MONETARY POLICY, CREDIT RATIONING AND UNCERTAINTY

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ABSTRACT

The objectives of this thesis are to assess contemporary Keynesian descriptions of the monetary policy transmission mechanism, with particular reference to credit rationing, to Australia's experience with deregulated financial markets and the allocation of credit; and to discuss the implications thereof for financial stability and the conduct of monetary policy and prudential control in Australia.

The views of neo-Keynesian, New Keynesian and post Keynesian economists with respect to the monetary policy transmission mechanism are compared and contrasted. Granger causality tests are undertaken to determine whether there is any basis, in fact, for preferring one description of the monetary policy transmission mechanism over the others in Australian financial markets. All of the Keynesian descriptions of the transmission mechanism are shown to be inadequate to their task, at least when applied to financial markets in Australia.

Because it was believed that, once financial markets were deregulated in Australia, interest rates would adjust to clear the market for loans and no credit directives would be issued, credit as a component of the transmission mechanism has largely been ignored. I explore whether credit rationing is a component of the monetary policy transmission mechanism in Australia using maximum likelihood estimates of loan supply and loan demand in the business and personal loan markets. I also show that banks have improved their ability since deregulation to set the interest rate which maximises profits when taking into account the effect of a change in interest rates on

borrowers' probabilities of default. This is the interest rate at which the loan supply schedule becomes backward bending so that non-price credit rationing may set in. Thus, the empirical work with respect to the bank-optimal interest rate provides additional support for the non-price credit rationing hypothesis when applied to Australian financial markets.

The conditions under which non-price credit rationing occurs may be important. Post Keynesians, in general, argue that economic agents do not act upon the basis of rational expectations because conditions are fundamentally uncertain. In contrast, neo- and New Keynesians argue that economic agents profit maximise and utility maximise upon the basis of well defined probability distributions. I argue that both views are flawed. Greater understanding of the behaviour of agents in financial markets including that to do with credit rationing and the allocation of credit can be achieved if we allow for the spectrum of behaviours which occur when conditions are merely risky to those which occur when conditions are fundamentally uncertain. As conditions in financial markets become increasingly uncertain, economic agents resort to 'rule-governed' behaviour so that non-price credit rationing arises. My analysis provides a tighter behavioural foundation than currently exists for some of the post Keynesian analysis with respect to credit markets, and for how decision-making is viewed more generally in post Keynesian analysis.

The previous analysis is then followed by a consideration of the interrelations between financial instability, decision-making under uncertainty and non-price credit rationing; and the implications thereof for monetary policy and prudential control in Australia.

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by any other person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Penelope Nancy Neal

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As I worked on this thesis, I submitted two papers derived from chapters in this thesis to the *Journal of Post Keynesian Economics* and *Australian Economic Papers.* I am grateful to referees from those journals for comments on those papers.

Chapter 1 Introduction

1.1 Introduction

The original motivation for this study was an interest in the 'political economy' of monetary policy and the transmission mechanism. That is not to say that this thesis is entirely, or even mostly, an essay in political economy. Indeed, much of it is based upon empirical work which seeks to gain an understanding of how the monetary policy transmission mechanism works in Australian markets since financial deregulation. When one reads in the area of monetary economics, one is struck by the variety of approaches to the analysis of monetary policy. To restrict the field of study, I focus on theories of the monetary policy transmission mechanism as argued by proponents of contemporary Keynesian perspectives; these being the neo-Keynesian, New Keynesian and post Keynesian schools of thought; and, in empirical work, concentrate upon the way in which credit is allocated and monetary policy is conducted in a deregulated financial system with particular reference to Australia. Even though the analysis is restricted to 'Keynesian' views, there are widespread divergences between the Keynesian schools of thought as to the ways in which monetary policy is conducted and transmitted. It seems to me that if one particular viewpoint is more adequate to the task of description of the transmission mechanism it purports to represent and has more predictive power, then perhaps the policy recommendations of that particular viewpoint deserve more serious consideration than other viewpoints which have less descriptive and predictive content. If policymakers can exploit the descriptive and predictive powers of a particular theory, then they are part way towards achieving their ends.

In summary, the objectives of this thesis are to assess contemporary Keynesian descriptions of the monetary policy transmission mechanism, with particular reference to credit rationing, to Australia's experience with deregulated financial markets and the allocation of credit; and to discuss the implications thereof for financial stability and the conduct of monetary policy and prudential control in Australia. In addition, I attempt in this thesis to reconcile the New Keynesian and post Keynesian explanations of credit rationing in a more general theory of choice than currently adhered to by either school of thought, but in a way which is more appropriate to description of the actual behaviour of agents in financial markets.

1.2 Keynesian perspectives on the monetary policy transmission mechanism

The neo-Keynesians and New Keynesians both emphasise the causal process in the transmission mechanism as running *from* changes in money *to* changes in activity with changes in interest rates along the way. The policy instrument is base money. The transmission mechanism in contemporary neo-Keynesian monetary economics places emphasis on a Tobin-like portfolio balance approach where a change in monetary policy affects the rates of return in a portfolio of financial assets differentially so that monetary policy provides incentives for asset holders to rearrange their portfolios in a way that policymakers desire. For example, monetary policy may be able to reduce the rate of return on bonds and increase the rate of return on equities, so that assetholders demand less of the former and more of the latter with the result that real private investment should increase.

New Keynesians place emphasis on credit rationing as a channel additional to changes in money through which monetary policy can be transmitted even in a deregulated financial environment. They argue that, because borrowers and lenders have asymmetric information, adverse selection and adverse incentive effects can cause there to be such an increase in the probability of default when there is a rise in interest rates, that it may not be profitable for a lender to raise interest rates even when there is an excess demand for loans. The additional interest income may be insufficient to compensate the lender for any increase in risk.

Post Keynesians also argue that credit rationing is a channel through which the effects of monetary policy are transmitted. More importantly, and in contrast to the other Keynesian schools of thought, post Keynesians argue that the money supply is endogenously determined by the demand for money, so that the monetary policy transmission mechanism runs *from* changes in interest rates *to* changes in activity. The policy instrument is the short-term interest rate. The monetary aggregates have no fundamental place in the transmission mechanism. Any changes in monetary aggregates in response to changes in the demand for money depend upon the willingness of central banks to accommodate the changes. The post Keynesians themselves have divided into two major camps: those, termed *accommodationists*, who believe that the central bank is able to exogenously determine the short-term interest rate from which changes in other interest rates will follow and who believe that the central bank will fully accommodate any increases in the demand for money at this interest rate in the interests of maintaining the stability of the financial system; and those post Keynesians, termed *structuralists*, who believe that although the central bank can influence the short-term interest rate, it may not be prepared to fully accommodate so that market forces may bring about changes in interest rates independently of central bank actions; or alternatively that the assumption of increasing risks either by borrowers or lenders will increase interest rates even when the central bank is prepared to fully accommodate.

There is another major division between neo- and New Keynesians on one side, and post Keynesians on the other side, which applies to all areas of economics, but is of interest to us in this thesis when applied to monetary economics. That is in the treatment of risk and uncertainty. Neo- and New Keynesian analyses regard economic agents as utility maximising and profit maximising beings who base their behaviour on rational expectations and probabilistic assessments of risk. In contrast, post Keynesians argue that many economic decisions must be made in conditions of fundamental uncertainty. That is, many, or all decisions, in the case of the extreme post Keynesian view, must be made on the basis that participants do not know the objective probabilities upon which their behaviours should converge for consistency with rational expectations, and so can not behave 'as if' they know the true structure of the model. In these cases, economic agents must resort to other modes of decision-making, for example, conventions, rules of thumb, habit or whim.

In this thesis, I argue that the two views - the rational expectations view adopted by many proponents of neo- and New Keynesian monetary economics, and the fundamental uncertainty view adopted by proponents of post Keynesian monetary economics - should be regarded as the two extreme positions of a more general decision theory which incorporates a spectrum of behavioural choice. Decisions must *sometimes* be made in circumstances when there is no objective basis whatsoever on which to base the decision as argued by the post Keynesians, but there are many routine decisions for which there are plenty of objective criteria. The task is to determine the conditions under which behaviour moves from being governed by these routine decisions to being governed by the other modes of decision-making referred to above - conventions, rules of thumb, habits and whims. It appears that decisions become less routine and behaviour less flexible when conditions become increasingly uncertain. I consider the implications for the behaviour of participants in financial markets of this more general theory of choice, and then apply the theory to analysis of the determinants of financial instability.

1.3 Credit

There is an emphasis on credit throughout this thesis as being more important to the monetary policy transmission mechanism than money *per se*. This emphasis arises for several reasons. First, financial deregulation in Australia saw a huge and unexpected increase in the volume of credit made available, particularly for business loans, but also to a lesser extent for housing and personal loans. Many Keynesians would argue that it is access to finance, rather than the volume of money, that is important to the level of economic activity. Without access to credit, many firms would be unable to finance their working capital needs, or be able to undertake investment expenditures. Many firms, because of their small size are unable to access the capital markets and so are restricted to the use of retained earnings or borrowed funds for these purposes.

Thus, without access to credit, many projects with positive net present values would not be undertaken, imposing welfare costs on society. Nevertheless, borrowed funds can be applied to uses other than those with positive net present values. At times of rising asset prices, it is often attractive to borrow funds for the purposes of speculation. If one expects capital gains from an asset such as property or shares, then it is profitable to borrow monies to build or purchase the asset for subsequent resale at higher prices. If many others are doing the same, then prices will quickly rise and the promise of capital gains will be fulfilled. The problem arises when some participants attempt to 'make position' creating an excess supply of assets on the market at the prevailing market price, forcing prices down. The consequence is that many others who had borrowed on the expectation that the rise in prices would enable them to service their debts find themselves unable to do so. Because the prices of assets are falling, so too is the value of collateral and many firms find it harder to borrow to meet their finance commitments when it is most necessary. Thus, an increase in the volume of credit in the early stages of a cycle may lead to endogenous instability in the latter stages of a cycle if some firms renege on their debts. Lenders who had previously refused to lend because of reduced profit expectations may now find themselves unable to lend as bad and doubtful debts eat into their reserves. In the extreme, some lenders may become insolvent. To some extent, this is what happened in Australia in the late 1980s and early 1990s as a consequence of financial deregulation and the resultant ease of access to credit. Few would argue that it was the quantity of money rather than the volume of credit that led to asset price inflation and subsequent recession.

Second, although the volume of credit is not perceived by neo-Keynesians to have a major role in the monetary policy transmission mechanism,[1] it is important to the New and post Keynesian explanations of the transmission mechanism. Neo-Keynesians thought that, once regulatory impediments were removed, lenders would raise interest rates to compensate for making riskier loans so that non-price credit rationing would no longer exist. As explained above, New Keynesians argue that, because borrowers and lenders have asymmetric information, adverse selection and adverse incentive effects can cause there to be such an increase in the probability of default when there is a rise in interest rates, that it may not be profitable for a lender to raise interest rates even when there is an excess demand for loans. The additional interest income may be insufficient to compensate the lender for any increase in risk. Thus, even in deregulated financial markets, non-price credit rationing may still exist. That is, there may be an excess demand for loans even though some potential borrowers are willing to pay higher interest rates. Some post Keynesians also appeal to asymmetric information and adverse selection and adverse incentive effects as explanations of non-price credit rationing. Others appeal to the conventions that are used to guide lending decisions when lenders are faced with fundamental uncertainty. In either case, credit rationing is still an additional part of the monetary policy transmission mechanism even in deregulated financial markets. One of the questions to be addressed in this thesis is whether non-price credit rationing has existed in Australia since deregulation of the financial markets, and whether it has arisen due to the reasons cited by the New and post Keynesians. A further question is related to the macroeconomic significance of non-price credit rationing. Even if non-price credit

[1]Neo-Keynesians tend to emphasise the changing price of credit which results from the change in the money supply.

rationing exists, is it of sufficient magnitude to have much effect on the macroeconomy?

Implicit contract theory also provides a rationale for non-price credit rationing. Credit rationing may arise as a result of risk-sharing behaviour between banks and their clients which may lead to the formation of implicit contracts. Provided that the costs of lending to different classes of customers differ, two important theorems have been derived by the proponents of implicit contract theorems. The first is that, for each class of customer, the bank's profit maximisation problem leads the bank to charge the borrower a stable loan interest rate which once granted is invariant to some range of subsequent changes in the bank's cost of funds. Second, the utility available to the customer when he is not credit rationed depends, in part, upon his being able to obtain a loan at an interest rate which remains stable even when the cost of funds to the bank deviates from the expected cost of funds. Being able to obtain a loan at a stable interest rate, even when the cost of funds to the bank varies, causes the borrower's utility to be greater than the utility available to him should he negotiate loans on spot markets but it also gives rise to the possibility of the borrower being credit rationed. As implicit contract theory is based on the maxims of profit maximisation and utility maximisation, and as it also relies on interest rate rigidity to generate non-price credit rationing, it is easily encompassed by New Keynesian economics; although to date the New Keynesians have seemed to apply implicit contract theory to the analysis of labour markets whilst largely ignoring its role in credit markets.

A third important reason for the emphasis on credit as a major component of the monetary policy transmission mechanism in this thesis is that it currently seems to be one of the variable's upon which the Reserve Bank of Australia focuses its attention. In fact, monetary policy actions seem to be dominated to some extent by what is happening in credit markets. For example, lending for housing boomed in 1994 and the Reserve Bank responded with three increases in interest rates between August and December 1994, even though there was little evidence to the effect of price increases in that market, or in the economy more generally. In the latter part of 1994 and in early 1995, it was clear that GDP was growing at a faster rate than the monetary authorities desired, so that tighter monetary policy was an appropriate action, but the *initial* spur to tighten monetary policy was the volume of credit being made available for housing.[2]

1.4 Outline of thesis

Chapter 2 is a brief chapter which sets the scene. It is largely descriptive and provides a brief Australian history of the evolution of monetary policy and the allocation of credit, moving quickly through a description of regulations and quantitative controls, monetary targeting, the checklist approach and open market operations with reference to the school of thought which appears to have had most influence on the Reserve Bank's method of monetary policy implementation as monetary policy has evolved in Australia since the late 1970s. Chapter 2 also seeks to illustrate the Australian empirics of credit, activity and interest rates both pre- and post-deregulation. As most of this is already well documented, other than providing a brief background, I

[2] In his statement on the 17 August 1994 when monetary policy was tightened for the first time in 5 years, Mr Bernie Fraser, the Governor of the Reserve Bank of Australia (Reserve Bank *Bulletin*, September 1994, p. 23), stated "[a]ggregate credit is now growing at a pace consistent with sustained expansion in economic activity. It is, however, unbalanced credit growth, in that lending for housing has been increasing rapidly while lending for business has only just begun to rise."

concentrate on drawing out what at first glance appear to be surprising features of the empirics, for example, the extremely high rate of credit growth and the high positive correlation between interest rates and activity even when one allows for lags in the post-deregulation environment. By examining the changes in credit and interest rates and their relations to economic activity, we can rid ourselves of any predetermined ideas with respect to the relations that are inconsistent with the facts and see what features of the monetary policy transmission mechanism require further explanation. As the primary focus of this thesis is with respect to deregulated financial markets, and as the Reserve Bank has not effectively treated the money supply as part of the transmission mechanism since the early 1980s, I do not pursue the relations between money and activity in Chapter 2 although I address the issue in Chapter 3.

In Chapter 3, the views of neo-Keynesian, New Keynesian and post Keynesian economists with respect to the monetary policy transmission mechanism are compared and contrasted. The chapter then presents results based upon Granger causality tests to determine whether there is any basis, in fact, for preferring one description of the monetary policy transmission mechanism over the others in Australian financial markets. Although there have been other empirical studies with respect to how monetary policy is transmitted in Australian financial markets, none of them has sought to compare the competing views, to discover whether some theoretical basis is more appropriate than another. If there is some basis for preferring one description of the monetary policy transmission mechanism over the others, then it would perhaps be wise to concentrate on the policy recommendations of economists from that particular group. Unfortunately, the evidence of Chapter 3 shows that all of the Keynesian descriptions of the transmission mechanism are inadequate to their task, at least when applied to financial markets in Australia. This suggests that the transmission of monetary policy, as it is currently practised in Australia, is ill-understood.

Because it was believed that, once financial markets were deregulated in Australia, interest rates would adjust to clear the market for loans and no credit directives would be issued, credit as a component of the transmission mechanism has largely been ignored. In Chapters 4 and 5, I explore whether credit rationing is a component of the monetary policy transmission mechanism in Australia. In Chapter 4, I concentrate on the theoretical explanations put forward by the New Keynesians based on asymmetric information, and that based on implicit contract theory which I believe is perfectly consistent with New Keynesian monetary economics but which is largely neglected by economists of this school. Some consideration is given to the extent to which collateral can overcome the problem of non-price credit rationing. Post Keynesian theory with respect to credit rationing is also surveyed. As the Campbell Committee took the neo-Keynesian view that the removal of regulatory controls from banks would eliminate non-price credit rationing, Chapter 5 considers the implications of the non-price credit rationing hypothesis for empirical work. Empirical tests based upon the technique of maximum likelihood estimation are carried out for the Australian business and personal loan markets. I conclude that there has been little evidence of non-price credit rationing in the business loan market in Australia since 1986, by which time almost all regulatory impediments other than those relating to prudential requirements had been removed from financial markets, but that there has been some non-price credit rationing in the personal loan market, although one needs to be somewhat wary of the latter results as the demand equation for personal loans is not at all well specified. Nevertheless, it is in the area of business loans that there has been a huge increase in the volume of credit followed by a huge downturn; and so it is on business loans that changes in monetary policy will be most likely to have the greatest impact. That is, changes in monetary policy are likely to be largely transmitted to the real economy through their impact on business loans.

The empirical work of Chapter 5 also shows that banks have improved their ability since deregulation to set the interest rate which maximises profits when taking into account the effect of a change in interest rates on borrowers' probabilities of default. This is the interest rate at which the loan supply schedule becomes backward bending so that non-price credit rationing may set in. Thus, the empirical work with respect to the bank optimal interest rate provides additional support for the non-price credit rationing hypothesis when applied to Australian financial markets.

The conditions under which non-price credit rationing occurs may be important. Post Keynesians, in general, argue that economic agents behave as though conditions are fundamentally uncertain as opposed to merely being risky. This presupposes that agents, including those in financial markets, do not act upon the basis of rational expectations. In contrast, neo- and New Keynesians argue that economic agents profit maximise and utility maximise upon the basis of well defined probability distributions. In Chapter 6, I argue that both views are flawed. Greater understanding of the behaviour of agents in financial markets including that to do with credit rationing and the allocation of credit can be achieved if we attempt an integration of the models so that we allow for the spectrum of behaviours across conditions which are merely risky to those which are fundamentally uncertain. The analysis of Chapter

6 indicates that as conditions in financial markets become increasingly uncertain, economic agents resort to 'rule-governed' behaviour so that non-price credit rationing arises.

Chapter 7 then considers the interrelations between financial instability and decision-making under uncertainty. It does this by first applying the model of decision-making under uncertainty generated in Chapter 6 to a discussion of Minsky's financial instability hypothesis and Wray's work on financial instability and credit rationing. These are discussed with reference to episodes of financial instability in Australia in the late 1980s. Finally, the implications of the earlier analysis for monetary policy and prudential control in Australia are drawn out in Chapter 8.

I consider that Chapters 4, 5 and 6 to do with non-price credit rationing are the core chapters of my thesis and that the principal contributions to the literature arise from Chapters 5 and 6.[3] However, credit rationing is only one part of the monetary policy transmission mechanism and it may only be a small part. Thus, other chapters consider the transmission mechanism more generally and consider the implications of these core chapters for financial fragility and systemic stability. Preceding all of these chapters is a brief Australian history of monetary policy since the 1970s.

[3] During the preparation of this thesis, I have submitted two papers based on Chapters 4,5 and 6 to journals. The first paper is a shortened version of Chapter 6 titled 'Keynesian Uncertainty in Credit Markets' and this paper is to be published in the *Journal of Post Keynesian Economics*, Spring 1996, Vol. 18, No. 3, pp. 397-418. The second paper is based on material from Chapters 4 and 5, especially Chapter 5, and is titled 'The Effect of Changes in Bank Loan Interest Rates on the Probability of Default'. The editors of *Australian Economic Papers* have indicated that they are prepared to consider a revised version of this paper.

Chapter 2 The Evolution of Monetary Policy: A Brief Australian History

2.1 Introduction

The purpose of this chapter is to provide empirical background material to the rest of this thesis. It first summarises briefly the evolution of Australian monetary policy since the late 1970s with reference to the schools of thought which had most influence on each policy change. Deregulated financial markets ultimately led the Reserve Bank to the determination of short-term interest rates as the instrument of monetary policy, in the manner described by post Keynesian monetary economists. Second, the chapter discusses the huge increase in the volume of credit since financial markets have been deregulated, and refers briefly to the asset price inflation and consequent instability in financial markets which occurred in the late 1980s and early 1990s. Third, the chapter discusses the relations between credit and interest rates, and GDP and private final demand and interest rates. Since the Reserve Bank has been using interest rates as the instrument of monetary policy, changes in credit, GDP and private final demand have become highly positively correlated with changes in interest rates in contrast to regulated markets where the correlations were negative when interest rates were lagged. The high positive correlations in deregulated financial markets beg some questions with respect to the transmission mechanism of monetary policy, a topic which is addressed in Chapter 3.

2.2 The evolution of monetary policy in Australia[1]

In the 1970s, the Reserve Bank sought to implement monetary policy by controlling changes in the money supply as measured by M3. The Reserve Bank did this by requiring that a certain proportion of deposits be kept in statutory reserve deposits to be held with the Reserve Bank (the SRD ratio). The Reserve Bank also required that a certain proportion of deposits be kept as specified liquid assets and government securities (the LGS ratio). Monetary policy was implemented with either a change in the SRD ratio, which had the effect of changing the size of the credit multiplier so that the money supply changed, or by an open market purchase or sale of Commonwealth Government securities. The intent was to change the money base and thus the money supply, a description consistent with the neo-Keynesian view of money supply determination. Other regulations imposed on the banking system included maxima on interest rates payable on deposits and on interest rates charged on loans. Some quantitative lending restrictions were also imposed. These regulations curtailed the deposit and loan activity of the banks, and caused disintermediation frustrating the intentions of the Reserve Bank with respect to the volume of money. In addition, the exchange rate system was that of a crawling peg, a system closely analagous to a fixed exchange rate system. This meant that changes in the foreign exchange reserves of the Reserve Bank deriving from changes in the balance of trade and capital flows had, at times, a great impact upon the volume of money through increasing the money base as

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[1] I have previously described the evolution of monetary policy in Australia in Rogers and Neal (1994, pp. 261-270). The evolution of monetary policy in the 1980s is discussed in more detail in Milbourne (1990).

in 1972-73 when, because of a large trade surplus, M3 increased by 25 %. That wide-ranging regulations were used in financial markets in Australia in the 1970s is consistent with the neo-Keynesian view that policy intervention in financial markets is appropriate.

In the early 1980s, as a result of the recommendations of the Campbell Committee, whose task it was to report on the regulation and control of the financial system and in particular to consider whether regulations should be extended to cover the whole of the financial sector or whether the banking system should be deregulated, many of the regulations imposed upon banks were removed. Banks were able to determine interest rates on deposits and on most loans. Quantitative lending restrictions were abolished. The removal of these restrictions enabled the banks to pursue increased market share through the expansion of credit. That the banks expanded credit on a grand scale was very important to the subsequent history of banking in the 1980s and into the 1990s. The banks changed from having a fairly passive role in asset management to actively being able to engage in both asset and liability management. The banks could actively seek deposits from which they could fund increased loans. The exchange rate was allowed to float from December 1983. Controls on capital flows were largely abolished. The monetarist view that market mechanisms should be allowed to freely operate in financial markets replaced the neo-Keynesian prescription of wide-ranging regulations.

In December 1979 and in June 1982 tender systems replaced the previous "tap" systems for the sale of Treasury Notes and the sale of Treasury bonds respectively. Under the tender system, the Treasurer determines the timing and quantity of bond sales but financial market participants bid for bonds and so determine the price from which the Reserve Bank calculates average yields. Monetary policy came to be seen as more market oriented than the previous tap system where securities had been offered at fixed yields. That the Reserve Bank can choose to reject some bids, and so influence the price of Commonwealth Government securities, raises doubts as to whether yields are, in fact, market determined.

Concern about high inflation rates in the second half of the 1970s led to the adoption of monetary targets in Australia in 1976. These targets were announced conditional projections for M3 that were indications of the growth in M3 which, at the time, seemed consistent with the Budget. Monetary targeting was based on the revival of the quantity theory of money attributable to Milton Friedman and the rise of monetarism which occurred around the world. Targeting assumed a stable income velocity of circulation. If the income velocity of circulation was stable, any increase in the money supply in excess of the growth rate of real output would lead to inflation. Thus, limiting the rate at which the money supply could grow would limit the inflation rate, and importantly, in addition, cause inflationary expectations to subside. Disintermediation and subsequent reintermediation meant that velocity was not stable. In fact, the velocity of M3 was highly variable as funds first flowed away from, and then flowed back to, the banking system. Monetary targeting was not successful and was formally abandoned in January 1985, although effectively it had been abandoned much earlier.

Following the official abandonment of monetary targets, the Reserve Bank adopted a checklist approach to the implementation of monetary policy. The checklist comprised, *inter alia*, all the monetary aggregates, interest rates, the exchange rate, external accounts, the current performance and outlook for the economy, including movements in asset prices, inflation, the outlook for inflation and market expectations about inflation. Although no explicit reference to the checklist approach has been made in recent years, it seems from the statements made by the Governor of the Reserve Bank at times when the Reserve Bank changes official cash rates that the checklist approach still dominates determination of monetary policy changes. (See, for example, Reserve Bank of Australia, *Bulletin*, September 1994, p. 23, where the statement that monetary policy is to tighten is based upon described developments in overseas interest rates, output in Australia, employment, unemployment, capacity utilisation, household spending, business investment, aggregate credit, housing and business credit, and inflation.) The checklist approach reflects a discretionary and interventionist approach rather than a rules approach to monetary management. Keynesian policy again came to the fore.

The Reserve Bank's current procedure when it wishes to implement changes in monetary policy is to announce that it intends to operate in the financial markets in order to bring about a change in the cash rate equal to some number of percentage points. It carries out the operation through the purchase or sale of previously issued Treasury Notes. The explicit intention of the Reserve Bank at times of monetary policy changes is to cause there to be an exogenous change in interest rates; it is not to bring about some desired change in the money supply. The former is the post Keynesian description of monetary policy operations. Neo-Keynesian interventionist policies through regulation and determination of the money base; and monetarist free market and money growth rules have come to be replaced with Reserve Bank operations on short-term interest rates. All of the post Keynesian monetary economists argue that, because central banks operate through changing short-term interest rates, they must accommodate changes in the demand for money at the central bank's chosen rate of interest.

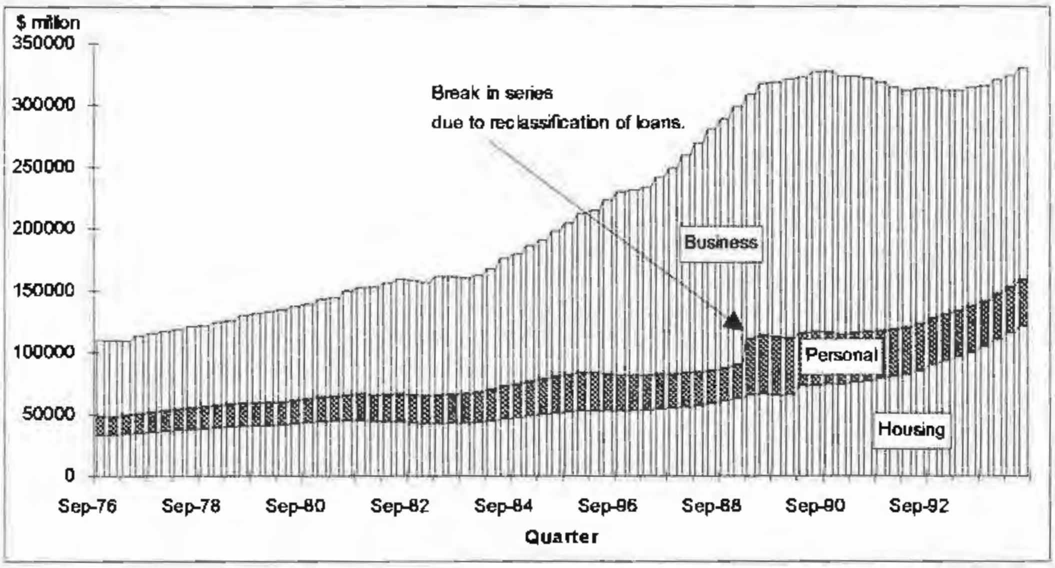
It seems then that there were at least three changes in monetary regime in Australia in the 1980s. First, the decade started with a large number of regulations imposed on the banking system, a crawling peg exchange rate, implementation of monetary policy via changes in the SRD ratio and a tap system for the issue of Commonwealth government securities. The monetary policy transmission mechanism was supposed to run from changes in the money base to changes in activity and prices in the way described by the neo-Keynesian and New Keynesian schools. Second, by 1984 most regulations were removed from the banking system, exchange rates were floating and a tender system for the issue of Commonwealth government securities was in place. Interest rates were supposedly being determined by financial markets. However, transmission was still believed to be from money to activity and prices. Third, by the late 1980s, and following a massive expansion in credit, the Treasurer was admitting that the Reserve Bank rather than financial markets were determining short-term interest rates, indicating that by that time it was believed that transmission ran from interest rates to activity, in the way that the post Keynesian school describes. Credit aggregates came to have a heavy weight in the list of variables that the Reserve Bank cited when implementing changes in monetary policy, although the Reserve Bank claims that it does not treat credit aggregates as an intermediate target of monetary policy. Fraser (October 1994, p. 20) stated: "Monetary and credit aggregates may still contain useful material, including corroborative information about turning points in nominal demand, or about structural developments (such as changes in debt levels in particular sectors). We continue to scrutinise them in that light; we do not believe, however, that they can be elevated to the status of an intermediate target for monetary policy."

In contrast to the stated position of the Reserve Bank, both the New Keynesian and post Keynesian schools argue that a credit or loans channel is an important part of the monetary policy transmission mechanism; the former arguing that it is in addition to the money channel, and the latter that it is in addition to the interest rate channel. Following discussion of the massive expansion in the volume of credit once financial markets were deregulated; Chapter 3 discusses further the various Keynesian descriptions of the transmission mechanism and reports the results of Granger causality tests to determine whether any of the Keynesian descriptions of the transmission mechanism are appropriate to the Australian situation, both before and after financial markets were deregulated.

2.3 The explosion of credit

One of the most startling features of the financial sector in Australia in the 1980s was the very rapid expansion of credit. The amount of credit outstanding, *in real terms*, tripled between 1976 and 1994. Between 1984, when deregulation of financial markets was virtually complete, and 1990, a period of only six years, the value of credit outstanding doubled. Prior to the early 1980s, interest rate restrictions imposed on banks meant that they were limited in both what they could charge for loans and what they could pay on depositors' funds restricting growth in both loans and deposits, a source of funds for loans. Banks were also constrained from time to time by quantitative lending guidelines on the amount that they could lend for certain purposes, for example, housing. The removal of these restrictions saw a massive increase in the rate of credit expansion. Figure 2.1 shows how the expansion in credit in 1989-90 prices was divided between credit for housing, personal and business uses. Most of the expansion was in business credit.

Figure 2.1 *The volume of credit in 1989-90 prices (September quarter 1976 - June quarter 1994)*



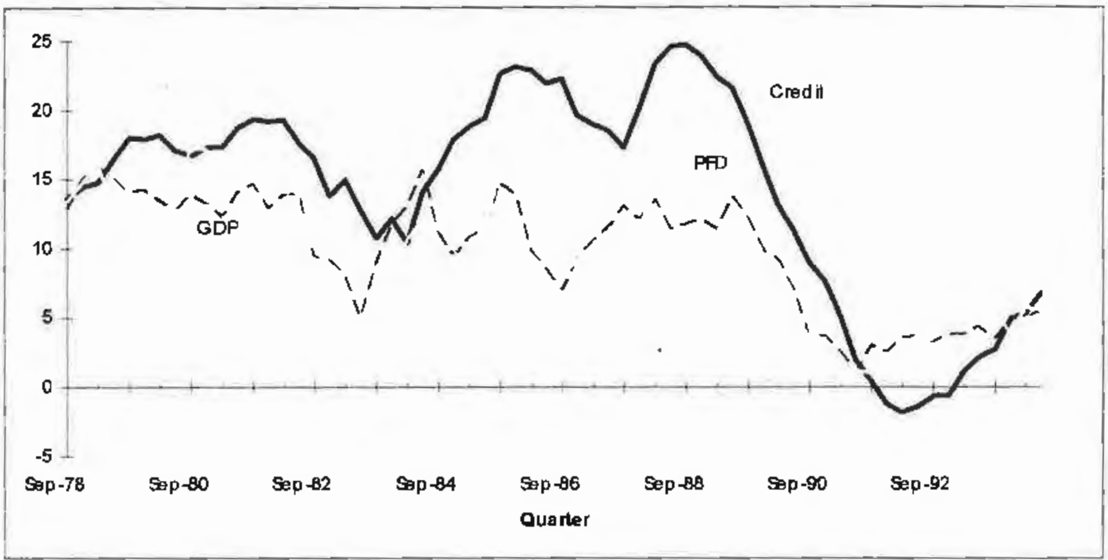
Sources: dX database and Reserve Bank of Australia, *Bulletin*, various issues.

It had, of course, been anticipated by the Campbell Committee's *Inquiry Into the Australian Financial System* (1981) that credit would expand as a result of financial deregulation. What had not been anticipated was the scale of expansion. Interest rate and quantitative lending restrictions had caused many potential borrowers to be credit rationed. With the removal of restrictions, it was thought that banks would be able to raise interest rates to riskier borrowers so that the market for loans would clear. Non-price credit rationing was to be eliminated. Whether elimination of non-price credit rationing occurred is the subject of Chapter 5 of this thesis. With hindsight, it is clear that interest rates were not sufficiently high to offset the increased risks of default that banks faced when they made a large number of additional loans to riskier borrowers. Because of increased competition in the deregulated environment, many of the banks had explicit policies to pursue increased market share at the expense of increased short-run profitability. This caused certain state banks, the State Bank of South Australia (SBSA) and the State Bank of Victoria (SBV), to have such serious financial difficulties, that in the case of SBSA, it had to have several injections of capital from the South Australian government which ultimately totalled $3 billion, and the SBV had to be sold to the Commonwealth Bank. The policy of increasing market share at the expense of profitability also caused some of the major commercial banks to experience a massive increase in bad and doubtful debts. Credit expansion had other macroeconomic consequences: asset price inflation in the late 1980s and the subsequent tightening of monetary policy which led to recession in the early 1990s.

Also not expected by the Campbell Committee as a result of financial deregulation was the consequent volatility in interest rates and exchange rates. This volatility contributed to the instability experienced by the financial sector in the latter part of the 1980s, to be discussed in Chapter 7 of this thesis.

Credit expansion was not associated with nearly as great an expansion in either GDP or in private final demand (PFD) which is defined, as in Bullock, Morris and Stevens (1989), as the sum of private consumption expenditure and private gross final capital expenditure. Figure 2.2 illustrates the annual percentage change in total credit against the annual percentage changes in GDP and PFD in real terms. Until financial markets were deregulated credit expansion was generally slightly in excess of the expansion of activity for the period for which credit data are available. From 1984 until 1989 the rate of credit expansion was far in excess than that of either GDP or PFD.

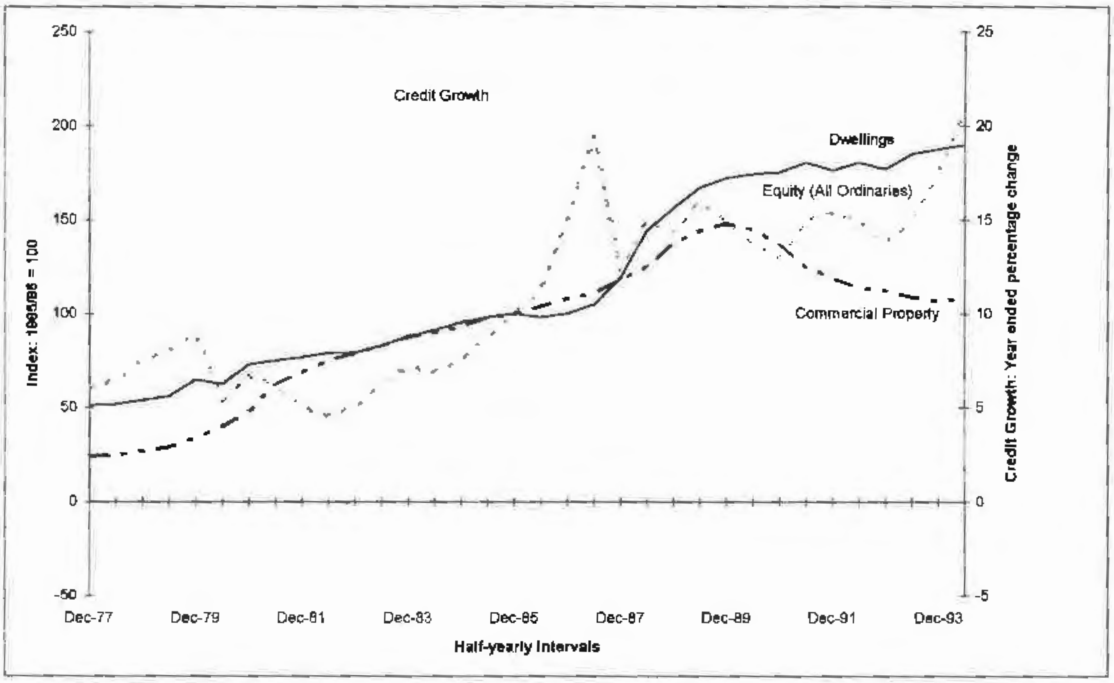
Figure 2.2 *Credit and activity at 1989-90 prices: four quarter percent change (September quarter 1977 - June quarter 1994)*



Sources: dX database and Reserve Bank of Australia, *Bulletin*, various issues.

The problem with the credit expansion of the 1980s was that much of it financed speculative activity. It is unlikely that the asset price inflation in the stock market, and then in the housing and commercial property markets would have occurred in the absence of such rapid credit growth. Figure 2.3 illustrates the annual percentage change in total credit against the all ordinaries share price, dwellings and commercial property price indices. The marked ascent in share prices from 1984 to 1987 was preceded by a 13 percentage point increase in real credit growth from 1984. The stock market crash in October 1987 precipitated an increase in the rate of credit expansion for a short time as the Reserve Bank made it clear that it would ensure liquidity following the crash. The rapid rise in the share price index from 1992 until 1994 was also accompanied by some increase in credit growth, although not as rapid as in the 1980s. Another source of asset price inflation was the rise in established house prices which can be gleaned from the housing price index published by the Australian Bureau of Statistics[2], and which shows that for Sydney for each quarter in 1988-89, the change in the index from the corresponding quarter of the previous year was 43.8 %, 50.4 %, 52.5 % and 38.5 % respectively. It is clear from Figure 2.1 that lending for housing began to increase at an increasing rate at this time. Commercial property prices also rose dramatically as is evident from Figure 2.3.

Figure 2.3 *Credit growth and asset price inflation*
(Half-yearly intervals from December 1977 to June 1994)



Sources: Derived from Argy (1995, p. 25) and Reserve Bank of Australia, *Bulletin*, various issues.

[2] Australian Bureau of Statistics, *Housing Price Indexes: Eight Capital Cities*, Catalogue No. 6416.0.

The relationship between credit and interest rates has changed greatly since financial market deregulation. Figure 2.4 charts the four quarter percentage change in credit in nominal terms against both the 90 day bank adjusted bill rate and the 2 year Treasury bond rate.[3] Table 2.1 presents the contemporaneous correlation coefficients between the four quarter percentage change in credit and interest rates and the correlation coefficients when interest rates are lagged four quarters and eight quarters so account is taken of 'the long and variable lags' often claimed for monetary policy to take effect. The striking feature of Table 2.1 is the very high positive contemporaneous correlation since financial markets were deregulated between changes in credit and interest rates, .81 for both the 90 day bank adjusted bill rate and the 2 year Treasury bond rate. Of course, correlations say nothing about causality. It may be that as interest rates rise, lenders find it more profitable to lend and so expand credit; or equally, it may be that as credit expands, interest rates are forced to rise in the face of increased competition for funds, or the Reserve Bank may cause interest rates to rise in a deliberate policy response to circumvent the rate of expansion of credit. Granger causality tests presented in Chapter 3 attempt to capture some more information with respect to the direction of causality. When interest rates were lagged one year in deregulated financial markets, the correlation coefficient between credit and interest rates was halved from the contemporaneous correlation but was still very positive at .41 and .46 for 90 day bank adjusted bill rates and 2 year Treasury bond rates respectively. When interest rates were lagged two years, there was virtually no correlation. In contrast, when financial markets were regulated, the correlation coefficients indicate that credit expansion fell one and two years after increases in interest rates.

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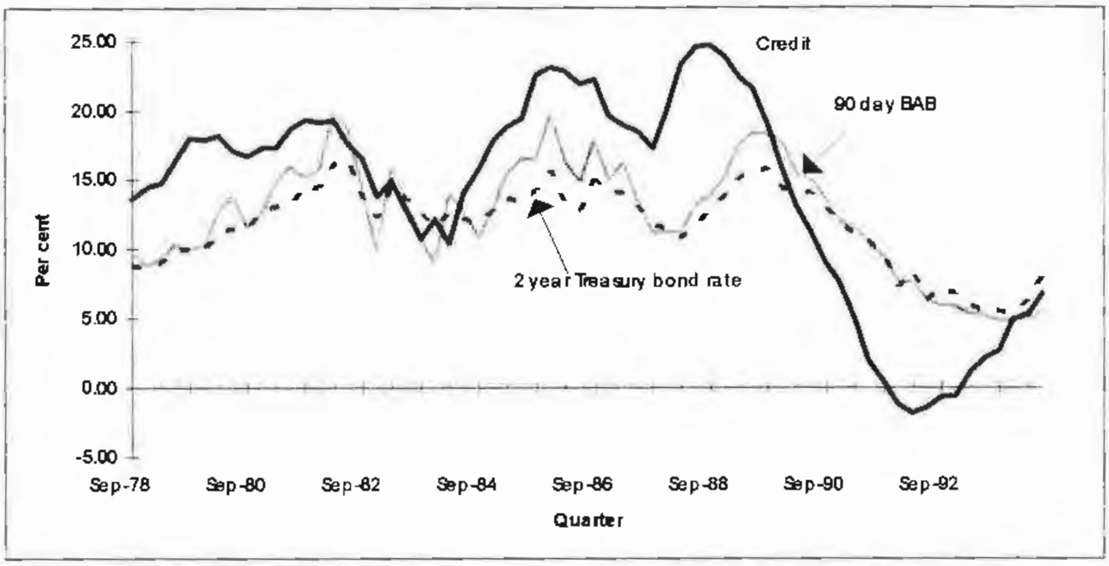
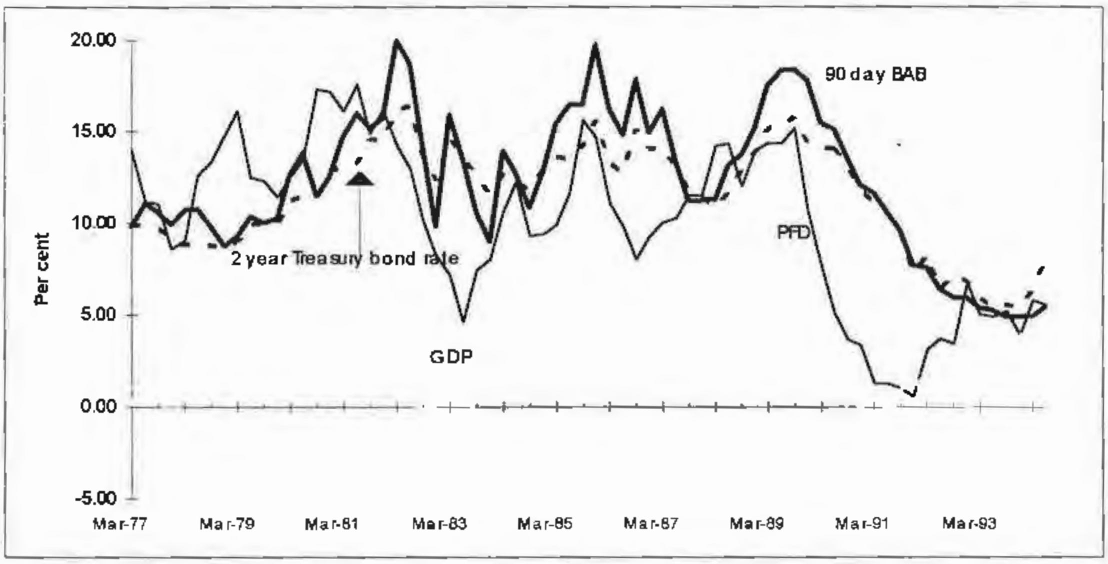
[3] The pattern for 10 year Treasury bond rates closely follows that of 2 year Treasury bond rates until 1992.

