CREDIT SUPPLY AND DEMAND AND THE AUSTRALIAN ECONOMY

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ABSTRACT

The paper explores the lending behaviour of financial intermediaries over the business cycle in the light of new theories emphasising agency costs. During a "credit crunch" loans from financial intermediaries are unobtainable at any price, so that credit may have a "causal" role in influencing economic outcomes in the short run. Tests of this phenomenon show that it is not supported by the Australian data. However, while credit may not "cause" economic activity it may, nevertheless, have useful leading indicator properties. This is because the demand for credit is based on expectations about future demand as well as the current cost of credit. Indeed, monetary policy operates in part via intertemporal substitution in demand, which is reflected in, though not caused by, the behaviour of credit. These properties of credit are shown to be broadly consistent with Australian data.

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1. INTRODUCTION

The role of financial intermediaries in the economy is of particular importance for two reasons - they hold a central position in the payments system, and provide credit to borrowers who find it difficult to obtain funds in open markets. Prior to the liberalisation of financial markets in the early 1980s, the central role of banks in issuing liquid liabilities that functioned as "money" ensured that bank deposits and currency had a reasonably close relationship with nominal expenditure. Financial liberalisation, however, undermined this role. New financial products have emerged which are close substitutes for money. In addition, banks have partly moved from their traditional deposit base to wholesale markets to finance their lending.[1] This has led some authors to suggest that credit may be a more useful indicator for policy than the monetary aggregates.[2]

While financial deregulation has undermined banks' position as providers of "money", depository institutions continue to play an important role in the provision of credit to small borrowers. Small, heterogeneous commercial borrowers, without the reputations of larger companies, find it prohibitively expensive to borrow directly in open markets. Similarly, in the housing market purchases are primarily financed by household borrowing from intermediaries. In liberalised financial markets since the early 1980s, credit is likely to have become a better leading indicator of nominal spending. Unconstrained by official regulations, borrowing is more likely to be based on expectations about future returns and on the cost of borrowing influenced by monetary policy. A shift in monetary policy that reduces expected future income and wealth, while also increasing the cost of borrowing, affects current decisions about future spending by businesses and

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[1] See Blundell-Wignall, Browne and Manasse (1990) for an empirical investigation of these issues in OECD countries.

[2] See King (1986), Friedman (1983), Brunner and Meltzer (1988), and Bernanke and Blinder (1988).

households. While causation is from monetary policy to unobservable expected future income, wealth, spending and prices, it should first be observable in reduced credit demand before, or at least contemporaneously with, the decline in actual spending. Lending may even have a causal impact on economic activity, if independent influences on credit supply imposed by financial intermediaries lead to rationing or "credit crunch" episodes in a liberalised financial environment.

In contrast to these predictions, a previous study based on data to 1987 by Bullock, Morris and Stevens (1989) found that total credit lagged nominal demand. One possible reason for this is that their sample period contained relatively few observations from the deregulated environment since 1984. As more observations are now available, it is possible to test the extent to which the earlier finding may need to be reconsidered.

In Section 2 factors influencing the supply of and demand for business credit are explained and tested on data from the early 1980s to the end of 1991. These provide an explanation for the behaviour of credit over this period, and demonstrate that rationing has not been important. Simple temporal ordering tests are then used to examine whether business credit has become a more useful leading indicator of investment since 1983. Section 3 re-examines the relationship between total credit and nominal GDP. The apparent importance of regulations (or their absence) in understanding the links between credit and the economy is discussed in Section 4. Section 5 concludes.

2. BUSINESS CREDIT AND INVESTMENT

Investors often do not have sufficient information to assess the riskiness of investing in small and medium-sized companies, or such information may be too expensive to gather. Hence many companies find it prohibitively expensive to raise funds in open capital markets by issuing their own debt or equity. Financial intermediaries, such as banks, play a key role in providing credit to these enterprises over the business cycle.[3] They collect savings and

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[3] Banks are also important lenders to large companies. But such companies can more readily substitute between different sources of financing in response to relative price movements.

allocate credit, with lending rates to particular firms reflecting their relative riskiness. Nevertheless, financial intermediaries, which specialise in assessing the potential riskiness of borrowers, may at times lack information to assess risks fully, and may find it in their own interest to ration credit.

2.1 Loan Supply and Demand with the Possibility of Credit Rationing

Debt contracts deal in promises to pay interest and repay principal in the future. If the risk associated with any project was known equally by both parties, and the borrower's behaviour could be monitored perfectly, the issuance of debt would be straightforward.[4] In the absence of official regulations, intermediaries would set prices to reflect known risks and demand would be equated with supply at that price. However, the efficient allocation of credit via interest rates presupposes that information about borrowers' projects is freely available. In practice this is not the case because of the presence of asymmetric information - borrowers know more about the risks associated with their projects than do banks and have an incentive to act in a manner which is not in the interests of the lender. This gives rise to a costly state verification problem as in Townsend (1979, 1988). Whenever there is an asymmetry of information between borrowers and lenders, optimal financial arrangements will involve deadweight losses which are referred to as "agency costs". These include adverse selection and moral hazard costs (see below), but also all other transactions and information costs.

The existence of agency costs has two related implications for the behaviour of bank lending: (i) the potential for equilibrium credit rationing (as in Stiglitz and Weiss (1981)); and (ii) the cyclical movement of bank lending and interest rates. Both factors may combine to accentuate the business cycle.

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[4] This is the well-known result of the Modigliani-Miller theorem. See Modigliani and Miller (1958).

Considering the first of these, the interest rate charged by a bank may itself influence the riskiness of the banks' pool of loans. As interest rates rise there are two effects at work:

- the quality of the borrower pool declines as prudent investors drop out of the loan market. The borrowers who are willing to pay the higher interest rate are those with the riskier projects, with potentially higher returns, but they have to repay the loan in fewer states (between "good" and "bad" economic outcomes) of the world. That is, adverse selection occurs; or

- borrowers may undertake riskier projects at higher interest rates (with potentially higher returns but lower probabilities of success). That is, a moral hazard problem arises.

Thus, as contractual interest rates rise, the bank's expected return on loans at first rises. But beyond some point the deterioration in the borrower pool begins to outweigh the direct gains from the higher contractual rates. This also implies that the variance of loan returns rises with interest rates, as default rates increase. This is illustrated by the backward bending loan return frontier in the top section of Figure 1, where expected returns peak at the rate r_m, while the variance of returns (shown along the horizontal axis) rises.[5] Beyond some interest rate the expected return to the bank falls because anticipated increases in defaults more than offset any increase in interest receipts. At this point increased loan demand would cause the bank to maximise profit by denying loans to some companies, even though these could not be distinguished from firms receiving credit. Price rationing is abandoned in favour of equilibrium quantity rationing.[6]

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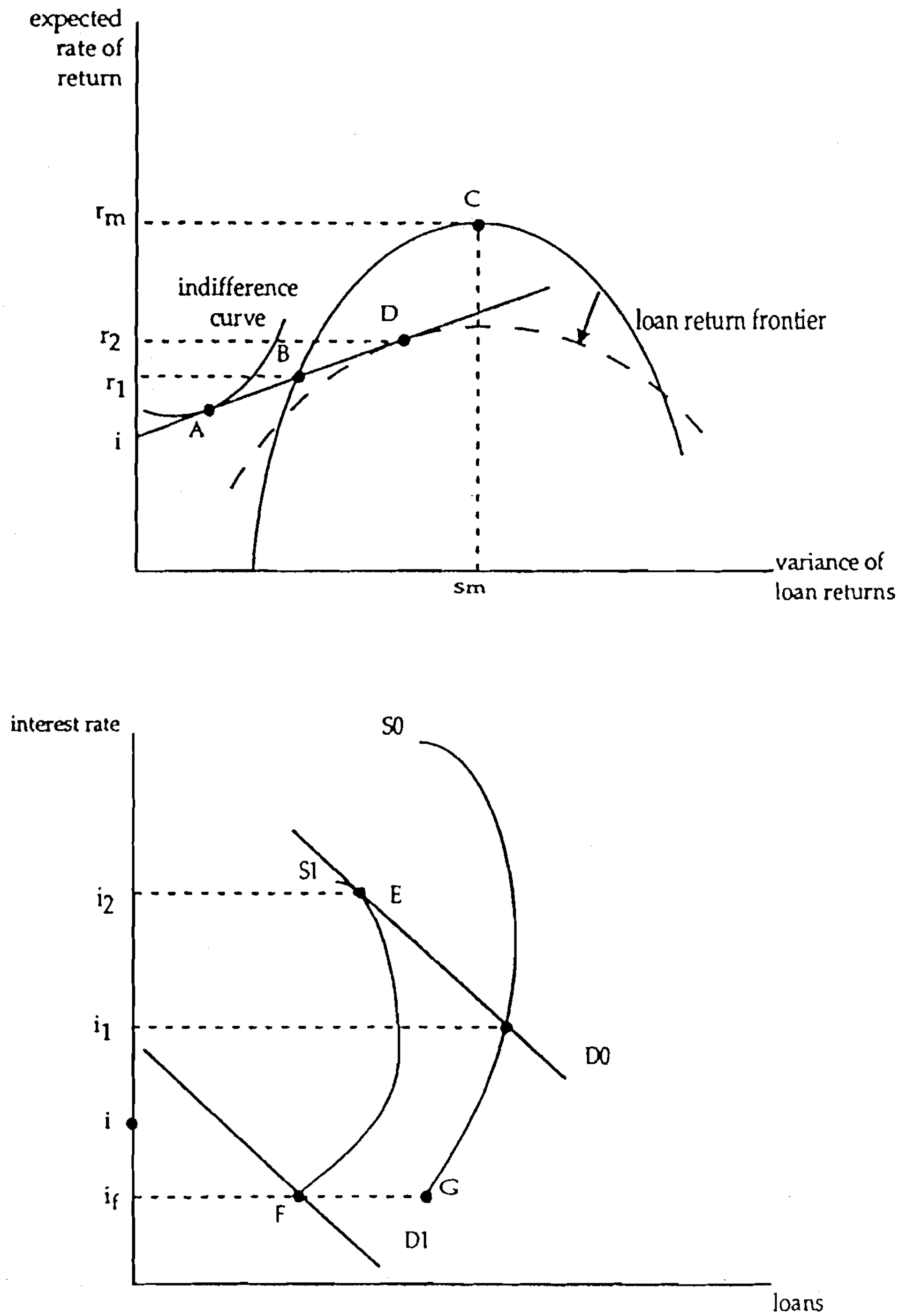
[5] This diagram also assumes that borrowers accept a common loan size and that lenders are unable to distinguish amongst borrowers.

[6] For credit rationing to be effective in reducing investment, firms must be unable to raise funds in other ways, or other sources of funds must be less than perfect substitutes for bank loans. That is, firms cannot costlessly offset a decline in bank credit by obtaining funds elsewhere.

Figure 1


expected rate of return
C
r_m
indifference curve
D
loan return frontier
r_2
B
r_1
A
i
variance of loan returns
sm
interest rate
S0
S1
i_2
E
i_1
D0
i
i_f
G
F
D1
loans

The corresponding loan supply curve is shown in the bottom panel of Figure 1. The cost of funds to the bank, i_f, is a weighted average of low cost deposits and wholesale funds (raised at the riskless market rate i), set by monetary policy. The supply curve is not defined at lending rates below i_f. As the loan rate rises above i_f supply at first increases. The supply curve S_0 becomes backward-bending at some point, as expected returns diminish.

The second aspect of agency costs is their cyclical nature. They are likely to decline when borrowers are more solvent, and rise as solvency declines (Bernanke and Gertler (1989)). Solvency is a function of factor prices and profits, which are driven mainly by the business cycle. Most defaults, for example, occur during economic downturns. Hence, agency costs are cyclical, declining in booms (as borrowers net worth and hence collateral rises) and rising in recessions (as borrower net worth and collateral declines). Thus a recession would be reflected in a downward shift and flattening out of the loan return frontier. That is, at each interest rate the expected return to the bank would be lower and the variance of returns higher.

