THE ROLE AND CONSEQUENCES OF INVESTMENT IN RECENT AUSTRALIAN ECONOMIC GROWTH

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Reserve Bank of Australia

Research Discussion Paper

8704

April 1987

* Paper originally prepared for conference on "Recent Australian Economic Growth", held at ANU on 24-26 November 1986. We wish to thank other contributors to the conference and members of Research Department at the Reserve Bank for helpful comments. In particular, we are grateful to Rob Trevor for assistance with econometric issues and Ian Russell and Michele Droop for assistance with computing issues. We also wish to thank Phil Graham, Wendy Vanke, Michelle Kelly and Jan Favorito for invaluable assistance with production. The views expresssed in this paper are our own and are not necessarily shared by our colleagues at the Reserve Bank.

ABSTRACT

By international and historical standards, Australia does not appear to be under-capitalised. Nevertheless, the past decade has seen a clear reversal of the steady upward trend in capital intensity; this reversal was most marked after the short-lived increase in capital spending associated with improved prospects in Australia's resource-intensive industries in the early 1980s. Since then, there has been a sharp decline in investment relative to GDP, as reductions in real labour costs relative to capital costs encouraged the substitution of labour for capital. The existence of excess capacity in the early 1980s meant that substitution of labour for investment in new capital was possible without a major slowdown in growth of economic activity or employment.

The prospects for continued economic growth depend, in part, on the resumption of investment spending to complement the growth of labour. It will be important for investment to occur in those industries where recent gains in competitiveness have been greatest. Prospects for achieving these outcomes will be enhanced if government policies are directed towards further reducing distortions in investment incentives, encouraging the expansion of technology and providing a mix of overall stabilisation policies that reduces pressures on capital markets.

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1. INTRODUCTION

Of all the basic building blocks in macroeconomics, investment is probably the one with which economic analysis has dealt least effectively. There is no shortage of appealing models. Students of the topic are offered a wide range of approaches, from the grass roots simplistic to the inordinately detailed and complex. Yet, when the data are confronted, the gap between theory and practice is usually found to be substantial.

While the empirics of investment remain elusive, the consequences of investment remain at the very heart of economic growth. In the short run, fluctuations in investment are a dominant source of fluctuations in economic growth. In the longer run, investment determines the capital stock and this, probably more than any other factor, determines the trends of growth in economic activity and employment.

This paper considers the role and consequences of investment in Australia's post-war economic growth. In the paper, we have sought to emphasise both the short-run demand and the longer-run supply aspects of investment and capital formation. In tackling this subject we entertained no false illusions about our ability to resolve the unresolvable; inevitably we have found as many puzzles as we have answers. Yet, through all this, a number of relationships appear to hold firm, offering at least some support for accepted wisdom and some binding threads for the maze of data available on investment and capital.

In the remainder of the paper, Section 2 reviews the facts, looking at trends in investment and capital accumulation in aggregate and by sector. Section 3 examines the relationship between capital and trends in economic activity and employment. Section 4 turns to the role of investment in generating cyclical fluctuations in economic activity. Section 5 looks at the determinants of investment and Section 6 provides a brief overview and conclusion.

2. INVESTMENT AND CAPITAL: SOME POST-WAR TRENDS

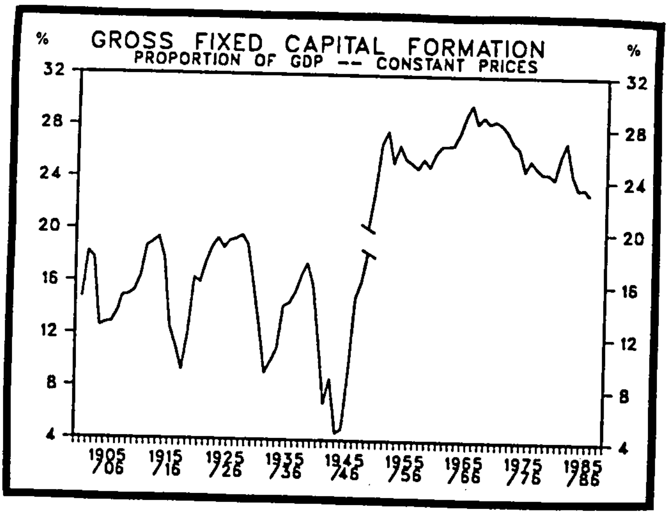
2.1 Trends in investment

Over a long period, gross investment by the Australian economy (unless otherwise stated, gross investment will include business fixed investment, investment in dwellings and public sector investment) has shown considerable volatility. Figure 2.1 shows data for gross investment as a proportion of GDP since the turn of the century. Changes in the quality of data over time mean that comparisons over long periods should be made with a degree of caution. This caveat given, two features of Figure 2.1 are particularly striking:

- first, the average investment ratio roughly doubled to around 26 per cent of GDP in the post-war period; and

- second, cycles in the investment ratio have been considerably smaller in the post-war period than previously.

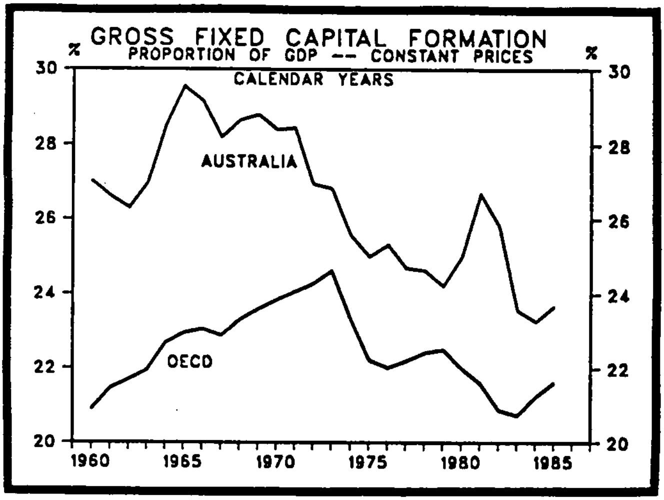
Figure 2.1



The influence of the two world wars is evident in Figure 2.1. From a twentieth century high of around 19-1/2 per cent in 1914, the investment ratio fell to a low of less than 9-1/2 per cent by 1918. Then, after recovering slowly from the depression low of around 9 per cent in 1932 to around 17-1/2 per cent in 1939, the investment ratio again fell sharply to less than 5 per cent in 1944 and 1945. In contrast, the Korean War (1950-1953) appears to have had little effect on investment. The size of the swings in investment in the two world wars is, however, amplified by the treatment in the National Accounts of military expenditure as entirely current consumption. To the extent that investment in military hardware (though in one sense this is more destructive than constructive capital) replaced private investment in these periods, the amplitude of the fluctuations will be overstated.

Not only has the post-war gross investment ratio been high by Australian standards, it appears to have been high by international standards. Figure 2.2 shows gross investment ratios for Australia and the average for all OECD countries since 1960. While the investment ratio for Australia is still above the OECD average, the gap between the two has narrowed considerably since the start of the 1970s. An exception to this convergence of trends is the three-year period from the beginning of the 1980s when Australian investment was boosted sharply by improved prospects in resource-based industries following the second major oil price rise late in 1979.

Figure 2.2



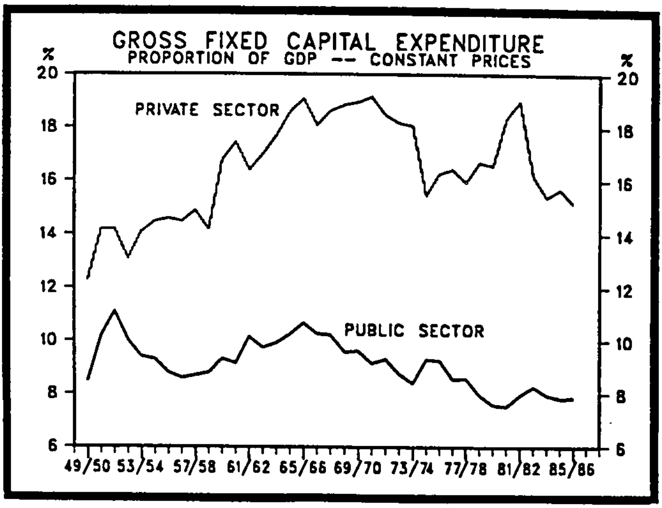
Abstracting from the resources boom, the past decade has seen a similar downward trend in investment in both the OECD and Australia. However, the extent to which Australian investment growth has slowed relative to that in the OECD area over the longer period shown in Figure 2.2 is reflected in the fact that real investment in the OECD has increased by almost 130 per cent since 1960, compared with an increase of just over 100 per cent for Australia.

Gruen (1986) presents evidence of a relatively low rate of increase in investment per person employed in Australia. Although real investment per person in Australia is still above the OECD average, it has grown by only

25 per cent since the early 1960s, compared with growth of the OECD average of just under 40 per cent. Australia's relatively high rate of population growth, of course, accounts for the divergence between gross investment ratios for Australia and the OECD group.

Figure 2.3 shows separately the levels of gross investment (as a ratio to GDP) by the public and private sectors in Australia since 1950.[1] Private investment shows very sharply the effects of the resources booms in the late 1960s and early 1980s but, otherwise, has shown little net decline as a proportion of GDP since the beginning of the 1960s. Investment by the public sector declined during the Korean War then rose steadily to a peak in the mid 1960s. Thereafter, it has shown a fairly steady downward trend, despite a temporary surge in the mid 1970s associated with a general increase in government spending at that time.

Figure 2.3

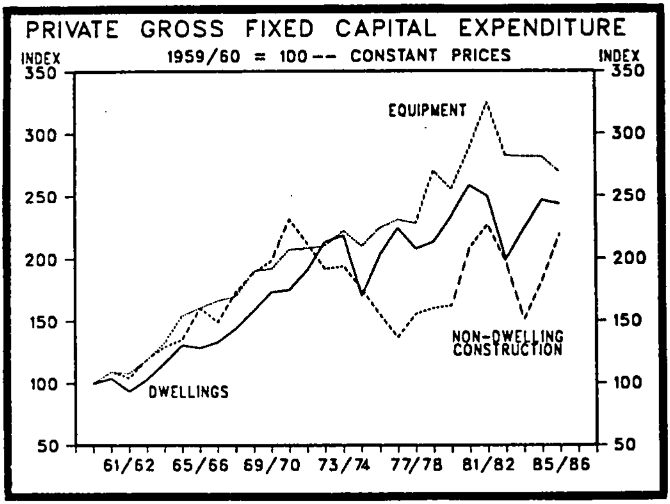


Further decomposition of private sector investment by type is given in Figure 2.4. Investment in dwellings, while subject to cyclical swings, has

1. Data in Figures 2.3 and 2.4 are adjusted for major sales of fixed assets between public and private sectors which are leased back to the sector of sale. These transactions involve a change in the legal ownership of assets but do not alter the level of investment effectively undertaken by either sector.

grown steadily since 1960 and, as a proportion of GDP, has stayed relatively constant at a little over 5 per cent. Investment in non-dwelling construction grew steadily up to the early 1970s, before falling sharply over the following half decade. A strong rise with the resources boom in the early 1980s brought the level of real investment in non-dwelling construction back to its level of the early 1970s though, as a ratio to GDP, it fell from just over 3 per cent of GDP in the 1960's to about 2-1/2 per cent in the early 1980s. However, since the recession in 1982/83, investment in non-dwelling construction has been the dominant source of investment spending.

Figure 2.4

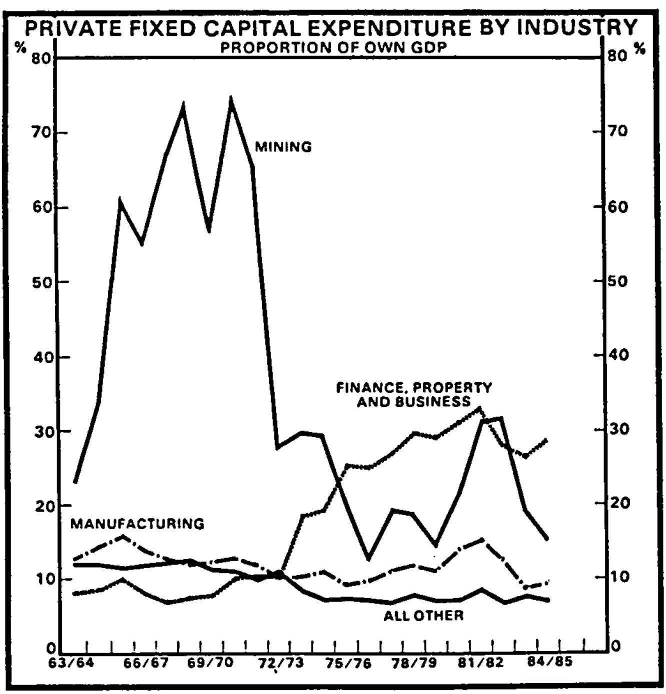


Investment in plant and equipment is the largest component of private sector investment, averaging a little over 8 per cent of GDP over the period shown in Figure 2.4. Like non-dwelling construction it also shows the impact of the resources boom. Unlike non-dwelling construction, however, investment in plant and equipment continued to grow, albeit modestly, throughout most of the 1970s.

The divergent trends between investment in plant and equipment on the one hand and construction on the other reflect, in large part, trends in the industrial structure of the Australian economy. In the first half of the 1960s, investment in mining accounted for less than 2-1/2 per cent of total private investment; over the first half of the present decade, it accounted for more than 10 per cent of the total. In contrast, the manufacturing sector's share fell from over 20 per cent of private investment to around 16 per cent over the same period. Investment in plant and equipment is concentrated in manufacturing industry, while investment in mining and property development is largely in the form of construction.

Gross new private investment by industry is shown as a proportion of output in those industries in Figure 2.5. The picture for mining in Figure 2.5 is dramatic. Throughout the 1960s, investment in mining surged as the nation sought to tap its mineral wealth in the face of buoyant commodity prices around the world. In 1969 and again in 1971, investment in the mining industries accounted for almost 75 per cent of the value of production of these industries. The decline in this ratio after 1972 reflects both reduced investment spending and increased mining output flowing from the earlier investment.

Figure 2.5



Investment in manufacturing industries has remained relatively steady as a proportion of manufacturing output. However, with growth of the latter being relatively subdued over the period, so too has been the growth of investment spending in manufacturing. Investment in finance, property and business services has shown a strong rise since the start of the 1970s. This trend was helped by a property boom throughout much of the 1970s and, more generally, by the expansion of tertiary industry, especially finance. As discussed below, the strength of the rise has been overstated as a result of a general increase in leasing since the start of the 1970s.

Of the remaining industries (grouped together under "all other" in Figure 2.5), the ratio of investment to output in agriculture has been on a secular decline, while in wholesale and retail trade it has shown little change.[2]

The rapid growth of investment in finance, property and business services raises a difficult issue. The Australian Bureau of Statistics (ABS) allocates expenditure on capital to the industry registering ownership of the capital, rather than the industry in which it is used. This means that all leased buildings, plant and equipment are recorded as investment by the lessor, most often a financial institution or property developer. The rapid growth of investment in finance, property and business services may, at least in part, reflect the rapid growth of leasing from about 4 per cent of business fixed investment in 1967/68 to over 16-1/2 per cent by 1985/86.

Data are available for leasing of plant and equipment by industry since 1985. While it is not possible to accurately adjust data prior to 1985 for leasing, some idea of the impact of leasing can be obtained by rough approximation. In adjusting the data prior to 1985 we have assumed that leasing undertaken by each industry bears a constant relationship to its share of GDP in each year; the shares are based on trends since 1985. The unadjusted series are shown as an index in Figure 2.6a. Figure 2.6b shows the same data adjusted approximately for leasing. For ease of comparison, both graphs are drawn to the same scale.

For most industries the adjustment for leasing does not change the long-run picture dramatically. But, not surprisingly, there is a major change in investment by finance, property and business. Although the property boom and

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2. Due to the method of construction, this category also includes purchases of second-hand assets by all industries.

the expansion of the finance industry are still reflected in the data, more than half the investment undertaken by this sector since the early 1970s appears to be attributable to investment goods leased to other industries.

