

Changing factor market conditions in South Africa: the capital market – a sectoral description of the period 1970–97

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This article explores changing conditions in South African real capital markets. Noteworthy is the evidence of strong restructuring in this market during the 1990s. Whereas the 1970s and 1980s showed the best investment performance among primary commodity sectors and sectors with strong parastatal involvement, the highest investment rates of the 1990s have been associated with the manufacturing industry. We show that the real user cost of capital and capital productivity contribute plausible determinants of investment rates in South Africa. The extent to which market forces are allowed to bring in line marginal cost and marginal return on capital appears to influence the sustainability of investment.

1. INTRODUCTION

Investment rates in physical capital in South Africa have shown a downward trend for a considerable period of time. The centrality of investment in physical capital stock as a determinant of sustainable long-term economic growth makes such evidence a legitimate source of concern. Given the problems encountered frequently on South African data, a review of sectoral economic data has the advantage of identifying potential obstacles to more sophisticated analysis, and of providing an initial assessment of the plausibility of some simple alternative explanations of investment in South Africa on the basis of exploratory data analysis.

We point to a few of the conclusions to emerge from the discussion that follows, by way of aiding the reader in the digestion of what will amount to a reasonably large amount of information.

First, the evidence points to two distinct forms of structural change in the South African capital market. Relative capital usage by economic sector has been subject to

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steady long-term changes over the full 1970–97 time-frame, suggesting that at least some of the changing patterns of capital usage in the economy cannot be identified exclusively with the changing policy environment of the 1990s. Secondly, a consideration of growth rates in the real capital stock also makes it plausible to suggest that for at least some economic sectors the 1990s mark a structural break – and the altered policy environment may well have been responsible for at least some of these changes. What is most notable about the structural break associated with the 1990s is its coincidence with the emergence of a series of manufacturing sectors as those that maintained the highest investment rates on average over 1990 to 1997. This marks the first point in the 1970–97 time-frame at which manufacturing sectors constituted such an unambiguous leadership position among South African economic sectors.

We also suggest that a possible reason for the restructuring of the South African capital markets may be declining degrees of capital market distortions. What is noticeable about the investment rates of the 1970s and 1980s is that there is a strong presence of sectors with heavy state-led investment activity among sectors maintaining sustained high levels of investment expenditure. Such heavy state-led demand for investment goods may have had distortionary impacts on the cost of capital. Those sectors relying heavily on state intervention show strong declines in their investment activity during the course of the 1990s, being replaced by sectors dominated by the private sector that may have been crowded out by state activity in earlier decades. This suggests that the increased reliance on market forces in the policy environment of the 1990s may be stimulating a restructuring of the South African economy and capital market, and may result in improving the efficiency of production in South Africa.

The data used for this study were provided by the Industrial Development Corporation (IDC), Statistics South Africa (SSA) and the Trade and Industry Policy Secretariat (TIPS).

2. CAPITAL STOCK OF THE ECONOMY: EVIDENCE OF STRUCTURAL CHANGE

The focus of this article will be on the machinery and equipment measure of the capital stock of economic sectors in South Africa. South African statistics list three classes of capital stock on a sectoral basis: buildings and construction, machinery and equipment and transport equipment. However, to the extent that one is either implicitly or explicitly concerned with the production function of the economy, interest may emanate from either questions concerning distribution of output between capital and labour or questions about the long-term productive potential of sectors of the economy and the related issue of the determinants of investment expenditure. The strongest economic interest lies in the fixed capital stock of the economy approximated by machinery and equipment, since this approaches most closely the concept of the capital factor of production. Moreover, since for many sectors of the South African economy building and construction constitutes a large proportion of the total capital stock, small changes in this category of capital may imply large changes in capital that are not changes in fixed capital stock.

2.1 The importance of South African economic sectors in the use of machinery and equipment

The focus of the present subsection is on the use of machinery and equipment by South

African economic sectors. While this does not provide a measure of the capital intensity of production, it does offer some indication of the distribution of capital across sectors of the South African economy.

Table 1 provides rankings of sectors in terms of capital stock as measured by machinery and equipment for the years 1970, 1980, 1990 and 1997. (Sectors that showed dramatic changes in terms of their relative importance as employers of capital are shown in bold type.) The evidence suggests that the relative importance of sectors in the aggregate capital market for machinery and equipment has been subject to considerable change over the 1970–97 period. Only four of 38 sectors show no change in their relative importance as employers of capital in the market, and a number of sectors show very strong changes in their relative importance.

It is noticeable that for most industries, the strongest change in their relative importance in the capital market occurs before 1990. The implication is that the changing patterns of relative capital usage in the South African economy are thus likely to be attributable to long-term structural factors, rather than to any factor that is associated with policy or circumstantial changes that occurred during the 1990s. In particular, explanations that identify single factors such as trade liberalisation, for instance, as the reason for changing patterns of relative capital usage are likely to be hard-pressed to provide the evidence, given the long-term structural patterns of change noted.

The evidence on the relative importance of sectors as employers of capital in South Africa has to be tempered, however, by the realisation that in absolute terms, changes in the four to five largest sectors in terms of the stock of machinery and equipment employment will have a disproportionately large impact on the level of the aggregate capital stock of the economy.

The South African capital market has been dominated by a relatively small number of sectors: electricity, gas and water; agriculture, forestry and fishing; transport, storage and communications; basic iron and steel; wholesale and retail trade; gold and uranium ore mining; finance, insurance and real estate; and diamond mining. If we ignore the dominant position of electricity, gas and water, however, the preponderance of certain key sectors is not as severe as for the labour market (see the discussion in Fedderke et al, 2000). A feature of the absolute capital employment figures is that the top capital-using sectors are generally not manufacturing sectors – the one exception being basic iron and steel. Indeed, a rather surprising feature is the preponderance of service sectors among sectors with strong exposure to machinery and equipment in the South African economy.