If the portfolio problem faced by the bank is restricted to a choice between investing in a low-risk asset at rate i determined by monetary policy, or lending to a firm, it will wish to be on the optimal frontier. The efficient portfolio frontier faced by the bank is the line drawn from i to the point on the loan return frontier corresponding to the interest rate that equates loan supply and demand - for example, initially the frontier is the line from i to point B in Figure 1.[7] The bank will choose a point on the efficient frontier, i.e. a mix of riskless bonds and loans, such as point A, where its overall portfolio return lies somewhere between i and the expected return on riskier loans r_1.[8]

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[7] The optimum frontier from the bank's viewpoint would be a line from i to the point of tangency on the loan-return frontier. But if supply exceeded demand at the interest rate corresponding to this point, competition would drive interest rates and expected returns down to a point like B.

[8] Note that the loan rate i_1, corresponding to the expected return r_1, is higher than r_1. For a more complete derivation of the efficient portfolio frontier, see Greenwald and Stiglitz (1990).

Now consider the case in which a downturn in economic activity reduces firm profitability and increases agency costs. The increase in agency costs is reflected in the downward shift and flattening of the loan return frontier (the broken curve). At any given interest rate the bank would make less funds available - lending standards would be tightened - and the supply curve shifts from S_0 to S_1. For illustrative purposes, assume that loan supply is equated to demand at the higher interest rate i_2. Suppose in this case that the efficient frontier is the line from i to the point of tangency at D. The higher loan rate enables the bank to achieve the same overall risk-return trade-off at point A (where it would hold a greater proportion of its portfolio in bonds and less in loans, since the latter are now riskier). The margin between the bank loan rate and the risk free rate rises from $(i_1 - i)$ to $(i_2 - i)$. The increase in the margin between the loan rate and other market rates are risk premia that reflect increased probabilities of default as the economy moves into recession. While the market for loans is cleared at the rate i_2 in this example, any further increase in loan demand would lead to a state of excess demand. This is because at interest rates above i_2 the bank's loan supply curve becomes backward bending, and equilibrium credit rationing would come into effect.

However, rationing may be unlikely in practice. In the above analysis, rationing requires relatively strong loan demand at a time of rising agency costs. Since agency costs are cyclical, loan demand is more likely to be very weak during recessions when such costs are highest. The demand curve is much more likely to move inwards to a position such as D_1 when a downturn in activity shifts the supply curve inwards. But while rationing seems implausible in practice, the above analysis did demonstrate that there may be a cyclical risk premium in the loan rate, which could serve to exacerbate the business cycle. The economic cycle affects the net worth and hence collateral of the company sector as a whole. Default risks that arise from the cyclical behaviour of the aggregate economy cannot be diversified away by financial institutions. As the economy enters a downturn corporate net worth falls, raising agency costs and hence the loan rate relative to the riskless interest rate. This reduces investment and magnifies the extent of the contraction in activity. This process is reversed during an upturn in activity.

A general specification of the loan supply function consistent with the above discussion may be written as:

$$L_t^s = F\{ D_{t-1}, (e_b/e)_{t-1}, E_{t-1}, (i_L - i_f)_t, (i_L - i)_t, \sigma_t, \pi_t \} \quad (1)$$

where: $F_1', F_2' F_3', F_4' > 0; \; F_5', F_6', F_7' < 0.$

The first term states that loan supply depends on the sum of deposits and the book value of financial institutions' capital at the beginning of the period D_{t-1}. The second term, the banking sector share price relative to the market average $(e_b/e)_{t-1}$, captures the stockmarket's assessment of the relative expected profitability of banks and other financial intermediaries. This determines the ease with which new capital can be raised to finance loans in the forthcoming period. The third term, E_{t-1}, is the market capitalisation of corporate equity at the beginning of the period. This affects the net worth of the corporate sector and hence the collateral available to banks - the higher is corporate net worth, the more collateral is available, and the more willing are banks to extend loans. The fourth term is the lending rate minus the weighted average cost of funds in the current period $(i_L - i_f)_t$. The higher the loan rate relative to the cost of funds, the better is the bank's average profit margin, and the more desirable is lending up to the point where the supply curve becomes backward bending.

The above discussion also suggests that during cyclical downturns agency costs rise, so that banks increase the loan rate relative to the current market interest rate, which is also the marginal cost of financing new loans. This cyclical risk premium is captured by the lending rate minus the certificate of deposit rate $(i_L - i)_t$ in the current period. Such quality spreads have been found by Stock and Watson (1989), amongst others, as useful forecasters of swings in activity - a rise in the spread leading a downturn in activity. In Australia's case the loan rate minus the CD rate has also led fluctuations in the output gap since 1983 (Chart 2). The term is an imperfect measure of the risk premium, however, as it may have been affected by other factors. For example, the higher cost of traditional deposits as competition between banks has increased might have served to raise the margin between the loan rate and the CD rate independently of cyclical agency costs. For this reason other variables purporting to capture risks relevant for banking were also included in the equation.

The sixth term is the variance of bank share prices relative to the market average, σ_t. Any increase in the variance of expected returns on a bank's loan portfolio (the horizontal axis of the upper panel of Figure 1) should also be reflected in bank share prices. The seventh term π_t is the expected inflation rate. This is a more forward-looking variable associated with lending risks. High inflation is likely to be associated with asset price speculation and the misallocation of real resources. It is possible that banks may be relatively more cautious lenders, other things being given, in a high-inflation environment.

On the demand side of the market for loans, debt financing by companies depends on expected future investment and relative prices:

$$L_t^d = L(k_t^e, i_{Lt}, Ep_t, \pi_t) \tag{2}$$

where: L_1', L_3', $L_4'>0$ and $L_2'<0$

and k_t^e is future investment demand expected in period t; i_{Lt} is the loan rate in period t; Ep_t is the cost of equity finance in period t, proxied by the earnings-to-price ratio; and π_t is the inflation rate expected in period t.

It is important that the investment spending variable used in the study of business loan demand is a forward-looking expectations series (Laffont and Garcia (1977), Sealey (1979)). These are proxied, somewhat imperfectly, by the Confederation of Australian Industry and Westpac Banking Corporation survey series. Given expected investment, the demand for loans from financial intermediaries also depends negatively on the lending rate. Higher lending rates for a given rate of inflation cause investment plans to be delayed. Lower lending rates cause them to be brought forward in time. This intertemporal substitution is a key element of the monetary policy transmission mechanism. Its effects should be seen first in observed borrowing behaviour, before actual spending and activity adjusts (see below). Changes in the earnings-to-price ratio induce substitution effects between debt and equity. A higher ratio is associated with a higher cost of equity and substitution towards debt financing. Finally, the demand for loans depends positively on inflation expectations (the expected future change in the relative price of goods).

The above loan supply and demand functions can be estimated with limited dependent variables methods, using the likelihood function derived by Maddala and Nelson (1974), (see Appendix A for a full technical exposition). The requirement that the interest rate adjusts to clear the market for loans is not imposed. Instead the loan rate enters as an explanatory variable, but instruments are applied to deal with simultaneity between supply, demand and the price of loans (the instrumental variables are described in Appendix B). Estimation requires the assumption that the observed quantity of loans transacted is the minimum of supply or demand. The technique permits the probabilities that each observation belongs to the supply or demand function to be derived, enabling the parameters of both to be estimated by maximising the likelihood function. Because most of the variables contain a unit root, the model is estimated in an error-correction form, where the lagged-dependent is included. Data definitions and issues are detailed in the Data Appendix.

2.2 The Behaviour of Business Credit Since the Early 1980s

The results for the model estimated on monthly data from December 1982 to July 1991 are presented in Table 1. All of the parameters of loan demand and supply have the expected signs and appear to be reasonably well determined.[9]

The estimated percentage excess of demand over supply is shown in the top panel of Chart 1. The only evidence of excess demand, or credit rationing, is during the 1983 recession. At this time the financial system was still in the process of moving from a regulated to a more liberalised state. To the extent that rationing was present at this time, it was more likely to have been of a disequilibrium variety related to the remaining effects of regulations. Interest ceilings on bank deposits were removed, credit directives ceased by the middle of 1982, and competition for deposits began to increase. This was reflected in a marked rise in the loan rate shown in

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[9] The standard errors calculated by the limited dependent variables method are only a guide to significance - see Appendix A.

Chart 2A, which was an important factor in the elimination of any excess demand that may have existed before 1984.

In the deregulated period from early 1984 onwards, there is no evidence of excess demand. Indeed, estimated supply has exceeded demand on occasions by about 1-2 per cent. Such outcomes are theoretically plausible, because loan demand is influenced by the level of interest rates, whereas loan supply depends on interest margins and other factors such as corporate net worth, bank profitability, etc. In terms of the analysis in Figure 1, if the supply curve was S_0 and the demand curve was D_1, excess supply FG would exist at the interest rate i_f. However, these circumstances do not seem very plausible in practice. As noted earlier, in a cyclical downturn both supply and demand functions tend to move inwards, reducing the likelihood of excess supply or demand. Since the excess supply finding is typically relatively small, given the standard error of the model, it is concluded that the market for business loans appears to have been broadly in equilibrium since 1984.

The second panel of Chart 1 shows monthly percentage changes of business credit from December 1982 and the model estimates of this series. The model appears to fit the data rather well, as reflected in the R^2 and the standard error. Two broad episodes stand out:

i) the rise in business credit growth to monthly rates of about 2 per cent (24 per cent at annual rates) from 1984 to the end of 1988 (though somewhat more slowly in 1987); and

ii) the marked decline in business lending from early 1989 to the end of 1991, when lending growth eventually became negative.

TABLE 1: Limited Dependent Variable Estimates of Loan Supply and Demand

$$\Delta \ln L_t^d = \alpha_0 + \alpha_1 k_t^e + \alpha_2 i_{Lt} + \alpha_3 \pi_t + \alpha_4 Ep_t + \alpha_5 \ln L_{t-1}$$

$$\Delta \ln L_t^s = \beta_0 + \beta_1 \ln D_{t-1} + \beta_2 \ln E_{t-1} + \beta_3 \ln (e_b / e)_{t-1} + \beta_4 (i_L - i_f)_t + \beta_5 (i_L - i)_t + \beta_6 \sigma_t + B_7 \pi_t + B_8 \ln L_{t-1}$$

(Sample Period: December 1982-June 1991; Monthly Data)

	Demand		Supply	
Constant	9.598	(28.4)	-47.739	(16.0)
Lagged AFI credit to business $\ln L_{t-1}$	-0.01	(6.9)	-0.114	(384.7)
Investment expectations k_t^e	0.024	(7.1)		
Overdraft rate i_{Lt}	-0.151	(2.8)		
Inflation expectations π_t	0.438	(3.4)	-0.378	(5.1)
Earnings/price ratio Ep_t	37.843	(1.5)		
Broad money plus capital $\ln D_{t-1}$			0.102	(95.6)
Corporate net worth $\ln E_{t-1}$			0.051	(75.9)
Relative bank share price $\ln (e_b / \ln e)_{t-1}$			4.185	(3.1)
Loan rate less weighted cost funds $(i_L - i_f)_t$			0.327	(0.6)
Loan rate less CD rate $(i_L - i)_t$			-0.372	(0.8)
Relative bank share price variance σ_t			-1.492	(6.7)
Log likelihood	-107.018			
R^2 (for min (S, D) vs actual per cent change outcome)	0.45			
Standard error of estimate	0.783			

Note: Details of the estimation procedure are outlined in Appendix A. The current loan rate is treated with instrumental variables since in principle it is simultaneously determined with supply and demand. Details of instruments are set out in Appendix B. Approximate t-statistics are shown in parenthesis. Credit, broad money and corporate net worth are logged and multiplied by 100.