Figure 2.6a

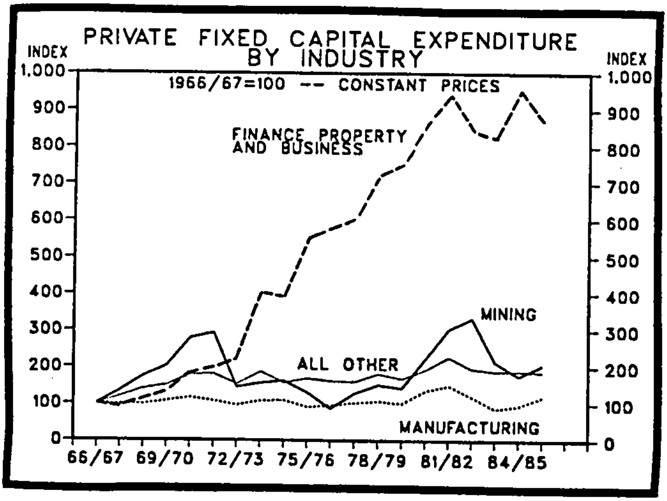
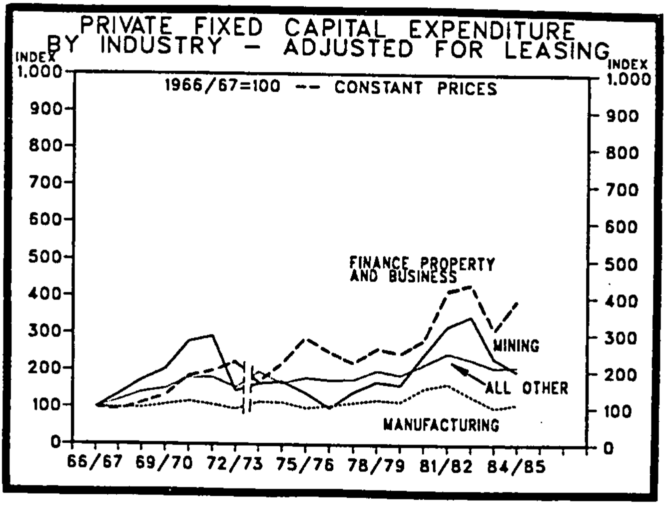


Figure 2.6b



Mining is little affected by the leasing adjustment, since the majority of leasing appears to have taken place in manufacturing and other industries. After adjusting for leasing, the manufacturing sector shows stronger growth in investment throughout the late 1970s but a weaker performance, relative to the 1970s following the most recent resources boom. Investment by all other industries shows similar trends adjusted and unadjusted, although at a slightly higher level. Our adjustments are, of course, approximate and only one of several possible approaches to the problem. The extent to which the data shown in Figure 2.6b differ from other estimates of the impact of leasing, such as those produced by Hall (1984)[3], highlights the need to interpret estimates of leasing by industry with caution.

2.2 The aggregate capital stock

Investment spending is of interest in its own right, in particular for its impact on economic activity through its contribution to aggregate demand. More important, however, is the contribution of investment to the stock of productive capital in the economy. While new investment is the primary source of addition to the capital stock, the effective stock is also influenced by the rate of depreciation of existing capital, the rate of technological progress and the compatibility of the existing stock with the desired industrial structure of the economy.

The factors influencing the effective capital stock are not all easily measured and, as a consequence, there is no single, widely-accepted measure of capital. Figure 2.7 shows one measure of capital (public plus private but excluding dwellings) as a ratio to the employed labour force (the capital/labour ratio), where labour is defined in efficiency units; i.e., allowing for technological progress.[4] The measurement of technological progress is explored further in Section 3.

From Figure 2.7, it appears that capital per effective worker followed a steady upward trend until the late 1970s. Since that point there has been a trend decline, punctuated by a temporary rise with the resources boom in the early 1980s. The decline in the past two years has been quite dramatic. The recent fall in the capital/labour ratio reflects both falling investment and a

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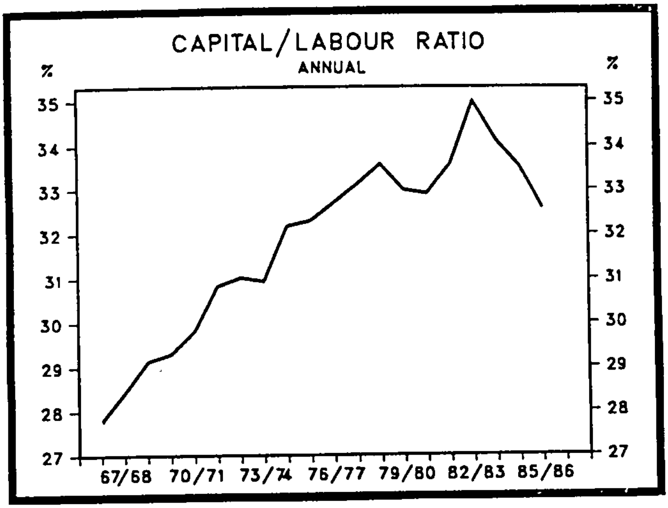
3. Hall (1984) allocates a fixed proportion of investment in finance, property and business to other industries in proportion to their non-leasehold investment. However, he was not able to incorporate data on leasing by industry (which have only recently become available) and did not allow for the finance, property and business sector's leasing to itself. Consistent with Hall, we have only adjusted for leasing since 1973/74. For details of the methodology used in Figure 2.6(b) see Appendix C.

4. For a description of labour efficiency units see Section 3.1. The method used to calculate the capital soock is described in Appendix B.

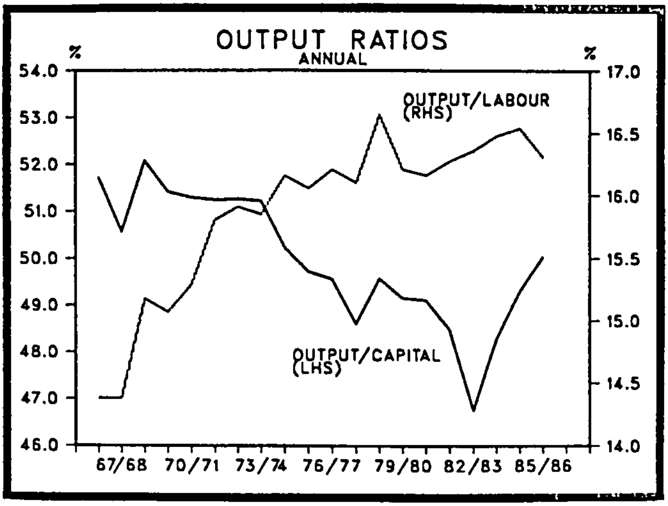
Figure 2.7



sharp increase in employment. Of course, while the overall pattern of change would be unaltered, assuming a higher rate of technical progress (Figure 2.7 assumes a rate of technological progress of 1.1 per cent per annum) would tend to show the capital/labour ratio as flatter in the period prior to the mid 1970s and declining more sharply thereafter.

Figure 2.8 shows the output/labour and output/capital ratios based on the data used in Figure 2.7. Consistent with the pattern in the capital/labour ratio,

Figure 2.8

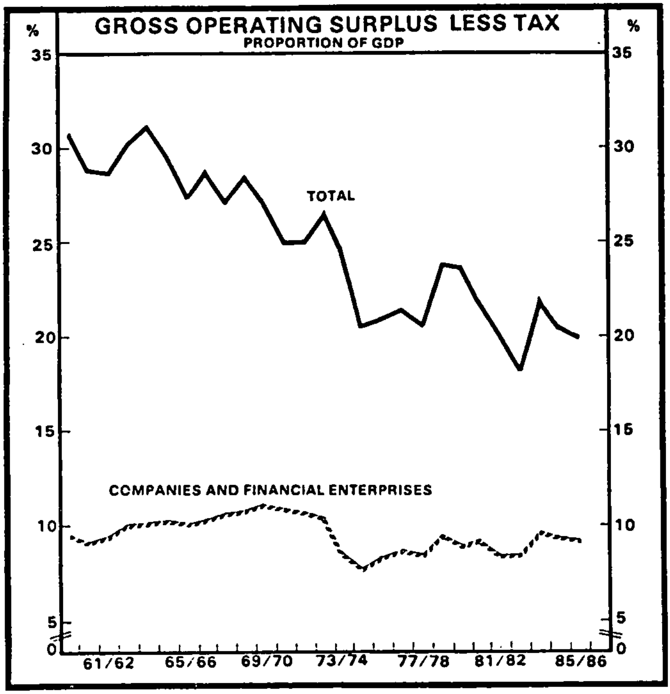


output per efficiency unit of labour tended to rise throughout the period to the mid 1980s (although at a much faster rate through the first half of this period) before declining, while output per unit of capital declined until the end of 1982, after which point it rose sharply.

2.3 Factor shares

Another characteristic of the economic system that tends to follow closely from the behaviour of investment and capital is the relative share of production paid to factors. Figure 2.9 shows the post-tax profit share; i.e., the share of production being returned to those who own capital.

Figure 2.9



Several features are worthy of note:

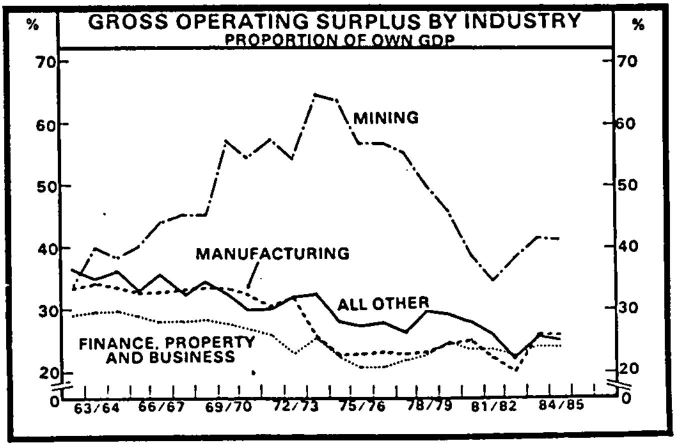
- there has been a trend decline in the level of profitability since the early 1960s, much of which has been concentrated in the unincorporated sector;

- a large part of the trend decline in the gross operating surplus of unincorporated enterprises reflects trends in agriculture, forestry and fishing. The profits of unincorporated enterprises in this sector have declined from over 9 per cent of GDP in the early 1960s to average less than 4 per cent of GDP over the past few years; and

- despite a recovery in the past few years, profits of private companies and financial enterprises as a proportion of GDP are still well below the peak reached in the late 1960s and have shown greater volatility since the early 1970s than was evident in previous years.

Figure 2.10 shows the profit shares of the major industry groups. Profitability in mining has followed the pattern of investment fairly closely, with a strong rise in the mid 1970s and again in the recovery since mid 1983. Finance has shown little additional return for the apparent surge of investment in the mid 1970s and again in the early 1980s (part of this surge was, of course, a reflection of leasing activity). Manufacturing has, apart from a once-off downward shift in 1972/73, shown little trend decline in the level of profitability.

Figure 2.10



2.4 Summary

Investment in Australia accelerated sharply in the early post-war recovery period. Since then, it has remained at a high level of around 25 per cent of GDP. While a longer-term perspective suggests that Australia's investment performance has been creditable, there is evidence of a slowdown since the mid 1960s, relative to both the post-war average and to experience in other OECD countries. One effect of this slowdown has been a net decline in the capital stock per unit of effective labour over the past decade.

On an industry basis, the pattern of investment has been broadly in line with the structural changes occurring in the economy in this period. There has been a decline in the relative importance of agriculture, a steady increase of investment in tertiary industry and, concentrated into two main periods, a substantial increase of investment in mining and extractive industries.

These trends raise two questions in particular:

- first, to what extent has the performance of investment contributed to the overall macroeconomic performance of the Australian economy?; and
- second, is the performance of investment consistent with general principles of investment theory?;

These questions are taken up in turn in the remaining sections of the paper.

3. CAPITAL AND GROWTH

In assessing the contribution of investment to economic growth it is useful to separate the effect of investment spending on aggregate demand from the effect of productive capital on the aggregate supply of output. The supply aspect is, in a sense, the more fundamental since it concerns the overall trends in output and employment. The demand aspect is more relevant to fluctuations about the trends. This section deals with investment as an influence on supply, while the next section turns to investment as an influence on demand.

In evaluating the role of investment and capital in determining the underlying trend of growth it is difficult to avoid the notion of an aggregate production function, relating aggregate output to inputs of capital and labour. The existence, meaning and measurement of aggregate production functions has been one of the most hotly debated issues in economics and has spawned an extensive literature - much of it in the form of an exchange between economists in Cambridge England and Cambridge Massachusetts.[5]

At the heart of the debate are the conditions under which microeconomic production functions (about which there is much less controversy) can be aggregated. The issues of debate include the measurement of capital (in particular, whether it is possible to aggregate heterogeneous capital goods) and the technical conditions under which microeconomic properties are preserved at the aggregate level.

Our limited understanding of this literature is that the theoretical issue of whether an aggregate production function necessarily exists or exhibits sensible properties has been awarded to the opponents of production functions. At the same time, the empirical evidence appears to support those who have championed the aggregate relationship. It is not our intention to buy into this now largely closed debate. The existence of an aggregate production function is essentially an empirical issue. In this section we take the pragmatic approach of asking whether the data discussed so far are broadly consistent with the patterns that would occur if output could be characterised by a simple production function. We then explore some of the implications of such a relationship.

3.1 Capital, labour and output: the patterns

To give some structure to the exercise, suppose national output, Q, can be represented by the following general relationship:

$$Q_t = f(K_t, L_t, A_t) \qquad (1)$$

where K is the nation's capital stock, L is the employed labour force, A is a term representing the impact of technological progress and t is time. This is, of course, a very simple representation which ignores other factors of production and intermediate inputs.

Suppose further that A_t takes the form of Harrod-neutral labour-saving innovation and that f(.) can be described by a linear homogeneous function in capital and labour in efficiency units, L^*, where $L_t^* = L_t\,(1+\delta)^t$ and δ is the rate of technological progress.

5. For a survey of the Cambridge controversies see, for example, Harcourt (1972).

There are a number of empirically estimable production functions that satisfy these conditions. The simplest is the Cobb-Douglas function:

$$Q_t = \beta K_t^{\alpha} L_t^{*(1-\alpha)} \tag{2}$$

where α is capital's share of the value of output and β is a constant term.

If we assume further that factor markets are reasonably competitive, so that factors are paid the value of their marginal products, we get the following additional relationships:

$$\frac{\partial Q_t}{\partial L_t^*} = (1-\alpha)\frac{Q_t}{L_t^*} = w_t \tag{3}$$

$$\frac{\partial Q_t}{\partial K_t} = \alpha \frac{Q_t}{K_t} = r_t + \mu \tag{4}$$

where w is the real wage rate per efficiency unit of labour, r is the rate of profit per unit of capital (or user cost of capital), and μ is the rate of depreciation.

Equations (2), (3) and (4) (and their more general forms) contain the key elements of neoclassical growth theory. From these simple relationships we can derive some immediately testable implications:

(a) the output/capital ratio (Q/K) should fall and the output/labour ratio (Q/L*) should rise as the capital/labour ratio (K/L*) rises; and

(b) real wages should be positively related and real profits (per unit of capital) should be inversely related to the capital/labour ratio.

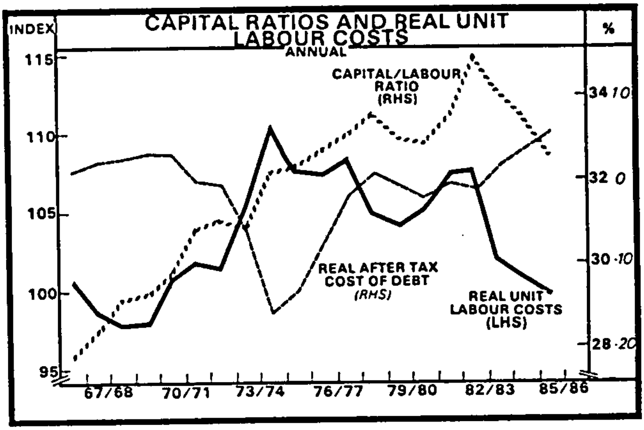
The general properties under (a), linking the output/capital, output/labour and capital/labour ratios, are borne out by Figures 2.7 and 2.8 in Section 2.

Figure 3.1 shows the capital/labour ratio along with real unit labour costs (real wages per efficiency unit of labour) and the real after-tax cost of debt[6] (although imperfect, this is one measure of the profit rate per

6. Further consideration is given to this measure in Section 3.4.

marginal unit of capital). The positive relationship between real wages and capital intensity and the inverse relationship between the approximation to marginal profits and capital intensity are reasonably well identified in the graph. Further, while the assumed rate of technological progress is consistent with estimates reported in Section 3.2, the relationship between factor prices and capital intensity would be even more striking for higher assumed rates of technological progress.

Figure 3.1



The relationships highlighted in Figures 2.7, 2.8 and 3.1 appear consistent with the existence of an aggregate production function and relatively competitive factor markets. They do not necessarily imply any causal relationships or offer any explanation as to why capital, labour and output have behaved as they have done over this period. The issue of causality is addressed in Section 5.

While they do not suggest causality, these relationships can be used to carry out some simple counterfactual exercises for the historical period. To conduct such exercises it is necessary to be more precise about the parameters in the production function.

3.2 Some estimated production functions

International experience with empirical production functions has been mixed. In his Presidential Address to the American Economic Association, Douglas (1948) summarised a large body of cross section and time series results for different countries and industries for which Cobb-Douglas production function estimates fitted remarkably well. Results for Australia have, in general, been less impressive.

One of the problems with empirical production functions in Australia has been the paucity of reliable data about the capital stock. The data graphed in Section 2 have only recently become available[7] and offer a useful opportunity to re-estimate these functions for Australia.

