686	2,215	103.4	420	5,371	28,072	2,605
1963	18,520	2,264	106.4	450	5,552	29,268	2,663
1964	19,296	2,303	107.1	470	5,745	30,980	2,723
1965	20,259	2,361	108.7	600	6,057	32,388	2,783
1966	21,686	2,476	112.6	600	6,354	33,756	2,843
1967	22,195	2,483	112.0	530	6,567	35,096	2,888
1968	22,839	2,503	112.4	520	6,758	36,612	2,901
1969	24,152	2,594	114.9	525	6,945	38,224	2,961
1970	26,117	2,748	120.2	500	7,098	40,000	3,011
1971	27,509	2,844	124.7	475	7,218	41,464	2,967
1972	27,284	2,772	121.3	245	7,102	42,748	2,980
1973	27,305	2,727	123.7	440	7,187	43,536	3,016
1974	28,508	2,800	131.6	645	7,473	44,748	2,841
1975	25,878	2,500	92.1	220	7,319	45,284	3,115
1976	26,985	2,569	96.9	250	7,203	45,492	3,182
1977	29,640	2,780	105.4	220	7,063	45,976	3,199
1978	32,074	2,964	110.9	275	6,985	46,816	3,477
1979	34,729	3,163	121.3	280	6,916	48,032	3,478
1980	37,162	3,334	121.3	250	6,820	49,844	3,636
1981	39,154	3,455	124.0	280	6,759	51,840	3,688
1982	33,401	2,989	107.8	247	6,668	52,072	3,504
1983	32,516	2,774	104.0	248	6,583	51,872	3,700
1984	34,468	2,892	107.3	260	6,513	51,892	3,896
1985	35,293	2,911	106.8	265	6,453	52,304	4,091
1986	37,058	3,006	104.7	320	6,450	52,908	4,092
1987	39,184	3,123	108.6	300	6,428	53,968	4,172
1988	42,067	3,300	112.8	350	6,456	55,466	4,330
1989	46,270	3,570	120.2	350	6,483	57,562	4,455
1990	47,261	3,586	119.6	348	6,507	60,127	4,523
1991				400	6,582		
1992				485	6,738		
1993				600	7,001		