Chart 1A: Excess Demand
(percentage by which demand exceeds supply)

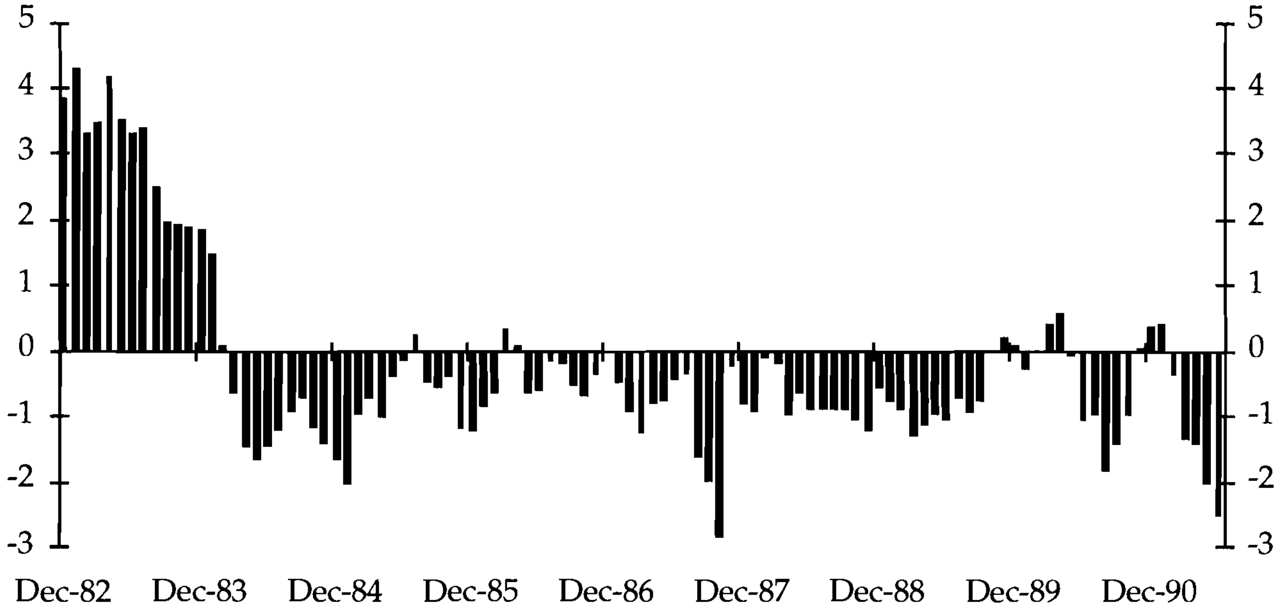


Chart 1B: Actual and Modelled Business Credit
(monthly log changes)

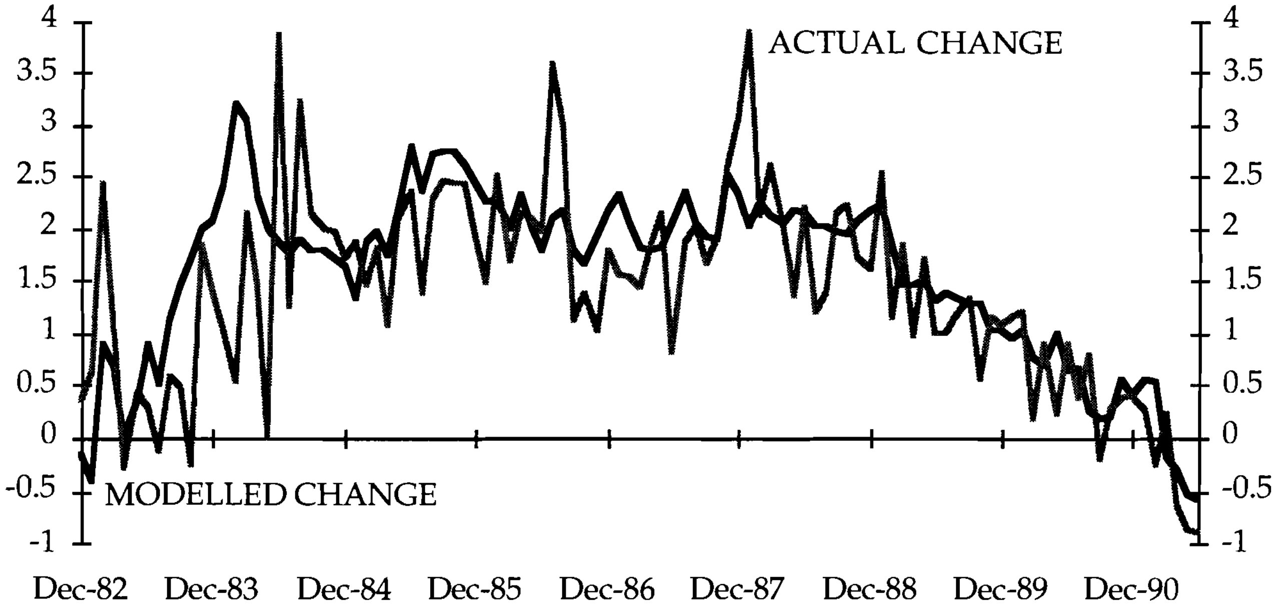


Chart 2A: The Nominal and Real Loan Rate

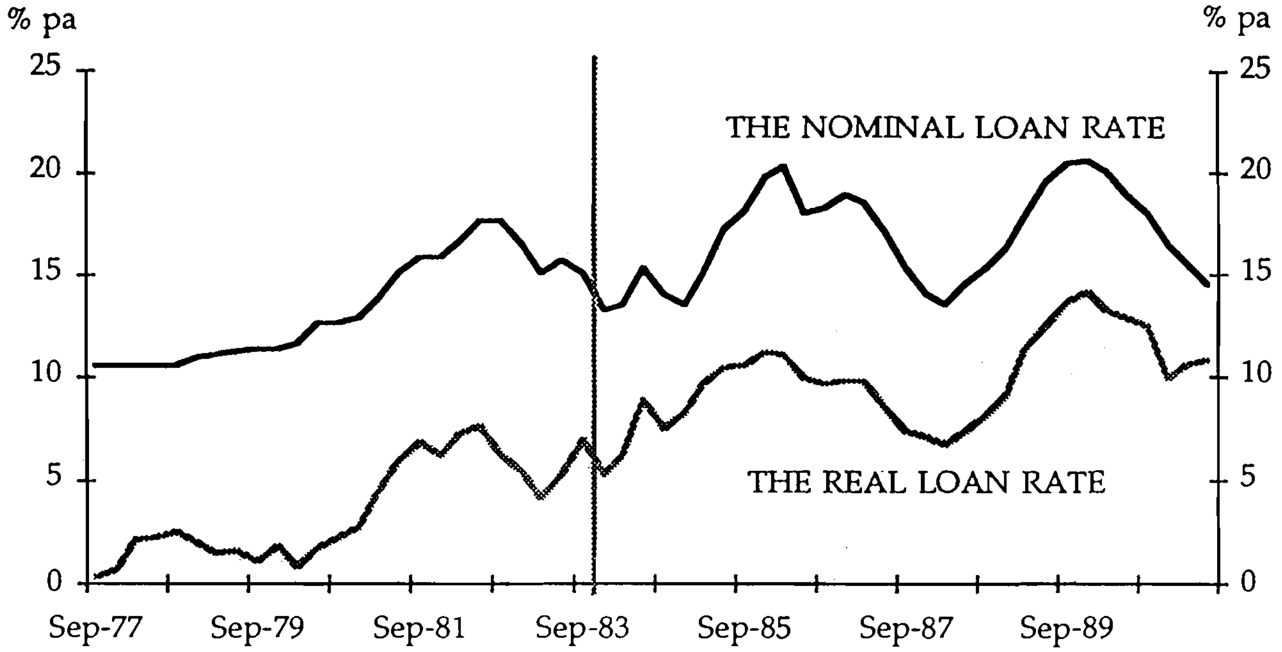
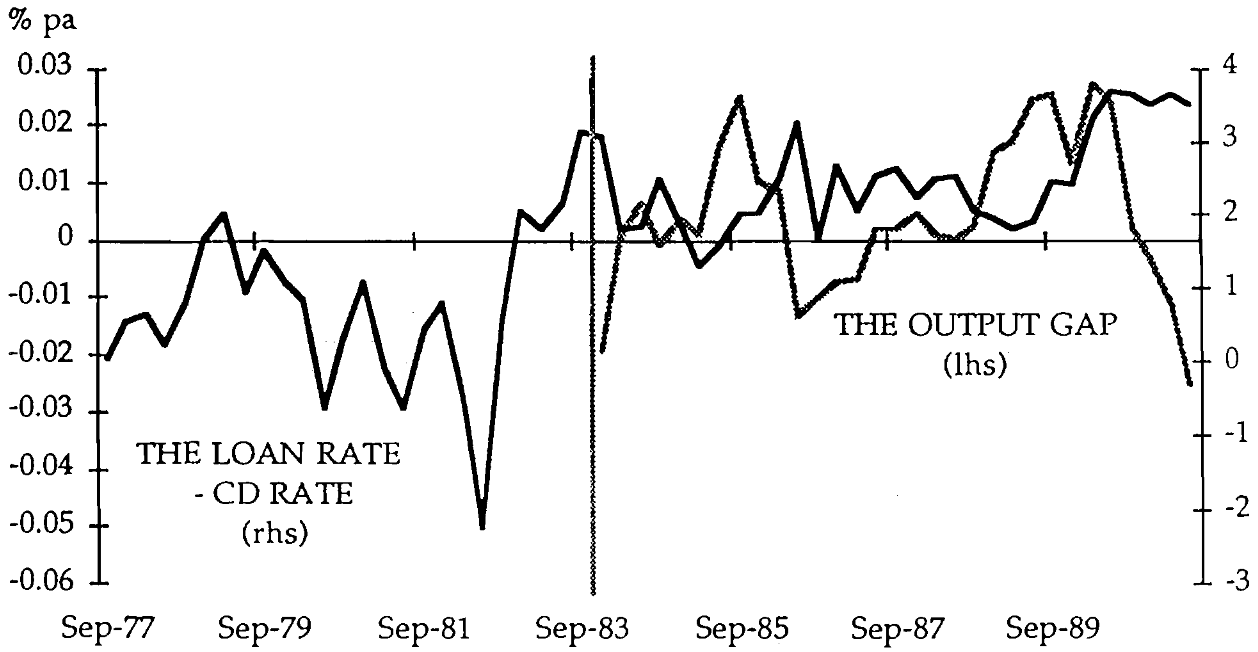


Chart 2B: The Differential Between the Loan Rate and the CD Rate and the Output Gap

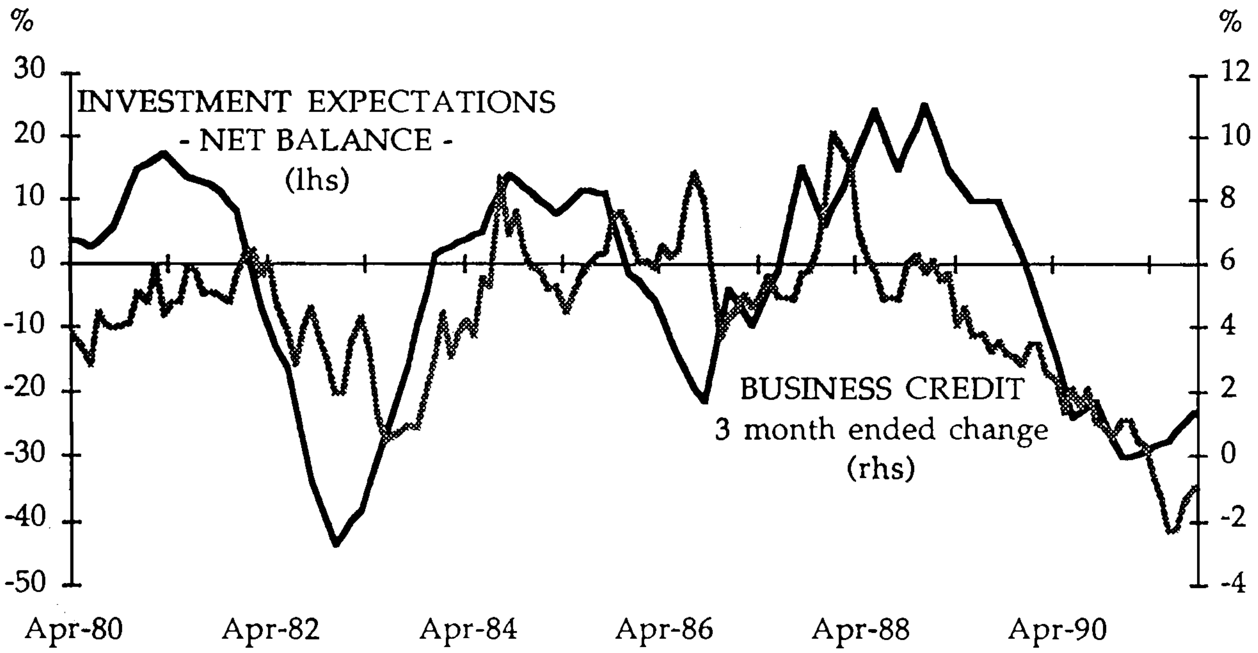


Note: The output gap is obtained as the difference between the log of actual and smoothed output, where smoothed output is the result of applying the Hodrick-Prescott filter to the log of actual output (see Hodrick and Prescott (1980)).