Equation (1) in Table 3.1 presents estimates of an aggregate Cobb-Douglas production function using quarterly Australian data from 1967(3) to 1986(2). To facilitate estimation of the rate of technological progress, the equation is estimated by non-linear least squares, using the statistical package SAS. Figures in brackets are standard errors. The sum of the estimated co-efficients on labour and capital are not significantly different from unity, thereby supporting the assumption of linear homogeneity in equation (1).[8]

One of the limitations of the Cobb-Douglas form is that the elasticity of substitution between capital and labour, σ, is fixed at unity.[9] This, in turn, requires that factor shares remain constant as the capital intensity varies over time - a restriction that is not supported by the data graphed in Section 2. A commonly used and more general production function that permits a non-unitary elasticity of substitution and non-constant factor shares is the CES function:[10]

$$Q_t = B\ [\gamma K^{-\rho} + (1-\gamma)L^{*-\rho}]^{-1/\rho} \qquad (5)$$

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7. See Walters and Dippelsman (1986) for annual data and Dews (1986) for the method used to derive quarterly estimates.

8. The value of the F statistic in testing this restriction is 0.251. This statistic is distributed F (1, 68). Estimates of the Cobb-Douglas production function without the restriction of linear homogeneity are reported in Appendix A (Table A.1).

9. $\sigma = [(d(LnK/L)/d(Ln\partial L/\partial K)]$

10. See Arrow, Chenery, Minhas and Solow (1961).

where ρ (the substitution parameter) is related to the elasticity of substitution by the relationship $\sigma = 1/(1+\rho)$, B (the scale parameter) is comparable to the constant term, β, in the Cobb-Douglas function and γ (the distribution parameter) is comparable to the share parameter, α, in the Cobb-Douglas function. For the CES production function to have meaning, the parameters should satisfy: $B > 0$, $0 < \gamma < 1$, and $\rho \geq -1$.

When $\rho = 0$, the CES function collapses to the Cobb-Douglas function.[11] For $\rho \neq 0$, factor shares vary with the capital intensity according to:

$$wL^*/Q = (1 - \gamma)B^{-\rho}(Q/L^*)^{-\rho} \tag{6}$$

$$rK/Q = \gamma B^{-\rho}(Q/K)^{\rho} \tag{7}$$

Estimating the coefficients of the CES function directly has proved difficult, due to the accentuated non-linearity of the functional form. This has led a number of researchers to utilise the first-order conditions for cost minimisation with respect to labour to estimate the elasticity of substitution indirectly. In their original paper, Arrow et.al. (1963) use the indirect approach to estimate industry elasticities of substitution using cross-section data for a number of countries. Murphy et. al. (1986) use a similar approach in estimating an aggregate elasticity of substitution for Australia for the AMPS model of the Australian economy.

The Arrow and Murphy papers both find elasticities generally less than unity. However, apart from limiting the number of parameters that can be estimated, the indirect approach using labour has been shown by Maddala and Kadane (1966) to yield estimates of γ that are biased downwards and often at variance with estimates obtained using the cost minimisation conditions with respect to capital.[12] Another major weakness of this approach is that it assumes that perfect competition holds at all points in time, which direct estimation of the production function does not.

Our efforts to estimate equation (5) directly also encountered difficulties. In particular, there appeared to be problems associated with identifying the

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11. This is not obvious from equation (5). In fact the Cobb-Douglas function is a limiting form of the CES function as $\rho \to 0$ (provided there are also constant returns to scale).

12. See also Dhrymes (1965).

share parameter γ and the substitution parameter ρ separately. To simplify the procedure we fixed the value of γ and undertook a grid search over values between zero and unity. There were little grounds on which to choose between the estimates obtained in this way. A rough mid-point of the estimates is shown in equation (7) of Table 3.1. The other estimates are shown in Appendix A (Table A.1).

The estimates behave oddly as γ approaches its limits. For reasonable values of γ, however, the parameter estimates are quite stable. In particular, the estimates of σ for a wide range of values of γ are surprisingly close to unity, suggesting that the Cobb-Douglas function in equation (1) of Table 3.1 may be a reasonable first approximation to an empirical aggregate production function for Australia. In all Cobb-Douglas equations in Table 3.1, the dependant variable is LnQ_t. In the CES production functions we exploited the homogeneity assumption and divided through by labour, making the dependant variable $LnQ_t - LnL_t$.

TABLE 3.1
SUMMARY OF ESTIMATED PRODUCTION FUNCTIONS
1967(3) to 1986(2)

	Constant β / B	Share α / γ	Elasticity σ	Technological Progress δ	R^2
Cobb-Douglas:					
1. Aggregate	378.96	0.36	1.00	0.0028	0.995
	(0.576)	(0.057)		(0.0003)	
2. Private Sector	278.11	0.42	1.00	0.0014	0.985
	(0.462)	(0.048)		(0.001)	
3. Mining	120.00	0.57	1.00	-0.0066	0.959
	(0.368)	(0.034)		(0.002)	
4. Manufacturing	235.46	0.41	1.00	0.0064	0.923
	(0.550)	(0.057)		(0.0003)	
5. Finance, etc.	79.88	0.64	1.00	-0.0449	0.753
	(0.756)	(0.073)		(0.010)	
6. Other Industries	47.83	0.62	1.00	0.0034	0.982
	(1.46)	(0.162)		(0.0003)	
CES:					
7. Aggregate	317.31	0.40	0.98	0.0028	0.984
	(91.74)		(0.023)	(0.0003)	
8. Private Sector	252.56	0.50	0.94	0.0023	0.965
	(58.06)		(0.019)	(0.0004)	
9. Mining	103.86	0.60	0.99	-0.0065	0.896
	(18.35)		(0.012)	(0.002)	
10. Manufacturing	151.34	0.50	0.96	0.0064	0.970
	(42.08)		(0.022)	(0.0003)	
11. Finance, etc.	45.79	0.60	1.12	-0.1942	0.980
	(1.17)		(0.002)	(0.011)	
12. Other Industries	51.85	0.60	1.01	0.0034	0.917
	(38.15)		(0.077)	(0.0003)	

In view of the criticisms that have been levelled at aggregate production functions we have also attempted to estimate some disaggregated functions for the private sector and by industry. In doing so, we made no attempt to adjust for leasing. Equations (2) and (8) in Table 3.1 show estimates of a private sector production function.[13] These estimates are broadly similar to those obtained for the aggregate production function, although, in most cases the estimated rate of technological progress is a little lower. Further estimates are shown in Table A.2 in Appendix A. The lower rate of technological progress may, at least partially, be explained by the extent to which excluded public expenditure induces private capital expenditure. Gruen (1986) points out that in so far as governments have a role in determining private expenditure the distinction between public and private spending is arbitrary.

Equations (3) to (6) and (9) to (12) in Table 3.1 report a summary of the estimates for the mining, manufacturing, finance property, and business services and other industries. More estimates for each of these sectors are reported in tables A.3, A.4, A.5 and A.6 respectively in Appendix A.

Of the disaggregated functions, only those for manufacturing and other industries are relatively well-determined and not greatly at variance with the aggregate estimates. The poor identification of the relationship for finance property and business is likely to be a consequence of the treatment of leasing. As outlined in Section 2, to the extent that the finance sector purchases capital and leases it to other sectors, its capital stock will be overstated. In particular, this could tend to bias the measure of technological progress. The treatment of leasing will also affect other sectors but, on average, they will be affected less than finance property and business services.

Subject to the caveat about leasing, the estimates for manufacturing and other industries are quite interesting. In particular, the estimated rate of technological progress in manufacturing is well above the average for the

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13. In each of the equations in Table 3.1, an optimal lag between the installation and utilisation of capital was chosen on the basis of experimentation. In each case we selected the lag length with the highest R^2 statistic. The chosen lag for the aggregate function was six quarters (i.e. production in the current quarter is assumed to be produced by current quarter labour input and the capital stock put in place six quarters earlier), for the private sector it was also six quarters, for mining eight quarters, for manufacturing four quarters, for finance, property and business services two quarters, and for other industries six quarters.

economy and is quite well-determined across the range of values for the distribution parameter γ used in the CES production function. This is consistent with the trend rise in productivity in manufacturing experienced over this period.

While satisfactory in most other respects, the insignificance of the constant term in estimates for the other industries category may reflect the fact that data for this sector are calculated residually and therefore contain the majority of measurement errors.

The estimates obtained for mining are a little more curious. In particular the estimated rate of technological progress for mining is significantly negative. There are several factors which may have influenced this surprising outcome. While our estimates suggest that problems related to leasing should be negligible for this sector, there is reason to believe that, due to methods of classification, some output related to the mining industry may be included in manufacturing or "other" (for example, manufacturing involving processed minerals). It is also quite likely that problems associated with capacity utilisation are important for this industry, (this is discussed at some length in Section 3.3 below). Since excess capacity for capital is likely to emerge in industries with long implementation lags, effective capital could have been overstated in the mining industry for long periods in the late 1960s and early 1970s and again in the early 1980s.

Our assumption that it takes an average of 8 quarters for mining capital to begin producing output (see footnote 13) means that decisions regarding required capacity are made two years prior to production. Using recent experience as an example, it seems unlikely that falls in prices for mineral exports in 1985/86 could have been foreseen two years earlier. As a result, investment decisions made then, may have resulted in excess capacity today. The extent to which excess capacity has existed from time to time may mean that measured capital may overstate the amount of capital actually employed in the production process.

On balance, the general consistency of the estimates for the private sector, manufacturing and other industries with those for the whole economy is at best suggestive of the existence of an aggregate function. There are several shortcomings to this analysis, including our failure to deal with the problems associated with variation in the rate of utilisation of capital, and also labour. Importantly, no attempt has been made to allow for excluded factors of production such as energy and land or for investment in human capital. At a disaggregated level, although we have identified problems associated with leasing, we were not sufficiently confident of our approximate adjustments to adjust the industry capital stock estimates accordingly. There are also possible problems with the measurement of output by industry and, in a more general sense, problems associated with changing quality of data over time resulting from breaks in both output and employment series.

Despite these limitations and the simplicity of this analysis, the results offer some support for the existence of a reasonably stable aggregate production function. Characteristics obtained estimating a relatively simple Cobb-Douglas production function are, in each case, supported by results from the CES functions. In particular, the rate of technological progress was remarkably stable in the aggregate production functions, estimates of the elasticity of substitution of labour for capital were close to unity in most cases, and estimates of the share parameter appear to be broadly consistent with profit share data obtained from the national accounts. At the very least, even though the hurdles are formidable, these features should encourage further work to be undertaken in this area.

3.3 Capacity utilisation

A particular shortcoming of the production functions reported in Section 3.2 is the implicit assumption that there is a constant rate of utilisation of capital. In the case of labour, the use of employment rather than labour force is a reasonable, though imperfect, approximation to utilised labour; the rate of utilisation of labour may rise above and fall below labour employed across the business cycle as a result of labour hoarding and variations in hours worked.

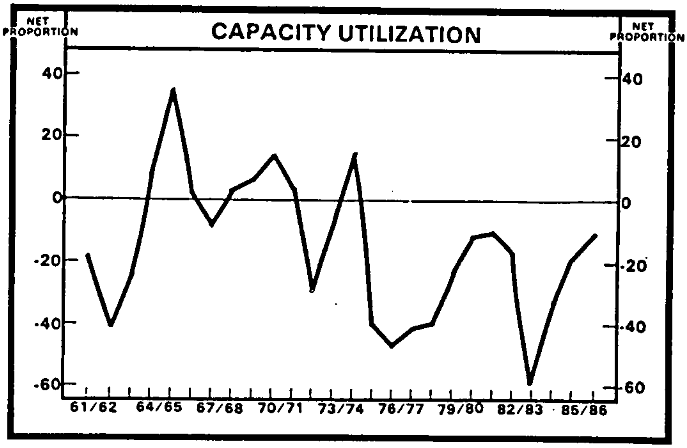
In the case of capital there is no ready approximation to the rate of utilisation. A rough guide may be obtained by "linking peaks" in GDP over time. However, the choice of peaks is arbitrary and there is no guarantee that the various peaks in GDP are obtained when capacity is fully utilised. This method also uses total product, based on all factors, not just capital.

One of the few pieces of evidence available over a long period of time relating directly to capital utilisation is the CAI/Westpac Survey of

Manufacturing. Figure 3.2 below shows the proportion of respondents to this survey who stated they were operating at a "satisfactorily full" rate of operation, less the proportion of respondents who stated that they were not. If these figures could be taken as representative of the entire economy there would have been a relatively high rate of utilisation of capital during the 1960s resources boom, which largely tapered off through the 1970s. Excess capacity emerged strongly in the second half of the 1970s and again in the early 1980s with the second resources boom. The general restoration of capacity utilisation in recent years appears consistent with the low levels of investment over this period.

The movements in this series are largely similar to those obtained using the "linking peaks" method. Although, by definition, the "linking peaks" method must mask the longer-run downward trend in utilisation evident from Figure 3.2. In the estimates in this paper we have made no attempt to adjust for the rate of capacity utilisation.

Figure 3.2



3.4 Some simple counterfactual calculations

Subject to the limitations of the estimates outlined above, the aggregate production function reported in Table 3.1 can be used in some simple counterfactual exercises for the post-war period. In these exercises we will use the Cobb-Douglas estimates reported in equation (1) in Table 3.1.

To begin with, since we have estimated the production function directly, we can use the estimated function to examine the neoclassical assumption of perfect competition. The estimated function can be solved, using historical data, to provide approximate series for the marginal products of labour and capital over the estimation period. These are given by the left-hand equalities in equations (3) and (4). Figure 3.3 shows, for labour and capital, the deviations of these measures of marginal product from their relevant measures of factor costs (real unit labour cost for labour and the real after-tax cost of debt for capital).[14] If markets had been perfectly competitive through this period (and there were no periods of rationing), marginal product and factor cost would coincide and the deviations would be negligible. In fact, deviations have been systematic and substantial. (This, of course, could be a result of misspecification of the aggregate due to omitted factors).

From Figure 3.3, it is apparent that the marginal product of capital is greater than its factor cost over most of the period. One possible explanation for this is the presence of a risk premium, requiring the marginal product to be above the cost of funds in order to cover the risk involved with investment (this risk premium may vary over time).

Further, our measure of the factor cost of capital used in Figure 3.3 is an imperfect one, since it does not include any provision for the cost of equity. A measure incorporating both equity and debt was constructed by Carmichael and Stebbing (1982). It showed that in many periods the average real after-tax cost of capital was somewhat higher than indicated by our simple debt-based measure. Although no current data are available on their measure, the relative cheapness of equity finance over the last few years might in fact lower the average real after-tax cost of capital. Allowing for these factors, it is possible that the marginal product of capital would have been more closely associated with its "true" factor cost in the late 1960's and early 1970s. The association would probably have been close in the early 1980s.

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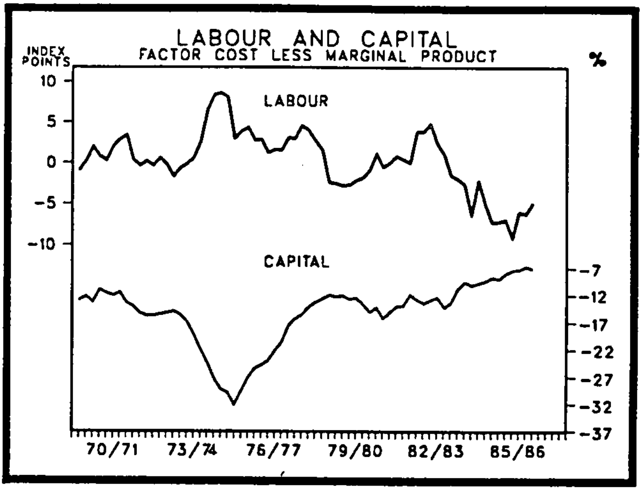
14. Details of the methodology used to construct these measures are contained in Appendix B.

Figure 3.3



In the labour market there appears to have been a major divergence from competition in the mid 1970s and again in the early 1980s. The pattern for capital is, to some extent, a mirror image of that for labour. For example, in the mid 1970s, when labour was apparently being paid in excess of its marginal product, the gap between the return to capital and its cost increased. In more recent years, factor cost has fallen below the marginal product of labour, while the gap between capital returns and capital costs has been quite small.

More generally, the extent of the mirror reflection between labour and capital is an indication of the "fit" of the production function. The divergence between factor costs and measured marginal product is also an indication of the extent to which direct estimation of the production function might dominate indirect estimation as an approach.

Drawing together the evidence from Figures 3.1 to 3.3, it appears that, abstracting from problems related to capacity utilisation, the broad trends in factor prices are consistent with both the existence of an aggregate production function and a reasonable level of competition. But, there appear to have been prolonged periods during which actual factor payments have deviated from the competitive solution.

The second counterfactual calculation examines possible consequences for employment of alternative rates of growth of the capital stock in coming years. Assuming that currently available capital is fully utilised, and that there is limited scope for real unit labour costs to continue falling, growth of employment will require growth of capital.

For this exercise we used Australia's trend rate of labour force growth (about 2 per cent per annum) to construct a labour force series. To keep unemployment from rising, employment would need to rise at the same rate. Holding the capital/labour ratio constant we generated a series for the required capital stock. From this series, and the historical rate of depreciation, it was found that gross investment would need to grow by an average of over 3 per cent per year over the next five years to maintain the desired rate of employment growth. This compares with growth of investment of about 1-1/2 per cent in 1985/86 and an average of around 2 per cent over the past decade.

Of course, this exercise assumed that the relative prices of capital and labour stay the same. Alternatively, equation (3) suggests that, if factor markets were to behave competitively, capital stock growth at the slower rate of 1.2 per cent annum, for example, would require real unit labour costs to fall by over 2 per cent over the next five years to maintain employment growth sufficient to prevent an increase in unemployment.

