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# ABSTRACT

The Social Opportunity Cost of Consumption for Australia, 1960-61 to 1988-89



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The social opportunity cost of consumption (SOCC) for an economy is the rate at which current consumption can be traded for consumption in the future. The SOCC is an important determinant of the socially optimal levels of investment and the current account surplus and should be an input into the framing of government economic policy. Using overseas interest rates, the SOCC for Australia is calculated in this paper. The calculated series is fairly constant for the 1960's and then has a pronounced cyclical pattern from the late 1960's to 1988-89. The average value of the SOCC for Australia is about four per cent.

# The Social Opportunity Cost of Consumption for Australia, 1960-61 to 1988-89

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In public debates over economic management a lot of attention is paid to the aggregate level of investment and to the current account surplus of the balance of payments. Frequently, commentators argue that these aggregates are at undesirable levels. For example, in the 1980's many thought the Australian current account to be too far into deficit. But what are the desirable levels of investment and the current account surplus that should be aimed at? How should these desirable levels be calculated? Using the economic theory of the socially optimal level and disposition of saving, the socially optimal levels of investment and the current account surplus depend on the terms through which society, by abstaining from consumption today, can be rewarded with consumption in the future. In this paper these terms of intertemporal trade are called the social opportunity cost of consumption (SOCC). For an open economy where borrowing and lending to overseas residents, institutions and governments is possible, the SOCC depends on interest rates in the world capital market. In this paper overseas interest rates are used to calculate a series of the SOCC for Australia.

Other things being equal, the value of the SOCC influences the socially optimal levels of investment and the current account surplus in the following way. (For a more detailed derivation see McDonald (1985)). A high value of the SOCC implies that the socially optimal level of investment is low. On the other hand, if the SOCC is high then the socially optimal level of the current account surplus is high. The economy should lend overseas while increasing the domestic capital stock at a low rate. The high level of lending to overseas requires a high current account surplus.

By knowing the value of SOCC the management of the economy may be improved. For example, other things being equal, if the SOCC is high then there is greater reason for

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concern over a current account deficit and greater reason for setting government policy to reduce such a deficit, e.g. for choosing a mix of restrictive fiscal policy and expansive monetary policy along with the implied low value for the exchange rate.

To calculate a rate by which consumption today can be converted into consumption in the future, the consumer price index is used to deflate the nominal value of the overseas interest rate. The overseas interest rate is the return on a portfolio composed of several overseas assets. To construct the portfolio, a share in the portfolio for each overseas asset has to be calculated. These asset shares have to have some relation to economic welfare if the resulting measure of the SOCC is to be a guide to socially optimal levels of investment and the current account surplus. In this paper the shares are chosen to minimize the risk of the expected return from the portfolio of overseas assets. This may appear an excessively cautious approach. One may wish to argue that it is socially optimal to accept some extra risk for some extra return. To extend the method of calculation of the SOCC in this direction may be a useful subject for future research.

Since the objective of the study is to calculate a series which will be helpful in identifying socially optimal outcomes, distortions that face private individuals but not society, such as tax rates, are excluded. As a result the series for SOCC is not the intertemporal terms of trade that faces a private individual. It is instead the rate relevant for the framing of economic policy. Of course the fact that the private rate of return differs from the social rate of return is one reason why private decisions may not be socially optimal and why corrective government policy may be required.

The SOCC is a particular definition of the world real interest rate. It is the world real interest rate which measures the rate by which society can convert consumption today into consumption in the future. There are other definitions of the world real interest rate. For example in a recent paper Barro and Sala-i-Martin (1990) calculate a world real interest rate that they argue will be the outcome of market transactions. Their rate is not the SOCC. For example, they weight the country interest rates by the share of country GDP in aggregate GDP. While such a weighting scheme may be appropriate for their purpose, it is not appropriate for the SOCC.

In measuring the SOCC for Australia, the calculations in this paper are based on the assumption of perfect foresight. In particular it is assumed that the values expected for the future of the exchange rate and the consumer price index are equal to the actual future values. One factor which may cause the actual outcomes of investment and the current account surplus to deviate from their optimal levels is incorrect prediction of the future. If, instead, the perfect foresight estimates of the SOCC as calculated here are used to construct optimal levels of investment and the current account surplus then the sub-optimality associated with incorrect forecasts will be avoided.

One weakness of the perfect foresight assumption should be borne in mind. It is probably the case that perfect foresight is not socially optimal because it is costly to improve in the accuracy of forecasts. There must come a point where further improvement in the accuracy of prediction is not worth the cost. However, one would, given the present state of knowledge in this area, have little idea on the socially optimal degree of predictive accuracy. Given the impossibility at present of defining a socially optimal prediction, the best alternative is to assume perfect foresight.

A Single Asset Model

To initiate the development of the concept of the SOCC, assume there is only one overseas asset available for purchase. Consider the rate of return from refraining from consumption now (at time t), in order to increase consumption in the future (at time t+n). Assume current consumption is reduced by $X_t$ units of consumption. This makes the amount of $P_tX_t$ of domestic currency available for lending where $P_t$ is the price of a unit of consumption at time t. At an exchange rate of $F_t$ units of foreign currency for one unit of domestic currency, foreign assets to the value of $F_tP_tX_t$ can be purchased. If these assets are expected to earn a nominal rate of return of i per period then, after n periods, the loan will be worth $(1+i)^nF_tP_tX_t$. Deflating this amount by $F_{t+n}$, the value of the exchange rate expected at time t+n, gives the expected value of the loan in units of domestic currency at time t+n and deflating further by the price of a unit of consumption at time t+n, $P_{t+n}$, gives the expected value in terms of units of consumption of the loan at t+n. This is labelled $X_{t+n}$. Thus

$$X_{t+n} = \frac{(1+i)^nF_tP_tX_t}{F_{t+n}P_{t+n}} \tag{1}$$

The SOCC, r, is then defined by

$$(1+r)^n = \frac{X_{t+n}}{X_t} \tag{2}$$

Substitution of (1) into (2) gives the familiar formula

$$1+r = \frac{1+i}{1+p} \tag{3}$$

where

$$1+p = \left(\frac{F_{t+n}P_{t+n}}{F_tP_t}\right)^{\frac{1}{n}} \tag{4}$$

The formula is familiar in that one plus the real rate of return is equal to one plus the nominal rate of return divided by one plus the expected rate of inflation. However the definition of the expected rate of inflation is not so familiar. It depends on both the expected change in the exchange rate and the expected change in the domestic price of a unit of consumption.

It was explained in the introduction that the aim of the paper is to measure what the SOCC would have been under the assumption of perfect foresight. For the expected rate of inflation (p) the assumption of perfect foresight suggests the use of actual values for inflation. That is the approach taken in this paper. So to define p it is assumed that the predicted future values of the price level and of the exchange rate are the actual future values. For example, to calculate the SOCC over a ten year period starting in 1960-61 it is assumed that in 1960-61 the predicted values for P and F for 1970-71 are the values of P and F that actually occurred in 1970-71. (For more recent years, where the end of the forecast period has not actually occurred, predicted values are manufactured using an extrapolative technique.)

Adjusting the Nominal Interest Rates for Imperfect Foresight

The aim of the paper is to construct a series of the SOCC for Australia assuming that agents had perfect foresight. However the market nominal rates of interest observed are affected by actual predictions of inflation. According to the Fisher effect, the market nominal rate of interest moves one for one with the expected rate of inflation. So if economic agents made incorrect predictions about the future rate of inflation then the market nominal rate of interest will differ from the perfect foresight nominal rate of interest. For example, if, as seems likely, in the late 1960's people underpredicted the future rate of inflation then that error would have reduced the market nominal rate of interest. To attempt to create perfect foresight would require for the late 1960's an upward adjustment to the market nominal rate of interest. That adjustment is explained in this section.

Consider Figure 1. In the figure IS and LM curves for the world economy are shown. The curves IS (actual) and LM (actual) are drawn assuming that the expected rate of inflation held by agents is less than the perfect foresight rate of inflation, as seems reasonable for the late 1960's. The intersection of IS (actual) and LM (actual) determines the market nominal interest rate, $i_a$, and the level of real output, $Y_1$. If, instead, economic agents had had perfect foresight they would have predicted a higher rate of future inflation. This would have raised the expected nominal rate of return to investment and shifted up the investment function. That would have shifted the IS curve upwards. A shift is shown to IS (perfect foresight). Assuming governments had aimed at the same level of aggregate demand, monetary policy would have been tighter yielding an LM curve at LM (perfect foresight). So with perfect foresight the market nominal rate of interest would have been $i_P$.

To calculate the adjustment factor for converting the market nominal interest rate that is observed into the perfect foresight nominal interest rate, we assume that the implicit change in the expected rate of inflation does not affect the real rate of interest. In practice there are likely to be distortions in the economic system through which changes in the expected rate of inflation may be non-neutral and affect the real rate of interest. For example, tax systems are the cause of some these distortions. But it is not easy to predict the net effect of the many possible distortions. Some distortions would cause the nominal interest rate to under-adjust and others to over-adjust to changes in the expected rate of inflation (see Jha, Sahu and Meyer (1990) for a formal review of the various distortions). We assume here that these distortions are offsetting and that the real rate of interest is independent of the expected rate of inflation.

Defining $p_a$ as the expectation of the rate of inflation which people actually held and $i_a$ as the actual nominal rate of interest, the real rate of interest is given by

$$1+r = \frac{1+i_a}{1+p_a} \qquad (5)$$

To define the adjustment factor for the nominal rate of interest which takes account of using the expected rate of inflation with perfect foresight, define the perfect foresight nominal rate of interest, $i_p$, by

$$1+r = \frac{1+i_p}{1+p_p} \qquad (6)$$

where $p_p$ is the expected rate of inflation with perfect foresight. Combining (5) and (6) gives the perfect foresight nominal rate of interest as

$$1+i_p = \left(\frac{1+p_p}{1+p_a}\right)(1+i_a) \qquad (7)$$

The adjustment factor, $(1+p_p)/(1+p_a)$ is labelled A.