In explaining the rise in loan demand in the first episode, investment expectations appear to have been important. Chart 3 shows three-month ended growth in AFI credit to the business sector and the CAI-Westpac investment expectations net balance series. Investment expectations rose from 1984 and, while dipping in 1986, remained high until early 1989, when they began to decline very steeply. The model explains the strength of the demand for business credit through 1986, in spite of weaker investment expectations, mainly through its inflation term. Business borrowing, at the time, was strongly related to the asset price speculation and takeover activity usually associated with an inflationary environment.

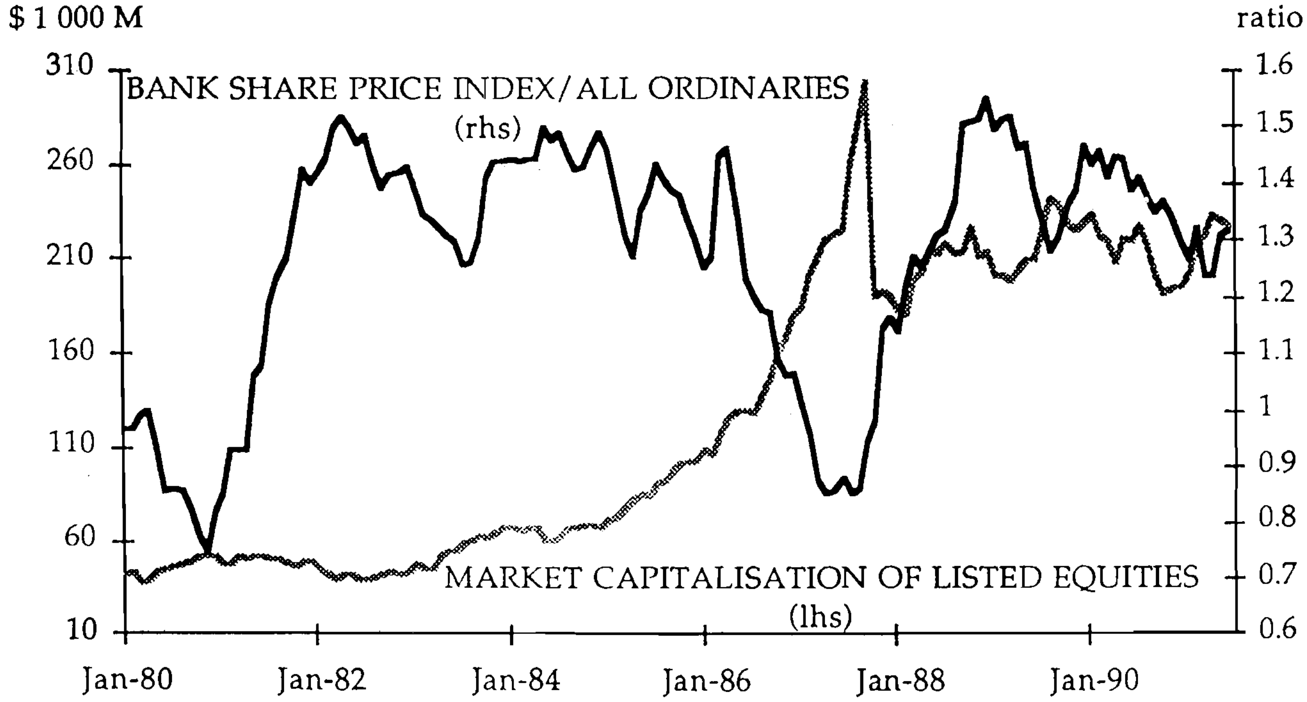
On the supply side, the interaction between perceived bank profitability and the net worth of the corporate sector were, according to the estimated model, important factors. Chart 4 shows the bank share price relative to the All Ordinaries index, and the market capitalisation of corporate equity. Financial liberalisation was associated with a sharp rise in the perceived profitability of banks in the early 1980s, with their share price rising 50 per cent relative to the market average. However, at that time the net worth of the corporate sector had not begun to increase significantly, as the economy was in recession. From 1984 corporate net worth did begin to grow rapidly and, given the perceived profitability of banks, credit supply rose in line with increasing demand. In 1986 and the first half of 1987, bank share prices declined relative to the average, largely in response to tight monetary policy. In liberalised financial markets higher interest rates increase the probability of non-performing loans. Since banks' balance sheets are directly affected, their share prices tend to be relatively adversely affected during such episodes. However, credit supply continued to grow rapidly despite the change in the relative market valuation of banks. According to the model presented here, this was due to the abnormal behaviour of corporate net worth. From January 1986 to October 1987 the market capitalisation of listed corporate equities grew from $100 billion to over $300 billion. This greatly increased the collateral of the corporate sector, thus offsetting the impact of high interest rates on bank share prices.

Chart 3: Investment Expectations and Business Credit



Note: Investment expectations are measured as the net balance of survey respondents who expect their capital expenditure on buildings, plant and machinery to rise over the following twelve months, as reported in the CAI - Westpac Survey of Industrial Trends.

Chart 4: The Bank Share Price Index Relative to the All Ordinaries and the Market Capitalisation of Listed Equities



Credit supply remained strong after the stockmarket break in October 1987, when corporate net worth fell and agency costs should have risen. However, banks came back into relative favour with the stockmarket throughout the second half of 1987 and 1988, when there was a marked recovery in their average share price compared to the All Ordinaries index. The reasons for this improvement in the relative performance of banks were twofold. First, the favourable effects of the easing of monetary policy in 1987 and, after the stockmarket collapse, the Reserve Bank's announcement (in line with similar announcements in other countries) to guarantee the liquidity of banks. Second, dividend imputation was introduced in mid 1987. This was particularly favourable for banks because most of their dividends are fully franked. The improved market perception of the economic position of banks, then, helped underpin continued lending to the corporate sector during late 1987 and 1988. Demand remained particularly strong at this time because investment expectations had not been undermined, and the stockmarket break greatly increased the cost of equity finance (proxied in the model by the earnings-to-price ratio).

In the second major episode, business credit began to slow at the end of 1988, about one year after the stockmarket crash. On the demand side this was due to high real interest rates (Chart 2A), falling investment expectations and eventually declining inflation (Chart 3). On the supply side, corporate net worth did not fully recover after the stockmarket crash and, from the end of 1988, non-performing loan problems have seen bank share prices steadily decline relative to the All Ordinaries, as their profitability has been re-assessed. A credit crunch episode, in the sense of banks denying loans to borrowers regardless of the price they are prepared to pay for them, was not identified for this period, suggesting that the slowdown in credit growth was driven by a fall in the demand for loans rather than an excessive fall in supply. However, tougher lending standards operating through the normal price mechanism do appear to have been important. In cyclical downturns it is normal that lending rates should rise relative to the market rate underpinned by monetary policy. As shown in Chart 2B, the loan rate minus the CD rate led the downturn in activity, reflecting to a large extent the normal cyclical risk premium discussed earlier.

2.3 The Relationship Between Business Credit and Investment

The above results suggest that business credit supply and demand have been roughly in balance since the end of 1984. Credit demand was driven by expected future investment spending, the earnings-to-equity-price ratio, inflation expectations and the cost of credit. Moreover, supply was driven in large part by corporate net worth and bank share price behaviour - equity prices being determined by expected future returns. Cyclical risk premium were also found to be important. In other words, major influences on business credit are driven by variables which are (i) dependent on expectations about future activity (share prices, risk premia), or (ii) influence future activity, such as the intertemporal substitution effects induced by variations in the loan rate. In the absence of constraining regulations, these forward-looking influences suggest that business credit, in principle, should contain useful information for forecasting future business spending.

There is a certain cash-in-advance element to investment good purchases. Most capital goods, for example are imported, and it is necessary to make a succession of payments from the time orders are placed until the import and investment is recorded by the Statistician. Domestic orders of heavy machinery are counted as stocks of work in progress of the producer. Payments again need to be made, but the good is not recorded as investment until later. In liberalised financial markets these payments are more likely to be made at the discretion of companies through borrowing. Firms are not liquidity constrained in the sense of being dependent on cash flows or liquidity generated by the upswing in the economic cycle itself.

In a recession lending rates are relatively high due to the previous stance of monetary policy and increased cyclical risk premia, while cash flow is relatively poor. As it becomes clear the economy will recover, risk premia in lending rates begin to decline and asset values (and hence collateral begin to rise). At these times borrowing may be important in financing stock building and working capital in the initial stages of recovery. As the recovery gets under way and sales pick up, cash flow improves providing a contemporaneous accelerator boost to business investment later on. But in the initial stages of the recovery access to credit from financial intermediaries may play a pivotal role in financing investment in deregulated markets.

Conversely, at the top of the economic cycle a tightening of policy reduces expectations about future activity and profits, while increasing the cost of borrowing. Increased cyclical risk premia exacerbate the rise in the cost of credit and asset values fall. This leads to substitution towards internal sources of funds and reduced overall expenditure in the downswing phase. These factors ensure that the downswing will be contemporaneous with or led by a marked fall in borrowing from financial intermediaries.

Chart 5 shows 12-month-ended and 3-month-ended percentage changes in business credit and the 12-month-ended percentage change in business investment. The decline in growth of business credit in response to tight monetary policy in the late 1980s led the decline in investment by about one year.

The usefulness of business credit as a leading indicator of investment suggested by the above analysis may be tested explicitly. To do this, cointegration tests between the logarithm of business credit, the logarithm of nominal investment and the level of the loan rate were conducted to see whether there was a long-run equilibrium relationship between them.[10] The results (not reported) were decisively negative. This suggested that vector autoregression techniques were appropriate for testing the leading indicator properties of the changes in these series vis-a-vis each other. The results are set out in Table 2, using quarterly data over two sample periods: 1984Q1 to 1991Q2, when financial markets were fully deregulated and the loan market was not in a state of excess demand; and the full sample period 1977Q3 to 1991Q2. The null hypothesis is that the sums of the coefficients on the explanatory variables are zero. The table shows the estimated sum of the coefficients on the lagged variables and levels of significance of the F-statistics relating to the test of the null. The second statistics in parentheses are levels of significance for the test of the hypothesis that the coefficients on the lagged explanatory variables are jointly equal to zero.

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[10] Business credit and investment appear to be integrated of order one. The loan rate appears to be stationary. Since the VAR results discussed below concern short-run changes in the logarithms of nominal investment and GDP, and since price deflators are relatively inert, most of the variation in these variables over the short-run concern real magnitudes.

The results suggest some differences between the two sample periods. Over the full sample period investment appears to be a useful leading indicator of business credit. There is also some weaker evidence that business credit has useful information for forecasting changes in investment. However, if the sample is restricted to the shorter period of liberalised financial markets (and no excess demand), nominal investment no longer leads business credit. Instead, business credit becomes a very strong leading indicator for nominal investment. These findings are consistent with the view that during the 1980s loan supply and demand have come to be driven by more forward-looking variables, as financial markets have been liberalised.