Figure 2.4 *Credit (four quarter percent change) and interest rates (September quarter 1978 - June quarter 1994)*



Sources: dX database and Reserve Bank of Australia, *Bulletin*, various issues.

Figure 2.5 *GDP and PFD (four quarter percent change) and interest rates (March quarter 1977 - June quarter 1994)*



Sources: dX database and Reserve Bank of Australia, *Bulletin*, various issues.

The strong positive correlation between the change in credit and interest rates since financial markets have been deregulated suggests that high interest rates may not, in general, be successful in reducing the rate of credit expansion.

Figure 2.5 illustrates nominal GDP and nominal PFD against nominal interest rates. Tables 2.2 and 2.3 show the correlation coefficients between GDP and interest rates, and PFD and interest rates respectively. Again, as with credit, the positive contemporaneous correlation between both GDP and PFD and nominal interest rates is striking for the period in which financial markets have been deregulated. When interest rates are lagged the correlation becomes less striking but remains positive with the exception of the correlation coefficient between PFD and the 90 day bank adjusted bill rate lagged eight quarters. These positive correlation coefficients for deregulated financial markets are in contrast to the negative correlation coefficients between GDP and PFD and lagged interest rates when markets were regulated.

Table 2.1 Correlation coefficients for credit (4 quarter percent change) and interest rates

	Entire sample*	Regulated*	Deregulated
	Sept. 77 - June 94	Sept. 77 - June 94	Mar. 84 - June 94
90 day BAB			
Contemporaneous	.73	.50	.81
Interest rate lagged 4 quarters	.28	-.25	.41
Interest rate lagged 8 quarters	-.08	-.54	.05
2 year Treasury bond rate			
Contemporaneous	.71	.22	.81
Interest rate lagged 4 quarters	.29	-.34	.46
Interest rate lagged 8 quarters	-.05	-.61	.15

** When interest rates were lagged 8 quarters, the sample period began in March 1978.*
Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

Table 2.2 Correlation coefficients for GDP (4 quarter percent change) and interest rates

	Entire sample*	Regulated*	Deregulated
	Sept. 77 - June 94	Sept. 77 - June 94	Mar. 84 - June 94
90 day BAB			
Contemporaneous	.50	.09	.68
Interest rate lagged 4 quarters	.04	-.38	.28
Interest rate lagged 8 quarters	-.15	-.52	.15
2 year Treasury bond rate			
Contemporaneous	.49	.01	.69
Interest rate lagged 4 quarters	.04	-.47	.37
Interest rate lagged 8 quarters	-.16	-.47	.24

** When interest rates were lagged 8 quarters, the sample period began in March 1978.*
Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

Table 2.3 Correlation coefficients for PFD (4 quarter percent change) and interest rates

	Entire sample*	Regulated*	Deregulated
	Sept. 77 - June 94	Sept. 77 - June 94	Mar. 84 - June 94
90 day BAB			
Contemporaneous	.51	.21	.67
Interest rate lagged 4 quarters	-.04	-.38	.17
Interest rate lagged 8 quarters	-.30	-.73	.00
2 year Treasury bond rate			
Contemporaneous	.46	.03	.66
Interest rate lagged 4 quarters	-.06	-.48	.23
Interest rate lagged 8 quarters	-.30	-.70	.11

* *When interest rates were lagged 8 quarters, the sample period began in March 1978.*
Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

2.4 Implications of the credit explosion for the analysis of monetary policy

Targeting of the monetary aggregates was officially abandoned in January 1985. In recent years, it seems that the Reserve Bank has been using credit as an important variable to which it refers when deciding upon the stance of monetary policy. For example, in the statement by the Governor of the Reserve Bank in August 1994 on the first tightening of monetary policy in five years, he stated (*Bulletin*, September 1994, p. 23): "Aggregate credit is now growing at a rate consistent with sustained expansion in economic activity. ....[L]ending for housing has been increasing rapidly while lending for business has only just begun to rise. ......Given these developments, the current interest rate regime, which was adopted more than a year ago when the recovery was much less robust is no longer appropriate." References to credit have consistently been made by the Governor of the Reserve Bank upon changes in the official cash rate rather than to any of the monetary aggregates. This suggests that credit is seen by the Reserve Bank to be an important component of the monetary policy transmission mechanism where changes in official cash rates impact upon the price and therefore the volume of credit.

In the following chapter, I examine some Keynesian views with respect to the transmission mechanism. Amongst those views, it is the post Keynesian school which most emphasises the role of the availability and price of credit in the monetary policy transmission process. Because post Keynesians argue that the money supply is endogenously determined by the demand for credit money, they argue that the money supply as measured by one of the monetary aggregates is a residual quantity rather than a quantity which is central to the transmission process. Very simply, the process known as the *monetary circuit* runs thus:[4] Firms demand credit from banks for working capital purposes. Banks grant credit by increasing their loan books, and, at the same time, increasing the deposit liabilities of firms. The money supply has increased endogenously in response to an increase in the demand for credit money. The firms use the credit monies to pay for raw materials and to pay wages to labour. The loan monies flow to households who then use most of their newly acquired revenues to purchase the output of firms. The firms use the proceeds of the sale of output to repay loans with interest. Thus, the former increase in the money supply due to the increase in loans is largely extinguished by the repayment of debt. However, some of the newly acquired revenues are saved by households as deposits in banks. The increase in

[4] See, for example, Lavoie's (1992, pp. 151-169) description of the monetary circuit.

deposits by households, which is the *residual* of the economic activity previously described, is what shows up as an increase in the money supply.

Smithin (1994, pp. 65-66), with reference to the work of Seccareccia (1991), argues that the problem with this simplistic description of the monetary circuit is that firms will not generate enough monies to repay their loans let alone the interest bill. Seccareccia points out that this is usually remedied with the introduction of a deficit spending government sector, or in a two sector model, by arranging the purchases of one sector from another in a way that means the total *value* of production, rather than the cost of production, must be loan financed. Smithin, himself suggests, if loans made in the current period need not be repaid until the next period, when output produced in the current period is sold; then at the beginning of the next period there will be monies circulating from the current period's loans plus monies circulating from next period's loans so that firms are easily able to repay debts and interest incurred in the current period in the next period.

Post Keynesians argue that the increase in the money supply has no causal relation in the transmission mechanism. The central bank is assumed to be able to exogenously administer the short-term rate of interest, changes in which affect the price of credit. Provided that the demand for credit is sufficiently interest-rate elastic, the change in the price will affect the demand for credit, and the change in the cost of funds to the banks will affect the supply of credit. In Chapter 3, I present the results of Granger causality tests between interest rates and economic activity, and credit and economic activity to see whether the post Keynesian description of the transmission mechanism is consistent with Australian experience.

The New Keynesians argue that changes in money are the most important conduit of the monetary policy transmission mechanism. However, they argue that loans are a conduit additional to money through which changes in monetary policy affect economic activity. In particular, New Keynesians argue that non-price credit rationing can take place even in a deregulated financial environment. The explosion of credit in Australia in the 1980s suggests that credit was made readily available and appears to be inconsistent with the credit rationing hypothesis. The theoretical bases for credit rationing are discussed in Chapter 4, and whether credit was rationed as an empirical matter in Australia is the subject of Chapter 5.

With the benefit of hindsight, it is clear as an empirical matter that too much credit in Australia was granted in the 1980s to borrowers who were at high risk of default. There was a massive expansion in banks' bad and doubtful debts. Some state banks came very close to failing, and would have done so if it were not for government capital injections and/or arrangements to sell the distressed banks to other banks. In addition, the expansion of credit fuelled a large increase in asset price inflation. Minsky (1972, 1977, 1982a, 1982b, 1985, 1986) argues that a stable capitalist economy which relies on credit relations sows the seeds of its own instability, that is, it endogenously creates the preconditions from which a debt deflation can result. First, when economic conditions are relatively stable, banks are willing to grant loans to firms. As the firms' activities generate profits so that loans are repaid with interest, lending activity is profitable for banks. Profitable activity by firms leads to an increased willingness to borrow which is met by an increase in loans from banks. Loan funds tend to flow to those sectors where profits are greatest, so that banks face an increasing exposure to one sector of the economy. (See also Revell (1986).) As monies flow into the exposed sector, there is pressure for asset prices within the sector to rise. A financial crisis or an increase in interest rates can make the debt structure of the economy increasingly precarious so that some firms who had previously been able to repay their debts can no longer do so and those firms fail. Other firms attempt to sell their assets leading to asset price deflation. Banks become very cautious about making loans at the very time that firms are most in need of loan funds. Australian financial instability in the late 1980s is the subject of Chapter 7 and follows on the discussion in Chapter 6 of how an increase in uncertainty can follow a "crisis" event, and precipitate an increase in the amount of credit rationing which occurs.

2.5 Conclusion

This chapter has presented some empirical background to the discussion of the monetary policy transmission mechanism, credit rationing, uncertainty in financial markets and implications of these for financial instability in Australia which follow in this thesis. The volume of credit has become enormously important in Australian financial markets. That credit was able to expand so rapidly following financial deregulation had macroeconomic consequences for increased activity and for asset price inflation. Subsequent tight monetary policy led some financial institutions to experience severe liquidity and solvency problems. Access to credit became more difficult for many firms.

The high positive correlation coefficients between interest rates and credit, GDP or PFD beg some questions with respect to the transmission mechanism of monetary policy. The Reserve Bank is explicit in its use of the official cash rate as the instrument of monetary policy. Changes in the official cash rate affect interest rates along the maturity spectrum. An increase in interest rates, by affecting the price of credit, is supposed to reduce the demand for credit. It may also reduce asset prices through its impact on the marginal efficiency of capital; and it may lead to an appreciation of the exchange rate. All three of these effects of increased interest rates should lead to a reduction in the level of activity. In fact, in deregulated financial markets, higher interest rates seem to be associated with higher levels of activity and a greater volume of credit at least in nominal terms, even when interest rates are lagged. Does transmission then run from interest rates to activity; or does the Reserve Bank respond to increases in the credit aggregates and activity with increases in interest rates? The next chapter addresses the transmission mechanism in Keynesian economics with reference to Australia's experience in both regulated and deregulated financial markets.

Chapter 3 The Transmission Mechanism in Keynesian Economics

3.1 Introduction

Required for the effective implementation of monetary policy is some understanding of the transmission mechanism, that is, some understanding of the way in which the variables (monetary policy instruments) over which the central bank has control may be used to influence the values of other variables over which it has no direct control but which are the targets of monetary policy. The control variables are usually either the size of the monetary aggregates, interest rates or credit directives to financial intermediaries. In regulated financial markets, the Reserve Bank of Australia attempted to control monetary aggregates and issued credit directives to the banks. Since the deregulation of financial markets, the Reserve Bank has attempted to use changes in interest rates as the instrument of monetary policy. Monetary policy targets have included nominal GDP or GNE, real GDP or GNE, the inflation rate and exchange rates.

This chapter canvasses the three major contemporary Keynesian perspectives; the neo-Keynesian, New Keynesian and post Keynesian perspectives, on how monetary policy is transmitted and presents results based upon Granger causality tests to determine whether there is any basis, in fact, for preferring one description of the monetary policy transmission mechanism over the others. Although there have been other empirical studies with respect to how monetary policy is transmitted in Australian financial markets (see, for example, Bullock, Morris and Stevens (1988), Stevens and Thorpe (1989), Neal (1993) and Nelson (1994)), none of them has sought to compare the views of various schools of thought on the transmission mechanism, to discover whether some theoretical basis is more appropriate than another. Underlying monetary policy in regulated financial markets in Australia was the neo-Keynesian view that monetary policy was transmitted from a change in the money supply (or money base) to a change in interest rates and thence to a change in economic activity and the price level. Most important to this analysis is that changes run *from* money *to* activity. New Keynesians also argue that transmission runs from money to activity but they argue that, in addition to changes in money, monetary policy is transmitted through changes in credit, and, in particular, through equilibrium or non-price credit rationing, when rationing may occur even though interest rates are free to adjust. In contrast to both neo-Keynesian and New Keynesian analysis, post Keynesians claim that the money supply is endogenously determined by the demand for money. The central bank is able to set the short-term interest rate and allows the money supply to adjust to money demand at the chosen rate of interest. Transmission runs from a change in interest rates to a change in activity and/or the price level. The post Keynesian description of the transmission mechanism best characterises the Reserve Bank's own view of how monetary policy *first* works in deregulated financial markets, although the neo-Keynesian description of portfolio balance still underlies its views of how monetary policy is ultimately transmitted.

If there is some basis for preferring one description of the monetary policy transmission mechanism over the others, then it would perhaps be wise to concentrate on the policy recommendations of economists from that particular group. Unfortunately, the evidence of this chapter shows that all of the Keynesian descriptions of the transmission mechanism are inadequate to their task, at least when applied to financial markets in Australia. This suggests that the transmission of monetary policy, as it is currently practised in Australia, is ill-understood. The severity of the 1990-92 recession is also testament to the lack of understanding of the effects of monetary policy. This suggests that further consideration be given to the less well explored aspects of the transmission mechanism. What are these less well explored aspects? First, although studies have been undertaken with respect to the Australian transmission mechanism (Bullock, Morris and Stevens (1989), Stevens and Thorp (1989), Neal (1993) and Nelson (1994), none of them has considered transmission over the whole of the business cycle in deregulated financial markets. This has been a matter of timing rather than one of deliberate neglect. Until the recession of 1990-92, it was not possible to adequately consider transmission over the whole cycle as deregulation of financial markets can only be considered to have been largely completed by the beginning of 1984, subsequent to the previous recession of 1980-81. Second, credit rationing as a component of the transmission mechanism has largely been ignored. Blundell-Wignall and Giyzcki (1992) have addressed the issue, but I have serious reservations as to the dependent variable used in their analysis. In Chapter 5, I also attempt to measure whether non-price credit rationing has been occurring in Australian financial markets, using maximum likelihood estimation as they have done but with a revised dependent variable. Thiessen (1995, p. 10), the Governor of the central bank of Canada, suggests that "[t]he aspect of the analysis of credit markets that is of interest to the Bank [of Canada] is whether its monetary policy actions lead to a systematic adjustment by financial institutions of their non-price terms and conditions of lending. If there were such adjustments that were not correlated with interest rate movements, the Bank would need to track them closely in assessing the effects on the economy of its policy actions." The Reserve Bank of Australia should be similarly interested. A further issue is whether the Reserve Bank can, in fact, influence short-term interest rates other than when expenditures are interest rate inelastic. If expenditures are interest rate elastic, then one would expect, consequent upon an easing of monetary policy, that expenditures will increase, the demand for money will increase, interest rates will rise and offset the fall wrought by the change in monetary policy. I have previously considered this issue (Neal (1993)), as has Harper (1992). Both came to the conclusion that monetary policy in the short-term *may* be pro-cyclical, and in the longer-term is probably ineffective. Also, not attempted in Australia, to my knowledge, is an examination of the role of uncertainty in determination of liquidity preference and the behaviour of agents in financial markets. Does fundamental uncertainty emphasised by the post Keynesians lead to different behaviour than that behaviour predicated upon risk-based probabilistic assessments of economic conditions? I consider this question in Chapters 6 and 7. The analysis of the current chapter can be seen as an attempt to discover whether one of the Keynesian descriptions of the transmission mechanism is a more appropriate starting point to a better understanding of the transmission mechanism than another.

3.2 The Neo-Keynesian transmission mechanism and elasticity pessimism

The simplest neo-Keynesian model is the IS-LM model. This model begins with three markets: the goods market, the money market and a market for all other interest-earning assets which are given the generic title of "bonds". It is assumed that no interest is earned on money, but that money does provide transactions and liquidity services from which is derived, in part, the demand for money. In addition, there is some demand for money as a risk-free asset, Keynes' speculative demand for money, which is inversely related to the interest rate and expectations of the interest rate. First, there is an opportunity cost of holding money as opposed to holding "bonds". Therefore, the higher the interest rate, the more bonds and less money agents hold. Second, the higher the interest rate, the greater the likelihood that the interest rate is expected to fall in future, so that future bond prices are expected to rise and bond holders anticipate capital gains. Agents reduce their asset demand for money and purchase bonds. There is an inverse relationship between interest rates and the asset demand for money.

Walras' Law states that, in a three market model, if two markets are in equilibrium so, too, is the third. Walras' Law thus allows the "bonds" market to be suppressed in the IS-LM model when both the goods market and the money market are in equilibrium, so that the IS-LM model collapses into a two market model. Further, the IS-LM model implicitly assumes that "... bonds and real capital are perfect substitutes. This arises from the fact that in equilibrium in the IS-LM model, the rate of interest on bonds is equal to the marginal efficiency of capital."[1]

The transmission mechanism in the IS-LM model proceeds thus: First, the central bank causes an exogenous increase in the money supply, perhaps by changing the money base, or by changing the money multiplier by varying the required reserve ratio. This exogenous increase in the money supply causes the LM schedule to shift to the right in the IS-LM model, which, with an unchanged IS curve, causes the interest rate to fall and the level of aggregate demand to increase. The change in the interest rate results from a number of effects. First, there is an increase in the supply of money which economic agents will want to divide between money and "bonds". As the demand for "bonds" increases so also does their price. The inverse relationship between "bond" prices and interest rates causes the yield on bonds to fall following an increase in the money supply. The fall in the interest rate stimulates aggregate demand as investment and, perhaps, consumption expenditures are held to be interest rate elastic by neo-Keynesians. This is the Keynes effect. Second, real money balances are a component of wealth. As agents' wealth increases, so too does their consumption which causes the IS curve to shift to the right offsetting some of the initial fall in interest rates, but further increasing aggregate demand. This is the real balance effect. Nevertheless, neo-Keynesians hold that, in general, interest rates will fall in response to an increase in the money supply and there will be some stimulus to aggregate demand, the degree of stimulus depending upon the relative elasticities of the IS and LM curves. Also, in general, neo-Keynesians hold that the LM curve is more interest rate elastic than the IS

[1] Stevenson, Muscatelli and Gregory, (1988, p. 155).

curve; the steepness of the latter deriving from the dominance of the influence of expectations over interest rates upon investment expenditures, and the elasticity of the former deriving from the asset demand for money.

Several problems arise when the IS-LM model is used to describe the transmission of monetary policy. The first is that referred to above; the marginal efficiency of real capital is held to be equal to the rate of return on bonds when the model is in equilibrium. This assumes that there is effective arbitrage between the real sector and the financial sector. In fact, Mehra and Prescott (1985) found that, over a ninety-year period, the average return on equity far exceeded the average return on virtually default-free short-term debt which suggests that either arbitrage between the real and financial sectors is not effective; or that models must take into account transactions costs, liquidity constraints and incomplete markets. By 1995, the equity premium puzzle had still not been resolved but had only deepened as indicated by Deborah Lucas (1994) with various attempts to incorporate factors that might give rise to frictions leading to the equity premium. If there was always effective arbitrage between the real and financial sectors, it would be very difficult to explain financial crises. Taylor and O'Connell (1989, p. 3) explain with reference to Minsky's financial instability hypothesis (to be discussed in Chapter 7) that asset choices by firms and households are not coordinated and "..[t]he market valuation of shares can deviate substantially from the book value of capital, with the difference being absorbed by net worth. With total wealth fluctuating over time, separate portfolio decisions by firms and households can interact to create crises." Second, the IS-LM model excludes from the transmission mechanism, a consideration of behaviour under conditions of fundamental uncertainty as opposed to risk. As is to be demonstrated in Chapter 6, agents behave differently when conditions are uncertain than they do when conditions are merely risky, and because their behaviour affects loan behaviour, it affects the transmission of monetary policy. Third, the neo-Keynesian transmission mechanism assumes that the money supply is exogenously determined by the central bank, albeit tempered by the recognition that the portfolio choices of the non-bank public affect the money multiplier and foreign exchange transactions affect the money base. In fact, the money supply may be endogenously determined so that changes in the money supply result from changes in the demand for money, which themselves may arise from changes or expected changes in the level of economic activity. When the money supply is endogenously determined by the demand for money, an increase in loan activity which leads to a subsequent increase in deposits can bring about a change in the money supply with no change in interest rates. Here, the transmission mechanism is definitely not from a change in the money supply to a change in interest rates and/or the price level. Fourth, and related to the endogenous money issue, is that the derivation of the LM curve, and so analysis based upon the IS-LM model, assumes a stable money demand function. Empirical work has demonstrated that this assumption is suspect. See, for example, de Brouwer, Ng and Subbaraman (1993). Fifth, and related to the first problem, is that the model does not explain why investors should hold a diversified portfolio of financial assets. Tobin (1958), and in subsequent papers (for example Tobin (1969)), has developed a portfolio balance approach to the transmission mechanism of monetary policy, where monetary policy has differential effects on the rates of return to "bonds" and to real capital which has become the basis for the neo-Keynesian description of the transmission mechanism when it is extended beyond IS-LM analysis.

In the portfolio approach, wealth is divided between money, bonds and real capital, the latter in the form of equity. Asset demands are assumed to be a positive function of their own rates of return, and a negative function of the rates of return on alternative assets. Money is assumed to have a zero rate of own return but money demand is assumed to be positively related to income. Because, in Tobin's model, all of the changes in money holdings (when the money supply is held fixed) are assumed to come out of bond holdings, the demand for bonds is assumed to be a negative function of income. Using Tobin's q theory of investment, when the marginal efficiency of capital is greater than the rate of return required by equity holders (that is, $q>1$), the market value of equity is greater than the replacement cost of the outstanding capital stock, and so the firm should find it profitable to invest.[2]

A three curve model for portfolio balance, analagous to the IS-LM model, can be constructed in which the BB curve indicates equilibrium in the bonds market, the KK curve indicates equilibrium in the market for equity and the MM curve indicates

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[2] Tobin's q theory of investment suggests that a firm should invest when the market value of equity is greater than the replacement value of the outstanding capital stock. Following Stevenson, Muscatelli and Gregory (1988, pp. 156-57) we can write $V_t = C_t + \frac{C_{t+1}}{(1+r_k)} + \frac{C_{t+2}}{(1+r_k)^2} + \ldots\ldots$ where V_t is the market value of equity, C_{t+i} is the expected return on capital at time $t+i$ and r_k is the rate of return which equity holders require to induce them to hold the outstanding capital stock. If the expected returns in all periods are equal, then $V_t = \frac{C_0}{r_k}$. The marginal efficiency of capital is ρ_k and is obtained from the expression $P_k K = C_t + \frac{C_{t+1}}{(1+\rho_k)} + \frac{C_{t+2}}{(1+\rho_k)^2} + \ldots\ldots$ so that if the expected return is the same in all periods, then $P_k K = \frac{C_0}{\rho_k}$. As $q = \frac{V}{P_k K} = \frac{\rho_k}{r_k}$, the firm should invest when the marginal efficiency of capital is greater than the rate of return required by asset holders to hold the outstanding capital stock, that is, when $q>1$.

equilibrium in the money market as in Figure 3.1.[3] The MM curve is negatively sloped because money demand is a negative function of both r_b, the rate of return on bonds, illustrated on the horizontal axis, and r_k, the rate of return on equity, illustrated on the vertical axis. Therefore, *ceteris paribus*, if there is no change in the money supply, as r_b increases, there will be a reduction in the demand for money as there is an incentive for agents to shift out of money into bonds and equity. Thus, r_k must fall to induce an offsetting increase in the demand for money so that equilibrium in the money market will be maintained. As r_b rises, r_k falls and the MM curve is negatively sloped. The BB curve is positively sloped because, with an unchanged bond supply, as r_b increases, so also will the demand for bonds. To offset the increase in the demand for bonds, an increase in r_k is required which will have the effect of inducing an increase in the demand for real equity. This increase in the demand for equity will offset the increase in the demand for bonds thus maintaining equilibrium in the bond market. The KK curve is positively sloped, because, without a change in the supply of equity, as r_b increases, the demand for equity will fall. Thus, r_k must increase to induce an offsetting increase in the demand for equity so that equilibrium in the market for equity is maintained. Each asset is assumed to be more elastic with respect to its own rate of return than to the rate of return on alternative assets. This explains why the BB curve is more positively sloped than the KK curve in Figure 3.1. Figure 3.1 illustrates that the rate of return on equity, r_k, and the rate of return on bonds, r_b, are jointly determined by equilibrium in the equity, bonds and money markets. Obviously, the model could be generalised to as many assets as one thinks it appropriate to differentiate between for

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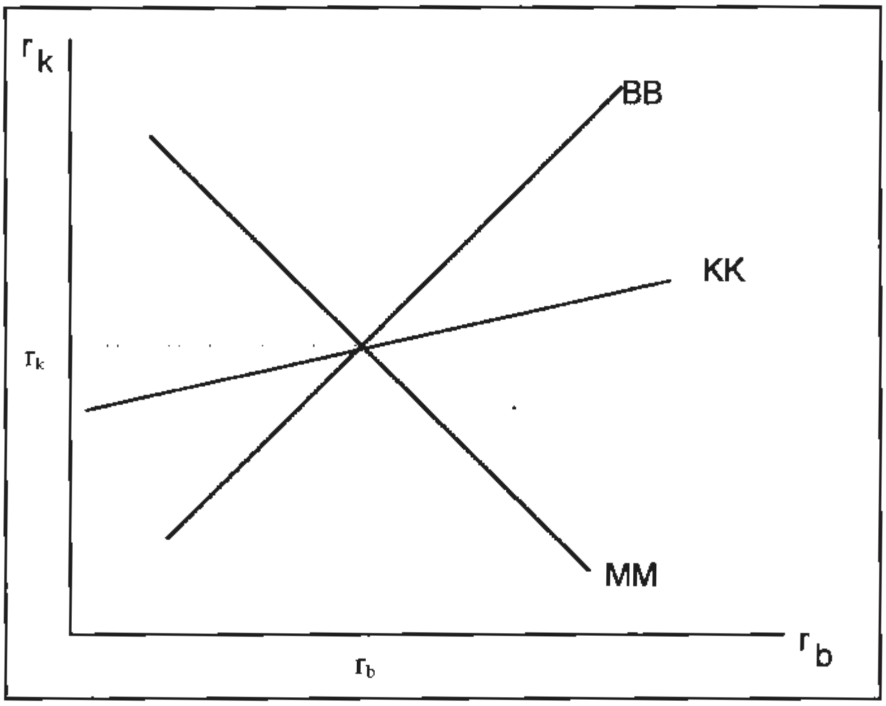
[3] The following analysis of portfolio balance is based on the discussion of Tobin's model in Stevenson, Muscatelli and Gregory (1988).

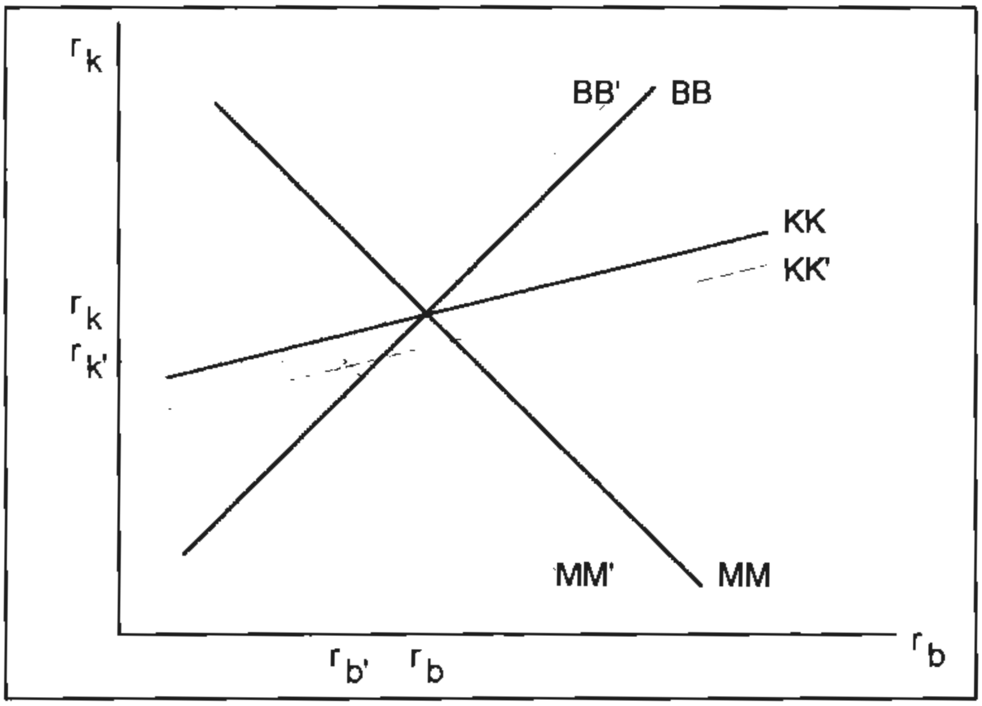
the purposes of analysis at hand. However, our interest is in the monetary policy transmission mechanism and it is sufficient to work with these three markets.

Figure 3.1 Portfolio balance



First, consider the effects of an exogenous increase in the money supply, illustrated in Figure 3.2. An increase in the money supply represents an increase in wealth which, according to the neo-Keynesians, *ceteris paribus*, will be divided between money, equity and bonds. In order to maintain equilibrium in the money market, there needs to be an increase in the quantity of money demanded. For that to occur, the rates of return on alternative assets, r_b and r_k, must fall. Thus, the MM curve shifts to the left to MM'. As there is an increase in the demand for equity without a concomitant increase in its supply, the rate of return on equity must fall and the rate of return on bonds must rise so that there is an offsetting reduction in the quantity of equity demanded in order that equilibrium in the equity market be maintained. Thus, the KK curve shifts to the right to KK'. Similar reasoning applies to the market for bonds. As there is an increase in the demand for bonds without a concomitant increase in bond supply, the rate of return on bonds must fall and the rate of return on equity must rise so that equilibrium is maintained in the bond market. Thus, the BB curve shifts to the left to BB'. Overall, there is a reduction in the rates of return on equity and bonds to $r_{k'}$ and $r_{b'}$ respectively.

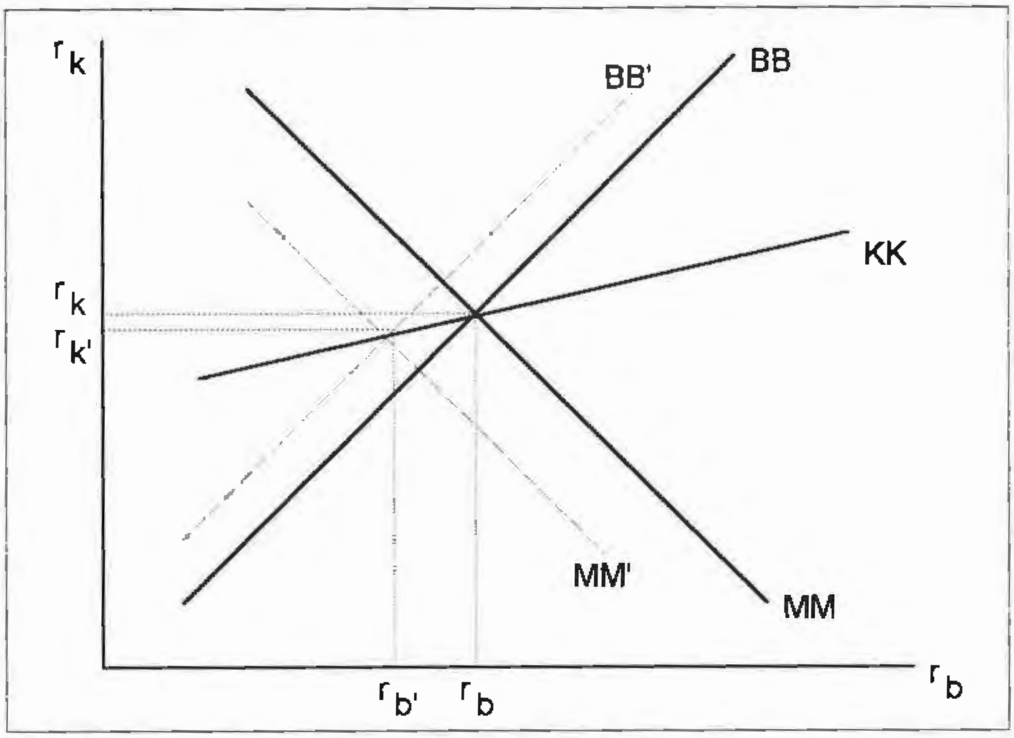
Figure 3.2 The effects of an exogenous increase in the money supply upon portfolio balance



Important to the transmission of monetary policy here is the fall in r_k. The fall in r_k, because it represents a fall in the cost of capital to firms and a rise in Tobin's q (see footnote 2), should, in the longer-run, stimulate investment expenditures and aggregate demand.

Often, an increase in the money supply is achieved through an open market purchase of bonds. This will mean that there is no increase in wealth so that the market for equity is unaffected. Thus KK does not shift in Figure 3.3. As before, and for the same reasons, the increase in the money supply causes the MM schedule to shift left to MM'. If agents are not to apply part of their increase in money holdings to purchases of bonds and equity, then r_b and r_k must fall. The reduction in the bond supply due to open market operations means that, for the bond market to remain in equilibrium, there must also be a reduction in the quantity of bonds demanded. This is achieved by reducing the rate of return on bonds and increasing the rate of return on equity. Thus, the BB curve shifts to the left to BB' in Figure 3.3. Again, both r_k and r_b are lower after the open market increase in the money supply. Monetary policy is transmitted through the effect upon investment expenditures of the change in r_k. However, if, as in deregulated financial markets, most money bears some interest, part of the portfolio balance adjustment will fall on the rate of return to money, thus reducing the impact of an increase in the money supply on r_k, and thus reducing the stimulatory impact of easier monetary policy on aggregate demand.

Figure 3.3 *The effects of an increase in the money supply due to open market operations upon portfolio balance*



The neo-Keynesian position with respect to the transmission mechanism can be summarised thus: The money supply is exogenously determined by the central bank. The interest rate is then determined endogenously by liquidity preference, that is, by the interaction between the exogenously determined money supply and a stable demand for money function which reflects the preferences of agents for holding money for liquidity and transactions services, and their holding of money as an asset which can be used for speculative purposes. Because, in the standard IS-LM model, firms are assumed to invest to the point where the marginal efficiency of capital falls to be equal to the interest rate, the central bank can influence aggregate demand by adjusting the money supply to achieve the desired (full employment?) rate of interest. In Tobin's model of portfolio balance, the central bank can influence aggregate demand by adjusting the money and/or bond supply to influence the rates of return on real capital so that the desired (full employment?) level of investment takes place. The transmission of monetary policy according to neo-Keynesians, therefore runs from a change in the money supply to a change in interest rates, or to a change in the rate of return to real capital, to a change in aggregate demand. The change in aggregate demand derives principally from a change in investment expenditures but may also derive from a change in consumption expenditures, and in an open economy, from a change in net exports. The evidence to be presented later in this chapter on the basis of Granger causality tests indicates that there is a problem with the neo-Keynesian description of the monetary policy transmission mechanism for Australia, both when financial markets were regulated and now when financial markets are deregulated. In fact, there is very little evidence to the effect that transmission runs *from* money *to* activity.

3.3 The New Keynesian transmission mechanism and market rigidities

In contrast to neo-Keynesian economics, New Keynesians argue that there may be a conduit additional to changes in money aggregates of the transmission of monetary policy to the level of aggregate activity even when financial markets are deregulated, and that additional conduit is changes in credit. These changes in credit make economic fluctuations more marked than would changes in the level of monetary aggregates alone. It now appears to be rather widely accepted that equilibrium credit rationing does exist. What is under greater debate is the empirical significance of equilibrium credit rationing for the macroeconomy. The term 'equilibrium' is used here in the Keynesian state of rest tradition. Equilibrium credit rationing occurs when, even though there is an excess demand for loans; lenders, because they are already engaging in profit maximising behaviour, have no incentive to expand the loan supply. Both the theoretical bases for the existence of equilibrium credit rationing in deregulated financial markets, and the measurement of credit rationing for the business and personal loan markets in Australia are explored in depth in the following two chapters. Of interest to us here is whether or not there is a credit channel in addition to a money channel as part of the monetary policy transmission mechanism.

King (1986) develops a simple model of equilibrium credit rationing consistent with the work of Stiglitz and Weiss (1981)[4] which he uses as the basis for empirical work seeking to find whether equilibrium credit rationing exists and, if so, whether it has significant implications for the macroeconomy. Some of his results are consistent with the equilibrium credit rationing hypothesis. He uses Maddala and Nelson's (1974) maximum likelihood technique for establishing whether excess loan demand or supply exists and finds that most months of his sample period exhibit excess loan demand. However, King also finds that loan supply is positively related to the interest rate, a finding he claims to be inconsistent with the equilibrium credit rationing hypothesis. The inconsistency does exist for the periods in which there is excess loan demand, as the implication of the equilibrium credit rationing hypothesis is that the excess demand will arise only when banks ration credit rather than further raise the interest rate to eliminate the excess demand for loans. However, in periods of excess loan supply, it is to be expected that loan supply is positively related to the interest rate. The equilibrium credit rationing hypothesis does not claim that loan supply is other than positively related to the interest rate except when adverse selection and adverse incentive effects

[4] The Stiglitz and Weiss (1981) paper is the seminal contribution to the New Keynesian literature on credit rationing. The analysis of this paper is used as the basis of the theoretical and empirical work of the next two chapters.

are sufficiently strong to offset the positive effects on the marginal revenue of an increase in interest rates on new loans.[5] It is only in the latter case that empirical work should find that loan supply is negatively related to the interest rate. As to the significance of equilibrium credit rationing for the macroeconomy, King, using Granger causality tests and vector autoregressions, finds little evidence to suggest that bank loans play an important part in the transmission of monetary policy.

In a critique of Stiglitz's work on equilibrium credit rationing, Brunner and Meltzer (1988) are critical of the significance of the role assigned to credit rationing in the transmission of monetary policy: They argue that economic shocks lead to adjustments in the composition of asset portfolios, and, therefore, to changes in relative asset prices. It is through these changes in asset prices that monetary policy changes are transmitted to the output market. Thus, the central assignment of the transmission of monetary policy should not be to credit rationing. This is not to say that equilibrium credit rationing does not exist. Indeed, in concluding, they state (p. 450): "..loan rationing supplements interest rate rationing, and other responses to relative price changes, as part of the monetary transmission process". Consistent with Stiglitz's work on credit rationing, Brunner and Meltzer argue that loan applicants with highly uncertain repayments, large information costs and potentially large transactions costs will be rejected, and so credit rationed, because the expected net loan rate, given these costs, is too low, and raising the loan interest rate will further increase the implicit risk premium.

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[5] Adverse selection occurs when, as interest rates rise, the more risk averse borrowers drop out of the market for loans, and adverse incentive effects occur when the rise in interest rates provides the remaining borrowers with an adverse incentive to engage in riskier activities. Adverse selection and adverse incentive effects may cause the expected return to lenders to decline as they raise interest rates. These effects and their impact on revenue are explored in more detail in the following chapter.

One person who has argued that a credit rationing channel can have significant effects for the macroeconomy, at least in some circumstances, is Bernanke. Bernanke (1983) argues that the decline in output of the Great Depression can be attributed, in part, to nonmonetary financial effects. In particular, he argues, that bank failures and debtor insolvency led to an increase in the cost of credit intermediation, so that safe borrowers found it more difficult, or impossible, to obtain loans. As banks increased interest rates charged on loans (because the cost to banks of credit intermediation was rising with a greater number of borrowers defaulting) or increased the shadow price of obtaining credit (many borrowers either could not obtain loans or could obtain loans only under conditions, such as higher collateral requirements, that were more stringent than previous requirements); potential borrowers found it more costly, without a concomitant increase in deposit interest rates, to obtain loans, and so the level of aggregate demand declined. To show that there were nonmonetary effects of the financial crisis of the Great Depression that could be distinguished from monetary effects, Bernanke fitted output equations using monetary variables, and then showed that by including proxies for nonmonetary financial factors - the deposits of failing banks and the liabilities of failing businesses - that the explanatory power of these equations could be improved.

Bernanke and Blinder (1989) are critical of neo-Keynesian IS-LM models which collapse bank loans with all other debt instruments into a "bond" market so that changes in money aggregates have a role in the determination of aggregate demand which is not allowed (in the IS-LM model) to changes in any of the debt instruments because the "bond" market is suppressed by Walras' Law. In this 1989 paper, Bernanke and Blinder develop a very simple variant of the IS-LM model which includes a market for commodities and credit in addition to a market for money. Because the model allows the transmission of monetary policy through a credit channel as well as a money supply channel, the model suggests that monetary policy should be more expansionary or contractionary than is indicated by the IS-LM model.

In a further paper, Bernanke and Blinder (1992) continue to argue that monetary policy works, in part, through a credit channel, as well as through money aggregates. First, they find, using Granger causality tests, that the Federal funds rate in the US is a better predictor of a host of real variables than is money. They conclude from this that the Federal funds rate is a better indicator of monetary policy actions than are monetary aggregates. Second, Bernanke and Blinder (1992, p. 917) state: "If the funds rate measures policy intentions, and if these intentions are predetermined [that is, not determined within the current month], then the reduced-form responses of economic variables to innovations in the funds rate should measure the effects of policy". Working from this premise, they estimate three vector autoregressions, where in each the indicator of monetary policy is the Federal funds rate, and the other variables are the unemployment rate and the CPI. In addition, each one of the vector autoregressions included either deposits, securities or loans as an additional variable. From the VARs, they calculated impulse response functions which trace out the effect of innovations in the Federal funds rate (assumed to be due to monetary policy changes), and show that the effect of these innovations is to cause loans and unemployment to move together. Bernanke and Blinder claim that this is consistent with their claim that bank loans are an important component of the monetary transmission mechanism.

