Review of Income and Wealth
Series 38, Number 4, December 1992

CAPITAL ACCUMULATION IN LATIN AMERICA: A SIX COUNTRY COMPARISON FOR 1950-89

BY ANDRÉ A. HOFMAN

ECLAC

This article provides estimates of gross and net fixed capital stock for six Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela for 1950-89. The capital stocks have been generated using the perpetual inventory method. To use the perpetual inventory method, historical time series of gross fixed investment, broken down into machinery and equipment, residential and non-residential structures were estimated. The diskette accompanying the article contains a detailed description of the sources and series used and for each country, long-term series (1900-89) of GDP at constant 1980 national prices, GDP at constant 1980 international dollars, population, GDP *per capita* and gross total and disaggregated investment in national currencies and as a percentage of GDP. The diskette also contains a complete set of net and gross capital stock estimates, average ages, average service life and capital-output ratios for 1950-89 each in national currencies and international dollars.

The findings show rising capital-output ratios in most countries, except for Chile, where it remains more or less constant, and Colombia, where the ratio falls.

I. INTRODUCTION

The lack of comparable estimates of fixed capital stocks between different Latin American countries has, for a long time, hindered the analysis of economic development within the region and comparison with other developing and developed countries. This article tries to fill part of this gap by providing estimates of gross and net fixed capital stock for six Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela. These are part of an ECLAC project on long-term economic development of Latin America using a growth accounting framework. The capital stock estimates will be related to other variables such as employment but, here we restrict ourselves to the presentation of the total capital stock series.

The estimates have been generated by employing the "Perpetual Inventory" technique currently used by most OECD countries to estimate their capital stocks

Note: The author is a staff member of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). The views expressed in this article are his responsibility and do not necessarily reflect those of the United Nations.

I am especially grateful to Angus Maddison for his help and encouragement during all phases of the investigation. Sergio Zamora was of great assistance during the initial phase and Nanno Mulder helped in the final stage of the study.

At ECLAC, I am grateful to Oscar Altimir and to the late Fernando Fajnzylber, who helped to launch the investigation, and to Gloria Bensan, Mario Castillo, Mikio Kuwayama, Mario La Fuente, Juan Mediano, Marcelo Ortúzar, Mónica Roeschmann and José Miguel Villa, for their valuable support in the gathering and interpretation of the data.

I received useful comments from Ricardo Bielschowski, Derek Blades, Ricardo Ffrench-Davis, Felipe Jiménez, Mark Keese, Elio Londero, John Musgrave, Dirk Pilat, Víctor Urquidi and Michael Ward and from participants of seminars in ECLAC and the University of Groningen. Alan Heston kindly provided the purchasing power parities for Latin America.

and therefore the most appropriate in an international comparison. The analysis is concentrated on the methodology and results for Latin America, but also includes a comparison with the U.S.A., using the same methodology.[1]

In spite of both the theoretical and practical difficulties with respect to the use, estimation and meaning of capital stock estimates, they continue to be extensively employed and are useful for many kinds of analysis, such as growth accounting, productivity analysis, economic forecasting, studies of cyclical fluctuations and of the relationship between capital, output and labour and the role of technical progress.

In the past several efforts have been made to estimate capital stocks in Latin America.[2] However no official time series of capital stock figures are prepared on a regular basis and the existing unofficial estimates have been made by autonomous researchers and institutes. This explains the great differences in methodology and coverage. These estimates can be useful for various types of analysis within each country, but are difficult to use for international comparisons because of differences regarding definitions and assumptions with respect to GDP, capital formation and its disaggregation, the use of initial stocks, the length of asset lives, retirement patterns (i.e. distribution of service lives around the mean life), and differences in the relative prices of assets.

As more and better data are now available, the United Nation's Economic Commission for Latin America and the Caribbean (ECLAC) considers it useful to make new capital stock estimates for Latin America, using a common methodology which makes comparisons possible within the region and with other developing and developed countries.

II. Methodology

There are basically two methods, each with its variations, to estimate capital stocks: (a) direct measurement of the capital stock for a bench-mark year, through different types of surveys such as of physical assets, insured values or company book values or direct estimation on the basis of stock exchange values, (b) by cumulating historical series on past investment and deducting assets which are scrapped, written off or destroyed by war.

The second method is widely known as the "Perpetual Inventory Method" pioneered by Raymond Goldsmith (1951). In this article annual fixed capital stock estimates are presented which were computed for the 1950-89 period based on a perpetual inventory model.[3] Our preference for the perpetual inventory model is based upon the fact that it uses a methodology which facilitates international comparisons and because it produces figures with clearer meaning because all the hypotheses and clculations are transparent and consistent and permit analysis of the structure and age distribution of the capital stock. It is

[1]The estimates for the U.S.A. come from the worksheets of Angus Maddison (1991) and have been slightly adjusted for changes in the bench-mark year from 1985 to 1980 and for the use of somewhat different asset service life assumptions.

[2]For an overview of existing estimates of capital stocks in Latin America see the corresponding chapter in the (forthcoming) ECLAC publication "Long Run Growth in Latin America."

[3]The description of this model is based upon Michael Ward (1976a).

now generally used in official estimates, sometimes combined with direct estimates of the initial stock, e.g. the Japanese statisticians use a postwar wealth survey bench-mark.[4]

Capital assets considered consist of the various durable goods that are included in gross fixed capital formation in the national accounts. Generally the countries in this study follow the recommendations of the United Nations classification (United Nations, 1968) where gross fixed capital formation is defined as the outlays (purchases and own-account production) of industries, producers of government services and producers of private nonprofit services to households, on additions of new durable goods (commodities) to their stocks of fixed assets less their net sales of similar second-hand and scrapped goods. Excluded are the outlays of government services on durable goods for military use. In general, the goods included are durable (lasting more than one year), tangible (intangible assets like patents and copy-rights are excluded), fixed (inventories and work in progress are excluded) and reproducible (natural forests, land and mineral deposts are excluded).[5]

We have separated capital formation by three asset types—residential and non-residential structures and machinery and equipment. For each separate asset type we have estimated fixed capital stocks on the basis of past investment.

In this article we present estimates of both gross and net fixed capital stocks. This makes it possible to differentiate between "ex-post" and "ex-ante" notions of capital, i.e. between actual and expected contributions of capital to production.[6]

This study forms part of a research project in which these capital stock estimates are used for the explanation of the economic performance of the six Latin American countries in comparisons with a sample of other developing and developed countries for the 1950–89 period. Therefore, capital has been used, in that study, in its "*ex post*" notion, its observable role as a factor input in already realized production.

The capital stocks have been valued at constant 1980 prices and the accompanying diskette contains a library documentation file with a description of sources and methodology for all series of GDP and investment used. GDP and capital stocks were then converted to international dollars by the International Comparison Project (ICP) PPP's rather than exchange rates.[7] Separate PPP's for GDP, investment in residential structures, non-residential structures and machinery and equipment have been used.

The perpetual inventory method (PIM) estimates capital stock as a weighted sum of past gross investment flows. This involves the estimation of an initial capital stock consisting of the sum of past investment during the assumed life-times of the different asset categories. This initial stock can easily be updated on a yearly basis adding investment during the year and subtracting investment in

[4]See Angus Maddison (1991), Appendix D.

[5]See Derek Blades (1989), p. 3.

[6]See Ward (1976a), pp. 19–20.

[7]The ICP was a joint responsibility of the United Nations Statistical Office, the World Bank, and the International Comparison Unit of the University of Pennsylvania. Alan Heston kindly provided the 1980 PPP's for GDP and capital formation for the Latin American countries (including Mexico) which were somewhat revised as compared to the ones published in United Nations and Eurostat (1987).

assets that are withdrawn. The related net capital stock estimate can be obtained by applying an appropriate capital consumption coefficient to the gross capital formation values in the relevant period, or by deducting derived cumulated capital consumption estimates from the gross capital stock series.

To be able to use the perpetual inventory method, historical time series of gross fixed investment were needed over a long period of time, basically since 1900. These time series, which are especially long for Latin America where in many cases official series do not go back further than 1950, were needed for GDP and gross fixed investment broken down into machinery and equipment, residential and non-residential structures.

The precision of the model depends primarily on the accuracy of these basic data. In the library documentation file on the diskette accompanying this article we therefore present a detailed description of the sources and series used for each country. The diskette also contains tables for each Latin American country which present long term series (1900–89) for GDP at constant 1980 national prices, GDP at constant 1980 international dollars, population and GDP *per capita*. Also Tables with long term (1900–89) gross total and disaggregated investment in national currencies and as a percentage of GDP are presented. At the same time this diskette contains the explanation of procedures applied in case no series were available and we had to construct them. For most of our countries it was relatively easy to obtain information from 1925 (except for Venezuela where time series were only available from 1937) although, for example, investment in residential construction presented problems for the whole period in some countries. However, for the period 1900–25 we were obliged to construct most of the basic series.

We have assumed a working life of 50 years for residential structures, 40 years for other structures and 15 years for machinery and equipment, for all countries, over the entire period. These assumptions seem realistic for non-residential structures and machinery and equipment. Several countries use asset life estimates which come close to ours (e.g. the asset lives which the BEA uses are on the average practically the same as ours, although the official U.S. estimates are more finely disaggregated). In the case of residential structures the asset life of 50 years is probably rather low, but it is practically impossible to obtain data regarding investment in residential structures before 1900 in Latin America and therefore we have adopted the 50 years asset life assumption.[8] The objective of this study was to generate capital stocks for the 1950–89 period. In order to be able to generate the initial total capital stock for 1950, capital formation in machinery and equipment was needed since 1935, in non-residential construction since 1910 and in residential construction since 1900.

One characteristic of the perpetual inventory method is that errors in the estimates of early investment become progressively less important as such investment represents a diminishing proportion of the current total stock in existence.

[8]The official estimate of the U.S. Department of Commerce (1987), uses a service life of 80 years for new, 1–4 unit structures and 65 years for new, 5 or more unit structures. However, for additions, alterations, major replacements and some other items service lives are much lower so the average service life might be well below 80 or even 65 years.

The model described above produces a "capacity stock" of capital.[9] This includes all capital assets, but some of these may be temporarily idle and others may have been withdrawn from production and held in reverse in case they are needed to meet an unexpected rise in demand. So the PIM will not produce estimates of the "utilized stock." The service lives used in this method refer to the total length of time from the initial installation of assets to the moment when they are finally scrapped. Clearly these lives may include periods when the assets are not being used to produce anything.

Together with the above mentioned working lives for the assets we have assumed a rectangular retirement pattern, that is, assets are completely scrapped after serving their respective lives (15, 40 and 50 years). These assumptions about the mortality function and the fixity of service life have been adopted for reasons of data availability, transparency and simplicity.