4. INVESTMENT AND FLUCTUATIONS IN ECONOMIC GROWTH

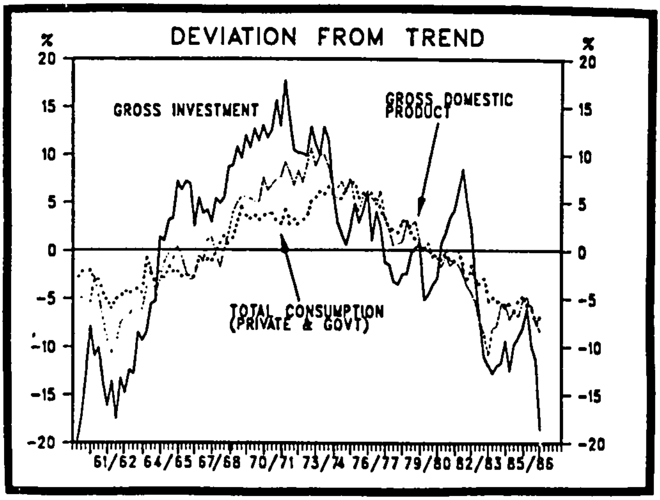
Investment affects economic activity in the first instance through its impact on aggregate demand. Historically, investment has been the most volatile component of aggregate demand. In the past three decades, the annual growth rate of investment has fluctuated between -27 per cent and 23 per cent, compared with growth rates of GDP between -1 per cent and 8 per cent. Coefficients of variation of the growth rates for the major components of expenditure over the past two decades are shown in Table 4.1 below. As can be seen from that table, cycles in the components of investment are considerably larger than those in the other components of demand.

Table 4.1
Coefficients of Variation of Growth Rates
1979/80 Prices

Expenditure component	Coefficients of Variation
Total consumption	1.55
. Private consumption	1.49
. Government consumption	3.52
Total investment	5.64
. Dwellings	13.35
. Plant and equipment	11.89
. Construction	16.92
. Public enterprises	13.34
. General government	8.30
Exports	7.24
Imports	11.84
GDP	2.40

Figure 4.1 shows the deviation of the log of some major components of spending and deviations of GDP, from their respective linear trends. This provides some idea of the contributions of these components to deviations of GDP from its trend. On average, over the whole period, gross investment has accounted for about a quarter of GDP growth per annum. However, the volatile nature of investment relative to total GDP, highlighted in Figure 4.1, is consistant with a much greater contribution from investment in some periods and less in others. As suggested by Table 4.1, fluctuations in investment spending appear to have been a major source of fluctuations in GDP.

Figure 4.1



The extent of the influence of investment on cycles in GDP, of course, depends on the many behavioural relationships that make up the economic structure. Estimates of the impact and long-run multiplier effects of changes in exogenous demand vary widely. These multipliers apply to unexpected or exogenous shocks to components of aggregate demand. Over the past 25 years, the most obvious candidate period for an investment shock is that associated with the mineral boom in the early 1980s.

In order to calculate a very rough estimate of the impact of investment in this period, we assume that the entire deviation of business-fixed investment from its trend was in the nature of an exogenous shock and simulate its impact on GDP using the RBII model of the Australian economy.[15] Under this assumption, the cumulative shock to investment over the four-year period from March 1980 was in the order of $9 billion, in 1979/80 prices, or a little over 2 per cent of GDP in that period. This shock contributed to a cumulative increase in GDP between March 1980 and December 1985 of around $11 billion, relative to trend, implying a multiplier of about 1.2. This calculation depends, of course, on the assumption that the surge of investment in this period was entirely autonomous.

Investment has clearly played a significant short-term role in the pattern of growth of output in Australia. Deviations of investment from trend set up, through their influence on aggregate demand, corresponding deviations in GDP about trend. As previously discussed, investment also influences the trend of GDP through its effect on the capital stock and thereby on the productive capacity of the economy. In the next section, we examine some of the factors that may have influenced the amount of private sector investment undertaken in the post-war period.

5. INFLUENCES ON PRIVATE CAPITAL ACCUMULATION

In Section 3 we noted that the broad empirical relationships observed among capital, labour, output and factor prices were, perhaps surprisingly, broadly consistent with the existence of an aggregate production function and competitive factor markets, although there have been some periods during which actual factor payments have deviated widely from the competitive solution. As mentioned in that section, these relationships imply the existence of a production function but they do not necessarily tell us anything about why labour and capital evolved as they have done over the past two decades or so.

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15. See Fahrer and Rankin (1984) for specification of the RBII model.

The most striking feature of the period under consideration is the trend increase in the capital intensity up to the late 1970s and the reversal of that trend since the early 1980s. This section considers some of the factors that may have influenced this outcome. Since the emphasis of the section is on the private sector's decision making processes, the analysis is restricted to private sector investment, excluding dwellings.

5.1 Neoclassical investment theory

Neoclassical investment theory starts from rigorous microeconomic foundations. The typical approach posits that firms choose inputs of capital and labour so as to maximise the present value of expected profits. The objective function can be expressed in the following terms:

$$\text{Max } H = \int_0^\infty \{e^{-rt}[p_tQ_t - w_tL_t - p_{kt}I_t]$$

$$+ \lambda_{1t}[F(Q_t, L_t, K_t)] + \lambda_{2t}[\dot{K}_t - I_t + \delta K_t]\}dt$$

where r is the firm's discount rate, p, w and p_k are the prices of output, Q, labour, L, and investment goods, I, while λ_1, and λ_2 are lagrange multipliers, and F(.) is a well-behaved production function.

The solution to this maximisation problem is a set of demand functions for capital and labour services and a supply function for output. The solutions are functions of relative prices, both current and future; that is, they depend on the entire expected time sequence of relative prices.

There have been many attempts to estimate investment equations derived directly from the neoclassical foundations sketched above.[16] Their success has been less than impressive. Hawkins (1979) outlines a number of reasons why it is difficult to apply neoclassical models to the 1970s. Most studies have focussed on the demand for investment, without much reference to the supply of investment goods or to demand for and supply of finance.

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16. See for example, Mackrell, Frisch and Roope (1971), McLaren (1971), Hawkins et.al. (1972) Pagan and Gray (1983) Perazzelli and Perrin (1983) and various other publications on the Treasury's NIF model and the Reserve Bank's RBA1 and RBII models.

One study which takes a more aggregative, equilibrium approach to these relationships is that by Kohli and Ryan (1985) which integrates production decisions with portfolio decisions. They argue that the stock of capital is given at any point in time so that, under competitive conditions, the rental price (user cost) of capital will tend to equal its marginal product. On this basis, they construct an integrated model of investment behaviour, taking into account the decisions to own, use and produce capital goods.

The great difficulty with empirical implementation of the neoclassical model, however, is the dominance of future expectations coupled with their lack of acceptable empirical measurement. As pointed out by Carmichael (1979), the demand functions derived from the neoclassical model can be interpreted as incorporating most ad hoc explanations of investment. For example, profits play a central role in the optimisation process of the neoclassical firm, but so too do the cost of capital, relative prices, expected output and so on. In a sense, most of the ad hoc or simplified models of investment can be interpreted as special cases of the more general neoclassical model, with an emphasis on empirical expedience. This feature of the neoclassical model as "nesting" more empirically-oriented approaches is both a strength (because of its generality) and a weakness (because it fails to yield unambiguous testable implications).

5.2 Some empirically-oriented explanations of investment

One of the earliest theories of investment behaviour, the accelerator approach, links the level of investment with changes in the rate of growth of output. Since investment generates changes in the capital stock, and output is related to the level of capital rather than its rate of change, the simple accelerator explanation relies on growth in output to stimulate investment. In his extensive survey of the literature Hawkins (1979) found that, until the early 1970's, business investment fitted an accelerator mould. Hawkins cites the insignificance attributed to other variables, such as tax incentives, as evidence that demand influences outweigh other factors. However, he found that the relatively simple accelerator mechanism no longer seemed appropriate in the mid to late 1970s. This was reflected in the number of studies which attempted to take into account additional factors including the rise in real wages, movements to equal wages, higher inflation and exchange rate movements.[17] Even more sophisticated versions of the accelerator hypothesis incorporated capacity constraints and limited substitution between labour and capital.

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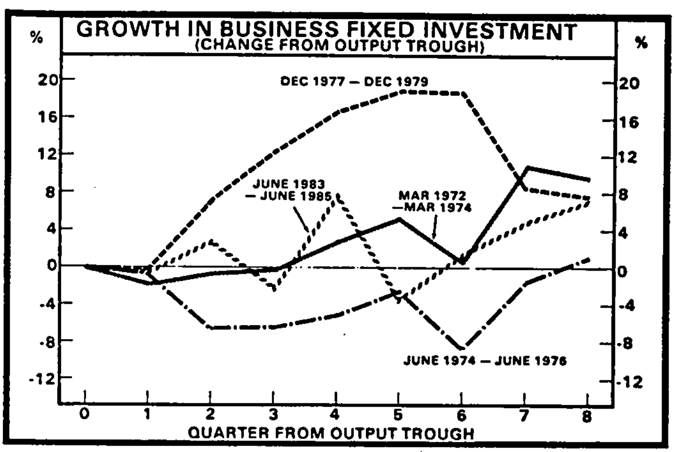
17. See for example, Higgins et.al. (1976) and Sheehan et.al. (1979).

Figure 5.1 (reproduced from EPAC (1986)) shows growth in business-fixed investment during a number of economic upswings. As illustrated by this graph, upswings in economic activity have been associated with a wide variety of investment profiles. While the evidence does not support a simple accelerator relationship between investment and cyclical growth, Stegman (1982) has found evidence of an accelerator effect in a more complex model incorporating a profitability constraint. However, Stegman concluded that his approach was only a "qualified success" after finding some evidence that investment was constrained by profitability from late 1970 to the end of 1971 and during 1975.

One empirical relationship that has received a lot of attention in a number of countries is that between investment and a measure known as Tobin's "q". This measure is constructed as the ratio of the market value of existing capital to its replacement cost. When this ratio is low, existing capital is cheap relative to purchasing and installing new capital. Under these circumstances, investors have an incentive to take over existing enterprises. Correspondingly, when the ratio is high, investors have an incentive to install new equipment.[18]

Figure 5.1

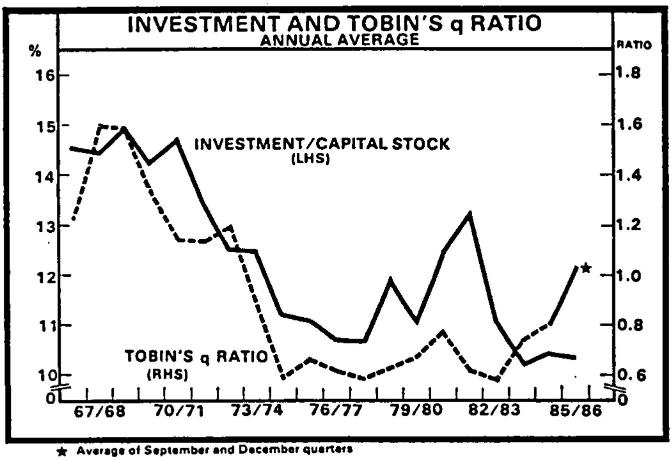


18. For a fuller explanation, see Tobin (1969) and Dews (1986).

Figure 5.2 shows a measure of Tobin's q, graphed against business investment as a ratio to business capital stock. Allowing for a lag of at least a year between the emergence of the incentive to invest and the actual installation of capital, the graph suggests a fairly close relationship along the lines predicted by Tobin. The period since the start of the 1980s, however, does not fit well with the general picture; in that period, q indicates a strong rise in the incentive to investment while actual investment, as a proportion of the private sector's capital stock, has been falling.

There is little agreement about how to measure the cost of employing capital. In a wide range of empirical work in Australia (see, for example, EPAC (1986) and the works cited by Hawkins (1979)) the cost of capital has been based on its opportunity cost; namely, the rate of return on government securities.

Figure 5.2



EPAC (1986) have suggested a measure of incentive to invest based on the ratio of the expected rate of return on capital to the opportunity cost of funding the capital expenditure. In concept, this measure is quite similar to Tobin's q since it incorporates many of the same factors. In practice, the two are quite different, largely as a result of the data used. In particular, the EPAC measure of incentive to invest uses a long-run measure of expected returns based on their AMPS model.[19] Tobin's q, on the other hand, is based

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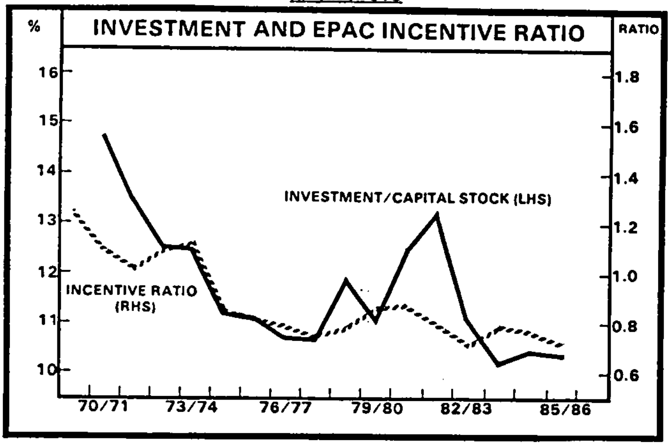
19. See Murphy et.al. (1986).

on data from a large sample of listed companies. This tends to reduce the variance of the EPAC series relative to Tobin's q.

Figure 5.3 shows the ratio of investment to capital against the EPAC variable. Again, the relationship is as predicted and quite credible. In particular, the EPAC measure explains the lacklustre performance of investment over the past two years better than does Tobin's q, though the latter provides a better explanation of the early to mid 1970s.

In comparing the Tobin and EPAC measures of incentive to invest it is useful to think of Tobin's q as reflecting expected profitability and the cost of equity-funded investment, while the EPAC measure uses debt as the relevant financing instrument. In the past year or two, real interest costs have risen, while the cost of equity capital has fallen.

Figure 5.3



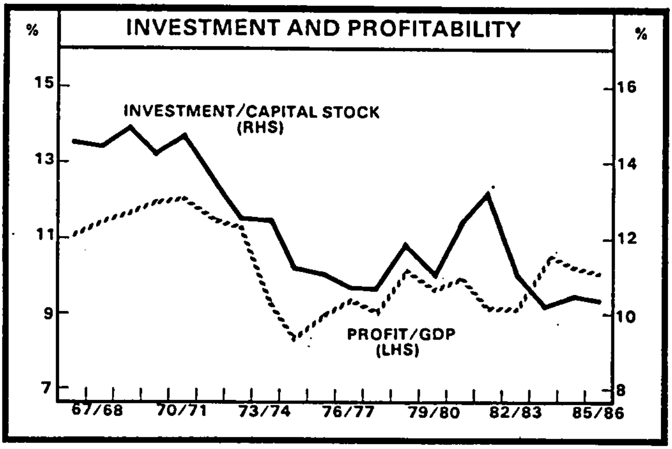
Both Tobin's q and the EPAC incentive ratio are essentially forward-looking concepts. An often-quoted determinant of investment that is less oriented to expectations is current profits. Current profits generate readily accessible funds for investment and, at times, may be a guide to future profitability. The importance of profitability has been highlighted by Gruen (1986 p.192) who argues that:

> "Allowing the profitability of economic activity generally to improve and, in the process, encouraging higher rates of capital formation is probably the single most important step we could take to improve our lacklustre per capita growth performance".

Figure 5.4 shows business-fixed investment as a ratio to business capital graphed against the after-tax corporate profit share (including financial enterprises). Again, the fit is quite creditable and, as with Tobin's q, the relationship fits less well since the beginning of the 1980s.

While it is difficult to determine why the measures of incentive to invest and profitability fit the pattern of investment less well in some periods, part of the answer may be incorporated in the extent of capacity utilisation. If the data in Figure 3.2 can be taken as indicative of trends throughout the economy rates of utilisation of existing capital are currently still quite low by historical standards. This may have contributed to recent slow growth in investment. This is in contrast to the pattern evident throughout the investment boom of the late 1960s, during which existing capital was more full utilised.

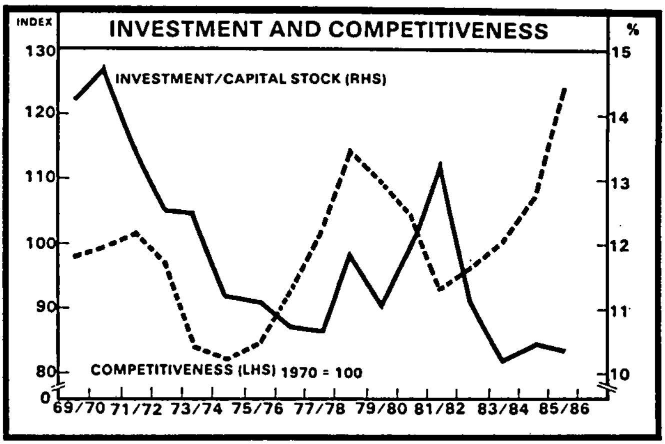
Figure 5.4



Another factor often regarded as a key determinant of investment is relative prices. Of particular relevance is the price of capital relative to the price of labour; when labour becomes more expensive, there is an incentive to substitute capital for labour (and vice versa). The cost of employing labour is reflected primarily in direct wage and on-costs (workers' compensation, payroll tax and so on). Figure 3.1 in Section 3 provides a widely-used measure incorporating these factors.