Further empirical testing as to whether monetary policy is transmitted, in part, through a credit channel was undertaken by Kashyap, Stein and Wilcox (1993). They test whether monetary policy affects investment through a loan supply channel as distinct from the conventional money channel by examining the changes in the proportions of firms' external financing which is derived from bank loans and from commercial paper issuance following monetary policy shocks. Kashyap, Stein and Wilcox (1993, p. 82) argue that there are two necessary conditions if the transmission mechanism of monetary policy is to have an impact upon aggregate demand through a distinct lending channel:

> "(i) Loans and paper must be imperfect substitutes as bank assets. That is, banks must not react to a contraction in size simply by reducing their holdings of paper and leaving loan supply unchanged.
> (ii) Loans and paper must also be imperfect substitutes as corporate liabilities. Firms must not be able to offset costlessly a reduction in bank loan supply by issuing more paper."

Kashyap, Stein and Wilcox find that, using changes in Federal funds rates and Romer dates[6] as indicators of changes in the stance of monetary policy, and controlling for interest rates, commercial paper issuance rises relative to bank loans following tightenings of monetary policy, and that the change in the mix of commercial paper issuance to bank loans affects investment. The finance mix, therefore, does have an impact upon the macroeconomy through bank loans.

Benjamin Friedman (1988), who was originally an advocate for the use of a credit target rather than a money target for monetary policy purposes as he believed that the credit to GNP ratio was more stable, for the US, than the money to GNP ratio, now

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[6] Christina Romer and David Romer (1990) used the minutes of the meetings of the Federal Reserve Open Market Committee to determine the dates of changes in the stance of monetary policy. These dates have become known in the literature as Romer dates.

believes that the relationship between all quantity variables, including money and credit, and GNP has collapsed in recent years. He states (1988, p. 442): "What matters [for monetary policy] is simply whether the movements of some financial quantity convey information about future movements of income or prices that is not already contained in observed movements of income or prices themselves. If so, then monetary policy can exploit that information by systematically reacting to observed movements of these variables". Granger causality tests he undertakes for the US for a period stretching well into the 1980s suggest that quantity aggregates have conveyed no such information. Friedman (1988, p. 445) suggests that economists should now examine the question of how to conduct monetary policy without quantity variables.

The evidence for Australia, upon the basis of the Granger causality tests to be presented later in this chapter, suggests that there is two way causality between changes in credit and changes in nominal activity, but that changes in real activity are predictors of changes in credit. Thus, it seems that monetary policy, at least in part, is transmitted to nominal activity through changes in credit. Supporting this is the empirical work which I have undertaken on non-price credit rationing, the results of which are reported in Chapter 5. The empirical tests, based upon the maximum likelihood technique, conclude that some amount of equilibrium credit rationing of personal loans and to a small extent credit rationing of business loans has existed in Australia even in deregulated financial markets. Credit rationing must therefore be seen as an additional conduit to the transmission of monetary policy. New Keynesians argue that credit rationing is a conduit additional to changes in money, whereas post Keynesians argue that credit rationing is a conduit additional to changes in interest rates.

3.4 The post Keynesian transmission mechanism and endogenous money

In contrast to both neo-Keynesian and New Keynesian analysis, post Keynesians claim that the money supply is endogenously determined by the demand for money. That is, central banks set the short-term interest rate and allow the money supply to adjust to whatever level of money and credit is demanded at that interest rate. The monetary policy transmission mechanism, therefore, in post Keynesian analysis, runs from a change in interest rates to changes in domestic demand; and also to changes in the exchange rate in flexible exchange rate systems so that changes in interest rates also affect net exports.

Moore (1988) is the most prominent expositor of the post Keynesian position. He argues that banks act as price setters and quantity takers in retail loan markets; the price (interest rate) on loans being determined as a mark-up over the wholesale cost of funds which is itself determined by the central bank's influence over short-term interest rates. Once the banks set interest rates, they accept whatever quantity of deposits is lodged with them, and supply whatever quantity of credit money (loans) is demanded from them at those interest rates. Thus, the supply of credit money is perfectly elastic with respect to the loan rate of interest which explains the term 'horizontalists' in the title of Moore's book, *Horizontalists and Verticalists: The Economics of Credit Money*. To the extent that expenditures are interest rate elastic, monetary policy works through the effect of the central bank's change in short-term interest rates on other interest rates, and the subsequent effects of the change in retail loan interest rates upon expenditure decisions.

Other prominent expositors of the post Keynesian position with respect to the endogeneity of money in credit markets are Rousseas (1986) and Wray (1990). However, in contrast to Moore, they do not take as horizontalist a position. Although they agree that the central bank is able to determine the short-term rate of interest, and it is by using this means, rather than by changing the money supply, that the central bank effects monetary policy; they argue that either increasing competition for funds, in the absence of full accommodation of increases in the demand for money by the central bank, or riskier leverage ratios (of both borrowers and banks) will ultimately cause the banks to increase interest rates. Thus, the supply curve of credit money will not be perfectly elastic with respect to the interest rate as argued by those post Keynesians who take a horizontalist position but instead will be positively sloped, but not for the reasons in neo-Keynesian and New Keynesian analysis where the central bank is assumed to be able to control the money supply. Rather, the first step in the causal process is still an increase in the demand for credit money. It is this increase in the demand for money which then generates an increase in the supply of credit money from the banking system and ultimately an increase in interest rates. Thus, even on this view, the money supply is still endogenously determined by the demand for money. Pollin (1991) has given the term *structuralists* to those post Keynesians who hold that the money supply curve is upward sloping. Lavoie (1992, pp. 202-203) is highly critical of the approach of the structuralist post Keynesians: "To claim that a growing economy will eventually trigger rising (real) interest rates, presumably as a consequence of excess credit demand or lack of savings, is to reintroduce scarcity analysis through the back door. This would be the exact antithesis of the endogenous credit money theory."

That monetary policy is transmitted to the real economy via changes in short-term interest rates, as post Keynesian analysis describes, has been canvassed by Australian central bankers, Ian Macfarlane, the current Deputy Governor of the Reserve Bank of Australia, and Glenn Stevens. Macfarlane and Stevens (1989, p. 4) state: "... short-term interest rates are, for all intents and purposes, the first line in the process by which monetary policy is "transmitted" to the economy. This is the case not only in Australia, since deregulation of interest rates, but also in most developed economies." Further, Macfarlane and Stevens (1989, p. 5) are explicit about the endogenous determination of the money supply: "For all intents and purposes, the quantity of "money", defined as M1, M3 or some other "M", will be determined endogenously: there is no thought of the central bank actually directly controlling the supply of this "M", as is assumed in the conventional textbook treatment, which describes the first stage of a change in monetary policy as "ΔM"." They go on (1989. p. 6) to state that the starting point of the monetary transmission process is a change in overnight rates of interest which will then become reflected in other rates of interest.[7]

Macfarlane and Stevens argue that the next stage of the transmission mechanism is due to substitutability between various financial and real assets so that savings, consumption and investment decisions respond to changes in interest rates, that prices in labour and goods markets are sticky so that monetary policy has short-run effects, but that monetary policy is neutral in the long-run. This is where Macfarlane and

[7] I have discussed the mechanics of how the Reserve Bank of Australia determines short-term interest rates, and given a diagrammatic exposition of how, when the RBA determines short-term interest rates, the money supply becomes endogenously determined by the demand for money in Rogers and Neal (1994, pp. 267-270 and pp. 276-281).

Stevens depart from the post Keynesian description of the transmission mechanism. In fact, the analysis is neo-Keynesian. The change in short-term interest rates appears to cause portfolio disequilibrium so that substitutability between financial and real assets must take place in order to restore portfolio balance. Lavoie (1992, p. 185), a post Keynesian, is critical of this portfolio disequilibrium approach: his argument is that money earns a rate of interest similar to that earned on bonds. Consequently, in post Keynesian analysis, an increase in interest rates on bonds does not induce a flight away from money; rather the relative interest rates on money and bonds would need to change. Thus, there is no reason to believe that there should be a negative relationship between interest rates and some measure of the broad money stock.

The post Keynesian transmission mechanism is through central bank influence over interest rates and the subsequent effects of changes in interest rates upon interest elastic expenditures, or through direct credit controls. I have previously shown in Neal (1993) that the central bank can influence interest rates only in the region in which expenditures are relatively interest rate inelastic. Once the central bank attempts to push interest rates into regions in which expenditures are interest rate elastic, the resulting change in the level of income brings about a change in the quantity of money demanded, so that the monetary policy change in interest rates is offset by a subsequent change in interest rates in the opposite direction brought about by the change in money demand. Harper (1991, p 15, p. 16 and p. 18) comes to similar conclusions with respect to Australian experience: "There is a limit to the length of time over which the RBA can keep the cash rate at its level of choosing", "[t]he induced changes in the demand for cash will tend to *counteract* the stimulatory or restrictive effects of changes in the supply of cash. Another way to make the same point is to say that the long-run impact of monetary policy is neutral, i.e., non-existent" and "[i]n particular, the central bank will not be able to maintain a particular level of the cash interest rate without repeated bursts of monetary contraction or expansion. Interest rate targeting in the long term is ineffective and in the short-term is probably pro-cyclical."

Furthermore, Rogers (1995) argues that monetary policy actions based upon interest rates as the instrument of monetary policy may be impotent for another reason. This is because, although a decline in interest rates instituted by the central bank may lead to increased investment due to the increase in the net present value of capital assets; the decline in interest rates may also impact negatively upon wages and prices which will then feed through into a reduction in the marginal efficiency of capital through the effects of reduced wages and prices on the expected returns to investment. This will have the effect of reducing investment demand. Thus, the demand by firms for investment may rise or remain unchanged with respect to an easing of monetary policy even though real balances may be increasing. Whether monetary policy is effective or not may depend on the relative impact of interest rate changes on the demand and supply sides of the economy.

Important, then, to the post Keynesian description of the monetary policy transmission mechanism is that causation runs from a change in interest rates exogenously engineered by the central bank to changes in activity. Money is unimportant in the transmission mechanism. The Australian evidence based on Granger causality tests, the results of which are presented in the following section provides some limited support for the post Keynesian description of the transmission mechanism.

3.5 Australian evidence on the transmission mechanism

To determine whether there is any basis, in fact, for preferring one description of the monetary policy transmission mechanism over the others, Granger causality tests were undertaken using Australian data which looked at the relations between either monetary aggregates, interest rates or credit and measures of nominal and real activity. Granger causality is said to exist if when Y_t is regressed against lagged values of Y_t and X_t, the estimated coefficients on X_t are significantly different from zero; but when X_t is regressed against lagged values of X_t and Y_t, the estimated coeffecients on Y_t are insignificantly different from zero. In this case, X_t is said to Granger cause Y_t, that is, the addition of X_t to the lagged values of the dependent variable generates better predictions than the information contained in past values of the dependent variable alone. Granger causality is therefore a test of whether a variable aids in prediction of another, not a direct test of causality. Nevertheless, the information derived from Granger causality tests may be exploited for monetary policy purposes in the manner previously described with reference to Benjamin Friedman (1988) if the central bank is prepared to systematically react to observed movements of variables which are good predictors of changes in activity or prices.

Variables used in the Granger causality tests are M3, broad money, nominal and real private final demand which is the sum of private consumption expenditure and private gross fixed capital expenditure, nominal and real GDP, credit (all seasonally adjusted) and the 90 day bank accepted bill rate as the nominal short-term interest rate and the 2 year Treasury bond rate as the nominal longer-term interest rate. For measures of real interest rates, the nominal rates were discounted by the CPI. The CPI was used as it is the most accessible and widely disseminated measure of inflation and it avoids the problems associated with proxying for expectations. All data are quarterly. Prior to the Granger causality tests, the variables to be used in the tests were tested for unit roots. Many time series are not stationary in levels. These series have time varying means and variances which mean that the usual tests used to gauge statistical significance of results do not hold. Most time series can be made stationary by first differencing the series, and if not by first differencing, by subsequent differencing. Appendix 3.1 discusses further the issue of testing for (non)stationarity and unit roots and Appendix 3.2 shows the results of the tests for unit roots. Only credit proved to have a unit root. However, because we are interested in the effects of *changes* in interest rates, money or credit on *changes* in PFD and GDP, all series were first differenced and the Granger causality tests undertaken with the first differenced variables other than with respect to the yield spread between the 10 year Treasury bond rate and the 90 day bank accepted bill rate. (A stationary variable when first differenced will remain stationary.) The results of these tests are presented in tables at the end of this chapter. First differenced variables, in these tests, are quarterly changes. Thus, the first column in Table 3.2, for example, presents the F-statistics for the test which regresses the quarterly change in M3 on lagged values of itself and on lagged values of the quarterly change in private final demand. Each test was undertaken for lags of one to six quarters.

The sample period was split into two sub-samples: the first being the period of regulated financial markets with the Granger causality tests covering the period from the September quarter of 1971 until the December quarter of 1983, and the second being the period in which financial markets were deregulated from the March quarter of 1984 to the June quarter of 1994. In December 1980, interest rate ceilings were removed from bank deposits. In June 1982, quantitative lending controls over banks were lifted and in December 1983, the Australian dollar was floated. Repurchase agreements between the Reserve Bank and the authorised money market dealers were introduced in August 1994. Attempts at targeting the growth rate of M3 were formally abandoned in January 1985. The implication for the transmission mechanism of these deregulatory changes is that monetary policy switched from being implemented through changes in money to being implemented by changes in interest rates. Because of a lack of data, tests with broad money and credit could only be carried out from the June quarter of 1978.

A verbal summary of the results of the Granger causality tests which enables quick comparisons between the sample periods appears in Table 3.1 at the end of this chapter. Tests were conducted using both nominal and real activity and interest rate variables. Unless indicated otherwise, all variables in Table 3.1 refer to their values in nominal terms. Data was derived from the dX database and various issues of Reserve Bank of Australia, *Bulletin*. The results of the Granger causality tests for the regulated sample period are presented in Table 3.2, for the deregulated sample period in Table 3.3 and for the whole sample period in Table 3.4.[8] The variables are defined as follows: DM3 is the quarterly change in M3, DBM is the quarterly change in broad money, DBAB90 is the quarterly change in the 90 day bank accepted bill rate, DBOND2IR is the quarterly change in the 2 year Treasury bond rate, DBAB90RL is the quarterly

[8] I am not sure that the results for the whole sample period have any real meaning, because the structural characteristics of the financial markets changed so much between the regulated and deregulated periods. Nevertheless, I have included them for the sake of completeness for those people who argue, for example, that causality *always* runs from money to activity.

change in the real 90 day bank accepted bill rate, DBOND2IL is the quarterly change in the real 2 year Treasury bond rate, DCRED is the quarterly change in credit, SPREAD is the yield spread between the 10 year Treasury bond rate and the 90 day bank accepted bill rate, DPFD is the quarterly change in private final demand, DPFDRL is the quarterly change in private final demand in real terms, DGDP is the quarterly change in GDP, and DGDPRL is the quarterly change in GDP in real terms.

The results are interpreted as follows. In Table 3.2, for example, the top part of the first column shows the F-statistic associated with the Granger causality test of adding changes in private final demand to changes in M3 from an equation regressing changes in M3 both on lagged values of itself and lagged values of private final demand. The bottom part of the first column shows the F-statistic from a regression of private final demand on lagged values of private final demand and lagged values of M3. If the F-statistics in the top part only of the first column of Table 3.2 prove to be significant, then private final demand is said to Granger cause M3. That is, changes in private final demand added to changes in M3 are more successful in predicting changes in M3 than are changes in M3 alone. If the F-statistics in the bottom part only of the first column of Table 3.2 prove to be significant, then M3 is said to Granger cause private final demand. That is, changes in M3 when added to changes in PFD are more successful in predicting changes in private final demand than are changes in private final demand alone. If the F-statistics in both the top and bottom parts of the first column of Table 3.2 are significant, then feedback effects between M3 and private final demand exist. If the F-statistics in the top and bottom of the first column of Table 3.2 are insignificant then there is no Granger causal relationship between M3 and private final demand. More generally, if the F-statistics in only the top part of any of the tables are significant, then the activity variables are said to Granger cause the money, interest rate and credit variables. If the F-statistics in only the bottom part of the tables are significant, the money, interest rate and credit variables are said to Granger cause activity.

Table 3.2 indicates that there are feedback effects between M3 and private final demand in nominal terms for the regulated sample, and that the other measures of activity: real private final demand, nominal GDP and real GDP appear to Granger cause M3 (although there is a slight indication of possible feedback effects). These are interesting results, because it is in this regulated period that the transmission mechanism is supposed to have run from changes in money to changes in activity as described by the neo- and New Keynesians. Here, in contrast, our analysis shows that changes in activity predict changes in money rather than the other way around as in the conventional view. These results are, in fact, more consistent with the post Keynesian view that loans make deposits. An increase in economic activity requires finance, particularly for working capital. Firms approach banks or other financial institutions for loans, which, if they believe that the loans will be profitable, agree to finance the projects. The loans are made, deposits are increased and subsequent to that, the banks look for reserves to support those deposits. The central bank is unable to refuse the banks the reserves that they require lest the stability of the financial system be threatened. The money base expands as does the money supply.

I have previously described in Rogers and Neal (1994, pp. 276-277) why, I believe, even prior to deregulation, it was unlikely that the money supply was under the control of the Reserve Bank but I feel it is worth reproducing here at length:

"As indicated by the Reserve Bank in its 'Meeting on Monetary Issues' in 1985,[9] discussion of the first two of the following points led to general agreement among the participants of the meeting that (page 2) ' ... the supply of money base was better regarded in the short run as demand-determined, but at a price set in the market place (which will be influenced by the setting of monetary policy).' First, the money base is comprised mostly of currency held by the non-bank private sector (over three-quarters of the money base in 1992 was currency) and it has always been Reserve Bank practice to meet any change in the demand for currency. Thus, the money base is largely demand-determined by the demand for currency. Second, statutory reserve deposits were determined by the level of trading bank deposits in the previous month, meaning that an increase in deposits led to an increase in the money base rather than vice-versa. The Reserve Bank could not, in the short-run, withhold base money but only affect the price at which it was made available. The stability of the banking system could otherwise have been threatened. Third, holdings by the banks of LGS assets in excess of minimum requirements could be used to offset the effects of any changes in required reserve ratios. Fourth, prior to the floating of the exchange rate Australia was operating under what was effectively a fixed exchange rate regime. In such circumstances, an increase in the terms of trade, for example, led to increases in foreign exchange reserves of the Reserve Bank and so to an increase in the money base unless sterilised by open market sales or an increase in the administered yield on government securities.[10] In the absence of effective capital controls, higher interest rates increased capital inflow generating increases in the money base which offset the initial effects of the monetary policy action."

It seems, therefore, to have even been the Reserve Bank's view that base money and so the money supply was demand determined even when financial markets were regulated. That the activity variables appear to Granger cause M3 appears to be consistent with that view. Table 3.2 shows that there was no causal relationship between broad money and the activity variables in the regulated sample period with the single exception of the change in nominal PFD causing a change in broad money for one quarter only. The lack of a causal relationship is probably because of the short sample period for broad money, which because of the number of lags in the estimations limits the degrees of freedom making it difficult to obtain statistically significant results.

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[9] For further discussion of these issues see 'Meeting on Monetary Issues', Reserve Bank of Australia, *Bulletin*, December 1985, pp. 1-4.

[10] Prior to the introduction of the tender system for the issue of Commonwealth Government securities, these securities were issued 'on tap'. That is, securities were continuously available from the Reserve Bank, which determined the yield on bonds when first issued, and was then supposed to move the yield in line with market conditions.

In the deregulated sample period, Table 3.3 provides evidence again of two way causality between M3, and private final demand and GDP in nominal terms, and evidence that real private demand and real GDP seem to Granger cause M3 (although the former exhibits some feedback effects for the second and third quarters). The effects of changes in real GDP appear to last only one year. In contrast to the regulated period, there are feedback effects between nominal GDP and M3 for eighteen months when financial markets are deregulated. In addition, Table 3.3 indicates that there are now Granger causal relationships between activity and broad money. Real private final demand and real GDP appear to Granger cause broad money, there is some six months feedback between nominal GDP and broad money but further back it seems that nominal GDP aids in prediction of broad money. Feedback effects exist between nominal PFD and broad money. Two way causality and activity variables which Granger cause money are consistent with post Keynesian analysis which suggests that as activity increases so also does the demand for money. Lenders respond with an increase in the supply of money which may be applied to a further increase in activity. Two way causality and activity variables which Granger cause money are inconsistent with the neo- and New Keynesian explanations of the transmission mechanism.

For the whole sample period which extends over both the time of regulated and deregulated financial markets, the results of which are presented in Table 3.4, there is two way causality between M3 and all activity variables, and between broad money and the nominal activity variables. Real private final demand and real GDP appear to Granger cause broad money. The interesting point to note with respect to the above discussion of the results of the Granger causality tests using monetary aggregates is that at no time did money Granger cause activity. This suggests that the transmission of monetary policy in Australia, even in regulated financial markets, was not *from* money *to* activity. At best, there was a two way relationship between money and activity in which changes in money affected activity but was itself also influenced by changes in activity.

Now consider changes in nominal interest rates. For the regulated sample period, Table 3.2 indicates that changes in nominal short-term interest rates predict changes in nominal activity for 6 to 15 months ahead, but that changes in real activity Granger caused changes in nominal short-term interest rates. Perhaps this is consistent with the fact that monetary policy is often aimed at reducing the rate of inflation. Tight monetary policy is therefore aimed at quickly reducing the level of nominal activity in order to bring about that reduction in the inflation rate. Thus, changes in nominal short-term interest rates lead to changes in nominal activity. In the longer term, however, real activity will also be reduced. The reduction in real activity leads to a reduction in the demand for money which, in turn, leads to a reduction in interest rates if the central bank is targeting the money supply, as it was when financial markets were regulated. Thus, it is quite consistent that changes in nominal short-term interest rates Granger cause changes in *nominal* activity whilst changes in *real* activity Granger cause nominal short-term interest rates. Similar results hold for longer term interest rates (2 year Treasury bond rates). There is some evidence from Table 3.2 that changes in real activity Granger caused changes in nominal longer-term interest rates, while changes in nominal longer-term interest rates Granger caused nominal private final demand. The causation also mostly runs from nominal longer term interest rates to nominal GDP although there is some evidence of feedback in the second and third quarters.

The analysis of the previous paragraph suggests that, in Australia, even when financial markets were regulated, and the transmission of monetary policy was supposed to be through changes in money, it was in fact, transmitted through changes in short-term interest rates as argued by the post Keynesians. In addition, there was some impact on nominal activity from nominal longer-term interest rates.

Table 3.3 indicates that there is two way causality between nominal short-term interest rates and nominal activity in the deregulated sample period consistent with post Keynesian analysis as previously described although the predictive power of the equations is only weakly significant. Changes in real private final demand Granger cause changes in nominal short-term interest rates whilst there appears to be almost no relationship between changes in real GDP and changes in nominal short-term interest rates (although real GDP predicts the 90 day bank accepted bill rate one quarter and six quarters ahead). Changes in nominal longer-term interest rates appear to Granger cause changes in nominal private final demand (although there is a feedback effect for the first quarter) and Granger cause changes in nominal GDP for only two quarters.

For the entire sample period, Table 3.4 shows that changes in real activity Granger cause changes in nominal short-term interest rates, and that real private final demand Granger causes changes in nominal longer-term interest rates. Changes in nominal longer-term interest rates Granger cause changes in nominal activity and there appears to be no causality between changes in nominal longer-term interest rates and changes in real GDP. There is little to suggest here that any of the Keynesian explanations of the transmission mechanism is adequate.

Of more interest, perhaps, are the tests using real interest rates. In the regulated sample period, as indicated in Table 3.2, changes in real short-term interest rates appear to largely Granger cause nominal private final demand (although there are feedback effects in two quarters). Changes in real activity Granger cause changes in real short-term interest rates. As to changes in real longer-term interest rates, these are predicted by changes in real activity and by changes in nominal GDP, and there is two way causation between 2 year Treasury bond rates and nominal private final demand which suggests again the inadequacy of any of the Keynesian descriptions of the transmission mechanism.

In the deregulated sample period, changes in real activity predict changes in real short-term interest rates as shown in Table 3.3. Feedback exists between real short-term interest rates and nominal private demand, and to a lesser extent, nominal GDP. This seems suggestive of a monetary policy reaction function where changes in nominal activity, particularly if brought about by changes in the price level, lead the monetary authorities to respond with a tightening or loosening of policy with offsetting effects.

Since financial markets were deregulated, the Reserve Bank of Australia has been reactive rather than proactive in its policy stance. The transmission mechanism is generally viewed as starting with some action of the central bank; but the reactive stance of the RBA suggests that the transmission mechanism, in fact, begins with a change in activity and/or prices. For example, economic activity and prices may increase rapidly. This may lead the RBA to increase the cash rate which then feeds through into rises in other interest rates along the maturity spectrum. The rise in interest rates then causes the exchange rate to appreciate and interest rate sensitive consumption and investment expenditures to fall. Both of these effects will cause activity and prices to fall, offsetting the initial increase in activity and prices.

That the Reserve Bank is reactive rather than proactive should lead us to expect two way causality between activity and prices and interest rates. The Reserve Bank cannot be sure of the number of percentage points by which the cash rate needs to be changed to cause activity and prices to return to their target values. If the Reserve Bank gets it right, then the monetary policy action will just offset the initial increase in activity and prices, and monetary policy will be neutral with respect to real output in the long-run. If, as is more likely, the Reserve Bank gets it wrong, then changes in prices and activity lead to changes in interest rates which lead to changes in prices and activity - hopefully in a virtuous circle as the Reserve Bank homes in on the extent of the change in interest rates required to return prices and activity to their target levels. Thus, two way causality exists as the increase in activity and prices cause the Reserve Bank to raise interest rates, and the rise in interest rates leads to a subsequent decline in activity and prices.

The reason for the Reserve Bank's reactive rather than proactive stance is that quantity variables such as the monetary and credit aggregates show no consistent relationship with prices and activity. To conduct monetary policy without quantity variables requires either that interest rates be used as the instrument of monetary policy or that direct credit controls be imposed. In keeping with deregulation of financial markets, the Reserve Bank's choice has been to use interest rates as the instrument of monetary policy.

The Reserve Bank has not always made clear the objectives of its then current monetary policy actions. This was particularly evident when the Reserve Bank was explicitly using a checklist approach to monetary policy. There has been an increased emphasis in recent years on maintaining a low inflation rate and low inflationary expectations. At other times, it appears the emphasis is on generating increases in nominal income sufficient to generate job growth. Edey (1989) provides a theoretical analysis of monetary policy rules specified in terms of the interest rate as the instrument of monetary policy. Edey's explanation of money supply determination is consistent with the position of the accommodationist post Keynesians who suggest that the central bank sets short-term interest rates and that the money supply is endogenously determined by money demand (p. 150): "[U]nder an interest rate rule with price level target, the money demand function plays no part in determining either prices or the interest rate; its only role is in determining the stock of money once these other variables have been determined."

Edey sets up a very simple neoclassical model where output supply is fixed at the natural rate and where excess demand in the goods market depends on the nominal interest rate less the expected rate of inflation and money demand depends positively on the inflation rate and real income in the current period and negatively on the nominal interest rate. Price level determination depends on shocks to excess demand in the goods market. If excess demand increases, flexible prices ensure that the price level will increase so that the market clears. Edey suggests that the two necessary conditions for this to occur are that (p. 151) "... real demand must be sensitive to the real interest rate; and secondly, the policy target must be expressible in terms of a nominal level." The second condition can easily be met by targeting, for example, nominal income. This will tie down the price level.

The first condition, which reflects the transmission mechanism of policy changes, is more difficult and is not under the control of the central bank. The empirical work of this chapter indicates that, in deregulated financial markets, real demand is not sensitive to changes in real interest rates. Rather, changes in real private final demand and real GDP *predict* changes in real short-term interest rates. There is virtually no relationship between real longer term interest rates and real PFD or real GDP.

Benjamin Friedman (1988, pp. 444-445) is a critic of interest rate targeting for monetary policy purposes even though he acknowledges that there is no longer a consistent relationship between monetary or credit aggregates and activity. His criticism comprises three parts. First, he argues that with targeting of interest rates, there is no nominal quantity to anchor the price level. This problem is easily addressed by following a policy which varies interest rates in response to deviations of nominal output from its target value as suggested by Edey. That is, the policy variable to be targeted is nominal income, not the interest rate. Friedman's criticism rests on confusion between the instrument and the policy objective. His third criticism of the targeting of interest rates is that Federal Reserve officials make just that mistake and so delay too long the implementation of changes in interest rates or make changes of insufficient magnitude. Friedman's second criticism is that agents, including Fed officials, often fail to distinguish nominal from real interest rates. Consequently, changes in nominal interest rates are perceived by agents to be changes in policy stance even when the real interest rate has not changed. Moreover, determination of the real interest rate is problematic, given the variation in inflationary expectations across agents. Therefore, in some cases, it is difficult for the central bank to determine whether it is easing or tightening monetary policy, particularly given that changes in the official cash rate in Australia are generally of small magnitude.

However, as already indicated, the problem is more deep-rooted. Unless demand responds to changes in interest rates, interest rates are not, in fact, the mechanism by which monetary policy actions are transmitted to the economy. The empirical work of this chapter shows there is feedback between longer-term interest rates and nominal private final demand for a short period, no relationship between longer-term interest rates and real private final demand, changes in nominal GDP Granger cause changes in longer term interest rates (although there is feedback in the first quarter) and changes in real GDP appear to Granger cause changes in longer-term interest rates for only two quarters. Furthermore, the use of interest rates as the instrument of monetary policy has unfortunately led to non-systematic actions by the Reserve Bank which has led to increased uncertainty in financial markets with respect to monetary policy actions with the additional costs that are imposed by uncertainty. That increased uncertainty, of itself, has led to agents demanding a higher liquidity premium, and thus has led to higher nominal interest rates. The relationship between interest rates and uncertainty is discussed further in Chapter 6.

It is interesting to note that, in the deregulated sample period, the time in which the transmission of monetary policy is supposed to have been through interest rates, neither changes in real short-term nor real long-term interest rates have Granger caused changes in either nominal or real activity. At best, there has been two way causality between interest rates and private final demand. Otherwise, changes in activity have predicted changes in real interest rates. It seems then that the current received wisdom of the transmission mechanism in deregulated markets running from changes in interest rates to changes in activity may also not be in order, as was the case with money in regulated markets. This point is taken up by Milbourne (1990, p. 267): "... the correlation and timing between the real interest rate and investment does not support a standard monetary transmission explanation".

For the whole sample period, the results presented in Table 3.4 suggest that there is two way causality between changes in both short- and long-term interest rates and nominal activity, and that changes in real activity Granger cause changes in both short- and long-term interest rates.

Rather than working through changes in the *level* of interest rates, it may be that monetary policy is transmitted by changing the slope of the yield curve by changing the yield spread, i.e., the difference between long-term and short-term interest rates. The yield spread used in the empirical tests reported in this chapter is the 10 year Treasury bond rate less the 90 day bank accepted bill rate. Table 3.2 shows that there was some amount of two-way causality between the yield spread and changes in nominal PFD and GDP when financial markets were regulated. In contrast, changes in real PFD and real GDP were found to Granger cause changes in the yield spread.

When financial markets were deregulated, there was again some degree of two-way causality between the yield spread and the nominal activity variables, although the effect ran more strongly over a longer time period *from* activity *to* the yield spread as indicated in Table 3.3. As was the case with regulated financial markets, the activity variables in real terms were found to have Granger caused the yield spread. Over the whole sample period, there was two-way causality between the nominal activity variables and the yield spread; and the real activity variables were found to predict the yield spread as shown in Table 3.4.

Whereas New Keynesians suggest that the transmission mechanism may work through a credit channel as well as through a money channel; the post Keynesians agree that while transmission may take place through a credit channel, it is in addition to an interest rate channel rather than a money channel. To this point, the Australian evidence presented here favours the post Keynesian explanation of an interest rate channel for the time when financial markets were regulated, but it seems that the transmission mechanism is not as straightforward as any of the Keynesian explanations for it since financial deregulation. Consider now the tests for whether Granger causality exists between credit and activity. Table 3.2 shows that no Granger causality was found in regulated markets. However, these results need to be interpreted with caution because the short availability of credit data meant that the number of observations was limited, limiting the degrees of freedom making it much more difficult to obtain statistically significant results. Since financial markets have been deregulated, the Granger causality tests in Table 3.3 show that there has been two way causality between changes in credit and changes in nominal activity, and that changes in real activity have Granger caused changes in credit. Similar results, noted in Table 3.4 pertain to the entire sample period.

3.6 Implications for Monetary Policy

What does the empirical work of this chapter suggest for the conduct of monetary policy in deregulated financial markets? First, no simple Keynesian description of the transmission mechanism is adequate to the explanation of the interaction between monetary policy and nominal or real activity. Second, changes in monetary aggregates do not lead changes in nominal or real activity. At best, there is a two way relationship between money and nominal activity. Changes in real activity predict changes in money. Thus, monetary aggregates should not be considered to be a control variable in monetary policy. Third, as with money, there is no clear relationship between interest rates or the yield spread and activity. There is two way causality between both nominal and real short-term interest rates and nominal activity. This may be indicative of a monetary policy reaction function. Consequent upon a fall in interest rates, the demand for money increases and activity picks up. Central bank monetary policy actions have become reactive rather than proactive. Two way causality between interest rates and activity means that interest rates may not be all that effective as a control variable in monetary policy. In any case, see Neal (1993) for a more complete exposition of how it is that the central bank can only influence interest rates for the longer-term in the region in which expenditures are interest rate inelastic. The effectiveness of monetary policy, therefore, seems to me *not* to be determined by changes in interest rates *per se*, a view which is supported by the results of the Granger causality tests. Instead, the effectiveness or otherwise of monetary policy may derive from the impact of a change in interest rates on agents' expectations. If the central bank can force a decline in expectations, liquidity preference and activity will fall.

If monetary policy changes are effective because of their impact upon expectations, then there are serious implications for the behaviour of the Reserve Bank. All monetary policy changes in interest rates and the reasons for those changes should be announced. This has been done in Australia in recent years. Changes in interest rates should be made in larger steps than hitherto, otherwise the central bank may be changing interest rates only in the region where expenditures are interest rate inelastic in which case monetary policy is ineffective. This necessitates further actions by the central bank and increases the lag between the implementation of monetary policy and its impact upon activity. Lavoie (1992) and Kaldor (1964) are (and were) of similar opinion. (Lavoie (1992, p. 187) noted drawing on Kaldor's work: "While small variations in interest rates have little impact on economic activity, large fluctuations in interest rates provoke large swings in production. 'Relatively moderate changes in interest rates may have no certain or predictable effect on either consumer expenditure or on business expenditure ... Only drastic and spectacular changes in interest rates can be counted on to exert a marked effect on capital expenditures' (Kaldor, 1964, pp. 132, 134)". That there is two way causality between changes in credit and changes in nominal activity indicates that a credit channel as distinct from a money channel or interest rate channel is also part of the transmission mechanism. This suggests that quantitative controls over the amount and type of credit lending may be an appropriate tool of monetary policy. Whereas changes in interest rates are a very blunt instrument impacting across all areas of the economy, controls over credit flows may be applied to those areas where they are most needed without adverse impact in other areas. For example, in

Australia in 1994 it was considered that the housing market was overheating raising the prospect of asset price inflation in that market. The Reserve Bank reacted with several increases in official interest rates. Perhaps, it would have been preferable to control the flow of credit to that market so that interest rates did not adversely impact upon investment expenditure in other areas.

3.7 Conclusion

This chapter canvassed the three major contemporary Keynesian perspectives; the neo-Keynesian, New Keynesian and post Keynesian perspectives, on how monetary policy is transmitted and presented results based upon Granger causality tests to determine whether there is any basis for preferring one description of the monetary policy transmission mechanism over another. All of the Keynesian descriptions of the transmission mechanism were shown to be inadequate to their task when applied to deregulated financial markets in Australia. This suggests that the transmission mechanism as it currently operates in Australia is ill-understood.

Anticipated by the proponents of deregulation was the elimination of non-price credit rationing. In recent years, there has been a renewed interest in whether, in fact, non-price credit rationing has remained a feature of the monetary policy transmission mechanism even when when banks have been free to adjust the interest rate on loans. The remaining chapters of this thesis address this issue and its implications for the treatment of uncertainty in Keynesian monetary economics and financial stability.

Table 3.1 Summary of Granger Causality Tests for Monetary Policy Transmission Mechanism[(a)]

Deregulated Financial Markets	Regulated Financial Markets	Entire Sample Period
2 way causality between M3 & private final demand	2 way causality between M3 & private final demand	2 way causality between M3 & private final demand
Real private final demand Granger causes M3	Real private final demand Granger causes M3	2 way betweem M3 and real private final demand
2 way causality between M3 and GDP	GDP Granger causes M3	2 way causality between M3 and GDP
Real GDP Granger causes M3	Real GDP Granger causes M3	2 way causality between M3 and real GDP
2 way between broad money and private final demand	No causal relationship between BM & PFD	2 way between broad money and private final demand
Real private final demand Granger causes broad money	No causal relationship between BM & real PFD	Real private final demand Granger causes broad money
GDP Granger causes broad money	No causal relationship between BM & GDP	2 way between broad money and GDP
Real GDP Granger causes broad money	No causal relationship between BM & real GDP	Real GDP Granger causes broad money
2 way between 90 day bill rate & private final demand	90 day bill rate Granger causes private final demand	2 way between 90 day bill rate & private final demand
Real private final demand Granger causes 90 day bill i/r	Real private final demand Granger causes 90 day bill i/r	Real private final demand Granger causes 90 day bill i/r
2 way between 90 day bill rate & GDP	90 day bill rate Granger causes GDP	2 way causality between 90 day bill rate and GDP
No causal relationship between 90 day i/r & real GDP	Real GDP Granger causes 90 day bill rate	Real GDP Granger causes 90 day bill rate
2 yr Treasury bond i/r Granger causes PFD	2 yr Treasury bond i/r Granger causes PFD	2 yr Treasury bond i/r Granger causes PFD
No cansal relationship between 2 year i/r and PFD	Real PFD Granger causes 2 year Treasury bond rate	Real PFD Granger causes 2 year Treasury bond rate
2 year Treasury bond rate Granger causes GDP	2 way causality between 2 year bond rate and GDP	2 year Treasury bond rate Granger causes GDP
No causality between 2 year bond rate & real GDP	Real GDP Granger causes 2 year Treasury bond rate	No causality between 2 year bond rate & real GDP

(a) Table is continued on next page.

Table 3.1 Summary of Granger Causality Tests for Monetary Policy Transmission Mechanism (continued)

Deregulated Financial Markets	Regulated Financial Markets	Entire Sample Period
2 way cansality between real 90 day bill i/r & PFD	Real 90 day bill rate Granger causes PFD	2 way causality between real 90 day bill i/r & PFD
Real PFD Granger causes 90 day bill rate	Real PFD Granger causes 90 day bill rate	Real PFD Granger causes 90 day bill rate
GDP Granger causes 90 day bill rate	GDP Granger causes 90 day bill rate	2 way causality between 90 day bill rate and GDP
Real GDP Granger causes 90 day bill rate	Real GDP Granger causes 90 day bill rate	Rcal GDP Granger causes 90 day bill rate
2 way causality between real 2 year bond rate and PFD	2 way causality between real 2 year bond rate and PFD	2 way causality between real 2 ycar bond rate and PFD
No causal relationship between 2 year i/r & real PFD	Private final demand Granger causes 2 year bond rate	Private final demand Granger causes 2 year bond rate
GDP Granger causes 2 year Treasury bond rate	GDP Granger causes 2 year Treasury bond rate	2 way causality between 2 year bond i/r and GDP
Real GDP Granger causes 2 year Treasury bond rate	Real GDP Granger causes 2 year Treasury bond rate	Real GDP Granger causes 2 year Treasury bond rate
2 way causality between credit & private final demand	No causal relationship between credit & PFD	2 way causality between credit & private final demand
Real private final demand Granger causes credit	No causal relationship between credit & real PFD	Real private final demand Granger causes credit
2 way causality between credit and GDP	No causal relationship between credit and GDP	2 way causality between credit and GDP
Real GDP Granger causes credit	No causal relationship between credit and real GDP	Real GDP Granger causes credit
2 way causality between yield spread & nominal PFD	2 way causality between yield spread & nominal PFD	2 way causality between yield spread & nominal PFD
Real private final demand Granger causes yield spread	Real PFD Granger causes yield spread	Real PFD Granger causes yield spread
2 way causality between yield spread & nominal GDP	2 way causality between yield spread & nominal GDP	2 way causality between yield spread & nominal GDP
Real GDP Granger causes yield spread	Real GDP Granger causes yield spread	Real GDP Granger causes yield spread

Table 3.2 Granger Causality Tests for Regulated Financial Markets (F-statistics)[(a)]

	Sample: Sept. Qtr 1971 to Dec. Qtr 1983					Sample: June Qtr 1978 to Dec. Qtr 1983			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DM3					DBM				
1	5.64**	6.28**	11.52**	4.82*		4.03*	2.19	.34	.41
2	2.97**	3.32*	5.72**	5.31**		2.28	1.07	.31	.22
3	2.97**	2.84*	4.85**	3.47**		2.34	1.49	.67	.56
4	2.37**	2.14	3.59**	2.51*		1.59	1.04	.50	.60
5	1.88	1.65	2.85**	1.96		1.44	1.07	1.00	.80
6	1.49	1.30	2.34*	1.65		1.27	1.10	.80	.77
1	4.59*	2.42	1.35	2.40		.13	.44	1.62	1.38
2	5.84**	1.21	1.46	3.40*		1.31	.83	.85	.90
3	4.12**	1.18	3.04*	2.21		.98	.55	1.10	.62
4	3.48**	1.24	2.19*	1.76		.96	.87	1.39	1.31
5	3.65**	1.39	1.90	1.60		.70	.61	2.08	1.50
6	3.16**	1.33	1.53	1.60		1.06	1.12	2.09	1.15

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.2 Granger Causality Tests for Regulated Financial Markets (F-statistics continued)[(a)]

	Sample: Sept. Qtr 1971 to Dec. Qtr 1983					Sample: Sept. Qtr 1971 to Dec. Qtr 1983			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90					DBOND2IR				
1	.58	1.72	.25	3.50*		.48	1.23	.50	1.00
2	1.86	2.98*	2.18	4.48**		2.32	3.77*	3.28*	2.76*
3	1.29	2.97*	1.53	2.94*		2.22	4.53**	2.85*	3.87**
4	1.21	2.55*	1.54	3.05**		1.77	3.28**	2.17	2.80*
5	.93	2.21*	1.23	2.47*		1.41	2.74*	1.79	2.13*
6	1.43	2.19*	1.60	2.58*		1.26	2.18*	1.48	1.86
1	2.73	.20	2.02	1.95		2.28	.38	.73	2.49
2	4.95**	.30	.71	1.81		4.90**	.48	.43	1.75
3	3.47**	.28	2.97*	1.39		3.43**	.49	3.13*	1.28
4	3.43**	.64	2.38*	1.03		3.34**	.64	2.53*	.97
5	2.73*	.59	2.11*	.94		2.74*	.75	2.39*	.82
6	2.24	.88	1.67	1.00		2.18*	.74	2.21*	1.23

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.2 Granger Causality Tests for Regulated Financial Markets (continued)[(a)]

	Sample: Sept. Qtr 1971 to Dec. Qtr 1983					Sample: Sept. Qtr 1971 to Dec. Qtr 1983			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90RL					DBOND2IL				
1	1.29	1.74	.99	3.14		5.16**	5.17**	4.81*	4.76*
2	3.10*	3.55**	2.92*	5.68**		4.40**	4.35**	3.80**	3.91**
3	2.54*	3.26**	2.44*	4.56**		3.68**	3.61**	3.56**	3.38**
4	2.02	2.95*	2.35*	4.08**		3.09**	3.43**	3.57**	2.92*
5	1.57	2.37*	1.95	3.21**		2.43*	2.63*	2.94**	2.30
6	1.58	2.15*	3.23**	2.77**		2.10*	2.37*	2.49*	2.37*
1	2.58	.12	.23	2.11		2.28	.54	.13	2.36
2	4.93**	.33	.26	1.95		5.08**	.72	.07	1.98
3	3.75**	.24	2.77*	1.55		3.94**	.49	2.69*	1.55
4	3.74**	.68	2.09	1.14		3.99**	.85	1.93	1.16
5	3.10**	.73	1.77	1.04		3.20**	.78	1.66	.91
6	2.57*	.87	1.57	.97		2.58*	.71	1.49	.97

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.2 Granger Causality Tests for Regulated Financial Markets (F-statistics continued)

		Sample: June Qtr 1978 to Dec. Qtr 1983					Sample: Sept. Qtr 1971 to Dec. Qtr 1983			
No of lags		DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP.	DGDPRL
	DCRED					SPREAD				
1		3.84*	2.77	1.95	.54		8.05**	8.39**	7.70**	13.00**
2		2.80	2.11	2.04	1.09		4.28**	4.46**	5.08**	6.90**
3		3.07*	3.23*	3.05*	1.68		2.98*	3.95**	3.26**	4.98**
4		2.64	2.61	2.65	1.74		2.19*	3.10**	2.38*	3.69**
5		2.30	2.28	2.11	1.35		2.66*	3.53**	3.45**	4.86**
6		1.92	1.80	1.98	1.07		3.10*	3.46**	3.28**	4.71**
1		.11	.36	.93	1.59		2.82	0.57	1.33	1.50
2		1.14	.64	.64	.77		5.01**	0.75	0.67	1.82
3		.81	.38	.59	.83		3.47**	0.53	3.02*	1.77
4		.94	.45	.89	.61		3.42**	0.69	2.20*	1.33
5		1.62	1.36	1.52	1.38		2.71*	0.67	2.10*	1.04
6		1.61	1.20	1.57	2.37		2.16*	0.69	1.77	1.13

* Significant at 5 % level, ** Significant at 1 % level.