Blades analyses these different assumptions in detail. In our model we use a simultaneous exit mortality function which is also still in use in Canada, Japan and Norway. Simultaneous exit may be regarded as a limiting case of a bell-shaped function which Blades considers the only plausible candidate for a mortality function and although its assumptions are clearly unrealistic, i.e. all assets of a given vintage disappear simultaneously, its results are not very different from the bell shaped.[10]

A major problem in this kind of research is the estimation of the length of life of the capital assets. Not much empirical information about service life is available, especially not in Latin American countries.[11] Changing service life assumptions not only affects the estimated size of the capital stock, but also affects its rate of growth. We have applied a uniform constant 50, 40 and 15 years of asset life (in residential structures, non-residential structures and machinery and equipment respectively).

Another aspect is whether or not the average service lives remain constant in time as we have assumed. The service life of a given type of asset almost certainly varies both between different users and from one period to another. When business conditions are favourable assets will be used more intensively and discarded sooner. Blades concludes that: "There is, however, no evidence of any secular tendency for given types of assets to be retained in production for longer or shorter periods."[12] Of course this does not mean that the average service life of the aggregated capital stock also remains constant because this also depends on the distribution of the different assets in the stock.

For developing, especially Latin American, countries these length of life assumptions may be critical as they are often not only related to technological and economic considerations but also to shortages of foreign exchange and the absence of regular repairs and maintenance because of budgetary constraints. Furthermore the obsolescence of capital seems to be less significant than the collapse of the product market in determining both use and utilization rates.

[9]See Colin Campbell (1977), quoted in Blades (1989), p. 6.
[10]See Blades (1989), Figure 2, p. 25.
[11]Well-known studies regarding the U.S.A. are the studies by Terborgh (1954) and Winfrey (1935).
[12]See Blades (1989), p. 39.

Future research should clarify the relative importance of these issues in Latin American capital stock estimates.

For the calculation of net capital stock one has to define a depreciation function for allocating the cost of the asset over its service life. Actually there exists no agreement over this depreciation function, but in the literature two approaches prevail. The first is the straight-line pattern of depreciation in which the efficiency declines linearly over the life-time of the capital good. A second method, also used with some frequency is the so-called declining balance depreciation in which efficiency of the capital good declines geometrically.

In order to obtain the net capital stock in this study we have chosen the first method, assuming that the capital services are used up in equal installments over time, i.e. applying straight-line depreciation over the working life of the different types of assets. We also assumed that the obsolescence value at the end of the economic life of the capital good is zero, which is of course often not the case, but this treatment of obsolescence greatly simplifies the calculating procedure. This procedure is used in several of the OECD countries for the estimation of net capital stock, but other definitions of depreciation for allocating the cost of the asset over its service life can be used.

A model layout for capital stock estimation was developed to make all procedures transparent and to facilitate the replication of these results by other researchers (see Tables 1-3 of Annex A). We also give the algebra of our procedures. In Table 1 of Annex A an example is presented of the procedure for estimating alternative bench-mark capital stocks in non-residential structures as of 31 December 1949. This procedure is the same for each country. Also the procedure is the same for each category of investment except that in the case of residential capital stock the series start in 1900 and in the case of machinery and equipment in 1935.

In order to go step-by-step through this example we use capital stock estimation in non-residential structures in Argentina. The gross gross-increment to capital stock of column 3 results from the multiplication of GDP at 1980 constant prices in column 1 and the ratio of total gross fixed investment in construction to GDP at constant prices in column 2. End 1949 gross fixed capital stock in construction equals the sum of 1910–49 gross fixed investment or gross increments to capital stock as given in column 3.

The initial end year gross capital stock was calculated as follows:

$$GGI_t^i = a_t^i * GDP_t \tag{1}$$

where:

$$GK_b^i = \sum_{m=b-\theta+1+j}^{b} GGI_m, \qquad j = 0, \ldots, (\theta - 1). \tag{2}$$

GGI_t^i = Gross Increment to Capital Stock of asset i during period t,

GDP_t = Gross Domestic Product in t,

GK_b^i = Gross Initial Capital Stock of asset i at b,

a_t^i = Ratio of Total Gross Fixed Investment of asset i to GDP at constant prices in t,

b = Initial year,

θ = Length of life of asset i,

i = Type of asset,

t = Time.

Column 4 presents the annual depreciation provision based upon straight-line depreciation which means that, in each year in which depreciation takes place, 1/40th of gross investment is depreciated. Column 5 gives the yearly components of depreciated capital formation remaining by end 1949, corresponding to 1/40th for 1910, 2/40th for 1911, etc. End 1949 net stock consists of the sum of 1910–49 components of depreciated capital formation which equals 1910–49 sum of column 5. Net mid-year capital stock was calculated as follows:

$$D_t^i = \frac{1}{\theta} \sum_{m=t+1-\theta}^{t} GGI_m^i \tag{3}$$

$$NK_b^i = \sum_{m=b-\theta+1+j}^{b} \frac{(1+j)}{\theta} * GGI_m^i \tag{4}$$

where:

D_t^i = Depreciation of asset i during t,

NK_b^i = Net Initial Capital Stock of asset i at b.

This procedure of benchmark year capital stock estimation can of course also be used to estimate the 1950–89 end year net and gross capital stocks. Alternatively the procedures which are detailed in Tables 2 and 3 of Annex A can be applied. In these tables capital stock estimates for the 1950–89 period are elaborated. In Table 2, 1950 end year gross capital stock (column 6) equals the bench-mark end year 1949 capital stock plus the gross gross increment in capital stock in 1950 as given in column 3 minus retirement of gross gross increment to capital stock of 40 years ago (column 4). The 1950 end year net stock equals the 1949 stock plus the gross gross increment to capital stock (column 3) minus annual depreciation (column 7). The respective net and gross end year capital stock series were calculated as follows:

$$GK_t^i = GK_{t-1}^i + GGI_t^i - GGI_{t-\theta}^i \qquad (t > b), \tag{5}$$

$$NK_t^i = NK_{t-1}^i + GGI_t^i - D^i t, \tag{6}$$

where:

GK_t^i = Gross Capital Stock of asset i and t

NK_t^i = Net Capital Stock of asset at t.

Columns 10 and 11 of table A2 present average ages of gross and net capital stocks respectively and in columns 12 and 13 the end-year gross and net capital stock estimates are brought to a mid-year basis. Column 14 gives the average of mid-year net and gross capital stocks. The formulas for the calculation of average age and re-adjustment to mid-year are given below.[13] Finally the formulas for

[13]The calculation procedure comes from Ward (1976a), p. 58 who calls this the approximate method.

total gross and net capital stock aggregation and total gross and net capital stock average age calculation are presented.

$$(7) \qquad AAGK_t^i = \frac{\sum_{m=t-\theta+1+j}^{t} (\theta - j) * GGI_m}{GK_t^i}, \qquad j = 0, \ldots (\theta - 1),$$

$$(8) \qquad AANK_t^i = \frac{\sum_{m=t-\theta+1+j}^{t} (j+1)/\theta * (\theta - j) * GGI_m}{NK_t^i};$$

$$(9) \qquad GMK_t^i = \frac{GK_{t-1}^i + GK_t^i}{2};$$

$$(10) \qquad NMK_t^i = \frac{NK_{t-1}^i + NK_t^i}{2};$$

$$(11) \qquad TGK_t = \sum_{i=1}^{n} GK_t^i;$$

$$(12) \qquad TNK_t = \sum_{i=1}^{n} NK_t^i;$$

$$(13) \qquad AAGK_t = \frac{\sum_{i=1}^{n} AAGK_t^i * GK_t^i}{TGK_t};$$

$$(14) \qquad AANK_t = \frac{\sum_{i=1}^{n} AANK_t^i * NK_t^i}{TNK_t};$$

where:

$AAGK_t$ = Average Age of Gross Capital Stock of asset i in t;

$AANK^it$ = Average Age of Net Capital Stock of asset i in t;

GMK_t = Gross capital stock, mid-year t;

NMK_t = Net capital stock, mid-year t;

TGK_t = Total Gross Capital Stock in t;

TNK_t = Total Net Capital Stock in t;

$AAGK_t$ = Average Age of Total Gross Capital Stock in t;

$AANK_t$ = Average Age of net Capital Stock in t;

n = Number of assets i.

III. Results

In the tables on the diskette a complete set of net and gross capital stock estimates are presented for each country: i.e. Gross and Net Reproducible Capital Stocks by Type of Asset, 1950–89 at constant 1980 national prices; Gross and Net Capital Stocks by Type at constant million 1980 international dollars; Ages, Service Lives and Capital-Output Ratios, 1950–89 on the basis of national

currencies and Ages, Service Lives and Capital-Output Ratios calculated on the basis of international dollars.

1. *Comparison of National and Standardized Estimates*

In a previous paper a detailed comparison of the existing capital stock estimates in Latin America was made, see Hofman (1990). Table 1 presents a confrontation of these national estimates with our standard capital stock. In this table we only present the most recent estimates. The existing estimates have been elaborated for different time periods and we present those closest to our benchmark years. For Argentina the Goldberg/Ianchivolici (1986) article is an excellent study which is also the only existing estimate completely based upon the perpetual inventory method. The differences withour standardized estimates are mainly caused by the much higher assumptions regarding service lives of assets. As a result the Secretaría de Planificación (1991) study, which is an up-date of the Goldberg/Ianchivolici (1986) study, has higher fixed capital stock levels and lower growth rates than our estimate.

In the case of Brazil, estimates of Goldsmith (1986) and Langoni (1974) were included. The Goldsmith estimate is largely based upon the study by Langoni which is one of the few concerned with the problem of fixed capital stock estimation in Brazil. However Langoni's initial fixed stock estimate seems rather high and the falling capital-output show a tendency contrary to ours. The tendencies of the capital-output ratio in the Chilean case coincide with ours in the Haindl/Fuentes (1986) study and also largely in the case of the Urrutia study, but again the initial stock estimate based, in both cases, upon a methodology developed by Harberger (1976), is rather high.

In Colombia the estimates of Harberger (1976) concide largely with ours in levels as well as in tendency of capital-output ratio; the more recent estimates of Henao (1983) show much higher levels and a clear downward tendency of the capital-output ratio. Finally the Mexican estimates by the Banco de Mexico (1969 and 1985) show very distinct levels and tendencies and are by the lack of methodological information very difficult to interpret.

