

Capital Stock Conference  
March 1997  
Agenda Item IV

# **Development in fixed capital stock: 1960-1995**

**J.W. Prinsloo and H. Smith  
South African Reserve Bank**

# Developments in fixed capital stock: 1960-1995

by J. W. Prinsloo and H. Smith

## 1. Introduction

An important structural change in the South African economy since the mid-1980s has been the sharp decline in the share of gross domestic fixed investment relative to gross domestic product. This ratio fell from an average of 24 per cent in the period 1960 to 1985 to 18½ per cent in the period 1986 to 1995. Owing to this decline, the rate of increase in real fixed capital stock deteriorated from an average annual increase of 5½ per cent between 1960 and 1985 to about 1 per cent over the last ten years.

Standard growth theory holds the view that the level of fixed investment, and hence the growth rate of capital stock, has a material influence on an economy's labour productivity, business competitiveness and ultimately the rate of increase in the standard of living. Estimates of capital formation and the stock of physical capital are therefore key indicators for assessing macro-economic performance.

The purpose of this article is to describe the developments in South Africa's fixed capital stock since 1960. As a general background to this discussion, the first section gives an overview of the methodology used in measuring the capital stock for national accounts purposes. This is followed by a brief discussion of the influence of privatisation on the institutional classification of capital stock. The next three sections deal with the growth in fixed capital stock, changes in the composition of capital stock and capital-output ratios. The last section contains a summary and some concluding remarks.

## 2. Measurement and methodology

In an analysis of production, the effect of capital accumulation on output and productivity is not so much determined by the growth in the capital stock, but rather by changes in the flow of services generated by that stock. Unfortunately, the flow of services from capital is difficult to obtain. In the absence of direct measures of capital services, analyses of production usually assume that such flows are to some extent proportional to the changes in capital stock. In reality, this need not be the case. For example, in an economy that emerges from a recession, the use of existing plant and equipment becomes more intensive and the flow of services from capital rises faster than the increase in capital stock. Strict proportionality does not apply. The change in capital stock therefore serves only as an approximate indicator of the actual flow of capital services.

An estimate of the capital stock refers to a value that is attached to the total physical capital in existence at a specific point in time in an economy. In contrast, the value of capital services is a flow and has a specific time period dimension because it reflects the changing capital inputs over a period of time. However, irrespective of whether the focus is on the capital stock or on the flow of capital services, the estimates relate in principle to a physical measure: estimates of the value of capital stock reflect the actual physical capacity available for repeated use in the production of other goods and services. In practice, it is usually calculated as gross or net capital stock in real terms and the "perpetual inventory method" is used to produce estimates of the stock of tangible reproducible assets.

In order to calculate the real value of fixed capital stock, the gross domestic fixed investment at current prices must be deflated by appropriate price indices. Estimates of gross domestic fixed investment are made for five types of assets, namely residential buildings, non-residential buildings, construction works, transport equipment and machinery and other equipment. The gross fixed investment in buildings and construction works is deflated by price indices which reflect the construction costs of these assets. Investment in transport equipment and machinery and other equipment is deflated by the specific production price indices for these assets. The same price indices are used for the assets of nearly all the different

economic sectors and institutions. The only exception is the agricultural sector, for which machinery and transport equipment are deflated with appropriated indices compiled for farming requisites.

## **2.1 The definition of fixed capital stock**

According to the guidelines of the 1993 United Nations *System of National Accounts* (SNA), the capital account records the values of non-financial assets and distinguishes between the following five classifications:

- gross fixed capital formation;
- consumption of fixed capital;
- changes in inventories;
- acquisitions less disposals of valuables; and
- acquisitions less disposals of non-produced, non-financial assets (e.g. mineral deposits).

Gross fixed capital formation, which is important for calculating the fixed capital stock, comprises the value of acquisitions less disposals of new or existing fixed assets. Fixed assets consist of tangible and intangible sets produced as outputs from production processes and used repeatedly or continuously in other production processes over periods of more than one year. However, in the calculation of the fixed capital stock for the South African economy a narrow definition of fixed assets is used: the stock of capital is defined as consisting of durable and reproducible tangible assets. It excludes tangible assets such as land and sub-soil mineral deposits as these kinds of assets are not producible. Other kinds of "fixed assets", such as computer software, are also excluded because they are intangible. In addition, the transactions in existing assets between sectors are not taken into account in the current national accounts estimates of gross capital formation and the calculation of fixed capital stock. The value of transactions in existing assets is relatively small in relation to total gross domestic fixed investment and should therefore not affect the reliability and usefulness of the sectoral estimates of the capital stock unduly.

## **2.2 The perpetual inventory method**

As already indicated, the perpetual inventory method is normally used in the calculation of fixed capital stock. The perpetual inventory method used for estimating the gross capital stock consists of an accumulation of past flows of gross fixed capital expenditure, after the deduction of the estimated value of retirements from the stock, but before taking the deduction of any allowances for the consumption of fixed capital into account. Estimates of net capital stock (as published in the *Quarterly Bulletin* of the South African Reserve Bank) are obtained by applying a capital consumption function based on the expected economic lives of the various assets. Consumption of fixed capital may be defined as that part of the gross domestic product which is required to replace fixed capital used up in the production process during an accounting period. It is based on the concept of the expected economic lifetime of an asset and is designed to cover the loss in value due to normal wear and tear, expected obsolescence, and the normal amount of irreparable accidental damage. Unforeseen obsolescence is treated as a capital loss rather than as consumption of fixed capital.

Estimates of net capital stock in South Africa are based on a straight line retirement function. Although different survival retirement functions can be identified, all these methods have some drawbacks. These shortcomings stem mainly from differences in the extent to which users are either retained or discarded in economic recessions or cyclical upswings. The issue is complicated further by changes in the economically useful lives of assets caused by monetary or fiscal policies, such as investment incentives and the scrapping of capital subsidies or grants.

The difference between the gross and net calculation of fixed capital stock and the calculation of the average age of capital stock according to type of asset is dealt with briefly in the following section.

## 2.3 The lifetime and age of capital stock

To calculate the value of the net capital stock according to the perpetual inventory method, it is essential to estimate the economic lifetimes of assets. The Reserve Bank's estimates of economic lifetimes of the different types of assets vary between an indefinite period for government construction works and a maximum of 80 years for construction works in the agricultural sector, and a minimum of 8 years for transport equipment (see Table 1). An international comparison of the economic lifetime of assets shows that the Bank's estimates generally correspond with those used in industrial countries such as the United States of America, United Kingdom, Germany, Italy and Belgium. Although the level of capital stock at a specific point in time will differ depending on the economic lifetime used in the calculation of fixed capital stock for a specific type of asset, a trend analysis, as illustrated in Graph 1, shows that the difference in the general trend over time between estimates of capital stock based on different lifetimes is relatively small.

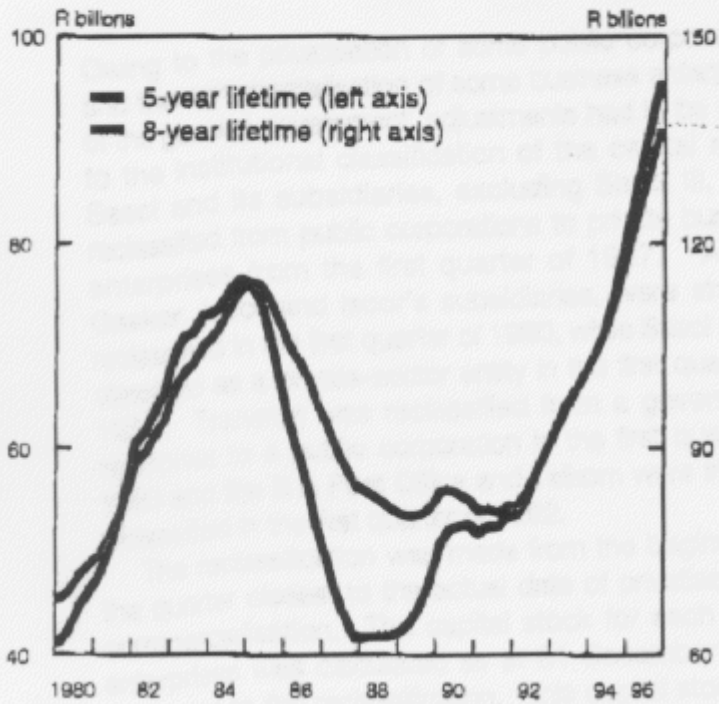
The calculated net capital stock is essentially a weighted average of past real investment spending. The weights assigned to real investment spending in past periods decline with an increase in the age of the assets. In contrast, "gross" Capital stock is calculated using weights of which the values remain fixed at the value of one until the capital good is retired. The gross stock therefore represents cost of the total investment over time in a specific asset that is still used in the production process,