Table 3.3 Granger Causality Tests for Deregulated Financial Markets[(a)]

	Sample: March Qtr 1984 to June Qtr 1994				Sample: March Qtr 1984 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL	DPFD	DPFDRL	DGDP	DGDPRL
DM3				DBM				
1	12.89**	10.47**	11.03**	8.96**	24.68**	17.60**	20.98**	15.77**
2	6.59**	5.96**	5.54**	4.86**	14.22**	10.74**	11.28**	8.81**
3	4.56**	3.82**	3.85**	3.14*	9.64**	7.51**	7.57**	5.93**
4	3.61**	2.87*	3.17**	2.26*	7.11**	5.31**	5.73**	4.30**
5	3.71**	2.81*	2.70*	2.07	7.78**	5.18**	6.14**	4.16**
6	3.21**	2.82*	2.68*	1.93	7.15**	5.52**	5.00**	3.55**
1	8.81**	2.51	7.01**	1.48	7.67**	2.18	6.60**	.92
2	6.60**	3.11*	3.42*	1.01	4.07**	1.27	3.21*	.68
3	4.80**	2.38*	2.61*	1.12	2.58*	.85	2.21	.45
4	4.06**	1.71	2.40*	1.80	2.31*	1.22	1.63	.95
5	4.88**	1.34	3.59**	1.93	2.73*	.95	2.05	.97
6	3.88**	1.24	2.94**	1.66	2.48*	.92	1.62	1.01

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.3 Granger Causality Tests for Deregulated Financial Markets (F-statistics continued)[(a)]

	Sample: March Qtr 1984 to June Qtr 1994					Sample: March Qtr 1984 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90					DBOND2IR				
1	7.33**	6.47**	5.11**	3.73*		3.32*	2.83	1.78	.83
2	4.40**	4.09**	3.06*	2.24		1.73	1.59	.89	.50
3	3.01*	3.40**	2.44*	2.00		1.42	1.70	.89	.62
4	2.40*	2.82*	1.88	1.63		1.01	1.23	.66	.44
5	1.84	2.12	1.67	1.53		1.18	1.29	.90	.78
6	2.78*	2.91**	3.14**	4.53**		1.46	2.05	1.05	2.03
1	6.24**	1.98	5.03*	1.31		6.52**	1.95	5.59**	1.12
2	3.95**	1.42	2.94*	.86		4.28**	1.73	2.85**	.61
3	2.65*	1.04	2.31	.56		2.85*	1.17	2.10	.39
4	2.00	.74	2.00	1.29		2.25*	.86	1.54	.86
5	2.21*	.85	2.46*	1.52		2.46*	.86	1.98	1.03
6	1.96	.71	2.02	1.29		2.45*	.90	2.04	1.28

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.3 Granger Causality Tests for Deregulated Financial Markets (F-statistics continued)[(a)]

	Sample: March Qtr 1984 to June Qtr 1994					Sample: March Qtr 1984 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90RL					DBOND2IL				
1	6.08**	4.24*	7.72**	5.38**		4.48*	3.14	6.29**	3.97*
2	6.04**	4.89**	6.86**	5.11**		3.65*	2.77*	4.43**	3.01*
3	3.83**	3.59**	4.45**	3.40**		2.35	1.97	2.98*	1.93
4	3.07*	2.99**	3.79**	3.03*		1.85	1.75	2.38*	1.74
5	2.38*	2.31*	2.90*	2.31*		1.71	1.51	2.40*	1.67
6	2.44*	2.32*	4.08**	3.66**		1.70	1.54	2.05	1.80
1	6.24**	2.06	5.08*	.78		6.22**	2.05	4.72*	.58
2	3.98**	1.32	2.55	.51		3.90**	1.39	2.47	.34
3	2.66**	.95	2.04	.36		2.54*	.89	1.85	.22
4	1.99	.69	1.85	1.36		1.92	.65	1.53	1.06
5	2.25*	.88	2.26*	1.50		2.12	.73	1.95	1.24
6	2.02	.76	1.89	1.22		2.01	.68	1.92	1.20

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.3 Granger Causality Tests for Deregulated Financial Markets (F-statistics continued)

	Sample: March Qtr 1984 to June Qtr 1994					Sample: March Qtr 1984 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DCRED					SPREAD				
1	117.27**	113.29**	91.67**	91.14**		71.22**	60.02**	60.94**	53.52**
2	58.68**	61.27**	48.65**	49.00**		35.34**	29.48**	29.27**	25.65**
3	37.87**	39.74**	31.00**	32.01**		22.87**	19.66**	18.73**	16.27**
4	28.05**	28.15**	22.10**	22.65**		16.66**	14.27**	14.03**	11.88**
5	21.32**	21.78**	19.31**	20.06**		13.24**	11.27**	11.62**	9.49**
6	19.26**	20.74**	17.25**	16.92**		11.20**	8.92**	11.61**	9.46**
1	14.28**	2.62	10.13**	.68		6.23**	3.17	4.98*	0.74
2	8.43**	2.93*	4.92**	.86		3.97**	1.91	2.95*	1.26
3	5.36**	2.21	3.47**	.69		2.67*	1.30	2.26	0.82
4	3.87**	1.76	2.85*	1.12		2.11	0.95	1.61	1.04
5	3.09**	1.40	2.51*	1.24		2.40*	0.84	2.34*	1.80
6	3.03**	1.35	2.40*	1.60		1.93	0.76	1.95	1.43

* Significant at 5 % level, ** Significant at 1 % level.

Table 3.4 Granger Causality Tests for Financial Markets for Entire Sample Period (F-statistics)[(a)]

	Sample: Sept. Qtr 1971 to June Qtr 1994				Sample: June Qtr 1978 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL	DPFD	DPFDRL	DGDP	DGDPRL
DM3				DBM				
1	18.58**	17.71**	23.15**	14.40**	39.87**	28.38**	31.44**	25.57**
2	9.17**	8.88**	11.37**	9.31**	22.30**	16.89**	17.98**	15.24**
3	6.24**	6.03**	8.00**	6.22**	15.60**	12.26**	12.73**	10.78**
4	4.72**	4.56**	6.13**	4.59**	11.58**	9.00**	9.95**	8.16**
5	3.94**	3.91**	4.79**	3.64**	10.57**	7.57**	9.66**	6.63**
6	3.36**	3.37**	4.01**	3.64**	9.66**	7.44**	8.71**	5.95**
1	18.08**	4.07*	5.53**	3.49*	10.38**	2.15	8.88**	.51
2	16.22**	2.74*	3.14*	4.03**	6.69**	1.41	5.16**	.38
3	12.07**	2.89*	7.22**	2.91*	4.31**	1.05	3.99**	.36
4	8.96**	2.62*	5.78**	2.38*	3.82**	2.04	3.59**	1.62
5	7.92**	2.37*	4.90**	2.00*	3.74**	1.59	3.00**	1.26
6	6.65**	2.34*	4.14**	1.91*	3.71**	1.64	2.55*	1.08

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.4 Granger Causality Tests for Financial Markets for Entire Sample Period (F-statistics continued)[(a)]

	Sample: Sept. Qtr 1971 to June Qtr 1994					Sample: June Qtr 1978 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90					DBOND2IL				
1	3.33*	5.60**	1.54	2.05		2.88	3.24*	.29	.30
2	4.01**	5.99**	3.61**	3.13*		2.79*	3.57**	2.37	.54
3	2.62*	5.56**	2.37	2.27*		2.30*	4.52**	2.06	2.06
4	2.42*	4.89**	2.24*	2.55*		1.78	3.49**	1.51	1.63
5	1.89*	4.09**	1.79	2.01*		1.58	2.91**	1.34	1.40
6	2.51**	4.15**	2.60**	2.92**		1.40	2.75**	1.27	1.38
1	14.27**	1.29	2.86	1.75		13.82**	1.32	4.33*	1.80
2	13.78**	1.24	3.33*	1.49		13.88**	1.52	3.06*	1.29
3	9.47**	1.03	6.58**	1.45		9.68**	1.15	6.67**	1.33
4	7.09**	1.06	4.86**	1.11		7.33**	1.19	5.00**	.99
5	5.80**	.94	3.91**	.89		6.04**	1.14	4.01**	.89
6	4.81**	1.09	3.37**	1.08		4.95**	1.15	3.43**	1.02

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.4 Granger Causality Tests for Financial Markets for Entire Sample Period (F-statistics continued)[(a)]

	Sample: Sept. Qtr 1971 to June Qtr 1994					Sample: Sept. Qtr 1971 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DBAB90RL					DBOND2IL				
1	4.42*	4.79*	3.30*	3.23*		9.68**	8.39**	7.98**	7.31**
2	6.90**	7.59**	6.11**	6.51**		8.23**	6.92**	6.51**	5.64**
3	5.00**	6.22**	4.41**	4.41**		6.06**	5.04**	5.00**	3.87**
4	4.04**	5.52**	3.87**	4.32**		5.10**	5.11**	4.58**	4.08**
5	3.23**	4.50**	3.32**	3.45**		4.25**	4.07**	3.92**	3.32**
6	3.18**	4.26**	4.98**	3.28**		3.53**	3.69**	3.46**	2.82**
1	13.89**	1.22	2.95	1.99		13.62**	1.67	2.12	2.21
2	13.76**	1.26	2.31	1.74		13.90**	1.68	1.81	1.68
3	9.57**	.92	6.24**	1.66		9.95**	1.17	6.18**	1.64
4	7.21**	1.06	4.72**	1.28		7.52**	1.25	4.73**	1.27
5	5.85**	.87	3.72**	1.08		6.12**	1.01	3.71**	1.01
6	4.90**	.98	3.34**	1.13		5.07**	.94	3.47**	1.01

* Significant at 5 % level, ** Significant at 1 % level.

(a) Table is continued on next page.

Table 3.4 Granger Causality Tests for Financial Markets for Entire Sample Period (F -statistics continued)

	Sample: June Qtr 1978 to June Qtr 1994					Sample: Sept. Qtr 1971 to June Qtr 1994			
No of lags	DPFD	DPFDRL	DGDP	DGDPRL		DPFD	DPFDRL	DGDP	DGDPRL
DCRED					SPREAD				
1	103.36**	93.37**	80.48**	75.64**		46.76**	47.50**	43.28**	47.25**
2	60.13**	60.96**	50.92**	49.49**		23.14**	23.91**	23.66**	23.47**
3	39.59**	41.53**	35.11**	34.84**		15.86**	19.02**	15.61**	16.20**
4	28.97**	30.13**	25.63**	25.26**		11.66**	14.71**	11.47**	11.98**
5	22.63**	23.46**	20.03**	19.56**		10.74**	13.23**	11.15**	12.05**
6	20.02**	20.65**	18.82**	18.04**		9.25**	11.12**	9.83**	10.84**
1	14.25**	2.47	9.50**	.52		13.92**	2.79	3.81*	1.82
2	7.43**	1.54	5.44**	.39		13.79**	2.37	3.06*	1.51
3	4.81**	1.13	4.04**	.39		9.52**	1.70	6.44**	1.56
4	3.65**	1.22	3.37**	.89		7.11**	1.49	4.76**	1.21
5	3.19**	1.36	2.76**	.90		5.79**	1.27	3.75**	1.08
6	2.63**	1.19	2.36*	1.08		4.72**	1.07	3.23**	1.32

* Significant at 5 % level, ** Significant at 1 % level.

Appendix 3.1 Testing for (Non)stationarity and Unit Roots

Weak stationarity implies that a variable has a constant mean and constant variance. Non-stationarity implies that the variable has time-varying mean and variance. If a series must be differenced *d* times before it becomes stationary, then it is said to be integrated of order *d*, ie., it is *I(d)*. If a series is *I(d)*, then it is said to have *d* unit roots, so testing for (non)stationarity is often referred to as testing for unit roots. Such tests are necessary, because if a series does have a unit root, then the usual statistical properties of the first and second sample moments (mean and variance) do not hold.

At its simplest, testing for a unit root is the test that a regression of y_t on y_{t-1} yields a coefficient of one; i.e.,

$$y_t = y_{t-1} + u_t . \tag{A3.1}$$

In this case, if u_t is a zero mean stationary process (as it should be if it is representing white noise), then an increase in u_t of C will increase y_t in each subsequent time period by C. That is, there is a permanent shock to y_t so that the series does have a unit root and so is not stationary, as it does not have a constant mean. A random walk process is not stationary but its first difference will be stationary.

On the other hand, if $y_t = \beta y_{t-1} + u_t$ (A3.2)

and $|\beta| < 1$, then if u_t increases by C, then y_t will increase by C in the initial period, followed by increases of $C\beta$, $C\beta^2$, $C\beta^3$ and so on in subsequent time periods. As the effects of the shock ultimately die out, the series does not have a unit root and so the series is stationary.

Alternatively, (A3.2) can be reformulated as:

$$y_t - y_{t-1} = \beta y_{t-1} - y_{t-1} + u_t;$$

or $$\Delta y_t = (\beta - 1) y_{t-1} + u_t. \tag{A3.3}$$

and one can test the null hypothesis that the coefficient on y_{t-1} is zero against the alternative that it is negative. If the coefficient on y_{t-1} is zero, then the variable has a unit root and is not stationary. This follows from the fact that, if $\beta = 1$, then the change in y_t will be permanently increased by C if u_t rises by C.

To test the null hypothesis that the coefficient on y_{t-1} in (A3.3) is 0, form the Dickey-Fuller (DF) statistic by using the ratio of the estimated coefficient to the standard error of the estimate, and use the table of critical values of DF statistics available in Fuller (1976). For the DF test to be valid, the residuals from the regression must not be autocorrelated. If they are autocorrelated, lagged values of the differenced variable can be included in the regression until there is no autocorrelation. If lagged variables are used in the regression, the DF statistic is called the *augmented* Dickey-Fuller (ADF) statistic, and it is the ADF which must be used for comparison with critical values. The critical values for DF and ADF statistics, for a single variable, are the same.

Appendix 3.2 Tests for Unit Roots[(a)]

Sample period: Sept. Qtr 1971-June Qtr 1994

Variable	ADF Statistic	ADF Statistic of first differenced variable
90 day bank accepted bill rate - nominal	-7.91692** (.000)	
90 day bank accepted bill rate - real	-8.42032** (.000)	
2 year Treasury bond rate - nominal	-8.64935** (.000)	
2 year Treasury bond rate - real	-12.5134** (.000)	
10 year Treasury bond rate - nominal	-8.40553** (.000)	
Yield spread	-9.28319** (.000)	
M3	-5.49804** (.000)	
GDP at current prices	-9.66276** (.000)	
GDP at constant 1989-90 prices	-10.6433** (.000)	
PFD at current prices	-4.13538** (.008)	
PFD at constant 1989-90 prices	-7.66551** (.000)	
Sample period: June Qtr 1978-June Qtr 1994		
Broad money	-4.76007** (.002)	
Credit	-1.88102 (.706)	-10.2209** (.000)

(a) The null hypothesis is that there is a unit root in the times series data. The augmented Dickey-Fuller statistics are presented with their corresponding P-values. If the null of a unit root is accepted, the ADF statistic is presented with its corresponding P-value for the first difference of the variable.
** Indicates significance at 1 %.

Chapter 4 Credit Rationing and the Allocation of Credit: Theory[1]

4.1 Introduction

Credit rationing occurs when the demand for loans is greater than the supply of loans at the prevailing rate of interest. In regulated financial markets, credit rationing arose as a consequence of controls over the maximum interest rates which could be charged on loans and quantitative controls over the amounts which could be lent. It was expected that as a result of the removal of these controls the interest rate would adjust to eliminate the excess demand for credit in the same way that the price of a commodity adjusts to eliminate excess demand for that commodity. Disequilibrium in loan markets was believed to be the result of regulatory impediments. However, the loan market is not analogous to the goods market. In the goods market, the seller is not generally concerned with the use to which his product, once sold, is put. In the maket for loans, the lender is concerned with the use which is made of the borrowed funds. In this market, the lender's (seller's) expected return will depend upon the future activities of the borrower (buyer). These activities may be such that they

[1] A shorter version of Chapters 4 and 5, *Credit Rationing in Australia: Theory and Evidence*, was presented to the PhD conference in Economics and Business held at the University of Western Australia from November 3-5, 1993. I am grateful to Professor Ross Milbourne, Professor Ian Harper, Dr Philip Lowe and other conference participants for useful comments and suggestions on that paper.

generate a positive probability of default on the loan in which case the lender does not realise the full 'price' of his 'product'. Unless the borrower generates revenue sufficient to meet loan repayments, the lender will realise a loss. In the extreme case, if the borrower realises no return on his borrowed funds and has pledged no collateral against his loan, the lender will realise a loss equal to the size of the loan plus any administrative or monitoring costs associated with making the loan.

Because the expected return to the lender is not equal to the price charged to the borrower, the removal of regulatory impediments from financial markets did not necessarily mean that credit rationing would disappear. Credit rationing still occurs in deregulated financial markets and it is an equilibrium phenomenon in the Keynesian state of rest tradition as the interest rate will not adjust to clear the market for loans. Equilibrium credit rationing is defined in this study to be the situation where lenders may be faced with a set of potential borrowers, who for all practical purposes related to the lending decision appear to be indistinguishable from each other, and yet the lender will grant loans to some of these borrowers but not to others, even though there is no regulatory impediment to the lenders making such loans and even though all potential borrowers are prepared to pay the market rate of interest.

Two explanations dominate the literature as the rationale for this type of credit rationing. The first is asymmetric information and the second is implicit contracts. The outline of this chapter is as follows. First there will be some discussion of how asymmetric information and moral hazard give rise to adverse selection and adverse incentive effects. The chief proponents of this view are the New Keynesians. Adverse selection and adverse incentive effects ensure that there will be an optimal (in the profit maximising sense) interest rate charged by the banks at which there may exist an excess demand for loans. Furthermore, rather than limiting the number of loans that are made, banks may choose to grant loans to all potential borrowers but quantity ration by reducing the size of the loan made to each borrower below the size demanded by borrowers given the bank loan interest rate. Second, it will be shown that implicit contracts between banks and borrowers mean that efficient risk-sharing arrangements can also lead to non-price rationing even in the absence of asymmetric information. Either the existence of implicit contracts or asymmetric information is sufficient to generate non-price credit rationing. Neither is necessary. Third, I discuss whether the provision of collateral by borrowers is sufficient to prevent non-price credit rationing. Fourth, I briefly survey the post Keynesian position with respect to credit rationing. Post Keynesians emphasise that credit rationing is based upon uncertainty in contrast to the New Keynesian view which emphasises that credit rationing is based upon the profit maximisation and utility maximisation of economic agents. Last, there is a brief discussion as to why the Campbell Committee took the neo-Keynesian view that financial liberalisation in Australia would lead to the elimination of non-price credit rationing. In the following chapter, the implications for empirical work of the equilibrium credit rationing hypothesis are followed by empirical tests for Australia to determine if non-price credit rationing has occurred in the markets for business loans and personal loans since deregulation of financial markets.

The major policy conclusions of this chapter follow from the existence of moral hazard in credit markets. There exists a moral hazard problem where one party to a contract engages in activities which are likely to be detrimental to the interests of other parties. It has been demonstrated (Stiglitz and Weiss (1981), McKinnon, (1988), Villaneuva and Mirakhor, (1990)) that if the central bank guarantees liquidity, there is the potential for credit rationing not to arise, but that the amount of credit granted and the interest rate charged by the banks will lie above their socially optimal level as borrowers with a high probability of default are not rationed out of the market for loans. Although the central bank guarantee of liquidity usually comes at a cost should banks need to use the central bank's lender of last resort facilities, this cost will nearly always be less than the insolvency costs that would usually otherwise be imposed on the banks in the event of liquidity crises. Otherwise, those banks faced with liquidity crises would not be prepared to pay the price to the central bank for liquidity support and would, as a result, most likely become insolvent. Thus, although costly central bank support tempers banking activity, it doesn't *remove* the moral hazard problem that support gives rise to in the banking system. This theory has implications for the role of the central bank. It is shown that a central bank, by providing access to lender of last resort facilities and/or deposit insurance, leads banks to provide a greater number of loans but at higher interest rates than the free market equilibrium but it also increases the probability of default by borrowers. I also demonstrate that, if banks are profit maximisers, the Walrasian imperfect information market clearing equilibrium will not be attained *either* when the financial sector is totally deregulated *or* when the central bank provides access to lender of last resort and/or fixed price deposit insurance facilities.

Implicit contract theory suggests that the central bank's actions have further implications for the supply of credit. It is shown that the supply of loans will constrict when the average cost of funds to the banks and their variance increases. Thus, the authorities, in implementing monetary policy, should look to a low and stable interest rate regime if interested in the elimination of credit rationing. Removal of regulations will not clear the market for loans.

4.2 New Keynesians and aysmmetric information

That credit rationing may arise as an *equilibrium* phenomenon in deregulated financial markets with imperfect information has been canvassed in the mainstream economics literature since Stiglitz and Weiss published their influential paper in the *American Economic Review* in 1981. Jaffee and Stiglitz (1990) provide a survey of many of the issues arising from that literature. Stiglitz and Weiss demonstrated that if lenders could not perfectly discriminate between borrowers prior to making loans, increases in the interest rate could lead to adverse selection and adverse incentive effects. If lenders are profit maximisers, these effects will lead lenders to engage in non-price credit rationing.

In credit markets neither borrowers nor lenders have perfect information with respect to returns to be generated as a result of access to, or granting of, loans. For the borrower, the calculation of the expected return upon any investment project is fraught with uncertainty. For the lender, the expected return depends upon both the interest rate charged to the borrower and the borrower's probability of default. The borrower's probability of default is not independent of the interest rate which the borrower is charged. Neither is the borrower's chosen investment project independent of the interest rate. Thus the bank by setting the interest rate can influence the riskiness of the activities undertaken by borrowers.

It is now generally accepted in the literature that the market for credit is usually one of asymmetric information; i.e., the borrower has better knowledge of the expected return and risk associated with his project than does the lender, and that the lender knows only the expected return and risk of the average project in the economy (See, for example, Jaffee and Stiglitz (1990, p.840)). Associated with the borrower's promise to repay the lender the principal plus interest is some probability of default. Therefore the expected rate of return to the lender is less than the interest rate on the loan.

Lenders are unable to distinguish perfectly between borrowers and so are unable to observe the degree of risk-aversion on the part of any individual borrower. Yet lenders know that as the interest rate rises the more risk-averse borrowers will be aware that their probability of default on the loan is increasing and will choose to drop out of the market for loans rather than face possible bankruptcy. This is the adverse selection effect. As the interest rate rises, a pool of less risk-averse borrowers remains in the market for loans. The rise in the interest rate has led to an adverse selection, by the lender, of less risk-averse borrowers.

Because the interest rate is rising borrowers choose investment projects with higher expected returns than they chose prior to the rise in interest rates which are associated with a higher risk of failure - the adverse incentive effect. As the interest rate rises from say, r_o to r_1, projects with an expected return below r_1 will no longer be undertaken. Projects with an interest rate of r_1 become marginal. Because projects with expected returns below r_1 are no longer undertaken, the average expected return to borrowers will now be higher than the average expected return prior to the rise in interest rates. In general, higher expected returns to borrowers are usually associated with riskier projects. The probability of default by borrowers rises as riskier projects are undertaken. Therefore, the expected return to the lender falls as the expected return to the borrower rises. A rise in interest rates provides adverse incentives to borrowers to undertake riskier activities. Borrowers and lenders will both benefit if those activities are successful but should the projects fail, borrowers bear no additional cost (from the lender's perspective) over the activities undertaken at lower interest rates. Lenders bear a greater cost because of the increased probability of failure by the borrower. If the revenue loss from the increase in the probability of default generated by a rise in the interest rate is greater than the revenue gained as a direct consequence of the rise in the interest rate then lenders will bear a loss as interest rates rise. Of course, many borrowers may have pledged collateral so that, in the event of default, the lender receives some positive return. However, unless the value of the collateral to the lender is sufficient to recover the *whole* of the value of the loan monies advanced, the increase in the probability of default brought about by a rise in the interest rate will generate a reduction in the expected return to the lender, albeit smaller than in the absence of collateral. This issue of collateral is taken up in more detail later in this chapter.

The previous discussion can be illustrated more rigorously with reference to the following model which is largely based on Blanchard and Fischer's (1989) exposition of the Stiglitz-Weiss model of credit rationing. This version of the model assumes risk-neutral borrowers and thus relies upon the adverse incentive effect rather than the adverse selection effect to explain the inverse relationship between loan interest rates and the probability of loan repayment. (Note that the notation has been changed from that used in Blanchard and Fischer.)

Let L equal the loan amount and r equal the loan interest rate. If a project which has been financed by borrowed funds is successful, the entrepreneur will repay the bank the contracted loan repayment, $L(1+r)$.

Let X equal the same expected return to all projects financed by borrowing, where the expected return between projects differs only according to risk. Further, let X_i^s equal the return to successful projects where the projects are indexed by the subscript, i, and X^f equal the return if projects fail. Should the project fail, the borrower will repay the bank all of the return, X^f, which may equal zero. Let λ_i equal the probability of success of a project. Borrowers are assumed to repay bank loans if projects are successful; therefore λ_i is also equal to the probability of loan repayment. Since the expected return is assumed to be the same across all projects financed by borrowing we can write:

$$\lambda_i X_i^s + (1-\lambda_i)X^f = X \qquad \forall i. \tag{4.1}$$

The distribution of the density function of λ_i may be characterised by the density function, $g(\lambda_i)$.

Because a successful project financed by borrowing returns a greater amount than the contracted loan repayment, and an unsuccessful project returns a lesser amount than the contracted loan repayment:

$$X_i^s > (1+r)L > X^f \qquad \forall i. \tag{4.2}$$

Assuming risk neutrality on the part of both the borrower and the bank gives rise to the following expressions where $E(\pi_i)$ is the expected return to the borrower, and $E(\pi_b)$ is the expected return to the bank:

$$E(\pi_i) = \lambda_i[X_i^s - (1+r)L], \tag{4.3}$$

and $$E(\pi_b) = (1+r)L\int_0^{\lambda}\lambda_i g(\lambda_i)d\lambda_i + X^f\int(1-\lambda_i)g(\lambda_i)d\lambda_i \tag{4.4}$$

where λ is the cut-off probability at which potential borrowers come to banks for loans.

Substitute (4.1) into (4.3) to give:

$$E(\pi_i) = X - X^f - \lambda_i[(1+r)L - X^f] \tag{4.5}$$

which indicates that the expected return to the borrower, $E(\pi_i)$, rises as λ_i, the probability of success of the project falls (because $(1+r)L>X^f$). Thus, there is an adverse incentive for borrowers to undertake riskier projects.

Differentiating the expected return to the bank with respect to a change in the loan interest rate gives:

$$\frac{dE(\pi_b)}{dr} = L\int_0^{\lambda}\lambda_i g(\lambda_i)d\lambda_i + (\frac{d\lambda}{dr})[(1+r)L\lambda g(\lambda) + X^f(1-\lambda)g(\lambda)] \tag{4.6}$$

The first term on the R.H.S. is the direct impact of a change in the loan interest rate on expected bank profits by those borrowers who repay loans; and the second term is the indirect impact on the bank's profits brought about by the impact of a change in the loan interest rate upon the probability of success of the project, and therefore upon the probability of loan repayment. Instead of undertaking projects, potential borrowers may choose to invest their wealth, $\mathcal{W}$, in risk-free government securities with a return equal to ρ. The expected returns at the margin from borrowing and from investing in risk-free government securities must be equal. Thus:

$$\mathcal{E}(\pi_i) = \rho \,. \tag{4.7}$$

Making use of the expression for $\mathcal{E}(\pi_i)$ indicated in Equation (4.3) it can be shown that:

$$\frac{d\lambda_i}{dr} = -\frac{\rho}{\mathcal{L}^2} \tag{4.8}$$

and so is negative. Thus, the probability of success of the project and thus probability of loan repayment falls as the loan interest rate rises. Since $\frac{d\lambda_i}{dr}$ is negative, Equation (4.6) demonstrates that the increase in expected returns to the lender from an increase in interest rates are reduced by the impact of the rise in loan interest rates on the borrower's probability of default.

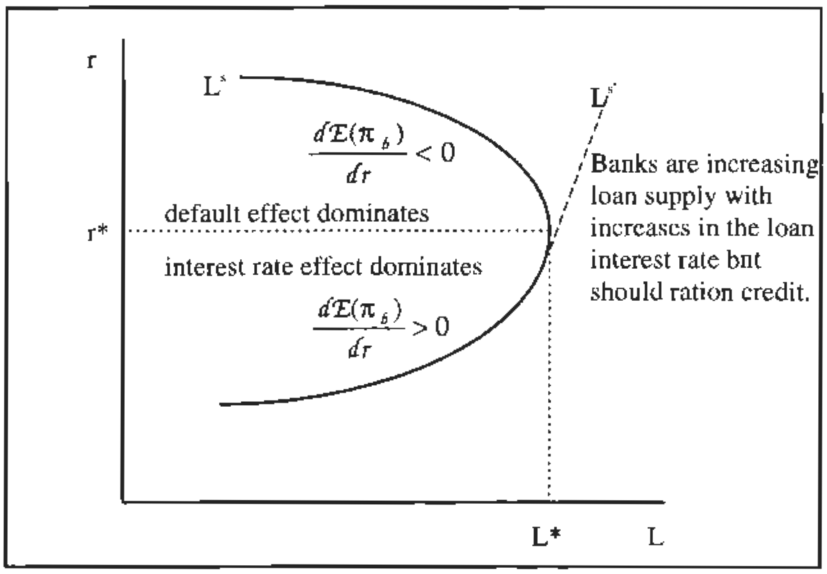
Ex ante, lenders cannot distinguish between less risk-averse and more risk-averse borrowers. Only by raising interest rates will lenders cause potential borrowers to divulge this information as the more risk-averse borrowers drop out of the market for loans. The existence of asymmetric information is therefore crucial to the concept of adverse selection of the less risk-averse borrowers as interest rates rise. *Ex ante*, lenders are less certain of the expected returns to investment projects than are borrowers. Again, borrowers only divulge this information as interest rates rise when applications are no longer made for loans to fund what were previously marginal projects. Asymmetric information is therefore also necessary to the adverse incentive effect.

There comes a point where the increase in the expected return to the bank generated by a rise in the interest rate is just offset by a reduction in the expected return due to the increased probability of default brought about by the rise in the interest rate. This point determines the interest rate at which the bank expects to maximise its profits and occurs when $\frac{dE(\pi_b)}{dr} = 0$. Even if there remains an excess demand for loans at the current interest rate the bank will not raise its interest rate any further as the rise in interest rates reduces its expected return.

If the bank is maximising its expected return, $\frac{dE(\pi_b)}{dr} = 0$. If $\frac{dE(\pi_b)}{dr} > 0$ due to the positive interest rate effect dominating the negative effect upon the probability of loan repayment and there is sufficient loan demand, the bank should increase its loan rate. If the default effect dominates the interest rate effect so that $\frac{dE(\pi_b)}{dr} < 0$, the bank should reduce the loan interest rate so that the interest rate falls to the point where the interest rate effect and the default effect exactly offset each other. By so doing, the bank will maximise its expected return.

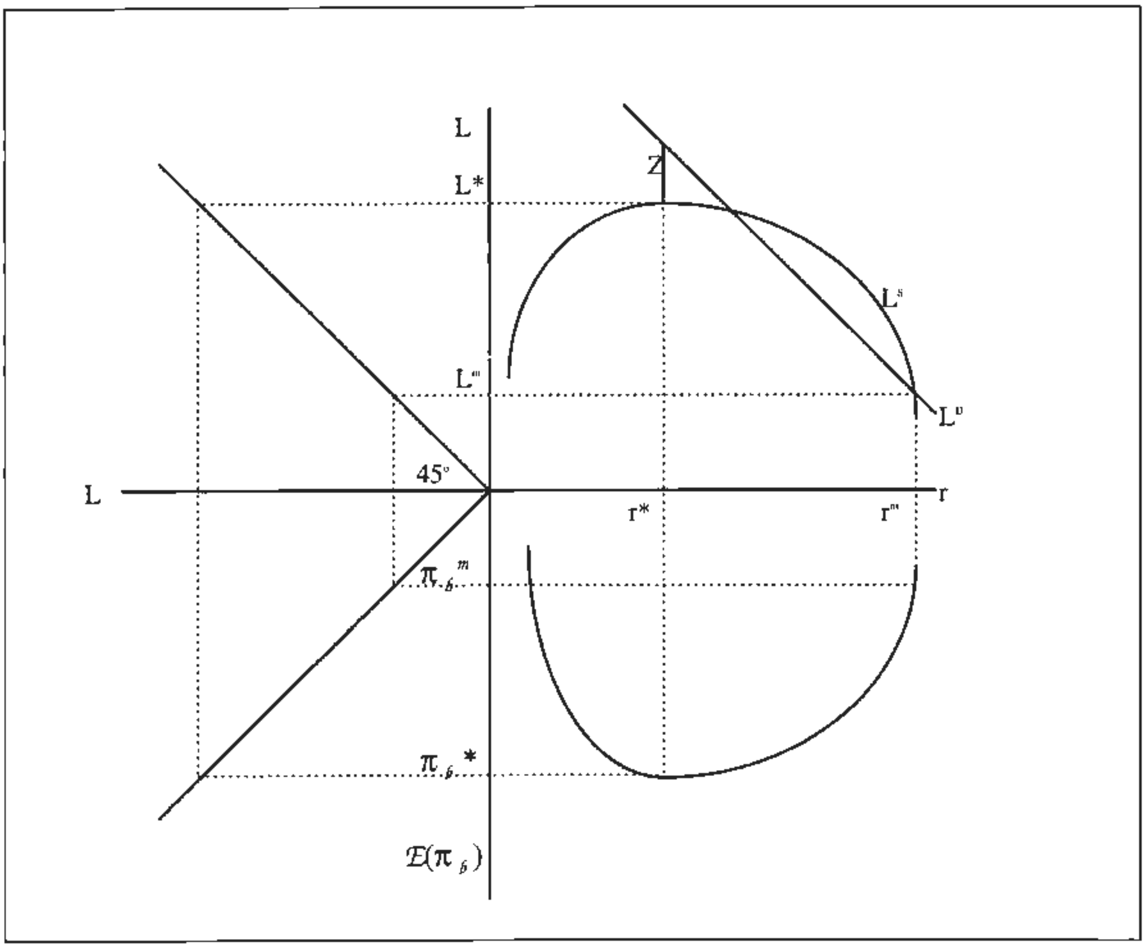
The previous discussion can be summarised in Figure 4.1 which depicts the loan supply function as a concave function of the loan interest rate. As the loan interest rate rises banks will initially increase the loan supply as the interest rate effect dominates the default effect and thus the effect of an increase in interest rates on the bank's expected return is positive. There will be no credit rationing. At some point a further increase in the interest rate will lead to the interest rate effect being exactly offset by the default effect so that $\frac{dE(\pi_b)}{dr}$ equals zero. At this point the loan supply schedule reaches a maximum, the bank is charging the loan interest rate, r^*, and making the number of loans which maximises its expected returns. If the interest rate is raised further the default effect will exceed the interest rate effect and $\frac{dE(\pi_b)}{dr}$ will become negative. The banks' loan supply schedule will become backwards bending. Banks should ration credit rather than raise the interest rate to the point where the default effect exceeds the interest rate effect. If, in fact, empirical work finds evidence that a rise in interest rates reduces the bank's expected return it can be concluded that banks are making inefficient loans, i.e., the loan supply function is rising monotonically with the loan interest rate as indicated by the dashed portion of the loan supply schedule in Figure 1. The loan supply function will be monotonic when banks are protected in some way from realising losses should borrowers default. This may occur if, for example, the central bank guarantees support in the event of a liquidity crisis. If there are no such guarantees, the loan supply schedule will be concave and below the optimal interest rate, r^*, the bank's expected returns will rise as the loan interest rate rises. At r^*, the bank will be maximising its expected returns, and at interest rates greater than r^*, the bank's expected returns will fall as the loan interest rate rises. Rather than cause their expected returns to fall, the banks should ration credit.

Figure 4.1 *Concave and monotonic loan supply schedules*



Stiglitz and Weiss (1981), McKinnon (1988) and Villaneuva and Mirakhor (1990) have discussed the selection of the bank optimal interest rate with reference to the diagram illustrated in Figure 4.2. The upper right-hand quadrant of Figure 4.2 depicts loan demand as a declining function of the interest rate and loan supply as a concave function thereof. The bottom right-hand quadrant depicts the bank's expected return at various interest rates. The bottom left-hand quadrant shows that the number of loans made is an increasing function of the bank's expected return.

Figure 4.2 Selection of the bank optimal interest rate



The bottom right-hand quadrant illustrates that the effect on the expected return to the bank is initially positive as interest rates rise but that there is a negative effect on the bank's expected return as interest rates continue to rise because of the increase in the probability of default brought about by adverse selection and adverse incentive effects. The bank will loan to the point where it maximises its expected return, at which point the bank's optimal rate of interest, r^*, is determined as is the optimal number of loans, L^*. For interest rates below r^* the bank will increase the amount of loans made as the interest rate rises as shown in the upper right-hand quadrant of

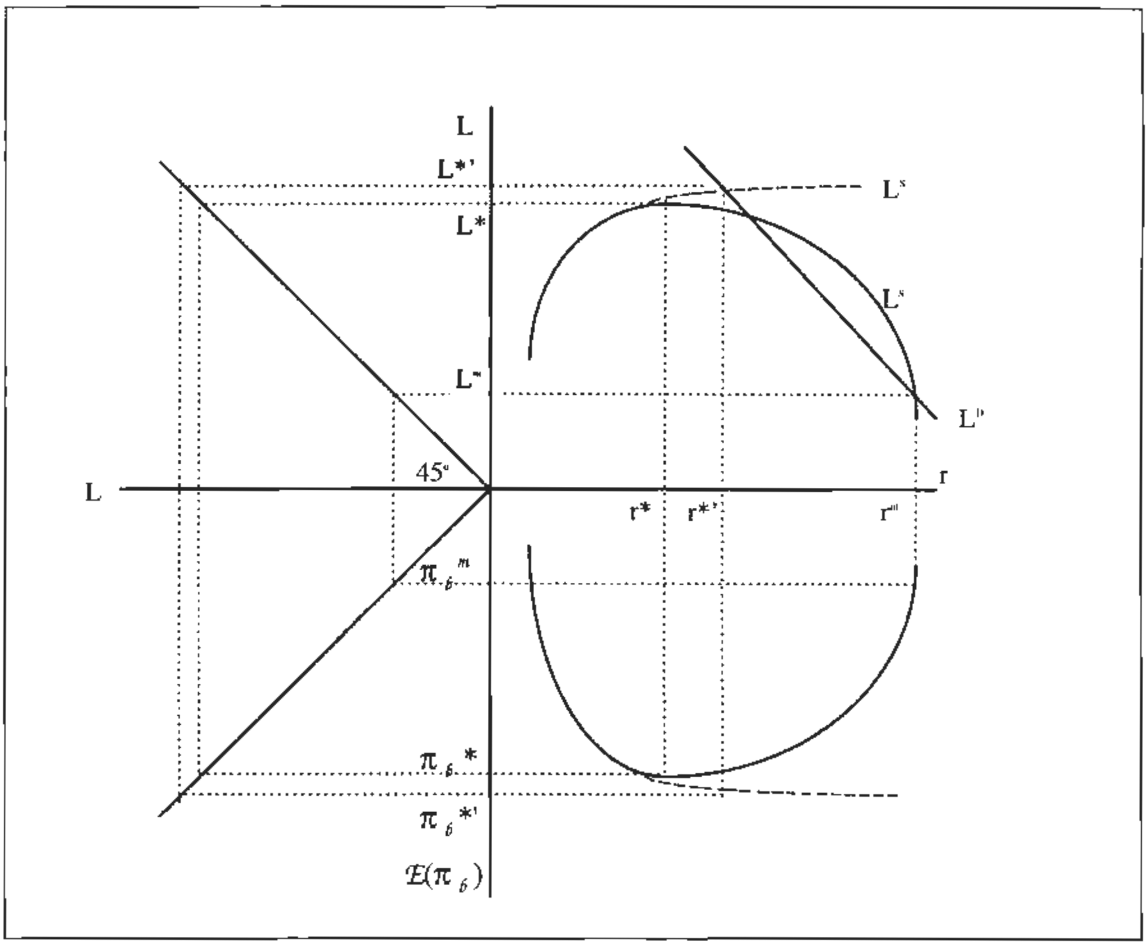
Figure 4.2. However if interest rates were to rise above r^* the bank's expected return will fall. Therefore the bank should not expand its loan portfolio beyond $\mathcal{L}^*$.

At the optimal interest rate, loan combination, r^*, $\mathcal{L}^*$, the demand for loans exceeds the supply of loans by the distance Z. Hence, there is an excess demand for loans at the interest rate which maximises the bank's expected returns so that credit rationing exists and it is an *equilibrium* phenomenon in the Keynesian tradition as there is no incentive for banks or borrowers to alter their behaviour such that a Walrasian market-clearing equilibrium is achieved. The combination r^*, $\mathcal{L}^*$, is a profit maximising equilibrium for the banks. In addition, because the banks don't raise interest rates above r^*, riskier borrowers with riskier projects are rationed out of the market for loans because it is the less risk-averse borrowers who undertake riskier projects at higher interest rates.