One important caveat is in order here. This is that the dataset used in this study treats the manufacturing sector at a relatively disaggregated three-digit Standard Industrial Classification level, while other sectors (services, mining) are treated at a relatively high two-digit level of aggregation. Thus, the comparison across sectors is placing the manufacturing sector at a disadvantage. However, to our knowledge no more disaggregated data than those employed for this study are publicly available on capital stock in non-manufacturing sectors, and we therefore have no means of improving the precision of our comparison. Moreover, this disadvantage is no longer present when considering investment rates or growth rates of capital stock – the main focus of this study.

Strong changes in the capital stock of the manufacturing sector will simply not translate into very significant changes in the aggregate stock of machinery and equipment in the economy as a whole. Given the relatively small contribution of manufacturing sectors

Table 1: Machinery and equipment (M&E)

Low rank indicates high capital stock	Rank 1970	Rank 1980	Rank 1990	Rank 1997	ChgRank 1970–97
Manufacturing M&E	1	2	2	1	0
Electricity, gas & water M&E	2	1	1	2	0
Mining & quarrying M&E	3	3	3	3	0
Agriculture, forestry & fishing M&E	4	4	8	11	-7
Transport, storage & communications M&E	5	5	5	6	-1
Iron & steel basic industries	6	7	10	4	2
Wholesale & retail trade M&E	7	8	9	8	-1
Finance, insurance, real estate M&E	8	10	6	5	3
Gold & uranium ore mining M&E	9	6	4	9	0
Diamond & other mining M&E	10	9	7	7	3
Petroleum refined	11	11	11	10	1
Food manufacturing	12	16	16	12	0
Other chemicals & fibres	13	13	14	15	-2
Basic chemicals	14	15	18	20	-6
Textiles & knit	15	19	21	26	-11
Construction M&E	16	12	12	17	-1
Other non-metallic minerals	17	18	22	22	-5
Motor vehicles & accessories	18	20	17	19	-1
Paper & paper products	19	22	15	13	6
Fabricated metals	20	17	23	25	-5
Machinery & apparatus	21	21	25	27	-6
Non-ferrous metal basic industries	22	26	26	16	6
Coal mining M&E	23	14	13	14	9
Beverages	24	25	19	18	6
Publishing & printing	25	28	28	24	1
Electrical machinery	26	23	27	29	-3
Rubber products	27	29	29	30	-3
Plastic products	28	27	24	23	5
Community, social & personal services M&E	29	24	20	21	8
Wood & wood products	30	33	31	33	-3
Wearing apparel	31	30	30	34	-3
Radio, TV & communication equipment	32	31	33	32	0
Transport equipment	33	32	37	31	2
Other manufactures & recycling	34	35	35	38	-4
Glass	35	34	32	28	7
Furniture	36	38	34	35	1
Tobacco products	37	36	38	39	-2
Footwear	38	37	36	36	2
Instruments	39	39	39	40	-1
Leather & tanning	40	40	40	37	3

to the total capital stock of the economy, it also follows that should South Africa's capital markets be restructuring from state-led investment to private sector investment expenditure in manufacturing, high investment rates in the sectoral level would not

necessarily translate into high investment rates in aggregate. Thus, a low aggregate investment rate for the South African economy as a whole need not necessarily be evidence of serious structural problems for the economy.

2.2 Capital stock and machinery and equipment: the relative rate of change in the capital stock of the South African economy and the investment rate

An examination of the absolute employment of capital stock in the economy by sector and its changes points to the importance of the proportional growth rate in the capital stock by sector. Strong proportional growth rates in machinery and equipment could have been maintained by various (or all) economic sectors, without any changes in the ranking of the sector in terms of capital employed.

Table 2 provides details of the average growth rates in the real stock of machinery and equipment maintained by sectors, reported in terms of decade averages. Decade averages were employed since the growth rate of the capital stock is subject to strong fluctuations on an annual basis.

The growth in the real stock of capital, as measured by machinery and equipment for the economy as a whole, has shown a sharp downward trend over the 1970–97 period. While the 1970s saw an average growth rate in real capital stock of 7,08 per cent, this declined to 3,77 and 1,4 per cent in the 1980s and 1990s, respectively. This growth rate has been computed as an average across all sectors. It is thus unweighted for the relative size of capital stock in each of the sectors.

This aggregate trend, however, inevitably conceals strong sectoral differences. In particular, the most noticeable structural change in the growth of capital to emerge is that manufacturing sectors that traditionally had relatively low growth rates in comparison with other sectors in the economy have, during the course of the 1990s, shown the most rapid expansion of their capital stock. Thus, the 10 sectors of the South African economy with the most rapidly growing capital stock in the 1990s were manufacturing sectors.

Symmetrical conclusions emerge from a consideration of investment rates, computed as the ratio of real net investment (corrected for depreciation) to real net output for each economic sector. One limitation is that the data are not consistently available by category for both real net output and real net investment for all South African economic sectors. This means that consistent investment rate ratios were computable for only 37 sectors in the economy. Table 3 reports decade averages for the net investment rate, together with a ranking of economic sectors in terms of their investment rate.

One notes immediately that the investment rate evidence for the economy as a whole confirms the pessimistic evidence gained from the growth in capital stock data and, if anything, darkens the picture yet further. For the economy as a whole the investment rate throughout the 1970–97 period was poor, remaining at 2 per cent throughout the 1970s and 1980s, and declining yet further to 1 per cent during the course of the 1990s. (By way of a final reminder, our investment rate has been computed purely for the machinery and equipment component of capital stock, not total capital stock.) As for the growth in the aggregate capital stock, however, the picture obscures strong sectoral differences. Evidence that the 1990s have seen a restructuring of the South African economy in response to declining primary commodity reliance in the economy as a whole, and perhaps reduced levels of distortion emerging from government-led invest-