Chart 5A: Nominal Investment and All Financial Intermediaries' Lending to Business

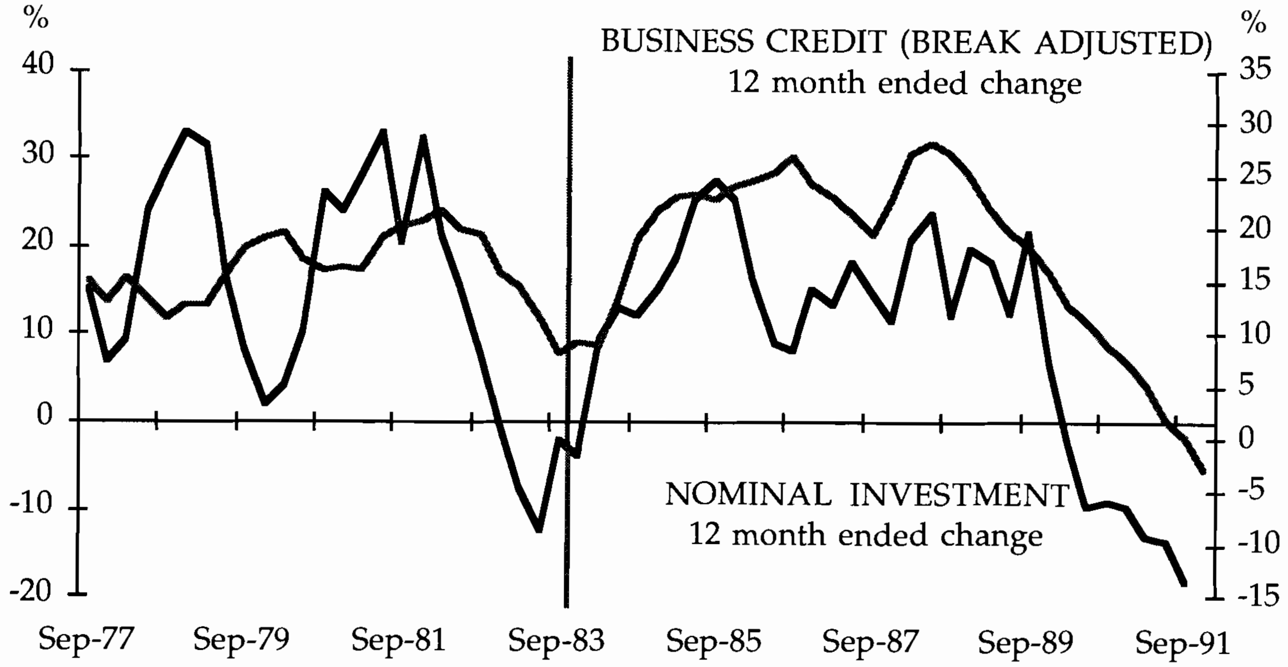


Chart 5B: All Financial Intermediaries' Lending to Business (Break Adjusted) 3 month ended change

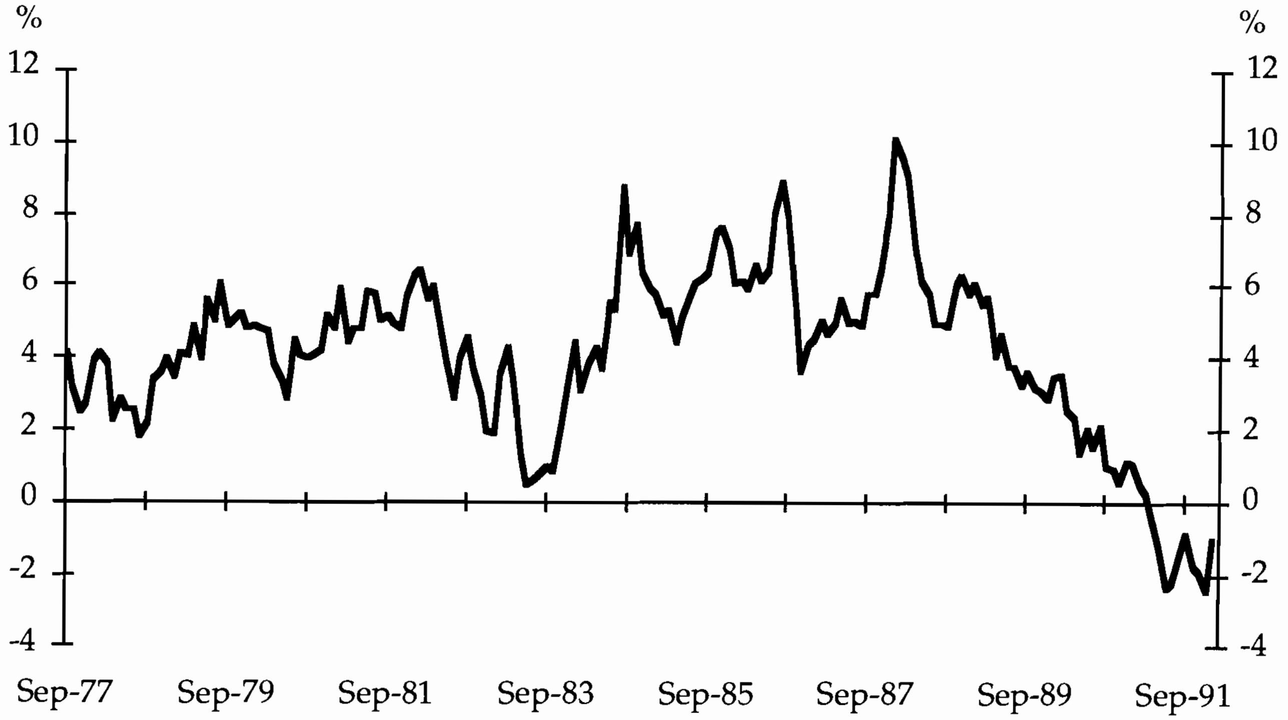


TABLE 2: VAR Estimates: Nominal Investment, Business Credit and Overdraft Rate

	Business Credit		Nominal Investment		Overdraft Rate	
	Sample Period: 1984Q1-1991Q2 (Quarterly Data Lags = 3)					
Dependent Variables						
Business Credit	0.761		0.243		-0.001	
	(0.00)**	(0.00)**	(0.17)	(0.50)	(0.49)	(0.41)
Nominal Investment	1.766		-0.165		-0.005	
	(0.00)**	(0.00)**	(0.69)	(0.88)	(0.16)	(0.18)
Overdraft Rate	3.549		9.582		0.815	
	(0.81)	(0.95)	(0.43)	(0.72)	(0.00)**	(0.00)**
	Sample Period: 1977Q3-1991Q2 (Quarterly Data Lags = 3)					
Business Credit	0.758		0.212		-0.000	
	(0.00)**	(0.00)**	(0.01)**	(0.03)*	(0.81)	(0.24)
Nominal Investment	1.097		0.138		-0.006	
	(0.01)**	(0.07)	(0.60)	(0.84)	(0.02)*	(0.02)*
Overdraft Rate	12.501		5.291		0.934	
	(0.13)	(0.33)	(0.30)	(0.69)	(0.00)**	(0.00)**

Note: Business credit and nominal investment are in quarterly percentage changes. The overdraft rate is a quarterly average (in levels). The table shows the sum of the co-efficients on the lagged variables. The first figure in parenthesis is the significance of the F-statistic for the test of the null hypothesis that sum of the co-efficients is zero. The second figure in parenthesis is the level of significance of the F-statistic for the null hypothesis that the co-efficients on the lagged variables all equal zero. Significant F-statistics indicate rejection of the null hypothesis. Two asterisks denotes significance at the 1 per cent level. One asterisk denotes significance at the 5 per cent level. All variables are defined in the Data Appendix.

3. TOTAL AFI CREDIT AND GDP

The study by Bullock, Morris and Stevens (1989) found that all financial intermediaries (AFI) credit unambiguously lagged GDP growth. This finding was based on data to the end of 1987, and was therefore dominated by the regulated period. Total AFI credit consists of the business loans analysed in Section 2, housing loans and personal loans. However, the bulk of AFI credit is made up of lending to the business sector. The forward-looking variables and intertemporal substitution mechanisms influencing business credit are also relevant for forecasting the level of economic activity itself, and not just investment. Expectations about future activity are, after all, a key influence on investment decisions. In any case, turning points in business investment and GDP are often in line with each other (see Chart 7), and business credit was shown to lead business investment. For these reasons it might be useful to see whether more recent data has improved the indicator value of AFI credit with respect to GDP.

Chart 6 shows 12-month-ended percentage changes in AFI credit compared to nominal GDP in the top panel, and 3-month-ended percentage changes in credit in the bottom panel. Credit appears to have lagged GDP for all of the period prior to 1984Ql. The subsequent sustained strength of credit growth from 1984 to 1986 was driven by business credit. This grew strongly with investment in 1984 and 1985, and did not follow the downturn in GDP in the latter year. Business credit also grew strongly in 1986, even though GDP and investment growth declined. There was, then, some decoupling of AFI credit from the GDP cycle in these years, largely because of the behaviour of the business sector in the newly-deregulated financial system.

Chart 6A: All Financial Institutions Credit and Total GDP

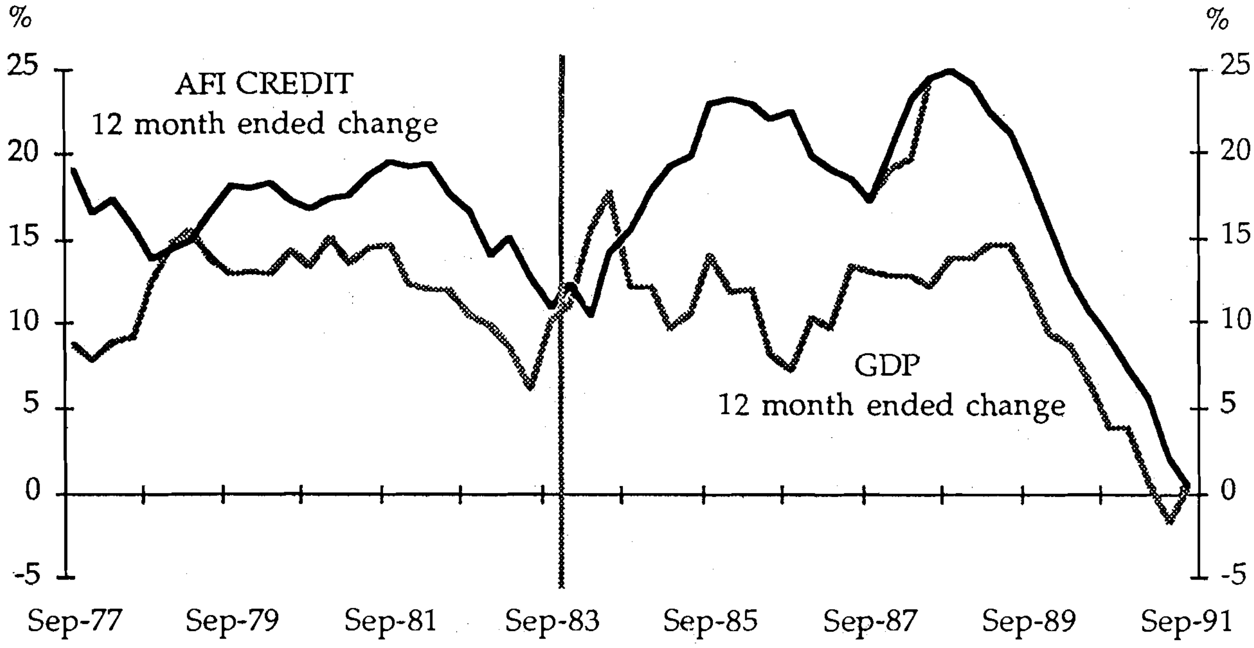


Chart 6B: All Financial Institutions Credit (3 month ended change)