Wage costs are relevant to the choice between capital and labour in producing any given desired output. In a competitive environment, where capital is mobile internationally, the cost of labour in Australia relative to that in our major competitors abroad can also influence the level of investment. Figure 5.5 shows a measure of unit labour costs in major OECD countries relative to unit labour costs in Australia, adjusted for the exchange rate (an index of competitiveness), graphed against the performance of investment. As the index rises, Australian labour becomes more competitive relative to labour abroad. This should encourage investment in Australia. The relationship in Figure 5.5, is rather loose. However, a rough apportioning of the period into times of high and low competitiveness suggests that (with a lead time of about one year) high competitiveness correlates with rising investment and low competitiveness with falling investment.

Figure 5.5



5.3 Determinants of investment

For any one or more of the factors listed above to qualify as major determinants of investment over the post-war period in Australia it would be necessary for them to have been largely exogenous over the period. There are, of course, few variables for which true exogeneity can be claimed. For example, the boost to wages in 1974 undoubtedly had an element of exogeneity but, for most of the period, it is unlikely that the behaviour of wages was not as influenced by capital accumulation as was capital accumulation by wages.

The same can be argued about profits and, to a lesser extent, about the cost of capital. In the case of capital costs, monetary and fiscal policy can at times impart a degree of independence. This occurs both through the impact of policy on the nominal interest rates of competing assets and through the impact of inflation on real rates of return.

This latter point has been somewhat controversial. According to the well-known Fisher theorem, real interest rates should be largely independent of the rate of inflation. Carmichael and Stebbing (1983) found, to the contrary, that in both the United States and Australia, the data were more consistent with the alternative hypothesis that nominal interest rates are largely independent of inflation, while real rates fluctuate inversely one-for-one with inflation. While they raised a number of caveats against using this relationship for projecting into the future, their results do suggest that, over the post-war period, the rate of inflation has been a major determinant of the cost of capital and, through it, the path of capital accumulation.

Accepting this line of argument would suggest inflation as a key factor in determining the capital intensity. But, even here, inflation would be no more than a proximate determinant of Australia's capital intensity, since inflation is itself an endogenous variable. The ultimate determinants of capital intensity would be the factors such as monetary and fiscal policy, world inflation and so on, that determine the rate of inflation in Australia over this period.

Of course, economic policies also respond to domestic developments. Nevertheless, there appears to be a case that the overall trend in capital intensity has been largely policy related. That is, the rise in capital intensity in the mid 1970s appears to have been associated with expansionary stabilisation policies that fueled inflation and reduced the cost of capital to historically low levels (by many measures, including that in Figure 3.1, the real after-tax cost of capital became negative in this period). Similarly, in the late 1970s and since the start of the 1980s, firmer policies have reined in the rate of inflation which, coupled with deregulation of interest rates, resulted in a higher cost of capital and quite probably through that channel, a lower capital intensity.

This general trend was punctuated in the early 1980s by the increase in capital intensity associated with the resources boom, which exogenously raised expected profitability relative to the cost of capital. The subsequent reversal of that increase in expected profitability has reduced the desired capital intensity relative to the cost of capital.

6. SUMMARY AND CONCLUSIONS

This paper has surveyed the historical evidence on investment. In looking at the role of investment in economic growth we have examined the dual roles of investment as a source of both supply and demand for output.

As a component of demand, investment is notable mainly for its volatility. In other respects, there is little to distinguish investment spending from other components of demand. As a percentage of GDP, total investment has declined since the mid 1960s, relative to both its post-war average and the performance of other OECD countries. Nevertheless, investment has remained at a fairly high level, at around 25 per cent of GDP. At the same time, there have been substantial divergences in investment performance among industries.

However, while the demand aspects of investment are interesting, it was the contribution of investment to the stock of productive capital that absorbed most of our attention. In the final analysis, if an economy has to sustain output growth and real incomes without inflation, it is essential to maintain an adequate stock of productive capital.

The analysis of capital accumulation raises a host of issues, mostly related to measurement. These include: the role of human capital and capital utilisation; aggregation of heterogeneous physical capital; the measurement of labour input; and the role and measurement of technological progress. Our treatment was necessarily rough.

With these shortcomings given, we sought to estimate an aggregate production function for Australia. While the evidence supports the existence of such a production function, it does not strongly support the existence of perfectly competitive factor markets, at least in the short run.

Based on our estimates, and other supporting evidence, the main conclusions of our paper are:

- despite a sharp fall in the capital/labour ratio since the start of the 1980s, the Australian economy does not appear to be greatly under-capitalised;
- the expansion of employment and reduction in the capital/labour ratio since 1982/83 has been encouraged by the relative factor costs of labour and capital;
- the maintenance of labour productivity through the upswing from mid 1983 appears to reflect high levels of excess capacity of both labour and capital in 1982/83;
- in general, growth appears to have been retarded in periods when factor prices have been well out of line with marginal products;
- in 1986, labour still appears to be cheap relative to its marginal product, while capital remains relatively expensive. (However, the relative costs of debt and equity appear to have altered considerably since the mid 1970s, with equity now considerably cheaper and debt more expensive);
- with signs of capacity constraints being reached in 1986, there will be a need to induce capital widening in coming years if both capital and labour are to grow in tandem without the need for further large falls in real wages; and
- with the improvement in Australia's international competitiveness following exchange rate depreciation in 1985 and the impending introduction of dividend imputation, at least some of the pre-conditions for a return to solid capital growth in the latter part of the 1980s appear to be in place.

Research Department
2 April 1987

APPENDIX A
ESTIMATED PRODUCTION FUNCTIONS

TABLE A.1
Aggregate Production Function
1967(3) to 1986(2)

	Constant	Share	Elasticity	Technological Progress	
	ß / B	α / γ	σ	δ	R^2
Cobb-Douglas:*					
1.	378.96	0.36	1.00	0.0028	0.995
	(0.576)	(0.057)		(0.0003)	
CES:					
3.	934.93	0.20	1.09	0.0028	0.984
	(241.75)		(0.028)	(0.0003)	
4.	533.37	0.30	1.03	0.0028	0.984
	(147.77)		(0.025)	(0.0003)	
5.	317.31	0.40	0.98	0.0028	0.984
	(91.74)		(0.023)	(0.0003)	
6.	191.05	0.50	0.95	0.0028	0.984
	(56.67)		(0.022)	(0.0003)	
7.	113.92	0.60	0.91	0.0028	0.984
	(34.18)		(0.020)	(0.0003)	
8.	65.70	0.70	0.87	0.0028	0.984
	(19.65)		(0.018)	(0.0003)	
9.	35.28	0.80	0.84	0.0028	0.984
	(10.31)		(0.017)	(0.0003)	
10.	16.03	0.90	0.79	0.0028	0.984
	(4.39)		(0.015)	(0.0003)	

* Estimated without imposing linear homogeneity (assuming δ = .0028) the capital share (α) = 0.355 and the labour share = 0.670.

TABLE A.2
Private Sector Production Function
1967(3) to 1986(2)

	Constant	Share	Elasticity	Technological Progress	
	ß / B	α / γ	σ	δ	R^2
Cobb-Douglas:					
1.	278.11	0.42	1.00	0.0014	0.985
	(0.462)	(0.049)		(0.0006)	
CES:					
2.	2091.99	0.10	1.20	0.0022	0.965
	(365.67)		(0.030)	(0.0005)	
3.	1117.28	0.20	1.09	0.0022	0.965
	(222.42)		(0.025)	(0.0005)	
4.	660.82	0.30	1.03	0.0022	0.965
	(141.31)		(0.022)	(0.0004)	
5.	406.32	0.40	0.98	0.0023	0.965
	(90.86)		(0.020)	(0.0004)	
6.	252.56	0.50	0.94	0.0023	0.965
	(58.06)		(0.019)	(0.0004)	
7.	155.51	0.60	0.91	0.0023	0.965
	(36.24)		(0.017)	(0.0004)	
8.	92.77	0.70	0.87	0.0023	0.965
	(21.60)		(0.016)	(0.0004)	
9.	25.77	0.80	0.87	0.0023	0.532
	(19.42)		(0.054)	(0.002)	
10.	24.64	0.90	0.78	0.0023	0.965
	(5.28)		(0.013)	(0.0004)	

TABLE A.3
Mining Production Function
1967(3) to 1985(2)

	Constant	Share	Elasticity	Technological Progress	
	ß / B	α / γ	σ	δ	R^2
Cobb-Douglas:					
1.	120.00	0.57	1.00	-0.0066	0.959
	(0.368)	(0.034)		(0.002)	
CES:					
2.	2747.60	0.10	1.28	-0.0074	0.893
	(426.12)		(0.020)	(0.002)	
3.	1174.81	0.20	1.17	-0.0072	0.894
	(199.65)		(0.017)	(0.002)	
4.	596.34	0.30	1.11	-0.0070	0.895
	(105.44)		(0.015)	(0.002)	
5.	325.40	0.40	1.07	-0.0068	0.895
	(58.44)		(0.014)	(0.002)	
6.	183.28	0.50	1.103	-0.0067	0.896
	(32.89)		(0.013)	(0.002)	
7.	103.86	0.60	0.99	-0.0065	0.896
	(18.35)		(0.012)	(0.002)	
8.	57.77	0.70	0.95	-0.0064	0.896
	(9.88)		(0.011)	(0.002)	
9.	30.44	0.80	0.91	-0.0062	0.897
	(4.92)		(0.010)	(0.002)	

TABLE A.4
Manufacturing Production Function
1967(3) to 1985(2)

	Constant	Share	Elasticity	Technological Progress	
	ß / B	α / γ	σ	δ	R^2
Cobb-Douglas:					
1.	235.46	0.41	1.00	0.0064	0.923
	(0.550)	(0.057)		(0.0003)	
CES:					
2.	1346.69	0.10	1.23	0.0064	0.970
	(296.35)		(0.036)	(0.0003)	
3.	697.84	0.20	1.12	0.0064	0.970
	(172.44)		(0.030)	(0.0003)	
4.	404.98	0.30	1.05	0.0064	0.970
	(106.42)		(0.027)	(0.0003)	
5.	166.88	0.40	1.04	0.0063	0.946
	(60.18)		(0.033)	(0.0004)	
6.	151.34	0.50	0.96	0.0064	0.970
	(42.08)		(0.022)	(0.0003)	
7.	60.23	0.60	0.95	0.0064	0.04
	(92.55)		(0.119)	(0.0017)	
8.	55.16	0.70	0.89	0.0064	0.970
	(15.30)		(0.019)	(0.0003)	
9.	30.83	0.80	0.85	0.0064	0.970
	(8.309)		(0.017)	(0.0003)	
10.	14.86	0.90	0.79	0.0064	0.970
	(3.72)		(0.015)	(0.0003)	

TABLE A.5

Finance, Property and Business Production Function

1967(3) to 1985(2)

	Constant	Share	Elasticity	Technological Progress	
	β / B	α / γ	σ	δ	R^2
Cobb-Douglas:					
1.	79.88	0.64	1.00	-0.0449	0.753
	(0.756)	(0.073)		(0.010)	
CES:					
2.	2707.62	0.10	1.35	-0.0858	0.973
	(84.91)		(0.005)	(0.007)	
3.	897.13	0.20	1.26	-0.1051	0.975
	(26.32)		(0.004)	(0.008)	
4.	377.47	0.30	1.21	-0.1232	0.977
	(10.47)		(0.003)	(0.009)	
5.	171.55	0.40	1.17	-0.1426	0.978
	(4.73)		(0.002)	(0.010)	
6.	88.74	0.50	1.14	-0.165	0.979
	(2.30)		(0.002)	(0.010)	
7.	45.79	0.60	1.12	-0.1942	0.980
	(1.17)		(0.002)	(0.011)	
8.	23.87	0.70	1.09	-0.235	0.981
	(0.613)		(0.001)	(0.013)	
9.	14.91	0.80	0.99	-0.076	0.921
	(5.53)		(0.044)	(0.037)	
10.	22.04	0.90	0.84	-0.031	0.921
	(6.91)		(0.020)	(0.005)	

TABLE A.6

Other Industries Production Function

1967(3) to 1985(2)

	Constant	Share	Elasticity	Technological Progress	
	β / B	α / γ	σ	δ	R^2
Cobb-Douglas:					
1.	47.83	0.62	1.00	0.0034	0.982
	(1.46)	(0.162)		(0.0003)	
CES:					
2.	700.38	0.10	1.42	0.0034	0.917
	(484.45)		(0.155)	(0.0003)	
3.	353.63	0.20	1.26	0.0034	0.917
	(261.21)		(0.121)	(0.0003)	
4.	205.83	0.30	1.17	0.0034	0.917
	(155.80		(0.105)	(0.0003)	
5.	127.30	0.40	1.11	0.0034	0.917
	(96.80)		(0.094)	(0.0003)	
6.	80.95	0.50	1.06	0.0034	0.917
	(60.96)		(0.085)	(0.0003)	
7.	51.85	0.60	1.01	0.0034	0.917
	(38.15)		(0.077)	(0.0003)	
8.	32.82	0.70	0.96	0.0034	0.917
	(23.21)		(0.070)	(0.0003)	
9.	19.99	0.80	0.91	0.0034	0.917
	(13.25)		(0.063)	(0.0003)	
10.	11.02	0.90	0.84	0.0034	0.917
	(6.48)		(0.054)	(0.0003)	

Cobb-Douglas: $Q_t = BK_t^{\alpha} L_t^{*(1-\alpha)}$

CES: $Q_t = B[\gamma K_t^{-\rho} + (1-\gamma)L_t^{*-\rho}]^{-1/\rho}$

where: Q = the appropriate measure of GDP for the 4 quarters ended the current quarter in 1979/80 prices, consistent with ABS (1986);

L = the average number of people employed over the 4 quarters up to and including the current quarter;

K = the average 1979/80 price value of the appropriate measure of the capital stock (excluding dwellings) over the 4 quarters ended:

- 6 quarters prior to the current quarter for aggregate, private sector, and other industries;
- 8 quarters prior to the current quarter for mining;
- 4 quarters prior to the current quarter for manufacturing;
- 2 quarters prior to the current quarter for finance, etc.; and

t = time.

Figures in parentheses are standard errors.

Quarterly estimates of private sector output, employment and output by industry have been constructed using a number of assumptions. Details are contained in Appendix B; as are the sources, definations and copies of all data used in this study.

APPENDIX B
DATA SOURCES AND DEFINITIONS

This appendix contains definitions and sources of data used in this paper, as well as the actual data used. It incorporates all data available in November 1986.

Where possible data have been obtained directly from ABS publications. However, in order to obtain historical series it was sometimes necessary to use other sources and/or derive series using simplifying assumptions.

The sources of all series are listed in section B.1. The definitions of and assumptions underlying the estimated series, are outlined in section B.2. All of the series described are contained in section B.3.

B.1 Sources

Further details of series obtained from sources (a),(b),(c) and (d) are contained in Australian National Accounts: Concepts Sources and Methods (Australian Bureau of Statistics, Canberra) Catalogue No. 5216.0.

(a) Australian National Accounts, National Income and Expenditure 1984-85 and previous issues (Australian Bureau of Statistics, Canberra) Catalogue No. 5204.0.

(b) Quarterly Estimates of National Income and Expenditure, Australia June Quarter 1986 (Australian Bureau of Statistics, Canberra) Catalogue No. 5206.0 and Magnetic Tape with historical series available from the ABS.

(c) Australian National Accounts Gross Product by Industry 1984-85 (Australian Bureau of Statistics, Canberra) Catalogue No. 5211.0.

(d) Historical Series of Estimates of National Income and Expenditure, Australia September Quarter 1959 to June Quarter 1980. Supplement to March Quarter 1986 issue of 5206.0 (Australian Bureau of Statistics, Canberra) Catalogue No. 5207.0.

(e) Private New Capital Expenditure, Australia June Quarter 1986 Survey and previous issues (Australian Bureau of Statistics, Canberra) Catalogue No. 5626.0.

(f) The Labour Force, Australia June 1986 and previous issues (Australian Bureau of Statistics, Canberra) Catalogue No. 6203.0.

(g) Civilian Employees Australia, June 1966 to June 1979 (Australian Bureau of Statistics, Canberra) Catalogue No. 6203.0.

(h) Employed Wage and Salary Earners, Australia March 1986 previous issues (Australian Bureau of Statistics, Canberra) Catalogue No. 6248.0 and interim ABS data.

(i) Lease Finance, Australia, June 1986 (Australian Bureau of Statistics, Canberra) Catalogue No. 5644.0.

(j) Finance Companies, Australian December 1985 and previous issues (Australian Bureau of Statistics, Canberra) Catalogue No. 5614.0.

(k) Walters R. and Dippelsman R. (1986) "Estimates of Depreciation and Capital Stock Australia" Australian Bureau of Statistics, Occasional Paper No. 1985/3.