2. *Exchange Rates and Purchasing Power Parities*

A very crucial element in international comparisons is how to convert estimates in local currencies to estimates expressed in a common currency, either existing e.g. the U.S. dollar or fictive such as the concept of constant 1980 international dollar.[14] The use of exchange rates as the conversion factor is the easiest and most direct way, but since the official exchange rate basically reflects the purchasing power of tradable goods and services and does not include the non-tradables, it may give rise to distortions.[15] These distortions may be small,

[14]Dollar with the same purchasing power parity over total GDP as the U.S. dollar, but with a purchasing power over subaggregates and over detailed categories determined by average international prices rather than by U.S. relative prices.

[15]The exchange rates normally used are the (rf) series of the IMF, published in *International Financial Statistics*, various editions, which refer to period averages of market exchange rates for countries quoting in units of national currency per U.S. dollar.

TABLE 1

A CONFRONTATION OF OUR ESTIMATES OF FIXED CAPITAL STOCKS WITH EXISTING ESTIMATES ON THE BASIS OF GROSS AND NET CAPITAL-OUTPUT RATIOS, 1950–89

(On the basis of national currencies)

	Argentina			
	Our Estimates		Goldberg/Ianchilovici (1986)	
	Gross	Net	Gross	Net
1973	3.4	2.2	3.8	2.4
1980	3.8	2.5	4.2	2.7
1986	4.5	2.7	4.9	3.2

	Brazil			
	Our Estimates		Langoni (1974)	Goldsmith (1986)
	Gross	Net	Net	Net
1952	1.6	1.1	2.5	1.9
1968	2.0	1.4	2.2	2.0
1980	2.4	1.8		2.0

	Chile			
	Our Estimates		Urrutia (1983)	Haindl/Fuentes (1986)
	Gross	Net	Net	Net
1950	3.2	2.0	2.8	
1973	3.6	2.3	2.8	3.0
1980	3.3	2.0	2.4	2.6
1984	3.8	2.2		3.0

	Colombia			
	Our Estimates		Harberger (1976)	Henao (1983)
	Gross	Net	Net	Net
1952	2.8	1.8	2.0	3.3
1967	2.7	1.6	1.9	2.7
1973	2.4	1.5		2.2
1980	2.4	1.5		2.2

	Mexico				
	Our Estimates		(1969)	Banco de Mexico Diskettes (1985)	
	Gross	Net	Net	Gross	Net
1950	1.7	1.2	2.6		
1967	2.2	1.6	2.2	0.5	0.3
1973	2.4	1.7		0.5	0.3
1980	2.6	1.8		0.5	0.3
1985	3.2	2.2		0.6	0.3

Source: National Sources and Hofman (1990).

as is probably the case between two very open economies such as The Netherlands and Belgium, but can also be quite large in the case of low-income developing countries. Since the aim of the present study is to make internationally comparable estimates of capital stocks and also purchasing power parities with respect to the constituent parts, non-residential and residential construction and machinery and equipment, are necessary as capital stocks normally consist in part of tradables, especially machinery and equipment which in the case of Latin American countries is purchased, in great part, from abroad and partly of non-tradables. It is for this reason that the use of purchasing power parities instead of official exchange rates are the most appropriate conversion factor. However purchasing power parities are only available for a limited number of countries for a limited number of years.

In Latin America the first attempts to estimate real income and purchasing power parities date from the late 1940s under the influence of the pathbreaking study of Colin Clark (1957). One of the earliest was an interesting, but not very well-known study conducted at the Inter-American Statistical Institute under the technical guidance of Simon Kuznets, Dominguez (1947), using PPP's to convert 1940 national income estimates into dollars. The national income data available at that time were not very reliable and the basket of goods compared to estimate a PPP consisted only of 12 items, all of them food. Despite the shortcomings of the study it provided a rough estimate of real income levels and gave an indication of the range of income disparities within Latin America and compared with the U.S.A. At the Economic Commission for Latin America and the Caribbean (ECLAC), the first estimates of real income in dollars were made for the 1945–52 period, ECLAC (1954).[16] However the methodology used was not yet very rigorous and was based partly upon a United Nations (1950) study which calculated dollar estimates of real income on the basis of projections of exchange rates of a "normal" period and partly on arbitrary estimates of economists who were familiar with price levels and living standards in Latin American countries. The first systematic effort to calculate purchasing power estimates in Latin America was the pioneering study of ECLAC (1963) conducted by Stanley Braithwaite. Towards the end of the 1960s ECIEL, a research programme of comparative studies on economic integration, initiated an international comparison project on the same lines as the ECLAC study.[17] Finally during the 1970s and the 1980s ECLAC and ECIEL cooperated with the different phases of the International Comparison Project (ICP), initially a joint effort of the United Nations and the World Bank and, during later phases, also of the Statistical Office of the European Communities (EUROSTAT) and the Organization for Economic Cooperation and Development (OECD).

In Table 2 we present the exchange rate and the purchasing power parities (PPP's) prepared during different phases of the ICP project from 1970–85. We also give the adjusted exchange rates used in 1980 by ECLAC and World Bank for conversion to dollars. For 1980, our bench-mark year, we compare the PPP's

[16]Better known under the Spanish acronym CEPAL.

[17]Spanish acronym standing for: Programa de *E*studios *C*onjuntos sobre la *I*ntegración *E*conómica *L*atinoamericana.

TABLE 2

EXCHANGE RATES AND PURCHASING POWER PARITIES WITH RESPECT TO THE INTERNATIONAL DOLLAR FOR GDP, 1970-1985

(National currency units per international dollar)

	Exchange rate					GDP purchasing power parities							
	1970	1973	1975	1980	1988	ICP I 1970	ICP II 1973	ICP III 1975	ICP IV 1980	AH 1980	S & H 1988	ECLAC 1980	World Bank 1980
Argentina				1,837.0	8,753.0				2,709.0	2,595.9	5,689.0	3,334.2	4,116.8
Brazil			8.2	52.7	39,229.9			5.2	30.6	32.4	18,045.0	50.9	51.0
Chile				39.0	245.0				28.8	26.5	90.7	41.7	44.7
Colombia	18.4	23.8	30.9	47.3	2,992.0	7.3	9.5	10.8	23.1	21.6	101.7	48.6	52.5
Mexico			12.5	23.0	2,250.0			7.4	13.4		900.0	25.4	30.8
Venezuela				4.3	14.5				3.6	3.1	7.0	5.0	9.7
	PPP/Exchange rate deviation index												
Argentina									1.47	1.41	0.65	1.82	2.24
Brazil								0.63	0.58	0.61	0.46	0.96	0.97
Chile									0.74	0.68	0.37	1.07	1.15
Colombia						0.40	0.40	0.35	0.49	0.46	0.34	1.03	1.11
Mexico								0.59	0.58		0.40	1.10	1.34
Venezuela									0.84	0.73	0.48	1.17	1.09

Source: Exchange rates come from the (rf) series of IMF, *International Financial Statistics*, (various editions), ICP refers to the different phases of the International Comparison Project, see Kravis *et al.* (1975, 1987, 1982) and United Nations and Eurostat (1987), AH refers to PPP's for Latin America which were kindly supplied by Alan Heston of the University of Pennsylvania and former director of the ICP project, S & H come from the underlying data of Summers and Heston (1991) and ECLAC and World Bank refer to the adjusted exchange rates used by these organisations.

we used, provided to us by Alan Heston (formerly) of the ICP project, with the ones published by the United Nations and Eurostat (1987).

In this table the exchange rates come from IMF and the headings ICP I, II, III and IV refer to different phases of the International Comparison Project (ICP) as published in Kravis *et al.* (1975, 1978, 1982) and in United Nations and Eurostat (1987). As already indicated above AH refers to revised estimates of phase IV of ICP which were given to the author by Alan Heston, which are the same as those underlying the Summers and Heston (1991) article. Our results are presented in 1980 constant intenational dollars while the base year in Summers and Heston (1991) is 1985. Also enclosed are the PPP's for Mexico which were originally not published. The AH results show that all countries, with the exception of Argentina which has a 32 percent lower exchange rate, have much higher exchange rates than PPP's as can be seen in the column which gives the total GDP/PPP exchange rate deviation index. The range goes from 0.49 in Colombia to 1.47 in Argentina. This implies that for all countries, except Argentina, a conversion from national currencies to international dollars gives higher GDP's than in the case of conversion with the exchange rate.

The PPP—exchange rate deviation index in the lower part of Table 2 indicates, in spite of the scanty evidence, that the AH results for 1980 are similar to those of ICP IV. At the same time the comparison of these results with previous phases of the ICP shows that the PPP's are rather stable in time. Somewhat an exception are the 1988 Summers and Heston estimates which are on the average somewhat lower than previous ones.

In Table 3 the disaggregated PPP's with respect to capital formation are presented with the resulting PPP—Exchange rate deviation index as estimated by various phases of ICP which is still the only source for this kind of disaggregated information. Here we give the results for our two estimates for 1980, ICP IV and AH, but we also analyze these PPP's in time, only for the 1970-80 period, as for 1985 we do not dispose of the disaggregation. When comparing the ICP IV and AH 1980 results it becomes directly clear that the main difference occurred in the case of non-residential structures. In this case the results for ICP IV are not very reliable as a major transcription error occurred. In analyzing the PPP's of the components of gross investment in time, the pattern is obviously not as uniform as in the case of total GDP, but the deviation index of machinery and equipment is higher in all cases. Non-residential structures PPP's are generally lower. In the case of Colombia, for which we have 5 observations, the first three (1970, 1973 and 1975) are almost identical and the 1980 estimates also show a rather stable tendency. In the case of Brazil the estimates for 1975 and 1980 are rather similar as is the case in Mexico, although with somewhat higher differences.

It is in light of all the above mentioned that, on the diskette, we both present the capital stock estimates at national currencies and at international prices, and therefore give the potential user the option to apply other PPP's or exchange rates than the ones used by us, without having to go through the procedure of calculating the capital stock. The application of these disaggregated PPP's has, as will be shown below, a great impact on the capital stock levels.

TABLE 3

CAPITAL FORMATION PPP'S/EXCHANGE RATE DEVIATION INDEX, 1970-80

(National currency units per international dollar)

	PPP's of capital formation														
	1970 (ICP phase I)			1973 (ICP phase II)			1975 (ICP phase III)			1980 (ICP phase IV)			1980 (Alan Heston)		
	Res	N.R.	M & E	Res.	N.R.	M & E	Res.	N.R.	M& E	Res.	N.R.	M & E	Res.	N.R.	M & E
Argentina										4,025.0	1,389.0	3,959.0	4,057.0	4,670.0	3,899.0
Brazil							4.6	5.4	7.6	33.7	27.1	46.3	32.0	25.9	47.0
Chile										52.2	15.4	51.2	52.1	27.0	50.7
Colombia	4.3	4.5	21.6	5.2	5.5	32.5	8.3	7.4	4.3	20.1	17.6	53.6	19.6	22.3	54.8
Mexico							6.6	5.9	17.0				16.2	19.2	21.2
Venezuela										5.1	6.4	4.55	5.5	5.1	4.5
	PPP/Exchange rate deviation index														
Argentina										2.19	0.76	2.15	2.21	2.54	2.12
Brazil							0.56	0.66	0.93	0.64	0.51	0.88	0.61	0.49	0.89
Chile										1.34	0.39	1.31	1.34	0.69	1.30
Colombia	0.23	0.25	1.18	0.22	0.23	1.36	0.27	0.24	1.38	0.42	0.37	1.13	0.41	0.47	1.16
Mexico							0.53	0.47	1.34				0.70	0.83	0.92
Venezuela										1.19	1.49	1.06	1.29	1.20	1.06

Source: Same as Table 2.