In the empirical work in this paper nominal interest rates from several countries are used. For each country, adjustment factors using equation (7) are calculated. To make these calculations a series for the expected rate of inflation ($p_a$) is constructed from an autoregression on the GDP deflators for the country concerned. For example, to adjust the West German nominal interest rate, a series which forecasts the West German GDP deflator is constructed. This forecast series is calculated from a regression of the GDP deflator on its lagged values. The construction of these forecasts is explained in greater detail in the empirical section below.

The adjustment factor has been explained in terms of a scenario where interest rates bear all the brunt of the adjustment for the divergence between perfect foresight and actual foresight. It is possible to conceive of an alternative scenario where exchange rates bear some of the adjustment. This alternative scenario would yield a similar adjustment factor and so the adjustment procedures undertaken here also apply to cases where exchange rates adjust. There is no need to make an additional adjustment for hypothetical exchange rate movements.

<u>Allowing for Several Assets</u>

There is not a single foreign asset. Instead to shift consumption forward in time, wealth can be held in a number of foreign assets. Assets can be categorized by length to maturity, risk type and country. In this paper two SOCC's are calculated for Australia, one based on a portfolio of assets which have five years to maturity and the other on assets with ten years to maturity. The assets in the portfolio have a similar risk type (government bonds) but are from different countries. For the five year SOCC the portfolio consists of five year government bonds from four countries (U.S., U.K., W. Germany and Switzerland). For the ten year SOCC the portfolio consists of ten year government bonds from three countries (U.S., U.K., W. Germany). To combine these assets the share of each asset in the portfolio has to be calculated. The basis for calculating the asset shares is set out in this section.

To construct the SOCC it is assumed that the shares of assets are chosen to minimize the variance of the return of the portfolio. Identifying variance with risk, the shares give the minimum-risk portfolio. To calculate the variance-minimizing shares define the return on a portfolio of n assets (R) as

$$R = \sum_{i=1}^{n} a_i r_i, \text{ with } \sum_{i=1}^{n} a_i = 1, \tag{8}$$

where $a_i$ is the share of asset i and $r_i$ is one plus the rate of return on asset i. The variance of the return on the portfolio (V) is

$$V = E[R^2] - (E[R])^2 \tag{9}$$

where E[] is the expectations operator. The shares $a_i$ are chosen to minimize V. So the n-1 first order conditions are

$$\frac{\partial V}{\partial a_i} = \frac{\partial E[R^2]}{\partial a_i} - \frac{\partial (E[R])^2}{\partial a_i} = 0 \quad \text{for } i = 1...n-1 \tag{10}$$

The nth equation needed to determine the n shares is the constraint $\sum_{i=1}^{n} a_i = 1$. In the empirical work for Australia four assets are used for the five year real interest rate and three assets are used for the ten year real interest rate. The specific form of the first order conditions (10) for the four and three asset cases are derived in the appendix.

A basic assumption underlying the method of calculation is that the borrowing and lending rates of interest are equal. Since government bond rates are used in the empirical section this is a reasonable assumption. The Australian government can be reasonably considered to be as risky as (and no more risky than) the governments whose bonds are used (U.S., U.K., West Germany and Switzerland). For the calculated rate of interest to be a borrowing rate one can imagine the Australian government issuing bonds denominated in foreign currency (U.S. dollars, pound sterling, German marks or Swiss francs). Furthermore the optimal shares are not constrained to be positive. A negative value for an $a_i$ implies the coexistence of borrowing and lending.

Calculations

The construction of the series for the SOCC for Australia can be divided into three stages.

(1) Calculating a series of adjustment coefficients for the interest rates of each country

For each country (U.S., U.K., West Germany and Switzerland) a series for the expected rate of inflation was calculated by estimating an autoregressive equation on the country's GDP deflator. These autoregressive equations were used to forecast future values of the GDP deflator. From these forecasts the expected rate of inflation was calculated.

Before running the autoregression the GDP deflator series was tested in its levels, its first difference and its second difference to find a stationary form. The stationary form of the series was used in the autoregression. Having determined the stationary form, the predictions for the GDP deflator in five years and ten years time were calculated as follows. For a particular year (say 1960-61) the series for the GDP deflator up to that year was used to estimate an autoregression. The current value was regressed on lagged values plus a constant. The number of lags and the inclusion of the constant term was decided on the basis of significance of the coefficients, determined by inspection of t-values. Then the regression equation is projected five years and ten years ahead to generate the five and ten year forecasts of the GDP deflator. These predicted values of the GDP deflator are used to generate the expected rate of inflation. Then the expected rate of inflation is used to calculate the adjustment factor, as defined in equation (7). This procedure is repeated for each year.

The actual GDP deflator, the forecast GDP deflator and the adjustment coefficients are shown in tables 1 to 7. Tables 1 to 4 cover five year rates and tables 5 to 7 cover ten year rates. These tables should be read as follows. Take the first row in table 1. This refers to the year 1960-61 for the U.S. In 1960-61 the U.S. five year bond rate (the nominal interest rate) was 3.80 percent. The U.S. GDP deflator five years hence (i.e., in 1965-66) was 34.40. The forecast in 1960-61 of the U.S. GDP deflator for five years ahead, based on the estimated forecasting equation, was 33.43. This forecast implies that in 1960-61 inflation was underpredicted for the period 1960-61 to 1965-66 in the U.S. Based on this underprediction the adjustment factor for the nominal interest rate was 1.0057 which is an adjustment of the order of about 0.6 of a percentage point.

For recent years the actual value of the GDP deflator for five years ahead and ten years ahead are not known. To fill this gap the forecasting equation for the GDP deflator based on the entire sample period, 1960-61 to 1988-89, was used to generate "actual" values of the GDP deflator for the years 1989-90 onwards. This procedure leads to the adjustment factor approaching 1 as the year 1989-90 is approached.

(2) Calculating country real rates of interest for Australia

The sixth column in table 1 shows the actual inflation rate for the next five years of the price series $F_tP_t$. This is the Australian consumer price index converted into foreign currency. Thus in the first row of table 1 the entry 1.37 means that the Australian consumer price index converted into U.S. dollars grew by 1.37 percent per annum over the five year period 1960-61 to 1965-66. Using this inflation rate to deflate the five year U.S. bond rate from column 2 yields a U.S. real rate of interest for Australia of 2.39 percent for 1960-61 (see column 8). However if the U.S. five year bond rate is adjusted by the adjustment factor in column 5 and then deflated by the inflation rate of column 6, an adjusted figure for the U.S. real rate of interest for Australia of 2.98 is obtained (see column 7).

For recent years values of the Australian consumer price index expressed in foreign currency for five years and ten years ahead are not known. To fill this gap it was assumed that the Australian consumer price index will grow by five percent per annum after 1988-89 and that exchange rates will continue at their 1988-89 values. One way to think of this assumption is that if Australia's trading partners inflate at five percent per annum then the real value of the Australian dollar is assumed to remain constant.

(3) Calculating the SOCC for Australia

The uncertainty facing Australian lenders is the uncertainty about the future values of $P_tF_t$, the Australian consumer price index expressed in foreign currency. Nominal interest rates from holding bonds to maturity are, of course, known with certainty. Variances and covariances of the price series $P_tF_t$ are used to calculate the shares of each country's asset in the portfolio of assets. For the portfolio of five year assets and for ten year assets the shares are given in Table 8. These shares are then used to sum the country real rates of interest for Australia to yield the SOCC for Australia. The SOCC's are shown in Table 9. Four rates, unadjusted and adjusted five and ten year rates, are shown in Table 9. For comparative purposes, the SOCC based on equal shares of each country's assets, using adjusted five year and ten year rates, are also shown in Table 9.

Discussion of the Calculated Series for SOCC

From Table 9 for the SOCC based on five year rates it can be seen that the adjustment made to nominal rates of interest in the four countries to allow for errors in predicting inflation transformed negative values for the SOCC for Australia into positive values for each year in the period 1968-69 to 1971-72 and for the two years 1976-77 and 1978-79. Later on, after 1979-80, the adjustment tends to reduce the SOCC, reflecting the tendency to overpredict inflation during the period of slowdown of inflation. As 1988-89 approaches the adjustment gets smaller by definition because the forecasting equation is used to predict the future values (i.e. post-1988-89) of the GDP deflators. However for 1988-89 there is still a small adjustment because, at the time of making the calculations, data to the end of calendar 1989 was available. There is a somewhat similar pattern of adjustment for the SOCC based on ten year rates.

For the rest of this section the discussion focuses on the values of the SOCC adjusted for errors in predicting inflation. In Chart 1 both the series for the SOCC for Australia based on five year bond rates and the country-specific five year real rates of interest are drawn. The SOCC based on ten year bond rates and the country-specific ten year rates are shown in Chart 2. In Chart 3 the five year and the ten year SOCC's are both shown for comparative purposes, along with the unemployment rate.

From an analysis of the data presented in Charts 1, 2 and 3, the following characteristics of the SOCC for Australia can be established.

1) The mean value for the SOCC for Australia over the period 1960-61 to 1988-89 is about four percent, using either the five year rate of the ten year rate.
2) For the period from 1960-61 to the end of the 1960's (to 1967-68 for the five year SOCC and to 1969-70 for the ten year SOCC) the SOCC showed little year-to-year variation. For the rest of the period, that is from the late 1960's to 1988-89, both five

and ten year SOCC's showed a pronounced cyclical pattern, in which deviations from the mean value of about four percent lasted for only a few years. This cyclical pattern around a fairly constant mean is very different from the pattern of aggregate resource usage in the Australian economy over the period as measured by the unemployment rate.