Graph 2 illustrates the estimated values of gross and net capital stock of machinery and equipment. From the graph it is clear that the cyclical movement in the two series is almost identical. However, in the example the gross capital stock lags the net capital stock by two quarters at the peak of the cycle and by five quarters at the lower turning-point of the cycle. In some studies it is argued that it is important to use the concept of gross stock to determine the relationship between fixed capital stock and current output. Over a fairly short period of time it is meaningful to compare current output with capital input, measured as a function of all assets still in operation. However, over a longer period of time the capacity of the stock measured by its unexpired life expectation becomes more relevant, because the regularity in the depreciation of the capital stock is in keeping with the declining production capacity of assets as time moves on.

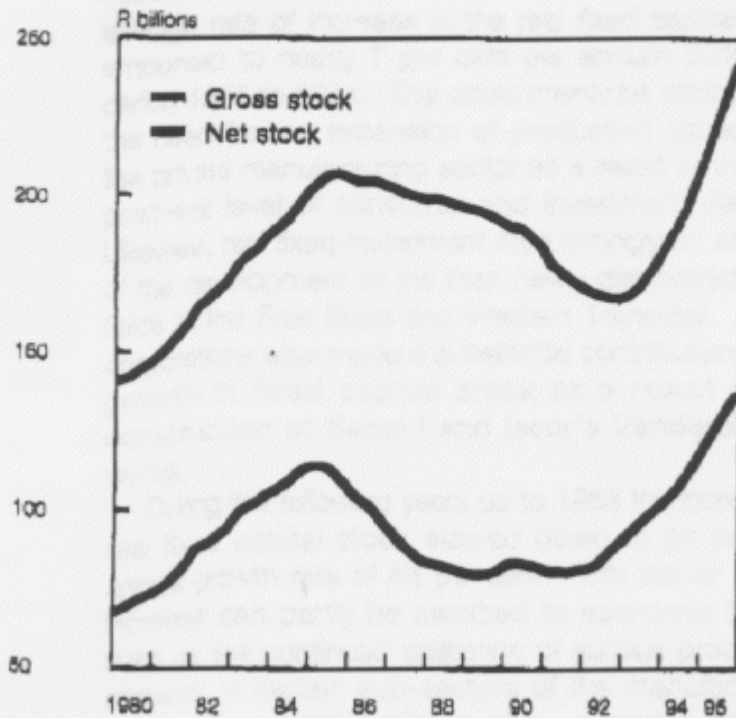
**Table 1. The economic lifetime according to type of asset**

Type of asset	Sector	Lifetime
Residential buildings		50 years
Non-residential buildings		50 years
Construction works	Agriculture	80 years
	Mining	30 years
	Other	50 years
	General government	Indefinite
Transport equipment		
Machinery and other equipment	Manufacturing	8 years
	Mining and electricity, gas and water	16 years
	Other	10 years

**Graph 1. Fixed capital stock of machinery and equipment with economic lifetimes of 5 and 8 years**

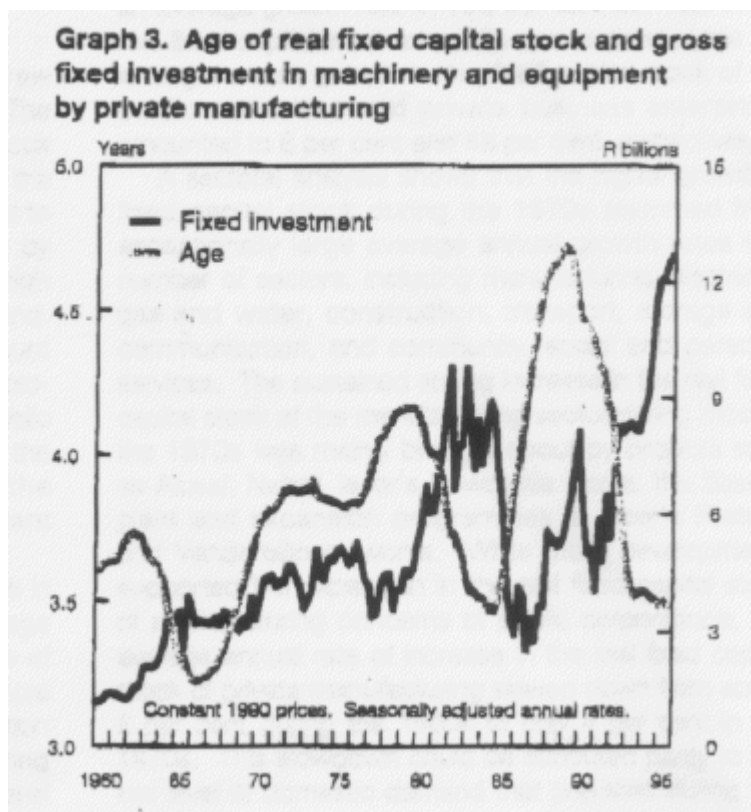


**Graph 2. Gross and net fixed capital stock of machinery and equipment with a lifetime of 8 years**



The perpetual inventory method also makes it possible to calculate the *average age of the capital stock* for assets with the same lifetime. An analysis of the average age of capital stock evaluates the necessity for replacement demand. Over the lifetime of an asset the capital expenditure which took place in each period is multiplied by the period of investment and the sum of the weighted investment is divided by the capital stock to reflect the average age of the capital stock.

Graph 3 shows the relationship between the age in years of real gross fixed capital stock and real fixed investment in machinery and equipment by the private manufacturing sector. The average age of the asset and fixed investment cycles are negatively correlated. The general ageing of capital equipment carries an obvious risk of technological obsolescence and backwardness and, potentially, a loss of competitiveness of a country's products in the international markets. The historical high age of machinery and equipment in South Africa in the first quarter of 1988 reflected the need for the replacement of obsolete stock at that point in time. The general upward trend in real outlays on machinery and equipment, which had started in the first quarter of 1986, brought the average age of machinery and equipment down from 4.72 years in the first quarter of 1989 to 3.49 years in the fourth quarter of 1995, i.e. below the long-term average of 4 years.



### 3. Privatisation and the institutional classification of capital stock

Owing to the privatisation of some public corporations and the commercialisation of some business enterprises of the general government, adjustments had to be made to the institutional classification of the capital stock. Sasol and its subsidiaries, excluding Sasol III, were reclassified from public corporations to private business enterprises from the first quarter of 1987. Alusaf, Gaskor, Iscor and Iscor's subsidiaries, were similarly reclassified in the first quarter of 1990, while Sasol III was classified as a private-sector entity in the first quarter of 1991. Transnet was reclassified from a government enterprise to a public corporation in the first quarter of 1990 and the S A Post Office and Telkom were similarly reclassified in the first quarter of 1992.

The reclassification was made from the beginning of the quarter closest to the actual date of privatisation or commercialisation. The capital stock for each of the enterprises was calculated

as at 31 December of the year prior to the reclassification. This capital stock was then subtracted from the one institutional aggregate and added to the other. This means that the values of the capital stock of the institutional sectors are not consistent over time. However, the value of capital stock classified according to economic sector is still consistent.