Table 2: Proportional growth rate for machinery and equipment

A low rank indicates a high growth rate	Average growth 1970s	Average growth 1980s	Average growth 1990s	Rank 1970s	Rank 1980s	Rank 1990s
All economic activities	7,08	3,77	1,4			
Transport equipment	6,47	-10,61	26,19	13	40	1
Non-ferrous metal basic industries	2,12	2,09	25,87	23	24	2
Glass	-1,79	10,5	20,38	34	2	3
Publishing & printing	-1,61	5,66	14,15	33	12	4
Iron & steel basic industries	8,38	-3,52	13,58	8	38	5
Beverages	3,16	5,89	12,24	22	10	6
Food manufacturing	0,12	2,84	10,74	30	15	7
Plastic products	3,25	6,59	10,64	21	6	8
Leather & tanning	0,35	-2,01	10,44	28	35	9
Radio, TV & communication Equipment	6,27	-1,27	9,99	14	34	10
Rubber products	0,79	-0,11	9,61	25	32	11
Community, social & personal services	11,49	3,78	8,96	3	14	12
Manufacturing	3,99	1,06	8	20	26	13
Motor vehicles & accessories	-1,94	6,08	7,51	35	9	14
Other non-metallic minerals	0,31	2,23	6,45	29	22	15
Wood & wood products	-2,73	2,65	5,98	38	17	16
Fabricated metals	4,09	-2,47	5,72	19	36	17
Wholesale & retail trade	6,68	0,74	5,66	12	28	18
Diamond & other mining	10	2,48	5,55	6	19	19
Furniture	-2,98	9,54	5,12	39	3	20
Paper & paper products	-0,68	18,3	5,05	32	1	21
Finance, insurance, real estate	5,72	5,86	4,9	15	11	22
Petroleum refined	11,02	2,72	4,16	4	16	23
Basic chemicals	4,24	0,85	4,08	18	27	24
Tobacco products	-0,33	-4,69	3,88	31	39	25
Other chemicals & fibres	7,61	0,32	2,07	11	30	26
Coal mining	15,51	6,33	1,48	1	7	27
Footwear	0,38	0,26	1,45	27	31	28
Textiles & knit	-4,43	2,5	0,8	40	18	29
Electrical machinery	5,58	0,67	-0,01	16	29	30
Transport, storage & communications	8,15	4,71	-0,13	9	13	31
Mining & quarrying	9,32	6,16	-0,45	7	8	32
Machinery & apparatus	0,49	2,47	-0,97	26	20	33
Construction	13,48	-1,11	-1,08	2	33	34
Wearing apparel	1,32	2,34	-1,36	24	21	35
Agriculture, forestry & fishing	5,47	-2,94	-2,72	17	37	36
Electricity, gas & water	10,96	7,03	-4,16	5	5	37
Other manufactures & recycling	-2,68	2,03	-4,95	37	25	38
Gold & uranium ore mining	8,04	8,94	-5,39	10	4	39
Instruments	-2,33	2,23	-7,79	36	23	40

Table 3: Investment rates

Low rank indicates high investment rate	Average 1970s	Average 1980s	Average 1990s	Rank 1970s	Rank 1980s	Rank 1990s
Iron & steel basic industries	0,07	-0,04	0,16	4	37	1
Non-ferrous metal basic industries	0,06	0	0,13	6	31	2
Other transport equipment	0,01	-0,01	0,09	19	35	3
Glass & glass products	0	0,02	0,08	34	9	4
Coke & refined petroleum products	0,21	0,29	0,08	2	1	5
Beverages	0,02	0,02	0,07	13	11	6
Other mining	0,07	0,02	0,06	5	10	7
Food manufacturing	0	0,01	0,05	29	15	8
Plastic products	0,03	0,02	0,05	12	7	9
Rubber products	0,01	0	0,04	24	26	10
Printing, publishing & recorded media	0	0,01	0,04	35	14	11
Non-metallic minerals	0	0	0,03	32	27	12
Paper & paper products	0,01	0,06	0,03	21	3	13
Radio, TV & communication equipment	0,01	0	0,03	17	25	14
Motor vehicles, parts & accessories	0	0,01	0,02	30	16	15
Finance, insurance, real estate	0,03	0,02	0,02	11	8	16
Leather & leather products	0	0	0,02	25	23	17
Basic chemicals	0,02	0	0,02	15	24	18
Wood & wood products	0	0	0,01	27	18	19
Metal products excluding machinery	0,01	0	0,01	20	33	20
Other chemicals & man-made fibres	0,08	0	0,01	3	29	21
Wholesale & retail trade	0,01	0	0,01	18	22	22
Coal mining	0,04	0,03	0,01	8	5	23
Furniture	0	0,01	0,01	33	13	24
Tobacco products	0	0	0	28	32	25
Footwear	0	0	0	26	21	26
Textiles & knit	-0,01	0,01	0	37	17	27
Machinery & equipment	0	0	0	31	30	28
Wearing apparel	0,01	0	0	22	19	29
Transport, storage & communications	0,04	0,03	0	9	6	30
Electrical machinery	0,02	0	0	14	28	31
Other industries	-0,01	0	0	36	20	32
Building construction	0,04	-0,01	-0,01	10	34	33
Professional & scientific equipment	0,01	0,01	-0,01	23	12	34
Agriculture, forestry & fishing	0,04	-0,02	-0,02	7	36	35
Gold & uranium ore mining	0,02	0,05	-0,04	16	4	36
Electricity, gas & water	0,26	0,25	-0,13	1	2	37
All Economic Activity	0,02	0,02	0,01			

ment projects, continues to come to the fore. As for the growth in the capital stock, what is noticeable is the emergence during the course of the 1990s of the manufacturing sector as a leader in investment rates in a number of its subsectors.

Once again, therefore, the evidence suggests the plausibility of a distortion in the South

African capital markets owing to the heavy reliance on the mining of primary commodities during earlier phases of development of the South African economy, and the presence of substantial government-led investment in capital stock in a number of core sectors (electricity, gas and water; petroleum refining). There is the possibility of an argument for Dutch disease effects here; however, this is beyond the scope of this article and is left for future research.

The gradual disappearance of a reliance on primary commodities in the South African economy, and reduced state involvement in 'strategic' investments, have at least plausibly triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have been limited owing to the demand emerging from mining and state sectors (both increasing the financial cost of entry into financial capital markets) have shown strong growth in their capital stock during the course of the 1990s. The implication is again that the 1990s, with their greater reliance on market forces and a decreased reliance on state-led investment, are leading to a restructuring of the South African capital markets. Since restructuring of capital markets inevitably takes time to accomplish, such a process is likely to be in its early phases.