3. *Standardized Estimates*

By developing the above described model layout for capital stock estimation, all procedures have been made transparent.[18] For each country a detailed description and explanation is given of all sources and series used in the elaboration of our final 1980 constant prices series.[19]

The tables on the accompanying diskette present for each country average ages of total and non-residential gross and net capital stock, the total and non-residential average service life and the capital-output ratios for the 1950–89 period, both on a national currencies basis as well as in international dollars.

The average age of the capital stock has been estimated giving each vintage of capital formation as a weight the number of years it formed part of the capital stock (which in the case of machinery and equipment is a minimum of 1 year and a maximum of 15 years). The average life expectation of the capital stock has been estimated by dividing the gross stock of a given year by the depreciation allowance in the same year. As we use straight-line depreciation this gives a reasonable estimate of average service life.[20]

Table 4 presents a summary of the results with respect to average service lives. It becomes clear that average service lives decrease in all countries (except for Brazil) from 1950–80 and remain almost constant afterwards. As we have assumed fixed asset lives for the separate assets, this shortening of lives is caused by changes in the composition of the capital stock, basically an increase of machinery and equipment and a decrease of residential structure (see also Tables 9 and 10).

TABLE 4

LATIN-AMERICA: AVERAGE LIFE EXPECTATION IN OUR ESTIMATES OF TOTAL AND NON-RESIDENTIAL FIXED CAPITAL STOCK 1950-89

(On the basis of international dollars)

	1950		1973		1980		1989	
	Total	N-R.	Total	N-R.	Total	N-R.	Total	N-R.
Argentina	38.1	29.8	34.2	27.4	33.7	27.1	33.5	26.7
Brazil	30.4	23.9	33.6	28.9	32.3	28.3	32.9	28.7
Chile	37.3	32.8	35.0	30.9	35.5	31.7	35.6	31.1
Colombia	39.3	35.3	37.5	32.9	36.5	32.1	35.3	31.2
Mexico	38.8	33.9	33.1	24.8	31.9	23.5	31.3	22.2
Venezuela	33.6	30.5	28.3	25.2	27.7	24.6	26.1	23.4

Source: Tables on diskette.

In Table 5 levels of total and non-residential gross fixed capital stock are presented on a per capita basis and we also give the levels compared to the U.S.A. The comparative level fell in Argentina, Chile both had rather high initial levels) and Colombia and rose during the whole 1950–89 period in Brazil and Mexico (especially during 1950–73).

[18]See for an example of this layout Annex A and for its complete description the pages above.
[19]See the library documentation file on the accompanying diskette.
[20]See Maddison (1982), p. 216.

TABLE 5

LEVELS OF TOTAL AND NON-RESIDENTIAL GROSS FIXED CAPITAL STOCK PER CAPITA 1950-89

(In 1980 international dollars)

	Total Capital Stock				Non-residential Capital Stock			
	1950	1973	1980	1989	1950	1973	1980	1989
Argentina	4,820	7,637	9,030	9,092	2,322	4,374	5,315	5,178
Brazil	1,234	4,413	7,501	9,998	751	3,097	5,527	7,230
Chile	5,500	8,228	8,567	9,012	3,711	5,819	6,147	6,249
Colombia	3,596	4,595	5,420	6,719	2,501	3,063	3,709	4,709
Mexico	2,252	6,492	9,110	11,310	1,499	3,522	4,796	5,639
Venezuela	4,311	9,510	12,884	13,230	3,319	7,560	10,267	10,671
U.S.A.	27,288	42,563	50,228	60,885	17,503	26,319	31,876	38,265
	(as percent of U.S.A. per capita level)							
Argentina	18	18	18	15	13	17	17	14
Brazil	5	10	15	16	4	12	17	19
Chile	20	19	17	15	21	22	19	16
Colombia	13	11	11	11	14	12	12	12
Mexico	8	15	18	19	9	13	15	15
Venezuela	16	22	26	22	19	29	32	28
U.S.A.	100	100	100	100	100	100	100	100

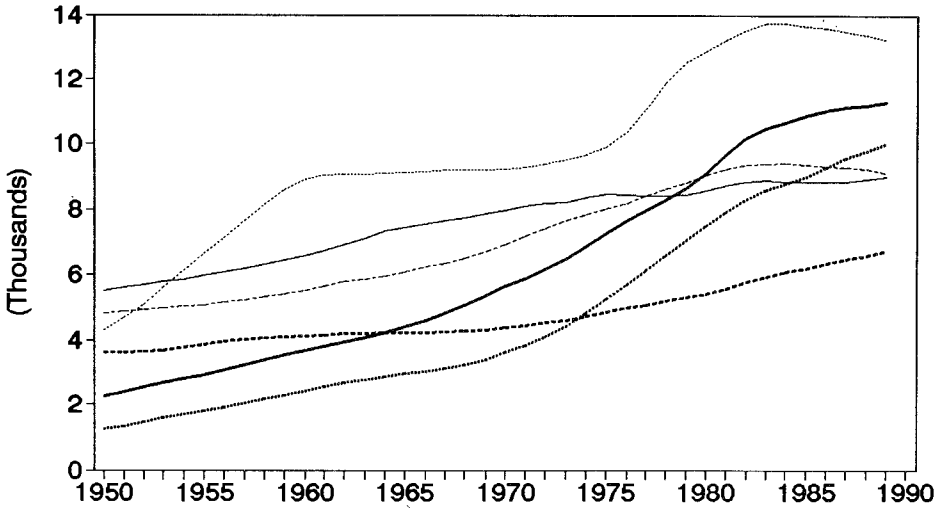
Source: Tables on diskette.

Graph 1 presents the growth of gross total fixed capital stock per capita in the six Latin American countries. Here the impressive growth in Brazil and Mexico in 1950-89 becomes quite clear. Another aspect that draws attention in this graph is the fact that Argentina and Chile had high total fixed capital stock per capita levels in 1950 but had fallen far behind Brazil and Mexico in 1989.

The growth performance of Venezuela is also quite impressive; starting from a rather low level in 1950 its per capita stock initially grew very rapidly, reaching the highest level in Latin America in the late fifties. After a new growth sprint in the seventies, as a result of the oil crisis, and subsequent stabilization in the 1980s Venezuela still maintains the highest level per capita in Latin America. Chile, Argentina and Colombia all have experienced steady growth.

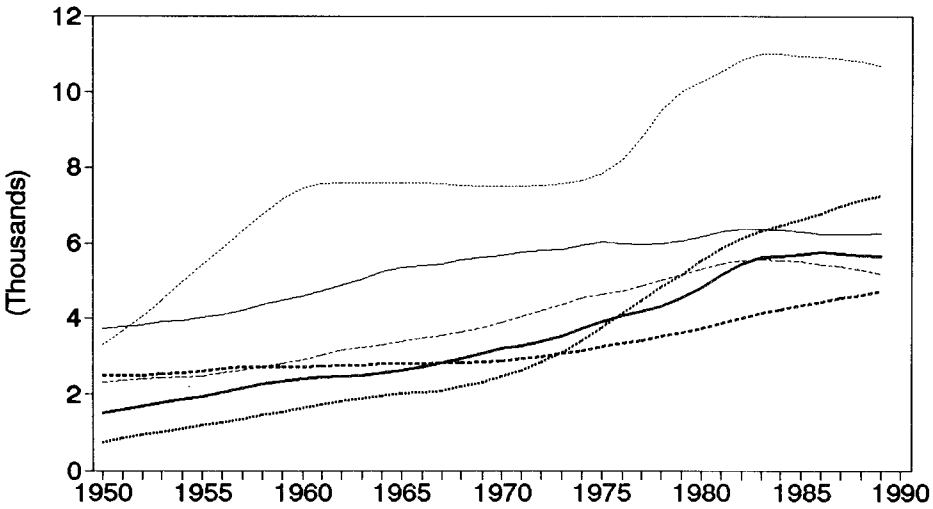
Graph 2 shows the growth of total fixed non-residential capital stock per capita in our sample of Latin American countries for the 1950-89 period. This graph is of course very similar to Graph 1, but there are also some interesting differences. The total non-residential capital stock better represents the productive capacity of a country than the total capital stock, and is therefore a more appropriate measure in, for example, a growth accounting exercise. With respect to the results, it is clear that Brazil has been the fastest growing country. Very similar to Graph 1 is the impressive growth of per capita total non-residential capital stock in Venezuela. Colombia, where non-residential capital stock per capita grew steadily but not very fast and the other low performers Chile and Argentina are shown.

Graph 3 shows the development of GDP per capita in the sample of Latin American countries measured in international dollars during the 1950-89 period.



Source: Tables on diskette.

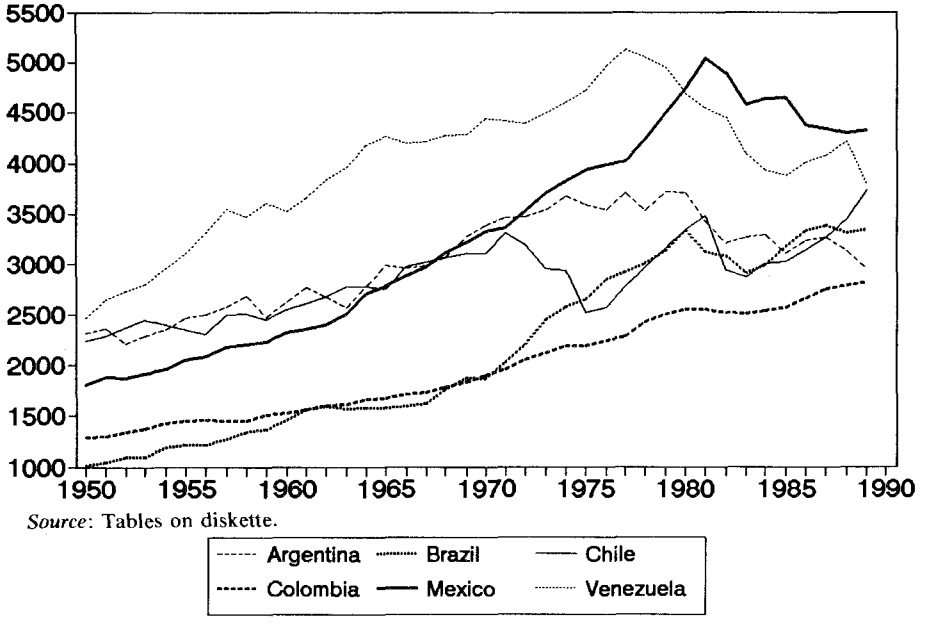
Graph 1. Latin America: Total Fixed Capital Stock Per Capita, 1950-89



Source: Tables on diskette.