The Walrasian market-clearing rate of interest is r^m where the quantity demanded of loans equals the quantity supplied of loans at $\mathcal{L}^m$. The expected rate of return to the bank at interest rate r^m is $\pi_b{}^m$, lower than the expected rate of return to the bank, $\pi_b{}^*$, when the interest rate is r^*. Thus, rather than raise the interest rate to eliminate the excess demand for loans, the bank, if it is a profit maximiser, will set the interest rate at r^*, provide a quantity of loans equal to $\mathcal{L}^*$ and ration credit by non-price means.

Observed interest rates may be higher than r^*. However they will never be as high as the imperfect information Walrasian market-clearing equilibrium interest rate, r^m, depicted in Figure 4.2. If the central bank guarantees the liquidity of the banks by providing access to lender of last resort facilities, the bank's loan supply and expected return functions become monotonic and increasing functions of the rate of interest as illustrated in Figure 4.3. Figure 4.3 is a reproduction of Figure 4.2 with the now effective loan supply and expected return functions being dashed extensions of the previous loan supply and expected return functions. As observed in the introduction to this chapter, although the central bank guarantee of liquidity usually comes at a cost should banks need to use the central bank's lender of last resort facilities, this cost will nearly always be less than the insolvency costs that would usually otherwise be imposed on the banks in the event of liquidity crises. Otherwise, those banks faced with liquidity crises would not be prepared to pay the price to the central bank for liquidity support and would, as a result, most likely become insolvent. Goodhart (1993 and 1995) argues that, if a bank turns to the central bank for liquidity support, then it is most probably because the market already suspects its solvency, as otherwise the other banks or private lenders would be prepared to lend against the security of the bank's assets without the adverse reputational consequences that borrowing from the lender of last resort at penalty rates would imply. Goodhart argues further that, given the short time frames generally involved, the central bank will very often have no time to determine whether a bank is illiquid or insolvent. Thus, although costly central bank support tempers risk-taking by banks, it doesn't *remove* the moral hazard problem that support gives rise to in the banking system. This is not to say that banks, because they have access to lender of last resort facilities in case of need, will necessarily engage in imprudent banking practices making loans to all who apply for loans regardless of risk. If it is clear to the banks that central bank support will be confined to banks which are experiencing *temporary* shortages of liquidity, and not be available to those banks suffering liquidity crises as a consequence of imprudent management, so that they may become insolvent, banks will reduce their risk-taking activities and so reduce the number of risky loans that they make. Nevertheless, the presence of liquidity support does reduce the cost to the banks, at the margin, of making risky loans so that there is an incentive for banks to make more loans and charge higher interest rates than in the absence of liquidity support.

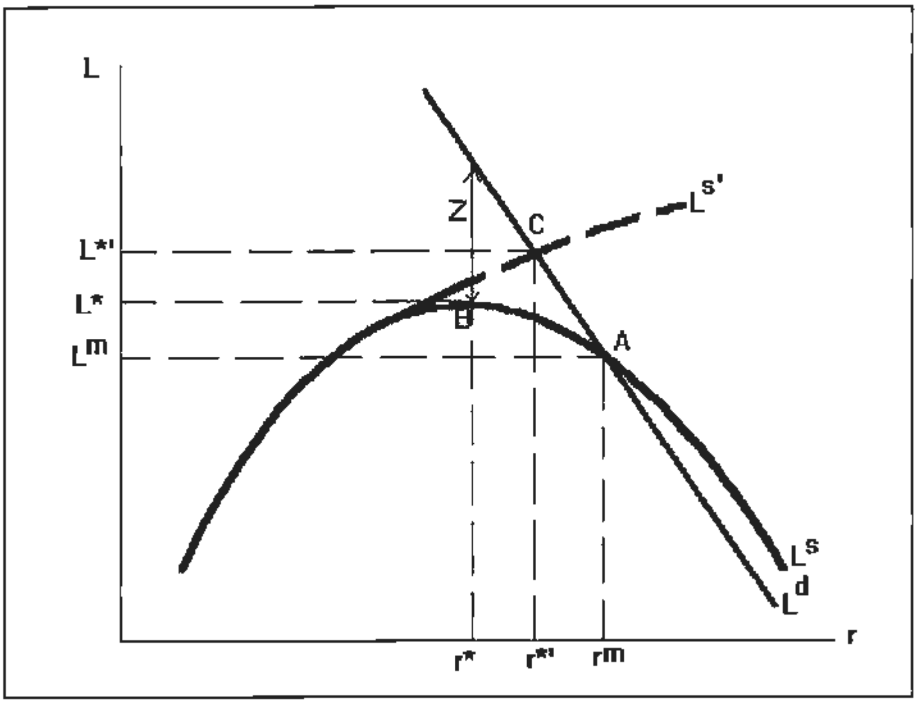
Figure 4.3 *The central bank may prevent credit rationing by providing lender of last resort facilities*



Banks will extend credit beyond L^* and raise interest rates beyond r^* to $L^{*\prime}$ and $r^{*\prime}$ respectively as they benefit from the higher interest rates charged to borrowers should the borrowers' projects be successful whilst being quarantined by the central bank from the full extent of losses that would be incurred should the projects of borrowers be unsuccessful. No credit rationing occurs. Supply equals demand at $L^{*'}$. Bank's expected return rises to $\pi_b{}^{*'}$. Note that even with access to lender of last resort facilities or fixed-price deposit insurance, the banks will not raise interest rates as high as r^m. Thus the *unregulated* market clearing equilibrium is not attained either when banks have access to lender of last resort facilities, or in the absence of central bank intervention. The implications of this analysis are important to an understanding of the relationship between the behaviour of the banking system in deregulated financial markets and the role of central banks. This point may be made more clearly with reference to Figure 4.4 taken from the top right-hand quadrant of Figure 4.3.

A is the Walrasian market clearing equilibrium in the absence of central bank intervention. L^m loans are provided at an interest rate of r^m. However, the bank's profits are lower at the Walrasian market clearing equilibrium than they are at B where L^* loans are provided at an interest rate of r^*. At B there is an excess demand for loans equal to Z. Also at B, the additional profit derived from an increase in the interest rate is just offset by the profit loss from the increase in the probability of default brought about by the rise in the interest rate. There is no incentive in a free market for banks to raise their interest rate beyond r^*.

Figure 4.4 *Walrasian, unregulated and regulated equilibria*



If the central bank provides access to lender of last resort facilities or deposit insurance, the banks will be willing to provide an increased number of loans $L^{*\prime}$ at an interest rate $r^{*\prime}$ at point C in Figure 4.4. Banks in a *regulated* market with strong liquidity support facilities therefore provide more loans and charge higher interest rates than banks in a *deregulated* market where liquidity support facilities are weak, if the loan demand schedule cuts the loan supply schedule to the right of B. In a deregulated market, the Walrasian equilibrium will never be reached if banks are profit maximisers and the loan supply schedule is concave. Neither will the Walrasian equilibrium be reached in a regulated market because the existence of liquidity support ensures that the loan supply schedule changes from being a concave function of the interest rate to being a monotonic function of the interest rate.

Banks, if profit maximisers, will raise the loan interest rate to clear an excess demand for loans if and only if the central bank stands ready to provide access to lender of last resort facilities should borrowers renege on their loan commitments. Even then, because central bank support leads to a monotonic loan supply function, the quantity of loans supplied will be higher and the interest rate will be lower than the Walrasian market clearing equilibrium in the absence of central bank support. Yet central bank support will lead to higher interest rates and a greater quantity of loans supplied than a free market because changes in interest rates lead to adverse selection and adverse incentive effects which, without central bank support, will cause the banks to ration credit by non-price means. In a free market, the Walrasian equilibrium will never be reached if the loan supply schedule is concave and the loan demand schedule intersects the loan supply schedule to the right of its maximum point.

Stiglitz and Weiss (1981) showed that if interest rates were raised, either adverse selection or adverse incentive effects could lead to lenders facing a pool of borrowers with a higher probability of default than was the case prior to the rise in the interest rate. Although lenders can require collateral against loans, the requirement for collateral makes no difference to the essential result that a rise in interest rates can reduce the expected return to the lender provided the collateral is set less than the maximum possible loss to the bank in the case of the borrower's default. Stiglitz and Weiss (1992) extend Stiglitz and Weiss (1981) to take into account that i) the risk aversion of wealthier borrowers may differ from that of poorer borrowers; and ii) collateral requirements may also be used in conjunction with interest rates in forming a credit contract, so that the banks, by choosing particular interest rate/collateral combinations, can influence the choice of a risky versus safe technique (where the probability of success of the safe technique is higher), into which the borrower invests borrowed funds. Even though this differentiation allows banks to offer several contracts, credit rationing may still exist as an equilibrium phenomenon. This issue is further explored in Appendix 4.1 of this chapter.

4.3 Credit Rationing by Limiting the Size of Loans

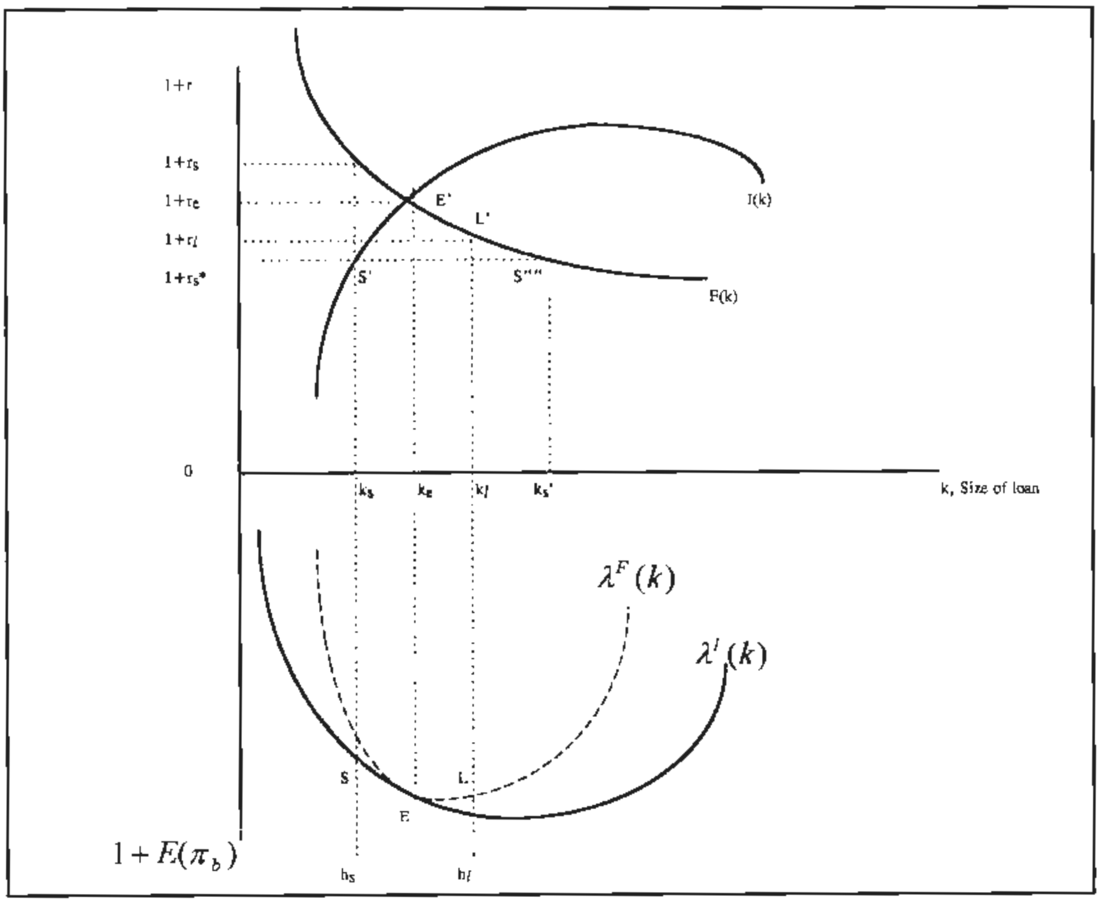
Consider now the implications of banks rationing credit by making smaller loans than are requested by potential borrowers, rather than rationing credit by limiting the number of loans that are made as discussed above. That is, banks might not refuse to lend to any comer at the bank's chosen loan rate, but lend to each of a class of borrowers a smaller amount than requested. Profit maximising firms and utility maximising consumers will apply for loans to finance those projects which have the highest expected returns, or which give them the highest level of satisfaction. If borrowers do not receive the full amount of loan monies for which they have applied they must either forego the project (consumption activity), increase their own equity in the project (consumption activity), undertake other projects (consumption) with lower expected returns (utility), borrow the shortfall elsewhere at higher cost, borrow smaller amounts over several periods, or proceed with the project on the basis that 'forced' borrowing may have to take place in future.

Given that projects with the highest expected returns tend to be the riskiest projects, the offer of a small loan which makes the potential borrower forego the intended risky project may work to increase the lender's expected return as more loan monies are available for less risky projects. Increasing the amount of borrower's equity in a project acts as a positive incentive for the borrower to ensure that the project is successful so as to minimise any potential losses. In this respect, requiring an increase in borrower equity invested in a project by providing a smaller loan than requested is analagous to increasing the collateral requirement on a loan, and so it will also increase the lender's expected return above that available when larger loans are made. Forcing firms to undertake projects with lower expected returns gives rise to two offsetting effects. First, it means lower risk projects are undertaken reducing the probability of default. Second, there is a smaller gap between the expected return on the project and the loan interest rate so that the probability of default for projects at any given loan interest rate increases. Whether the probability of default increases or decreases depends on the relative size of the two effects. Thus, smaller loans may change the probabilities of success of those activities into which the borrowed funds are invested. Further, there will be a reduction in the expected return to the first lender should firms (consumers) borrow the shortfall in loan funds from another source at higher cost, because the borrower's probability of default will rise with an increase in the total cost of the project (consumption activity). This problem can only be overcome if the first lender requires collateral be pledged against the maximum possible loss on the loan, and the first lender makes it a requirement of the loan contract that it has first call on that collateral. If the firm (consumer) proceeds with the original intended project (consumption activity) despite a smaller loan, it may have to take out a sequence of loans over successive time periods. The firm or consumer may even be forced into the situation where, without further borrowing from the initial lender, it may default or partially default on the loan so that the lender must decide whether further loan monies will maintain the possibility of eventual repayment.

Gray and Wu (1995) develop a model to illustrate that if credit rationing takes the form of restrictions on the *size* of loans, interest rates are not invariant with respect to changes in credit market "tightness" as they may be when credit rationing takes place by restricting the number of loans that are made. Gray and Wu (1995, p. 412) state: "Under size rationing the intermediary may no longer choose to deny loans to some applicants while granting them to other (identical) applicants; all firms receive loans. But the intermediary may stipulate a loan size that is smaller than the loan size the representative firm desires at the going loan rate". Their analysis may be illustrated with reference to Figure 4.5 which is based on Figure 1 of their paper.

The *I(k)* schedule illustrated in the top half of Figure 4.5 shows the loan interest rate that maximises the bank's expected profits for loans of given size, *k*, when *r* is the loan interest rate. The *I(k)* schedule is concave because of the effect of the change in the loan interest rate on the probability of default. As the loan interest rate rises, the loan repayments from firms which remain solvent increase, although the probability of default also increases. The first effect dominates as interest rates initially rise for loans of greater size, but as interest rates rise further, the second effect comes to dominate so that the *I(k)* schedule becomes negatively sloped. In the bottom half of Figure 4.5, the bank's expected returns, $E(\pi_b)$, taking into account both the loan interest rate and the probability of default associated with loans made along the *I(k)* schedule in the top half is mapped by the $\lambda^I(k)$ schedule.

Figure 4.5 Credit rationing by limiting the size of loans



Also illustrated in the top half of Figure 4.5 is the *F(k)* schedule which maps the size of the loan that maximises the firm's (borrower's) profit at any given loan interest rate. This schedule is negatively sloped indicating that as loan interest rates fall, firms can maximise profits by taking out larger size loans. Only at loan size, k_e, does the firm demand a loan at interest rate r_e, which is a loan size and interest rate combination which maximises both the firm's profits and the bank's profits. At any other loan size, the loan interest rate which maximises the firm's profits is not the loan interest rate which maximises the bank's profits. Thus, the $\lambda^F(k)$ schedule in the bottom half of Figure 4.5 illustrates the *bank's* expected rate of return when it supplies loans of interest rate and size combinations which are consistent with points on the *firm's F(k)* schedule; and lies everywhere above (i.e., the expected returns are lower) for every loan size other than k_e where the loan interest rate r_e which maximises the bank's profits is also the loan interest rate that maximises the firm's profits. This is indicated in the bottom half of Figure 4.5 by the tangency of the $\lambda^{\mathcal{F}}(k)$ and the $\lambda^{I}(k)$ schedules when a loan of size k_e is made.

The bank will always wish to provide loans in interest rate and size combinations which are consistent with positions along the $I(k)$ schedule. However, should firms demand loans of a greater size than k_e, e.g., of size k_n at interest rate r_n, (at point L' on the $\mathcal{F}(k)$ schedule), banks will not be able to charge the higher interest rate that would maximise their profits (the interest rate consistent with k_n on the $I(k)$ schedule) without forcing a decline in the size of loans that firms are prepared to take on. Thus, for loans of greater size than k_e, the best that the bank can do given the firm's actions is to provide loans in interest rate and size combinations which are consistent with positions along the $\mathcal{F}(k)$ schedule and receive the corresponding rate of return indicated by the $\lambda^{\mathcal{F}}(k)$ schedule.

Firms may, however, demand loans of a smaller size than k_e, e.g., k_s, for which they are willing to pay a loan interest rate of r_s. Banks will be unwilling to charge r_s as it is higher than the profit maximising interest rate for loans of size k_s. Instead banks will lower the interest rate to r_s*. The lower interest rate will cause firms to demand loans of size k_s', so that banks *may* ration the size of the loans by providing only a fraction equal to k_s/k_s' of the firm's desired loan size. This, at first glance seems surprising, given that the bank's expected return from providing a loan at point S'' associated with non-rationing may be higher than the expected return at point S' when size rationing takes place.

According to Gray and Wu (1995), whether rationing by the size of loans occurs or not, depends on the "supply of credit" where this supply is equal to deposits held by households at the bank. Assuming competitive markets, the bank's expected return will equal the interest rate paid on deposits. Further, assume that the supply of credit is interest inelastic. If the supply of credit is equal to h_1 indicated in the bottom half of Figure 4.5, then loans of size k_1 will be provided at an interest rate of r_1 and no credit rationing will take place because $k_c > k_1$. If the supply of credit is equal to h_2, then banks will set an interest rate of r_2* and provide loans of size k_2 even though firms will be demanding loans of size k_2'. That is, banks will be rationing loans by limiting the size of the loans. In this case, loan interest rates and loan size will increase as the supply of credit rises. If credit is made tighter, banks will respond by further reducing interest rates and by more heavily rationing the size of loans. This contrasts with the invariance of interest rates to changes in credit market conditions suggested by models where credit rationing takes the form of limiting the number of loans rather than the size of loans.

Casual empiricism suggests that in the Australian context, many borrowers are quantity rationed in the way described above where they receive smaller loans than desired. In many cases, loan size is based on factors such as the borrower's equity in the project, borrower's income and pledged collateral. Factors such as these are included in determination of loan supply schedules in the empirical work attempting to measure the amount of credit rationing in Australia in the next chapter. However, casual empiricism of the recession of the early 1990s also suggests that quantity rationing of the type that has been the principal focus of this chapter where some borrowers did not receive loans at all took place even though they were willing to pay the then current interest rates and appeared indistinguishable from other borrowers who did receive loans. This type of credit rationing is also the focus of the next section where credit rationing arises not as a consequence of asymmetric information, but as a result of implicit contracts.

4.4 New Keynesians and implicit contracts

Credit rationing may arise for reasons other than asymmetric information. In particular, Fried and Howitt (1980) have demonstrated that credit rationing may arise as a result of risk-sharing behaviour between banks and their clients which lead to the formation of implicit contracts. These contracts are said to be implicit because "[a] borrower and lender can benefit not only from trading loan contracts now, but also from an "understanding" or "implicit contract" concerning the amounts they will be willing to trade, and at what prices, under various conditions in the future."[2] States of the world are defined as states in which the cost of funds to the banks varies. In exchange for more stable but higher average borrowing rates across different states of the world, potential borrowers subject themselves to the possibility of being non-price rationed.

As implicit contract theory is based on the maxims of profit maximisation and utility maximisation, and as it also relies on interest rate rigidity to generate non-price credit

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[2] Fried and Howitt (1980, p. 472).

rationing, it is easily encompassed by New Keynesian economics;, although to date the New Keynesians have seemed to apply implicit contract theory to the analysis of labour markets whilst largely ignoring its role in credit markets. In contrast to the analysis based upon asymmetric information, implicit contract theory depends upon the nature of customer relations. Fried and Howitt impose upon their analysis a cost to switching trading partners so that the loan market is distinguished from a spot competitive market such that there is an incentive for borrowers and lenders to enter into risk-sharing arrangements. This accords with actual banking practice where a customer who has previously established relations with a bank is generally preferred to a new customer when it comes to allocating loans. Some might argue that this is analagous to asymmetric information. However, the important difference is not that the bank is assumed to know less about the 'new' customer, but that different types of potential borrowers impose different costs on the bank. For example, it may be that provision of a housing loan is less costly to a bank than provision of a business loan, and thus the potential housing borrower is less likely to be credit rationed than is the potential business borrower in the same way that the 'old' borrower is less likely to he rationed than is the new (more costly) borrower.

Fried and Howitt derive two important theorems. The first is that, for each class of customer, the bank's profit maximisation problem leads the bank to charge the borrower a stable loan interest rate which once granted is invariant to some range of subsequent changes in the bank's cost of funds. Second, the utility available to the customer when he is not credit rationed depends, in part, upon his being able to obtain a loan at an interest rate which remains stable even when the cost of funds to the bank deviates from the expected cost of funds. Being able to obtain a loan at a stable interest rate, even when the cost of funds to the banks varies, causes the borrower's utility to be greater than the utility available to him should he negotiate loans on spot markets but it also gives rise to the possibility of the borrower being credit rationed. The expected utility that a potential borrower derives from applying for a loan is proportional to his probability of obtaining a loan which he recognises as being equal to the number of customers in his class receiving a loan divided by the number of customers in his class making application for a loan. If the number of applications exceeds the number of loans, the choice by the bank of which customers to be rationed is random. This is consistent with the definition of equilibrium credit rationing given in the introduction to this chapter. The second theorem leads to determination of the maximum cost of funds at which the bank will provide loans at any given interest rate.

Fried and Howitt set out their model as follows. The random variable is the bank's cost of funds, i. The set $I \subset \mathcal{R}_+$ is the set of all possible values of i. Its random behavior is governed by the probability distribution $q(i)$ where $q(i)>0$ for all $i \in I$. The bank has both established customers, K^0, and new customers, K^1. The total administrative cost of lending to n^0 established customers and n^1 new customers is $c(\alpha\ n^0 + n^1)$ where $0 \leq a \leq 1$ to indicate that the costs associated with lending to established customers are less than the costs associated with lending to new customers. There is therefore a cost to the customer of switching banks because the second bank will find it more costly to process the new customer's loan which, as to be demonstrated below, will increase his probability of being credit rationed.

The assumption is made that customers are risk-averse but that the bank is risk-neutral. Let $n^k(i)$ denote the number of class customers $(k=0,1)$ to whom the bank will lend in state i. The bank attempts to maximise expected profits:

$$\sum_{i\in I}\{\sum_{k=0}^{1} n^k(i)[r^k(i)-i]-c(\alpha n^0(i)+n^1(i))\}q(i) \tag{4.9}$$

If the borrower obtains a loan at interest rate, r, his expected utility is $w(r)=E_\chi u(\chi-r)$ where χ is the random real return to a project financed by borrowing. Risk aversion is indicated as $w'(r)<0$ and $w''(r)<0$, i.e., there is decreasing marginal utility of wealth. If the potential borrower is unable to obtain a loan his utility is $\mathcal{U}$. A loan application is defined by

$$\delta=\{r^k(i),n^k(i),m^k\}_{k=0,1},i\in I \tag{4.10}$$

where m^k is the number of class k customers who enter an application, and $n^k(i)\le m^k$ for all i, k. If $n^k(i)<m^k$, the choice of which customers to be rationed is random. The probability of a class k customer getting a loan is $n^k(i)/m^k$. Therefore, the expected utility that a customer derives applying for a loan is:

$$\mathcal{U}+\sum_{i\in I}\{w(r^k(i)-\mathcal{K}]\,[n^k(i)m^k]q(i)\,. \tag{4.11}$$

A competitive constraint is imposed on the bank such that it must allow its customers to attain a minimum level of utility, $\mathcal{K}$, where $\mathcal{K}>\mathcal{U}$, $k=0, 1$. The optimal contract must solve the problem of maximising the bank's profits subject first to the potential borrowers entering loan applications obtaining some minimum level of utility, second to the number of borrowers being less than or equal to the number of potential borrowers making loan applications, and third to the number of rationed potential borrowers being greater than or equal to zero.

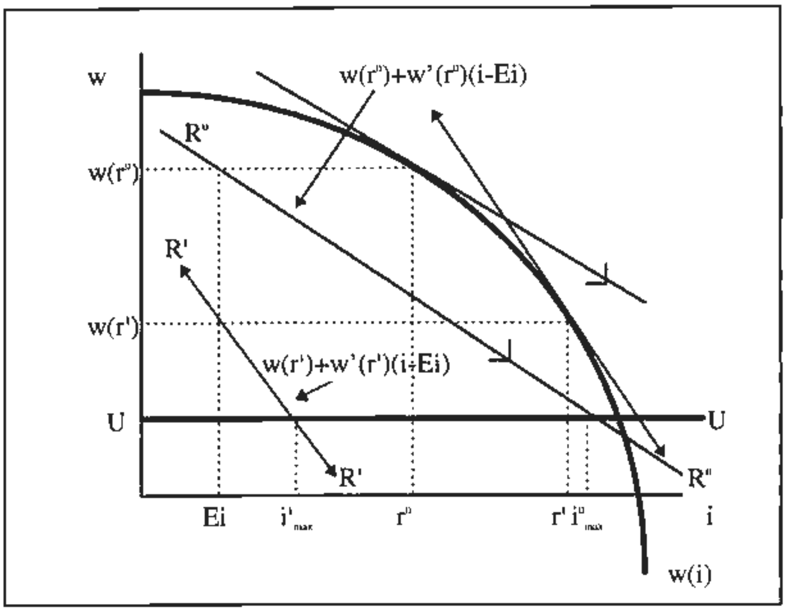
Two theorems are derived.[3] Theorem 1 states that in any optimal contract, $r^k(i)=r^k(i')$ for all i, $i' \in I$ such that $n^k(i) \neq 0 \neq n^k(i')$. That is, the bank will charge the same interest rate to class k customers independently of any change in the bank's cost of funds. Theorem 2 states that if δ is an equilibrium with respect to $(m^o, m^1)>0$ with $n^k(i)=m^k$ (i.e. no rationing exists) $\forall\, i,k$, then $w(r^k)+w'(r^k)(i-Ei)>U; \forall i, k$. That is, the expected utility to the customer of a loan at interest rate r^k plus the marginal utility derived from the customer's risk-sharing arrangement with the bank which keeps the loan interest rate stable when the cost of funds to the bank deviates from its average cost of funds must be at least equal to the utility available to the customer if he is unable to obtain a loan. The above analysis can be used to construct Figure 4.6 as illustrated by Fried and Howitt. The customer's expected utility, $w(r^k)$, is plotted against the bank's cost of funds, i.

Equation (A4.16) in Appendix 4.1 shows that $r^k(i)=Ei+\alpha^k c'(\alpha m^o+m^1)$. That is, the interest rate charged to a class k customer for a given state of the world, i, equals the average cost of funds to the bank plus the marginal cost of making loans. Recall that $w(r)\ ^o\ E_\chi u(\chi-r)$, $w'(r)<0$, $w''(r)<0$ and that r^k is positively related to i. Thus $w(i)$, or written out in full $w(r(i))$, is a concave function of i as drawn in Figure 4.6. Also from Equation A4.16 in Appendix 4.1, r^o and r^1 can be calculated when potential borrowers are not credit rationed. Figure 4.6 shows that, if, for example, the interest rate charged

[3] The mathematics of the derivations are detailed in Appendix 4.2.

to an established customer is r^0, the level of utility obtained by that customer in the absence of risk-sharing arrangements is $w(r^0)$. If the interest rate charged to a new customer is r^1, then the utility obtained by that customer in the absence of risk-sharing arrangements is $w(r^1)$. $\mathcal{U}$ is the level of utility available to a potential borrower should he be credit rationed.

Figure 4.6 *Risk-sharing arrangements and the possibility of credit rationing*



Equation (A4.19) of Appendix 4.1 shows that for r^k, $w(r^k) + w'(r^k)(i - Ei) \geq \mathcal{U}$. The customer's marginal utility is obtained by drawing a tangent to the slope of $w(i)$ at the utility level pertinent to the loan interest rate. For example, at the interest rate of r^0, marginal utility is $w'(r^0)$ and at interest rate r^1, marginal utility is $w'(r^1)$. The bank is prepared to provide loans at r^0 over a range of cost of funds when the expected cost of funds is $\mathcal{E}i$. That is, the bank is prepared to hold the loan interest rate steady whilst the cost of funds to the bank varies within some range of the expected cost of funds. To determine the maximum cost of funds, i^0_{max} at which the bank is prepared to provide loans at r^0, draw a line parallel to the tangent to $w(i)$ at r^0 which passes through $\mathcal{E}i$, $w(r^0)$. (That is, draw the line through the point which indicates the utility available to the customer when the expected cost of funds to the bank is $\mathcal{E}i$ holding marginal utility equal to the marginal utility that the customer obtains when he is charged $r^\prime$.) Writing the equation for this line in point-slope form gives: $w(r^k) + w^\prime(r^k)(i - \mathcal{E}i) \geq \mathcal{U}$. Because the minimum utility that the bank must provide to the customer when there is no credit rationing is $\mathcal{U}$, the intersection of this parallel line with $\mathcal{U}$ determines the maximum cost of funds, i^0_{max} at which the bank is prepared to provide loans at r^0, when its expected cost of funds is $\mathcal{E}i$.[4] Label the line for r^0, $\mathcal{R}^0\mathcal{R}^0$, and the equivalent line for r^1, $\mathcal{R}^1\mathcal{R}^1$.

The bank in its risk-sharing arrangement with customers will, in some circumstances, ration credit. If the state of the world is such that $i<i^1_{max}$, when the bank's average cost of funds is $\mathcal{E}i$, then no customers will be rationed unless the demand for loans exceeds the supply of loans. If $i^1_{max}<i<i^0_{max}$ then type 1 customers (new customers) will not receive loans at all, and if the demand for loans by established customers is greater than the supply of loans then some established customers will be credit rationed. Thus it is more likely that new rather than established customers will be credit rationed because of the additional costs associated with processing new customers.

[4] See Equation A4.14 of Appendix 4.1.

Figure 4.6 shows that credit rationing will increase because the supply of credit will contract when:

i) Ei increases. A higher average cost of funds to the bank will mean that R^oR^o and R^1R^1 become steeper which reduces $Ei - i^o_{max}$ and $Ei - i^1_{max}$

ii) σ_i^2, the variance of cost of funds to the banks increases.

iii) $c'(i)$, the marginal cost of loans increases. This increases $r^k(i)$ which again increases the slope of R^oR^o and R^1R^1 reducing $Ei - i^o_{max}$ and $Ei - i^1_{max}$

iv) m^1/m^o, the proportion of new customers to established customers, for a given number of customers increases. See the equation for $r^k(i)$. Because $\alpha <1$, as m^1 increases relative to m^o, for a given number, m^o+m^1, $\alpha^k c'(\alpha m^o+m^1)$ rises causing $r^k(i)$ to increase.

v) U, the utility available to a rationed customer increases. This reduces i^o_{max} and i^1_{max} causing $Ei - i^o_{max}$ and $Ei - i^1_{max}$ to fall.

vi) $1/Ex$, the reciprocal of the expected return from a customer's project increases. This causes the slope of $w(i)$ and thus the slopes of R^oR^o and R^1R^1 to be steeper.

Implicit contract theory has implications for monetary policy. Credit rationing is less likely if the monetary authorities can ensure that the opportunity cost of funds to the banks is low and stable. The stability of a given loan interest rate depends upon the banks' perception of the *range* of cost of funds at which they will provide loans at a given rate. Banks will become less willing to maintain a stable lending rate as they become increasingly uncertain with regard to the future cost of funds. Because implicit contracts give rise to more stable borrowing rates than do loans negotiated in spot markets, investment plans can proceed more smoothly if the monetary authorities ensure stability in financial markets. In addition, credit rationing will also decrease if fiscal and monetary authorities engage in actions which increase the expected return to investment projects.

Olekalns and Sibly (1992) criticise Fried and Howitt's approach on two counts. First, because Fried and Howitt assumed that banks were risk neutral, they, in effect, assumed that banks have access to perfect capital markets, enabling the complete diversification away of risk. However, Fried and Howitt themselves note that the assumption that the banks are risk neutral is not crucial to the existence of rationing. Had the assumption been (1980, p. 486) "...that the banks were relatively less risk averse than borrowers the loan rate would generally vary with i but gains would be still obtained from an explicit contract that had an inelastic response of r to i and permitted some rationing in some states." Second, Olekalns and Sibly note that, in unregulated credit markets, there is considerable variation in borrowing rates across different states of the world in which the cost of funds to banks varies. By relaxing the assumption that banks are risk neutral, Olekalns and Sibly find considerable variation in the behaviour of borrowing rates across different states of the world but that non-price credit rationing can still exist.

In a further paper, Olekalns and Sibly (1994) extend Fried and Howitt's work in another direction by demonstrating that increases in the probability of default lead to increased credit rationing and they show that different risk classes of borrowers face different rates of interest but that, if credit rationing is in force, high risk borrowers are not necessarily charged *higher* interest rates but they will be more heavily rationed than lower risk classes of borrowers.

4.5 Collateral and credit rationing

To this point , I have considered loan contracts which are variant only in their interest rates. In practice, many loan contracts impose upon borrowers not only an interest rate requirement but also a collateral requirement where the borrowers pledge to transfer ownership of some asset(s) to the lender in the event that the borrower cannot meet the whole of the principal of the borrowed amount plus interest payments. Let the value of the collateral equal C. Loan repayment equals $(1+r)L$ where L = the amount of borrowed monies. $C \leq (1+r)L$. Thus, the value of the collateral may or may not be sufficient to cover promised repayment should the return on the investment project be too small to meet the promised repayments. Should the borrower default on all or part of the promised repayment so that the lender takes ownership of the collateral, the lender will suffer no loss if the following conditions hold: The value of collateral is equal to promised repayment, that is, $C=(1+r)L$; the lender is guaranteed of the value of C, and there are no costs associated with the recovery and marketing of C should the borrower be unable to meet his scheduled repayments.

In many cases, however, the aforementioned conditions do not hold. The borrower may have assets of insufficient value to cover full repayment on the loan, or the bank may be unwilling to accept some of the assets that the debtor does have as collateral. Assets may have a different value to the debtor than to the creditor. For example, inventories may be worth far more to a debtor who is 'in the trade' than to a creditor in the financial sector who may have difficulty in selling those same inventories should he acquire them as the consequence of a debtor's default. Assets may vary in value between the time that they are pledged as collateral when the loan is taken out and the time that ownership is transferred from the debtor to the creditor. An example of this is commercial property which was pledged as collateral against default on loans in Australia in the late 1980s. An excess supply of property and the bust in property prices meant that even when financial institutions acquired property through the default of borrowers, it was difficult to sell or lease so that, in fact, it had very little commercial value to the creditors. Transfer of the legal ownership of property obviously involves recovery costs. Unless, the collateral is of a financial nature, for example, government securities or the accounts payable of the defaulting debtor, the acquiring financial institution will usually want to sell the assets. This will nearly always involve it in some form of marketing costs. The upshot of all this is that lending institutions perceive that lending is still a risky business even when collateral is pledged against default by the borrower.

Consider now the reasons for the imposition of collateral requirements by lenders in loan contracts. First, including collateral in a loan contract increases the bank's expected return in case of default by the debtor. In the limiting case, $C=(1+r)L$, so there is no risk to the bank of loss provided the conditions outlined above hold, even when the project into which the debtor invests the borrowed funds fails and yields zero or low returns. Second, the imposition of a collateral requirement may make default of the debtor less likely as it makes default more costly for the debtor. When there is no collateral requirement imposed upon the debtor, the debtor's liability is effectively limited to zero.[5] If the behaviour of the debtor can not be adequately

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[5] The debtor may suffer a drop in his credit rating, making it difficult to subsequently obtain funds, so he suffers an implicit liability greater than zero. From the creditor's point of view, however, the liability of the defaulting debtor is zero.

monitored by the creditor, this may even provide an adverse incentive to the debtor to declare losses on investment projects even when projects have been successful and have generated positive returns. Third, collateral may cause borrowers to undertake less risky projects than they otherwise would because it increases the cost of default to the debtor. Therefore, even if the pledged collateral has very little worth if ownership of it should be transferred to the creditor, it may change the behaviour of the borrower in a way which increases the creditor's expected return.

Imposition of collateral requirements by the lender must be tempered by considerations of those circumstances when banks might find it not in their interests to increase the collateral requirements in a loan contract. Increasing collateral requirements may mean that less of a borrowing firm's capital is available for investment by debtors. Given that firms will have applied for loans for investment in projects which maximise the firms' expected returns, increasing the collateral requirement may mean that only smaller projects which the debtors consider have a lower expected return than the project with the lower collateral requirement can be undertaken. If the project's expected return is a function of its size, and the size of the project is inversely related to its risk; then these projects will have a higher risk of failure than larger projects. In addition, debtors with projects which are both smaller and which have a higher risk of failure are more likely to need to approach their creditors at some stage during the project to arrange further finance in order that the viability of the project be maintained. If this further finance is not forthcoming, the debtor may become bankrupt and the creditor suffer losses if the collateral is less than the promised repayment. These losses may not have been incurred if the creditor had not insisted on as high an amount of collateral at the commencement of the project so that more of the debtor's own capital was available for investment in the project.

Alternatively, the debtor who has to put up a higher collateral requirement may invest the borrowed funds into a riskier project than he would otherwise have done in order to bring the expected return of this riskier project as close as possible to the expected return of his preferred project. Thus, increasing collateral provides an adverse incentive to the debtor to engage in riskier projects.

The amount of collateral which a debtor can put up may be highly and positively correlated with wealth. If wealth is positively correlated with willingness by debtors to take risks, then an increase in collateral requirements selects against the less wealthy risk-averse potential debtors. This adverse selection of less risk averse borrowers by lenders may reduce the lenders' expected returns in the same way as an increase in interest rates.

Another problem for creditors is one to which we have previously referred. That is, collateral may not have the same value to creditors as it does to debtors. Moreover, collateral may fluctuate in value. Creditors may not be willing to increase collateral requirements if they are unsure of the direction of future price level changes in the economy and how those changes will affect the value of the collateral to them, or if they believe that macroeconomic conditions are becoming increasingly unstable opening up the possibility of debt deflation. Consider now whether the imposition of collateral requirements can eliminate credit rationing.

Stiglitz and Weiss (1981) demonstrated that lenders may not be willing to increase collateral requirements if borrowers are risk averse. They indicated that those potential borrowers with more wealth, and hence collateral, may be those borrowers who, in the past, have undertaken greater risks, and who by so doing, have accumulated more wealth than the more risk-averse potential borrowers. Increasing collateral requirements thereby leads to an adverse selection effect where, as collateral requirements are increased beyond that amount available to some potential borrowers, the more risk-averse individuals have no choice but to drop out of the market for loans. Lenders are thus faced with a pool of less risk-averse borrowers who undertake riskier projects. Strengthening Stiglitz and Weiss' conclusions is a paper by Wette (1983) which demonstrates that even when potential borrowers are risk-neutral, lenders may not be willing to use collateral requirements as a rationing device because increases in collateral can lead to adverse selection effects that decrease lenders' expected returns on loans.

In contrast to Stiglitz and Weiss (1981), Broll and Gilroy (1986) place emphasis on collateral aspects of the loan contract rather than the interest rate. They show that whilst increasing collateral requirements leads to a positive repayment effect, it also leads to an adverse selection effect as less risky projects drop out of the market for loans. They also demonstrate the optimal collateral policy for the bank at which the bank maximises its expected returns. This occurs when collateral is set so that the positive effect of an increase in collateral on the bank's expected return is exactly compensated by the negative adverse selection effect as was the case with a rise in the interest rate. Broll and Gilroy show that credit rationing may exist when the optimal collateral policy is adopted.

Bester (1985) develops a model of bank loans where loan contracts are defined by both interest rate and collateral requirements. He argues (p. 850) that 'no credit rationing will occur in equilibrium if banks compete by choosing [simultaneously] collateral requirements and the rate of interest to screen investors' riskiness.' His argument relies on the assumption that riskier individuals are less willing to pledge collateral and proceeds thus: A credit rationing equilibrium pools both good and bad risks. If a potential borrower does not receive a loan on his preferred terms, he will apply for a loan on terms which are being made available to less risky borrowers. This will be a contract with a higher collateral requirement than that preferred by the potential borrower. However, Bester argues that if there is such a pooling equilibrium, there must be another equilibrium with higher expected returns for the bank which selects from the pool of potential borrowers, by increasing the collateral requirements, only those borrowers who are good risks. The increase in collateral requirements elimimates those borrowers who are poor risks.

Jaffee and Stiglitz (1990, p. 867, footnote 31) are critical of this type of approach where examples are developed in which credit rationing does not occur: '[T]o show that credit rationing does not occur is an exercise directed at an irrelevant question; they would have to show that credit rationing does not arise in any "plausible" model'. Stiglitz and Weiss (1986) criticise Bester's approach arguing that elimination of the information asymmetry (of being able to sort good from poor risk borrowers) is not a reflection of real world banking practice. In any case, Bester's model relies on low-risk borrowers being able to raise sufficient collateral to enable banks to distinguish them from high-risk borrowers, something which low-risk borrowers may be unable to do. Bester (1985, p. 854) himself recognises the importance of this limitation: '[P]erfect sorting in a credit market equilibrium may be impossible if some low-risk firms face a binding constraint on the amount of collateral they can provide.' Stiglitz and Weiss (1992) argue that credit rationing can still occur even when lenders can sort borrowers by simultaneously setting interest rate and collateral requirements. Stiglitz and Weiss's (1992) model of collateral and credit rationing is presented and discussed in Appendix 4.2.

4.6 Credit rationing in post Keynesian economics: a brief survey

The post Keynesian position with respect to credit rationing is varied across post Keynesian authors. A generalised post Keynesian position with which few post Keynesian economists would argue (with the exception of the reference to the administered rate of interest on loans) is encompassed in the following quote from Lavoie (1992, p. 178):

> 'In general, there will exist a *fringe of unsatisfied borrowers,* who cannot get bank advances although they consider their projected activities to be profitable at the market rate of interest. What matters, however, is the opinion of their banker. 'The fundamental activity is accepting, that is, guaranteeing that some party is credit worthy. (Minsky, 1986, p. 229). A banker may refuse to finance a firm for, basically, two reasons. First, he may not believe the projects of the firm to he profitable at the administered rate of interest on loans. The projects will thus not appear more profitable at a higher horrowing rate! Secondly, the potential customer may not fulfil the norms established for borrowing.'