An alternative explanation of the high investment rates in manufacturing might be that relative factor prices are forcing a switch to capital in place of labour. Of the 10 sectors with the strongest growth in capital stock, however, five experienced negative growth rates in real per labourer remuneration over the 1970–97 period (TV, radio and communications equipment; leather and leather products; basic iron and steel; publishing and printing; and transport equipment – see Fedderke et al, 2000) and three further sectors (plastics; beverages; and basic non-ferrous metals – see again Fedderke et al, 2000) experienced growth rates in labour productivity that exceeded those of the real wage. This is therefore unlikely to constitute a general explanation of the structural change in capital employment noted.

It also does not appear as if the improvement in investment rates among manufacturing industries we have noted for the 1990s has been achieved at the cost of higher volatility in investment rates. Indeed, the correlation between the decade average investment rate and the average decade standard deviation of the investment rate declines as we move from the 1970s and 1980s into the 1990s. While the correlation is 0,82 and 0,85 for the 1970s and 1980s, respectively, the correlation declines to 0,63 in the 1990s. This suggests that sectors that had high investment rates were less likely to have volatile investment rates during the 1990s than during the preceding decades.

For the economy as a whole, the standard deviation of the growth rate of the real stock of machinery and equipment declined from 4,72 during the 1980s to 3,39 during the 1990s. Similarly, the standard deviation of the investment rate in machinery and equipment, while it does not show a decline from that of the 1980s during the 1990s for the economy as a whole (it remains at 0,02), at least does not show evidence of an increase in the volatility of the investment rate. (Detailed information on the volatility of investment can be obtained from the authors; see also Fedderke et al, 2000.)

3. EXPLANATIONS OF THE STRUCTURAL CHANGE

3.1 The real cost of capital

In terms of economic analysis, changes in the quantity of any good, including capital stock, are at least potentially associated with changes in its price. As a consequence,

we now turn to the issue of the real cost of capital, and its potential impact on changing investment rates across South Africa's economic sectors.

For the purposes of the present analysis, we define the user cost of capital as:

$$uc = (i - \pi) + d + \tau \quad (1)$$

where i denotes the nominal interest rate, π the inflation rate calculated from the Consumer Price Index (South African Reserve Bank, Code RB7113X), d the depreciation rate on capital stock (machinery and equipment depreciation data as supplied by the Industrial Development Corporation, given as the ratio of actual depreciation to total capital stock) and τ denotes the corporate tax rate (obtained from the South African Reserve Bank).

Ideally, τ should be defined as the net real effective tax rate faced by each sector, such that the tax rate reflects the impact of any tax exemptions, breaks and subsidies faced by the economic sector. Unfortunately, such data for South Africa are not readily available, particularly since tax exemptions and subsidies are frequently defined on highly disaggregated definitions of capital stock. While we are constrained by data limitations in this regard, we also suggest that a future topic of research in South Africa might usefully examine the tax component of the user cost of capital in greater detail in order to develop more accurate real user cost of capital time series.

The user cost of capital can also be defined in terms of a number of different definitions of the interest rate. For the purposes of the current study, yields on long-term government bonds (with more than 10 years to maturity) are employed. We examined the sensitivity of the definition of the user cost of capital to alternative definitions of the interest rate and did not detect a strong divergence among the results.

Table 4 reflects the rank of economic sectors in terms of the real user cost of capital. In contrast with capital usage, relative real user cost of capital by economic sector shows greater stability over the full 1970–97 period. The correlation between the rank of economic sectors in terms of user cost of capital in 1970 and 1997 is +0,95, suggesting a high degree of stability of relative user costs across sectors over time.

An immediate implication of this evidence is that changes in the user cost of capital are perhaps unlikely to account for changing relative capital usage between sectors, since the relative cost of capital is unlikely to vary sufficiently to account for the changing patterns of capital employment across sectors.

Nevertheless, while the current descriptive context does not readily allow for generalisation, there is some evidence to suggest that the user cost of capital has formed a barrier to investment in the past for sectors of the South African economy. The correlation between the average real user cost of capital per sector for the 1970s, and the average investment rate for the 1970s and the average proportional growth rate in the real capital stock per sector in the 1970s is $-0,45$ and $-0,71$, respectively. Yet through the course of the 1980s, the two correlations were $-0,35$ and $-0,17$, and in the 1990s they rose further to $+0,20$ and $+0,24$. The implication appears to be that the user cost of capital formed a significant constraint on investment in real capital stock during the course of the 1970s, but that the severity of this constraint declined during the course of the 1980s and 1990s.

To the extent that it is plausible to argue that state-directed investment in South Africa may have raised the user cost of capital, and that the steady withdrawal of the state