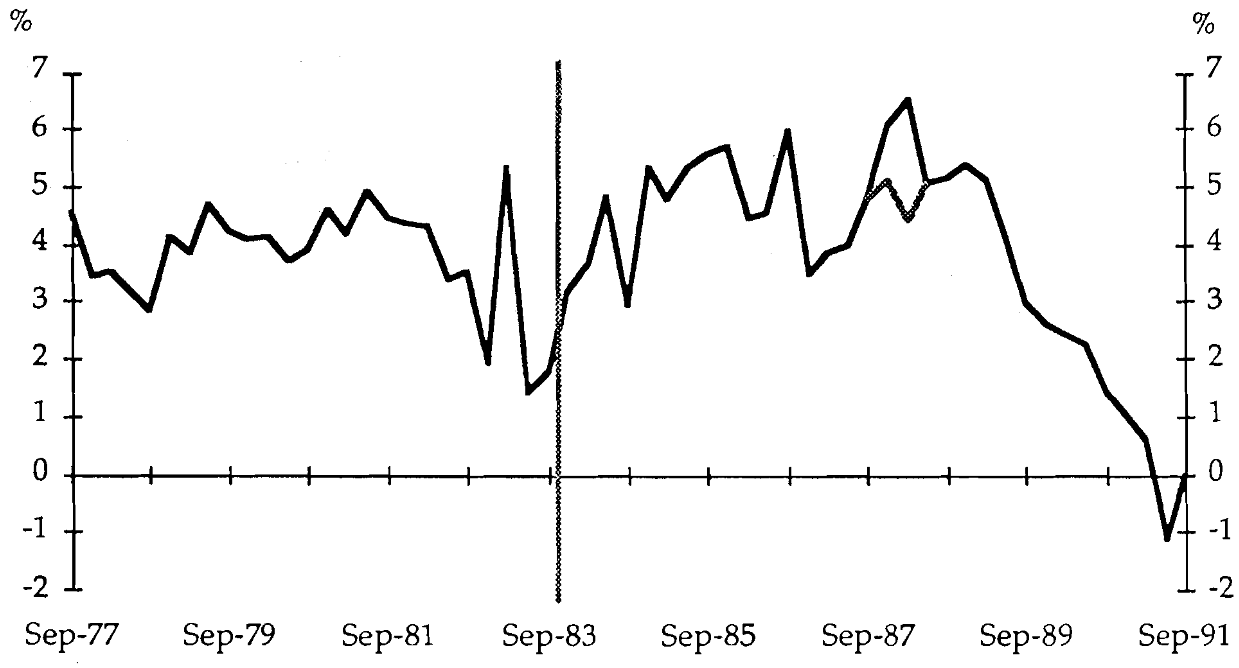


Chart 7A: GDP and Nominal Investment

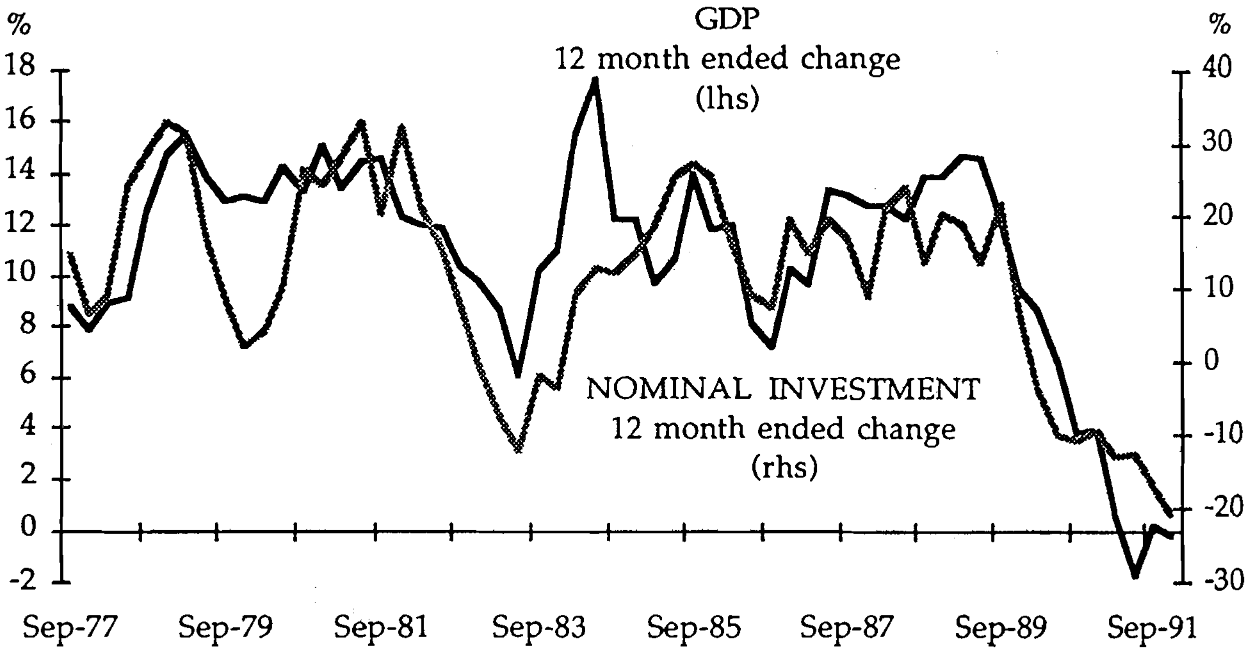
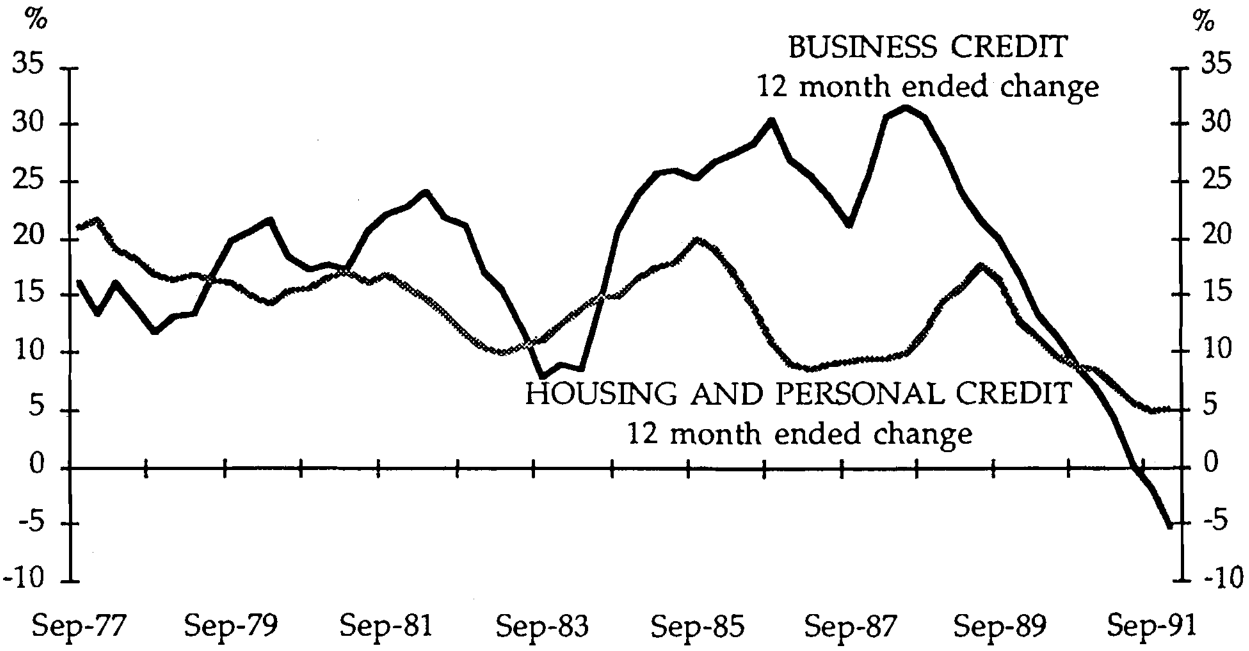


Chart 7B: Credit by Sector



However, from late 1988, following a period of very rapid growth, credit began to slow continually until the end of 1991. The downturn in credit led that of GDP by about one year. The timing of the turnaround in quarterly credit growth was even earlier than this, being superficially related to the spike in borrowing immediately after the stockmarket break. But even if monthly growth rates between December 1987 and April 1988 are assumed to be the same as the average monthly growth rates for the twelve months ending in November 1987, the timing of the turnaround in 12-month-ended credit growth is not significantly affected (shaded lines in the two panels of Chart 6). Whichever way it is measured, the timing of the downturn in annual credit growth in the late 1980s significantly precedes that for GDP.

To examine these relationships more formally, total credit, GDP and the loan rate are first tested for cointegration. The left panel of Table 3 shows results for the full sample period 1976Q1 to 1991Q4. The right panel shows results for the same shorter sample period used for business credit and investment. Each of the variables individually was found to be non-stationary (integrated of order one or two), a pre-condition for testing for cointegration.[11] Details of how the tests were conducted are set out in the note to Table 3. The left hand column of each panel shows the cointegrating regression, Augmented Dickey Fuller (ADF) and Phillips-Perron (Z) statistics.

Results for the longer sample period are focused upon first. These suggest that credit, GDP and the loan rate are cointegrated at the 10 per cent level using the ADF statistic, and at the 5 per cent level using the Z statistic.

The shortness of the sample period is such that the cointegration results are unlikely to be very robust. Nevertheless, the finding of any long-run relationship between these three variables suggests that the temporal ordering (or "causality") tests should at least be conducted in an error correction (as opposed to VAR) framework. The error correction regressions with GDP, credit and the loan rate, respectively, as the dependent variables, are shown in the second, third and fourth columns of

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[11] Most of the variables are integrated of order one. Nominal credit is ambiguous being either I(1) or I(2). Tests of the order of integration for each series are presented in Appendix C.

Table 3. The significance of the parameter on the residual from the long-run levels relationship in each of these cases suggest that:

- nominal credit adjusts to previous movements in the levels of nominal GDP and the loan rate;
- the loan rate also adjusts to prior movements of GDP and credit; but
- nominal GDP is not led by prior movements in the levels of nominal credit and the loan rate.

That is, the nominal activity variable appears to be weakly exogenous and leads the credit and loan rate variables, both of which are endogenous. This finding is entirely consistent with that of Bullock, Morris and Stevens.

The results for the shorter sample period shown in the second panel again suggest cointegration, this time at the 5 per cent level for both the ADF and Phillips-Peron statistics. The error correction results suggest a number of important differences compared to the results for the longer sample period. With credit as the dependent variable the parameter on the residual from the levels relationship -0.292, or speed of adjustment, is highly significant and much stronger compared to the long sample period results. It implies adjustment to the long-run equilibrium relationship of $3\frac{1}{2}$ quarters. This compares with a speed of adjustment of -0.066, or 15 quarters, if data from the regulated period is included. Credit still adjusts to prior movements in the loan rate and GDP, but much more rapidly than for the full sample period. With GDP as the dependent variable, the weak exogeneity finding over the full sample period is no longer supported by the data. Nominal GDP also adjusts endogenously to prior movements in the levels of credit and the loan rate over the period 1984Q1 to 1991Q4.

Both credit and GDP, therefore, appear to be useful for forecasting each other, when used in conjunction with the lending rate. Only the loan rate appears to be weakly exogenous over the shorter sample period (the final column of Table 3). The finding of two-way causation between GDP and credit since 1984 contrasts with that of Bullock, Morris and Stevens, who found that credit unambiguously lagged GDP.