Graph 2. Latin America: Total Non-Residential Capital Stock Per Capita, 1950-89

This picture is of course well-known and confirms once again that Colombia is the country which experienced a process of steady growth (the same as in the case of the total fixed per capita capital stock) during most of the whole period. This has not been the case in the other countries where the crisis has hit hard. Brazil and Mexico grew steadily at high rates (well over 6 percent) during the 1950-80 period, but the 1980-89 period has been disastrous with almost no growth in GDP, a decline on a per capita basis. The situation has been worse in Argentina and Venezuela where GDP only grew until about the mid-seventies and afterwards stagnated or even declined. An exception is the case of Chile where the growth process has been interrupted several times by severe crises, as was the case in the beginning of the seventies and the eighties, and therefore shows a weak growth performance over the 1950-89 period.



Source: Tables on diskette.

Graph 3. Latin America: GDP Per Capita, 1950-89

In Tables 6-9 the graphical presentation of Graphs 1 and 2 (which only show gross fixed capital stock per capita) is illustrated in more detail. Tables 6 and 7 give annual average compound growth rates for total capital stock and non-residential capital stock for the 1950-89 period. With respect to their growth rates these countries can distinctly be divided in two groups: the fast growers Brazil, Mexico and Venezuela and the slower growing group of Argentina, Chila and Colombia.

Table 7 presents the growth rates for gross non-residential capital stock which are, in comparison with the growth rates of gross total stock, somewhat higher in four countries (Argentina, Brazil, Chile, and Venezuela) and lower in Colombia and Mexico in the 1950-80 period. For the 1980-89 period the growth

TABLE 6

LATIN AMERICA: TOTAL GROSS CAPITAL STOCK, 1950-89

(Annual average compound growth rates)

	1950-73	1973-80	1980-89
Argentina	3.75	4.09	1.45
Brazil	8.76	10.40	5.51
Chile	4.00	2.13	2.27
Colombia	3.98	4.75	4.52
Mexico	8.10	7.84	4.83
Venezuela	7.44	8.05	3.09
Arithmetic average	6.00	6.21	3.61

Source: Tables on diskette.

TABLE 7

LATIN AMERICA: GROSS NON-RESIDENTIAL CAPITAL STOCK, 1950-89

(Annual average compound growth rates)

	1950-73	1973-80	1980-89
Argentina	4.53	4.50	1.08
Brazil	9.44	11.17	5.29
Chile	4.21	2.34	1.88
Colombia	3.79	5.14	4.80
Mexico	7.14	7.38	4.20
Venezuela	7.59	8.08	3.23
Arithmetic average	6.12	6.44	3.41

Source: Tables on diskette.

rate of non-residential capital stock, compared to total stock, is lower in almost all countries.

The relationship between the growth of the net and gross stocks depends on the history of capital formation. When growth decelerates as in the 1980-89 period gross stock will grow more rapidly than net stock, as happened in all countries, and the inverse is true in periods of growth acceleration. During 1950-1980 net stock grew faster in Argentina and Brazil. The growth rates of both stocks were about the same in Colombia and Mexico indicating a process of steady growth. For Chile and Venezuela the period 1950-89 was not homogeneous as both had a sub-period of faster and one of slower growth of net stock compared to gross.

Applying the PPP's of table 1 to the different components of capital has a considerable effect on the level of the capital stock. This becomes clear from the capital output ratios presented below. Here we are interested in the effect on the growth rates of the different stocks. Growth rates in international dollars may be different from those in national currencies because the PPP's change the composition of the capital stock. The sign of the change in the growth rate will depend on these compositional changes.

Table 9 gives an indication of changes in the composition of gross total capital stock, measured in international dollars, during the 1950-89 period. In

TABLE 8

LATIN AMERICA: COMPARISON OF GROSS AND NET TOTAL CAPITAL STOCK, 1950-89

(Annual average compound growth rates)

	1950-73		1973-80		1980-89	
	Gross	Net	Gross	Net	Gross	Net
Argentina	3.75	4.22	4.09	4.40	1.45	0.04
Brazil	8.76	9.23	10.40	10.50	5.51	4.41
Chile	4.00	4.14	2.13	1.24	2.27	2.02
Colombia	3.98	3.98	4.75	4.82	4.52	4.48
Mexico	8.10	8.07	7.84	7.56	4.83	4.00
Venezuela	7.44	7.10	8.05	8.81	3.09	0.99
Arithmetic average	6.00	6.12	6.21	6.22	3.61	2.66

Source: Tables on diskette.

all countries (except Brazil which had the highest share of all countries in 1950) the share of machinery and equipment in the total capital stock increased from 1950 to 1980 and stabilized or fell somewhat during 1980-89. The share of residential structures fell in Argentina, Brazil and Venezuela and it rose in Mexico, Colombia and Chile. Non-residential's share increased in Brazil and Argentina and fell in the other countries. A comparison of Tables 9 and 10 shows that measurement in international dollars or national currency makes a big difference in the composition of the capital stock. This effect, very notable in the cases of machinery and equipment in Chile and Colombia, causes some assets to fall to extremely low levels.

TABLE 9

LATIN AMERICA: COMPOSITION OF GROSS TOTAL CAPITAL STOCK 1950-89

(In 1980 international dollars and in % of total capital stock)

	Dwellings				Non-Residential Structures				Machinery and Equipment			
	1950	1973	1980	1989	1950	1973	1980	1989	1950	1973	1980	1989
Argentina	52	43	41	43	37	39	40	41	11	19	19	16
Brazil	39	30	26	28	28	47	49	53	33	23	24	19
Chile	33	29	28	31	57	57	58	56	11	14	13	13
Colombia	30	33	32	30	62	55	55	56	7	11	13	14
Mexico	33	46	47	50	56	29	25	25	11	25	27	25
Venezuela	23	21	20	19	52	48	46	46	25	31	34	35
Arithmetic average	35	34	32	34	49	46	46	46	16	20	22	20

Source: Tables on diskette.

Table 11 compares the growth of capital stock measured in national currencies with our preferred measure in international dollars. Argentina, Mexico and Venezuela show very small differences between the two growth rates. In other

TABLE 10

LATIN AMERICA: COMPOSITION OF GROSS TOTAL CAPITAL STOCK 1950-89

(On the basis of national currencies and in % of total capital stock)

	Dwellings				Non-Residential Structures				Machinery and Equipment			
	1950	1973	1980	1989	1950	1973	1980	1989	1950	1973	1980	1989
Argentina	49	41	39	41	41	42	43	44	10	17	18	15
Brazil	36	29	26	28	21	37	39	44	44	34	35	28
Chile	45	41	39	42	41	41	42	40	14	19	18	18
Colombia	25	26	24	22	58	49	48	48	17	25	28	30
Mexico	20	40	42	45	58	31	26	27	13	29	32	29
Venezuela	25	23	22	21	52	49	47	47	23	28	31	32
Arithmetic average	35	33	32	33	45	42	41	42	20	25	27	25

Source: Tables on diskette.

countries the differences are bigger. There are sometimes differences over 10 percent in the growth rates, especially in the 1980-89 period. For the 1950-80 period only Colombia showed differences of over 10 percent in non-residential capital stock.

TABLE 11

LATIN-AMERICA: A COMPARISON OF GROWTH RATES OF CAPITAL STOCKS IN NATIONAL CURRENCIES AND INTERNATIONAL DOLLARS 1950-89

(Difference in annual average compound growth rates)

	1950-73		1973-80		1980-89	
	Gross	Net	Gross	Net	Gross	Net
			Total Capital Stock			
Argentina	0.0	0.0	0.0	0.0	0.0	0.0
Brazil	0.3	0.4	0.0	0.0	0.4	0.5
Chile	−0.2	0.0	0.1	0.1	−0.2	−0.4
Colombia	−0.2	−0.2	−0.3	−0.3	−0.1	0.0
Mexico	0.0	0.1	0.0	0.0	0.1	0.1
Venezuela	0.0	0.0	0.1	0.1	0.0	0.0
			Non-Residential Capital Stock			
Argentina	0.1	0.1	0.0	0.0	−0.1	−0.1
Brazil	0.6	0.7	0.0	0.0	0.5	0.7
Chile	−0.3	−0.1	0.1	−0.1	−0.1	−0.2
Colombia	−0.4	−0.3	−0.5	−0.4	−0.2	0.0
Mexico	−0.1	−0.1	−0.1	−0.1	0.0	0.1
Venezuela	0.0	0.0	0.1	0.1	0.0	0.0

Source: Tables on diskette.

Note: Difference in annual average calculated as: growth rate in international dollars − growth rate in national currency.

Table 12 presents the ratio of non-residential capital stock to the total capital stock. This ratio can be seen as an indicator of the participation of the productive capital stock (measured as the non-residential stock) in the total stock.

The initial 1950 ratio of productive to total fixed capital was very low in Argentina where residential capital stock is greater than non-residential. The other countries had much higher productive capital stock participation levels—Brazil having the lowest and Colombia the highest. In 1989 at the end of the period under consideration Argentina remains the country with the highest level of residential capital stock, but Mexico definitely has the highest levels of residential capital stock. The role of productive capital is more dominant in the other countries of which Venezula has the lowest residential capital stock levels.

TABLE 12

LATIN-AMERICA: RATIO OF NON-RESIDENTIAL CAPITAL STOCK TO TOTAL CAPITAL STOCK 1950-89

(On the basis of international dollars)

	1950		1973		1980		1989	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Argentina	0.48	0.50	0.57	0.57	0.59	0.57	0.57	0.54
Brazil	0.61	0.60	0.70	0.70	0.74	0.73	0.72	0.70
Chile	0.67	0.65	0.71	0.71	0.72	0.72	0.69	0.67
Colombia	0.70	0.67	0.67	0.66	0.68	0.68	0.70	0.70
Mexico	0.67	0.64	0.54	0.49	0.53	0.47	0.50	0.44
Venezuela	0.77	0.77	0.79	0.77	0.80	0.78	0.81	0.78
Arithmetic average	0.65	0.64	0.66	0.65	0.68	0.66	0.66	0.64

Source: Tables on diskette.