Table 4: Real user cost of capital

Low rank indicates high real user cost	1970	1980	1990	Rank 1970	Rank 1980	Rank 1990
Rubber products	0,8	0,85	0,79	1	1	3
Glass	0,79	0,8	0,78	2	6	4
Publishing & printing	0,79	0,81	0,77	3	4	5
Other non-metallic minerals	0,78	0,81	0,8	4	3	1
Textiles & knit	0,77	0,78	0,76	5	9	7
Plastic products	0,76	0,8	0,76	6	5	8
Non-ferrous metal basic industries	0,76	0,82	0,75	7	2	10
Instruments	0,76	0,77	0,79	8	11	2
Paper & paper products	0,75	0,75	0,76	9	13	9
Basic chemicals	0,75	0,77	0,76	10	12	6
Beverages	0,74	0,78	0,74	11	10	12
Fabricated metals	0,73	0,79	0,74	12	8	11
Motor vehicles & accessories	0,72	0,74	0,71	13	18	17
Food manufacturing	0,72	0,75	0,7	14	14	19
Other manufactures & recycling	0,71	0,72	0,71	15	19	16
Wearing apparel	0,71	0,74	0,73	16	16	14
Leather & tanning	0,71	0,74	0,7	17	15	22
Transport equipment	0,69	0,79	0,69	18	7	24
Furniture	0,69	0,69	0,71	19	26	18
Electrical machinery	0,68	0,74	0,73	20	17	13
Machinery & apparatus	0,68	0,7	0,7	21	22	23
Tobacco products	0,67	0,7	0,67	22	24	27
Agriculture, forestry & fishing	0,67	0,71	0,72	23	21	15
Wood & wood products	0,66	0,69	0,66	24	27	30
Footwear	0,66	0,7	0,66	25	23	29
Petroleum refined	0,66	0,67	0,7	26	30	21
Wholesale & retail trade	0,66	0,68	0,68	27	29	26
Construction	0,65	0,7	0,7	28	25	20
Radio, TV & communication equipment	0,65	0,71	0,69	29	20	25
Other chemicals & fibres	0,63	0,65	0,67	30	31	28
Iron & steel basic industries	0,62	0,69	0,63	31	28	32
Finance, insurance, real estate	0,62	0,63	0,63	32	33	31
Manufacturing	0,61	0,63	0,62	33	32	33
Coal mining	0,58	0,54	0,57	34	39	38
Transport, storage & communications	0,57	0,58	0,61	35	35	34
Community, social & personal services	0,57	0,6	0,57	36	34	37
Mining & quarrying	0,56	0,55	0,57	37	36	36
Electricity, gas & water	0,55	0,55	0,6	38	37	35
All economic activities	0,55	0,55	0,56	39	38	39
Gold & uranium ore mining	0,54	0,51	0,56	40	41	40
Diamond & other mining	0,52	0,53	0,53	41	40	41

from directed investment and increased reliance on market forces over time may have lowered such distortions, the evidence may be interpreted as being consistent with the hypothesis of a real user cost barrier to investment in the 1970s and, to a lesser extent, the 1980s.

There is an alternative interpretation of the evidence, however. This is that the negative association between magnitude and cost of investment noted for the 1970s is in line with the expectations of economic theory. Moreover, the disappearance of this negative association is a reflection of the negative sentiment generated by the increased levels of political uncertainty that characterised the 1980s, and the political transition of the 1990s. See the discussion in Dixit & Pindyck (1994) and Fedderke (2000) on the effect of uncertainty on investment. The implication is that uncertainty may raise the threshold below which no investment occurs, thus lowering the impact of the rate of return on capital and the real user cost of capital on investment.

A final consideration confirms the likely importance of the real user cost of capital as a determinant of investment in the South African economy, whatever the nuance provided by uncertainty considerations and decade differences. Whereas the average investment rate and average user cost of capital for the economy show some ambiguity about the nature of the link between the real user cost of capital and investment, this ambiguity disappears when we consider the more detailed sectoral evidence.

Table 5 shows the correlations between real user cost of capital and both the investment rate and the growth rate of the real capital stock of each sector over the full 1970–97 period.

While for the economy as a whole the correlation is only $-0,54$ for the investment rate and $-0,53$ for the growth rate in real capital stock, the majority of economic sectors demonstrate a negative correlation between user cost of capital and growth in capital stock that is stronger than the average. The median for the correlation between user cost and investment rate is $-0,59$, and the correlation between user cost and the growth rate of the real capital stock $-0,54$. In effect, the economy-wide average is lowered by the presence of a few outlier sectors.

Thus, over time and for most sectors, the real user cost of capital does carry the potential of constituting at least one of the major determinants of investment expenditure in the South African economy – precisely as would be anticipated by economic theory. This evidence confirms the importance of analysis at the sectoral level. Future research may want to examine sectoral evidence in more detail.

3.2 Capital productivity

A further possible explanation besides changes in the real cost of capital for changing capital usage over time is provided by changes in capital productivity. Table 6 reports the ratio of real gross domestic product produced in the sector to the real stock of capital as measured by machinery and equipment in the sector, as a measure of total capital productivity. This is therefore the ratio of real value added to capital stock and gives a measure of the average capital-output ratio. Relative capital productivity showed relatively strong changes over the 1970–97 period. Table 6 reports relative capital productivity by economic sector in the form of rankings of sectors.

Changing capital productivity is not uniformly plausible as an explanation of changing investment performance in the South African economy. This is evident from the fact

Table 5: Correlations: investment rate and real growth in capital vs real user cost of capital (1970–97)

	User cost vs investment rate	User cost vs growth in capital stock
Agriculture, forestry & fishing	-0,74	-0,82
Coal mining	-0,59	-0,47
Gold & uranium ore mining	-0,84	-0,79
Diamond & other mining	-0,41	-0,49
Food manufacturing	-0,62	-0,60
Beverages	-0,64	-0,48
Tobacco products	-0,30	-0,22
Textiles & knit	0,05	0,03
Wearing apparel	-0,53	-0,37
Leather & tanning	-0,44	-0,42
Footwear	-0,30	-0,29
Wood & wood products	-0,60	-0,54
Paper & paper products	-0,49	-0,49
Publishing & printing	-0,62	-0,56
Petroleum refined	-0,40	-0,37
Basic chemicals	-0,50	-0,54
Other chemicals & fibres	-0,43	-0,28
Rubber products	-0,64	-0,62
Plastic products	-0,56	-0,47
Glass	-0,59	-0,57
Other non-metallic minerals	-0,60	-0,62
Iron & steel basic industries	-0,45	-0,48
Non-ferrous metal basic industries	-0,52	-0,40
Fabricated metals	-0,62	-0,63
Machinery & apparatus	-0,56	-0,48
Electrical machinery	-0,74	-0,66
Radio, TV & communication equipment	-0,69	-0,67
Instruments	-0,31	-0,30
Motor vehicles & accessories	-0,57	-0,52
Transport equipment	-0,66	-0,70
Furniture	-0,67	-0,57
Other manufactures & recycling	-0,34	-0,48
Electricity, gas & water	-0,79	-0,77
Construction	-0,88	-0,84
Wholesale & retail trade	-0,82	-0,83
Transport, storage & communications	-0,75	-0,75
Finance, insurance, real estate	-0,77	-0,69
All economic activities	-0,54	-0,53
Average	-0,57	-0,53

that only for some sectors does improving capital productivity predate improved investment rates. This would be in line with theories of investment expenditure in terms of which the rate of return on capital determines investment – see Jorgenson (1963),