The mean value of the SOCC based on ten year interest rates over the period 1960-61 to 1988-89 is 4.10. For the early sub-period 1960-61 to 1968-69, during which there is little annual variation, the mean is 4.27 with a variance of 0.12 and for the later period 1969-70 to 1988-89, during which there is pronounced cyclical variation, the mean is 4.03 with a variance of 6.20. For the five year SOCC the mean value over the 1960-61 to 1988-89 period is 3.96. For the two sub-periods the mean value of the five year SOCC is 4.05 with a variance of 1.20 for the 1960-61 to 1968-69 sub-period and 3.92 with a variance of 15.51 for the 1969-70 to 1988-89 sub-period. The similarity of the means across the sub-periods and for five year and ten year interest rates is very close. The variation in the SOCC's in the second sub-period, as shown by the variance, is much greater than in the first sub-period.

Consider now the cyclical behaviour of the two SOCC series. Over the sub-period 1969-70 to 1988-89 the ten year SOCC goes through two and a half full cycles. The first cycle has a duration of nine years (1969-70 to 1977-78 inclusive), the second cycle has a duration of about 7.5 years (1978-79 to 1985 inclusive) and the half cycle has a duration of four years (1985-86 to 1988-89 inclusive). The five year SOCC also goes through two and a half cycles. Starting the first cycle of the five year SOCC in 1968-69, a year earlier than the first cycle of the ten year SOCC, the first cycle has a duration of eight years (1968-69 to 1975-76 inclusive), the second cycles has a duration of nine years (1976-77 to 1984-85 inclusive) and the half-cycle has a duration of four years (1985-86 to 1988-89 inclusive). Both the ten year and five year SOCC's cycle around a mean of about four percent. Sequences of years below four percent are counterbalanced by sequences of years above four percent. For example, for the ten year SOCC consider the sequences of years that lie outside the band of $4 \pm 1.5$ percent. Below this band there are sequences of two years (1970-71 to 1971-72) and of four years (1985-86 to 1988-89). Above this band there are sequences of three years (1973-74 to 1975-76) and of four years (1980-81 to 1983-84). For the five year SOCC consider a slightly wider band of $4 \pm 2$ percent. The wider band is chosen because the variance of the five year

SOCC in the cyclical sub-period is greater than that of the ten year SOCC. Below this band there are sequences of three years (1969-70 to 1971-72), of two years (1977-78 to 1978-79) and of three years (1985-86 to 1987-88). Above this band there are sequences of two years (1973-74 to 1974-75) and of four years (1980-81 to 1983-84).

The cyclical pattern of the SOCC stands in sharp contrast with the pattern of the aggregate unemployment rate for Australia over the same period. The latter is shown in Chart 3. The series for unemployment does not cycle around a constant mean. Instead there is a strong upward tendency over the period with no regular cyclical pattern.

Conclusion

An important part of macroeconomic performance is the provision made for future consumption purposes. A determinant of the socially optimal level of this provision is the social opportunity cost of consumption (SOCC). This paper has calculated the SOCC for Australia for the period 1960-61 to 1988-89.

For the sub-period from 1960-61 to the end of the 1960's the SOCC showed little year-to-year variation. For the second sub-period, that is from the late 1960's to 1988-89, the SOCC showed a pronounced cyclical pattern. This cyclical pattern is very different from the pattern of aggregate resource usage in the Australian economy, as measured by the unemployment rate. In both the sub-periods the mean of the SOCC was about four percent. This evidence suggests that a long run value for the SOCC for Australia is about four percent.

The large fluctuations in the SOCC are derived from an estimating procedure in which nominal interest rates were adjusted to remove the influence of incorrect inflationary expectations. In the late 1960's and early 1970's the estimates reported here suggest, as is now widely believed, that people underpredicted the future rate of inflation. Because of this underprediction of inflation, in this paper the nominal interest rates were adjusted upwards for these years. The aim of this procedure was to generate a series for the SOCC based on the assumption of perfect foresight. If this adjustment had not been made the SOCC would have shown even greater fluctuations. As it is, the fluctuations in the series reported here cannot be blamed on incorrect foresight. That is to say the low rates for the SOCC in the later 1960's and early 1970's were not due to an underprediction of inflation. And similarly the high rates in the

1980's were not due to an overprediction of inflation. This makes more intriguing the question of why the SOCC has fluctuated by such a large amount. Does the fluctuation only reflect "real" factors such as changes in technology, tastes and the demographic composition of these economies? These questions deserve study.

The large size of the variation in the SOCC for Australia during the period under study suggests that there should have been some effect on the socially optimal levels of investment and the current account surplus. This implies that the economic debate over the performance of these aggregates is ignoring an important influence. Consider two particular episodes in recent Australian experience. Firstly, in 1981-82 the SOCC reached the value of 7.73 percent, based on the 10 year bond rates, and 10.5 percent, based on the 5 year bond rates. As chart 3 shows these values were the highest for their respective series over the period 1960-61 to 1988-89. These high values of the SOCC were accompanied by a current account deficit which exceeded five percentage points of GDP. The theory of optimal saving would cause one to question the social optimality of this large current account deficit. Other things being equal, if SOCC has a high value then it is socially optimal to lend to overseas rather than to borrow from overseas. During the second episode, in 1985-86 to 1986-87, the current account deficit was again at a high level of around five percentage points of GDP but, in contrast to 1981-82, the SOCC was at its lowest levels of the 1960-61 to 1988-89 period (see table 9 and chart 3). With such a low value for SOCC the large current account deficit during this second episode was of less concern than the current account deficit of the 1981-82 episode. It would appear that there was a stronger case for choosing a tighter fiscal/looser monetary mix in 1981-82 than in 1985-86 to 1986-87.

Table 1

US Real Interest Rate for Australia - 5 Year Rate

| Description | US 5 year bond rate (%) | US GDP deflator 5 years ahead | 5 year ahead forecast of US GDP deflator | Adjustment factor for US 5 year bond rate | Inflation rate for Australian CPI converted to US currency | US real interest rate for Australia (%) adjusted | US real interest rate for Australia (%) unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_t P_t}{F_{t+5} P_{t+5}}\right)^{0.2} = 1+p$ | rx100 | rx100 |
| 1960-61 | 3.80 | 34.40 | 33.43 | 1.0057 | 1.37 | 2.98 | 2.39 |
| 1961-62 | 3.59 | 35.45 | 34.22 | 1.0071 | 1.06 | 3.22 | 2.49 |
| 1962-63 | 3.65 | 36.80 | 34.79 | 1.0113 | 1.72 | 3.05 | 1.89 |
| 1963-64 | 3.89 | 38.75 | 36.93 | 1.0097 | 2.32 | 2.51 | 1.53 |
| 1964-65 | 4.14 | 40.90 | 38.46 | 1.0124 | 2.36 | 3.00 | 1.73 |
| 1965-66 | 4.69 | 43.20 | 38.86 | 1.0214 | 3.38 | 3.44 | 1.27 |
| 1966-67 | 5.12 | 45.45 | 39.86 | 1.0266 | 5.07 | 2.70 | 0.04 |
| 1967-68 | 5.33 | 48.00 | 41.67 | 1.0287 | 8.08 | 0.25 | -2.54 |
| 1968-69 | 6.22 | 51.75 | 44.27 | 1.0317 | 12.19 | -2.31 | -5.32 |
| 1969-70 | 7.11 | 56.65 | 46.64 | 1.0397 | 14.06 | -2.37 | -6.10 |
| 1970-71 | 6.57 | 61.20 | 49.44 | 1.0436 | 13.70 | -2.19 | -6.27 |
| 1971-72 | 5.81 | 65.20 | 52.02 | 1.0462 | 12.49 | -1.59 | -5.94 |
| 1972-73 | 6.39 | 69.75 | 55.43 | 1.0470 | 9.88 | 1.37 | -3.18 |
| 1973-74 | 7.37 | 75.40 | 61.04 | 1.0432 | 7.08 | 4.60 | 0.27 |
| 1974-75 | 7.79 | 82.15 | 67.58 | 1.0398 | 6.63 | 5.11 | 1.08 |
| 1975-76 | 7.48 | 89.85 | 72.03 | 1.0452 | 7.96 | 4.05 | -0.45 |
| 1976-77 | 7.09 | 97.00 | 76.70 | 1.0481 | 7.92 | 4.00 | -0.77 |
| 1977-78 | 7.66 | 101.95 | 83.54 | 1.0406 | 6.45 | 5.24 | 1.13 |
| 1978-79 | 8.92 | 105.80 | 91.70 | 1.0290 | 4.55 | 7.20 | 4.18 |
| 1979-80 | 10.50 | 109.45 | 100.97 | 1.0163 | 1.00 | 11.18 | 9.40 |
| 1980-81 | 12.86 | 112.65 | 111.52 | 1.0020 | -2.28 | 15.73 | 15.49 |
| 1981-82 | 13.63 | 115.80 | 118.96 | 0.9946 | -1.39 | 14.61 | 15.22 |
| 1982-83 | 11.91 | 119.45 | 121.97 | 0.9958 | 1.86 | 9.40 | 9.86 |
| 1983-84 | 11.52 | 123.90 | 126.55 | 0.9958 | 4.80 | 5.96 | 6.41 |
| 1984-85 | 11.18 | 128.90 | 131.33 | 0.9963 | 7.50 | 3.04 | 3.42 |
| 1985-86 | 8.71 | 133.89 | 134.56 | 0.9990 | 9.89 | -1.17 | -1.07 |
| 1986-87 | 7.62 | 139.05 | 138.41 | 1.0009 | 8.93 | -1.11 | -1.20 |
| 1987-88 | 8.21 | 144.69 | 143.19 | 1.0021 | 6.82 | 1.51 | 1.30 |
| 1988-89 | 8.49 | 151.04 | 149.94 | 1.0015 | 5.00 | 3.47 | 3.32 |