The quote suggests that some amount of credit rationing is the norm. Also, both expected returns to the projected activities and conventions have a place in determining whether or not a potential borrower receives a loan. What distinguishes the post Keynesian monetary theorists' discussion from that of the New Keynesians in analysis of credit rationing is that post Keynesians place emphasis on fundamental uncertainty. Post Keynesians argue that banks make loans based on conventions and rules of thumb. It is these which dictate whether or not a potential borrower will receive a loan rather than the profit maximising priciples which assume rational expectations as in New Keynesian analysis.[6] A brief survey of the views on credit rationing of the principal post Keynesian monetary economists follows.

Wray (1990, p.57) argues that an increase in the demand for credit money by creditworthy customers can always be met by financial institutions. These institutions make the loans and then look to the central bank to provide, if necessary, the reserves to support the loans. The central bank is acquiescent in this role as its primary role is to support the stability of the financial system. It cannot afford that either a large institution or a large number of institutions fail as a consequence of a liquidity shortage. However, the profit seeking behaviour of banks dictates that credit rationing is a normal feature of a capitalist monetary system as loans are only made to those who are extremely likely to repay them. This leads to the development of personal relations with potential borrowers and the application of rules of thumb, such as collateral requirements, credit history and leverage ratios, to the assessment of potential borrowers' creditworthiness. Wray argues that when the leverage (debt/equity) ratios of both the borrowers and lenders are low, loans made by the banks are validated, as both repayments of principal and interest are met, so that the banks become increasingly willing to lend. That is, they become increasingly willing to become more illiquid in the sense of having a higher proportion of relatively risky

[6] The contrast between decision-making in post Keynesian analysis which emphasises Keynesian uncertainty and New Keynesian analysis which emphasises risk is to be explored in Chapter 6. A reconciliation of the two approaches is also attempted.

assets to equity than was the case prior to the increase in loan activity.[7] The supply of credit money may be infinitely elastic for some period of time as argued by the horizontalist/accommodationist post Keynesians. By borrowing more, the banks' customers also become more illiquid.[8] At some point, the banks may perceive that, as their leverage ratios are rising, the risks associated with lending are increasing. Banks will then require an increase in interest rates to induce them to become even more illiquid.

Any event which leads to an increase in uncertainty such as recession, a stock market crash or a default by a major debtor leads to an increase in liquidity preference. This is because money acts as insurance against an uncertain future. By holding onto money rather than making irreversible commitments, economic agents keep their future options open either to take advantage of more certain profitable investment opportunities which may arise, or to prevent themselves from becoming illiquid in the future so that they can meet all contractual commitments. Because liquidity preference is rising, both lenders and borrowers will want to reduce their leverage ratios. In terms of the oft-quoted phrase of recent times the banks and borrowers will wish to 'repair the balance sheets'. Banks become unwilling to extend credit on demand. A general run to liquidity makes it hard for the banks to maintain a rate of reflux. Borrowers draw down deposits to retire debt. Depositors convert time deposits to liquid deposits. Banks lose reserves so that 'an unwillingness to lend is converted to an inability to lend'[9] and credit is rationed.

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[7] This statement assumes that if equity is growing because of increased profits, it is at a slower rate than lending activity.

[8] See previous footnote.

[9] Wray (1990, p. 149).

In the post Keynesian tradition, Wray (1990, p. 179) emphasises the importance of uncertainty and 'rule-governed' behaviour when discussing credit rationing:

> '[T]he money supply curve is not horizontal at a given rate of interest because banks face uncertainty. Banks are concerned with the ratio of loans to safe assets such as government bonds plus reserves, and with the ratio of loans to equity. Should borrowers default on loans, liquidation of safe assets permits banks to meet payment commitments temporarily, while equity allows banks to absorb loan losses. ... Even where additional loans can be made which are no more risky than loans which have been made previously, banks may require higher interest rates to compensate for riskier leverage ratios.'

and:

> '[B]ecause great uncertainty must always exist, it is still necessary to establish close relations with customers.....[B]anking is a risky business because the future is uncertain and because money commitments are necessarily future oriented. For these reasons, banks use a combination of price and quantity constraints to ration credit.'

The first quote emphasises the banks' concern with liquidity as protection against an uncertain future. Sufficient assets and equity prevent the bank from becoming firstly, illiquid, and secondly, insolvent should borrowers default on loans. The second quote is explicit in assigning the reason for credit rationing to uncertainty. There is both quantity and price credit rationing. Price rationing suggests that the interest rate will be raised to compensate the bank for increased uncertainty. Quantity rationing suggests that not all borrowers deemed to be creditworthy at the going interest rate will receive loans. This can be explained with reference to the fall in the rate of reflux. However, it is inconsistent with Wray's statement, to which we made previous reference, that an increase in the demand for credit money by creditworthy customers can *always* be met by financial institutions (emphasis added).

Wray suggests that credit rationing increases with a rise in liquidity preference. Banks recognise that an increase in the debt/equity ratios of both their own balance sheets and the balance sheets of their borrowers leads to an increased risk of an illiquid position in the future and they raise the interest rate in order to mitigate the impact of the increased risk that rising leverage imposes on their expected returns. Wray goes on to suggest that this rise in interest rates may lead to adverse selection and adverse incentive effects, and that quantity credit rationing of the type which occurs in New Keynesian analysis might then occur. It seems, in post Keynesian analysis, that credit rationing of this type - quantity rationing - can only occur if there is a role for liquidity preference in the determination of interest rates. The *accommodationist* post Keynesians object to a role for liquidity preference in determination of interest rates, arguing that the base rate is exogenously determined by the central bank, albeit in bounds determined by the expectations of the financial markets (See Dow and Saville (1990) and Neal (1993)), and that loan rates are determined as mark-ups over the base rate.

Wray's discussion of loan interest rates being, in part, determined by liquidity preference departs from many other post Keynesians who argue that loan interest rates are determined as a mark-up over the central bank's base rate - the administered rates referred to above. Wray's position is that the supply of credit money will be positively sloped with respect to the interest rate as leverage ratios rise beyond some prudent level. If subsequently, there is a collapse of expectations due, for example, to a default by a major debtor, the liquidity preference of both lenders and borrowers is likely to rise. An increase in liquidity preference causes an increase in the demand for cash hoards. Such an increase can only be met by the central bank increasing the amount of reserves available to the banks or by foreigners through a balance of payments surplus. If reserves to the banks are not increased, the increase in the demand for cash, an increase in the demand for money, will drive up the interest rate. As discussed in the previous paragraph, the adverse incentive and adverse selection effects arising from an increase in interest rates may lead to an increase in quantity rationing.

Wray's position with respect to credit rationing seems somewhat inconsistent when considered in the light of his comments regarding the role of the central bank. He argues that deregulated banking with implicit guarantees by the central bank of financial liabilities combined with periodic attempts at reserve constraints has pushed up the cost of issuing liabilities and has encouraged banks to take risky positions. When the central bank constrains the growth of reserves, the banks expand their balance sheets on the basis of a smaller liquid base (Wray, 1990, p. 297). Thus, here, Wray seems to be suggesting that less credit rationing takes place than otherwise would for any given increase in interest rates. This is because the central bank accommodates increases in liquidity preference when necessary as it is wary of the possibility of financial fragility and resultant systemic instability which may result from debt repudiation.

Whilst Wray argues that credit is both price and quantity rationed, implicit in Moore (1988) is that credit will only be price rationed. Indeed, given the extreme accommodationist position he takes, it is difficult to see how he could explain quantity rationing. The central bank sets the base rate. The banks set their loan rates as some mark-up over the base rate and then supply whatever quantity of credit money is demanded at those loan interest rates to creditworthy borrowers. Creditworthiness is determined on the basis of projects' expected returns and collateral (Moore, 1988, p. 376). The central bank is assumed to fully accommodate any increases in the demand for credit money at the base rate of its choice. In other respects, the story is similar to Wray's work. Whilst loans are being validated, collateral requirements and leverage ratios are adjusted downwards. It is only when there is a collapse in expectations that there is a surge in demand for liquidity and a rise in credit standards.

Uncertainty is also emphasised in Moore's analysis (p. 376):

> 'Conventional analysis correctly emphasizes the importance of expected returns in determining the amount of investment that will be undertaken. But it does not sufficiently emphasize that because the future is inherently unknowable, these expected returns are necessarily uncertain and widely heteregeneous. ... The expected return, together with the collateral capabilities of borrowers, determines which of these investment projects will be taken up for external finance by lenders.'

The last sentence of the quote is as applicable to the New Keynesian analysis of credit markets as it is to post Keynesian analysis. Credit rationing is the implication of some investment projects not going ahead because they are not taken up for external finance by lenders. Expected returns will depend on the interest rate charged to the borrower. What distinguishes the quote as belonging to the post Keynesian school is again the emphasis on fundamental uncertainty.

Rousseas (1986, pp. 21-22) argues that it is the continued presence of uncertainty that permits money to be used as a store of wealth or value as a hedge against uncertainty. He makes reference to Shackle's discussion: 'it [that is, money] allows decisions to be *deferred* in the sense of "avoiding commitments to technically specialized, hazardous types of assets." Money, he continues, is "the postponer of the need to take far reaching decisions" by virtue of the liquidity that money provides. It is, to put it otherwise, *the temporary abode of purchasing power in a world of uncertainty.*' Thus, liquidity preference will rise when there is an increase in uncertainty.

However, Rousseas' discussion (1986, p. 45) indicates an impatience with the notion that banks have much effect on the level of investment under normal conditions, and he therefore, assigns no role to credit rationing under normal conditions. Normal conditions are those which occur when interest rates are relatively low so that most borrowers have no difficuly in meeting repayment commitments. Loans are financed out of firms' internal funds and the excess liquidity of banks. As investment plans are realised, the increased demand for transactions balances are met out of increased savings associated with greater income. Shortfalls are met by financial innovations and changes in the velocity of circulation. Here, when conditions are normal, there is no place for credit rationing behaviour on the part of banks as most loans are profitable. In exceptional circumstances, when the central bank attempts to restrict the quantity of money, banks become less liquid and therefore less willing to lend. This curtailment of loan activity leads to a reduction in the level of investment. In Rousseas' analysis of exceptional circumstances, there is criticism of the horizontalist/accommodationist post Keynesian monetary theorists: 'to argue that the central bank fully accommodates any and all increases in the demand for money not only overstates the case but eliminates banks as a barrier to increased investment'. This underlines the problem that the accommodationist post Keynesian economists have in explaining credit rationing.

In contrast, Davidson (1991, pp. 65-66), another post Keynesian, argues that the central bank can, by controlling the ability of the commercial banks to make loans, stymie real output: 'in the absence of the creation of additional bank money deposits, managers will not be willing to sign additional hiring contracts, and long-run employment growth will be stymied'. However, this position suggests, perhaps not intentionally, a rejection of the concept of an endogenous money supply. Taken to its limit, it suggests that the central bank is able to control the money stock rather than the interest rate, a position rejected by all post Keynesians. All post Keynesians believe that the demand for credit money is an important determinant of the money supply. That is, the money supply is endogenously determined by the demand for money. If they are accommodationists, post Keynesians believe that the central bank will fully accommodate any increases in the demand for money so the ability of the commercial banks to make loans is not constrained. All that the central bank can do is set the base rate and hope that expenditures are sufficiently interest-rate elastic to bring about a reduction in the demand for money, and so, consequently, a reduction in money supply. Although the structuralist post Keynesians do not believe that the central bank will always accommodate increases in the demand for credit money, they do believe that lack of accommodation will drive up interest rates, rather than stifle the ability of the commercial banks to make loans. It is the increase in interest rates which leads to a reduction in the quantity demanded of credit money; not an inability on the part of banks to make loans which stymies employment growth.

Dow and Saville (1990, pp. 18-19) attribute credit rationing by banks to the existence of uncertainty. In their view: 'banks are not able to make precise estimates of the risks attaching to particular loans, and consequently (even apart from possible adverse selection and incentive effects) they could not protect themselves by charging more for riskier loans'. The pooling of risks as loans are made to many customers across diversified projects overcomes some of the uncertainty. However, borrowers are not certain of their future returns, so banks, judging at a further remove, are even less certain. This, Dow and Saville argue, drives banks to use rules of thumb in making loan decisions. But, even in the New Keynesian analysis of financial markets, rules of thumb must be used to determine who gets loans and who does not when asymmetric information or implicit contracts leads banks to charge an interest rate which does not clear the market for loans amongst borrowers between whom the bank cannot distinguish.

Dow and Saville argue that the determinant of a customer's creditworthiness depends on his past and prospective income, debt/equity ratio, collateral and prospective debt servicing ability. These determinants of creditworthiness are common to the post Keynesian authors. Importantly, because of its implications for the analysis of financial instability, Dow and Saville state that the value of collateral will be rising with rising nominal income so that the aggregate supply of loans is likely to be increasing as income rises. The demand for loans is likely to be increasing for the same reason. There should, thus, be a positive correlation between rising income and money supply, but not for the reasons suggested by the monetarists. Here, the money stock rises as a consequence of the increase in the demand for credit money, not because the central bank has brought about an exogenous increase in the money supply.

There is consensus amongst post Keynesian monetary economists that loans will only be made to those potential borrowers that the bank deems to be creditworthy. Given their emphasis on endogenous money and the role of the central bank as the lender of last resort it is difficult for the accommodationist post Keynesians to explain the type of quantity credit rationing generated by the New Keynesian analysis of asymmetric information and/or implicit contracts. The post Keynesian analysis suggests that *all* borrowers deemed to be creditworthy at the going interest rate should be granted loans. This was the position taken by the *Australian Financial System: Final Report of the Committee of Inquiry* (1981), otherwise known as the Campbell Committee, with reference to the removal of quantitative limits on lending and the lifting of controls on interest rates. Non-price credit rationing was to be eliminated. Prospective borrowers intending to undertake projects of higher risk but who were still deemed to be creditworthy were to be charged higher interest rates reflecting the increased risk. Structuralist post Keynesians can explain quantity credit rationing but only with recourse to an increase in liquidity preference. Banks first become unwilling to lend and then unable to lend, because reserves fall as a result of the decline in credit money supplied.

4.7 The neo-Keynesians and the elimination of credit rationing

The position taken by the Campbell Committee was based on a neo-Keynesian assessment of monetary institutions. Although the members of the Committee believed that efficiency is best achieved by competition, they were aware that free markets do not always achieve the best outcomes because of factors such as insufficient competion, and costly or unobtainable information. In addition, free markets do not always engender stability and confidence in market conditions. With respect to credit rationing, the Campbell Committee argued that quantitative lending controls led to reduced competition between the banks, controls on interest rates led to banks favouring low-risk borrowers, those with savings records and those who could bring new business so that interest rate controls increased the amount of credit rationing.

Neo-Keynesian economics suggests that, in the short-run, rigidities may be due to 'stickiness' in markets; but in the long-term, markets adjust to their Walrasian market-clearing equilibrium levels. Any maladjustment must be due to regulation. Appendix 2 of Chapter 4 of the Campbell Committee's report suggested that controls over the banks led to a reduction in allocative efficiency and to credit rationing. Because banks had difficulty in attracting funds as a result of the controls and so had to ration credit, it was argued that business had to shift their demand for loans to institutions which were less efficient, less able to spread risks and less able to cope with fluctuations in liquidity. The Campbell Committee recommended abolition of quantitative lending controls and controls on interest rates so that non-price credit rationing was to be eliminated. Whether this occurred as an empirical matter in Australia is the subject of the next chapter.

4.8 Conclusion

This chapter has canvassed the reasons for credit rationing from the New Keynesian, post Keynesian and neo-Keynesian perspectives. The New Keynesians have demonstrated that equilibrium or non-price credit rationing can arise even in deregulated financial markets where there is asymmetric information between borrowers and lenders as a consequence of adverse selection and adverse incentive effects which arise when there is an increase in interest rates. This conclusion holds even when collateral is introduced into loan contracts.

It has also been shown that implicit contracts, based on profit maximisation and utility maximisation principles consistent with New Keynesian economics, also lead to credit rationing because they lead to a loan interest rate which is more stable than the cost of funds to the bank.

The principal policy conclusions to be drawn from New Keynesian analyses of credit rationing are that credit rationing will not be entirely eliminated in deregulated financial markets, there will be higher loan interest rates and a lesser amount of credit rationing should the central bank provide liquidity support facilities in the case of crises, and the amount of credit rationing will be smaller the lower and more stable is the cost of funds to the banks which is largely determined by the monetary policy actions of the central bank.

The brief survey of the post Keynesian literature with respect to credit rationing showed that, in contrast to New Keynesian economics, where credit rationing results from profit and utility maximisation, post Keynesian monetary economists argue that credit rationing is based upon fundamental uncertainty, an issue to be explored in much more depth in Chapter 6. Post Keynesians, in general, argue for selective credit controls. See, for example, Rousseas (1986) and Wray (1990).

The Campbell Committee took the neo-Keynesian view with respect to deregulation of financial markets that the removal of quantitative lending controls and removal of controls over interest rates would remove the impediments to borrowers being able to charge risk-related interest rates to all forthcoming borrowers and so eliminate credit rationing. That not all non-price credit rationing was eliminated in Australia following financial deregulation is the subject of the next chapter.

Appendix 4.1 The Stiglitz-Weiss 1992 model of collateral and credit rationing

Stiglitz and Weiss (1981) showed that if interest rates were raised, either adverse selection or adverse incentive effects could lead to lenders facing a pool of borrowers with a higher probability of default than was the case prior to the rise in the interest rate. Although lenders could require collateral against loans, the requirement for collateral made no difference to the results. Stiglitz and Weiss (1992) extend Stiglitz and Weiss (1981) to allow for both the simultaneous inclusion of adverse selection and adverse incentive effects and the simultaneous inclusion of interest rate and collateral requirements, to differentiate amongst borrowers with different levels of wealth and varying degrees of default probabilities. Even though this differentiation allows banks to offer several contracts, credit rationing may still exist as an equilibrium phenomenon. Stiglitz and Weiss (1992, p. 718) state that under these circumstances,

> "[c]redit rationing can occur if three conditions are satisfied:
>
> 1. There must be some residual uncertainty (information imperfection), after lenders employ whatever means they have at their disposal to differentiate among applicants and to control their behaviour.
>
> 2. The adverse selection/adverse incentive effects of changing interest rates or the non-price terms of the contract (collateral, equity, etc.) must be sufficiently strong (at some values of the relevant variables) that it is not optimal for the lender to use these instruments to fully allocate credit.
>
> 3. The supply of funds must be such that at the Walrasian equilibrium (where demand equals supply, taking into account the use of non-price instruments), the expected returns to the lender are lower than for any other contract, at which there exists credit rationing."

The analysis so far described in this paper has indicated that changes in interest rates alone can lead to adverse selection of less risk-averse individuals and adverse incentives to those individuals to undertake riskier projects without taking into account that:

1) the risk aversion of wealthier borrowers may differ from that of poorer borrowers;

2) collateral requirements may also be used in conjunction with interest rates in forming a credit contract; so that the banks, by choosing particular interest rate/collateral combinations, can influence the choice of a risky versus safe technique (where the probability of success of the safe technique is higher), into which the borrower invests borrowed funds.

Stiglitz and Weiss (1992) assume that borrowers are of two types, rich and poor, and that they have a choice of two techniques, safe and risky, into which they can invest borrowed funds. The safe technique has a higher probability of success than the risky technique. Asymmetric information is still present in the model as the lender is assumed to be unable to observe which technique is being used by the borrower. Both types of borrowers are assumed to have the same utility functions.[10]

Let $\mathcal{R}^{ss}$ = return to safe project if project is successful,

$\mathcal{R}^{rs}$ = return to risky project if project is successful,

λ^{s} = probability of success of safe project,

λ^{r} = probability of success of risky project,

r = interest rate on borrowed funds,

C = collateral requirement,

$\mathcal{W}_0$ = borrower's initial wealth,

[10] Note that some of the following notation has been altered from that used in Stiglitz and Weiss (1992) in order to keep it consisitent with notation used elsewhere in this thesis.

ρ = safe return on wealth not invested in project,

$\mathcal{Y}_1$ = end of period wealth of borrower if project is successful, and

$\mathcal{Y}_0$ = end of period wealth of borrower if project is unsuccessful.

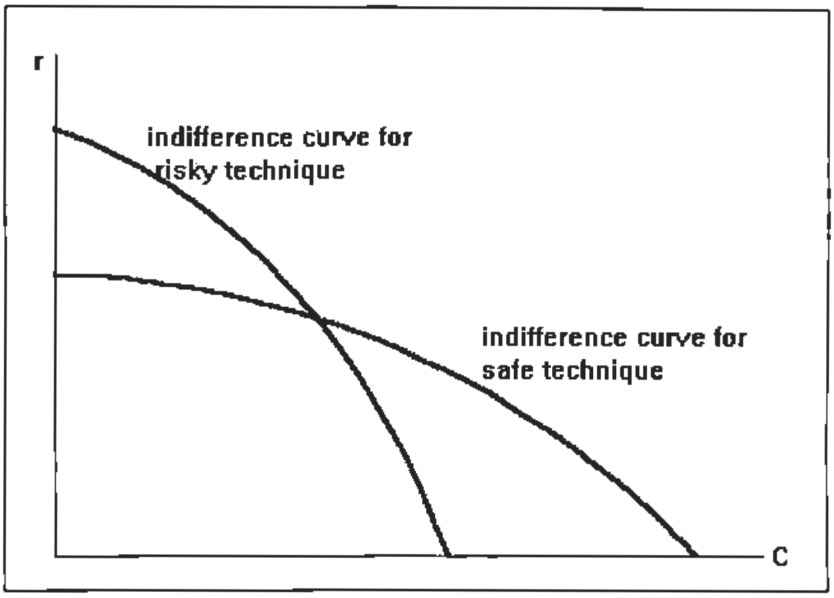
Then, if the amount borrowed is normalised to unity,

$$\mathcal{Y} = max\{\mathcal{W}+X-(1+r), \mathcal{W}-C\}.$$

That is, $\mathcal{Y}_1 = \mathcal{W}+X-(1+r)$ or $\mathcal{Y}_0 = \mathcal{W}-C$ where $\mathcal{W} = \mathcal{W}_0(1+\rho)$ and $C = C(1+\rho)$. The expected utility of the borrower is $\mathcal{E}\{\mathcal{U}\} = \mathcal{U}(\mathcal{Y}_1)\lambda + \mathcal{U}(\mathcal{Y}_0)(1-\lambda)$.

Stiglitz and Weiss assume that borrowers are risk averse and that there is decreasing absolute risk aversion which implies that the marginal utility of wealth is positive but diminishing. In other words, decreasing absolute risk aversion implies that the poorer is an individual, the more risk averse will be that individual. Formally, $\mathcal{U}'>0$ and $\mathcal{U}''<0$ and $d\mathcal{A}/d\mathcal{Y}<0$ where $\mathcal{A} = -\mathcal{U}''/\mathcal{U}'$. Decreasing absolute risk aversion leads to an *increasing* marginal rate of substitution of collateral for interest rates in a credit contract such that the indifference curves are concave in contrast to the more usual convex to the origin indifference curves. That is, for any given rise in interest rates, borrowers must be compensated by increasingly larger falls in collateral requirements in order to remain on the same indifference curve. Because a borrower will be prepared to put up more collateral, for any given reduction in the interest rate, against a safe technique than against a risky technique, the indifference curve associated with the safe technique will be flatter than the indifference curve associated with the risky technique. Figure A4.1.1 illustrates the indifference curves for the safe and risky techniques.

Figure A4.1.1 Indifference curves for safe and risky techniques



Because of the assumption of decreasing absolute risk aversion, a rich borrower is less risk averse than a poor borrower and the rich borrower is therefore prepared to put up a greater amount of collateral against any given fall in the interest rate than is a poor borrower. Thus the rich borrower's indifference curve is flatter than the poor borrower's indifference curve. Figure A4.1.2 illustrates the indifference curves for rich and poor borrowers.

Figure A4.1.2 Indifference curves for rich and poor borrowers

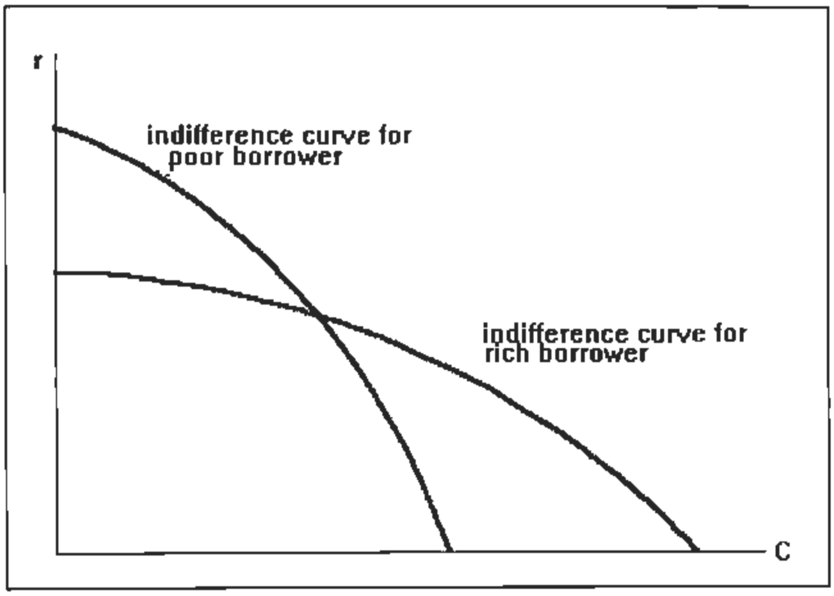
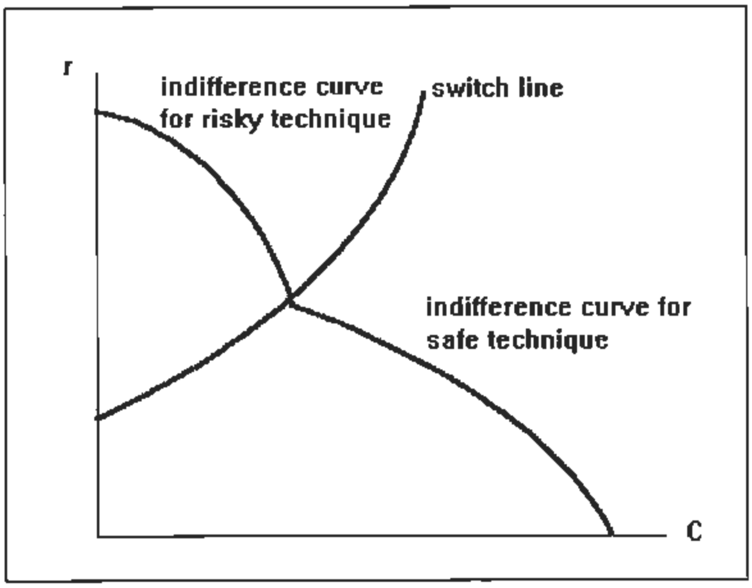


Figure A4.1.3 The switch line for an individual borrower



Any borrower will choose the technique which gives him the highest expected utility.

The borrower will be indifferent between techniques where:

$$E[U^r] = U(Y^r_1)\lambda^r + U(Y_0)(1-\lambda^r) = U(Y^s_1)\lambda^s + U(Y_0)(1-\lambda^s) = E[U^s].$$

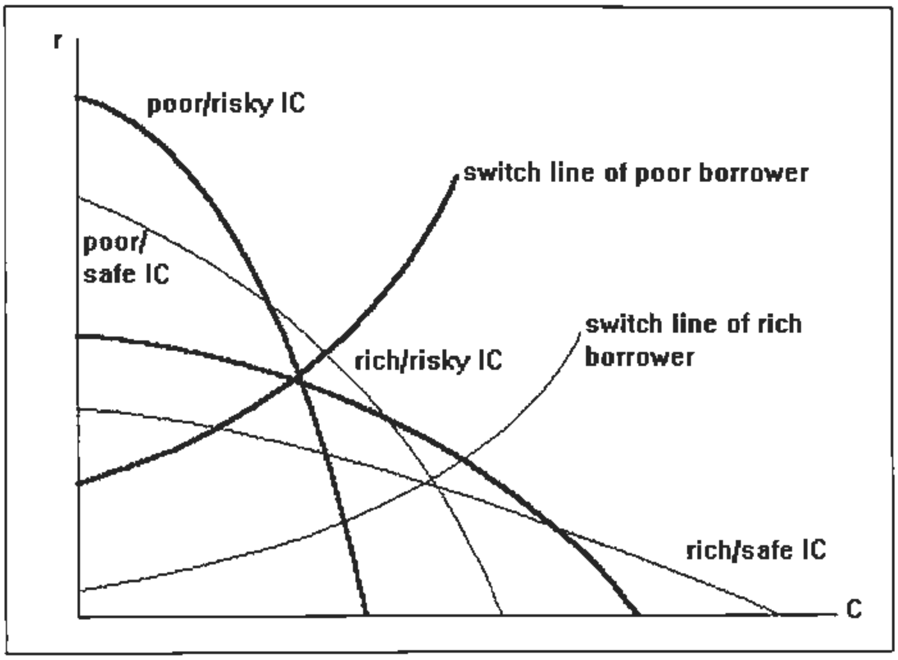
The locus of interest and collateral combinations at which this condition is met is called the switch line. That is, along this locus borrowers are indifferent about switching between the safe and the risky techniques. The switch line for an individual borrower is illustrated in Figure A4.1.3. Note that the indifference curve is no longer concave.

The switch line of rich borrowers will always lie below that of poor borrowers. This derives from the assumption of decreasing absolute risk aversion which led to the indifference curves of richer borrowers being even flatter than the indifference curves of poor borrowers. Consider Figure A4.1.4 which shows the indifference curves for both poor and rich borrowers for both safe and risky techniques and their associated switch curves.

More formally, Stiglitz and Weiss (1992, footnote 19, p. 702) note that "[a] switch from the safe to the risky technique can be viewed as a mean utility preserving change, in the sense of Diamond and Stiglitz (1974)....a mean-utility preserving change for one individual induces a reduction in expected utility for a more risk averse individual....Hence along the poor individual's switch line, $\mathcal{EU}(\mathcal{Y}^r_1)\,\lambda^r + \mathcal{EU}(\mathcal{Y}_0)(1-\lambda^r) < \mathcal{EU}(\mathcal{Y}^s_1)\,\lambda^s + \mathcal{EU}(\mathcal{Y}_0)(1-\lambda^s)$."[11]

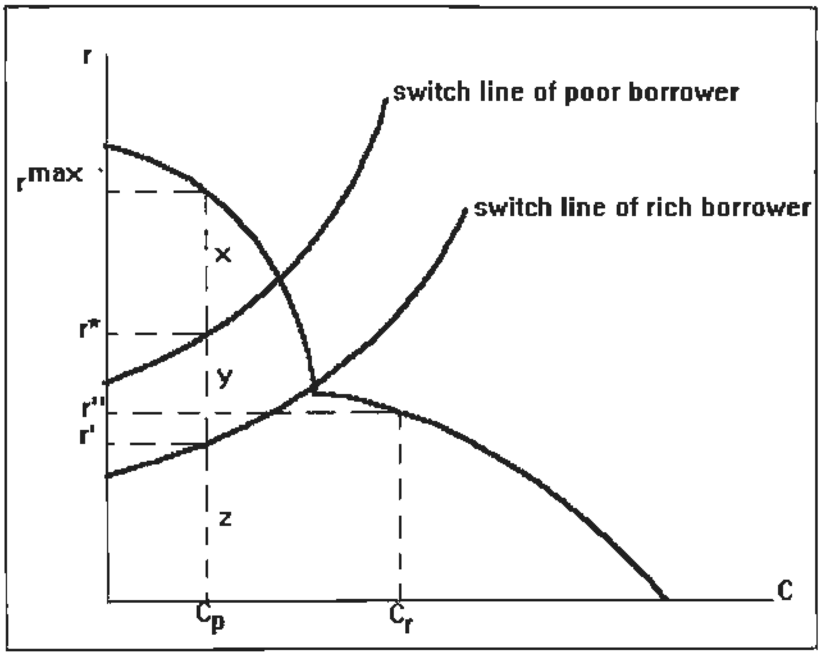
[11] The notation has been changed in this quote from the notation used in the original.

Figure A4.1.4 Switch curves for rich and poor borrowers



Consider now, with reference to Figure A4.1.5, how the choice of a given level of collateral, C_p, affects the choice of technique by both rich and poor borrowers.

Figure A4.1.5 The lender can affect the choice of safe or risky technique



Given that collateral is fixed at C_p, at interest rates below r', in region z, both rich and poor borrowers will use the safe technique. For interest rates which lie above r' and below r^*, in region y, the poor borrowers will continue to use the safe technique but the rich borrowers will switch to using the risky technique. That is, the bank in raising the interest rate above r', provides an adverse incentive to rich borrowers to undertake projects with the riskier technique. At interest rates above r^*, but below r^{max}, in region x, both rich and poor borrowers are provided with an adverse incentive to use the risky technique. No-one will borrow if the interest rate rises above r^{max}.

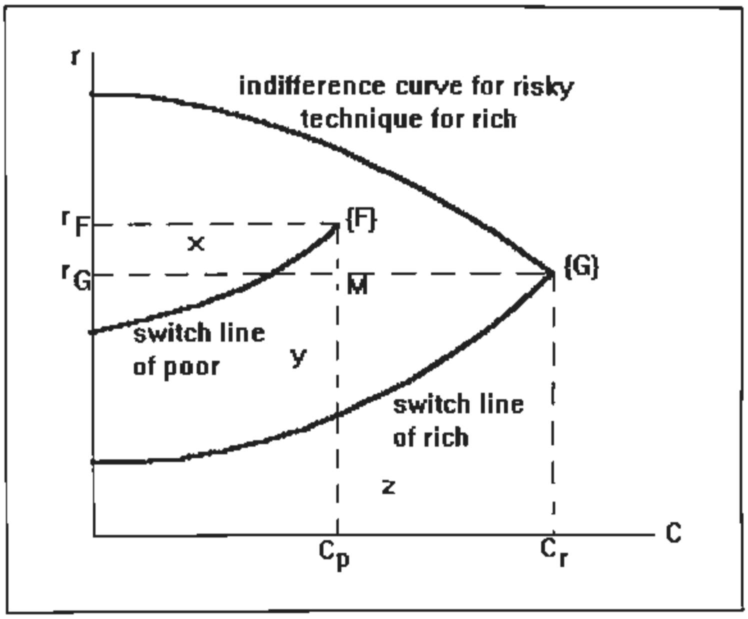
It can be seen with reference to Figure A4.1.5, that banks, by varying the amount of collateral and interest rates, can affect the choice borrowers make between safe and risky techniques. By setting collateral requirements above C_p, the bank can adversely select less risk-averse borrowers (the rich), and in choosing an interest rate in association with a collateral requirement, the bank can provide adverse incentives to borrowers to undertake riskier projects. The indifference curves in Figure A4.1.5 are drawn for rich borrowers (because it is the switch line of the rich which passes between the two indifference curves for the safe and the risky project). By setting the amount of collateral at C_p, the bank leads the rich borrower to use the risky technique at any interest rate below r^{max} and above r'. If the amount of collateral is set high enough to cause the rich borrower's credit contract (interest rate-collateral combination) to lie below his switch line, say at r'', C_r, the rich borrower will choose to use the safe technique.

Banks are assumed to be risk neutral and to attempt to maximise their expected returns, $\mathcal{E}(\pi_b)$, where

$$\mathcal{E}(\pi_b) = \lambda^i(1+r) + (1-\lambda^i)C$$

where the superscript, i, refers to the choice of technique by the borrower. {F} and {G} are two contracts such that {F} is the highest collateral, interest rate combination consistent with the poor using the safe technique and {G} is the highest collateral, interest rate combination consistent with the rich using the safe technique. That is, in terms of Figure A4.1.6, {F} = $\{C_p, r_{\mathcal{F}}\}$ and {G} = $\{C_r, r_{\mathcal{G}}\}$.

Figure A4.1.6 Credit contracts and rationing equilibria



Only rich borrowers can obtain contract {G} as the maximum collateral that the poor can put up is C_p. C_r is higher than C_p and this, when considered on its own, increases the bank's expected return but the interest rate at {G} may be lower or higher than the interest rate at {F}. If lower at {G} than at {F} it is possible that the expected return from contract {G} is lower than the expected return from contract {F}.

Consider now rationing equilibria. Pure pooling is where all borrowers, rich or poor, receive the same contract. If there is a pure pooling equilibrium it must lie at {F}. If contracts are granted above the switch line of the poor, in region x, all borrowers will be using risky techniques. As the expected return from a risky project is less than the expected return from a safe project, and as an interest rate higher than r_F can't be charged to compensate the bank for the switch to the risky technique, given the highest collateral requirement affordable by the poor is C_p, the optimal contract in this region is {F}.

For contracts granted below the switch line of the rich, in region z, all borrowers are undertaking safe projects. Here, the expected return to the bank can be maximised by charging the highest interest rate, collateral combination consistent with all borrowers continuing to undertake safe projects. This is at {G} where only rich borrowers can enter into contracts because of the high collateral requirement, C_G. Hence, {G} will not be a pure pooling equilibrium.

Poor borrowers' maximum collateral is C_p and so the highest interest rate they can be charged so that they undertake safe projects given collateral C_p is r_F. Therefore {F} is the optimal contract for the bank for poor borrowers in region y. Although rich borrowers may put up more collateral in region y, they undertake risky projects. Stiglitz and Weiss (1992, p. 706 and footnote 29) *assume* that "profits (per dollar loaned) at F when the fraction of the poor equals or exceeds z are higher than at any contract where the borrowers use the risky techniques" and "[t]hat is, $\lambda^r(1+r) < [\mathcal{E}(\pi_b)]_z\{F\}$."[12] Thus {F} is assumed to generate more profits to the bank than any other contract in the y region. This assumption seems to be unnecessary. Any contract with collateral greater than C_p will be unobtainable by the poor and such contracts will not allow for a pure pooling equilibrium. If rich borrowers are offered contracts above their switch line they will undertake risky projects and the highest interest rate

[12] Again the notation has been changed from the notation in the original quote.

consistent with the maximum collateral, C_p, *in a pooling equilibrium,* is $r_{\mathcal{F}}$ obtained with contract {F}. With a contract at a point such as $\mathcal{M}$, the rich and poor will undertake risky and safe projects respectively, put up the same amount of collateral, C_p, but pay a lower interest rate without any commensurate change in the riskiness of the projects undertaken. Thus the bank's profits from a contract at $\mathcal{M}$ will be lower than the profits from {F}.

So far all that has been established is that {F} is the optimal contract for a pure pooling equilibrium. If {F} is to be preferred to {G}, a non-pooling contract, by the banks, then the expected return from {F} must be higher than from {G}. If {F} is to be a pooling equilibrium *with rationing,* then the demand for loans must exceed the supply of loans at {F}. If the supply of loans is greater than the demand for them, then banks will compete for custom by reducing interest rate and collateral requirements so that poor customers continue to undertake the safe project (i.e. move southwest along their switch line).

A partial pooling, partial separating equilibrium with rationing can exist where some rich and poor borrowers receive contracts on the same terms whilst some rich borrowers receive contracts on different terms. Suppose that contracts {G} and {F} are both available and that the rich prefer {G} to {F}. The poor are unable to choose {G} because of its high collateral requirement. Suppose also that the expected return to the banks from offering {F} contracts to poor borrowers is less than the expected returns from offering {G} contracts to rich borrowers, which in turn is less than the expected returns from offering a combination of {F} and{G} contracts. Equilibrium requires that the expected returns to the bank from each contract are equally profitable. That is, $[\mathcal{E}(\pi_{\beta})]_{\chi}\{F\} = \mathcal{E}(\pi_{\beta})\{G\}$ where χ is the proportion of poor borrowers entering into {F} contracts. Represent the supply of loans by $L(\mathcal{E}(\pi_{\beta})\{G\})$. The demand for loans equals N_G, the number of {G} contract loans demanded plus N_F, the number of {F} contract loans demanded. If $L(\mathcal{E}(\pi_{\beta})\{G\}) < N_G$, then no {F} contracts are offered. If $N_G+N_F > L(\mathcal{E}(\pi_{\beta})\{G\}) > N_G$, both {F} and {G} contracts are offered and rationed. The necessity for offering both arises from the fact that equilibrium requires $[\mathcal{E}(\pi_{\beta})]_{\chi}\{F\} = \mathcal{E}(\pi_{\beta})\{G\}$. Rationing arises because $N_G+N_F > L(\mathcal{E}(\pi_{\beta})\{G\})$.

Appendix 4.2 Derivation of Implicit Contract Theorems

$$Max\sum_{i\in I}\{\sum_{k=0}^{1} n^k(i)[r^k(i)-i]-c(\alpha n^0(i)+n^1(i))\}q(i)$$

$$s.t.\ \mathcal{U}+\sum_{i\in I}[w(r^k(i))-\mathcal{U}][n^k(i)/m^k]q(i)-l^k\geq 0, k=0,1$$

$$m^k-n^k(i)\geq 0 \qquad k=0,1,\ \forall i\in I$$

$$n^k(i)\geq 0 \qquad k=0,1,\ \forall i\in I \qquad \text{(A4.1)}$$

Multiplying the first constraint by m leads to the formulation of the following Lagrangean:

$$Max\sum_{i\in I}\{\sum_{k=0}^{1} n^k(i)[r^k(i)-i]-c(\alpha n^0(i)+n^1(i))\}q(i)$$

$$+\theta^k\{m\mathcal{U}+\sum_{i\in I}[w(r^k(i)-\mathcal{U}](n^k(i))q(i)-ml^k\}$$

$$\mu^k(m^k-n^k(i)) \qquad \text{(A4.2)}$$

The Kuhn-Tucker conditions and non-negativity constraints derived from this maximisation problem with respect to r^k, n^k, m^k, ϕ^k and μ^k respectively where ϕ^k and μ^k are Lagrangean multipliers are:

$$q(i)n^k(i)+\phi^k w'(r^k(i))n^k(i)q(i)=0; \qquad \forall i,k \qquad \text{(A4.3)}$$

$$q(i)\{[r^k(i) - i - \alpha c'(\ )] + \phi^k[w(r^k(i)) - U]\} - \mu^k(i) \leq 0,$$

$$n^k(i) \geq 0; \quad \forall i, k. \tag{A4.4}$$

$$\phi^k(U - l^k) + \sum_i \mu^k \leq 0; m^k \geq 0; \qquad \forall i, k. \tag{A4.5}$$

$$\sum_i q(i)n^k(i)\{w(r^k(i)) - U\} + m^k(U - l^k) > 0; \theta^k \geq 0 \quad \forall i, k. \tag{A4.6}$$

$$m^k - n^k(i) \geq 0,\ \mu^k(i) \geq 0; \qquad \forall i, k \tag{A4.7}$$

As $w', w''<0$

and $\phi^k > 0$ if $m^k > 0$

$$q(i)n^k(i) + \phi^k q(i)n^k(i)w'(r^k(i)) = 0$$

$+ \qquad\qquad + \qquad\qquad -$

$$\Rightarrow q(i)n^k(i) = \phi^k q(i)n^k(i)w'(r^k(i))$$

or $1 = \phi^k w'(r^k(i))$

so that $r^k(i) = r^k(i')$. (A4.8)

Theorem 1 states that in any optimal contract, $r^k(i) = r^k(i')$ for all i, $i' \in I$ such that $n^k(i) \neq 0 \neq n^k(i')$. That is, the bank will charge the same interest rate to class k customers independently of any change in the bank's cost of funds.

Theorem 2 states that if δ is an equilibrium with respect to $(m^0, m^1) > 0$ with $n^k(i) = m^k$ (i.e. no rationing exists) $\forall i, k$, then $u(r^k) + u'(r^k)(i - Ei) > U; \forall i, k$.