Table 6: Capital productivity: real GDP/real stock of machinery and equipment

Low rank indicates high capital productivity					Rank	Rank	Rank	Rank	Chg
	1970	1980	1990	1997	1970s	1980s	1990s	1997	Rank
Footwear	9,58	9,38	8,15	5,39	1	3	5	5	-4
Leather & tanning	9,44	7,33	8,17	3,9	2	5	4	12	-10
Machinery & apparatus	8,66	13,07	9,72	6,87	3	1	2	4	-1
Gold & uranium ore mining	8,1	2,36	0,98	1,27	4	26	35	29	-25
Tobacco products	7,8	6,44	7,43	5,19	5	10	8	6	-1
Transport equipment	7,78	6,67	10,9	1,2	6	8	1	30	-24
Wholesale & retail trade	6,37	5,15	6,04	4,31	7	13	11	10	-3
Furniture	6,31	12,61	7,46	4,41	8	2	7	9	-1
Construction	6,03	1,73	2,12	2	9	31	28	18	-9
Fabricated metals	5,68	6,76	6,87	4,69	10	7	10	7	3
Wearing apparel	5,2	7,14	8,12	8,17	11	6	6	2	9
Glass	4,56	6,04	3,5	1,01	12	11	16	33	-21
Publishing & printing	4,22	5,97	5,33	1,79	13	12	12	20	-7
Radio, TV & communication equipment	3,6	2,48	7,17	2,52	14	24	9	14	0
Wood & wood products	3,51	8,52	5,22	4,28	15	4	13	11	4
Coal mining	3,29	1,8	1,74	1,46	16	30	30	26	-10
Instruments	3,14	2,27	4,56	6,91	17	27	14	3	14
Motor vehicles & accessories	2,87	6,61	3,5	2,2	18	9	17	16	2
Electrical machinery	2,6	5,06	4,08	4,41	19	14	15	8	11
Other manufactures & recycling	2,6	4,06	9	24,06	20	17	3	1	19
Other non-metallic minerals	2,43	3,78	3,23	1,66	21	18	19	23	-2
Textiles & knit	2,4	4,43	2,17	2,47	22	15	27	15	7
Transport, storage & communications	2,37	2,01	1,53	1,77	23	29	31	21	2
Finance, insurance, real estate	2,18	2,47	2,31	2,02	24	25	24	17	7
Rubber products	2,18	3,62	3,31	1,41	25	21	18	27	-2
Beverages	2,08	3,68	2,7	1,05	26	19	22	32	-6
Paper & paper products	2	4,15	1,51	1,18	27	16	32	31	-4
Food manufacturing	1,92	3,67	2,87	1,3	28	20	21	28	0
Diamond & other mining	1,74	1,12	0,99	0,81	29	33	33	34	-5
Basic chemicals	1,66	2,07	2,48	1,91	30	28	23	19	11
Agriculture, forestry & fishing	1,31	1,12	2,24	3,01	31	34	25	13	18
Plastic products	1,1	2,88	2,19	1,48	32	23	26	25	7
Non-ferrous metal basic industries	1,01	3,04	3,14	1,74	33	22	20	22	11
Iron & steel basic industries	0,98	0,91	0,98	0,55	34	35	34	35	-1
Petroleum refined	0,88	0,16	0,66	0,4	35	37	36	37	-2
Other chemicals & fibres	0,71	1,3	1,82	1,65	36	32	29	24	12
Electricity, gas & water	0,41	0,28	0,27	0,46	37	36	37	36	1

Eisner & Strotz (1963) and Dixit & Pindyk (1994). For others, improved capital productivity seems to have been the consequence of an augmentation of the capital stock. This finding would be consistent with the literature on embodied technological change (see the seminal contribution by Nelson, 1964) in which high investment rates come to change the average age of the capital stock of a sector, thereby increasing its efficiency.

Of the sectors with strong growth in relative capital productivity – other chemicals and man-made fibres; agriculture, forestry and fishing; basic chemicals; and electrical machinery – the strongest growth in capital stock (as measured either in terms of the growth in the real capital stock or the investment rate) took place during the 1970s. It is noticeable that the capital productivity for these sectors improved *after* the capital stock for the sector had shown strong growth, particularly during the 1980s, with the improved capital productivity being maintained during the course of the 1990s. (See the evidence of Table 6.) One possible interpretation would be that the investment in new capital stock introduced new technology into production, thereby improving the productivity of production. The fact that other chemicals and man-made fibres experienced both positive growth rates in labour employment and strong relative increases in labour productivity, both not shown here, over the 1970–97 period suggests that technological change for this sector may have had elements of factor neutrality, enhancing the productivity of both factors of production. Note, however, that it is difficult to argue that improving capital productivity *led* to higher investment rates in these sectors, since investment predated the improved capital productivity.

There is also evidence of sectors in which improved capital productivity may have led to improved investment performance, however. For basic non-ferrous metals and plastics, growth in capital stock (again as measured either in terms of the growth in the real capital stock or the investment rate) is concentrated in the 1990s, while for basic chemicals there was a revival of the strong investment performance of the 1970s after a lull during the course of the 1980s. For these sectors, improvement in capital productivity predates the acceleration in investment activity. Improving capital productivity in perfect capital markets would translate into improvements in the rate of return to capital (a topic to which we turn in the next section). For these sectors, capital productivity may therefore be the explanation for changing investment activity, whereas for the preceding group, investment and associated technological advances may well have led the improvements in capital productivity.

We also note that for a number of the sectors with strong relative improvements in capital productivity, no strong temporal patterns in investment behaviour are detectable. Thus, for finance, insurance and real estate, investment was consistently relatively strong, and no decided distinction exists between investment in the 1970s, 1980s and 1990s. Textiles, other manufacturing, instruments and wearing apparel all manifest relatively undistinguished investment rates, without great variation between decades. Reasons for the relative change in capital productivity thus cannot be reduced to investment patterns (or vice versa) that are accessible at the level of aggregation presented in the data.