Table 2

U.K. Real Interest Rate for Australia - 5 Year Rate

| Description | UK 5 year bond rate (%) | UK GDP deflator 5 years ahead | 5 year ahead forecast of UK GDP deflator | Adjustment factor for UK 5 year bond rate | Inflation rate for Australian CPI converted to UK currency | UK real interest rate for Australia (%) adjusted | unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_tP_t}{F_{t+5}P_{t+5}}\right)^{0.2} = 1+p$ | rx100 | rx100 |
| 1960-61 | 5.67 | 21.80 | 21.76 | 1.0004 | 2.54 | 3.09 | 3.05 |
| 1961-62 | 5.87 | 22.65 | 22.61 | 1.0004 | 1.28 | 4.57 | 4.53 |
| 1962-63 | 5.33 | 23.45 | 23.17 | 1.0024 | 3.57 | 1.94 | 1.69 |
| 1963-64 | 4.78 | 24.55 | 23.76 | 1.0066 | 5.50 | -0.03 | -0.69 |
| 1964-65 | 5.75 | 26.15 | 24.74 | 1.0112 | 4.36 | 2.46 | 1.33 |
| 1965-66 | 6.72 | 28.35 | 25.81 | 1.0190 | 5.22 | 3.35 | 1.42 |
| 1966-67 | 7.01 | 30.85 | 26.79 | 1.0286 | 7.48 | 2.41 | -0.44 |
| 1967-68 | 7.72 | 33.20 | 27.85 | 1.0358 | 8.80 | 2.55 | -0.99 |
| 1968-69 | 8.38 | 36.85 | 29.22 | 1.0475 | 12.17 | 1.21 | -3.38 |
| 1969-70 | 8.05 | 44.80 | 31.03 | 1.0763 | 15.16 | 0.98 | -6.17 |
| 1970-71 | 6.92 | 53.90 | 37.18 | 1.0771 | 18.13 | -2.51 | -9.49 |
| 1971-72 | 7.70 | 61.60 | 44.64 | 1.0666 | 20.18 | -4.42 | -10.38 |
| 1972-73 | 10.64 | 69.25 | 48.66 | 1.0732 | 16.72 | 1.73 | -5.21 |
| 1973-74 | 12.02 | 78.20 | 59.80 | 1.0551 | 10.84 | 6.64 | 1.06 |
| 1974-75 | 11.62 | 91.75 | 91.68 | 1.0002 | 7.22 | 4.12 | 4.11 |
| 1975-76 | 11.73 | 105.75 | 108.58 | 0.9947 | 6.25 | 4.60 | 5.16 |
| 1976-77 | 11.03 | 115.75 | 104.96 | 1.0198 | 6.62 | 6.19 | 4.13 |
| 1977-78 | 11.46 | 123.15 | 108.87 | 1.0250 | 8.91 | 4.89 | 2.34 |
| 1978-79 | 13.44 | 129.00 | 126.02 | 1.0047 | 12.09 | 1.67 | 1.20 |
| 1979-80 | 13.69 | 135.55 | 175.57 | 0.9496 | 12.10 | -3.70 | 1.41 |
| 1980-81 | 14.34 | 141.95 | 192.65 | 0.9408 | 7.03 | 0.50 | 6.83 |
| 1981-82 | 13.13 | 147.70 | 174.12 | 0.9676 | 2.91 | 6.37 | 9.93 |
| 1982-83 | 11.06 | 157.30 | 173.24 | 0.9809 | 1.29 | 7.55 | 9.65 |
| 1983-84 | 11.34 | 168.27 | 175.43 | 0.9917 | 0.27 | 10.11 | 11.03 |
| 1984-85 | 10.82 | 177.84 | 185.11 | 0.9920 | 1.31 | 8.51 | 9.39 |
| 1985-86 | 9.94 | 188.32 | 192.25 | 0.9959 | 4.43 | 4.84 | 5.27 |
| 1986-87 | 9.58 | 199.83 | 196.94 | 1.0029 | 5.69 | 3.98 | 3.68 |
| 1987-88 | 9.42 | 212.35 | 214.10 | 0.9984 | 5.66 | 3.39 | 3.56 |
| 1988-89 | 10.55 | 225.88 | 229.38 | 0.9969 | 5.00 | 4.96 | 5.28 |

Table 3

West German Real Interest Rate for Australia - 5 Year Rate

| Description | W.German 5 year bond rate (%) | W.German GDP deflator 5 years ahead | 5 year ahead forecast of W.German GDP deflator | Adjustment factor for W. German 5 year bond rate | Inflation rate for Australian CPI converted to W. German currency | W. German real interest rate for Australia (%) adjusted | unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_tP_t}{F_{t+5}P_{t+5}}\right)^{0.2} = 1+p$ | rx100 | rx100 |
| 1960-61 | 6.10 | 50.45 | 42.53 | 1.0348 | 0.88 | 8.83 | 5.17 |
| 1961-62 | 5.95 | 51.65 | 43.83 | 1.0334 | 0.97 | 8.43 | 4.93 |
| 1962-63 | 6.06 | 52.55 | 45.62 | 1.0287 | 1.68 | 7.30 | 4.31 |
| 1963-64 | 6.16 | 54.25 | 47.24 | 1.0281 | 2.18 | 6.81 | 3.89 |
| 1964-65 | 6.48 | 57.50 | 53.03 | 1.0163 | 1.30 | 6.82 | 5.11 |
| 1965-66 | 7.20 | 62.00 | 58.20 | 1.0128 | 1.03 | 7.45 | 6.10 |
| 1966-67 | 7.10 | 66.10 | 59.41 | 1.0216 | 1.35 | 7.96 | 5.68 |
| 1967-68 | 6.38 | 69.95 | 61.11 | 1.0274 | 1.47 | 7.71 | 4.84 |
| 1968-69 | 6.38 | 74.65 | 63.23 | 1.0338 | 3.38 | 6.38 | 2.90 |
| 1969-70 | 7.30 | 79.50 | 69.55 | 1.0271 | 5.20 | 4.75 | 1.99 |
| 1970-71 | 7.89 | 83.30 | 81.16 | 1.0052 | 5.82 | 2.49 | 1.95 |
| 1971-72 | 8.14 | 86.40 | 85.66 | 1.0017 | 5.56 | 2.62 | 2.44 |
| 1972-73 | 9.04 | 89.85 | 87.42 | 1.0055 | 3.56 | 5.86 | 5.28 |
| 1973-74 | 9.54 | 93.55 | 96.37 | 0.9941 | 0.57 | 8.27 | 8.92 |
| 1974-75 | 8.82 | 97.70 | 102.51 | 0.9904 | -0.08 | 7.87 | 8.91 |
| 1975-76 | 7.66 | 102.00 | 103.17 | 0.9977 | 3.76 | 3.53 | 3.76 |
| 1976-77 | 6.32 | 106.30 | 104.57 | 1.0033 | 7.13 | -0.44 | -0.76 |
| 1977-78 | 5.84 | 110.35 | 109.19 | 1.0021 | 9.46 | -3.11 | -3.31 |
| 1978-79 | 7.08 | 113.20 | 113.91 | 0.9988 | 11.89 | -4.42 | -4.30 |
| 1979-80 | 8.47 | 115.55 | 119.67 | 0.9930 | 10.72 | -2.72 | -2.04 |
| 1980-81 | 9.45 | 118.60 | 124.93 | 0.9897 | 2.31 | 5.86 | 6.97 |
| 1981-82 | 8.77 | 121.65 | 129.79 | 0.9871 | -4.61 | 12.55 | 14.02 |
| 1982-83 | 7.92 | 124.20 | 134.04 | 0.9849 | -4.75 | 11.59 | 13.30 |
| 1983-84 | 7.51 | 126.60 | 135.45 | 0.9866 | -3.76 | 10.21 | 11.71 |
| 1984-85 | 6.52 | 129.26 | 137.27 | 0.9881 | -2.63 | 8.09 | 9.40 |
| 1985-86 | 6.00 | 132.78 | 141.38 | 0.9875 | 1.93 | 2.70 | 3.99 |
| 1986-87 | 5.72 | 136.98 | 144.71 | 0.9891 | 6.48 | -1.80 | -0.72 |
| 1987-88 | 5.95 | 141.64 | 145.82 | 0.9942 | 6.62 | -1.21 | -0.64 |
| 1988-89 | 6.95 | 146.64 | 147.77 | 0.9985 | 5.00 | 1.70 | 1.85 |