#### **4. Growth in real fixed capital stock**

Total real fixed capital stock in South Africa grew substantially in the immediate post-war period. The average rate of increase in the real fixed capital stock amounted to nearly 7 per cent per annum during the period 1946 to 1954. This could mainly be attributed to the need for the expansion of production capacity by the private manufacturing sector as a result of the high post-war level of consumer end investment demand. Likewise, real fixed investment rose strongly on account of the development of the then newly discovered goldfields in the Free State and Western Transvaal. Public corporations also made a substantial contribution to the growth in fixed capital stock as a result of the construction of Sasol I and Iscor's Vanderbijipark works.

During the following years up to 1963 the increase in real fixed capital stock slowed down to an average annual growth rate of 4½ per cent. This slower rate of increase can partly be ascribed to economic factors such as the continued existence of surplus production capacity in certain sub-sectors of the manufacturing sector, competition from abroad and a general slowdown in economic activity. The uncertainty and decline in confidence engendered by political developments in the beginning of the 1960s also contributed to the slowdown. However, for the remainder of the 1960s the growth in real fixed capital stock rose to an annual average rate of 6 per cent. As confidence improved and surplus capacity declined fixed capital outlays in both the private and public sectors recorded pronounced increases in the second half of the 1960s. The real fixed capital stock of the public corporations increased at an average rate of 11.4 per cent per annum in the period 1965 to 1969, compared with an average growth rate of 5 per cent in the preceding five years. The main contributions to this rapid growth were made by Eskom and Iscor. On the other hand, the rise in the fixed capital stock of the public authorities was boosted by increases in fixed capital outlays by the general departments of central government, mainly on water works, housing and development of the railway and harbour networks.

Although the private fixed capital stock which represents the most important component of the total fixed capital stock, increased at a lower rate than the capital stock of the public sector during the 1960s, an acceleration in the growth rate was noticeable from 1963 to the beginning of the 1970s. This better performance of the private fixed capital stock was the net result of a strong upward movement in the capital stock of manufacturing, construction, commerce and finance, as against lower growth of the capital stock in agriculture and mining.

For the period 1970 to 1979 the growth in the total real fixed capital stock maintained an average rate of 6 per cent per annum. This could mainly be ascribed to an average growth rate of 13½ per cent per year in the real fixed capital stock of public corporations, while the average annual growth in the fixed capital stock of the public authorities and private business enterprises amounted to 6 per cent and 4½ per cent, respectively.

A sectoral analysis shows that the higher growth in fixed capital stock during the 1970s stemmed from exceptionally large average annual growth rates in a number of sectors, including manufacturing, electricity, gas and water, construction, transport, storage and communication, and community, social and personal services. The sustained strong increase in the real fixed capital stock of the manufacturing sector during most of the 1970s was mainly brought about by projects such as Alusaf, Natref, Iscor's Newcastle works, the Sasol II plant and expansion programmes at Iscor's Pretoria and Vanderbijipark works. While these developments supported the expansion in the real fixed capital stock of manufacturing concerns of public corporations, the average annual rate of increase in the real fixed capital stock of private manufacturing slowed down from about 8 per cent during the 1960s to only 4 per cent in the 1970s. This slowdown could be attributed partly to the low level of domestic demand that prevailed during the 1974-77 downswing of the economy and the consequent existence of surplus production capacity.

**Table 2. Growth in total real fixed capital stock by kind of economic activity**

Percentage change

Period	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water	Construction	Wholesale and retail trade, catering and accommodation	Transport, storage and communication	Finance, insurance and real estate and business services	Community, social and personal services	Total
1960	1.5	3.9	3.0	4.1	2.4	4.5	4.6	3.7	10.2	4.9
1961	1.7	4.9	3.2	3.7	2.7	4.2	3.6	2.5	6.7	3.9
1962	1.6	1.9	3.7	3.6	4.2	3.6	3.1	2.0	6.5	3.4
1963	2.0	1.0	10.3	3.8	27.7	4.1	4.5	3.2	6.3	4.5
1964	2.5	2.4	16.3	2.6	23.4	5.2	4.9	5.0	6.7	5.7
1965	2.0	2.8	15.3	4.8	19.8	6.5	6.7	6.0	8.1	6.8
1966	1.6	-0.1	11.2	7.4	14.5	5.4	5.7	5.4	7.7	5.9
1967	2.1	0.1	6.6	7.6	5.8	5.7	5.9	6.1	6.9	5.6
1968	3.5	0.6	4.2	9.6	3.4	4.2	5.1	5.8	7.1	5.4
1969	3.8	1.4	4.5	8.1	11.6	6.4	4.1	7.2	8.3	6.0
1970	3.5	2.6	8.2	7.2	11.0	9.3	4.2	8.1	8.3	6.8
1971	3.9	2.1	7.9	7.2	6.5	9.0	6.1	7.6	9.0	7.1
1972	2.9	1.5	8.1	5.7	20.8	7.9	8.4	6.1	9.0	7.0
1973	2.4	3.2	10.3	5.0	24.9	7.5	7.1	6.9	7.2	6.8
1974	2.9	5.9	9.3	4.6	18.3	6.8	7.5	6.2	7.4	6.8
1975	5.0	11.4	7.8	7.2	13.4	5.3	9.1	5.0	7.2	7.1
1976	2.4	10.8	4.9	9.1	7.1	4.8	9.2	4.0	6.1	6.2
1977	1.9	6.5	5.3	11.7	4.2	3.8	5.6	2.5	5.1	4.9
1978	1.0	5.4	6.8	11.1	2.7	1.1	2.9	2.5	4.1	4.1
1979	0.7	8.0	8.3	9.7	1.9	0.5	2.2	2.0	4.0	4.1
1980	2.9	10.6	13.3	8.4	3.7	0.7	2.2	3.5	3.7	5.1
1981	4.9	10.0	10.3	7.7	3.8	2.8	3.3	4.6	3.7	5.4
1982	0.8	7.6	6.8	8.5	1.8	4.0	4.3	3.9	3.1	4.6
1983	-0.9	5.3	5.3	8.3	1.5	2.8	2.5	4.1	2.9	3.8
1984	-2.2	5.1	2.6	8.7	1.6	3.6	1.2	4.4	2.8	3.3
1985	-2.8	5.4	-1.1	6.6	-0.6	4.5	1.7	3.2	2.7	2.5
1986	-3.6	4.6	-3.2	1.5	-4.1	0.2	0.6	1.8	2.6	1.0
1987	-3.7	4.8	-3.1	0.2	-4.9	-0.3	0.0	2.0	2.4	0.8
1988	-2.8	5.3	-1.5	-1.3	-3.6	1.7	-0.3	3.1	2.4	1.2
1989	-1.5	4.3	2.4	-0.9	-3.1	0.1	-0.4	2.7	2.6	1.6
1990	-1.8	3.1	4.4	-1.4	-1.4	0.4	-0.6	1.5	2.4	1.4
1991	-2.2	2.1	3.0	-2.9	-0.5	0.7	0.1	1.0	1.9	0.9
1992	-2.4	0.1	2.5	-3.0	-2.1	1.0	-0.3	0.8	2.1	0.6
1993	-2.2	-2.0	2.8	-3.5	-3.2	1.0	-0.2	0.7	2.0	0.5
1994	-1.0	-1.0	3.2	-2.8	-1.8	1.7	-0.4	1.3	1.9	0.9
1995	-0.6	-0.5	4.6	-1.7	-0.3	2.4	0.0	1.7	1.7	1.3
Average for the period										
1960-1969	2.2	1.9	7.7	5.5	11.2	5.0	4.8	4.7	7.4	5.2
1970-1979	2.6	5.7	7.7	7.8	10.8	5.6	6.2	5.1	6.7	6.1
1980-1989	-0.9	6.3	3.0	4.7	-0.4	2.0	1.5	3.3	2.9	2.9
1990-1995	-1.7	0.3	3.4	-2.6	-1.5	1.2	-0.2	1.1	2.0	0.9

In the sector supplying electricity, gas and water, the real fixed capital stock increased at an average annual rate of nearly 8 per cent during the 1970s compared with a rate of 5.4 per cent in the preceding decade. This acceleration in the growth rate of fixed capital stock reflected increased capital outlays by Eskom on its nuclear and other power stations.