A number of sectors also experienced strong declines in relative capital productivity. While for coal mining, construction and gold and uranium ore mining the decline in capital productivity has been a long-term trend consistently present since the 1970s, this is not true of the other sectors. For the manufacturing sectors publishing and printing, glass, transport equipment and leather and tanning, the decrease in capital

productivity occurs during the course of the 1990s (see Table 6). Moreover, for all of these sectors the decline in capital productivity in the 1990s is not only marked, but also occurs off relatively high levels in absolute terms (see again Table 6).

Finally, we note that where the other manufacturing and recycling outlier is removed from the sample, the ratio of highest to lowest capital productivity in the economy has been on a steady downward trend, falling from 81,69 in 1980 to 40,37 in 1990 and, finally, to 20,43 in 1997. This evidence is consistent with the argument of earlier subsections of this article, of a decrease in market distortions in South African capital markets. Economic theory would anticipate that perfect capital markets would serve to equalise the marginal product of capital across sectors, thereby generating the most efficient allocation of capital stock. While advanced evidence exists concerning the average product of capital, the implication is at least potentially that the reallocation of capital has been such as to achieve at least an improved use of scarce capital resources in the economy. Whatever the source of the reallocation, therefore, capital market developments during the course of the 1990s continue to show features of a desirable restructuring in the allocation of capital stock. In this sense, the evidence of the present section continues to confirm the evidence of earlier subsections, namely that the severity of past capital market distortions has been on a downward trend since 1990.

3.3 Links between capital productivity, real cost of capital and capital usage

Economic theory would anticipate a link between real capital productivity and the real user cost of capital. It is expected that in equilibrium, the marginal product of capital is equal to its marginal cost. Moreover, when this condition is met we are likely to see evidence of a more sustainable investment rate. Table 7 reports the correlation between real capital productivity and the real user cost of capital by economic sector for which the relevant data are available. It is noticeable that for most sectors the correlation between the productivity of capital and the real user cost is not only positive, but frequently very strong. For 28 of 37 sectors for which the requisite data are available, the correlation conforms not only to economic theory, but is also reasonably strong – if it is borne in mind that economic theory assumes all other influences on the real user cost to be held constant in predicting a positive correlation between the productivity and the cost of factors of production.

The grouping of sectors with the strongest correlation between the real user cost of capital and capital productivity, namely in excess of + 0,8, also shows the highest average growth rate in real capital stock over the 1970–97 period. However, the average 1970–97 growth rate in real capital stock does not unambiguously decline as we move to sectoral groupings with lower correlations between real user cost of capital and capital productivity. In this context, it is worth recalling that the analysis of the preceding sections has suggested that market distortions in South African capital markets appear to have been diminishing over time, leading to a reallocation of capital stock. If so, the effect of the theoretically appropriate relationship between user cost of capital and capital productivity should have had desirable impacts on the investment rate and the average growth rate in the real capital stock in later time periods rather than earlier ones. This is indeed borne out by the evidence.

Figure 1 plots the correlation between the user cost of capital and capital productivity, and the investment rate maintained by sectors over the 1990–97 period.

With the exception of perhaps only the sector grouping with a correlation between

Table 7: Correlations

	User cost vs output- capital ratio	Average investment rate: 1970–97	Average investment rate: 1990–97	Average growth in real capital: 1970–97	Average growth in real capital: 1970–97
Non-ferrous metal basic industries	0,92	0,06	0,13	0,09	0,26
Publishing & printing	0,87	0,02	0,04	0,06	0,14
Transport equipment	0,84	0,03	0,09	0,07	0,27
Beverages	0,84	0,03	0,07	0,07	0,12
Food manufacturing	0,84	0,02	0,05	0,04	0,11
Other chemicals & fibres	0,81	0,03	0,01	0,03	0,02
Leather & tanning	0,80	0,01	0,02	0,05	0,13
Rubber products	0,79	0,01	0,04	0,03	0,10
Wood & wood products	0,78	0,01	0,01	0,02	0,06
Footwear	0,75	0,00	0,00	0,02	0,03
Fabricated metals	0,75	0,00	0,01	0,02	0,06
Other manufactures & recycling	0,74	0,00	0,00	– 0,01	– 0,04
Plastic products	0,73	0,03	0,05	0,07	0,11
Instruments	0,70	0,00	– 0,01	0,00	– 0,06
Other non-metallic minerals	0,67	0,01	0,03	0,03	0,07
Iron & steel basic industries	0,65	0,06	0,16	0,06	0,14
Basic chemicals	0,59	0,01	0,02	0,03	0,04
Furniture	0,58	0,01	0,01	0,05	0,06
Motor vehicles & accessories	0,58	0,01	0,02	0,04	0,08
Coal mining	0,56	0,03	0,01	0,08	0,02
Glass	0,54	0,03	0,08	0,10	0,21
Textiles & knit	0,54	0,00	0,00	0,00	0,01
Agriculture, forestry & fishing	0,53	0,00	– 0,02	0,00	– 0,03
Radio, TV & communication equipment	0,52	0,01	0,03	0,05	0,11
Electrical machinery	0,52	0,01	0,00	0,02	0,00
Wearing apparel	0,52	0,00	0,00	0,01	– 0,01
Petroleum refined	0,52	0,20	0,08	0,06	0,04
Electricity, gas & water	0,50	0,14	– 0,13	0,05	– 0,04
Tobacco products	0,49	0,00	0,00	0,01	0,05
Wholesale & retail trade	0,47	0,01	0,01	0,04	0,06
Paper & paper products	0,35	0,03	0,03	0,08	0,05
Finance, insurance, real estate	0,28	0,02	0,02	0,06	0,05
Diamond & other mining	– 0,04	0,05	0,06	0,06	0,06
Transport, storage & communications	– 0,05	0,02	0,00	0,04	0,00
Gold & uranium ore mining	– 0,08	0,01	– 0,04	0,04	– 0,05
Machinery & apparatus	– 0,50	0,00	0,00	0,01	– 0,01
Construction	– 0,56	0,01	– 0,01	0,04	– 0,01