Table 4

Swiss Real Interest Rate for Australia - 5 Year Rate

| Description | Swiss 5 year bond rate (%) | Swiss GDP deflator 5 years ahead | 5 year ahead forecast of Swiss GDP deflator | Adjustment factor for Swiss 5 year bond rate | Inflation rate for Australian CPI converted to Swiss currency | Swiss real interest rate for Australia (%) adjusted | unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_t P_t}{F_{t+5} P_{t+5}}\right)^{0.2} = 1+p$ | rx100 | rx100 |
| 1960-61 | 3.03 | 50.90 | 44.05 | 1.0293 | 1.40 | 4.58 | 1.60 |
| 1961-62 | 3.05 | 53.25 | 47.03 | 1.0252 | 1.09 | 4.50 | 1.93 |
| 1962-63 | 3.19 | 55.25 | 50.43 | 1.0184 | 1.72 | 3.31 | 1.44 |
| 1963-64 | 3.61 | 56.80 | 53.82 | 1.0108 | 2.20 | 2.48 | 1.38 |
| 1964-65 | 3.96 | 58.90 | 56.69 | 1.0077 | 2.21 | 2.49 | 1.71 |
| 1965-66 | 4.06 | 63.05 | 59.56 | 1.0115 | 2.81 | 2.37 | 1.21 |
| 1966-67 | 4.39 | 69.00 | 62.78 | 1.0191 | 3.23 | 3.05 | 1.12 |
| 1967-68 | 4.49 | 75.15 | 64.73 | 1.0303 | 3.40 | 4.12 | 1.06 |
| 1968-69 | 4.64 | 80.80 | 65.99 | 1.0413 | 4.81 | 3.96 | -0.17 |
| 1969-70 | 5.36 | 86.50 | 69.04 | 1.0461 | 4.55 | 5.42 | 0.78 |
| 1970-71 | 5.55 | 90.70 | 79.01 | 1.0280 | 2.79 | 5.55 | 2.68 |
| 1971-72 | 5.12 | 92.00 | 95.16 | 0.9933 | 2.21 | 2.15 | 2.85 |
| 1972-73 | 5.29 | 93.80 | 104.90 | 0.9779 | -0.67 | 3.65 | 6.00 |
| 1973-74 | 6.38 | 96.45 | 113.42 | 0.9681 | -4.58 | 7.92 | 11.48 |
| 1974-75 | 6.80 | 98.70 | 119.75 | 0.9621 | -3.77 | 6.77 | 10.98 |
| 1975-76 | 5.72 | 103.45 | 114.49 | 0.9799 | 0.99 | 2.57 | 4.67 |
| 1976-77 | 4.52 | 110.80 | 108.61 | 1.0040 | 3.54 | 1.35 | 0.94 |
| 1977-78 | 3.69 | 116.60 | 111.19 | 1.0096 | 6.17 | -1.40 | -2.33 |
| 1978-79 | 3.39 | 120.25 | 115.26 | 1.0085 | 9.98 | -5.19 | -5.99 |
| 1979-80 | 4.11 | 123.55 | 116.97 | 1.0110 | 8.59 | -3.07 | -4.12 |
| 1980-81 | 5.17 | 127.50 | 127.59 | 0.9999 | 0.89 | 4.23 | 4.25 |
| 1981-82 | 5.20 | 131.50 | 142.37 | 0.9842 | -5.16 | 9.18 | 10.92 |
| 1982-83 | 4.68 | 133.35 | 145.79 | 0.9823 | -4.70 | 7.89 | 9.83 |
| 1983-84 | 4.61 | 137.08 | 144.88 | 0.9890 | -3.55 | 7.26 | 8.46 |
| 1984-85 | 4.74 | 144.14 | 148.00 | 0.9947 | -2.55 | 6.91 | 7.48 |
| 1985-86 | 4.54 | 150.42 | 153.38 | 0.9961 | 1.95 | 2.13 | 2.53 |
| 1986-87 | 4.21 | 156.22 | 161.93 | 0.9929 | 6.58 | -2.93 | -2.23 |
| 1987-88 | 4.14 | 162.92 | 170.33 | 0.9911 | 6.65 | -3.23 | -2.36 |
| 1988-89 | 4.68 | 170.10 | 173.94 | 0.9956 | 4.98 | -0.74 | -0.29 |

Table 5

## US Real Interest Rate for Australia - 10 Year Rate

| Description | US 10 year bond rate (%) | US GDP deflator 10 years ahead | 10 year ahead forecast of US GDP deflator | Adjustment factor for US 10 year bond rate | Inflation rate for Australian CPI converted to US currency | US real interest rate for Australia (%) adjusted | unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_tP_t}{F_{t+10}P_{t+10}}\right)^{0.1} = 1+p$ | rx100 | rx100 |
| 1960-61 | 4.00 | 43.20 | 44.51 | 0.9970 | 2.37 | 1.29 | 1.59 |
| 1961-62 | 3.92 | 45.45 | 43.83 | 1.0037 | 3.05 | 1.21 | 0.84 |
| 1962-63 | 3.98 | 48.00 | 44.04 | 1.0087 | 4.85 | 0.02 | -0.84 |
| 1963-64 | 4.10 | 51.75 | 40.93 | 1.0238 | 7.14 | -0.54 | -2.84 |
| 1964-65 | 4.24 | 56.65 | 40.65 | 1.0338 | 8.06 | -0.28 | -3.54 |
| 1965-66 | 4.60 | 61.20 | 43.65 | 1.0344 | 8.42 | -0.20 | -3.52 |
| 1966-67 | 5.00 | 65.20 | 44.82 | 1.0382 | 8.72 | 0.27 | -3.42 |
| 1967-68 | 5.36 | 69.75 | 46.96 | 1.0404 | 8.98 | 0.58 | -3.32 |
| 1968-69 | 6.16 | 75.40 | 50.09 | 1.0418 | 9.60 | 0.90 | -3.14 |
| 1969-70 | 7.01 | 82.15 | 52.98 | 1.0449 | 10.29 | 1.38 | -2.97 |
| 1970-71 | 6.76 | 89.85 | 56.36 | 1.0478 | 10.80 | 0.95 | -3.65 |
| 1971-72 | 6.19 | 97.00 | 59.47 | 1.0502 | 10.18 | 1.21 | -3.62 |
| 1972-73 | 6.53 | 101.95 | 63.60 | 1.0483 | 8.15 | 3.25 | -1.51 |
| 1973-74 | 7.20 | 105.80 | 70.55 | 1.0414 | 5.81 | 5.51 | 1.32 |
| 1974-75 | 7.78 | 109.45 | 78.81 | 1.0334 | 3.78 | 7.32 | 3.85 |
| 1975-76 | 7.80 | 112.50 | 84.34 | 1.0292 | 2.72 | 8.02 | 4.95 |
| 1976-77 | 7.52 | 115.60 | 90.00 | 1.0254 | 3.16 | 6.86 | 4.22 |
| 1977-78 | 7.92 | 119.40 | 98.48 | 1.0195 | 4.13 | 5.65 | 3.63 |
| 1978-79 | 8.93 | 123.90 | 108.76 | 1.0131 | 4.68 | 5.43 | 4.06 |
| 1979-80 | 10.45 | 128.90 | 120.55 | 1.0067 | 4.20 | 6.71 | 6.00 |
| 1980-81 | 12.69 | 133.89 | 134.06 | 0.9999 | 3.63 | 8.73 | 8.74 |
| 1981-82 | 13.46 | 139.05 | 143.45 | 0.9969 | 3.68 | 9.09 | 9.43 |
| 1982-83 | 12.06 | 144.69 | 146.97 | 0.9984 | 4.31 | 7.26 | 7.43 |
| 1983-84 | 11.82 | 151.04 | 152.42 | 0.9991 | 4.90 | 6.49 | 6.59 |
| 1984-85 | 11.57 | 157.97 | 158.15 | 0.9999 | 6.24 | 5.00 | 5.01 |
| 1985-86 | 9.15 | 165.27 | 161.96 | 1.0020 | 7.42 | 1.82 | 1.61 |
| 1986-87 | 8.03 | 172.98 | 166.45 | 1.0039 | 6.98 | 1.37 | 0.98 |
| 1987-88 | 8.62 | 176.96 | 175.36 | 1.0009 | 5.90 | 2.65 | 2.56 |
| 1988-89 | 8.67 | 181.34 | 188.33 | 0.9962 | 4.99 | 3.11 | 3.50 |

Table 6

UK Real Interest Rate for Australia - 10 Year Rate

| Description | UK 10 year bond rate (%) | UK GDP deflator 10 years ahead | 10 year ahead forecast of UK GDP deflator | Adjustment factor for UK 10 year bond rate | Inflation rate for Australian CPI converted to UK currency | UK real interest rate for Australia (%) adjusted | unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_tP_t}{F_{t+10}P_{t+10}}\right)^{0.1} = 1+p$ | rx100 | rx100 |
| 1960-61 | 6.20 | 28.35 | 21.23 | 1.0294 | 3.87 | 5.24 | 2.24 |
| 1961-62 | 6.34 | 30.85 | 21.98 | 1.0345 | 4.33 | 5.44 | 1.92 |
| 1962-63 | 5.78 | 33.20 | 22.76 | 1.0385 | 6.16 | 3.48 | -0.35 |
| 1963-64 | 5.18 | 36.85 | 23.46 | 1.0462 | 8.78 | 1.15 | -3.32 |
| 1964-65 | 5.91 | 44.80 | 26.89 | 1.0524 | 9.63 | 1.67 | -3.39 |
| 1965-66 | 6.72 | 53.90 | 30.63 | 1.0582 | 11.49 | 1.29 | -4.28 |
| 1966-67 | 7.00 | 61.60 | 31.83 | 1.0683 | 13.65 | 0.57 | -5.86 |
| 1967-68 | 7.73 | 69.25 | 33.10 | 1.0766 | 12.69 | 2.92 | -4.40 |
| 1968-69 | 8.54 | 78.20 | 34.76 | 1.0845 | 11.50 | 5.56 | -2.66 |
| 1969-70 | 8.64 | 91.75 | 36.93 | 1.0953 | 11.12 | 7.08 | -2.23 |
| 1970-71 | 8.01 | 105.75 | 49.23 | 1.0795 | 12.03 | 4.07 | -3.59 |
| 1971-72 | 8.50 | 115.75 | 64.88 | 1.0596 | 13.20 | 1.56 | -4.15 |
| 1972-73 | 11.08 | 123.15 | 71.69 | 1.0556 | 12.75 | 3.99 | -1.48 |
| 1973-74 | 13.40 | 129.00 | 94.72 | 1.0314 | 11.46 | 4.93 | 1.74 |
| 1974-75 | 13.63 | 135.55 | 179.40 | 0.9724 | 9.63 | 0.78 | 3.65 |
| 1975-76 | 13.43 | 141.95 | 222.71 | 0.9560 | 6.64 | 1.68 | 6.36 |
| 1976-77 | 12.55 | 147.70 | 180.20 | 0.9803 | 4.52 | 5.56 | 7.68 |
| 1977-78 | 11.97 | 157.30 | 178.39 | 0.9875 | 4.80 | 5.51 | 6.85 |
| 1978-79 | 13.22 | 168.27 | 207.55 | 0.9792 | 6.02 | 4.58 | 6.79 |
| 1979-80 | 13.95 | 177.84 | 252.69 | 0.9655 | 6.57 | 3.23 | 6.92 |
| 1980-81 | 14.50 | 188.32 | 274.71 | 0.9630 | 5.72 | 4.29 | 8.30 |
| 1981-82 | 13.24 | 199.83 | 254.72 | 0.9760 | 4.29 | 5.97 | 8.58 |
| 1982-83 | 11.30 | 212.35 | 248.12 | 0.9846 | 3.45 | 5.93 | 7.59 |
| 1983-84 | 11.28 | 225.88 | 249.42 | 0.9901 | 3.11 | 6.86 | 7.92 |
| 1984-85 | 10.76 | 240.42 | 262.48 | 0.9913 | 3.64 | 5.93 | 6.87 |
| 1985-86 | 9.97 | 256.00 | 271.68 | 0.9941 | 5.23 | 3.89 | 4.51 |
| 1986-87 | 9.73 | 272.67 | 276.86 | 0.9985 | 6.13 | 3.24 | 3.40 |
| 1987-88 | 9.58 | 287.99 | 299.10 | 0.9962 | 6.09 | 2.90 | 3.29 |
| 1988-89 | 10.32 | 307.01 | 316.83 | 0.9969 | 5.52 | 4.21 | 4.54 |