The sector transport, storage and communication showed a marginally higher percentage

increase in real fixed capital stock than that of the overall economy during the 1970s. This development stemmed from capital expenditure by the former South African Railways and Harbours Administration and the Department of Posts and Telecommunications to provide an adequate transportation and communications infrastructure. This expenditure also included the acquisition of new aircraft for the South African Airways and the construction of the Richards Bay railway line and harbour. The expansion of the fixed capital stock by the private transport sector during the mid-1970s could be attributed entirely to the acquisition of ships and containers for the containerisation programme and the exportation of iron ore, following the completion of the Sishen-Saldanha railway line.

The sustained high rate of increase in real fixed capital stock of the sector community, social and personal services during the period 1970 to 1979, which amounted to an average annual rate of more than 6½ per cent, was largely brought about by the relatively high level of capital formation by the public sector on economic and social infrastructural development, such as roads, bridges, water schemes, schools, hospitals and the establishment of a television service.

During the 1970s the average annual growth in real fixed capital stock of the mining, commercial and financial services sectors varied between 5 and 5½ per cent. Although this was below the average annual growth rate in fixed capital stock for the economy as a whole, it exceeded the average growth rate in capital stock for these sectors in the preceding decade. In the mining sector the growth rate accelerated from an average of 2 per cent per year during the 1960s to 5½ per cent in the 1970s. This could be attributed to the relatively high level of investment at several gold mines, uranium plants and platinum mines during that period. The somewhat higher rate of increase in the real fixed capital stock of finance, insurance, real estate and business services during the 1970s was mainly accounted for by a high level of capital expenditure by leasing organisations and strong growth in real investment in private residential buildings.

Growth in real fixed capital stock slowed down substantially in the 1980s. A sectoral analysis shows that this slowdown was evident in all the major sectors of the economy apart from mining. In the case of the agricultural and construction sectors, the level of real fixed capital stock actually decreased at average annual rates of 1 per cent and ½ per cent respectively, while for the economy as a whole the growth in real fixed capital stock subsided to an average annual rate of 3 per cent.

The decline in the capital stock of the agricultural sector reflected the recurring drought conditions that obviously had a negative influence on investment, while the increase in the cost of agricultural finance to more market-related levels may also have contributed to the lower rate of capital formation in agriculture.

In the mining sector, the real fixed capital stock rose at an average rate of 6½ per cent per annum during the 1980s. This was partly the result of new developments and capacity expansions in the gold as well as the non-gold-mining industry at the beginning of the 1980s. Fixed investment activity in the mining sector accelerated during the mid-1980s on account of increased export demand for metals and minerals as well as the beneficial effect of the depreciation of the rand on mining profitability.

Most of the sub-sectors in the secondary and tertiary sectors of the economy experienced low or even negative growth in their real fixed capital stock during the second half of the 1980s. These developments were largely the result of various extraneous factors and developments which began to affect overall economic performance at about the same time. They included the negative effect of successive years of drought and the forward and backward linkages of the lower agricultural production on the rest of the economy, the completion of large expansion projects by Sasol and the decision by certain public corporations and business enterprises of general government to raise the cost-effectiveness of their operations and to become more responsive to market forces. The latter involved programmes of planned reduction in fixed capital expenditure by institutions such as Eskom, Transnet, Telkom and the South African Post Office to benefit fully from excess capacity brought about by substantial

investment programmes during the late 1970s and the beginning of the 1980s. In addition, an increase in civil unrest, growing negative foreign perceptions of the South African socio-economic and political situation, trade sanctions and boycotts, disinvestment by foreign business concerns and South Africa's exclusion from the international capital markets, as well as a "diffused" lack of confidence and a generally enhanced sense of uncertainty about the future, adversely affected fixed capital formation during those years.

Real fixed capital stock in the manufacturing sector recorded noticeable declines in the second half of the 1980s and receded at an average annual rate of 1½ per cent between 1985 and 1989. Large declines in gross fixed capital formation in the manufacturing sector during this period could, among other things, be attributed to an increase in the level of the relative "user cost" of capital goods<sup>1</sup>. After it had reached a lower turning-point in 1979 (see Graph 4), the relative user cost of capital rose moderately in the first four years of the 1980s. However, from 1983 to 1986 it increased strongly to a level that was about 18.5 per cent higher than in 1979. This reflected the cost-raising effect of successive declines in the effective exchange rate of the rand on the domestic prices of capital goods during this period. In addition, the relative user cost of capital also increased in 1984 and 1985 because of the higher level of domestic interest rates arising from the adverse balance of payments developments in those years and from the authorities' strict countervailing monetary policies.

From 1987 to 1991 the relative user cost of capital fluctuated along an upward trend to reach a historical high in 1991. Consequently, the growth in real fixed capital stock in the manufacturing sector was fragile during this period on the whole and only turned positive in 1989, mainly as a result of stepped-up investment outlays on projects such as Mossgas and Mossref. As the relative user cost of capital receded from 1992 to 1995, the growth in real fixed capital stock in the manufacturing sector accelerated from 2½ per cent in 1992 to 4½ per cent in 1995.

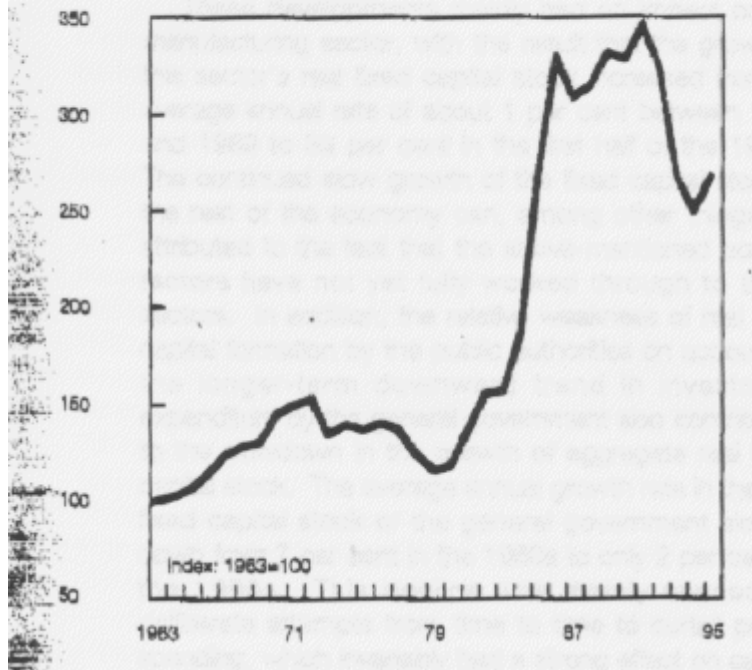
In the period 1990 to 1995 expansion in the real fixed capital stock of the economy as a whole slowed down considerably to an average of 1 per cent per annum against the long-term average of 4 per cent. This was the net result of declines in the level of the real fixed capital stock in the sectors agriculture, construction, transport, storage and communication and the sector supplying electricity, gas and water, which almost neutralised increases in the real fixed capital stock of the other sectors of the economy.

A contributing factor to the decline in the growth in real fixed capital stock during the 1990s is that the increase in gross fixed investment fell short of the growth in the depreciation allowance from 1989 to 1993. The ratio of net fixed investment and depreciation allowances relative to gross domestic fixed investment remained fairly stable throughout the period 1960 to 1983 and the gap between net fixed investment and depreciation allowances as a ratio of gross domestic fixed investment never exceeded a range of 20 per cent. However, from 1984 the gap between these two ratios widened and reached a high of about 80 per cent in 1987, before it decreased to less than 60 per cent in 1989. During the 1989-1993 downswing of the economy the gap increased again to 80 per cent in 1993, and then improved again to 60 per cent in 1995.

---

<sup>1</sup> The user cost of capital comprises elements of costs (or benefits) such as the price of new capital goods, depreciation allowances, long-term interest rates and various taxes (or tax concessions) pertaining to the purchase, leasing or operation of the capital goods concerned. The relative user cost of capital is the ratio of the user cost of capital to the general level of manufacturing output prices.