(l) Norton W.E. and Kennedy P.J. (1985) "Australian Economic Statistics 1949-50 to 1984-85: I Tables" Reserve Bank of Australia Occasional Paper No. 8A.

(m) Department of the Treasury The Round-up, October 1986 and previous issues (Australian Government Publishing Service, Canberra).

(n) Butlin, M.W. (1977) "A Preliminary Annual Database 1900/01 to 1973/74 Reserve Bank of Australia Research Discussion Paper 7701", May.

(o) Confederation of Australian Industry and Westpac Banking Corporation Survey of Industrial Trends Report On Quarterly Survey of Manufacturers in Australia No. 99 June 1986 and previous issues.

(p) OECD Department of Economics and Statistics National Accounts Number 2 1986 and previous issues (OECD, Paris).

(q) Carmichael J. and Stebbing P.W. (1981) "Some Macroeconomic Effects of the Interaction Between Inflation and Taxation" in A.R. Pagan and P.K. Trivedi (editors) The Effects of Inflation: Theoretical Issues and Australian Evidence Conference Papers, Centre for Economic Policy Research Australian National University, pp 101-136.

(r) Dews N. (1986) "Research Report: Tobins q - Some Updated Data" Reserve Bank of Australia Bulletin, June 1986 pp B6-B10.

(s) Budget Statements 1985/86 and previous issues. (Australian Government Publishing Service, Canberra).

(t) International Monetary Fund, International Financial Statistics, Volume 39, No.8 August 1986 and previous issues (IMF, Washington).

(u) Derived within Reserve Bank of Australia.

(B.2) Definitions

Data have been listed in order of use in the paper. All annual series are financial years and constant price series are $ million in 1979/80 prices, unless otherwise stated. Quarterly data have been seasonally adjusted by the ABS unless derived within the Reserve Bank. The later series have been seasonally adjusted using the X11Q seasonally adjustment software package. All constant price data for periods before September 1969 have been scaled from 1974/75 and 1966/67 price series to obtain comparable values.

(1) GDP: gross domestic product. That is, the total market value of goods and series produced, after deducting the cost of goods and services used up in the production process but before deducting allowances for the depreciation of fixed capital; used on 4-quarter-ended and annual bases, constant prices. Source (b) 1969/70-1985/86, source (d) 1959/60-1968/69, Source (a) 1949/50-1958/59, source (n) 1900/01-1948/49.

(2) Gross Fixed Capital Formation: gross fixed capital expenditure on dwellings, non-dwelling construction, plant and equipment by the private sector, general government and public enterprises. Includes both new and second hand purchases; annual, constant prices. Source (b) 1969/70-1985/86, source (d) 1959/60-1968/69, source (n) 1900/01-1948/49. Source (a) 1949/50-1958/59. Presented as a proportion of series (1) .

(3) Gross Fixed Capital Formation - Australia: definition as for series (2) above; annual, calendar years, constant prices. Source (b) 1970-1985, source (d) 1960-1969. Presented as a proportion of series (1)

(4) Gross Fixed Capital Formation - OECD: definition as for series (2) above; annual, calendar years, constant 1980 prices. Source (p). Presented as a proportion of total OECD GDP also from source (p).

(5) Gross Fixed Capital Expenditure - Private Sector: expenditure on dwellings, non-dwelling construction, plant and equipment by the private sector. Includes both new and second hand purchases. Adjusted for major sales of fixed assets between public and private sectors which are leased back to the sector of sale; annual, constant prices. Source (b) 1969/70-1985/86, source (d) 1959/60-1968/69, source (a) 1949/50-1958/59, source (m) for sale/leaseback adjustment. Presented as a proportion of series (1).

(6) Gross Fixed Capital Expenditure - Public Sector: definition as for series (5) except expenditure by general government and public trading enterprises. Format, sources and presentation as for series (5).

(7) Private Gross Fixed Capital Expenditure - Equipment: expenditure on new and second hand equipment by the private sector. Adjusted for major sales of fixed assets between public and private sectors which are leased back to the sector of sale; annual, constant prices. Source (b) 1969/70-1985/86, source (d) 1959/60-1968/69 source (m) for sale/leaseback adjustment. Presented as an index where 1959/60=100.

(8) Private Gross Fixed Capital Expenditure - Non-dwelling Construction: definition as for series (7) except expenditure on non-dwelling construction. Format, sources and presentation as for series (7).

(9) Private Gross Fixed Capital Expenditure - Dwellings: expenditure on new and second hand dwellings by the private sector. Format sources and presentation as for series (7).

(10) Private Fixed Capital Expenditure - Mining: expenditure on new plant, equipment, buildings and structures undertaken by the private sector in mining industry; annual. Source (e). Presented in current prices as a proportion of series (14), and in constant prices as an index where 1966/67=100. Constant price estimates 1966/67 to 1969/70 from source(s). For this period current price data for equipment and building and construction have been deflated by the implicit price deflators for equipment and non-dwelling construction respectively from source (c) scaled to equal the appropriate Capital Expenditure Survey deflators in September 1969 to derive constant price estimates.

(11) Private Fixed Capital Expenditure - Manufacturing: definition as for series (7) except expenditure by manufacturing industry. Source (e). Presented in current prices as a proportion of series (15), and as an index where 1966/67=100. Constant price estimates pre 1969/70 calculated as for series (10).

(12) Private Fixed Capital Expenditure - Finance, Property and Business: definition as for series (7) except expenditure by finance, property and business services sectors. Source (e). Presented in current prices as a proportion of series (16) and in constant price as an index where 1966/67=100. Constant price estimates pre 1969/70 calculated as for series (10).

(13) Private Fixed Capital Expenditure - All Other: expenditure on new plant, equipment, buildings and structures undertaken by the private sector in all remaining industries. That is, mainly wholesale and retail trade; transport and storage; electricity, gas and water; communication, recreation, entertainment, restaurants, hotels, personal services, agriculture, forestry, fishing and hunting; construction and

community services. Also includes purchases of second-hand assets by a industries; annual. Source (u) where (13) = (7)+(8)-[(10)+(11)+(12)].

Presented in current prices as a proportion of series (17) and in constant prices as an index where 1966/67=100. Constant price estimates pre 1969/70 calculated as for series (10).

(14) Own GDP - Mining: definition as for series (1) except mining industry only; annual, market prices. Source (c).

(15) Own GDP - Manufacturing: definition as for series (1) except manufacturing industry only; annual, market prices. Source (c).

(16) Own GDP - Finance Property and Business: definition as for series (1) except finance, property and business services sectors only; annual, market prices. Source (c).

(17) Own GDP - All Other: definition as for series (1) except all industries not included in series (14), (15) or (16) only. That is, those industries listed for series (13); annual, market prices. Source (u) where (17)=(1)-[(14)+(15)+(16)].

(18) Private Fixed Capital Expenditure Adjusted for Leasing - Mining: definition as for series (10) except adjusted for leasing; annual, constant prices, source (c); and for leasing adjustment source (f) 1984/85-1985/86, source (j) 1973/74-1984/85 and source (u) see Appendix C for details of leasing adjustment. Presented as an index where 1966/67=100.

(19) Private Fixed Capital Expenditure Adjusted for Leasing - Manufacturing: definition as for series (11) except adjusted for leasing. For details of leasing adjustment see Appendix C. Format, sources and presentation as for series (18).

(20) Private Fixed Capital Expenditure Adjusted for Leasing - Finance Property and Business: definition as for series (12) except adjusted for leasing. For details of leasing adjustment see Appendix C. Format, sources and presentation as for series (18).

(21) Private Fixed Capital Expenditure Adjusted for Leasing - All Other: definition as for series (13) except adjusted for leasing. For details of leasing adjustment see Appendix C. Format, sources and presentation as for series (18).

(22) Capital Stock: net capital stock owned by the private and public sectors excluding private dwellings where $K_t = KP_t + KG_t$; used on annual average and 4-quarter-average bases. Source(u)

In any quarter t,

$$KP_t = (1-d_t^c)KP_{t-1}^c + (1-d_t^c/2)I_t^c + (1-d_t^e)KP_{t-1}^e + (1-d_t^e/2)I_t^e$$

$$KG_t = (1-d_t^p)KG_{t-1}^p + (1-d_t^p/2)I_t^p + (1-d_t^g)KG_{t-1}^g + (1-d_t^g/2)I_t^g$$

d = rate of depreciation. Assumed to remain constant within each year. Depreciation rate for KP equals that implied for 1983/84 in 1984/85, 1985/86. Depreciation rate for KG equals that implied for 1981/82 from 1982/83 to 1985/86. In all other years, for c, e, p and g:

$d = [D/[(K-I+D) + I/2]]/4$

where

D = capital consumption, annual. Source (k).
K = end year net capital stock, annual. Source (k).
I = gross fixed capital expenditure, annual. Source (k).

KP = private sector capital stock excluding inventories; from source (k) in base year 1966/67
KG = public sector capital stock; from source (k) in base year 1966/67.
I = investment flow in current period. Source (b).

c,e,p,g indicate non-dwelling construction, plant and equipment, public enterprises and general government, respectively.

(23) Employed Labour Force: labour force employed in the private sector and the public sector excluding defence in efficiency units used on annual average and 4-quarter-average bases, where:

$L_t^* = L_t(1+\delta)^t$

and

L_t = total employment (excluding defence), thousands, Source (f)

δ = rate of technological progress estimated, using a Cobb-Douglas production function, to equal .0028. For further details see section 3.2 in text and Appendix A table A.1. Source (s).

t = time trend.

(24) Capital/Labour Ratio: ratio of capital stock to employed labour force. That is,

$K_t/L_t^* \times 100$

where:

K_t = series (22)

L_t^* = series (23)

(25) Output/Capital Ratio: ratio of GDP defined as series (1) to the end-year capital stock defined as series (22). That is,

$GDP_t/K_t \times 100$;

annual, constant prices. Sources as shown for series (1) and series (22).

(26) Output/Labour Ratio: ratio of GDP in constant prices as defined in series (1) to the labour force in efficiency units as defined in series (23). That is,

$GDP_t/L_t^* \times 100$;

annual. Sources as shown for series (1) and series (23).

(27) Gross Operating Surplus less Tax - Total: the excess of output of enterprises over costs incurred in producing that output before deducting depreciation provisions, dividends, interest, royalties and land rent payments but after deducting income tax payable. Includes the gross operating surplus of companies, financial enterprises, unincorporated enterprises and public enterprises, less income tax payable by these groups; annual, current prices. Source (c). Presented as a proportion of series (1) in current prices.

(28) Gross Operating Surplus less tax - Companies and Financial Enterprises: definition as for series (27) except including only companies and financial enterprises, less income tax payable by these institutions; annual, current prices. Source (c). Presented as a proportion of series (1) in current prices.

(29) Gross Operating Surplus by Industry - Mining: the excess of output of mining companies and mining unincorporated enterprises over costs incurred in producing that output before deducting depreciation provisions, dividends, interest, royalties, land rent payments and direct taxes payable; annual, current prices. Source (a). Presented as a proportion of series (14).

(30) Gross Operating Surplus by Industry - Manufacturing: definition as for series (29) except including manufacturing industry only; annual, current prices. Source (a). Presented as a proportion of series (15).

(31) Gross Operating Surplus by Industry - Finance Property and Business: definition as for series (29) except including finance property and business services sectors only; annual, current prices. Source (a). Presented as a proportion of series (16).

(32) Gross Operating Surplus by Industry - All Other: definition as for series (29) except including all industries not included in series (29), (30) or (31). That is, those industries listed for series (13); annual, current prices. Source (a). Presented as a proportion of series (17).

(33) Real unit labour cost: ratio of non-farm wages, salaries and supplements and payroll tax, deflated by the implicit price deflator for gross non-farm product, per hour worked by non-farm wage and salary earners to gross non-farm product in constant prices per hour worked by all persons employed in the non-farm sector, annual average. Source (m). Presented as an index where 1966/67 to 1972-73 = 100.

(34) Real after tax cost of debt: expost real rate of return on debt for a firm taking into account taxes payable, the rate of inflation and the rate of depreciation of the capital stock, annual average rate. Source (q). That is,

$$R = i^r - \frac{t\pi}{(1-\pi)} + \frac{\pi t \mu}{(1-t)[(1-t)r-t\pi+\pi+\mu]}$$

where:

$$i_t^r = i_{t-1} - \pi_t$$

and

i = yield on industrial debentures with five or less years to maturity; weighted average of month ending last Wednesday in third month of quarter. Source (u).

π = average four-quarter-ended percentage change in the non-farm GDP deflator. Source (c).

μ = weighted average annual rate of depreciation for the total capital stock. Sources and definitions as for series (22) except

$$\mu = \frac{KP^c}{K_t} \cdot d^c + \frac{KP^e}{K_t} .d^e + \frac{KG^p}{K_t} .d^p + \frac{KG^g}{K_t} .d^g$$

Assumed to remain constant within each year. From 1982/83 to 1985/86 depreciation rate assumed to equal that derived for 1981/82. Source (k).

(35) Private Sector Employment: Total employment (excluding defence) as defined for series (23) less Government employment; thousands, 4-quarter-average. Source (f) for total employment. For Government employment source (g) 1966/67-1971/72, source (h) 1972/73-1985/86.

Data from source (h) consists of annual data for the period 1972/73 to 1980/81. To create a quarterly series, we have assumed that employment growth occurs evenly through each year. For 1981/82 and 1982/83 data is quarterly average of monthly data. For the remainder of the period quarterly data is available.

For details of breaks in series and compatibility of data used see Information Paper on New Statistical Series: Employment, Average Weekly Earnings, Job Vacancies and Overtime, June 1984 (Australian Bureau of Statistics, Canberra) Catalogue No. 6256.0.

(36) Private Sector GDP: GDP as defined for series (1) except only for the private sector; 4-quarter-ended. Source (u). This series was first constructed on an annual basis using current price data from source (a).

It was assumed that private sector GDP equals private sector wages, salaries and supplements plus gross operating surplus of companies, unincorporated enterprises, dwellings owned by persons and private financial enterprises less private sector imputed bank service charge plus indirect taxes less subsidies paid by the private sector. The proportion of indirect taxes less subsidies included was the same as the proportion of private wage salaries and supplements plus private gross operating surplus in total wages salaries and supplements plus total gross operating surplus, in each year.

A 4-quarter-ended series was then obtained by assuming that private sector GDP has a similar quarterly profile to total GDP. That is, the quarterly change in 4-quarter-ended total GDP was scaled by the ratio of the annual change in private GDP to the annual change in total GDP, within each year.

This series was then deflated by the GDP deflator, from source (b) 1969/70 - 1985/86 and source (a) 1966/67-1968/69, to obtain a 4-quarter-ended constant price series.

(37) Private Sector Capital Stock: KP as defined for series (22); 4-quarter-average, constant prices. Source (u).

(38) Mining Employment: Private and public sector employment in the mining industry; thousands, 4-quarter-average. Source (f) 1979-1986, source (g) 1966-1979.

(39) Mining GDP: Definition as for series (14); 4-quarter-ended, constant prices. Converted to quarterly series using same assumption as applied to series (36).

(40) Mining Capital Stock: End-year net stock of mining capital owned by the private sector; 4-quarter-average; constant prices. Source (u). constructed from end June estimates of the mining capital stock from source (k) and quarterly constant price gross new capital expenditure flows from source (e) 1969/70 - 1985/86 and source (u) 1966/67 - 1969/70.

For the latter period current price data for equipment and building and construction have been deflated by the implicit price deflators for equipment and non-dwelling construction respectively from source (c) scaled to equal the appropriate Capital Expenditure Survey deflators in September 1969 to derive constant price estimates.

For the period 1966/67 to 1983/84, quarterly industry gross new mining capital expenditure data constructed from source (e) were scaled so that annual totals equaled mining industry gross fixed capital expenditure estimates from source (k). A quarter of the annual capital consumption (depreciation) from source (k) is then subtracted from each scaled quarterly estimate of industry gross capital expenditure to obtain an estimate of net capital expenditure.

The estimate of net capital expenditure for the March quarter of each year is added to the source (k) end-year capital stock of the previous year to obtain an end-September capital stock series in each year. Estimates of end-December and end-March net capital stock are constructed in the same manner, that is, by adding the estimates of net capital expenditure to the end-September and end-December capital stocks, respectively.

For 1984/85 and 1985/86 the quarterly mining capital stock is determined by the method shown for the total capital stock in series (22), where the depreciation rate for mining capital equals that implied for 1983/84 in 1984/85 and 1985/86.

(41) Manufacturing Employment: definition, sources and presentation as for series (38) except includes only manufacturing sector.

(42) Manufacturing GDP: definition as for series (15). Sources and presentation as for series (39) except includes only manufacturing sector.

(43) Manufacturing Capital Stock: definition, sources and presentation as for series (40) except includes only manufacturing sector gross fixed capital expenditure, capital consumption and net capital stock.

(44) Finance etc Employment: definition. Sources and presentation as for series (38) except includes only finance, property and business services sectors.

(45) Finance etc GDP: definition as for series (16). Sources and presentation as for series (39) except includes only finance, property and business services sectors.

(46) Finance etc Capital Stock: definition, sources and presentation as for series (40) except includes only finance, property and business services sectors, gross fixed capital expenditure, capital consumption and net capital stock.