Table 7

West German Real Interest Rate for Australia - 10 Year Rate

| Description | W. German 10 year bond rate (%) | W. German GDP deflator 10 years ahead | 10 year ahead forecast of W. German GDP deflator | Adjustment factor for W. German 10 year bond rate | Inflation rate for Australian CPI converted to W. German currency | W. German real interest rate for Australia (%) adjusted | W. German real interest rate for Australia (%) unadjusted |
|---|---|---|---|---|---|---|---|
| Notation | i x 100 | | | A | $\left(\frac{F_tP_t}{F_{t+10}P_{t+10}}\right)^{0.1} = 1+p$ | rx100 | rx100 |
| 1960-61 | 6.10 | 62.00 | 50.16 | 1.0214 | 0.88 | 7.43 | 5.17 |
| 1961-62 | 5.95 | 66.10 | 51.69 | 1.0249 | 1.08 | 7.43 | 4.82 |
| 1962-63 | 6.05 | 69.95 | 53.26 | 1.0276 | 1.57 | 7.29 | 4.41 |
| 1963-64 | 6.15 | 74.65 | 54.88 | 1.0313 | 2.78 | 6.51 | 3.28 |
| 1964-65 | 6.50 | 79.50 | 61.88 | 1.0254 | 3.24 | 5.77 | 3.16 |
| 1965-66 | 7.23 | 83.30 | 69.27 | 1.0186 | 3.40 | 5.63 | 3.70 |
| 1966-67 | 7.13 | 86.40 | 70.58 | 1.0204 | 3.43 | 5.69 | 3.58 |
| 1967-68 | 6.41 | 89.85 | 71.24 | 1.0235 | 2.51 | 6.24 | 3.80 |
| 1968-69 | 6.41 | 93.55 | 73.70 | 1.0241 | 1.96 | 6.88 | 4.36 |
| 1969-70 | 7.33 | 97.70 | 83.33 | 1.0160 | 2.53 | 6.36 | 4.68 |
| 1970-71 | 7.95 | 102.00 | 103.73 | 0.9983 | 4.79 | 2.85 | 3.02 |
| 1971-72 | 8.23 | 106.30 | 108.65 | 0.9978 | 6.35 | 1.55 | 1.77 |
| 1972-73 | 9.11 | 110.35 | 107.08 | 1.0030 | 6.47 | 2.78 | 2.47 |
| 1973-74 | 9.70 | 113.20 | 113.24 | 1.0000 | 6.08 | 3.41 | 3.42 |
| 1974-75 | 9.16 | 115.55 | 120.95 | 0.9954 | 5.18 | 3.30 | 3.78 |
| 1975-76 | 8.02 | 118.60 | 126.60 | 0.9935 | 3.03 | 4.15 | 4.84 |
| 1976-77 | 6.82 | 121.65 | 126.96 | 0.9957 | 1.09 | 5.22 | 5.67 |
| 1977-78 | 6.41 | 124.20 | 132.64 | 0.9935 | 2.11 | 3.53 | 4.21 |
| 1978-79 | 7.28 | 126.60 | 138.44 | 0.9911 | 3.76 | 2.47 | 3.39 |
| 1979-80 | 8.41 | 129.26 | 145.78 | 0.9880 | 3.82 | 3.17 | 4.42 |
| 1980-81 | 9.33 | 132.78 | 152.26 | 0.9864 | 2.11 | 5.62 | 7.07 |
| 1981-82 | 8.73 | 136.98 | 158.04 | 0.9858 | 0.74 | 6.40 | 7.93 |
| 1982-83 | 8.00 | 141.68 | 163.24 | 0.9859 | 0.77 | 5.67 | 7.18 |
| 1983-84 | 7.75 | 146.68 | 165.30 | 0.9881 | 0.51 | 5.93 | 7.20 |
| 1984-85 | 6.95 | 151.91 | 167.57 | 0.9902 | 1.10 | 4.75 | 5.78 |
| 1985-86 | 6.45 | 157.41 | 171.58 | 0.9914 | 3.44 | 2.02 | 2.90 |
| 1986-87 | 6.40 | 163.12 | 175.37 | 0.9928 | 5.73 | -0.09 | 0.63 |
| 1987-88 | 6.58 | 169.05 | 177.00 | 0.9954 | 5.80 | 0.28 | 0.74 |
| 1988-89 | 7.09 | 175.22 | 177.97 | 0.9984 | 5.01 | 1.82 | 1.98 |

Table - 8

Portfolio Shares

| | 5 Year Assets | 10 Year Assets |
|---|---|---|
| United States | .50341 | .54687 |
| United Kingdom | .01004 | -0.32304 |
| West Germany | .3162 | .77617 |
| Switzerland | .17035 | - |

Table 9

The Social Opportunity Cost of Consumption (SOCC) for Australia, 1960-61 to 1988-89

| YEARS | 5 YEAR RATE: Portfolio Shares based on risk minimization | | 5 YEAR RATE: Equal Portfolio shares | 10 YEAR RATE: Portfolio Shares based on risk minimization | | 10 YEAR RATE: Equal Portfolio shares |
|---|---|---|---|---|---|---|
| | adjusted | unadjusted | adjusted | adjusted | unadjusted | adjusted |
| 1960-61 | 5.11 | 3.15 | 4.87 | 4.75 | 4.14 | 4.61 |
| 1961-62 | 5.11 | 3.19 | 5.18 | 4.64 | 3.56 | 4.65 |
| 1962-63 | 4.43 | 2.58 | 3.90 | 4.51 | 3.06 | 3.56 |
| 1963-64 | 3.85 | 2.23 | 2.94 | 4.36 | 2.05 | 2.35 |
| 1964-65 | 4.12 | 2.80 | 3.69 | 3.76 | 1.88 | 2.36 |
| 1965-66 | 4.53 | 2.79 | 4.15 | 3.82 | 2.81 | 2.22 |
| 1966-67 | 4.43 | 2.01 | 4.03 | 4.35 | 2.31 | 2.15 |
| 1967-68 | 3.30 | 0.43 | 3.66 | 4.19 | 1.98 | 3.21 |
| 1968-69 | 1.55 | -1.82 | 2.31 | 4.01 | 2.37 | 4.40 |
| 1969-70 | 1.26 | -2.36 | 2.20 | 3.38 | 3.15 | 4.89 |
| 1970-71 | 0.62 | -2.17 | 0.84 | 1.40 | 1.67 | 2.60 |
| 1971-72 | 0.36 | -1.83 | -0.31 | 1.35 | -0.14 | 1.43 |
| 1972-73 | 3.19 | 1.04 | 3.15 | 2.63 | 0.52 | 3.31 |
| 1973-74 | 6.37 | 4.95 | 6.86 | 4.05 | 2.18 | 4.57 |
| 1974-75 | 6.27 | 5.30 | 5.97 | 6.30 | 2.96 | 3.76 |
| 1975-76 | 3.64 | 1.82 | 3.69 | 7.05 | 3.96 | 4.57 |
| 1976-77 | 2.17 | -0.42 | 2.78 | 5.98 | 4.47 | 5.82 |
| 1977-78 | 1.46 | -0.86 | 1.41 | 4.03 | 3.04 | 4.85 |
| 1978-79 | 1.41 | -0.28 | -0.14 | 3.40 | 2.60 | 4.12 |
| 1979-80 | 4.20 | 3.39 | 0.42 | 5.07 | 4.01 | 4.33 |
| 1980-81 | 10.50 | 10.80 | 6.58 | 7.73 | 7.46 | 6.15 |
| 1981-82 | 12.98 | 14.08 | 10.68 | 7.98 | 8.82 | 7.09 |
| 1982-83 | 9.84 | 10.97 | 9.11 | 6.43 | 7.05 | 6.22 |
| 1983-84 | 7.59 | 8.50 | 8.39 | 5.91 | 6.94 | 6.36 |
| 1984-85 | 5.36 | 6.08 | 6.64 | 4.48 | 5.74 | 5.17 |
| 1985-86 | 0.68 | 1.21 | 2.13 | 1.30 | 2.02 | 2.55 |
| 1986-87 | -1.60 | -1.18 | -0.47 | -0.37 | -0.07 | 1.49 |
| 1987-88 | -0.15 | -0.04 | 0.12 | 0.72 | 0.91 | 1.92 |
| 1988-89 | 2.20 | 2.26 | 2.34 | 1.75 | 1.98 | 3.02 |

## APPENDIX

In this appendix expressions determining the asset shares that minimize portfolio risk are derived for 4 asset and 3 asset portfolios.