TABLE 3: GDP, Credit and the Lending Rate
Cointegration and Error Correction Results

	Dependent Variables (1976Q1-1991Q4)				Dependent Variables (1982Q2-1991Q4)			
	lnC	ΔlnC	ΔlnY	Δi	lnC	ΔlnC	ΔlnY	Δi
Const.	-4.600	0.000	0.016	-1.110	-6.170	0.009	0.006	-1.250
		(0.2)	(3.8)	(2.2)		(2.8)	(0.8)	(3.2)
lnY	1.521	-	-	-	1.650	-	-	-
i	-0.009	-	-	-	-0.000	-	-	-
Resid-	-	-0.066	-0.020	-0.572	-	-0.292	-0.296	-2.680
ual		(3.7)	(0.6)	(6.8)		(12.4)	(4.0)	(-0.4)
ΔlnC_{-1}	-	0.847	-	-	-	0.499	-	19.970
		(7.4)				(7.4)		(2.7)
ΔlnC_{-2}	-	-	-	-	-	0.443	-	-
						(5.0)		
ΔlnC_{-3}	-	0.216	-	-	-	0.400	-	-
		(2.0)				(6.2)		
ΔlnC_{-4}	-	-	-	40.939	-	-	-	-
				(4.0)				
ΔlnC_{-5}	-	-0.068	-	-	-	-	-	-
		(2.4)						
ΔlnC_{-6}	-	-	-	-	-	-	-0.478	-
							(3.3)	
ΔlnY_{-1}	-	0.127	-	-11.990	-	-	0.677	-
		(2.1)		(2.1)			(4.4)	
ΔlnY_{-2}	-	-	0.369	-	-	-	0.449	-
			(3.0)				(4.0)	
ΔlnY_{-3}	-	-	-	-	-	-	-	-
ΔlnY_{-4}	-	-0.168	-	-	-	-0.348	-	-
		(2.4)				(6.5)		
ΔlnY_{-5}	-	-	-	-	-	-	0.459	-
							(4.4)	
ΔlnY_{-6}	-	-	-	-	-	-	-	18.420
								(1.7)

Table 3 continues on the next page.

TABLE 3 CONTINUED: GDP, Credit and the Lending Rate Cointegration and Error Correction Results

	Dependent Variables (1976Q1-1991Q4)				Dependent Variables (1982Q2-1991Q4)			
	lnC	ΔlnC	ΔlnY	Δi	lnC	ΔlnC	ΔlnY	Δi
Δi_{-1}	-	-0.005	-	0.704	-	0.008	-	0.270
		(5.8)		(5.4)		(8.0)		(2.0)
Δi_{-2}	-	0.004	-	-	-	-	-	-
		(3.2)						
Δi_{-3}	-	-	-	0.259	-	-	-	-
				(2.6)				
Δi_{-4}	-	-	-	0.327	-	-	-	-
				(4.0)				
Δi_{-5}	-	-	-	-	-	-	-	-
Δi_{-6}	-	-0.002	-	0.280	-	-0.003	-	-
		(3.8)		(2.5)		(4.5)		
ADF	-1.72*	-	-	-	-2.19**	-	-	-
Z	-2.17**	-	-	-	-2.08**	-	-	-
R^2	-	0.88	0.13	0.62	-	0.95	0.60	0.38
DW	-	2.4	1.6	2.1	-	2.01	2.42	1.76

Note: The Augmented Dickey Fuller (ADF) tests (with the null of a unit root) are performed on each model, allowing for trend and/or drift terms, if relevant. Two asterisks denotes that the null of no cointegration can be rejected at the 5 per cent level. One asterisk denotes rejection at the 10 per cent level. The Z test is the test proposed in Phillips (1987). This test involves making non-parametric adjustments to the ADF test. All standard errors in the error correction regressions are White (1980) - corrected for heteroskedasticity. C denotes credit, Y denotes GDP, and i denotes the loan rate.

4. CREDIT AND THE ECONOMY

The above findings suggest the leading indicator properties of business and total credit improved vis-a-vis both activity variables (investment and GDP) over the period in which financial markets have been fully liberalised. Prior to 1984 peaks and troughs in business and total credit always lagged behind peaks and troughs of the activity variable. A possible reason for this is that in regulated financial markets, which include the presence of deposit rate ceilings and foreign exchange controls, financial intermediaries cannot finance any demand for credit based on private sector plans for future expenditure. Instead, the bulk of lending is financed from "core" deposits. Banks are unable to bid directly for funds, and must depend upon growth in national saving to fund the demand for loans, once private sector holdings of financial assets other than deposits with financial intermediaries have been determined. Since saving is positively related to income, movements in GDP are more likely to precede movements in loans financed from deposits during periods affected by financial regulations. Credit is able to play a more important role in financing expenditure only when rising current income has in any case reduced liquidity constraints in the economy.

In liberalised financial markets liquidity constraints are greatly reduced. Lending is no longer constrained by national saving, as international capital flows can more easily adjust to ensure differences between national saving and investment are financed. In this environment credit is determined by the forward-looking supply and demand factors described in Section 2. Financial institutions are able to respond more quickly to loan demand, given market factors influencing supply. Credit is always available at a price. Financial intermediaries manage their liabilities, simply buying any additional deposits they need to finance lending in wholesale markets, either in the domestic economy or abroad.

The implications of this change in environment for the behaviour of credit in relation to the economy appear to be quite strong. Where business credit and investment had a two-way causal relationship over the full sample period, business credit has unambiguously led investment since deregulation. Eliminating observations from the regulated period also sees total credit providing some useful leading information about GDP. While GDP also leads credit, so that two-way causation is present, the speed of adjustment of total credit consequent upon prior movements in GDP and interest rates is increased.

It is still too early to conclude that these results will prove robust for future turning points in the economic cycle. Moreover, the presence of two-way causation suggests that any leading indicator properties of credit with respect to the overall level of activity will always need to be assessed in the light of other developments in the economy. Nevertheless, it is interesting to note that similar findings concerning the improved indicator qualities of credit have been found for the US economy. For example, Bernanke and Blinder (1988) found that credit had a much more reliable relationship with economic activity in the 1979 to 1985 period, compared to money, than during the 1974 to 1979 period, when money had a stronger relationship. More recently, O'Brien and Browne (1992), in an OECD study, showed that the leading indicator properties of credit in the United States greatly improved over the 1983Q1 to 1991Q2 period, compared to an earlier sample period of 1970Q1 to 1982Q4. Okina (1992) has shown that, in the case of Japan, broad definitions of credit have remained good leading indicators of inflation in the 1980s and early 1990s, compared to money supply variables which are now less useful for forecasting.

5. CONCLUSIONS

This paper has sought to examine the role of credit in the economy, taking account of new theories that emphasise the potential importance of informational problems that financial intermediaries need to overcome when operating in liberalised markets. These information problems may result in loan rationing, which would impart a causal relation between credit and subsequent developments in economic activity. However, such credit rationing effects were found to be absent when supply and demand functions were estimated for business loans over the period of financial liberalisation in Australia. Risks concerning the solvency of corporate clients appear to have been reflected in normal variations in the risk premia component of lending rates over the business cycle, rather than by rationing as such.

The estimated business loan supply and demand equations highlight the influence of forward-looking variables. Demand was influenced by investment expectations, inflation expectations and the earnings-to-equity-price ratio. Supply was affected by corporate net worth, cyclical risk premia, and bank share price behaviour. All of these variables are influenced by expectations about future activity. Furthermore, business and total credit were both shown to be influenced by the loan rate, which is a key aspect of the monetary policy transmission mechanism. Over the period of liberalised financial markets all of these factors should impart some leading indicator (though not necessarily "causal") role to the behaviour of business and total credit.

This was confirmed with formal tests which analyse the temporal ordering of variables. Business credit has been an unambiguous leading indicator of investment since 1984, whereas two-way causation is present if data from the regulated era are included. The leading indicator properties of total credit vis-a-vis GDP also improved somewhat. If data from the regulated period were included in the tests, total credit was found to have no leading indicator role for GDP. For the period 1984 Q1 to 1991 Q4 , however, total credit has a two-way relationship with GDP. There is information in current GDP growth useful for forecasting future credit growth, but at times credit may also have some information useful for forecasting GDP.

It seems likely that the role of credit as an indicator in an economy with liberalised financial markets may be different to its role in a regulated environment. When regulations are binding, banks are more dependent on their "core" deposits to finance their lending. "Core" deposits are accumulated in large part through saving from income, making it likely that GDP will have a tendency to lead credit. In liberalised markets the relative importance of core deposits in financing lending is greatly reduced, as financial institutions are able to manage their liabilities, essentially buying in wholesale markets at home or abroad any deposits needed to finance lending. Hence, to the extent that credit is determined by forward-looking variables, it is now somewhat more likely to provide leading information about the economic cycle than in the past.

However, experience suggests that the leading indicator properties of credit will nevertheless always need to be assessed with caution, taking due account of other relevant developments in the economy.

APPENDIX A: MAXIMUM - LIKELIHOOD ESTIMATION OF THE DEMAND AND SUPPLY OF BUSINESS CREDIT

1. The Likelihood Function

The model that we estimate is:

$$D_t = X'_{Dt}\beta_D + u_{Dt},$$
$$S_t = X'_{St}\beta_S + u_{St},$$

where D_t denotes the quantity demanded during period t, S_t the quantity supplied during period t, X_{Dt} and X_{St} denote the exogenous variables that influence D_t and S_t respectively, and u_{Dt} and u_{St} are the residuals. It is assumed that the observed quantity of loans transacted is the minimum of demand and supply. That is, as in any market with voluntary exchange, the short side of the market must prevail. Thus, let Q_t be the actual quantity observed during period t:

$$Q_t = \min(D_t, S_t)$$

Maddala and Nelson (1974) derive the likelihood function for this model using limited - dependent variable methods.

The probability that the observation Q_t belongs to the demand equation is given by:

$$\begin{aligned}\pi_t &= pr(D_t < S_t)\\ &= pr(\beta'_D X_{Dt} + u_{Dt} < \beta'_S X_{St} + u_{St})\\ &= pr(u_{Dt} - u_{St} < \beta'_S X_{St} - \beta'_D X_{Dt})\end{aligned}$$

It is assumed that u_D and u_S are independently and normally distributed, with variances σ_D^2 and σ_S^2 respectively (and that they are also serially independent). Therefore, $u_D - u_S$ is normally distributed with variance $\sigma^2 = \sigma_D^2 + \sigma_S^2$.

Hence,

$$\pi_t = \int_{-\infty}^{(\beta'_S X_{St} - \beta'_D X_{Dt})/\sigma} \frac{1}{\sqrt{2\pi}} e^{-u^2/2} \, du$$

Now define,

$$f_D(Q_t) = \frac{1}{\sqrt{2\pi}\sigma_D} \exp\left[-\frac{1}{2\sigma_D^2} (Q_t - \beta'_D - \beta'_D X_{Dt})^2 \right]$$

$$f_S(Q_t) = \frac{1}{\sqrt{2\pi}\sigma_S} \exp\left[-\frac{1}{2\sigma_S^2} (Q_t - \beta'_S - \beta'_S X_{St})^2 \right]$$

$$F_D(Q_t) = \frac{1}{\sqrt{2\pi}\sigma_D} \int_{Q_t}^{\infty} \exp\left[-\frac{1}{2\sigma_D^2} (D_t - \beta'_D - \beta'_D X_{Dt})^2 \right] dD_t$$

$$F_S(Q_t) = \frac{1}{\sqrt{2\pi}\sigma_S} \int_{Q_t}^{\infty} \exp\left[-\frac{1}{2\sigma_S^2} (S_t - \beta'_S - \beta'_S X_{St})^2 \right] dS_t$$

Then, given that Q_t belongs to the demand equation, the conditional density of Q_t is given by:

$$\frac{f_D(Q_t)\, F_S(Q_t)}{\int_{-\infty}^{\infty} f_D(Q_t)\, F_S(Q_t)\, dQ_t}$$

The denominator of this is equal to $pr(D_t < S_t)$ and, hence, is equal to π_t. Thus this can be written as:

$$\frac{f_D(Q_t)\, F_S(Q_t)}{\pi_t}$$

Similarly, the conditional density of Q_t, given that Q_t belongs to the supply equation, is written as:

$$\frac{f_S(Q_t)\ F_D(Q_t)}{1 - \pi_t}$$

Since Q_t lies on the demand equation with probability π_t and on the supply equation with probability $(1 - \pi_t)$, the unconditional density of Q_t (given the observed values of the exogenous variables X_{Dt}, X_{St}) is as follows:

$$f(Q_t \mid X_{Dt}, X_{St}) = \pi_t \left[\frac{f_D(Q_t)\ F_S(Q_t)}{\pi_t}\right] + (1 - \pi_t) \left[\frac{f_S(Q_t)\ F_D(Q_t)}{1 - \pi_t}\right]$$

$$= f_D(Q_t)\ F_S(Q_t) + f_S(Q_t)\ F_D(Q_t)$$

Hence, the log - likelihood, L, may be written as:

$$L(\beta_D, \beta_S, \sigma_D, \sigma_S \mid X_{Dt}, X_{St}) = \sum_{t=1}^{n} \log(f_D(Q_t)\ F_S(Q_t) + f_S(Q_t)\ F_D(Q_t))$$

where n is the number of observations.