**Graph 4. The relative user cost of capital in the manufacturing sector**



The gap between the above-mentioned ratios and the resultant weak growth in real fixed capital stock can be seen as part of the secular decline in capital formation that dates back to the early 1980s. Many of the causal factors behind the slowdown in the growth of fixed capital stock have turned around since 1993 and worked towards a strengthening of investment. These factors included:

- Financial sanctions imposed a binding balance-of-payments constraint from 1985. Lack of access to international capital markets forced South Africa to maintain current account surpluses to meet scheduled amortisations. This was achieved by more restrictive domestic financial policies than would have been necessary under other circumstances, thereby limiting investment to the amount of available domestic savings. Meanwhile, an expansion in government spending on social services led to reduced public saving.
- Uncertainty about South Africa's political future was pervasive. Investors apparently adopted a wait-and-see approach on account of such uncertainty.
- Factor price developments over the past decade were inimical to growth and employment creation. The South African labour market was dominated by strong and militant labour unions that negotiated successfully for high real wages that were not matched by productivity growth. The consequent distortion of relative factor prices undermined the economy's long-term growth potential and the inducement to invest waned.
- The user cost of capital rose strongly between 1983 and 1991, reflecting higher real (and expected real) lending rates, higher corporate taxes and fewer tax rebates as investment allowances were phased out and initial allowances reduced.
- The fact that the profitability of the corporate sector showed a downward trend, especially in the late 1980s and the beginning of the 1990s, contributed to the reluctance of the private sector to expand its fixed investment.

- During the 1989-1993 recession the percentage utilisation of production capacity in the manufacturing sector dropped from about 85 per cent in the second quarter of 1989 to a historical low of 77 per cent in the third quarter of 1992. Excess production capacity is not, of course, conducive to the creation of additional capacity.

The reversal of many of these factors after 1993 was largely responsible for the stronger growth in fixed investment that then developed. This better performance of investment was particularly due to:

- the lifting of trade sanctions, the reduction in political uncertainty and the decline in the aggregate level of politically inspired violence in the country, which encouraged investment expenditure by domestic and foreign investors;
- the unsolved problems in the labour market and the high level of real unit labour costs which still benefited the production factor capital relative to labour;
- the decline in the user cost of capital in 1993 and 1994;
- the sharp rise in the percentage utilisation of production capacity in the manufacturing sector during the current economic upswing;
- the noticeable rise in the profitability of the corporate sector from the beginning of 1992;
- the recent shift in the composition of the capital stock towards machinery and equipment which depreciate comparatively rapidly, away from fixed structures which depreciate comparatively slowly, accelerated investment demand for asset replacement; and
- a temporary tax incentive system in terms of section 37E of the Income Tax Act which allowed for notable depreciation concessions in order to encourage fixed investment in metals and minerals beneficiation projects.

These developments mainly had an impact on the manufacturing sector, with the result that the growth in this sector's real fixed capital stock increased from an average annual rate of about 1 per cent between 1982 and 1989 to 3½ per cent in the first half of the 1990s. The continued slow growth of the fixed capital stock in the rest of the economy can, among other things, be attributed to the fact that the above-mentioned positive factors have not yet fully worked through to these sectors. In addition, the relative weakness of real fixed capital formation by the public authorities on account of the longer-term downward trend in investment expenditure by the general government also contributed to the slowdown in the growth of aggregate real fixed capital stock. The average annual growth rate in the real fixed capital stock of the general government slowed down from 7 per cent in the 1960s to only 2 per cent in the 1990s. This decline was mainly caused by deliberate attempts from time to time to curtail public spending, which invariably had a strong effect on capital rather than on current expenditure.

## **5. The composition of fixed capital stock**

As already indicated, the privatisation and commercialisation of a number of public corporations and business enterprises of general government between 1987 and 1992 have affected the comparability of the value of fixed capital stock classified according to institution and function over time. In the period before the privatisation of public corporations there was some distortion in the allocation of the total fixed capital stock in the sense that investment was increasingly channelled towards public sector activities, with a much lower direct productivity than the private sector. The share of the private sector in the total fixed capital stock receded from an average of more than 51 per cent in the 1960s to 43½ per cent in the first half of the 1980s. As a result of the substantial decline in fixed investment by public corporations since 1984, the private sector has increased its share of the country's capital stock but this ratio was also influenced by privatisation. On account of these developments, the changes in the composition of the capital stock in the South African economy are

described in the following section according to the kind of economic activity and by type of asset only.

### 5.1 Fixed capital stock by kind of economic activity

A sectoral analysis of the distribution of the fixed capital stock by kind of economic activity shows that the proportionate share of the sectors responsible for construction works, commerce and financial and related services registered very little change between the 1960s and the first half of the 1990s. The relative stability of these sectors' contribution to the level of total fixed capital stock can mainly be ascribed to the generally subsidiary role played by the services sector in the process of economic development.

**Table 3. The composition of total fixed capital stock by kind of economic activity**

Sectors	Average for the period			
	1960 to 1969	1970 to 1979	1980 to 1989	1990 to 1995
Agriculture, forestry and fishing	10.3	7.5	5.5	4.2
Mining and quarrying	7.7	5.8	7.4	8.4
Manufacturing	9.1	10.7	12.5	12.5
Electricity, gas and water	6.5	7.0	9.4	8.5
Construction	0.5	0.8	0.7	0.5
Wholesale and retail trade, catering and accommodation	5.4	5.4	4.7	4.6
Transport, storage and communication	17.2	17.0	15.7	14.2
Finance, insurance, real estate and business services	20.8	20.4	19.3	20.3
Community, social, and personal services	22.5	25.4	24.8	26.8
Total	100.0	100.0	100.00	100.0

The mining sector's share in total fixed capital stock declined from 7½ per cent in the 1960s to 6 per cent during the 1970s, but then rose again to 8½ per cent in the beginning of the 1990s. The recent recovery in the mining sector's share in aggregate fixed capital stock mainly reflected investment in new diamond, coal and "other" mining developments in the late 1980s and the early 1990s.

The proportionate share of the fixed capital stock of agriculture and the sector transport, storage and communication declined almost without interruption since 1960. Fixed capital stock in the agricultural sector, as a percentage of total fixed capital stock receded from an average of 10½ per cent in the 1960s to 4 per cent from 1990 to 1995. Likewise, the transport, storage and communication sector's share in the fixed capital stock shrank from 17 per cent in the 1960s to 14 per cent in the first half of the 1990s. The decline in the relative importance of the agricultural sector in total fixed capital stock is broadly consistent with the process of economic development, typified firstly by a reduction in the share of agriculture in total production and secondly by the consolidation of farming units and the subsequent cut-down on physical infrastructural developments and investment outlays per farming unit. In addition, the decline in the proportionate share of the sector transport, storage and communication is also not unexpected. Initially, large amounts were invested in the railway and road transport

systems to establish an efficient transportation network. During the 1980s, the deregulation of transportation and the subsequent downsizing of unprofitable transport systems by Transnet also contributed to the diminishing share of transportation service in the total fixed capital stock.

The share of manufacturing and the sectors providing electricity, gas and water and community, social and personal services, to total fixed capital stock rose noticeably between the 1960s and the first half of the 1990s. The ratio of manufacturing increased from an average of 9 per cent in the period 1960 to 1969 to 12½ per cent in the years 1990 to 1995. This increase was the net result of moderate growth in the share of the fixed capital stock of private manufacturing, which was strengthened in the net half of the 1990s by investment in large capital projects such as the Columbus stainless steel plant and the Alusaf aluminium smelter, as well as investment by public corporations in strategically important industries.

The share of the fixed capital stock of the sector electricity, gas and water rose from an average of 6½ per cent in the 1960s to a peak of 9½ per cent during the 1980s, before falling back to an average of 8½ per cent between 1990 and 1995. This increase can mainly be attributed to an intensive capital expansion programme of Eskom between 1974 and 1984, which was based on an overly optimistic assessment of South Africa's future growth prospects and, more recently, the expansion of the electricity distribution network to lesser developed regions in the country.