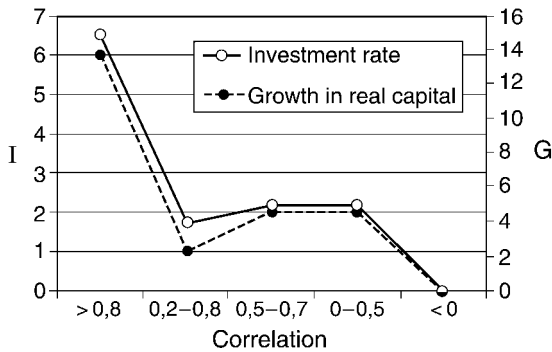


Figure 1: Investment rate and growth in real capital stock, by strength of correlation between user cost and rate of return on capital

+ 0,7 and + 0,8, the evidence appears to suggest the presence of declining investment rates in sectors as they conform less closely to the dictates of standard economic theory. Where the real user cost of capital is less closely linked to real capital productivity, the growth in capital also tends to be lower.

The implication that flows from such evidence is that for purposes of policy intervention in South African capital markets, ‘well-functioning’ capital markets – defined as those that link factor rewards to factor productivity in accordance with the requisites of economic theory – appear to be more likely to generate higher investment rates, at least during the 1990s. Note that this may not be true of the 1970s and 1980s owing to distortions in South African capital markets at that time.

4. CONCLUSIONS

This article concludes by reiterating some of the main findings of the preceding analysis. While advancing a series of hypotheses, we are aware of the fact that the exploratory data analysis undertaken here cannot provide definitive answers to some of the questions posed. Greater clarity will have to wait for more detailed econometric work. Notably, two points not addressed in the present analysis arise for future research. These are the investment behaviour of broad groups of manufacturing sectors; and the accurate measurement of the supply price of investment goods and its impact on investment expenditure.

Nevertheless, the results of the descriptive analysis showed some interesting findings, some of which were expected and some of which were surprising. We bear in mind that since a narrow focus on total capital stock is potentially misleading, the descriptive analysis here is therefore undertaken in terms of the asset type, machinery and equipment.

Sectoral growth rates in the capital stock of machinery and equipment suggest a bias in the South African capital markets owing to the heavy reliance on the mining of primary commodities during earlier phases of development of the economy, and the presence of substantial government-led investment in capital stock of a number of core sectors (electricity, gas and water; petroleum refining). The gradual reversal of these earlier trends appears to have triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have been limited owing to the demand originating from resource-based and state sectors during the earlier

decades of the period under review, have shown strong growth in their capital stock during the 1990s. The implication is that investment expenditure in South Africa, both in absolute terms as well as relative to value added, may currently be at such low levels because strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. Such sectors may have been prevented from increasing their capital stock from past biases in the economy's capital markets.

The 1990s and their changed policy environment may have had an impact on capital usage in the South African economy. This is most evident in the declining investment in machinery and equipment capital stock in electricity, gas and water, and above all the strong increase in the usage of this category of capital by manufacturing sectors. Given that the period after 1985 saw a sharp decrease in the value of the rand without any recovery post-1990, the implication is that the increased exposure to capital in these sectors took place despite the increasing supply price of capital goods.

The possibility of a structural break in capital accumulation during the 1990s does not appear to be translating into a greater volatility of investment. For the economy as a whole, the standard deviation of the growth rate of the real stock of machinery and equipment declined during the 1980s and 1990s. Therefore, the structural break in investment behaviour, if present, has not manifested itself in greater volatility of investment, but rather in a different distribution of investment across sectors and in a different level of investment expenditure in sectors.

Moreover, the strongest increase in volatility is associated with the increased political uncertainty of the 1980s, rather than the arrival of the 1990s. For the economy as a whole, the volatility of the investment rate declined from the levels maintained fairly consistently during the course of the 1970s and 1980s. This suggests that, for South Africa, risk factors that intruded from the political arena may well have played a significant role in determining at least the volatility, if not the level, of investment expenditure. Certainly for aggregate investment expenditure and for capital flight there exists strong empirical evidence suggesting that political risk factors are of importance to the South African economy. We leave a more detailed exploration of these questions for future research.

Correlation coefficients between user cost of capital and capital usage (as embodied in the investment rate and growth in capital stock of machinery and equipment) suggest that over time, and for most sectors, the real user cost of capital seems to carry the potential of constituting at least one of the major determinants of investment expenditure in the South African economy – as would be anticipated by economic theory.

The user cost of capital appears to have formed a significant constraint on investment in real capital stock during the course of the 1970s, but the severity of this constraint declined during the course of the 1980s and 1990s. It could therefore be argued that the state in its effort to direct investment in South Africa may have raised the user cost of capital, and that the steady withdrawal of the state from the capital markets and the increased reliance on market forces over time may have lowered such distortions. The disappearance of this negative association may also be a reflection of the negative sentiment generated by the increased levels of political uncertainty that have characterised the 1980s, and the political transition of the 1990s. In other words, the importance of the real user costs of capital as an explanatory variable of investment behaviour may to some degree have been eroded by a political uncertainty factor.

The descriptive analysis of capital productivity, defined here as the ratio of value added

and capital stock of machinery and equipment, suggests that the 1970s and 1980s showed strong deviations in the distribution of capital across sectors in the economy, such that the productivity of capital was strongly differentiated across sectors. Subsequent reallocation of capital stock in the economy appears to have equalised the productivity of capital across sectors. From a theoretical point of view, one would anticipate that more perfect capital markets would serve to equalise the marginal product of capital across sectors, thereby generating more efficient allocation of capital stock.

Examination of correlation coefficients between real user costs of capital and various measures of capital stock growth suggests the presence of declining investment rates in sectors as they conform less closely to the dictates of standard economic theory. In other words, where the real user cost of capital is less closely linked to real capital productivity, the growth in capital also tends to be lower.

For purposes of policy intervention in South African capital markets, 'well-functioning' capital markets, defined as those that link factor rewards to factor productivity more closely, are those that are likely to realise strong and sustainable investment performance. It is left to subsequent, detailed econometric work to explore these relations in greater detail.

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