From Equation A4.3 $\phi^k = -1 / u'(r^k(i))$ so substituting this expression for ϕ^k into (A4.4) we obtain:

$$q(i)\{r^k(i) - i - \alpha^k c'(.) - [u(r^k(i)) - U] / u'(r^k(i))\} - \mu^k \le 0 \qquad \text{(A4.9)}$$

Let $z(r) \equiv r - [u'(r)^{-1}[u(r) - U]$ (A4.10)

so that $q(i)[z - i - \alpha^k c'(.)] \le \mu^k(i)$. (A4.11)

From Equation A4.5 $\phi^k(U - I^k) \le -\sum_i \mu^k(i)$

$$U - I^k \le -(\sum_i \mu^k(i)) / \phi^k$$

Substitution of this expression into Equation A4.6 gives:

$$\sum_i q(i) n^k(i)[u(r^k(i) - U] \ge m^k(\sum_i \mu^k(i)) / \phi^{k)}$$

so
$$\sum_i q(i) n^k(i)[u(r^k(i) - U]\phi^k \ge m^k(\sum_i \mu^k(i)) \qquad \text{(A4.12)}$$

From Equation A4.7 and assuming that no credit rationing exists $m^k = n^k(i)$.

So
$$\sum_i q(i) n^k[u(r^k(i)) - U]\phi^k \ge \sum_i \mu^k(i) n^k(i) . \qquad \text{(A4.13)}$$

The complementary conditions in Equation A4.4 imply that

$$n^k(i)[q(i)\{[r^k(i) - i - \alpha^k c'(.)] + \phi^k[u(r^k(i)) - U]\} - \mu^k(i)] = 0 .$$

(A4.14)

So substituting Equation A4.13 into Equation A4.14 gives:

$$\sum_i q(i)n^k(i)[r^k(i) - i - \alpha^k c'(.)] = 0 \qquad \text{(A4.15)}$$

That is, the expected return from making loans to class k customers equals the marginal cost of making loans to class k customers.

From Equation A4.15:

$$r^k(i) = \mathcal{E}i + \alpha^k c'(\alpha m^0 + m^1). \qquad \text{(A4.16)}$$

The interest rate charged to a class k customer for a given state of the world, i, equals the average cost of funds to the bank plus the marginal cost of making loans.

Using Equation A4.7, $\mu^k(i) \geq 0$, and recalling Equation 4.11:

$$q(i)[z - i - \alpha^k c'(.)] \leq \mu^k(i) \geq 0$$

so $$z(r^k) - i - \alpha^k c'(\alpha m^0 + m^1) \geq 0. \qquad \text{(A4.17)}$$

To prove the second theorem, $w(r^k) + w'(r^k)(i - \mathcal{E}i) \geq \mathcal{U}$, use Equations A4.10, A4.16 and A4.17. From Equation A4.10, $z(r^k) = r^k - \{[w(r^k) - \mathcal{U}] / w'(r^k)\}$ so substituting for $z(r^k)$ in Equation A4.17 we obtain:

$$r^k - \{[w(r^k) - \mathcal{U}] / w'(r^k)\} - i - \alpha^k c'(\alpha m^0 + m^1) \geq 0. \qquad \text{(A4.18)}$$

From Equation A4.16, $r^k - \{[w(r^k) - \mathcal{U}] / w'(r^k)\} - i - r^k(i) + \mathcal{E}i \geq 0$. Multiply through by $w'(r^k)$ and rearrange to obtain:

$$w(r^k) + w'(r^k)(i - \mathcal{E}i) \geq \mathcal{U}. \qquad \text{(A4.19)}$$

Chapter 5 Credit Rationing in Australia: Empirical Evidence[1]

5.1 Introduction

The previous chapter argued that, even in deregulated financial markets, non-price credit rationing can arise as a consequence of the profit maximising and utility maximising behaviour of economic agents. Non-price credit rationing, according to the New Keynesian view, is the result of asymmetric information or implicit contracts. Post Keynesians argue that non-price credit rationing arises from the existence of fundamental uncertainty, that is, uncertainty that is not able to be overcome by probabilistic assessments of risk. The Campbell Committee took the neo-Keynesian view that deregulation of financial markets would eliminate non-price credit rationing as banks could charge higher interest rates to borrowers with a greater risk of default. This chapter considers whether, as an empirical matter, credit rationing has occurred in Australia since deregulation of financial markets in Australia.

[1] Whilst preparing this chapter, I submitted a paper, "The effects of changes in bank loan interest rates on the probability of default", based on a number of the sections in this chapter, to *Australian Economic Papers.* The editors of that journal have indicated that they are prepared to consider a revised version of the paper. I am grateful to Professor Tom Valentine and two anonymous referees for comments on the submitted paper.

This chapter proceeds first by considering the implications of the credit rationing hypothesis for empirical work. I then turn to empirical estimation using the maximum likelihood technique developed by Maddala and Nelson (1974) to determine whether banks rationed credit to business over the period from 1986 until 1994. The empirical estimates suggest that very little credit rationing to business occurred in this period other than in 1986. A small amount of credit rationing also occurred in 1991. The chapter then discusses the determination of both the expected probability of default and the bank optimal interest rate, that is, the loan interest rate at which banks maximise expected returns. Empirical estimates are then made of the probability of default on business loans using the relationship between the loan interest rate and the risk-free interest rate available to banks. The calculated probability of default rose substantially from 1989. This evidence is supported by a substantial increase in the number of business bankruptcies from 1990-91 to 1992-93. The calculated probability of default is also used to determine whether banks have been setting the bank optimal interest rate. The empirical estimates suggest that banks have been getting better over time at setting the interest rate which maximises their expected returns.

Maximum likelihood estimation is also undertaken to determine whether there has been credit rationing in the market for personal loans. The empirical estimates show that credit rationing occurred in 1986 and from mid 1989 to mid 1993. The degree of credit rationing was greater in the market for personal loans than in the market for business loans reflecting the higher risks associated with lending to persons than lending to business. The probability of default was also calculated for personal loans, and as was the case for business loans, it rose strongly from 1989. Personal bankruptcy data lends weight to these estimates.

5.2 Implications of the credit rationing hypothesis for empirical work

Neo-Keynesians argue that credit rationing is the result of regulatory impediments. Thus, the conclusion of the Campbell Committee, based as it was on the removal of controls over the banking system, was that deregulation should lead to the elimination of credit rationing in Australia. Banks would raise interest rates as compensation for making riskier loans. If the neo-Keynesian view is correct, then empirical work should find no evidence of credit rationing in Australia for the period in which financial markets have been deregulated.

In contrast to the neo-Keynesian view, post Keynesians argue that there is always a possibility of credit rationing because banks will always seek to lend only to those customers they believe to be creditworthy no matter how high an interest rate other potential borrowers are prepared to pay. Empirical work in support of the post Keynesian position should find that variables which purport to capture "creditworthiness" such as employment and collateral are significant in determination of the supply of loans.

However, most of the implications of the credit rationing hypothesis for empirical work arise from the New Keynesian explanation of credit rationing. Adverse selection and adverse incentive effects suggest that the loan supply schedule is concave so that the interest rate associated with the point of concavity is the bank's profit maximising interest rate. I am referring to this profit-maximising interest rate as the bank-optimal interest rate. Credit rationing should occur unless the loan demand schedule cuts the loan supply schedule to the left of the bank-optimal interest rate, that is, at an interest rate below the optimal rate. If empirical work should find no evidence of credit rationing then the following possibilities exist:

(i) Adverse selection and adverse incentive effects don't exist in which case the loan supply schedule will not be concave. Rather, it will be a positive and monotonic function of the loan interest rate, where lenders charge higher interest rates to riskier borrowers, but make loans to all comers provided the potential borrowers are prepared to pay the loan interest rate the lender considers appropriate to their risk of default.

(ii) Adverse selection and adverse incentive effects do exist but the reduced revenue to the banks arising from adverse selection and adverse incentive effects is insufficient to offset the increased revenue available from any increase in interest rates. This means that the loan demand schedule cuts the loan supply schedule to the left of the bank's optimal interest rate so that the loan supply schedule is not concave over the observed range.

(iii) Banks engage in "morally hazardous" behaviour facilitated by implicit or explicit guarantees of liquidity from the central bank, that is access to lender of last resort facilities. Access for bankers to fixed-price deposit insurance may also lead to moral hazard. In these cases, the loan supply schedule becomes an increasing and monotonic function of the loan interest rate because banks benefit should borrowers' projects be successful, but do not bear the full costs should borrowers default.

(iv) Competition between banks induces them to engage in loans at similar terms to other banks even though such terms do not maximise profits. This may be pertinent to the Australian case where commercial banking is dominated by the "big four". Casual empiricism suggests that in the 1980s banks were pursuing market share at the expense of short-run profitability on the basis that market share was the key to long-term profitability.

(v) Implicit risk-sharing arrangements between borrowers and lenders do not exist. In this case, banks may not hold loan interest rates more stable than the cost of funds to the banks so that credit rationing will not arise other than for reasons of asymmetric information.

(vi) Banks require that borrowers pledge sufficient collateral so that the former are compensated fully for any losses that would otherwise be incurred in the event of borrowers' default.

The purpose of this chapter is to determine whether credit rationing exists as an empirical phenomenon in Australia. If not, then the above possibilities must be considered. The credit rationing hypothesis based on New Keynesian analysis as discussed in Chapter 4 suggests that for credit rationing to exist where credit rationing takes the form of limiting the number of loans that are made, there must be some interest rate beyond which it is unprofitable for banks to further raise interest rates. These are the issues to which we now turn.

5.3 Credit rationing in Australia: Business loans

Blundell-Wignall and Gizycki (1992) tested for the presence of credit rationing on business loans in Australia for the period in which financial markets have been deregulated, for which time they found no evidence of excess demand other than in 1982 and early 1983 which they attribute to financial regulations still in force at that time. The technique used was maximum likelihood estimation using the likelihood function derived by Maddala and Nelson (1974). That Blundell-Wignall and Gyzicki found no evidence of credit rationing accords with the neo-Keynesian view held by the Campbell Committee that deregulation would eliminate non-price credit rationing by allowing banks to charge loan interest rates which reflected borrowers' risks of default. Riskier borrowers would be charged higher interest rates, but provided they were prepared to pay those higher interest rates, they would receive loans.

It is proposed in this chapter to replicate Blundell-Wignall and Gyzicki's study as far as is possible without access to internal Reserve Bank data, to update it with a view to ascertaining the influence of the recession on credit rationing and to address some reservations with respect to their study. First, Blundell-Wignall and Gyzicki have used changes in credit rather than the flow of new loans. Rather than use changes in credit by all financial intermediaries as did Blundell-Wignall and Gyzicki (BWG), the dependent variable in this chapter is lending commitments by banks. Changes in credit reflect changes in a stock variable and net out the impact of loan repayments (and write-offs) against new loans made. The lending decision is, however, a marginal one. Do banks grant additional loans to riskier customers and cover the increased risks by increasing interest rates? Lending commitments, defined to be a firm offer to provide finance which has been or is normally expected to be accepted by the borrower, are more pertinent to a discussion of those factors which influence the lending decision than are changes in credit. In addition, this chapter confines its discussion to lending commitments by banks, rather than by all financial intermediaries. This should ensure a closer relationship between bank loan interest rates and bank loan commitments than between bank loan interest rates and the lending commitments of all financial intermediaries.

Further, this chapter extends the analysis of BWG in other ways. It seeks to, by using macroeconomic data, calculate what Australian banks assess to be the probability of default when making bank loans; and to calculate what is the optimal interest rate that Australian banks should charge when making loans. The chapter then applies this analysis to a discussion of bank loan behaviour from 1986 until June 1994. In most other respects the model estimated in this chapter is similar to that of BWG.

The second reservation I have with BWG's analysis is that the theoretical work described in the previous chapter shows that in markets with asymmetric information or in markets where there are implicit contracts between borrowers and lenders, credit rationing should exist if banks are profit maximisers. It may be the case that if empirical work finds no evidence of credit rationing that banks are making inefficient loans. That is, banks may be lending at loan rates which increase the probability of default to such an extent that the effect on profits of an increase in the loan rate is negative. This issue is addressed later in this chapter. Third, if empirical work does find that banks are making inefficient loans it remains to determine the reasons. Do banks take advantage of the moral hazard generated by the liquidity support facilities of the Reserve Bank? Fourth, Blundell-Wignall and Gizycki looked only at business credit. This chapter will extend the analysis to personal loans. I have not considered housing loans as they are the least risky loans for banks, not least because banks usually require mortgage over the property which will usually compensate the banks for most of the losses they would otherwise incur in the case of borrowers' defaults.

King (1986) undertook maximum likelihood estimation of the credit rationing hypothesis for the United States for quarterly data from 1955:1 to 1979:3 and found that there was predominantly a state of excess demand for loans. In addition, King suggested that a necessary condition for rationing to exist is that banks act as though liquidity constrained, and he so found. This result accords with Gray and Wu's (1995) analysis where they argue that credit rationing by limiting the size of loans depends on the "supply of credit" where the latter is defined to be household deposits at banks. However, more generally New Keynesian and post Keynesian analysis suggests that credit rationing can occur even when banks are not subject to shortages of liquid funds with which they could make loans if they so chose. King's result is consistent with Blundell-Wignall and Gizycki finding that the supply of loans depends positively and significantly upon the sum of deposits and the book value of financial institutions' capital at the beginning of the period.

Relevant to the analysis of this chapter of the measurement of adverse selection and adverse incentive effects is that King, using a simple partial equilibrium model of bank behaviour, derives the first-order conditions for profit maximisation and suggests that (p.293) "[t]he bank will set the loan rate to the point where the marginal return to increasing the loan rate is zero, and will also equate the marginal net return on loans to the opportunity cost of funds - the rate on open market securities plus the expected cost of entering open markets as a borrower." Although he finds evidence for equilibrium credit rationing he does not use the above marginal criteria as I do later in this chapter to check whether banks, as profit maximisers, should have rationed credit even more heavily than they did. King also found that there was a significant and positive response of loan supply to the loan rate. This finding, although consistent with the theory when loan supply is an increasing function of the interest rate, is inconsistent with the equilibrium credit rationing hypothesis when the loan supply schedule becomes concave.

Following Blundell-Wignall and Gyzicki, general specifications for business loan supply and demand functions may be written respectively as follows.

$$L^s{}_t = F\{D_{t-1}, (e_b/e)_{t-1}, E_{t-1}, (i_L - i_f)_t, (i_L - i)_t, s_t, p_t\}$$

where $F'_1, F'_2, F'_3, F'_4 > 0$ and $F'_5, F'_6, F'_7 < 0$.

$$L^d{}_t = L\{k^e{}_t, i_{Lt}, Ep_t, p_t\}$$

where $L'_1, L'_3, L'_4 > 0$ and $L'_2 < 0$.

The variables are defined thus:

L^s_t= the supply of lending commitments in value terms in the current period.

L^d_t = the demand for lending commitments in value terms in the current period.

D_{t-1} = the sum of bank deposits and the book value of banks' capital at the beginning of the period. Bank deposits and bank capital are the principal sources of loan funds, therefore, the supply of loans is expected to rise positively with respect to the sum of bank deposits and the book value of banks' capital.

$(e_b/e)_{t-1}$ = the banking sector share price relative to the market average which determines the ease with which new capital can be raised to finance loans in the forthcoming period. The higher is this ratio, the greater the supply of loans is expected to be.

E_{t-1} = the market capitalisation of corporate equity at the beginning of the period. This is a measure of net worth. The higher is net worth, the greater the amount of collateral which business can pledge to banks against extended loans. Thus, loan supply is expected to be positively related to net worth. (See, however, the discussion with respect to the adequate valuation of collateral in Chapter 4.)

$(i_L - i_f)_t$ = the lending rate less the weighted average cost of funds in the current period. The higher is this margin, the more profitable are loans to banks provided that the loan supply schedule is positively sloped. Loan supply should be positively related to the lending rate less the weighted average cost of funds. However, if the lending rate is raised beyond the bank optimal interest rate determined by the maximum point of a concave loan supply schedule, banks' expected returns fall so that loans become less profitable when the lending rate less the weighted average cost of funds increases. In these circumstances, there will be an inverse relationship between loan supply and the lending rate less the weighted average cost of funds.

$(i_L - i)_t$ = the loan rate relative to the current market interest rate. The market interest rate used in the empirical work is the certificate of deposit rate. This is the marginal cost of financing new loans as the opportunity cost to banks of making a loan is purchasing some interest bearing asset. The rate of return on the loan less the rate of return on some other asset (assuming that the risk, term to maturity, and transactions costs associated with each are the same) is to some extent a measure of the risk premium associated with making a loan. This risk premium is expected to rise during cyclical downturns as agency costs rise. The supply of loans should fall as the loan rate rises relative to the current market interest rate.

s_t = the variance of bank share prices relative to the market average. An increase in variance of bank share prices is likely to be indicative of an increase in the variance of banks' expected returns. Since increasing variance is usually associated with an increase in uncertainty, it is to be anticipated that loan supply is negatively related to this variable.

p_t = the expected inflation rate. As high inflation leads to an increase in speculative activity, it is to be expected that lenders, if cautious, will decrease their lending activity. This assumes that banks are not speculators themselves. The expected inflation rate is also an argument in the demand for loan funds. As inflationary expectations rise, one would anticipate that intertemporal substitution should take place. That is, investment and consumption decisions should be brought forward in order to avoid price increases. This tendency may be reinforced given that investment decisions may be distorted by the tax regime so that investors anticipate capital gains on the basis of rising inflationary expectations. Thus, loan demand should be positively related to rising inflationary expectations.

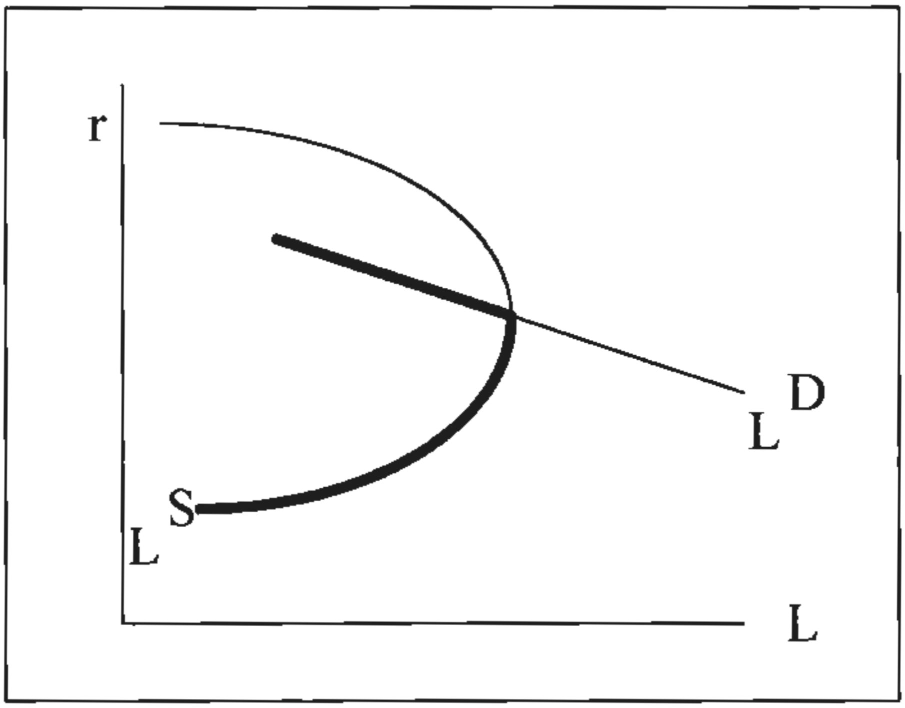
k^e_t = expected future investment demand. As expected investment demand rises, so too will the demand for loan funds.

i_{Lt} = the business loan interest rate. This, because it represents a substantial cost to business, will be negatively related to the demand for loans.

Ep_t = the cost of equity finance. As loan finance and equity finance are substitutes, at least for some businesses, it is to be anticipated that the demand for loans will rise as the cost of equity finance increases as business switches away from relatively more expensive equity finance towards relatively cheaper debt finance.

The difficulty for empirical estimation of non-price credit rationing is that only the value of loan transactions can be observed. One can not, *a priori*, determine whether the transaction should be classified to the loan demand schedule or classified to the loan supply schedule. However, as the post Keynesians are always keen to point out, banks can not make loans where there is no demand for them so that it can be assumed that should loan demand be less than loan supply, the observation can be classified to the demand schedule; and should loan supply be less than loan demand, the observation can be classified to the loan supply schedule. That is, the observation is assumed to be the minimum of demand or supply. In the case of a concave loan supply schedule, the observation will be classified to the heavy portion of either the loan demand or loan supply schedules as illustrated in Figure 5.1. If the observation lies above the loan demand schedule, it will be classified to demand; and if it lies below the demand schedule, it will be classified to supply.

Figure 5.1 Classification of loan observations to loan demand or loan supply schedules



The loan supply and loan demand functions are estimated with the maximum likelihood technique derived by Maddala and Nelson (1974)[2] which estimates the probability of the quantity transacted as belonging to the demand schedule or the supply schedule where the assumption is that the quantity observed is the minimum of demand or supply. The coefficients are estimated by maximising the likelihood function.

Because lending commitments data are available only from January 1985 and because the search for unit roots contained autoregressive parameters, the model was estimated

[2] The method of maximum likelihood and its use in classifying observations to the demand or supply schedules is described in Appendix 5.1 and data definitions and sources are detailed in Appendix 5.2. The results of tests for unit roots are detailed in Appendix 5.3. Instrumental variables used in the estimation are indicated in Appendix 5.4. The estimation was undertaken using the switching regression technique in TSP Version 4.2.

with monthly data from January 1986 until June 1994. In contrast to the results presented in BWG, only the investment variable in the business loans equation was found to have unit roots. The first difference of investment expectations was used in the estimation. As in BWG, instrumental variables were applied to the business loan interest rate, the spread between the loan rate and other interest rates and the cost of equity finance because of the possibility of the loan rate being simultaneously determined with loan demand and supply. Initially, estimation was undertaken without the inclusion of a lagged dependent variable. However, the parameter estimates and estimates of excess demand proved very unstable to changes in the sample period. Thus, a lagged dependent variable was included in both the demand and supply equations. To check the robustness of the results to the specification including the lagged dependent variable, recursive estimation was undertaken where one observation at a time was dropped from the estimation over eighteen runs with sample periods ranging from January 1986-January 1993 to January 1986-June 1994. Although the magnitude of some of the parameter estimates for the demand equation were somewhat unstable over the period indicating the likelihood of multicollinearity, our main interest is not in the size of the individual parameter estimates but rather is in determining whether there has been an excess demand for loan commitments over the sample period. The estimates of excess demand were relatively stable over all, bar one, of the eighteen runs. The maximum likelihood parameter estimates for all eighteen sample periods are presented in Appendix 5.5 and the estimates of excess demand for all eighteen sample periods are presented in Appendix 5.6 to facilitate comparison with the results reported in this chapter.

The results for the longest sample period, January 1986 to June 1994, are presented in Table 5.1. Table 5.1 shows that loan demand does depend positively and significantly, as expected, upon loan demand in the previous month, upon inflationary expectations and upon the cost of equity finance. The demand for loans is negatively, and significantly, related to the business loan interest rate. Although loan demand appears to be negatively related to investment expectations, the magnitude of the parameter estimate is extremely small and is insignificant.

Loan supply depends positively upon M3 plus banks' capital, corporate net worth, banks' share prices relative to the market average and the loan rate less the certificate of deposit rate, significantly so with respect to all variables. Contrary to expectations, loan supply also depends positively and significantly upon inflationary expectations. This may be because lenders view higher expected inflation as more favourable to the probability that the loan will be repaid. This could occur if lenders, as do borrowers, view expected inflation as conducive to providing capital gains. As predicted, loan supply depends negatively and significantly upon relative bank share price variance, which increases as cyclical downturns lead to increased risk. The parameter estimate for the loan rate less the certificate of deposit rate, an estimate of the risk premium on new loans, is positive and significant, contrary to expectations under the New Keynesian proposition that agency costs will affect the supply of loans. Rather, the positive correlation between loan supply and the risk premium seems to provide evidence for the neo-Keynesian proposition that, rather than ration credit, banks will increase the supply of loans should there be an excess demand and raise the interest rate to compensate for the increased risk in making more loans. The inclusion of the lagged dependent variable made very little difference to estimation of loan supply.

The parameter estimate for the loan rate less the weighted cost of funds is negative and significant. The loan rate less the weighted cost of funds is closely related to the profit margins on new loans. Under normal circumstances, one would expect that as the margin between the loan rate and the weighted cost of funds increased that banks would increase loan supply. However, this presupposes that the banks are operating on the positively sloped portion of their loan supply schedule. If so, any increase in interest rates relative to the weighted cost of funds increases the probability of default but not to such an extent that the effects of the increased probability of default on revenue offset the effects of the rise in the interest rate. The negative parameter estimate for the loan rate less the weighted cost of funds suggests that credit rationing should have occurred for at least part of the period under study. As indicated below, there is not much evidence of credit rationing. However, if the banks were interested in maximising market share rather than maximising profits, as at least some of the annual reports of some Australian banks indicated was the case in the period under study; loan supply may have depended negatively on profit margins as indicated by the parameter estimate, because increasing market share will have been at the expense of reduced profits.

Table 5.1 *Business loans: Maximum likelihood estimates of loan supply and demand*

$$\ln L^{d}_{t} = a_0 + a_1 k^{e}_{t} + a_2 i_{Lt} + a_3 p_t + a_4 Ep_t$$

$$\ln L^{s}_{t} = b_0 + b_1 \ln D_{t-1} + b_2 \ln E_{t-1} + b_3 \ln (e_b/e)_{t-1} + b_4(i_L - i_f)_t + b_5(i_L - i)_t + b_6 s_t + b_7 p_t$$

Sample period: January 1986 - June 1994 (102 monthly observations)

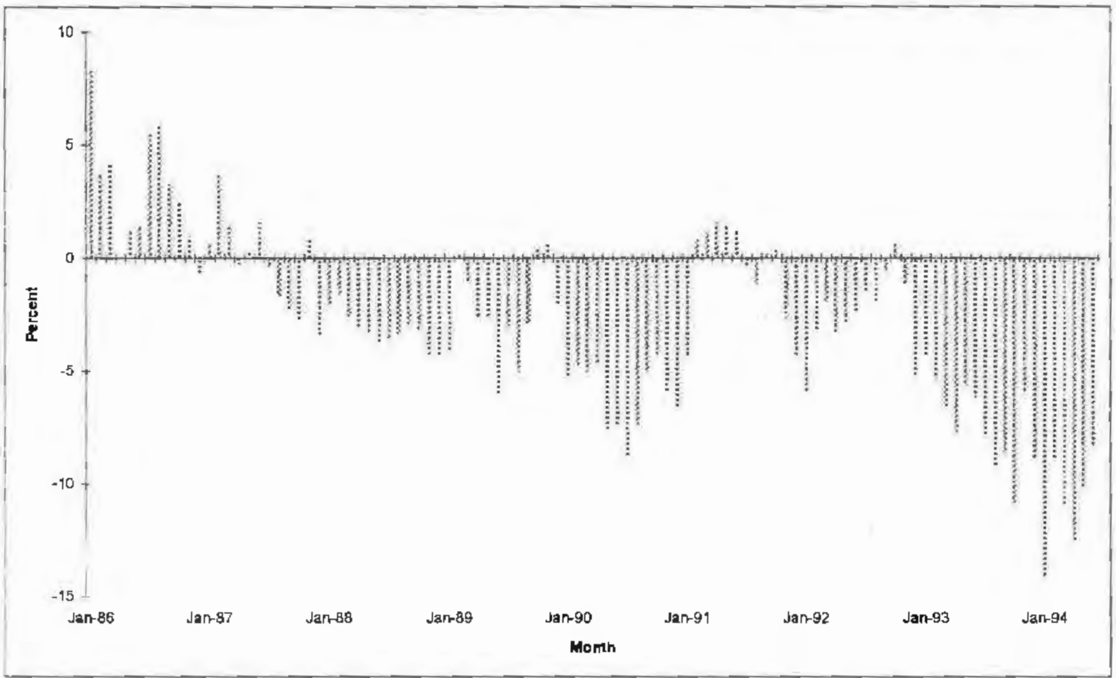
Dependent variable: Lending commitments L_t	Demand		Supply	
Constant	436.489	(5.510)**	-1283.12	(-5.274)**
Lagged demand for loan commitments L^{d}_{t-1}	.388	(3.515)**		
Investment expectations k^{e}_{t}	-.001	(-.125)		
Business loan rate i_{Lt}	-2.839	(-2.258)*		
Inflation expectations p_t	25.574	(1.977)*	147.283	(7.361)**
Cost of equity finance Ep_t	5.741	(2.382)*		
Lagged supply of loan commitments L^{s}_{t-1}			-.028	(-.248)
M3 + capital $\ln D_{t-1}$			1.009	(3.900)**
Corporate net worth $\ln E_{t-1}$			.728	(3.381)**
Relative bank share price $\ln(e_b/e)_{t-1}$			1.494	(4.089)**
Loan rate less weighted cost of funds $(i_L - i_f)_t$			-32.15	(-5.649)**
Loan rate less CD rate $(i_L - i)_t$			11.526	(3.718)**
Relative bank share price variance s_t			-40.671	(-3.243)**
Log likelihood	-381.316			

Approximate t-statistics are shown in parentheses. * Significant at 5 %. ** Significant at 1 %. These are only a guide to significance. Lending commitments, M3 and corporate net worth are logged and multiplied by 100.

The estimation undertaken above shows evidence of excess supply of loans for most of the period under study. Figure 5.2 illustrates the percentage by which estimated demand exceeds estimated supply. In 1986, excess demand was relatively high in some months at over 5 per cent. From 1987 until 1990, excess supply increased in most months. That credit rationing did not occur in this period was consistent with the asset price inflation which occurred in equities and in the commercial property market following the October 1987 stock market crash. Although the crash led to a sharp reduction in market capitalisation, the reduction was not even to pre-boom levels and the subsequent trend was for capitalisation to increase. Corporate net worth was rising, increasing firms' collateral and inflationary expectations, which may have led lenders to presume that loan repayments could be made against the capital gains that were anticipated by borrowers. In 1991 a small amount of credit rationing occurred, almost certainly because of the effects of the recession, and in 1992 there was only a relatively small amount of excess supply. Once the recession was over, the excess supply of loan commitments increased rapidly in 1993 and 1994 as the economy began to grow strongly.

As activity slowed and inflationary expectations fell in the 1990-92 recession, it was to be expected that there would be competing forces on the demand for loan funds. First, because interest rates were falling, it was to be anticipated that the demand for loan funds should rise. Second, the amount of attempted distress borrowing would have been rising as firms attempted to remain viable in the face of decreased economic activity. Decreasing the demand for loans was a marked fall in inflationary expectations. As inflationary expectations fell, the demand for loan funds should have fallen in response to the reduced intertemporal substitution effects; offsetting this may have been an increase in the demand for loans due to distress borrowing and the loss of net worth that many firms experienced with the decline in asset prices. (Also see Mishkin (1992).)

Figure 5.2 Excess demand for business loans: January 1986 to June 1994

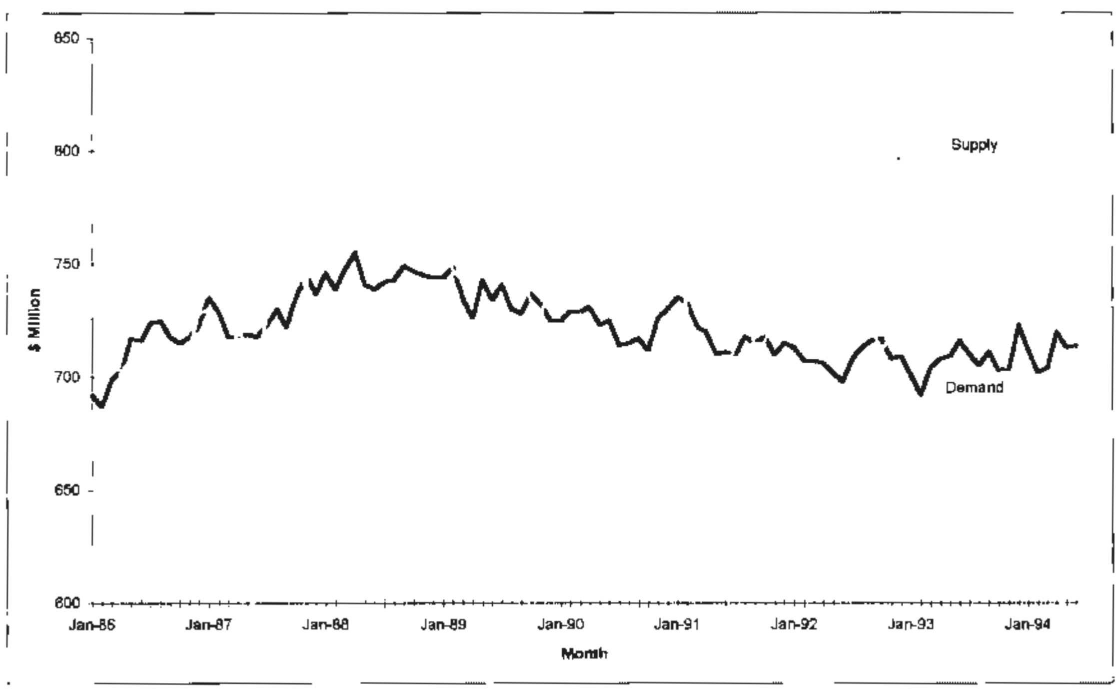


Source: Derived from maximum likelihood estimation undertaken by the author. Sources of data are detailed in Appendix 5.2.

One would have anticipated that falling investment would also have reduced the demand for loan funds but the parameter estimate on investment expectations is extremely low, negative and insignificant.

During the recession, when there were competing forces acting on the demand for funds, so that it is difficult to ascertain, *a priori*, whether the demand curve for loan funds should have shifted in or out, it is likely that the supply curve of loan funds shifted in. Corporate net worth and the banking sector share price relative to the market average fell for a period. The variance of bank share prices relative to the market average rose as did risk premiums on new loans, as agency costs rose with an increased number and amount of bad and doubtful debts. Even if the demand for loans declined during the recession, as seems probable given the supply and demand curves derived from the maximum likelihood estimation which are illustrated in Figure 5.3, evidence which is supported by the 1991 review of banking and deregulation, *A Pocket Full of Change*, p. 256; the supply of loans also declined, to the extent that the recession produced a small amount of credit rationing in 1991.

Figure 5.3   Maximum likelihood estimates of business loan supply and demand: January 1986 to June 1994



Source: Derived from maximum likelihood estimation undertaken by the author. Sources of data are detailed in Appendix 5.2.

The analysis of the previous chapter showed that as the risks to a bank rise in increasing the number of loans it makes, rather than further increasing the interest rate, the bank will cease to make additional loans but instead will ration credit by nonprice means by either imposing restrictions on the size of loans which are granted or by limiting the number of loans which are made. In the latter case, banks may cease to raise interest rates even when there is an excess demand for loans. That banks may cease to raise interest rates suggests that there is some bank-optimal interest rate at which the positive effect on profits of an increase in the interest rate is exactly offset by the negative impact on profits of an increase in the probability of default brought about by the increase in the interest rate. Determination of the probability of default and the bank-optimal interest rate is the subject of the next section.

5.4 Determination of the expected probability of default and the bank optimal interest rate

An implication of adverse selection and adverse incentive effects is that the probability of default on bank loans rises as the loan interest rate rises. Ultimately, the loan supply schedule becomes concave as illustrated in Figure 4.1 of Chapter 4. The loan interest rate at which the loan supply schedule becomes concave is also the interest rate which maximises the bank's expected returns.

The two major income producing assets of banks are loans and the holding of (virtually) risk-free government securities. Following Jaffee and Russell (1976), assume that the expected profits from lending depend on the probability of loan repayment which itself depends upon the contracted loan repayment, and so is dependent upon the loan interest rate and loan size. Banks are assumed to be able to borrow in a perfect capital market at a constant one-period interest rate, i. The bank's expected profits may be written:

$$\pi = LR\lambda[LR] - LI \tag{5.1}$$

where π is equal to expected profits.[3] The first term on the R.H.S. is the revenue banks expect to obtain from lending and the second term is the cost to banks of obtaining funds in the capital market with which to finance their own lending. LR denotes the contracted loan repayment which is equal to the loan amount, L, times $(1+r)$ where r is the interest rate payable by borrowers on loans. Competitive banks will attempt to choose a value for r which, once the effect of interest rates on adverse selection and adverse incentive effects is taken into account, will maximise profits. λ is the probability of loan repayment which depends on the size of the contracted loan repayment. LI, where $I = (1+i)$, is the amount banks have to repay in capital markets.

Instead of making loans, banks may choose to invest in (virtually) risk-free government securities. The expected profits from this investment may be written as:

$$\pi = L\mathrm{P} - LI \tag{5.2}$$

where $\mathrm{P} = (1+\rho)$ and ρ is the return on risk-free government securities. For a profit maximising bank, the returns at the margin from making loans and from investing in government securities must be equal. Thus:

$$LR\lambda[LR] - LI = L\mathrm{P} - LI \tag{5.3}$$

[3] For ease of notation, I am now using π rather than $E(\pi_b)$ to represent the bank's expected profits.

and so: $$\lambda[LR] = \frac{\mathrm{P}}{R} = \frac{1+\rho}{1+r}, \tag{5.4}$$

and: $$1 - \lambda[LR] = \frac{r-\rho}{1+r} \tag{5.5}$$

where $1 - \lambda[LR]$ is the probability of default on bank loans. Therefore, the probability of loan repayment or probability of default may be calculated with reference to the relationship between loan interest rates and the yields on risk-free government securities.[4] Although banks are not able to calculate the precise magnitude of default risks on an *a priori* basis for individual borrowers and so use screening devices such as varying interest rates and collateral requirements, banks are generally aware, at least in a limited way, of *aggregate* default probabilities and will take these into account in determination of the profit maximising loan interest rate as noted by Jaffee and Russell (1976, p. 658, footnote 9).

The bank's expected profits depend on the loan interest rate, the amount of monies it loans, the probability that borrowers will repay loans and on the bank's cost of funds. The loan interest rate depends on the loan amount and the probability of repayment. Loan supply depends on the bank's expected returns from making loans which, in turn, depend upon the loan interest rate and the probability of repayment. The probability of repayment depends on the loan interest rate and the loan amount. The bank takes the cost of funds as given at the risk-free rate. Formally:

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[4] The above analysis assumes that there is no secondary market for bank loans and that secondary markets for (virtually) risk-free government securities are relatively deep so that marketability plays no role as a factor in influencing *changes* in the difference between the loan interest rate and the risk-free rate. The analysis further assumes that there are no differences in the administration costs associated with the advancement and monitoring of loans, and the administration costs associated with investing in government securities.

$$\pi = f(R, L, \lambda, I)$$
$$R = g(L, \lambda)$$
$$L = h(R, \lambda)$$
$$\lambda = j(R, L)$$
$$I = \bar{I}$$

Differentiating expected profits with respect to a change in the loan interest rate gives:

$$\frac{d\pi}{dR} = \frac{\partial\pi}{\partial R} + \frac{\partial\pi}{\partial L}\frac{dL}{dR} + \frac{\partial\pi}{\partial\lambda}\frac{d\lambda}{dR} \tag{5.6}$$

The first term on the R.H.S. is the direct impact of a change in the loan interest rate on expected profits, the second and third terms are respectively the indirect impacts of a change in the loan interest rate on profits where the indirect impacts work through the effect of a change in the loan interest rate on the amount of monies that are loaned and the probability of loan repayment. Making use of the first-order condition for profit maximisation, $\frac{d\pi}{dR} = 0$, and that, from (5.4), $\frac{\partial\lambda}{\partial R} = \frac{-\mathrm{P}}{R^2}$, and so is negative, leads to derivation of the following condition which holds when the bank maximises its expected profits:[5]

[5] The derivation proceeds as follows:

As $\frac{d\lambda}{dR} = \frac{\partial\lambda}{\partial R} + \frac{\partial\lambda}{\partial L}\frac{dL}{dR}$ and $\frac{dL}{dR} = \frac{\partial L}{\partial R} + \frac{\partial L}{\partial\lambda}\frac{d\lambda}{dR}$,

then $\frac{d\pi}{dR} = \frac{\partial\pi}{\partial R} + \frac{\partial\pi}{\partial L}\frac{\partial L}{\partial R} + \frac{\partial\pi}{\partial L}\frac{\partial L}{\partial\lambda}\frac{d\lambda}{dR} + \frac{\partial\pi}{\partial\lambda}\frac{d\lambda}{dR} + \frac{\partial\pi}{\partial\lambda}\frac{\partial\lambda}{\partial L}\frac{dL}{dR}$.

As $\frac{\partial\lambda}{\partial R} = \frac{-\mathrm{P}}{R^2}$ is negative and as the first-order condition for profit maximisation is that $\frac{d\pi}{dR} = 0$,

$$\frac{\partial\pi}{\partial R} = \frac{\partial\pi}{\partial\lambda}\frac{d\lambda}{dR} - \frac{\partial\pi}{\partial L}\frac{dL}{dR}.$$

Substitution of the equation for $\frac{dL}{dR}$ into the equation for $\frac{\partial\pi}{\partial R}$ gives $\frac{\partial\pi}{\partial R} = -\frac{\partial\pi}{\partial\lambda}\frac{d\lambda}{dR}$.

$$\frac{\partial \pi}{\partial R} = -\frac{\partial \pi}{\partial \lambda}\frac{d\lambda}{dR}. \tag{5.7}$$

The bank optimal interest rate is derived from the point at which the positive impact on profit of an increase in the interest rate is just offset by the negative impact on profit of an increase in the probability of default brought about by the increase in the loan interest rate. Further, the interest rate at which the loan supply schedule becomes concave occurs when $\frac{dL}{dR} = 0$ which means that $\frac{\partial L}{\partial R} = -\frac{\partial L}{\partial \lambda}\frac{d\lambda}{dR}$. For both $\frac{\partial \pi}{\partial R} = -\frac{\partial \pi}{\partial \lambda}\frac{d\lambda}{dR}$ and $\frac{\partial L}{\partial R} = -\frac{\partial L}{\partial \lambda}\frac{d\lambda}{dR}$ to hold requires that $dR = -d\lambda$. Thus, the condition for profit maximisation and for determination of the bank-optimal interest rate is that $-d\lambda = dR$.

Several implications emerge from the above analysis. First, important to note is that the change in the probability of repayment or default is due purely to the change in interest rates, both the risk-free rate and the loan interest rate and the difference between these rates. From equation (5.5) when r does not equal ρ, $1-\lambda$ does not equal zero; and when r is greater than ρ, the probability of default is greater than zero. As r increases relative to ρ, the probability of default increases. The probability of default is therefore *not* due to other factors arising from downturns in economic activity except to the extent that those other factors are captured in the banks' setting of loan interest rates. These points are important as the isolation of adverse selection and adverse incentive effects requires that only the impact of changes in interest rates upon the probability of loan default be taken into account.

Second, banks in setting interest rates and the difference between the loan interest rate and the risk-free rate must have due regard to the effect that these have on changes in the probability of loan default.[6] Third, in competitive markets, for any given risk-free interest rate, there is some optimal loan interest rate which banks should be charging customers. Fourth, whenever expected profits deviate from zero, the banks should be changing the quantity supplied of loans.