(47) Other Industries Employment: definition, sources and presentation as for series (38) except for all other industries (as listed for series (13)) derived as a residual. That is, (47) = L_t-[(38)+(41)+(44)].

(48) Other Industries GDP: definition as for series (17). Sources and presentation as for series (39) except for all other industries (as listed for series (13)), derived as a residual. That is, (48) = (1) - [(39)+(42)+(45)].

(49) Other Industries Capital Stock: definition, sources and presentation as for series (40) except for all other industries (as listed for series (13)) derived as a residual. That is, (49) = K_t - [(40)+(43)+(46)].

(50) Capacity Utilisation: the proportion of respondants to the CAI/Westpac Survey of Manufacturing who stated they were operating at a "satisfactorily full" rate of operation, less the proportion of respondants who stated that they were not, annual average. Source (o).

(51) Labour - Factor Cost less Marginal Product: Factor Cost is defined as real unit labour cost (series (33)), quarterly. Source (m). Marginal product is derived from equation (3) in text, as discussed in section 3.4, where:

$$w_t = (1-\alpha)\ Qt/L_t^*$$

and

α = capital's share of output estimated, using a Cobb-Douglas production function, to equal 0.36. See Appendix A, table A.1. Source (u).

Q_t = GDP as defined for series (1), 4-quarter-ended, constant prices. Sources as for series (1).

L_t^* = labour force in efficiency units as defined for series (23). Source (u).

(52) Capital-Factor Cost less Marginal Product: Factor cost is proxied by the real after tax cost of debt (series (34)), quarterly, annual rate. Source (q). Marginal product is derived from equation (4) in text, as discussed in section 3.4 where:

$$r_t = \alpha . Q_t/K_t - \mu$$

and

α = capital's share of output estimated,using a Cobb-Douglas production function, to equal 0.36. See Appendix A, Table A.1.

Q_t = GDP as defined for series (1), 4-quarter-ended, constant prices. Sources as for series (1).

K_t = net capital stock as defined for series (22), end-quarter, constant prices. Sources as for series (22).

μ = weighted average annual rate of depreciation of the net capital stock as defined and sourced for series (34).

(53) Investment/Capital Stock: Private gross fixed capital expenditure on equipment and non-dwelling construction (series (7) and (8) respectively) as a proportion of private sector capital stock excluding inventories (defined as KP for series (22)), annual average. Source (u).

(54) Tobins q Ratio: Ratio of the market value of the private capital stock to its replacement cost, annual average. Source (r).

(55) EPAC Incentive Ratio: Ratio of the expected rate of return on capital to the opportunity cost of funding the capital expenditure, annual average. Source: available on request to EPAC.

(56) Profit/GDP: After-tax corporate profit (including financial enterprises) as a proportion of GDP (Series (1)). After-tax corporate profit includes gross operating surplus of companies and financial enterprises less the imputed bank service charge less income tax paid by companies and financial enterprises, current prices. Sources (a) and (b). GDP is as defined for series (1) except excluding indirect taxes less subsidies (that is, GDP at factor cost), current prices. Source (b).

(57) Competitiveness: Index of competitiveness constructed from a measure of unit labour costs in USA, Japan, UK, Germany, Canada and France (weighted by the average share of Australia's imports which comes from each) relative to unit labour costs in Australia, adjusted for the exchange rate, annual average. Source (u), derived from sources (p) and (t). Full details of methodology available on request.

	(2)
01	14.8
02	18.2
03	17.8
04	12.6
05	12.8
06	12.9
07	13.7
08	14.9
09	15.0
10	15.3
11	16.4
12	18.7
13	19.0
14	19.4
15	17.8
16	12.5
17	11.1
18	9.3
19	12.1
20	16.3
21	16.0
22	17.6
23	18.7
24	19.3
25	18.6
26	19.2
27	19.3
28	19.6
29	18.9
30	15.9
31	12.7
32	9.1
33	10.0
34	11.0
35	14.3
36	14.5
37	15.3
38	16.6
39	17.5
40	15.8
41	11.5
42	6.9
43	8.7
44	4.6
45	4.9
46	9.3
47	14.9
48	16.2
49	20.2
50	23.0
51	26.7
52	27.7
53	25.3
54	26.6
55	25.6
56	25.3
57	24.9
58	25.6
59	25.0
60	26.1
61	26.6
62	26.6
63	26.7
64	27.6
65	28.9
66	29.8
67	28.4
68	28.9
69	28.4
70	28.6
71	28.3
72	27.8
73	26.9
74	26.5
75	24.8
76	25.6
77	25.0
78	24.6
79	24.7
80	24.2
81	25.9
82	27.0
83	24.5
84	23.4
85	23.6
86	23.0

(B.3) <u>Data</u>

All data are presented as described in section B.2. Series are numbered (in parentheses) according to order of listing in section B.2.

	(1)Annual	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Jun-50				12.3	8.5					
Jun-51				14.2	10.2					
Jun-52				14.2	11.1					
Jun-53				13.1	10.0					
Jun-54				14.1	9.4					
Jun-55				14.5	9.3					
Jun-56				14.6	8.8					
Jun-57				14.5	8.6					
Jun-58				14.9	8.7					
Jun-59				14.2	8.8					
Jun-60	50939	27.0	20.9	16.8	9.3	100.0	100.0	100.0		
Jun-61	52516	26.6	21.5	17.4	9.2	109.1	109.8	103.9		
Jun-62	53199	26.3	21.7	16.4	10.2	108.5	104.4	93.9		
Jun-63	56775	27.0	22.0	17.0	9.7	119.0	119.4	103.1		
Jun-64	60784	28.5	22.7	17.7	9.9	132.9	129.6	116.5	23.2	12.8
Jun-65	65097	29.5	23.0	18.6	10.3	154.7	135.7	130.7	33.9	14.6
Jun-66	66625	29.2	23.1	19.1	10.7	161.1	160.5	128.8	61.5	16.0
Jun-67	70997	28.2	22.9	18.1	10.3	166.7	149.2	133.2	55.6	14.0
Jun-68	73755	28.7	23.3	18.6	10.2	170.0	173.5	144.1	67.2	13.0
Jun-69	80706	28.8	23.6	18.9	9.6	190.3	189.0	158.5	74.2	12.2
Jun-70	84600	28.4	23.9	19.0	9.6	191.6	198.4	175.4	57.5	12.5
Jun-71	89315	28.5	24.1	19.2	9.2	206.9	231.6	175.4	74.9	13.1
Jun-72	93988	26.9	24.3	18.5	9.3	208.0	212.4	190.9	65.5	12.1
Jun-73	98227	26.8	24.6	18.2	8.8	210.0	191.9	213.1	28.2	10.3
Jun-74	102317	25.6	23.3	18.1	8.4	222.4	194.1	218.4	30.0	10.4
Jun-75	104281	25.0	22.2	15.5	9.3	209.7	175.6	170.3	29.6	11.2
Jun-76	107098	25.3	22.0	16.3	9.3	224.6	155.3	203.1	20.7	9.5
Jun-77	110042	24.7	22.2	16.4	8.6	231.2	136.8	224.5	13.2	10.0
Jun-78	111075	24.6	22.4	16.0	8.6	228.1	155.9	207.5	19.4	11.2
Jun-79	116890	24.2	22.5	16.7	8.0	270.7	160.5	213.1	19.1	11.9
Jun-80	118818	25.0	22.0	16.6	7.6	255.7	162.1	234.1	14.9	11.1
Jun-81	122405	26.7	21.6	18.4	7.6	288.5	207.9	259.0	21.8	14.3
Jun-82	125298	25.8	20.9	19.0	8.0	325.2	227.1	250.0	31.4	15.4
Jun-83	123956	23.6	20.7	16.2	8.3	282.8	197.3	199.3	31.8	12.9
Jun-84	130646	23.3	21.3	15.4	8.0	282.3	151.1	223.5	19.4	9.0
Jun-85	136340	23.7	21.6	15.7	7.9	282.0	183.1	246.4	15.4	9.7
Jun-86	141425			15.2	7.9	269.7	219.9	243.4		

	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Jun-64	8.3	12.2	292	4727	1279	11940				
Jun-65	8.8	12.2	314	5272	1431	13081				
Jun-66	10.2	11.7	353	5535	1594	13616				
Jun-67	8.3	12.0	437	5920	1765	15137	100.0	100.0	100.0	100.0
Jun-68	7.0	12.4	484	6409	2005	15930	135.4	98.9	93.1	120.0
Jun-69	7.7	12.7	586	7072	2330	18038	175.4	99.4	112.8	141.4
Jun-70	8.1	11.4	928	7726	2728	19859	204.3	107.7	133.0	151.9
Jun-71	10.3	11.2	1043	8455	3159	21609	278.9	116.4	185.7	180.3
Jun-72	10.8	10.2	1333	9086	3562	24386	293.1	108.2	199.4	182.2
Jun-73	10.5	11.0	1617	9921	4254	27925	145.1	96.9	222.5	153.9
Jun-74	18.8	8.5	1806	11709	4937	33955	164.9	114.5	168.3	196.4
Jun-75	19.5	7.4	2391	13775	5774	41248	169.8	114.4	218.3	165.9
Jun-76	25.6	7.5	3151	15677	7062	48752	140.1	99.0	288.7	179.8
Jun-77	25.3	7.4	3715	17528	8323	55704	99.2	105.3	251.0	175.3
Jun-78	27.0	7.0	4140	18726	9080	60771	143.4	114.0	221.6	176.3
Jun-79	29.8	8.0	5428	20329	10836	68700	169.8	121.0	259.7	200.5
Jun-80	29.3	7.3	7280	22813	12641	76064	161.5	116.9	247.1	189.5
Jun-81	31.3	7.3	8533	26025	14907	85748	242.8	152.9	283.9	217.2
Jun-82	33.3	8.7	8875	29074	16645	97905	321.1	166.5	415.1	248.0
Jun-83	28.3	7.0	10622	30270	19329	106605	347.9	131.4	433.5	213.7
Jun-84	26.7	8.2	11868	33824	21384	122034	233.4	100.4	310.3	209.9
Jun-85	28.8	7.2	13102	36400	24178	135861	198.7	110.7	394.8	211.9

	(22)Annual	(23)Annual	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)
Jun-60						30.9	9.6						
Jun-61						29.0	9.2						
Jun-62						28.8	9.5						
Jun-63						30.4	10.1.	34.0	33.6	29.2	36.8		
Jun-64						31.2	10.2	40.1	34.3	29.7	35.2		
Jun-65						29.7	10.3	38.5	33.7	29.9	36.3		
Jun-66						27.5	10.1	40.2	32.9	29.2	33.2		
Jun-67	137925	4963	27.8	51.7	14.4	28.8	10.3	44.2	32.9	28.1	35.9	100.8	1.03
Jun-68	146378	5147	28.4	50.6	14.4	27.3	10.7	45.5	33.4	28.2	32.9	98.9	2.00
Jun-69	155456	5335	29.1	52.1	15.2	28.8	10.9	45.4	33.6	28.5	34.6	98.1	2.30
Jun-70	164541	5615	29.3	51.4	15.1	27.4	11.2	57.2	33.6	27.9	32.8	98.2	2.99
Jun-71	174135	5841	29.8	51.3	15.3	25.1	11.0	54.6	32.7	27.1	30.0	100.9	3.03
Jun-72	183388	5948	30.8	51.3	15.8	25.1	10.8	57.5	30.8	26.1	30.3	100.5	-0.20
Jun-73	191621	6176	31.0	51.3	15.9	26.7	10.4	54.3	31.8	23.1	32.1	101.7	-0.83
Jun-74	199757	6459	30.9	51.2	15.6	24.8	8.7	64.7	25.7	25.6	32.7	105.3	-6.02
Jun-75	207636	6454	32.2	50.2	16.2	20.7	7.9	63.7	23.1	22.5	28.4	110.8	-15.76
Jun-76	215397	6670	32.3	49.7	16.1	20.9	8.3	66.8	23.1	20.8	27.8	107.7	-13.16
Jun-77	222043	6792	32.7	49.6	16.2	21.5	8.7	56.8	23.5	21.0	28.0	107.5	-7.71
Jun-78	228528	6903	33.1	48.6	16.1	20.7	8.6	55.3	23.1	22.1	26.6	108.4	-2.00
Jun-79	235822	7025	33.6	49.6	16.6	23.9	9.5	50.4	23.4	23.0	29.9	105.0	0.61
Jun-80	241771	7335	33.0	49.2	16.2	23.7	9.0	45.9	24.8	24.9	29.4	104.4	-0.63
Jun-81	249267	7580	32.9	49.1	16.2	21.9	9.3	38.8	25.3	23.9	28.2	105.2	-2.27
Jun-82	258383	7700	33.6	48.5	16.3	20.0	8.5	34.9	22.5	23.8	26.3	107.5	-0.40
Jun-83	265080	7583	35.0	46.8	16.4	18.3	8.5	38.4	20.4	22.9	22.8	107.8	-1.14
Jun-84	270582	7934	34.1	48.3	16.5	22.0	9.7	41.7	26.2	24.1	26.0	102.8	1.67
Jun-85	276519	8248	33.5	49.3	16.5	20.8	9.4	41.4	26.1	24.1	25.3	101.1	3.48
Jun-86	282648	8679	32.6	50.0	16.3	20.0	9.2					100.0	5.55

	(50)	(53)	(54)	(55)	(56)	(57)
Jun-61	-18					
Jun-62	-41					
Jun-63	-24					
Jun-64	9					
Jun-65	35					
Jun-66	2					
Jun-67	-8	14.6	1.22		11.1	
Jun-68	3	14.5	1.60		11.6	
Jun-69	6	15.0	1.59		11.7	
Jun-70	14	14.3	1.35	1.2	12.0	98.2
Jun-71	3	14.8	1.15	1.1	12.1	99.7
Jun-72	-29	13.5	1.14	1.0	11.5	101.7
Jun-73	-7	12.5	1.20	1.1	11.0	97.2
Jun-74	14	12.6	0.90	1.1	9.3	84.2
Jun-75	-40	11.2	0.60	0.9	8.4	82.4
Jun-76	-47	11.1	0.67	0.8	9.0	85.0
Jun-77	-41	10.7	0.62	0.8	9.4	93.2
Jun-78	-40	10.7	0.59	0.8	9.1	102.0
Jun-79	-23	11.9	0.63	0.8	10.2	114.7
Jun-80	-12	11.1	0.68	0.9	9.7	109.8
Jun-81	-10	12.5	0.78	0.9	10.0	104.6
Jun-82	-18	13.3	0.63	0.8	9.2	93.5
Jun-83	-59	11.1	0.59	0.7	9.2	96.8
Jun-84	-33	10.3	0.74	0.8	10.6	100.6
Jun-85	-19	10.5	0.81	0.8	10.3	107.4
Jun-86	-11	10.4	1.04	0.7	10.1	124.4 p