## **5.2 Fixed capital stock by type of asset**

The asset composition of the real fixed capital stock between 1960 and 1995 is presented in Table 4. On average, the proportionate share of buildings and construction works in total fixed capital stock of about 80 per cent and machinery and transport equipment of about 20 per cent showed little change since the 1960s. In the 1970s and 1980s the share of buildings and construction works receded to 77½ and 76 per cent respectively for the two periods, while the share of machinery and transport equipment rose to 22½ and 24 per cent. These increases in the relative share of accumulated investment in machinery and equipment resulted mainly from an increase in the capital intensity of the production processes of public corporations.

A breakdown according to type of asset shows that the share of residential buildings relative to total fixed capital stock declined from an average of 20½ per cent in the 1960s to 17 per cent in the period between 1990 and 1995, while the corresponding ratio for non-residential buildings for the same periods rose from about 18½ per cent to 22 per cent. The increase in the relative importance of investment in non-residential buildings was related to sustained increases in the real fixed capital stock of the sectors commerce, finance and community, social and personal services. Broadly similar trends were recorded in the distribution of the fixed capital stock between machinery and equipment and transport equipment. In the case of transport equipment the ratio receded from an average of 8 per cent in the 1960s to 6½ per cent in the first half of the 1990s, while for machinery and equipment the ratio increased from 12 per cent to 14½ per cent for the corresponding periods.

**Table 4. The composition of total fixed capital stock by type of asset**

Type of Asset	Average for the period			
	1960 to 1969	1970 to 1979	1980 to 1989	1990 to 1995
Residential buildings	20.3	18.4	17.0	17.1
Non-residential buildings	18.7	19.2	19.1	21.9
Construction works	37.3	36.7	37.0	38.8
Transfer costs	3.9	3.4	3.0	3.4
Total: Buildings and construction works	80.2	77.7	76.1	79.0
Transport equipment	8.0	8.5	7.9	6.5
Machinery and other equipment	11.8	13.8	18.0	14.5
Total: Equipment	19.8	22.3	23.9	21.0
Total	100.0	100.0	100.00	100.0

The decline in the proportionate share of the fixed capital stock of transport equipment was particularly evident since 1985. This decline can be attributed to the sustained higher level of real interest rates since 1985, the sharp rise in the relative prices of transport equipment from the middle of the 1980s, the very long recessionary period experienced by the South African economy between 1989 and 1993 and smaller investment by Transnet in transport equipment as part of their rationalisation programmes during the second half of the 1980s. In contrast, the increase in the share of the fixed capital stock of machinery and equipment came from the growth in real fixed investment in these types of assets since the late 1980s, which has outpaced that of all other major classes of assets. In addition, the increase also reflects a shift from structures to equipment in the composition of the total fixed capital stock. This shift was most likely occasioned by the faster growth in the efficiency of equipment relative to that of structures. In particular, the revolution in computer and communications technology improved the price-performance ratio for equipment far more than the recent improvement in this ratio for structures.

## 6. The efficiency of fixed investment

The efficiency of investment is normally evaluated by the size and changes in the capital-output ratio, i.e. the proportion of the real gross domestic product to real fixed capital stock. This ratio gives an indication of the amount of capital utilised per unit of output.

An international comparison between the incremental capital-output ratio<sup>2</sup> (ICOR) in South Africa and some East Asian countries (see Table 5) clearly indicates the decline that took place in the efficiency of investment in South Africa relative to investment in the East Asian countries. In the beginning of the 1970s the incremental capital-output ratios for the selected countries varied between 1.54 and 2.51, while the ratio for South Africa was somewhat higher at 3.13. Although the ratio then increased in all the countries in the second half of the 1980s, it rose much more substantially in South Africa than in the East Asian economies.

<sup>2</sup> The average change in real fixed capital stock relative to the increase in real gross domestic product.

**Table 5. The incremental capital-output ratio for South Africa and some East Asian countries**

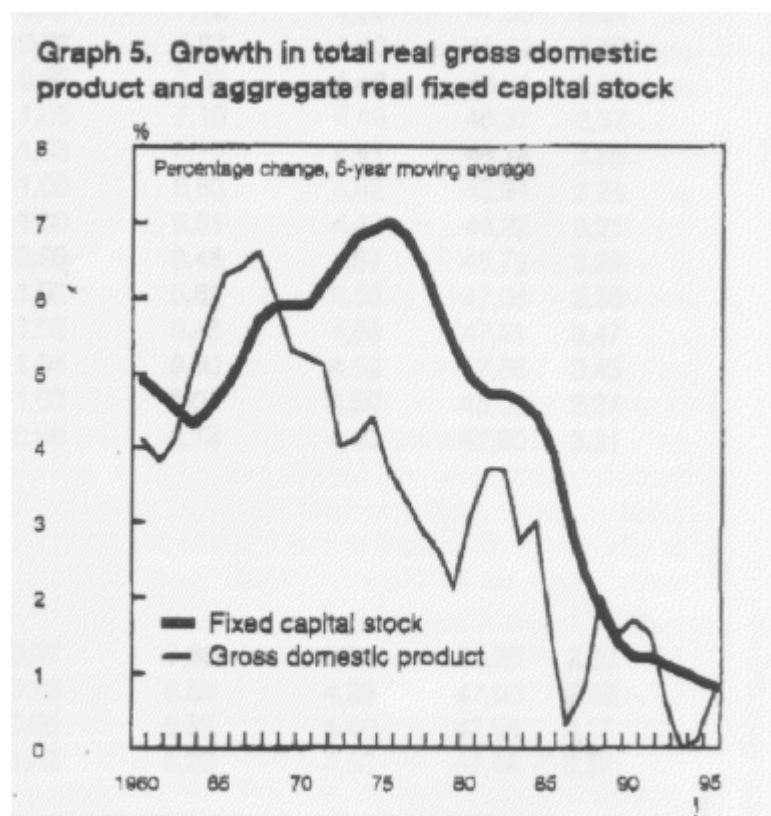
Period	Korea	Singapore	Thailand	Malaysia	South Africa
1971-74	1.54	2.51	2.12	1.62	3.13 <sup>1)</sup>
1975-79	1.98	2.81	1.86	1.99	5.34
1980-84	3.22	3.26	2.09	2.63	4.42
1985-88	1.96	4.30	1.88	2.99	6.56 <sup>2)</sup>
1990-95					5.24

<sup>1)</sup> 1970-74

<sup>2)</sup> 1985-89

Source: Larrain & Vergers (1993: 263)

In Table 6 the average capital-output ratios are provided for selected sectors and for the economy as a whole. The average capital-output ratio generally increased in all the main sectors, except agriculture, between 1960 and 1995. The rate of increase in the aggregate capital-output ratio nevertheless slowed down and then receded somewhat in the 1990s, when some sectors recorded declines in their capital-output ratios.