On a 4 asset portfolio the return R is

$$R = a_1 r_1 + a_2 r_2 + a_3 r_3 + a_4 r_4 \tag{A1}$$

Using the constraint $\sum_{i=1}^{4} a_i = 1$, (A1) can be written

$$R = a_1(r_1-r_4) + a_2(r_2-r_4) + a_3(r_3-r_4) + r_4 \tag{A2}$$

and

$$\begin{aligned} R^2 = {} & A_1 a_1^2 + A_2 a_2^2 + A_3 a_3^2 + r_4^2 + 2A_{12}a_1a_2 \\ & + 2a_1a_3A_{13} + 2a_1B_1 + 2a_2a_3A_{23} \\ & + 2a_2B_2 + 2a_3B_3 \end{aligned} \tag{A3}$$

where $A_1 = (r_1-r_4)^2$

$A_2 = (r_2-r_4)^2$

$A_3 = (r_3-r_4)^2$

$A_{12} = (r_1-r_4)(r_2-r_4)$

$A_{13} = (r_1-r_4)(r_3-r_4)$

$A_{23} = (r_2-r_4)(r_3-r_4)$

$B_1 = r_4(r_1-r_4)$

$B_2 = r_4(r_2-r_4)$

$B_3 = r_4(r_3-r_4)$

From equation (10) in the text the risk minimizing shares are determined by

$$\frac{\partial V}{\partial a_i} = \frac{\partial E[R^2]}{\partial a_i} - \frac{\partial (E[R])^2}{\partial a_i} = 0 \quad \text{for } i = 1....3. \tag{A4}$$

From differentiation of (A3)

$$\frac{\partial E[R^2]}{\partial a_1} = 2a_1E[A_1] + 2a_2E[A_{12}] + 2a_3E[A_{13}] + 2E[B_1] \tag{A5}$$

$$\frac{\partial E[R^2]}{\partial a_2} = 2a_2E[A_2] + 2a_1E[A_{12}] + 2a_3E[A_{23}] + 2E[B_1] \tag{A6}$$

$$\frac{\partial E[R^2]}{\partial a_3} = 2a_3E[A_3] + 2a_1E[A_{13}] + 2a_2E[A_{23}] + 2E[B_3] \tag{A7}$$

and

$$\frac{\partial (E[R])^2}{\partial a_1} = 2a_1(\hat{r}_1-\hat{r}_4)^2 + 2a_2(\hat{r}_1-\hat{r}_4)(\hat{r}_2-\hat{r}_4) + 2a_3(\hat{r}_1-\hat{r}_4)(\hat{r}_3-\hat{r}_4) + 2\ \hat{r}_4\ (\hat{r}_1-\hat{r}_4) \tag{A8}$$

$$\frac{\partial (E[R])^2}{\partial a_2} = 2a_2(\hat{r}_2-\hat{r}_4)^2 + 2a_1(\hat{r}_1-\hat{r}_4)(\hat{r}_2-\hat{r}_4) + 2a_3(\hat{r}_2-\hat{r}_4)(\hat{r}_3-\hat{r}_4) + 2\hat{r}_4\ (\hat{r}_1-\hat{r}_4) \tag{A9}$$

$$\frac{\partial (E[R])^2}{\partial a_3} = 2a_3(\hat{r}_1-\hat{r}_4)^2 + 2a_1(\hat{r}_1-\hat{r}_4)(\hat{r}_3-\hat{r}_4) + 2a_2(\hat{r}_2-\hat{r}_4)(\hat{r}_3-\hat{r}_4) + 2\hat{r}_4\ (\hat{r}_3-\hat{r}_4) \tag{A10}$$

where $\hat{r}_i$ is the expected value of $r_i$.

Substituting (A5) to (A10) into (A4) yields

$$\begin{bmatrix} \sigma_4^2+\sigma_4^2-2\text{cov}_{14} & \sigma_4^2+\text{cov}_{12}-\text{cov}_{14}-\text{cov}_{24} & \sigma_4^2+\text{cov}_{13}-\text{cov}_{14}-\text{cov}_{34} \\ \sigma_4^2+\text{cov}_{12}-\text{cov}_{14}-\text{cov}_{24} & \sigma_4^2+\sigma_4^2-2\text{cov}_{24} & \sigma_4^2+\text{cov}_{23}-\text{cov}_{24}-\text{cov}_{34} \\ \sigma_4^2+\text{cov}_{13}-\text{cov}_{14}-\text{cov}_{34} & \sigma_4^2+\text{cov}_{23}-\text{cov}_{24}-\text{cov}_{34} & \sigma_4^2+\sigma_4^2-2\text{cov}_{34} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix}$$

$$= \begin{bmatrix} \sigma_4^2 - cov_{14} \\ \\ \sigma_4^2 - cov_{24} \\ \\ \sigma_4^2 - cov_{34} \end{bmatrix} \qquad \text{(A11)}$$

where $\sigma_i^2$ is the variance of the return on asset i and $cov_{ij}$ is the covariance between the returns on asset i and asset j. (A11) determines the shares $a_1$, $a_2$ and $a_3$ which minimize the variance of the 4 asset portfolio. The fourth share is given by $a_4 = 1-a_1-a_2-a_3$.

For a 3 asset portfolio simply eliminate asset 1 from (A11). So the shares that minimize the variance of a 3 asset portfolio are given by

$$\begin{bmatrix} \sigma_4^2+\sigma_4^2-2cov_{24} & \sigma_4^2+cov_{23}-cov_{24}-cov_{34} \\ \sigma_4^2+cov_{23}-cov_{24}-cov_{34} & \sigma_3^2-\sigma_4^2-2cov_{34} \end{bmatrix} \begin{bmatrix} a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} \sigma_4^2-cov_{24} \\ \sigma_4^2-cov_{34} \end{bmatrix} \qquad \text{(A12)}$$

with the third share given by $a_4 = 1-a_2-a_3$.

## DATA SOURCES

(1) Series of G.D.P. Deflator

| | | | |
|---|---|---|---|
| (a) | Germany | : | International Financial Statistics - Yearbook |
| (b) | UK | : | " " " " |
| (c) | Switzerland | : | " " " " |
| (d) | USA | : | Economic Report of the President - 1990 |

(2) CPI (Australia) : International Financial Statistics (May '90)

(3) Exchange Rate

| | | | |
|---|---|---|---|
| (a) | Germany | : | International Financial Statistics (June '90) (Monthly) |
| (b) | UK | : | " " " " " |
| (c) | Switzerland | : | " " " " " |
| (d) | USA | : | " " " " " |
| (e) | Australia | : | " " " " " |

(4) 5 Year Interest Rates

| | | | |
|---|---|---|---|
| (a) | Germany | : | *Statishsche Beihefte Zeiden Monatsbeuichten der Deutschen Bundesbank |
| (b) | UK | : | Bank of England - Quarterly Bulletin (various issues) |
| (c) | Switzerland | : | International Financial Statistics - Year Book |
| (d) | USA | : | Federal Reserve Bulletin (1988) |

(5) 10 Year Interest Rates

| | | | |
|---|---|---|---|
| (a) | Germany | : | *Statishsche Beihefte Zeiden Monatsbeuichten der Deutschen Bundesbank |
| (b) | UK | : | Bank of England - Quarterly Bulletin (various issues) |
| (c) | USA | : | Federal Reserve Bulletin (1988) or Economic Report of the President - 1990. |

* "Red Booklet with Translation in English"

# REFERENCES

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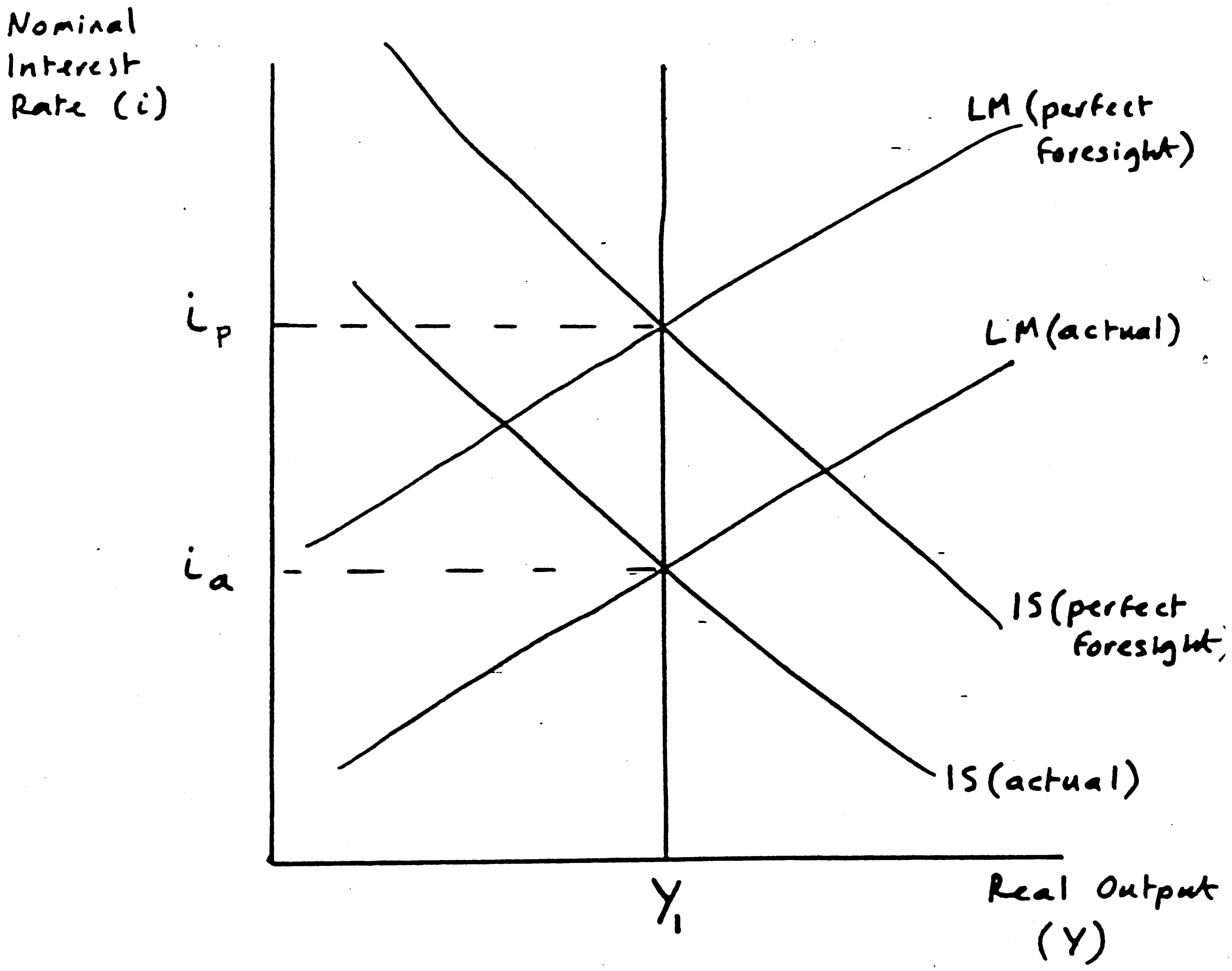
R. Jha, A.P. Sahu, and L.H. Meyer (1989) "The Fisher Equation Controversy: A Reconciliation of Contradictory Results", Southern Economic Journal, 57(1), pp 106-13.