In the following tables estimates for capital-output ratios are presented. There are many forces, such as technical progress, capital widening or capital deepening, demand and supply factors and other classical factors such as the rate of interest and problems of allocation and distribution, that affect the development for the capital-output ratios. An attempt to explain its development for 6 countries during a 39 years period does not fall within the objective of this article. We do however include these estimates because they are used rather intensively in economic analysis such as economic forecasting, planning and econometric models.

In Tables 13-16 a comparison of capital-output ratios of total and non-residential capital stock for the 1950-89 period is made. In Tables 13-15 these comparisons are based on estimations in international dollars and in Table 16 a comparison is made of differences in outcomes between estimates in international dollars and national currencies.

Table 13 shows clearly that in 1950 the countries had rather different gross capital-output ratios, Colombia having the highest and Brazil and Mexico the

lowest. This situation has changed at the end of the period under consideration, when Venezuela reached the highest levels and Colombia and Chile are among the lowest. During the 1950-89 period, the capital-output ratios of Chile and Colombia have remained more or less stable while the ratios of the other countries have risen substantially.

TABLE 13

TOTAL FIXED GROSS CAPITAL-OUTPUT RATIOS, 1950-89

(In 1980 international dollars)

	1950	1973	1980	1989
Argentina	2.1	2.2	2.4	3.1
Brazil	1.2	1.8	2.2	3.0
Chile	2.5	2.8	2.6	2.4
Colombia	2.8	2.2	2.1	2.4
Mexico	1.2	1.8	1.9	2.6
Venezuela	1.8	2.1	2.7	3.5
Arithmetic average	1.9	2.2	2.3	2.8

Source: Tables on diskette.

The gross non-residential capital-output ratios (see Table 14) show quite different and obviously much lower ratios than the ones in Table 13. In 1989 the gross total capital-output ratio of Venezuela (the highest) was about 50 percent higher than the ratio in Chile and Colombia (the lowest). With respect to gross non-residential capital-output ratios in 1989 this spread was much higher (115 percent) with Venezuela again the highest and Mexico the lowest. This difference in spread between total capital and non-residential capital-output ratios can be observed for the whole 1950-89 period.

TABLE 14

NON-RESIDENTIAL FIXED GROSS CAPITAL-OUTPUT RATIOS, 1950-89

(In 1980 international dollars)

	1950	1973	1980	1989
Argentina	1.0	1.2	1.4	1.8
Brazil	0.7	1.3	1.7	2.2
Chile	1.7	2.0	1.8	1.7
Colombia	1.9	1.4	1.5	1.7
Mexico	0.8	1.0	1.0	1.3
Venezuela	1.3	1.7	2.2	2.8
Arithmetic average	1.2	1.4	1.6	1.9

Source: Tables on diskette.

Table 15 shows a comparison of gross and net capital-output ratios for the 1950-89 period.

TABLE 15

A COMPARISON OF GROSS AND NET TOTAL CAPITAL-OUTPUT RATIOS, 1950-89

(In 1980 international dollars)

	1950		1973		1980		1989	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Argentina	2.1	1.2	2.2	1.4	2.4	1.6	3.1	1.8
Brazil	1.2	0.8	1.8	1.3	2.2	1.7	3.0	2.0
Chile	2.5	1.5	2.8	1.8	2.6	1.5	2.4	1.4
Colombia	2.9	1.8	2.2	1.4	2.1	1.5	2.4	1.7
Mexico	1.2	0.9	1.8	1.3	1.9	1.4	2.6	1.7
Venezuela	1.8	1.3	2.1	1.4	2.7	1.9	3.5	2.0
Arithmetic average	1.9	1.3	2.1	1.4	2.3	1.6	2.8	1.8

Source: Tables on diskette.

We have seen in Table 11 that the comparison of the growth rates of capital stock in national currencies and international dollars does not yield great differences. However the results of Table 16 show that a comparison of capital-output in national currencies or international dollars makes a significant difference. The conversion of GDP and capital stock from national currencies to international dollars has a great impact on their respective levels. From Tables 2 and 3 it becomes clear that the PPP's for GDP in the Latin American countries are generally lower than the exchange rate (with the exception of Argentina, see Table 2) and this causes an increase of the GDP level compared to the level measured with the exchange rate. The PPP's of the different components of the capital stock are generally higher than the PPP for GDP (see Table 3) and this causes a big decline in capital stock levels as compared to GDP.

TABLE 16

A COMPARISON OF TOTAL FIXED GROSS CAPITAL-OUTPUT RATIOS IN NATIONAL CURRENCIES AND INTERNATIONAL DOLLARS, 1950-89

(Both in 1980 prices)

	1950		1973		1980		1989	
	Nat. Curr.	Int. $	Nat. Curr.	Int. $	Nat. Curr.	Int. $	Nat. Curr.	Int. $
Argentina	3.3	2.1	3.4	2.2	3.8	2.4	4.9	3.1
Brazil	1.4	1.2	1.9	1.8	2.4	2.2	3.1	3.0
Chile	3.2	2.5	3.6	2.8	3.3	2.6	3.2	2.4
Colombia	2.9	2.8	2.4	2.2	2.4	2.1	2.7	2.4
Mexico	1.7	1.2	2.4	1.8	2.6	1.9	3.6	2.6
Venezuela	2.5	1.8	3.0	2.1	3.8	2.7	4.8	3.5
Arithmetic average	2.5	1.9	2.8	2.2	3.0	2.3	3.7	2.8

Source: Tables on diskette.

IV. Conclusions

Total capital stock increased in all Latin American countries but at very different paces, while in Brazil the capital stock grew at 8.3 percent during the 1950–89 period, this growth rate was only 3.3 percent in Argentina and Chile. The consequences of these performances become clear when its per capita level are compared with the those of the U.S.A. Here again the extremes are Brazil, Argentina and Chile. The first had a per capita stock level of 5 percent of that of the U.S.A. in 1950 which has risen to 16 percent in 1989, while Argentina and Chile started with relatively high levels around 20 percent in 1950 which now have fallen to a level of 15 percent.

These tendencies are confirmed when looking at the "productive," as represented by the non-residential, capital stock. Two elements are important to emphasize here. First the relatively high level, in 1950, of the residential capital stock in Argentina and the corresponding somewhat lower levels, in comparative perspective, of its productive capital stock. At the opposite one sees, also in 1950, Brazil with high levels of machinery and equipment in the composition of the total capital stock.

Capital–output ratios increased in Argentina, Brazil, Mexico and Venezuela indicating falling capital productivity. The capital productivity remained almost constant in Chile and increased somewhat in Colombia. There are some small differences when looking at total or non-residential capital–output ratios (Argentina and Chile for example), but the general trend is clear.

The estimates in this study are presented in national currencies and international dollars and the analysis indicates that the difference between the two estimates are not that great when looking at the growth rates, but that the levels of the capital stocks differ substantially.

The main objective of this article has been to estimate capital stocks for the 1950–89 period for six Latin American countries for which international comparable estimates were not available until now. Further research should refine these estimates and include estimates for additional countries.

References

Altimir, O. and Hofman, A. A., *Latin American Development Problems in Historical Perspective*, paper presented at the ECLAC University of Lund Symposium, Santiago, 1990.

Banco de México, *Cuentas nacionales y acervos de capital, consolidadas y por tipo de activadad económica, 1950–1967*, Documento del Departamento de Estudios Económicos, 1969.

Blades, D., *Capital Measurement in the OECD Countries: An Overview*, OECD, Paris, 1989.

Campbell, C., *Capacity Capital Formation in the New Zealand Manufacturing Industries, 1952–1973*, Wellington, 1977.

Clark, C., *Conditions of Economic Progress*, 3rd edn, Macmillan, London, 1957.

Denison, E. F., *Accounting for United States Economic Growth 1929–1969*, The Brookings Institution, Washington, D.C., 1974.

Denison, E. F. and Chung, W. K., *How Japan's Economy Grew so Fast: The Sources of Postwar Expansion*, The Brookings Institution, Washington, D.C., 1976.

Dominguez, L. M., National Income Estimates of Latin American Countries, *Studies in Income and Wealth*, Vol. 10, NBER, New York, 1947.

ECLAC, *Economic Survey of Latin America, 1951-52*, United Nations, New York, 1954.
———, *A Measurement of Price Levels and the Purchasing Power of Currencies in Latin America, 1960-1962*, Santiago, 1963.
———, *Long Run Growth in Latin America*, forthcoming, Santiago, 1992.
Goldberg, S. y B. I., *El Stock de Capital en la Argentina: Medición y Problemas Conceptuales*, Secretaría de Planificación, Buenos Aire, 1986.
Goldsmith, R. W., A Perpetual Inventory of National Wealth, *Studies in Income and Wealth*, Volume Fourteen, NBER, New York, 1951.
———, *Brasil 1850-1984, Desenvolvimento financiero sob um secolo de inflacao*, Harper & Row do Brasil, Sao Paulo, 1986.
Haindl, E. and Fuentes, R., Estimación del stock de capital en CHile: 1960-1984, *Estudios de Economía*, 13(1), 1986.
Harberger, A., On Estimating the Rate of Return to Capital in Colombia, *Project Evaluation*, University of Chicago Press, Chicago, 1976.
Henao, M. R., *La acumulación de capital fijo y los precios: una aproximación estructural. El caso de Colombia*, Bogotá, 1983.
Hofman, A. A., The Role of Capital in Latin America: A Comparative Perspective of Six Countries for 1950-89, *Working Paper No. 4*, ECLAC, Santiago, 1991.
———, *Existing Capital Stock Estimates*, (processed), Santiago, 1990.
IEERAL, Estadísticas de la evolución económica de Argentina. 1913-1984, *Estudios*, julio/septiembre, 1986.
IMF, *International Financial Statistics*, various editions, Washington, D.C.
Kendrick, J. W., *Productivity Trends in the United States*, National Bureau of Economic Research, New York, 1961.
Kravis, I. B., Kenessey, Z., Heston, A. and Summers, R., *A System of International Comparisons of Gross Product and Purchasing Power*, Johns Hopkins, Baltimore, 1975.
Kravis, I. B., Heston, A. and Summers, R., *International Comparisons of Real Product and Purchasing Power*, Johns Hopkins, Baltimore, 1978.
———, *World Product and Income*, Johns Hopkins, Baltimore, 1982.
Kuznets, S., *Capital in the American Economy, Its Formation and Financing*, Princeton University Press, Princeton, 1961.
Langoni, C. G., *As causas do crescimento economico do Brasil*, APEC Editor, Rio de Janeiro, 1974.
Maddison, A., *Phases of Capitalist Development*, Oxford, 1982.
———, Growth and Slowdown in Advanced Capitalist Economies. Techniques of Quantitative Assessment, *Journal of Economic Literature*, XXV, 1987.
———, *Dynamic Forces in Capitalist Development: A Long-Run Comparative View*, Oxford University Press, Oxford, 1991.
National Research Council, Panel to Review productivity Statistics, *Measurement and Interpretation of Productivity*, National Academy of Sciences, Washington, D.C., 1979.
OECD, *National Accounts in Developing Countries of Asia*, Development Centre, Paris, March, 1971.
Patterson, K. D. and Schott, K. (eds.), *The Measurement of Capital: Theory and Practice*, The Macmillan Press Ltd., London, 1979.
Summers, R. and Heston, A., The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988, *Quarterly Journal of Economics*, CVI (2), 1991.
Secretaría de Planificación, *Stock de Capital y Productividad*, Presidencia de la Nación, Buenos Aires, 1991.
Terborgh, G., *Realistic Depreciation Policy*, Machinery and Allied Products Institute, 1954.
United Nations, National and Per Capita Incomes of Seventy Countries in 1949 Expressed in United States Dollars, *Statistical Papers*, Series E, No. 1, New York, 1950.
———, A System of National Accounts, *Studies in Methods*, Series F, No. 2, Rev. 3, New York, 1968.
United Nations and Eurostat, *World Comparison of Purchasing Power and Real Product for 1990, Phase IV of the International Comparison Project, Part Two: Detailed Results for 60 Countries*, New York, 1987.
Urrutia, G. Mario, Ahorro y crecimiento en Chile en el período 1960-81 *Monetaria*, VI(2), 1983.
Usher, Dan (ed.), The Measurement of Capital, *Studies in Income and Wealth*, Vol. 45, The University of Chicago Press, 1980.
U.S. Department of Commerce, Bureau of Economic Analysis, *Fixed Reproducible Tangible Wealth in the United States, 1925-85* U.S. Government Printing Office, Washington, D.C., June 1987.
von Furstenberg, G. M. (ed.), *Capital, Efficiency and Growth*, Ballinger Publishing Company, Cambridge, MA, 1980.
Ward, Michael, *The Measurement of Capital*, OECD, Paris, 1976a.