**Table 6. The capital-output ratio by kind of economic activity**

Percentage change

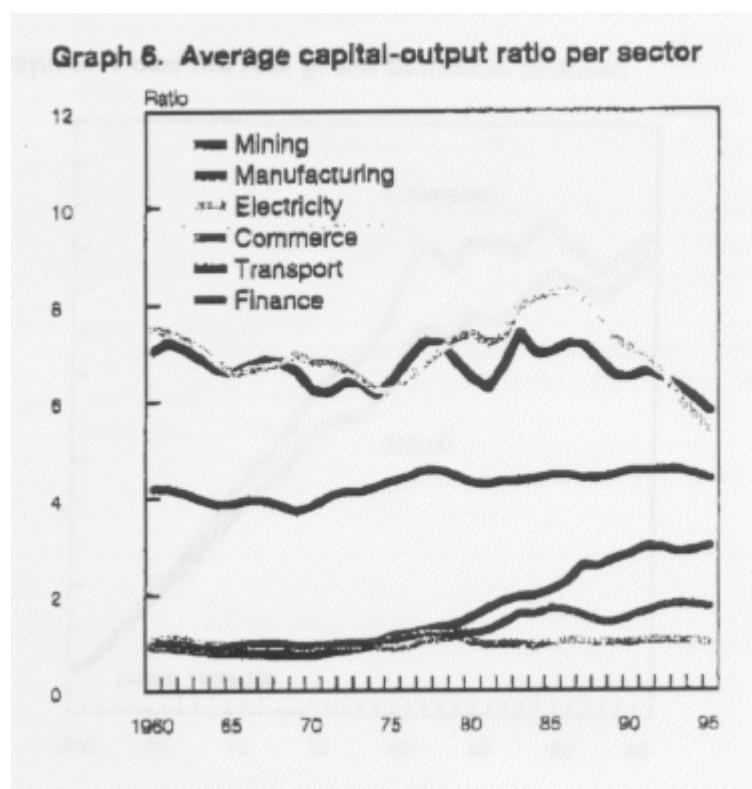
Period	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water	Construction	Wholesale and retail trade, catering and accommodation	Transport, storage and communication	Finance, insurance and real estate and business services	Community, social and personal services	Total
1960	4.10	0.92	0.98	7.52	0.21	1.06	7.05	4.21	29.01	2.41
1961	4.02	0.91	0.97	7.42	0.22	1.09	7.24	4.20	30.02	2.41
1962	3.87	0.88	0.94	7.29	0.22	1.06	7.07	4.10	30.63	2.36
1963	3.81	0.84	0.88	7.10	0.23	0.99	6.88	3.98	31.75	2.29
1964	4.40	0.80	0.86	6.80	0.23	0.95	6.66	3.87	32.03	2.23
1965	4.46	0.79	0.93	6.57	0.23	0.93	6.58	3.89	33.88	2.23
1966	4.20	0.78	0.98	6.68	0.28	0.96	6.75	3.97	35.17	2.27
1967	3.42	0.78	0.98	6.72	0.28	0.93	6.86	3.96	35.52	2.26
1968	3.99	0.76	0.99	6.80	0.27	0.88	6.81	3.85	35.85	2.27
1969	3.95	0.76	0.93	6.99	0.26	0.88	6.63	3.73	38.63	2.26
1970	4.39	0.74	0.93	6.81	0.25	0.87	6.23	3.84	40.25	2.28
1971	3.83	0.80	0.96	6.83	0.24	0.89	6.17	4.03	41.34	2.33
1972	3.99	0.85	0.98	6.67	0.25	0.94	6.39	4.14	44.52	2.44
1973	4.69	0.87	0.98	6.44	0.31	0.92	6.40	4.13	47.11	2.49
1974	3.69	0.99	1.02	6.22	0.33	0.91	6.11	4.23	47.81	2.52
1975	4.20	1.13	1.06	6.21	0.38	0.89	6.43	4.36	49.77	2.62
1976	4.46	1.18	1.10	6.48	0.43	0.93	6.88	4.45	51.18	2.73
1977	4.09	1.25	1.19	6.75	0.48	1.04	7.23	4.58	52.17	2.89
1978	3.99	1.32	1.18	7.04	0.55	1.07	7.22	4.58	52.59	2.93
1979	4.10	1.36	1.17	7.29	0.55	1.12	6.82	4.46	52.29	2.94
1980	3.79	1.52	1.18	7.42	0.52	1.01	6.47	4.31	52.43	2.88
1981	3.74	1.69	1.24	7.19	0.51	0.94	6.25	4.28	50.50	2.88
1982	4.21	1.85	1.39	7.33	0.55	0.97	6.73	4.35	49.22	3.05
1983	5.42	1.95	1.59	7.95	0.59	0.97	7.42	4.36	47.36	3.24
1984	4.80	1.97	1.57	8.14	0.58	0.92	6.97	4.40	45.61	3.19
1985	3.89	2.08	1.70	8.20	0.62	0.99	7.00	4.48	46.04	3.31
1986	3.53	2.25	1.65	8.31	0.66	1.06	7.19	4.49	46.37	3.37
1987	3.32	2.62	1.55	8.09	0.67	1.03	7.17	4.41	46.14	3.35
1988	3.11	2.58	1.43	7.63	0.63	1.00	6.83	4.42	45.94	3.24
1989	2.67	2.73	1.41	7.29	0.56	1.00	6.51	4.48	46.22	3.21
1990	2.83	2.84	1.52	7.09	0.54	0.99	6.48	4.57	46.72	3.29
1991	2.65	2.99	1.64	6.80	0.56	1.02	6.63	4.56	47.06	3.36
1992	3.56	2.98	1.74	6.58	0.59	1.05	6.48	4.58	47.31	3.47
1993	2.80	2.87	1.79	6.11	0.61	1.05	6.30	4.59	47.66	3.43
1994	2.46	2.91	1.78	5.71	0.59	1.03	6.07	4.50	48.00	3.37
1995	2.87	3.00	1.72	5.41	0.58	0.99	5.78	4.40	47.90	3.31
Average for the period										
1960-1969	4.02	0.82	0.94	6.99	0.24	0.97	6.85	3.98	33.25	2.30
1970-1979	4.14	1.05	1.06	6.68	0.38	0.96	6.59	4.28	47.90	2.62
1980-1989	3.85	2.12	1.47	7.76	0.59	0.99	6.85	4.40	47.58	3.17
1990-1995	2.86	2.93	1.70	6.28	0.58	1.02	6.29	4.53	47.44	3.37

As shown in Graph 5, the growth rates of the total real gross domestic product and the aggregate real fixed capital stock broadly corresponded in the beginning of the 1960s. The total capital-output ratio thus remained reasonably constant. After 1967 this situation changed significantly and the two growth rates began to diverge noticeably. The capital-output ratio of the economy as a whole increased at an average annual rate of 1½ per cent from the middle of the 1960s to 1995. The cyclical recovery in the economy after the gold-price boom of 1979-80, the economic upswing of 1987-88 and the recovery since the middle of 1993 had the effect of increasing the growth rate of the gross domestic product to become more on par with that of the capital stock.

During the 1990s the growth in South Africa's real gross domestic fixed capital stock declined to an average annual rate of less than 1 per cent compared with an average annual growth of 5 per cent in the 1960s, 6 per cent in the 1970s and 3 per cent in the 1980s. The rate of increase in real gross domestic product exceeded the rate of increase in total real fixed capital stock during the economic recovery from the middle of 1993. Consequently, the aggregate capital-output ratio declined by 4½ per cent between 1992 and 1995, following an increase of 8 per cent in the period 1989 to 1992.

The recent improvement in capital productivity was discernible in all the major sectors of the economy, with the notable exception of the mining industry. As shown in Graph 6, the capital-output ratios of the electricity and transport sectors have already improved since the late 1980s, reflecting the better utilisation of the production capacity that had been created in these sectors in the early 1980s. The recent levelling-off in the decline of the capital-output ratio of the manufacturing sector was occasioned by stronger output growth arising from the buoyancy of export demand for manufactured goods and the commissioning of the Columbus stainless steel and the Alusaf aluminium plants. The decline in the capital productivity of the mining sector was the combined effect of an increase in capital intensity and the decline in the grade of gold-bearing ore mined. The improvement in the capital-output ratio of the agricultural sector was broadly consistent with the increased competitive pressures faced by the sector and rationalisation of farming units.

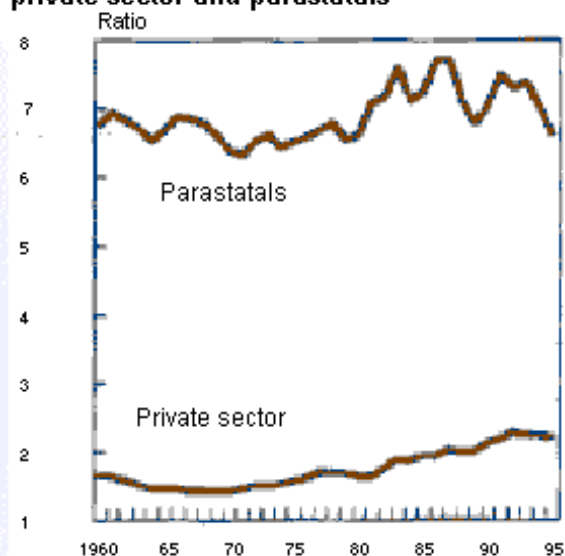
From Graph 6 it is also apparent that the capital productivity of the various production sectors differed markedly: the average amount of capital invested to produce one unit of output is between three and seven times higher in sectors such as electricity, gas and water, transport, storage and communication and the financial services sectors than in the mining, manufacturing and commerce sectors. Graph 7 shows the difference between the capital-output ratios of the "parastatal sector" (i.e. the business enterprises of general government and the public corporations) and the private sector. Although the expansion of infrastructural investment had a stimulatory effect on activity in the private sector, it also had the effect of increasing the share in the capital stock of sectors with low-yielding assets and thus reduced the growth and employment-creating potential of the economy.