	(1)4-Q-En	(22)4-Q-A	(23)4-Q-A	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)
66	67252		4772		53557		52	2070		1252	14750		167
66	68618		4806		54620		52	2241		1255	15185		169
67	70400		4841		56005		53	2463		1260	15751		170
67	71337	134919	4871	3912	56727	57877	53	2281	2710	1264	15287	21368	172
67	72227	136956	4899	6933	57305	58863	54	2372	2882	1269	15847	21626	174
67	73213	139002	4928	3956	57949	59866	54	2476	3078	1277	16468	21927	175
68	72969	141045	4957	3978	57701	60872	55	2450	3278	1284	16314	22219	177
68	74030	143157	4989	4002	58397	61914	55	2444	3481	1290	16275	22525	179
68	75396	145298	50'9	4025	59534	62985	56	2657	3701	1298	16855	22833	180
68	77761	147519	5046	4046	61486	64117	57	3026	3939	1305	17860	23121	182
69	79840	149763	5080	4074	63200	65264	58	2250	4192	1311	18743	23413	185
69	80974	152031	5112	4099	64154	66465	59	2943	4474	1320	17634	23709	187
69	82116	154291	5144	4125	65073	67667	60	3183	4767	1332	18050	23994	191
69	82066	156554	5187	4161	65043	68843	62	3172	5045	1344	10832	24290	194
70	82831	158816	5233	4199	65661	70018	64	3333	5317	1357	18311	24596	198
70	84600	161085	5285	4245	67078	71175	66	3577	5641	1368	18734	24906	202
70	85836	163381	5339	4289	67907	72340	68	4103	5955	1373	18877	25188	205
70	86955	165701	5387	4329	68668	73545	70	4579	6333	1380	19006	25481	209
71	88279	168096	5428	4361	69556	74819	71	5142	6762	1384	19158	25787	211
71	89315	170493	5466	4393	70216	76149	72	4949	7210	1388	19106	26072	214
71	90571	172979	5497	4409	71036	77536	74	5133	7710	1392	19226	26395	215
71	92069	175468	5516	4408	72027	78900	74	5353	8179	1395	19369	26714	217
72	92961	177866	5530	4395	72601	80160	75	5483	8615	1391	19454	26984	217
72	93988	180178	5540	4355	73269	81312	75	5550	8963	1386	19497	27228	217
72	94540	182343	5564	4337	73737	82349	75	5602	9180	1379	19585	27422	218
72	95741	184417	5601	4336	74731	83321	74	5715	9322	1375	19778	27566	219
73	97066	186480	5643	4346	75814	84290	74	5840	9407	1376	19990	27723	221
73	98228	188539	5680	4372	76775	85285	74	6054	9462	1380	20354	27878	223
73	99656	190551	5724	4405	77854	86267	74	6139	9544	1390	20581	28005	226
73	101025	192592	5765	4434	78879	87302	75	6219	9653	1402	20798	28191	228
74	101990	194638	5814	4473	79596	88351	75	6277	9762	1413	20951	28371	231·
74	102317	196675	5862	4511	79822	89368	75	6568	9877	1427	21733	28519	235
74	102428	198714	5881	4518	79397	90373	76	6572	10019	1429	21724	28700	238
74	102828	200715	5891	4512	79089	91256	77	6586	10135	1415	21691	28812	240
75	103000	202649	5873	4477	78796	92045	79	6592	10262	1388	21676	28899	240
75	104281	204623	5856	4440	79269	92780	80	6946	10375	1354	20838	28987	239
75	105061	206638	5853	4419	79631	93484	80	6924	10474	1301	20822	29022	273
75	105668	208638	5866	4417	79827	94150	80	6907	10544	1260	20810	28984	308
76	106598	210603	5897	4434	80304	94829	80	6881	10596	1231	20792	28955	343
76	107096	212548	5929	4454	80456	95536	79	6625	10613	1205	20609	28921	378
76	108511	214358	5943	4457	81367	96191	79	6714	10594	1202	20676	28904	379
76	109250	216131	5946	4451	81818	96889	79	6760	10551	1196	20711	28942	380
77	109722	217885	5955	4454	82077	97579	79	6790	10505	1188	20734	28963	382
77	110042	219550	5966	4459	82240	98185	79	7292	10454	1178	21113	28975	383
77	110449	221224	5990	4477	82376	98792	79	7298	10426	1168	21109	28975	384
77	110342	222846	6000	4481	82171	99345	79	7297	10452	1158	21110	28940	384
78	110481	224432	6003	4476	82143	99858	80	7299	10482	1174	21108	28925	406
78	111075	226056	6011	4474	82434	100443	82	7410	10551	1194	21030	28885	429
78	111637	227725	6016	4471	83044	101104	82	7417	10653	1206	21068	28903	451
78	113467	229472	6028	4475	84706	101874	81	7440	10754	1220	21190	28963	476
79	116029	231265	6045	4484	86947	102724	81	7473	10848	1210	21361	28998	482
79	116890	233090	6054	4486	87823	103620	81	7570	10931	1205	21869	29081	485
79	117530	234836	6072	4498	88366	104460	81	7556	10962	1213	21914	29097	490
79	118709	236476	6110	4530	89326	105210	83	7531	10993	1221	21996	29107	492
80	118194	238043	6150	4565	88984	105907	82	7542	11039	1232	21960	29114	493
80	118819	239532	6199	4609	89509	106580	81	7280	11100	1242	22613	29123	500
80	119747	241090	6251	4658	90149	107324	82	7285	11218	1245	22840	29170	507
80	120693	242727	6288	4694	90793	108157	83	7289	11336	1247	22868	29259	518
81	121161	244463	6326	4733	91101	109098	83	7292	11505	1246	22881	29377	531
81	122405	246342	6360	4771	91982	110190	83	7362	11751	1246	23291	29504	542
81	123483	248356	6388	4811	92836	111370	83	7354	11962	1245	23323	29673	554
81	124687	250545	6410	4844	93789	112884	83	7344	12304	1252	23358	29860	557
82	125099·	252776	6430	4891	94135	114410	85	7341	12643	1253	23370	30086	564
82	125298	255061	6437	4905	94323	115988	88	7229	13006	1249	23798	30318	567
92	125676	257260	6433	4899	93997	117501	92	7242	13443	1239	23749	30525	574
82	124622	259274	6415	4877	92742	118688	95	7205	13858	1214	23886	30685	578
83	124428	261142	6374	4816	92127	119767	98	7198	14263	1188	23912	30762	573
93	123956	2262824	6332	4768	91437	120623	99	7738	14569	1163	21926	30729	572
83	123705	264342	6297	4712	91520	121351	98	7730	14790	1147	21923	30635	569
83	125489	265743	6298	4689	93299	121997	98	7785	14886	1143	21944	30458	572
84	128217	267073	6323	4696	95879	122550	98	7870	14929	1140	21976	30280	586
84	130646	268456	6378	4730	98218	123151	98	8428	14950	1139	22188	30102	596
84	132410	269813	6434	4775	99751	123713	98	8500	14991	1142	22275	29974	608
84	134349	271181	6479	4812	101407	124256	97	8580	15035	1145	22370	29883	615
85	134717	272603	6532	4857	101797	124838	96	8595	15065	1151	22388	29817	618
85	136340	274095	6578	4894	103184	125404	94	9265	15089	1148	23190	29819	627
85	138579	275721	6635			126080			15117			29852	
85	139967	277406	6715			126759			15158			29930	
86	141105	279093	6788			127448			15242			30008	
86	141425	280630	6856			128016			15348			30137	

	(45)	(46)	(47)	(48)	(49)	(51)	(52)
Sep-66	7940		3302	39494			
Dec-66	8150		3330	41183			
Mar-67	8424		3359	43384			
Jun-67	8200	4672	3382	41581	30071		
Sep-67	8386	4814	3402	42009	30423		
Dec-67	8592	4989	3422	42482	30779		
Mar-68	8541	5160	3442	42365	31088		
Jun-68	8528	5328	3464	42335	31431		
Sep-68	8719	5503	3485	44335	31808		
Dec-68	9051	5688	3502	47797	32214		
Mar-69	9343	5888	3527	50841	32575		
Jun-69	8976	6141	3545	47017	33001		
Sep-69	9210	6376	3561	47665	33361	-0.88	-12.69
Dec-69	9200	6605	3588	47637	33699	0.23	-12.02
Mar-70	9357	6838	3613	48072	34059	2.02	-13.14
Jun-70	9594	7067	3649	48729	34333	0.83	-10.82
Sep-70	9850	7366	3692	49466	34632	0.32	-11.48
Dec-70	10082	7652	3729	50132	34926	2.11	-11.87
Mar-71	10356	7966	3761	50921	35190	2.91	-11.31
Jun-71	10262	8305	3792	50651	35506	3.46	-13.24
Sep-71	10276	8623	3815	51419	35845	0.42	-13.91
Dec-71	10292	8953	3831	52334	36122	-0.35	-15.14
Mar-72	10302	9273	3847	52880	36318	0.23	-15.60
Jun-72	10307	9608	3862	53158	36462	-0.35	-15.62
Sep-72	10347	9973	3893	53259	36704	0.58	-15.32
Dec-72	10432	10381	3933	63480	36954	-0.21	-15.10
Mar-73	10527	10798	3971	53723	37275	-1.61	-14.74
Jun-73	10690	11211	4003	54141	37636	-0.62	-15.42
Sep-73	10785	11451	4035	54594	37827	-0.10	-16.67
Dec-73	10876	11791	4060	55029	38155	0.70	-18.96
Mar-74	10940	12182	4094	55335	38593	2.63	-21.78
Jun-74	11267	12598	4125	56899	38957	6.48	-24.15
Sep-74	11268	13101	4138	56917	39403	8.46	-27.16
Dec-74	11272	13443	4159	56984	39703	8.61	-29.21
Mar-75	11274	13730	4167	57012	39875	8.08	-29.74
Jun-75	11381	14026	4183	58685	40097	3.04	-32.06
Sep-75	11384	14367	4198	58842	40319	3.96	-29.46
Dec-75	11387	14777	4219	58963	40590	4.42	-27.06
Mar-76	11391	15181	4243	59150	40890	2.83	-25.35
Jun-76	11431	15580	4267	60984	41218	2.89	-24.62
Sep-76	11471	15967	4284	61263	41479	1.34	-23.89
Dec-76	11492	16356	4291	61409	41820	1.69	-22.03
Mar-77	11506	16740	4307	61503	42127	1.63	-20.47
Jun-77	11734	17085	4326	63083	42376	3.14	-17.42
Sep-77	11743	17437	4359	63122	42618	3.04	-16.14
Dec-77	11741	17750	4380	63112	42776	4.56	-15.42
Mar-78	11744	18068	4343	63125	42894	4.09	-14.08
Jun-78	11897	18450	4305	63791	43105	2.86	-13.13
Sep-78	11913	18839	4277	63920	43316	1.62	-12.45
Dec-78	11967	19258	4252	64339	43594	-2.34	-11.86
Mar-79	12041	19700	4271	64925	43910	-2.46	-12.04
Jun-79	12263	20141	4284	66669	44169	-2.71	-11.94
Sep-79	12281	20539	4288	66701	44457	-2.68	-12.56
Dec-79	12314	20924	4314	66761	44587	-2.10	-12.36
Mar-80	12299	21301	4343	66735	44765	-1.79	-13.45
Jun-80	12641	21638	4376	67352	44924	-0.86	-14.91
Sep-80	12702	22023	4417	67437	45124	1.21	-14.05
Dec-80	12763	22407	4441	67523	45381	-0.47	-16.13
Mar-81	12794	22794	4466	67566	45632	0.00	-14.90
Jun-81	13712	23196	4489	68848	46006	0.67	-13.88
Sep-81	13751	23629	4507	69055	46387	0.43	-13.75
Dec-81	13794	24122	4518	69287	46893	0.02	-11.78
Mar-82	13809	24591	4528	69366	47344	3.88	-12.58
Jun-82	14332	25143	4533	72173	47774	3.86	-13.26
Sep-82	14335	25584	4529	72112	48025	4.83	-12.74
Dec-82	14326	25881	4529	72282	48159	2.41	-12.22
Mar-83	14325	26113	4515	72313	48217	1.12	-14.04
Jun-83	14456	26244	4497	69867	48186	-1.53	-13.21
Sep-83	14449	26541	4483	69824	48168	-1.93	-10.74
Dec-83	14498	26956	4484	70133	48041	-2.59	-9.43
Mar-84	14574	27462	4500	70607	47953	-6.38	-10.03
Jun-84	15073	28114	4544	73736	47814	-2.12	-9.61
Sep-84	15140	28604	4587	74036	49535	-5.03	-9.29
Dec-84	15214	29115	4622	74365	52310	-7.30	-8.60
Mar-85	15228	29641	4668	74428	55946	-7.19	-8.88
Jun-85	15850	30116	4708	77208	60555	-6.93	-7.88
Sep-85		30673			64264	-9.19	-7.26
Dec-85		31159			67705	-6.00	-7.19
Mar-86		31558			71067	-6.27	-6.60
Jun-86		31804			74004	-4.90	-6.91

APPENDIX C
ADJUSTING CAPITAL EXPENDITURE DATA FOR LEASING[1]

Expenditure on capital is allocated to industry of ownership of capital rather than the industry of its use in both the National Accounts (sources (a), (b), (c) and (d)) and the Capital Expenditure Survey (source (e)). As a result, the leasing of buildings, structures, plant and equipment from the finance sector by the non-finance sector can distort investment by industry data. In aggregate private sector investment is not affected unless a private financial institution has purchased a capital good and leased it to the public sector.[2]

Over the 1970s and 1980s the rapid growth of leasing has made data on capital expenditure difficult to interpret. For example, our estimates (which may understate the total) show that leasing grew from less than 0.5 per cent of GDP in 1967/68 to over 2.3 per cent in 1984/85. This appendix outlines the methodology and sources used to adjust the data presented in Figure 2.6 for leasing.

Whilst adequate data is available on new lease commitments undertaken by industry for the period January 1985 to June 1986 (source (i)), no data is available for leasing by industry prior to this time. However, aggregate data is available for leasing undertaken by finance companies from September 1966 to December 1985 (source (j)). Although the corporations classified as finance companies vary over time, to our knowledge, this data is to be the best historical series currently available.

C.1 The Method

Finance company leasing by industry has been allocated on an annual basis using the relationship between each industry's own GDP and total GDP excluding defence, dwellings, import duties and the imputed bank service charge (hereafter referred to as total adjusted GDP). All of which are available in current prices by industry on an annual basis.

In the first instance we assumed that the proportion of leasing undertaken by each industry was the same as that industry's contribution to total adjusted GDP. Whilst it is difficult to check the validity of this assumption, the table below shows that it appears to hold for finance, wholesale and retail and the other industry groups in 1985 (source (i)).

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1. A finance lease refers to "... the leasing or hiring of tangible assets under an agreement, other than a hire purchase agreement, which transfers from the lessor to the leasee substantially all the risks and benefits incident to ownership of the asset without transferring the legal ownership" (ABS Form LF1 p.3).

2. These transactions are identified in the Quarterly Estimates (source (c)) and The Round-up (source (m)). That is, sales from the public to the private sector which are leased-back to the public sector. The data shown in this paper has been adjusted for these transactions since September 1981.

However, it appears not to hold for mining, manufacturing and other services. Since some industries are characterised by high/low levels of leasing in relation to their proportion of GDP, this is not surprising. To account for this, an arbitrary adjustment has been made to the assumption for these industries. It was assumed that the relationship between their leasing and their own GDP remains the same in earlier years as was evident in 1985 (the category other services picks up any remaining leasing).

	Proportion of total new leasing undertaken (calendar year 1985	GDP (1984/85) Proportion of Total adjusted GDP		Adjustment		Allocator for 1984/85
Mining	4.8	7.2	x	0.67	=	4.84
Manufacturing	12.1	20.1	x	0.6	=	12.03
Finance, prop. etc.	13.4	13.3		-		13.3
Wholesale & retail	17.0	18.4		-		18.4
Other services	27.5	16.15	x	(100 - all other allocators)	=	26.53
Other (mainly agriculture	25.2	24.9		-		24.9
Total	100%	100%				100%

Figure 2.6 shows private fixed capital expenditure by industry using published data and adjusted for leasing using allocators calculated annually for each industry using the method outlined above. The allocations are then applied to the published constant price data. Both graphs a and b in figure 2.6 are shown as an index with 1966/67. Consistent with Hall (1984) we have only adjusted the published data for leasing since 1973/74 as it is suspected that the smaller quantity of leasing undertaken before 1973/74 was captured by the ABS sampling method used at this time.

C.2 Some Limitations

The first limitation relates mainly to the commitments data used for 1985/86. The national accounts only includes gross fixed capital expenditure on an accruals basis (i.e. when physical goods are received). Leasing commitments data (includes any... "firm offer to provide finance which has been or is normally expected to be accepted ..."[3]). This data could not be expected to line up with the national accounts exactly due to cancellations and lags between commitment and accrual.

Secondly, in both the commitments series and the earlier finance company data some leased items included may not be fixed capital. Their inclusion may overstate investment by particular industries since they were not included in aggregate gross fixed capital expenditure in the first place. Also, the ABS Capital Expenditure Survey (upon which data for gross fixed capital expenditure by mining, manufacturing and finance property and business sectors are based) includes only new fixed capital expenditure. Leasing data, on the other hand, includes the capital cost of new goods, the written down value of goods re-leased and the purchase price of the second-hand goods. The latter two categories are only included in the "all other private fixed capital expenditure" (see Appendix I, series (13)).

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3. ABS Form LF1 p.3.

Additionally, the data includes leasing provided to government and public authorities which are not included in the measures of private fixed capital expenditure used in figure 2.6. However, since there is no way to distinguish between leasing of new or second-hand assets in any period or leasing to the private or public sector, all assets leased are assumed to be new and leased by the private sector.

A further limitation relates to the scope of the data in both series. It includes only plant and equipment on lease - not buildings. To the extent that leasing of buildings still remains attributable to the finance property and business sector and not to the industry of use, this category may still be overstated.

Clearly, it appears that there are limitations which may overstate and/or understate the extent of leasing undertaken making the series derived an approximation at best. However, it is possible that these limitations are offsetting, at least to some extent.

C.3 An Alternative Method

Another method for adjusting for leasing was devised by Hall[4] in which 92.5 per cent of gross fixed capital expenditure on equipment by the Finance, Property and Business Services sector is allocated to other industries in proportion to their reported non-leasehold investment. However, the Hall method does not incorporate the information available from the leasing commitments data (source (i) (which was introduced after Hall's series was published) or allow for the Finance Property and Business services sector leasing to itself. Unlike Hall, our allocator is based on the total output (GDP) of each industry rather than reported non-leasehold equipment investment, on the assumption that the share of leasing undertaken by each industry is likely to be closely related to each industry's share of output in each period. Also, our method allocates all identifiable leasing to the four industry groups (including finance) while Hall's method allocates a fixed proportion of finance company equipment investment (92.5 per cent) to the other three groups.

While we have chosen to remain with our measure for this analysis, the extent to which the resulting data differ to those derived by Hall highlights the need to interpret the derived data with caution. Indeed, our method is just one plausible interpretation of the known data, and the data derived should thus be regarded strictly as estimates.

Post Script

Owing to changes in accounting standards it is expected that the ABS will provide more accurate estimates of gross fixed capital expenditure adjusted for leasing in 1987.

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4. A. Hall (1984), Leasing Finance and the Industry Composition of Investment. Business Council Bulletin No. 7. August. p.13-15.

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