2. The Estimation Method: Discussion

Parameter estimates were obtained by maximising the log - likelihood using the Broydon, Fletcher, Goldfarb and Shanno (BFGS) maximisation algorithm (which is a modification of the Davidon, Fletcher, Powell method).

A number of caveats are in order when estimating models with unknown sample separation. Firstly, a conceptual problem arises in that too much may be asked of the data when it is not known which observations are on the demand function and which are on the supply function. Monte Carlo methods find that there is considerable loss of information if sample separation is not known. However, empirical results obtained by some other studies using this method are quite good (Maddala (1983) p 299).

Secondly, it can be shown that the likelihood function for this model is unbounded for certain parameter values. However, it has been shown that even if the likelihood function diverges, a consistent estimate of the true parameter value in this model corresponds to a local maximum of the likelihood function, rather than a global maximum. Thus the fact that a local maximum is obtained rather than a global maximum is not a matter of concern, but this result does not ensure that the particular local maximum we have located will give a consistent estimate of the true parameter values.

Finally, the estimate of the covariance matrix produced by the BFGS method may not be precise. The estimated covariance matrix from the BFGS algorithm is (for a well - behaved function) approximately -H, where H is the Hessian of the objective function L. The only exact result that holds for the BFGS method is that if L is quadratic with K free parameters, then after K or more iterations the estimated covariance matrix will be exactly -H (Doan (1988). However, the log-likelihood from our model is considerably more complex than a quadratic function, hence standard errors reported in this paper should be interpreted as a guide to significance, rather than as a precise measure of significance.

APPENDIX B: THE LOAN RATE AND INSTRUMENTAL VARIABLES

Three interest rate variables are treated as being simultaneously determined with the observed quantity of credit: the loan rate itself, the spread between the loan rate and the certificate of deposit rate, and the spread between the loan rate and the weighted cost of funds.

The instruments applied to each of these variables is as follows.

The loan rate:

- lags of the loan rate;
- expected inflation;
- the 90 day bank bill rate;
- the previous period's non farm GDP;
- the spread between the mortgage rate and the thirteen week Treasury note rate;
- the previous period's broad money;
- the rediscount rate for Treasury notes;
- the current and lagged issue yield on thirteen week Treasury notes;
- all banks' capital;
- a time trend.

The spread between the loan rate and other interest rates:

- the maximum rate on certificates of deposit;
- the rediscount rate for Treasury notes;
- the spread between the mortgage rate and the thirteen week Treasury note rate;
- the previous period's broad money;
- the previous period's issue yield on thirteen week Treasury notes;
- the previous period's loan rate;
- all banks' capital;
- the monthly change in non farm GDP.

Instrumental variables were also applied to the earnings price ratio. The instruments were:

- the maximum rate on certificates of deposit;
- the rediscount rate for Treasury notes;
- the spread between the mortgage rate and the thirteen week Treasury note rate;
- the previous period's broad money;
- the previous period's issue yield on thirteen week Treasury notes;
- the previous period's loan rate;
- all banks' capital;
- the monthly change in non farm GDP;
- corporate net worth.

APPENDIX C: ORDER OF INTEGRATION TESTS

The following tables contain the results of testing for the order of integration of each variable. A variable is said to be integrated of order j if, after differenceing j times, the variable is stationary. Two tests of stationarity are reported - the ADF test and the Z test.

The ADF test is the Augmented Dickey Fuller test. The following regression is estimated:

$$\Delta y_t = \alpha + \phi t + \beta y_{t-1} + \gamma_1 \Delta y_{t-1} + \ldots + \gamma_k \Delta y_{t-k} + \varepsilon_t.$$

where k is the number of lags in the autocorrelation correction. The significance of the constant (α) and the time trend (ϕ) is tested by comparing their t-statistics with the critical values presented in Dickey and Fuller (1981). If appropriate, either or both of these variables are eliminated and the regression is re-estimated. The t-statistic on β is then compared with the critical values given by Fuller (1976) .

Z is the test proposed in Phillips (1987). This test involves making non parametric adjustments to the ADF test. For both tests a significant result indicates stationarity.

Sample Period: December 1982 - June 1991; Monthly Data
Autocorrelation Correction = 12 Lags

	Constant	Trend	ADF	Z
Level of:				
Overdraft Rate	3.709*	0.624	-3.703*	-2.439*
(Log of) Business Credit	2.629*	-1.61	-2.621	-2.331*
Expected Inflation	1.752	-0.249	-0.953	-1.898
Expected Investment	-0.897	-0.357	-1.676	-1.339

* denotes significance at the 5 % level
** denotes significance at the 10 % level

Sample Period: December 1982 - June 1991; Monthly Data
Autocorrelation Correction = 12 Lags

	Constant	Trend	ADF	Z
Level of:				
Price-Earnings Ratio	1.86	-1.0167	-0.31	-2.133
Differential between the Loan Rate and the Weighted Cost of Funds	2.24**	-1.49	-2.254	-2.393*
(Log of) Corporate Net Worth	1.535	0.115	1.416	-1.703
Banks' Share Prices	1.84	0.467	-0.902	-1.877
(Log of) Broad Money plus Banks' Capital	1.417	2.132	0.433	-1.296
Differential between the Loan Rate and the CD Rate	-1.658	3.232*	-2.945	-5.068*
Differential between the Loan Rate and the Mortgage Rate	1.993	-1.77	-0.918	-2.079
Relative Bank Share Price Variance	1.895	0.76	-0.246	-1.108
First Difference of:				
Overdraft Rate	0.085	-1.183	-2.06*	-6.335*
(Log of) Business Credit	2.703	-2.768**	-1.31	-9.048*
Expected Inflation	-0.605	-0.49	-3.117*	-6.157*
Expected Investment	-0.559	-0.793	-2.4*	-3.923*
Price-Earnings Ratio	-0.14	-0.324	-3.068*	-11.608*
Differential between the Loan Rate and the Weighted Cost of Funds	-0.118	-0.604	-2.841*	-8.875*
(Log of) Corporate Net Worth	1.351	-1.274	-2.022*	-9.125*
Banks' Share Prices	-0.105	0.636	-2.89*	-6.924*
(Log of) Broad Money plus Banks' Capital	0.6139	-1.359	-0.946	-8.918*
Differential between the Loan Rate and the CD Rate	0.411	1.549	-2.899*	-15.38*

* denotes significance at the 5 % level
** denotes significance at the 10 % level

Sample Period: December 1982 - June 1991; Monthly Data
Autocorrelation Correction = 12 Lags

	Constant	Trend	ADF	Z
First difference of:				
Differential between the Loan Rate and the Mortgage Rate	-0.055	-0.436	-2.231*	-6.664*
Relative Bank Share Price Variance	0.2	0.643	-2.112*	-2.721*
Second Difference of:				
(Log of) Business Credit	2.646	-2.712**	-3.726*	-44.797*
(Log of) Broad Money plus Banks' Capital	-0.704	-1.293	-3.709*	-23.242*

Sample Period: December 1976 - December 1991; Quarterly Data
Autocorrelation Correction = 5 Lags

	Constant	Trend	ADF	Z
Level of:				
(Log of) Business Credit	1.997	2.3301	-2.338*	0.211
(Log of) AFI Credit	1.503	2.449**	-0.146	0.794
(Log of) Nominal Investment	1.702	1.806	-0.692	-1.390
(Log of) Total GDP	1.698	2.241	0.857	0.039
The Loan Rate	3.947*	1.955	-3.357*	- -
First Difference of:				
(Log of) Business Credit	0.67	-1.09	-1.257	-1.486
(Log of) AFI Credit	1.326	0.189	-1.215	-1.589
(Log of) Nominal Investment	-0.157	-1.373	-1.007	-5.989 *
(Log of) Total GDP	1.64	-0.135	-0.743	-5.259*
The Loan Rate	0.171	-1.257	-3.156*	- -

* denotes significance at the 5 % level
** denotes significance at the 10 % level

Sample Period: December 1976 - December 1991; Quarterly Data
Autocorrelation Correction = 5 Lags

	Constant	Trend	ADF	Z
Second Difference of:				
(Log of) Business Credit	-0.703	-1.683	-0.835	-8.277*
(Log of) AFI Credit	-0.528	-1.287	-1.234	-7.669*
(Log of) Nominal Investment	-0.697	-1.161	-3.655*	-25.748*
(Log of) Total GDP	-0.142	1.097	-3.799*	-22.148*

* denotes significance at the 5 % level
** denotes significance at the 10 % level

DATA APPENDIX

Lending to Business - RBA Bulletin, Table D.4, Credit by all financial intermediaries - other (mainly business). This data is adjusted for seasonality and breaks in the series resulting from changes in reporting forms, conversion of building societies to banks and the like.

Total AFI Credit - RBA Bulletin, Table D.4 Credit by all financial intermediaries - total (seasonally adjusted).

Broad Money (seasonally adjusted) - RBA Bulletin, Table D.1.

Bank Capital - All banks' assets less all banks' liabilities, RBA Bulletin Table B1.

The Loan Rate - RBA Bulletin, Table F.3, Overdrafts $100 000 and over (maximum).

Weighted Cost of Funds - Calculated using RBA Bulletin data and internal RBA data. See Lowe and Rohling (1992).

The Mortgage Rate - RBA Bulletin, Table F.3, Housing loans to individuals for owner-occupation.

The Rediscount Rate for Treasury Notes - RBA Bulletin, Table F.1, Rediscount rate.

The Certificate of Deposit Rate - RBA Bulletin, Table F.3, Weighted average issue yield.

The Treasury Note Rate - RBA Bulletin, Table F.1, Issue yield on 13 week Treasury notes.

The Bill Rate - RBA Bulletin, Table F.1, Bank accepted bills, 90 days.

All Ordinaries Share Price Index - RBA Bulletin, Table F.5.

Banks Share Prices - Banks/Finance Share Price Index -- RBA Bulletin, Table F.5.

Relative Bank Share Price Variance - The ratio of the standard deviation (taken over the past two years observations) of the Banks/Finance Share Price Index and the standard deviation of the All Ordinaries Share Price Index.

Corporate Net Worth - RBA Bulletin, Table F.5, Market capitalisation of listed equities at end of month.

The earnings/price ratio - Monthly Index Analysis, Australian Stock Exchange. The ratio is adjusted by expected output growth to obtain a measure of the true cost of equity finance. Expected output growth is proxied by the rate predicted by a thirteenth-order autoregressive model. See Richards (1991).

Expected Investment - Confederation of Australian Industry and Westpac Banking Corporation Survey of Industrial Trends. Net balance of survey respondents expecting to increase capital expenditure (plant and machinery and buildings) in the next 12 months. Quarterly data interpolated to monthly data by fitting a straight line between each quarterly observation.

Inflation - expected inflation based on the Total Consumer Price Index (monthly figures obtained by interpolating quarterly data, assuming the growth rate of prices during each quarter is constant). Expected inflation is calculated as the rate predicted by an eighth order autoregressive model.

Activity - Non-Farm GDP (Seasonally Adjusted) -- RBA Bulletin, Table G.5.

Nominal Investment - Business Fixed Investment (Seasonally Adjusted) -- RBA Bulletin, Table G.5.

Monthly figures for activity were obtained by interpolating quarterly data, assuming that growth is constant throughout each quarter, and constraining the sum of the three months' activity (investment) in each quarter to be equal to the total quarter's activity (investment).

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