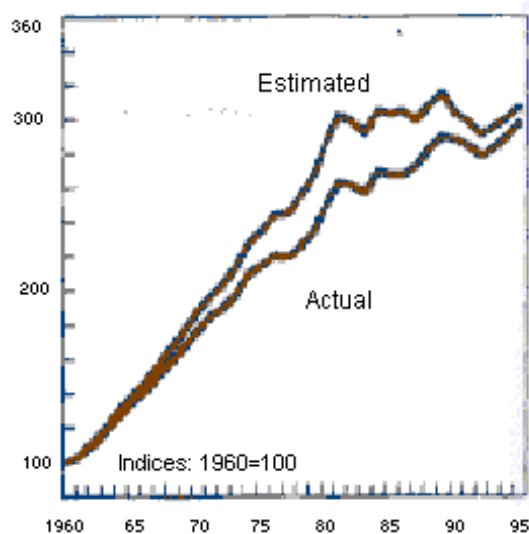
In the period before 1987 when the privatisation of public corporations began, the private sector's share in the total capital stock gradually dwindled. In the period 1960 to 1969 the private sector accounted for 51 per cent of the total real fixed capital stock, while the parastatal sector accounted for 28 per cent. These proportions changed to 43 per cent for the private sector and 34 per cent for the parastatals in the first half of the 1980s. The share in the capital stock of the private sector subsequently rose to an average of 48 per cent at the beginning of the 1990s; privatisation is estimated to have contributed about 4 percentage points to this increase.

Graph 7 shows that the productivity of capital, as measured by the capital-output ratio, is much higher in the private sector than in the parastatal sector. The average capital-output ratio of the parastatals amounted to about 6.9 between 1960 and 1995, which is about four times the size of the average capital-output ratio of 1.7 of the private sector. The shift of the capital stock from the private sector to the parastatals has had a marked impact on the growth of the real gross domestic product. To illustrate this, the level of real gross domestic product was estimated for each year since 1960 under the assumptions that the relative proportions of total fixed capital stock in the private and parastatal sectors remained unchanged at 1960 levels and that the respective sectors' capital-output ratios remained as actually recorded in each year. Although the effect of the reallocation in the composition of capital stock was marginal during the 1960s. It increased significantly during the second half of the 1970s and the early 1980s. At its peak in 1981, the reallocation effect accounted for a difference of approximately 15 per cent between the actual and the estimated level of output. This means that 15 per cent of potential output was forfeited on account of the diversion of the nation's resources in favour of parastatals. The negative impact of the reallocation of fixed investment after the mid-1980s declined, but this can be attributed, at least partly, to the privatisation referred to earlier.

**Graph 7. The capital-output ratios for the private sector and parastatals**



**Graph 8. Potential real gross domestic product**



## **7. Summary and conclusions**

This article presented a brief overview of the measurement and methodology used in South Africa for the calculation of the domestic fixed capital stock and to analyse the growth and changes in the composition of this stock of physical assets. The estimates show that the growth in aggregate real fixed capital stock rose rapidly during the 1960s and 1970s, but then slowed in the 1980s and 1990s.

In the period prior to the privatisation of public corporations there had been a shift in the allocation of total fixed capital stock as investment was increasingly channelled towards public-sector activities. The share of the private sector in total fixed capital stock consequently declined substantially between 1960 and the beginning of the 1980s. Since the second half of the 1980's, however, the private sector has increased its share of total capital stock. The estimates of the average age of machinery and equipment shows that the age of this type of asset reached a high towards the end of the 1980s before it declined to a recent low during 1996. This brought the average age of the stock of machinery and equipment to a level that is notably lower than its long-term average.

Despite the lower growth in aggregate real fixed capital stock, the rate of increase in total real fixed capital stock still exceeded the long-term growth in real gross domestic product. As a result, the total capital-output ratio rose from the 1960s to the 1990s, signalling a deterioration in the efficient usage of capital. An important reason for this development was the shift in the composition of the fixed capital stock from the private sector with a relatively low capital-output ratio to the parastatal sector with a comparatively high capital-output ratio. This had the effect of suppressing both the level and the growth of aggregate real gross domestic output.

In comparison to other countries, particularly some East Asian economies, the South African economy experienced a significant decline in fixed investment rates and a parallel slowdown in gross domestic product growth over the last one and a half decades. The effective use of scarce investment resources to improve the utilisation of the existing capital stock and future additions to this stock will be of great importance in bringing about a higher rate of economic growth and an improvement in the quality of life of all South Africans,

## 8. Bibliography

- Belgium. 1980. Statistieken ten dienste van de bedrijven, hun beschrijving en methodologie, *Statistische studiën nummer 58*, Nationaal Instituut voor de Statistiek.
- Blades, D. 1983. Service lives of fixed assets. *OECD Working paper*, No. 4.
- De Cindio, G. 1993. Average service life of fixed capital in Italy; Results of an ISCO special survey. *21st CIRET conference*.
- De Jager, B. L. 1973. The fixed capital stock and capital output ratio of South Africa from 1946 to 1972, *South African Reserve Bank Quarterly Bulletin*, June.
- Du Piesanle, C. J. 1968. Die bepaaing en die gebruik van kapitaalopbrengsverhoudings. Unpublished M.A, Econ dissertation, Pretoria; University of Pretoria.
- Fallon, P. & Pereira de Silva, L. A. 1994. South Africa: Economic performance and policies. *Informal discussion papers on aspects of the economy of South Africa*, The World Bank Southern Africa Department, Discussion paper 7.
- Hibbert, J., Gritfen, T. J. & Walker, R. L. 1977. Development of estimates of the stock of fixed capital in the United Kingdom. *Review of Income and Wealth*, Vol. 23, p. 117-137.
- Inter-Secretariat Working Group on National Accounts, 1993. *System of National Accounts*. Brussels: Eurostat, New York: UN, Paris: OECD, Washington D. C: IMF.
- Larrain, F. & Vergara, R. 1993. Investment and macroeconomic adjustment: The case of East Asia, in Serven, L. & Solimano, A. (Eds) 1993. *Striving for growth after adjustment: The role of capital formation*. Washington D. C: World Bank.
- Ollnor, S. D. 1989. The formation of private business capital: Trends, recent developments, and measurement issues. *Federal Reserve Bulletin*, December.
- Prais, S. J. 1986. Some international comparisons of the age of the machine stock. *Journal of Industrial Economics*, Vol. 34, No. 3.
- Serven, L. & Solimano, A. 1993. Private investment and macroeconomic adjustment: A survey, in Serven, L. & Solimano, A. (Eds). 1993. *Striving for growth after adjustment: The role of capital formation*. Washington D. C: World Bank.
- Serven, L. & Solimano, A. 1993. Economic adjustment and investment performance in developing countries: The experience of the 1980s, In Serven. L. & Solimano, A. (Eds). 1993. *Striving for growth after adjustment: The role of capital formation*. Washington D. C: World Bank.
- South African Reserve Bank. 1991. South Africa's national accounts, 1946 to 1990. Supplement to *Quarterly Bulletin*, June.
- Swanepoel, C. J. & Van Dyk, J. 1978. The fixed capital stock and sectoral capital-output ratios of South Africa, 1947 to 1977. *South African Reserve Bank Quarterly Bulletin*, September.
- Ward, M. 1976. *The measurement of capital: The methodology of capital stock estimates in OECD countries*. Paris: OECD.