I.M. McDonald (1985) Macroeconomic Policy in Australia Since the Sixties, Australian Economic Review, 1, 3, pp 6-19.

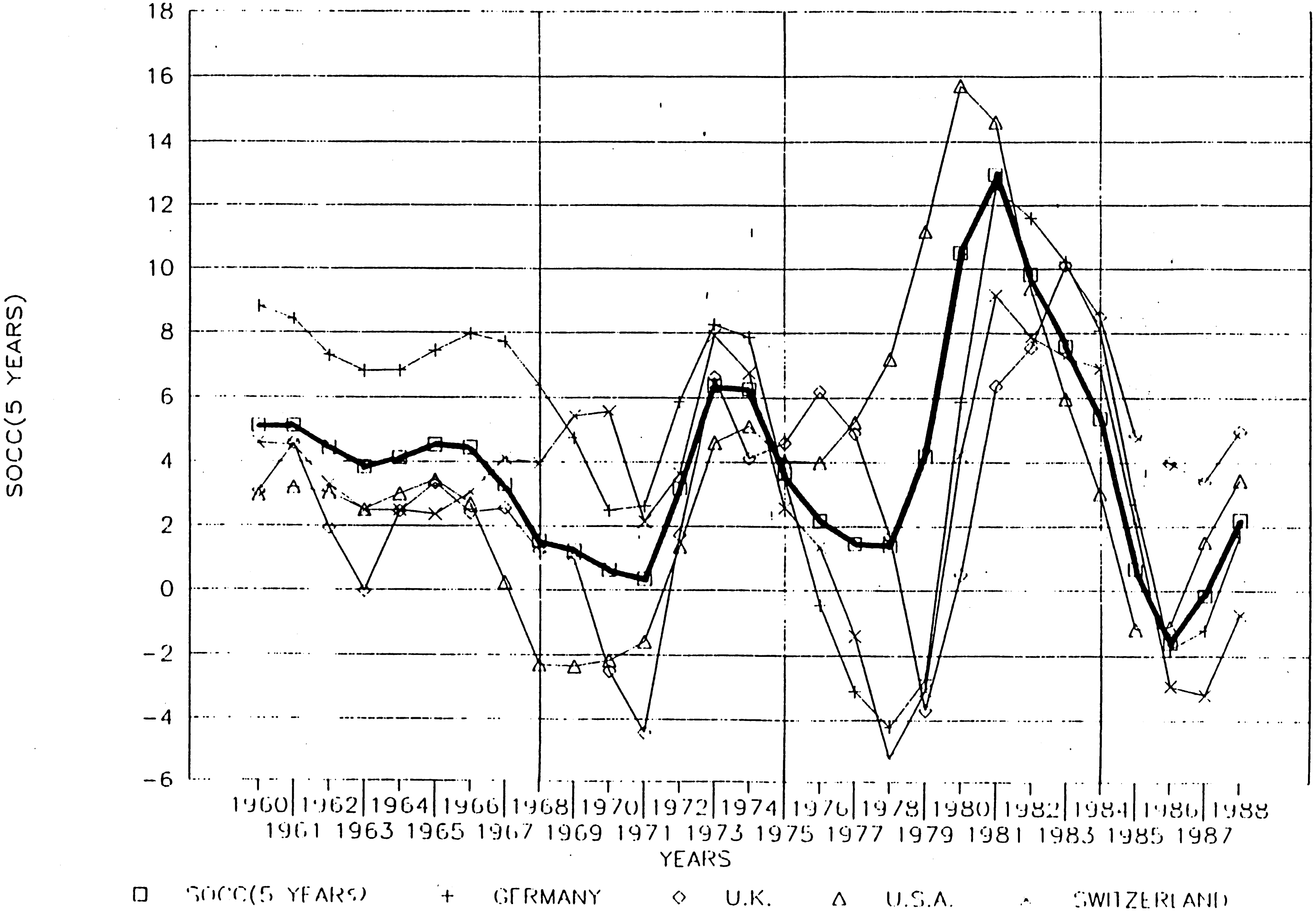


Nominal Interest Rate (i)
$i_p$
$i_a$
LM (perfect foresight)
LM (actual)
IS (perfect foresight)
IS (actual)
$Y_1$
Real Output (Y)


Figure 1

# CHART 1

The 5 year Social Opportunity Cost of Consumption (SOCC) for Australia



# CHART 2

## The 10 year Social Opportunity Cost of Consumption (SOCC) for Australia

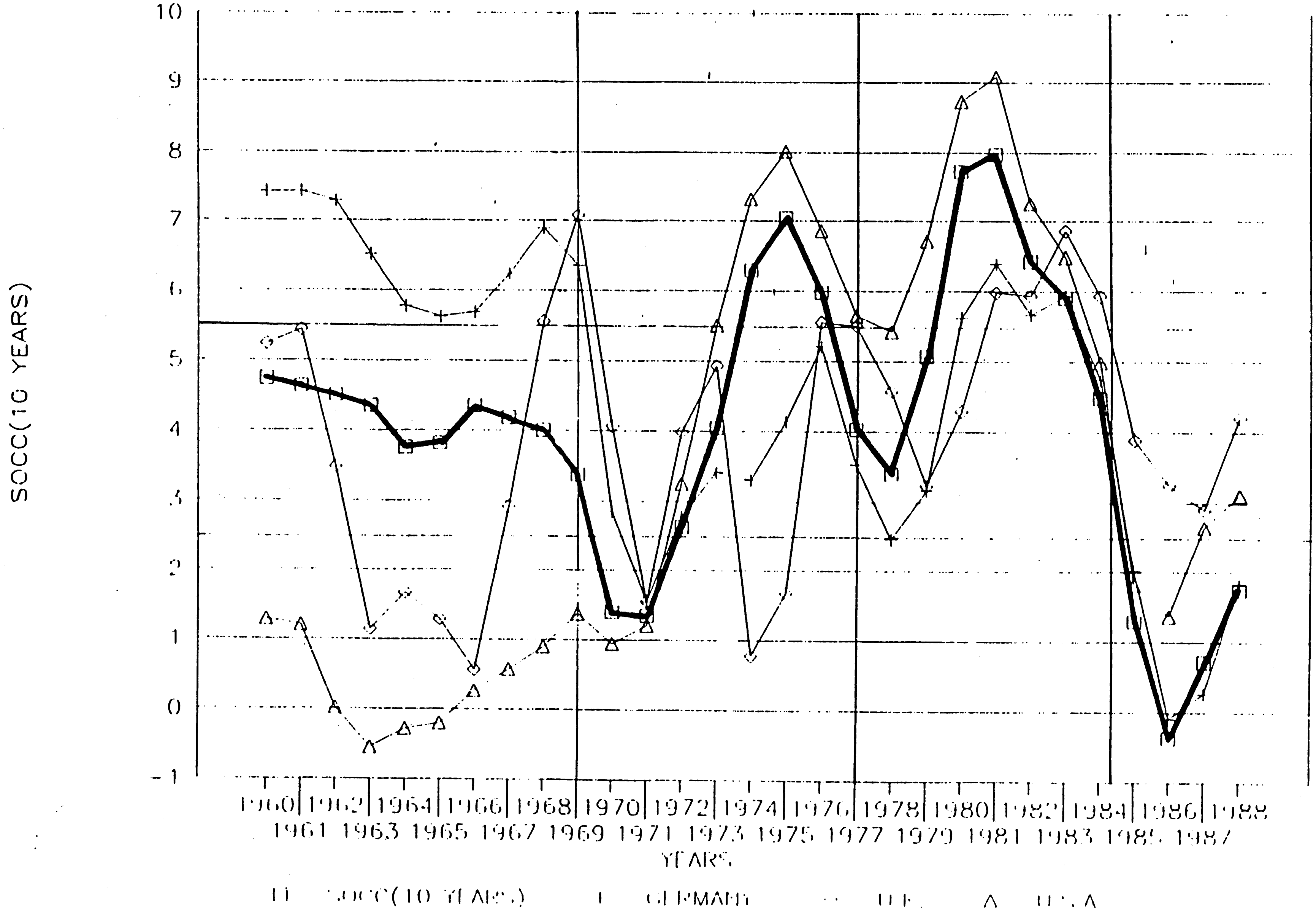


CHART 3

The Australian SOCC's and The Australian Unemployment Rate