Ward, Michael, Problems of Measuring Capital in Less Developed Countries, *The Review of Income and Wealth*, 22(3), 1976b.

Winfrey, R., Statistical Analyses of Industrial Property Retirements, *Bulletin 125*, Iowa Engineering Experiment Station, December, 1935.

Young, A. H. and Musgrave, J. C., Estimation of Capital Stock in the United States, in Usher, D. (ed.), The Measurement of Capital, *Studies in Income and Wealth*, Vol. 45, The University of Chicago Press, Chicago, IL, 1980.

ANNEX A
A MODEL LAYOUT FOR CAPITAL STOCK ESTIMATION

TABLE AR1
PROCEDURE FOR ESTIMATING ALTERNATIVE BENCHMARK CAPITAL STOCKS IN NON-RESIDENTIAL STUCTURES AT DECEMBER 31, 1949, INCLUDING VINTAGED VARIANTS

	GDP (1980 Australes)	Ratio of Total Gross Fixed Capital Formation to GDP at Constant Prices	Gross Gross-Increment to Capital Stock Course of Year Specified	Annual Straight-line Depreciation Provision (Equals 1/40th of Figure in Column 3)	Yearly Components of Depreciated Capital Formation Remaining by End 1949	Index of Vintage Effect (Assuming Steady Technical Progress of 1 percent per Annum)	Column 3 Adjusted for Vintage effect (Col. 3 * 6)	Column 4 Adjusted for Vintage effect (Col. 4 * 6)	Column 5 Adjusted for Vintage Effect (Col. 5 * 6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1910	3,286	11.2	368	9	9	1.00	368	9	9
1911	3,345	10.6	355	9	18	1.01	359	9	18
1912	3,618	7.7	280	7	21	1.02	286	7	21
1913	3,656	7.7	281	7	28	1.03	289	7	29
1914	3,277	7.6	251	6	31	1.04	261	7	33
1915	3,294	4.7	155	4	23	1.05	163	4	24
1916	3,200	4.1	133	3	23	1.06	141	4	25
1917	2,940	3.2	95	2	19	1.07	102	3	20
1918	3,479	2.5	87	2	20	1.08	94	2	21
1919	3,607	2.6	93	2	23	1.09	102	3	25
1920	3,870	4.1	158	4	43	1.10	174	4	48

1921	3,969	4.7	189	5	57	1.12	210	5	63
1922	4,286	5.0	214	5	70	1.13	241	6	78
1923	4,759	5.2	248	6	87	1.14	282	7	99
1924	5,130	5.8	295	7	111	1.15	339	8	127
1925	5,108	6.1	309	8	124	1.16	359	9	144
1926	5,355	6.5	350	9	149	1.17	410	10	174
1927	5.735	7.8	448	11	202	1.18	531	13	239
1928	6.090	8.8	534	13	254	1.20	639	16	303
1929	6,370	9.0	573	14	286	1.21	692	17	346
1930	6,107	8.1	492	12	258	1.22	601	15	315
1931	5,683	4.5	257	6	141	1.23	317	8	174
1932	5,495	3.4	188	5	108	1.24	234	6	134
1933	5,753	4.3	250	6	150	1.26	314	8	188
1934	6,207	5.6	350	9	219	1.27	444	11	278
1935	6,477	5.8	373	9	242	1.28	478	12	311
1936	6,531	6.6	433	11	292	1.30	560	14	378
1937	7,004	7.9	556	14	389	1.31	727	18	509
1938	7,026	8.8	618	15	448	1.32	817	20	592
1939	7,295	6.7	486	12	364	1.33	648	16	486
1940	7,413	5.6	417	10	323	1.35	561	14	435
1941	7,800	4.8	377	9	302	1.36	513	13	410
1942	7,886	4.0	316	8	261	1.37	435	11	359
1943	7,733	3.7	289	7	246	1.39	402	10	342
1944	8,715	4.1	360	9	315	1.40	504	13	441
1945	8,435	4.2	356	9	321	1.42	505	13	454
1946	9,188	4.9	450	11	417	1.43	644	16	596
1947	10,210	7.6	779	19	740	1.45	1,126	28	1,069
1948	10,770	7.7	825	21	804	1.46	1,204	30	1,174
1949	10,630	6.7	716	18	716	1.47	1,056	26	1,056
			14,301	358	8,653		18,131	453	11,551

TABLE AR2

PROCEDURE FOR ESTIMATING ALTERNATIVE VARIANTS OF 1950-89 CAPITAL STOCK IN NON-RESIDENTIAL STRUCTURES

	GDP (1980 Australes)	Ratio of Total Gross Fixed Capital Formation to GDP at Constant Prices	Gross Gross-Increment to Capital Stock in Course of Year Specified	Retirements	Increment to Gross Capital Stock in Year Specified (Col. 3-4)	End-year Gross Stock Equals Benchmark stock (see Table AR1) +Col. 5	Annual Depreciation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1949	19,630	6.7	716			14,301	
1950	10,759	6.1	661	368	293	14,594	358
1951	11,176	7.8	877	355	522	15,116	365
1952	10,614	6.8	724	280	444	15,560	378
1953	11,176	6.9	770	281	489	16,049	389
1954	11,638	5.9	687	251	437	16,486	401
1955	12,460	6.3	789	155	634	17,120	412
1956	12,806	6.5	828	133	695	17,816	428
1957	13,470	6.7	908	95	814	18,629	445
1958	14,292	7.0	1,007	87	920	19,550	466
1959	13,369	5.9	794	93	701	20,250	489
1960	14,421	7.7	1,115	158	957	21,207	506
1961	15,445	8.2	1,264	189	1,075	22,283	530
1962	15,200	7.5	1,147	214	933	23,216	557
1963	14,840	6.7	997	248	749	23,965	580

1964	16,369	6.7	1,097	295	802	24,767	599
1965	17,869	6.4	1,143	309	834	25,600	619
1966	17,984	6.6	1,187	350	837	26,438	640
1967	18,460	6.8	1,257	448	809	27,247	661
1968	19,253	7.4	1,427	534	893	28,140	681
1969	20,897	8.2	1,716	573	1,144	29,283	703
1970	22,021	7.7	1,687	492	1,194	30,478	732
1971	22,849	8.6	1,969	257	1,711	32,189	762
1972	23,323	8.8	2,043	188	1,855	34,044	805
1973	24,197	7.5	1,814	250	1,564	35,608	851
1974	25,504	7.2	1,842	350	1,493	37,101	890
1975	25,353	6.0	1,532	373	1,159	38,260	928
1976	25,351	8.1	2,065	433	1,633	39,892	956
1977	26,970	10.6	2,857	556	2,301	42,194	997
1978	26,099	9.5	2,473	618	1,854	44,048	1,055
1979	27,931	8.7	2,438	486	1,953	46,001	1,101
1980	28,337	8.8	2,506	417	2,089	48,090	1,150
1981	26,468	7.9	2,102	377	1,725	49,815	1,202
1982	25,160	6.3	1,588	316	1,272	51,087	1,245
1983	25,984	5.8	1,499	289	1,210	52,297	1,277
1984	26,604	4.4	1,172	360	813	53,110	1,307
1985	25,448	3.9	998	356	642	53,752	1,328
1986	26,868	4.0	1,085	450	634	54,386	1,344
1987	27,451	4.5	1,236	779	457	54,842	1,360
1988	26,708	3.9	1,042	825	217	55,059	1,371
1989	25,525	2.9	752	716	36	55,095	1,376

TABLE AR2—continued

	Increment to Net Capital Stock Equals Col. 3-7	End-year Net Stock Equals Bench-mark Stock (See Table AR1) +Col. 8	End-year Gross Stock Average Age	End-year Net Stock Average Age	Mid-year Gross Capital Stock	Mid-year Net Capital Stock	Average of Mid-year Gross and Net Stocks	Capital-Output Ratios	
	(8)	(9)	(10)	(11)	(12)	(13)	(14)	Net (15)	Gross (16)
1949		8,653	16.80	10.64					
1950	304	8,956	16.45	10.64	14,448	8,804	11,626	0.8	1.3
1951	512	9,468	15.95	10.36	14,855	9,212	12,034	0.8	1.3
1952	346	9,814	15.77	10.28	15,338	9,641	12,490	0.9	1.4
1953	381	10,195	15.59	10.23	15,805	10,005	12,905	0.9	1.4
1954	286	10,481	15.57	10.23	16,268	10,338	13,303	0.9	1.4
1955	377	10,858	15.63	10.18	16,803	10,670	13,736	0.9	1.3
1956	400	11,258	15.72	10.17	17,468	11,058	14,263	0.9	1.4
1957	463	11,721	15.83	10.25	18,223	11,490	14,856	0.9	1.4
1958	541	12,262	15.91	10.34	19,090	11,992	15,541	0.8	1.3
1959	305	12,567	16.18	10.50	19,900	12,415	16,157	0.9	1.5
1960	608	13,176	16.15	10.35	20,729	12,872	16,800	0.9	1.4
1961	734	13,910	16.03	10.13	21,745	13,543	17,644	0.9	1.4
1962	590	14,500	16.02	10.07	22,749	14,205	18,477	0.9	1.5
1963	417	14,917	16.10	10.13	23,591	14,708	19,149	1.0	1.6

1964	498	15,414	16.11	10.14	24,366	15,165	19,766	0.9	1.5
1965	524	15,938	16.10	10.18	25,184	15,676	20,430	0.9	1.4
1966	547	16,485	16.06	10.28	26,019	16,211	21,115	0.9	1.4
1967	596	17,082	15.92	10.28	26,842	16,783	21,813	0.9	1.5
1968	746	17,827	15.66	10.14	27,693	17,454	22,574	0.9	1.4
1969	1,013	18,840	15.27	10.00	28,712	18,334	23,523	0.9	1.4
1970	955	19,795	15.02	9.98	29,881	19,317	24,599	0.9	1.4
1971	1,207	21,001	14.90	9.85	31,334	20,398	25,866	0.9	1.4
1972	1,238	22,239	14.87	9.74	33,117	21,620	27,369	0.9	1.4
1973	963	23,202	14.94	9.75	34,826	22,721	28,774	0.9	1.4
1974	952	24,154	14.96	9.72	36,355	23,678	30,017	0.9	1.4
1975	604	24,758	15.12	9.90	37,680	24,456	31,068	1.0	1.5
1976	1,109	25,867	15.06	9.89	39.076	25,313	32,194	1.0	1.5
1977	1,860	27,727	14.71	9.66	41,043	26,797	33,920	1.0	1.5
1978	1,418	29,145	14.53	9.57	43,121	28,436	35,779	1.1	1.7
1979	1,337	30,482	14.49	9.63	45,025	29,814	37,419	1.1	1.6
1980	1,356	31,838	14.52	9.65	47,046	31,160	39,103	1.1	1.7
1981	899	32,737	14.71	9.87	48,953	32,288	40,620	1.2	1.8
1982	343	33,080	15.10	10.15	50,451	32,909	41,680	1.3	2.0
1983	222	33,303	15.53	10.49	41,692	33,191	42,442	1.3	2.0
1984	−135	33,168	16.02	10.95	52,703	33,235	42,969	1.2	2.0
1985	−330	32,838	16.56	11.37	53,431	33,003	43,217	1.3	2.1
1986	−259	32,579	17.04	11.78	54,069	32,708	43,389	1.2	2.0
1987	−124	32,455	17.33	12.00	54,614	32,517	43,565	1.2	2.0
1988	−329	32,125	17.66	12.38	54,951	32,290	43,620	1.2	2.1
1989	−624	31,501	18.13	12.82	55,077	31,813	43,445	1.2	2.2

TABLE AR3

PROCEDURE FOR ESTIMATING ALTERNATIVE VARIANTS OF 1950–86 CAPITAL STOCKS IN NON-RESIDENTIAL STRUCTURES WITH VINTAGE ADJUSTMENTS

	GDP (1980 Australes)	Ratio of Total Gross Fixed Capital Formation to GDP at Constant Prices	Gross Gross-Increment to Capital Stock in Course of Year Specified	Vintage Multiplier	Column 3 Adjusted for Vintage Effect (Col. 3 * 4)	Retirements	Vintage Effect Lagged 40 Years	Retirements Adjusted for Vintage Effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1949	10,630	6.7	716	1.47	1,056			
1950	10,759	6.1	661	1.49	984	368	1.00	368
1951	11,176	7.8	877	1.50	1,319	355	1.01	359
1952	10,614	6.8	724	1.52	1.099	280	1.02	286
1953	11,176	6.9	770	1.53	1,181	281	1.03	289
1954	11,638	5.9	687	1.55	1,065	251	1.04	261
1955	12,460	6.3	789	1.56	1,235	155	1.05	163
1956	12,806	6.5	828	1.58	1,308	133	1.06	141
1957	13,470	6.7	908	1.60	1,450	95	1.07	102
1958	14,292	7.0	1,007	1.61	1,624	87	1.08	−94
1959	13,369	5.9	794	1.63	1,293	93	1.09	102
1960	14,421	7.7	1,115	1.64	1,833	158	1.10	174
1961	15,445	8.2	1,264	1.66	2.099	189	1.12	210
1962	15,200	7.5	1,147	1.68	1,925	214	1.13	241
1963	14,840	6.7	997	1.69	1,690	248	1.14	282

1964	16,369	6.7	1,097	1.71	1,877	295	1.15	339
1965	17,869	6.4	1,143	1.73	1,975	309	1.16	359
1966	17,984	6.6	1,187	1.75	2,073	350	1.17	410
1967	18,460	6.8	1,257	1.76	2,217	448	1.18	531
1968	19,253	7.4	1,427	1.78	2,541	534	1.20	639
1969	20,897	8.2	1,716	1.80	3,087	573	1.21	692
1970	22,021	7.7	1,687	1.82	3,064	492	1.22	601
1971	22,849	8.6	1,969	1.83	3,6-2	257	1.23	317
1972	23,323	8.8	2,043	1.85	3,785	188	1.24	234
1973	24,197	7.5	1,814	1.87	3,395	250	1.26	314
1974	25,504	7.2	1,842	1.89	3,483	350	1.27	444
1975	25,353	6.0	1,532	1.91	2,924	373	1.28	478
1976	25,351	8.1	2,065	1.93	3,983	433	1.30	560
1977	26,970	10.6	2,857	1.95	5,566	556	1.31	727
1978	26,099	9.5	2,473	1.97	4,864	618	1.32	817
1979	27,931	8.7	2,438	1.99	4,854	486	1.33	648
1980	28,337	8.8	2,506	2.01	5,029	417	1.35	561
1981	26,468	7.9	2,102	2.03	4,260	377	1.36	513
1982	25,160	6.3	1,588	2.05	3,251	316	1.37	435
1983	25,984	5.8	1,499	2.07	3,100	289	1.39	402
1984	26,604	4.4	1,172	2.09	2,448	360	1.40	504
1985	25,448	3.9	998	2.11	2,105	356	1.42	505
1986	26,868	4.0	1,085	2.13	2,310	450	1.43	644
1987	27,451	4.5	1,236	2.15	2,658	779	1.45	1,126
1988	26,708	3.9	1,042	2.17	2,263	825	1.46	1,204
1989	25,525	2.9	752	2.19	1,651	716	1.47	1,056

TABLE AR3—continued

	Increment to Gross Capital Stock in Year Specified with vintage Adjustment (Col. 5-8)	End-year Gross Stock Equals Vintaged (See Table AR1) +Col. 9	Annual Depreciation Adjusted for Vintage Effect	Increment to Net Capital Stock Equals Col. 5-11	End-year Net Stock Equals Bench-mark Stock (See table AR1) +Col. 12	Mid-year Gross-Capital Stock	Mid-year Net Capital Stock	Average of Mid-year Gross and Net Stocks
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1949		18,131			11,551			
1950	616	18,747	453	531	12,082	18,439	11,816	15,128
1951	960	19,708	469	850	12,932	19,228	12,507	15,867
1952	814	20,521	493	606	13,538	20,115	13,235	16,675
1953	892	21,413	513	668	14,206	20,967	13,872	17,420
1954	804	22,217	535	530	14,736	21,815	14,471	18,143
1955	1,072	23,290	555	680	15,415	22,754	15,076	18,915
1956	1,168	24,457	582	726	16,142	23,873	15,778	19,826
1957	1,349	25,806	611	839	16,980	25,131	16,561	20,846
1958	1,530	27,336	645	978	17,959	26,571	17,469	22,020
1959	1,191	28,526	683	609	18,568	27,931	18,263	23,097
1960	1,659	30,185	713	1,120	19,688	29,356	19,128	24,242
1961	1,889	32,074	755	1,345	21,033	31,130	20,360	25,745
1962	1,684	33,758	802	1,123	22,156	32,916	21,594	27,255
1963	1,407	35,165	844	846	23,001	34,462	22,579	28,520

1964	1,538	36,703	879	998	23,999	35,934	23,500	29,717
1965	1,616	38,319	918	1,058	25,057	37,511	24,528	31,020
1966	1,663	39,982	958	1,115	26,172	39,151	25,614	32,383
1967	1,686	41,668	1,000	1,217	27,389	40,825	26,781	33,803
1968	1,903	43,571	1,042	1,500	28,889	42,620	28,139	35,379
1969	2,395	45,966	1,089	1,997	30,887	44,768	29,888	37,328
1970	2,464	48,429	1,149	1,915	32,802	47,198	31,844	39,521
1971	3,295	51,725	1,211	2,402	35,203	50,077	34,003	42,040
1972	3,552	55,276	1,293	2,492	37,696	53,501	36,449	44,975
1973	3,081	58,358	1,382	2,014	39,709	56,817	38,702	47,760
1974	3,039	61,397	1,459	2,024	41,733	59,877	40,721	50,299
1975	2,446	63,843	1,535	1,389	43,122	62,620	42,428	52,524
1976	3,422	67,265	1,596	2,386	45,509	65,554	44,316	54,935
1977	4,838	72,103	1,682	3,884	49,393	69,684	47,451	58,568
1978	4,047	76,151	1,803	3,062	52,455	74,127	50,924	62,525
1979	4,197	80,347	1,904	2,941	55,395	78,249	53,925	66,087
1980	4,467	84,814	2,009	3,020	58,415	82,581	56,905	69,743
1981	3,747	88,561	2,120	2,139	60,555	86,688	59,485	73,086
1982	2,816	91,378	2,214	1,037	61,592	89,969	61,074	75,522
1983	2,698	94,076	2,284	816	62,408	92,727	62,000	77,364
1984	1,944	96,020	2,352	96	62,505	95,048	62,456	78,752
1985	1,600	97,620	2,401	−296	62,209	96,820	62,357	79,589
1986	1,666	99,286	2,441	−130	62,079	98,453	62,144	80,299
1987	1,533	100,819	2,482	176	62,255	100,053	62,167	81,110
1988	1,059	101,878	2,520	−257	61,998	101,349	62,127	81,738
1989	595	102,474	2,547	−896	61,102	102,176	61,550	81,863