In the next section, I provide empirical evidence to the effect that banks have been getting better at determining the bank optimal interest rate over time since financial markets have been deregulated. That there is an interest rate at which banks maximise the expected return on loans implies that, in conditions of excess demand, banks should not raise interest rates above that optimal rate but should instead quantity ration credit. I also demonstrate that, when the banking sector is not perfectly competitive, banks have no incentive to reduce the interest rate below the bank-optimal rate even when there is an excess supply of loan commitments because banks accrue monopoly profits by charging the bank-optimal interest rate.

5.5 Empirical estimates of the calculated probability of default on business loans

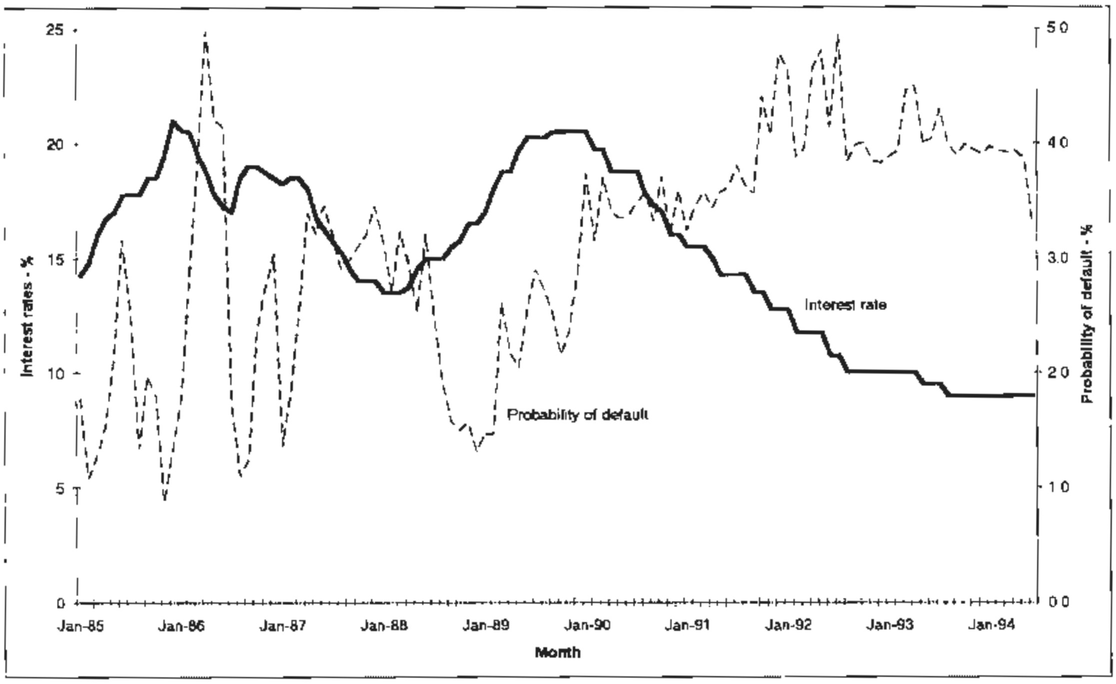
Figure 5.4 illustrates the expected probability of default calculated using expression (5.4) against business loan interest rates in Australia since 1985.[7] From 1985 until

[6] The capital asset pricing model (CAPM) of finance theory provides an analysis where the probability of default will have an impact on loan interest rates. The CAPM derives the result that the expected return on an efficient portfolio of income-earning assets in equilibrium comprises the risk-free reurn plus a risk premium where the risk-premium is derived with reference to the probability of losses on the portfolio.

[7] The calculated probability of default was derived with reference to the yield on 13 week Treasury Notes. I have repeated this and the following exercises using the yield on 2 year Treasury bonds as the

1988, there appears to be no consistent relationship. In 1989, the expected probability of default rose with the interest rate. From 1990 until June 1994, loan interest rates were falling but the expected probability of default was, at times, high. This may have reflected an increased conservatism on the part of the banks which saw the differential between the loan interest rate and the risk-free interest rate *increase* as both loan and risk-free interest rates fell. The increased conservatism may have been due to the banks' perceptions that agency costs increased as a result of the 1990-92 recession, the effects of which would continue to be felt in subsequent years. When the loan rate rises relative to the risk-free rate, then the probability of default will increase.

Figure 5.4: Business loan interest rates and the expected probability of default: January 1985 to June 1994



Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

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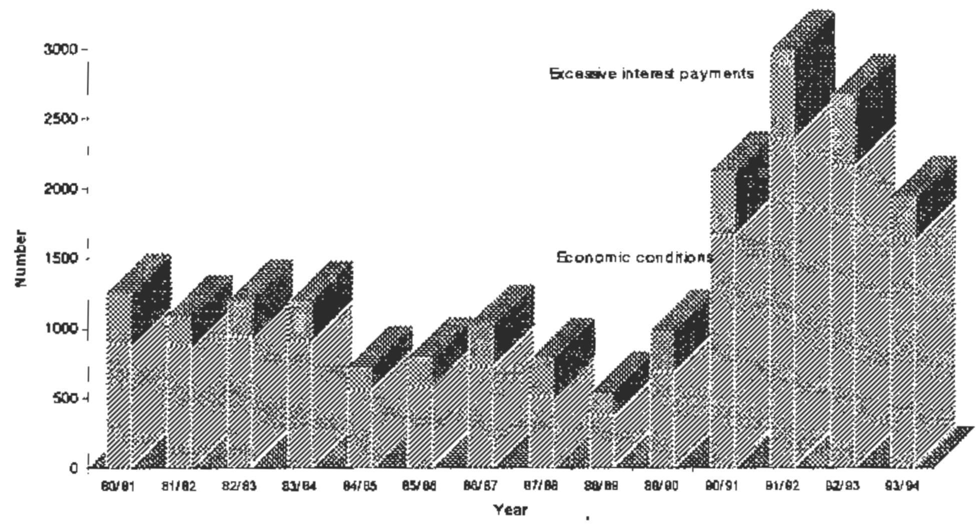
risk-free interest rate with much the same results. The business interest rate used in empirical work was the banks' business indicator rate for large business.

The expected probability of default as calculated with reference to expression (5.4) showed a strong upward trend from 1989 to 1993. Not being able to obtain actual defaults requires the use of a suitable proxy to ascertain whether, in fact, defaults did increase at this time. One such suitable proxy is the number of business bankruptcies. It is anticipated that there will be a strong positive correlation between the probability of default and the number of business bankruptcies, although the number of bankruptcies will be far fewer than the number of actual defaults, because, in many cases, banks will not be willing to incur the costs associated with recovery of assets that are worth less to them than the costs associated with their recovery. Figure 5.5 illustrates the number of business bankruptcies in Australia where the principal and major contributing causes were attributed to economic conditions (including credit restrictions) or excessive interest payments. The chart shows that business bankruptcies were very much higher in the years from 1990-91 to 1992-93 where the calculated probability of default was higher than it had been in earlier years. The fall in business bankruptcies in 1993-94 was correlated with a fall in the probability of default.

Figure 5.5 *Business Bankruptcies Attributed to Economic Conditions or Excessive Interest Payments: 1980-81 to 1993-94*

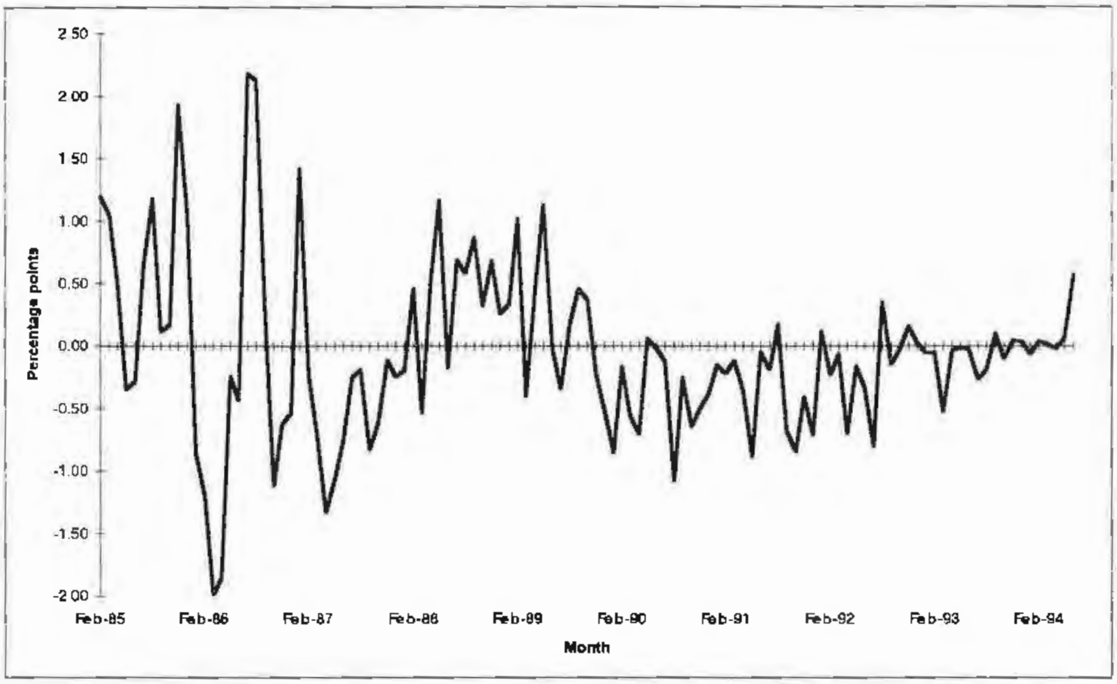


Source: Bankruptcy Act 1966. *Annual Reports*, various issues.

Given the risk-free interest rate, to maximise expected returns the bank should set the interest rate and the interest rate differential, so that the positive effects on profits of any increase in the interest rate is exactly offset by the negative effects on profits of the increase in the probability of default arising from the increase in the interest rate. If interest rates are set in this way marginal profit equals zero as was indicated with reference to expression (5.5). Figure 5.6 shows the change in the business loan interest rate less the change in the calculated probability of default since 1985. Although the chart shows that the difference between the loan interest rate and the probability of default has been volatile, as monthly figures have been used and no smoothing has taken place; it is nevertheless still indicative of fluctuations around the bank optimal loan interest rate. Profit maximisation requires $dR = -d\lambda$ which is indicated by a value of zero in Figure 5.6. A value of zero indicates that the bank has set the optimal interest rate for business loans given the risk-free interest rate. When the change in the loan rate less the change in the probability of default is positive, the banks are operating on the positively sloped portions of their loan supply schedules, as illustrated in Figure 4.1 of Chapter 4, and will benefit by raising both the loan supply and loan interest rates should there be sufficient demand. When $dR - d\lambda$ is negative, the banks are operating on the negatively sloped part of their loan supply schedules if not benefiting from a monotonic loan supply schedule due to the provision of access to lender of last resort facilities by the Reserve Bank as illustrated in Figure 4.1. If the graph in Figure 5.6 is negative, optimising behaviour in the absence of central bank support is to ration credit and reduce the difference between the loan interest rate and the risk-free rate to bring about a zero value for $dR - d\lambda$. Figure 5.6 indicates that banks have been getting better over time at setting the profit maximising interest rate, and that optimising behaviour by banks should have seen them rationing credit in 1986 and 1987 and from 1990 to 1992.

Figure 5.2 showed that there was an excess demand for business loans in 1986 and to a much lesser extent in 1987. However, the relative strength of excess demand in 1986 is not explained with appeal to the relationship between the interest rate and the probability of default. The strength of the economy in those years seems to have contributed to a rapidly increasing demand for loans which subsequently induced a large increase in the supply. The estimates of demand and supply derived from the maximum likelihood estimation illustrated in Figure 5.3 shows demand increased far more rapidly in 1986 and 1987 than in subsequent years. Supply appears to have increased in response to the increase in demand in 1986 and 1987.

Figure 5.6 *Change in business loan interest rates less change in probability of default: February 1985 to June 1994*



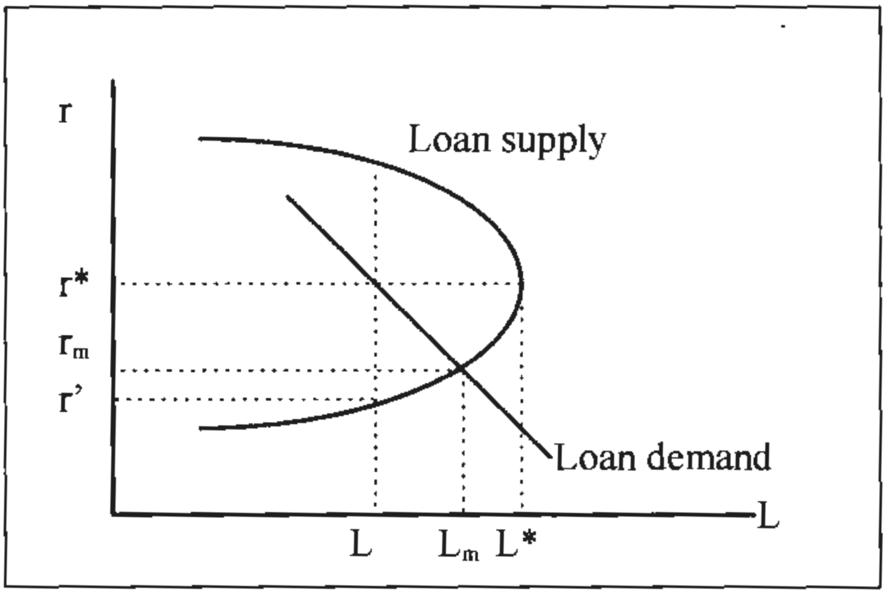
Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

A small amount of credit rationing also took place in 1991. Figure 5.6 indicates that in 1993 and 1994, the banks came close to charging the optimal interest rates on business loans, given the risk free interest rate available to them on government securities. Both Figures 5.2 and 5.6 suggest that there has been a learning period, since financial markets have been deregulated, where banks have taken some time to determine the appropriate loan interest rate at which they can maximise their expected returns.

The bank-optimal loan interest rate is that loan interest rate which is based on the assumption that banks are competitive, and ensures that the expected return from the loan interest rate equals the yield on risk-free government securities. It is when charging this interest rate that the bank maximises profits. Profit maximisation requires that $\frac{d\pi}{dR}$ equals zero. At this point, $\frac{dL}{dR}$ equals zero and no more loans will be offered. If interest rates are raised any further, there will be a fall in profits due to adverse selection and adverse incentive effects so that fewer loans will be offered. The loan supply curve becomes backward bending at the bank-optimal interest rate as discussed in Chapter 4. In that chapter there was some discussion of the consequences of an excess demand for loans.

Our empirical analysis has shown that excess supply rather than excess demand has been the norm in Australia in the market for business loans since deregulation of financial markets. Examination of Figure 5.6 suggests that there may be an excess supply of loans even though the banks appear to be charging the optimal loan interest rate. This situation may be illustrated with reference to Figure 5.7.

Figure 5.7 The effects of an excess supply of loans when banks are charging the bank-optimal interest rate



In Figure 5.7, the supply curve is backward bending due to adverse selection and adverse incentive effects at the bank optimal interest rate, r^*. The demand curve has its regular negative slope, and, because in 1993 and 1994 there was an excess supply of loans, the demand curve cuts the supply curve below its point of inflexion. The Walrasian market-clearing equilibrium interest rate is r_m, and the Walrasian equilibrium supply of loans is L_m. However, because the banks are charging r^*, the quantity *transacted* of loans at r^* (the minimum of loan demand or loan supply, loan demand in this case) is L.

The question remains: Given their supply curve, why do banks not reduce interest rates from r^* to r_m and increase loans from L to L_m? Several reasons emerge. The first and arguably the most important is that banks generally act as price setters and quantity takers in retail markets as argued by Moore (1988). Banks set the loan interest rate which they believe will maximise profits given their cost of funds. Although they are willing to supply L^* of loans at r^*, only an amount of loans equal to L is demanded by business at r^*. Second, banks in Australia do not operate under conditions approximating perfect competition. The industry structure is at best one of monopolistic competition. Thus, banks have monopoly power. They can raise profits by increasing prices (interest rates). Banks make *monopoly* profits when the demand for loans is L. In Figure 5.7, it is clear from their supply curve that the banks would be prepared to provide L amount of loans at r'. However, the competitive structure is such that they can, and do, charge a loan interest rate of r^* for an amount of loans equal to L. For these reasons, banks, given their supply curve, are not prepared to reduce interest rates from r^* to r_m and increase the quantity of loans transacted from L to L_m.

5.6 *Credit rationing in Australia: Personal loans*

A similar exercise to that of business loans was undertaken for personal loans. The loan supply and loan demand functions are specified respectively as follows:

$$L^{s}_{pt} = F\{D_{t-1}, (e_b/e)_{t-1}, W_t, (i_{Lp} - i_f)_t, (i_{Lp} - i)_t, s_t, p_t\}$$

where $F_1', F_2', F_3', F_4' > 0$ and $F_5', F_6', F_7' < 0$.

$$L^{d}_{pt} = L\{y_{ht}, u_t, i_{Lpt}, p_t\}$$

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

Most variables are defined as in the equations for business loans and have the same expected signs. Additional variables included in the estimation are household wealth, the personal loan interest rate, household income and the unemployment rate. The additional variables are defined thus:

W_t = household wealth in the current period. This is derived fom financial wealth and capital stock owned by the private sector. See data appendix for more details. Household wealth is an attempt to proxy for the amount of collateral available to households to be offered against personal loans and so a positive relationship is expected between the supply of loans and household wealth.

$(i_{Lpt} - i_f)_t$ = the personal lending rate less the weighted average cost of funds in the current period. The higher is this margin, the more profitable are loans to banks provided that the loan supply schedule is positively sloped. Loan supply should be positively related to the lending rate less the weighted average cost of funds.

$(i_{Lpt} - i)_t$ = the personal loan rate relative to the current market interest rate. This is an estimate of the risk premium associated with making new loans. This is expected to rise during cyclical downturns as agency costs rise. The supply of loans should fall as the loan rate rises relative to the current market interest rate.

y_{ht} = household income in the current period. As household income rises, so does the capacity of households to service debts. The demand for loans is expected to be positively related to the demand for loans.

u_t = the unemployment rate. As the unemployment rate rises one would expect the demand for loans to fall as a greater number of agents will have expectations of not being able to meet repayments.

i_{Lpt} = the personal loan interest rate. This, because it represents the cost to households of borrowing, will be negatively related to the demand for loans.

Table 5.2 presents the results.

With the exception of inflationary expectations and the lagged dependent variable, the parameter estimates for the demand equation are significant and correctly signed. Contrary to expectations, the demand for personal loans appears to depend negatively on inflationary expectations. This may reflect a real balance effect whereby present consumption is reduced on the expectation of falls in future real balances. Or perhaps the increasing uncertainty generally associated with inflationary expectations dominates the intertemporal substitution one would expect, so that, in fact, households don't bring their consumption expenditures forward in anticipation of higher prices in the future because they want to remain liquid to guard against an uncertain future. In any case, the parameter estimate for inflationary expectations is insignificant.

Table 5.2 Personal Loans: Maximum likelihood estimates of loan supply and demand

$$\ln L^d_{pt} = a_0 + a_1 y_{Lt} + a_2 u_t + a_3 i_{Lpt} + a_4 p_t$$
$$\ln L^s_{pt} = b_o + b_1 \ln D_{t-1} + b_2 \ln (e_b/e)_{t-1} + b_3 \ln W_t + b_4 (i_{Lp} - i_f)_t + b_5 (i_{Lp} - i)_t$$

Sample period: January 1986 - June 1994 (102 monthly observations)

	Demand		Supply	
Constant	-559.910	(-3.325)**	-686.275	(-2.380)**
Lagged demand for personal loans L^d_{pt}	-.022	(-.141)		
Household disposable income y_{Lt}	1.348	(5.256)**		
Unemployment rate u_t	-8.339	(-4.788)**		
Personal loan rate i_{Lpt}	-4.941	(-5.662)**		
Inflation expectations p_t	-18.366	(-1.362)	-23.836	(-1.319)
Lagged supply of personal loans L^s_{pt}			.311	(1.733)
M3 + capital $\ln D_{t-1}$			.929	(3.119)**
Relative bank share price $\ln(e_b/e)_{t-1}$			-.375	(-1.072)
Household wealth $\ln W_t$			51.968	(2.899)**
Personal loan rate less weighted cost of funds $(i_{Lp}-i_f)_t$			-10.067	(-1.071)
Personal loan rate less CD rate $(i_{Lp} - i)_t$			6.542	(1.035)
Relative bank share price variance s_t			-9.438	(-1.287)
Log likelihood	-365.161			

Approximate t-statistics are shown in parentheses. *Significant at 5 %. **Significant at 1 %. These are only a guide to significance. Lending commitments, M3, household disposable income and household wealth are logged and multiplied by 100.

The supply equation for personal loans appears to be less well specified than the demand equation. Significant and correctly signed in determination of the supply of personal loans were the M3 plus banks' capital and household wealth variables. Other variables appear to play little role in the determination of supply. The relative bank share price variable is incorrectly signed although its variance is negatively signed in accordance with expectations. Contrary to expectations, but as was the case for business loans and perhaps for similar reasons, the loan rate less the weighted cost of funds is negatively signed and the loan rate less the CD rate is positively signed.

The loan interest rate was significant in determination of the demand for personal loans, and significant in determination of the demand for business loans. Households have little recourse to alternative sources of finance other than banks and similar financial intermediaries. There being no substitutes available, it would not have been surprising had the interest rate been a less significant factor in determination of the demand for personal loans than it was for business loans although the interest rate still remains a significant cost to persons taking out loans. In contrast to most persons, business can make use of equity finance. The estimation showed that the cost of equity finance was indeed a significant factor in the demand for business loans.

In contrast to business loans, the maximum likelihood estimates show that, in addition to the credit rationing which occurred in 1986, credit was rationed throughout the recession from mid 1989 until mid 1993. The percentage by which the demand for personal loans exceeded the supply is illustrated in Figure 5.8. Figure 5.9 illustrates the maximum likelihood estimates for personal loan supply and demand. As with business loans, the supply of personal loans increased very rapidly as the economy recovered from the recession, and although demand also picked up, it was to a much smaller extent so that excess supply of greater than six per cent occurred in 1993-94.[8]

Figure 5.10 illustrates the calculated probability of default against personal loan interest rates since 1985. Although the loan interest rate has been relatively static for some months at times, the trend has been for the calculated probability of default to increase as the interest rate differential between the loan interest rate and the yield on 13 week Treasury Notes increased. This led to a marked rise in the calculated probability of default when the loan interest rate was falling.

The calculated probability of default is higher for personal loans than it is for business loans due to the higher interest rate on personal loans than on business loans when the yield on risk-free securities is unchanged whichever type of loan is made. The correlation between the loan interest rate and the probability of default is lower for personal loans than for business loans suggesting that the interest rate differential has been more variable for personal loans.

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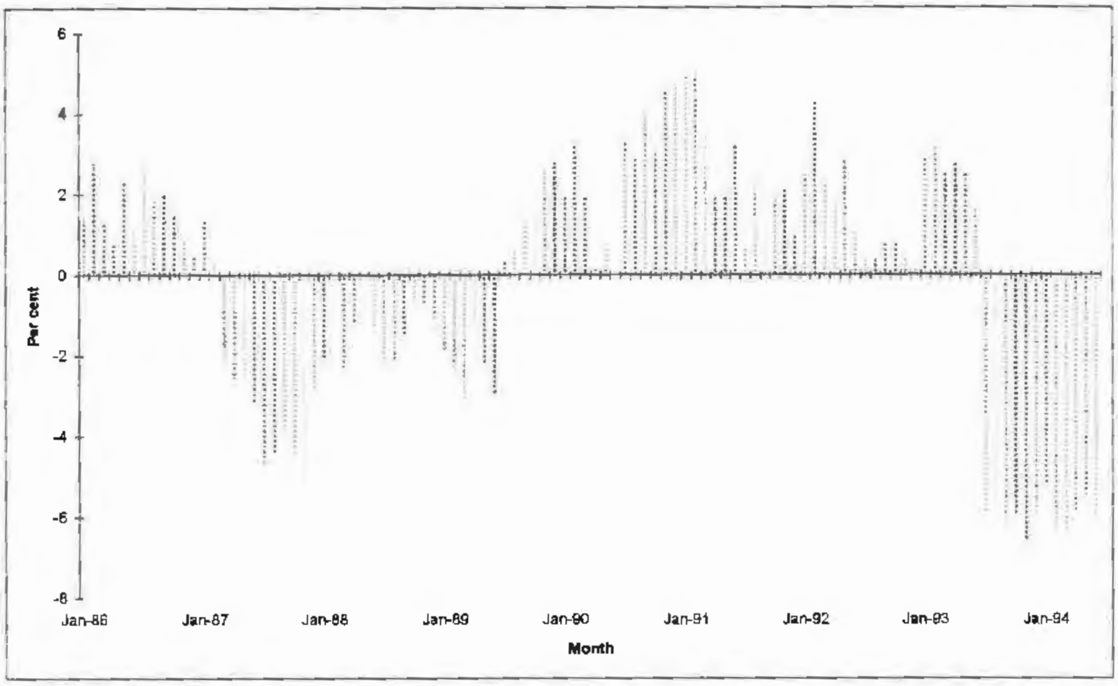
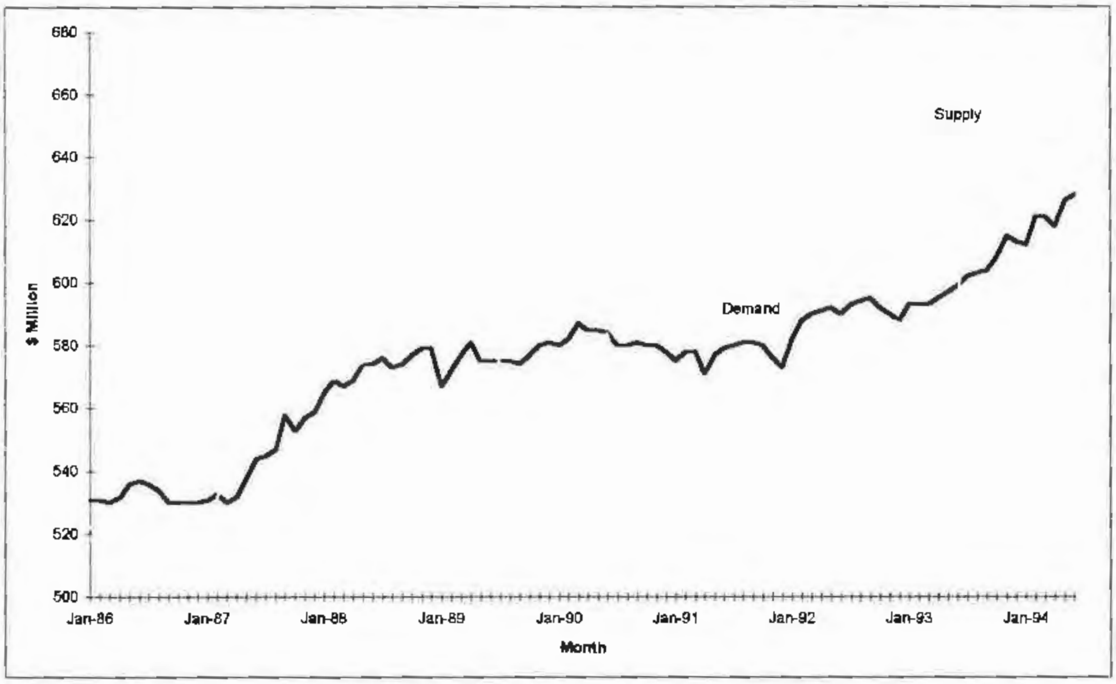
[8] As for business loans, recursive estimation was undertaken to determine whether the parameter estimates and estimates of excess demand were stable across different sample periods. The results are presented in Appendices 5.7 and 5.8. The estimates were somewhat less stable than was the case for business loans, but nevertheless, still relatively stable for the most part.

Figure 5.8 *Excess demand for personal loans: January 1986 to June 1994*



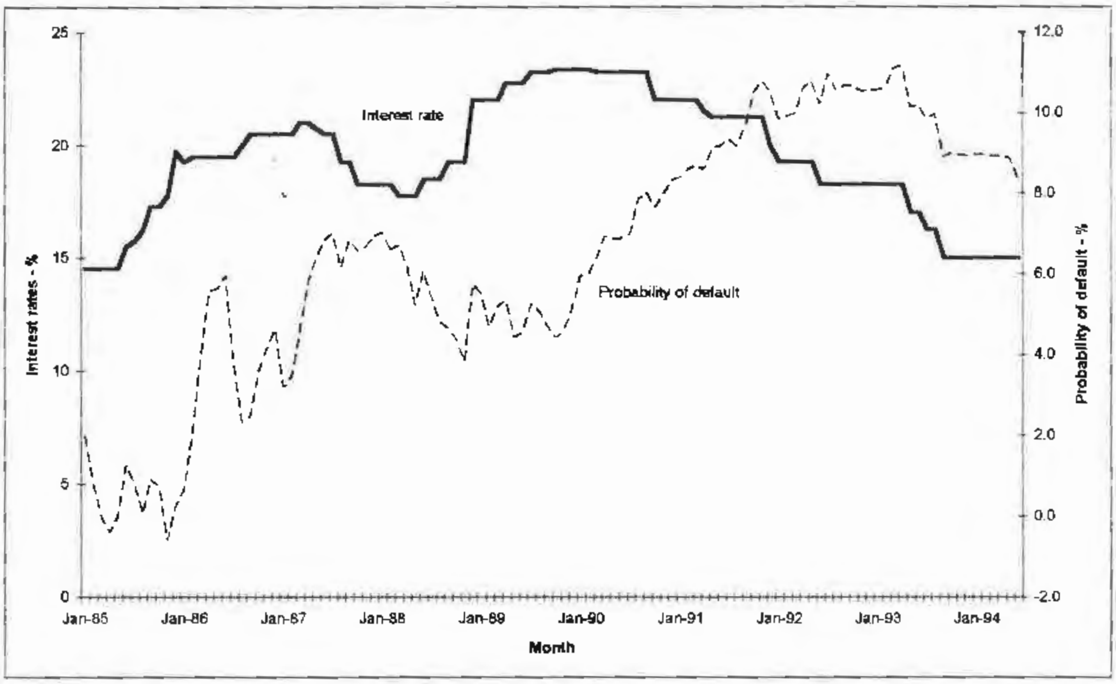
Source: Derived from maximum likelihood estimation undertaken by the author. Sources of data are detailed in Appendix 5.2.

Figure 5.9 *Maximum likelihood estimates of personal loan supply and demand: January 1986 to June 1994*



Source: Derived from maximum likelihood estimation undertaken by the author. Sources of data are detailed in Appendix 5.2.

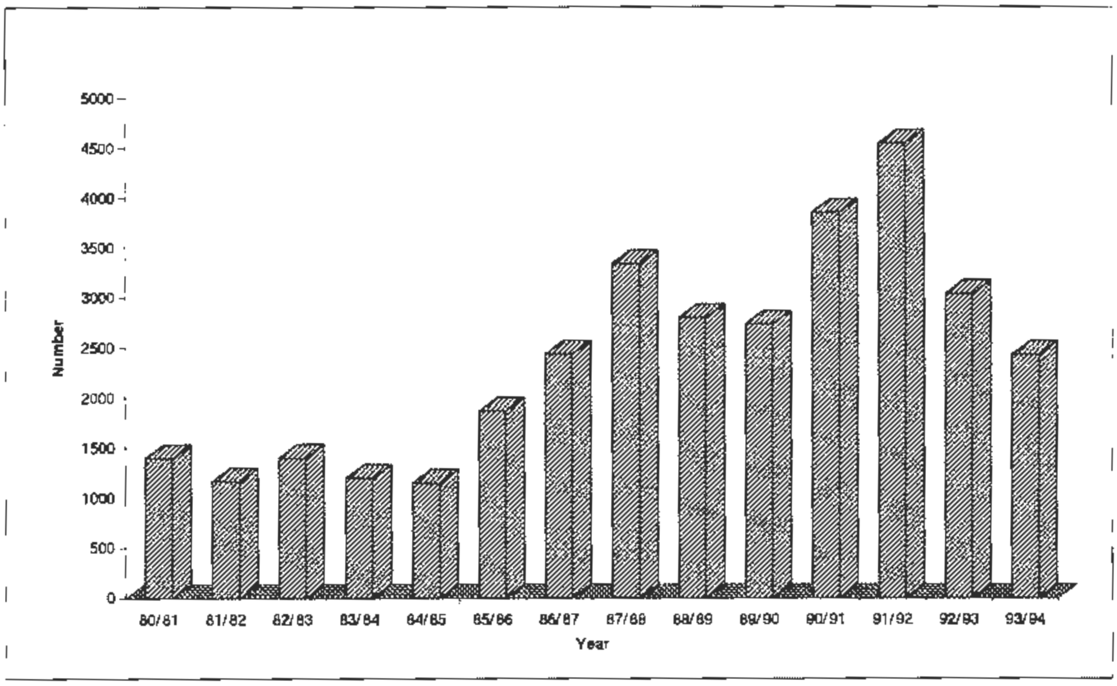
Figure 5.10 Personal loan interest rates and the probability of default: January 1985 to June 1994



Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

As for business loans, we can use non-business bankruptcies as a proxy to determine whether the calculated probability of default is consistent with actual default experience. Figure 5.11 illustrates the number of non-business bankruptcies where the principal cause was attributed to excessive use of credit facilities. Comparison of Figures 5.10 and 5.11 shows that there is a strong positive correlation between the calculated probability of default and the number of bankruptcies. Bankruptcies rose from 1985-86 to 1987-88 as did the probability of default, fell in the subsequent two years, and then rose again from 1990-91 to 1991-92 before falling away from 1992-93 to 1993-94. As was the case for business, the number of personal bankruptcies appears to be positively correlated with the probability of default calculated for personal loans.

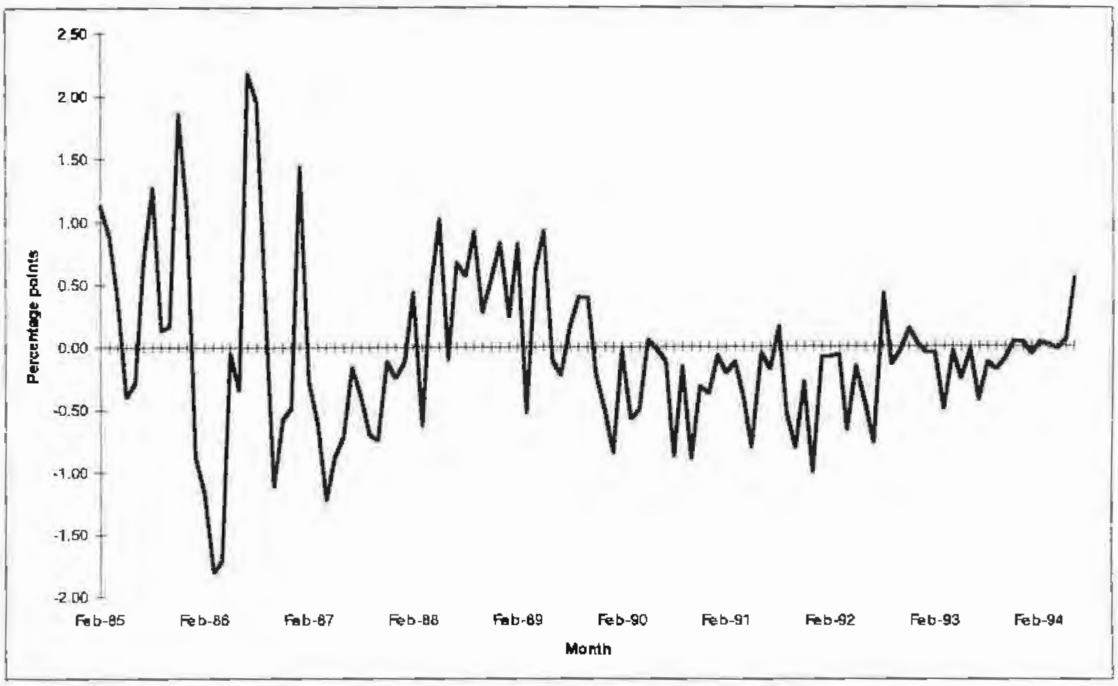
Figure 5.11 Number of Personal Bankruptcies: 1980-81 to 1993-94



Source: Bankruptcy Act 1966. *Annual Reports*, various issues.

Figure 5.12 shows the change in personal loan interest rates less the change in the probability of default. As was described with reference to business loans, where the net outcome of these is zero, the bank is charging the optimal interest rate on personal loans. If the chart shows a positive result the banks should be increasing loan supply and interest rates and if the chart shows a negative result the banks should be rationing credit. It is clear that credit should have been rationed for most of 1986, 1987 and 1988 and again from 1990 through 1992. Figures 5.8 and 5.9 showed that there was an excess demand for personal loans and thus credit rationing in 1986, and from mid 1989 through mid 1993.

Figure 5.12 Change in personal loan interest rates less change in probability of default: February 1985 to June 1994



Sources: Derived from dX database and Reserve Bank of Australia, *Bulletin*, various issues.

Banks have some *a priori* expectations with respect to the probability of loan repayment and default which allows determination of the appropriate loan interest rate when the yield on risk-free securities is known. The calculated probability of default on both business loans and personal loans rose sharply from the beginning of 1990 when the recession took hold. It is likely that the banks, rather than seeking to maximise expected returns by equating the expected returns across all assets in their portfolios, sought to compensate for an increase in the *perceived a priori* risk of default by incorporating a risk premium on the interest rate. In so doing, the banks may have thought to discourage borrowers by higher interest rates (price rationing) but may have been unaware that their actions, in fact, will have encouraged less risk-averse borrowers to undertake riskier projects so that by the banks' very actions to avoid increased risk, the probability of default by borrowers will have increased.

5.7 Conclusion

The previous chapter canvassed theories which demonstrate that asymmetric information and/or the existence of implicit contracts between borrowers and lenders give rise to nonprice credit rationing by the banking system even in deregulated financial markets; and that this nonprice credit rationing is the result of optimising behaviour on the part of borrowers and lenders. On the basis of empirical work, this chapter suggests that there has been a small excess demand for, and therefore credit rationing of business loans in 1986 and in 1991. In the market for personal loans, credit rationing was apparent in 1986 and from mid 1989 until mid 1993. The relationship between the loan interest rate and the risk-free rate allowed us to determine the probability of loan default expected by the banks and whether or not banks were setting the bank-optimal interest rate at which they could maximise expected returns. The empirical evidence suggests that banks have indeed been getting better over time at setting the bank-optimal rate.

Much of the analysis in this chapter has been based on the New Keynesian view discussed in Chapter 4 that non-price credit rationing can arise in deregulated financial markets as a consequence of asymmetric information or implicit contracts which lead banks to make probabilistic assessments of the risks associated with making loans. The post Keynesians argue that uncertainty, including that to do with making loans, is not able to be overcome by probabilistic assessments of risk. In the post Keynesian view, credit rationing is due to 'fundamental uncertainty'. Whether the views of the New Keynesians and the post Keynesians with respect to credit rationing can be reconciled is the subject of the next chapter.

Appendix 5.1 The method of maximum likelihood

The method of maximum likelihood looks for the set of parameters which maximise the likelihood that the parameter values are most likely given the observations. That is, given the observations, which parameter set is more likely than any other?

The following is based on Harvey (1990).

Suppose that there are T random variables, $y_1, \ldots\ldots, y_T$. The distribution of $y_1, \ldots\ldots, y_T$ is a joint density function depending on n unknown parameters in a vector $\Psi = (\Psi_1, \ldots\ldots, \Psi_n)$. Denote the joint density function:

$$L(y_1, \ldots, y_T; \Psi_n).$$

Once the sample has been drawn, $y_1, \ldots, y_T$, become a set of fixed numbers. The expression for the joint density function (the likelihood function) denoted by $L(\Psi)$ can then be reinterpreted as a function of Ψ where Ψ is any admissible value of the parameter vector.

The maximum likelihood estimate (MLE) of Ψ is given by $\tilde{\Psi}$ where

$L(\tilde{\psi}) \geq L(\hat{\Psi})$ and $\hat{\Psi}$ is any admissible estimate of Ψ.

Working with natural logarithms implies:

$$\log L(\tilde{\Psi}) \geq \log L(\hat{\Psi}).$$

The *n by 1* vector of first derivatives, $\partial \log L(\Psi) / \partial \Psi$, is then evaluated at $\Psi = \hat{\Psi}$ and set equal to zero to obtain the MLE. To check that a (local) maximum has been obtained, the Hessian matrix is then examined to see if it is negative definite.

To summarise the steps involved in maximum likelihood estimation:

1. Write down the unconditional density function.
2. Write down the likelihood function in logarithmic form: $\log L(\tilde{\Psi}) \geq \log L(\hat{\Psi})$.
3. Calculate the first derivatives with respect to each parameter in the likelihood function.
4. Set the first derivatives equal to zero to obtain solutions to the likelihood function.
5. Check that the matrix of second derivatives is negative definite to ensure that a (local) maximum for the likelihood function has been obtained.

Maximum likelihood and its use in disequilibrium trading models

Observation of the quantity of loans traded does not provide information as to whether the quantity traded is the whole of the amount which has been demanded or the whole of the amount that lenders are willing to supply. That is, observation of the quantity traded on its own is insufficient to classify the quantity traded to either the demand schedule or to the supply schedule. Maddala and Nelson (1974) showed that it is posssible to classify observations to the demand and supply schedules using the method of maximum likelihood.

Assume that the short side of the market always prevails. That is, the observed quantity traded is always the minimum of supply or demand. Then, the probability that the observation belongs to the demand equation is:

$$\pi_t = pr(D_t < S_t)$$

$$= pr(\beta_1 X_{1t} + u_{1t} < \beta_2 X_{2t} + u_{2t})$$

$$= pr(u_{1t} - u_{2t} < \beta_2 X_{2t} - \beta_1 X_{1t}).$$

Since u_1 and u_2 are assumed to be normally distributed with variance $\sigma^2 = \sigma_1^2 + \sigma_2^2$ and the probability density function (p.d.f.) for the normal distribution is:

$$(1/\sigma\sqrt{2\pi})e^{-(x-\mu)/\sigma^2}$$

and the p.d.f. for the *standard* normal distribution is:

$$(1/\sqrt{2\pi})e^{-(x-\mu)/\sigma^2}.$$

$$\pi_t = \int_{-\infty}^{(\beta_2 X_{2t} - \beta_1 X_{1t})/\sigma} (1/\sqrt{2\pi})e^{-u/2} du$$

Define the probability that any observation, A, lies on the demand schedule as:

$$f_1(Q_t) = [1/(\sigma_1\sqrt{2\pi})]\exp\{(-1/2\sigma_1^2)(Q_t - \beta_1 X_{1t})^2\}$$

and the probability that A lies on the supply schedule as:

$$f_2(Q_t) = [1/(\sigma_2^2\sqrt{2\pi})]\exp\{(-1/2\sigma_2^2)(Q_t - \beta_2 X_{2t})^2\}.$$

The distribution function F_i is the probability that an observation gives a value greater than, or equal to, Q_t when the market is demand constrained:

$$F_1(Q_t) = [1/\sigma_1\sqrt{2\pi}]\int_{Q_t}^{\infty} \exp\{(1/2\sigma_1^2)(D_t - \beta_1 X_{1t})^2\}dD_t .$$

Similarly, when the market is supply constrained:

$$F_2(Q_t) = [1/\sigma_1\sqrt{2\pi}]\int_{Q_t}^{\infty} \exp\{(1/2\sigma_2^2)(S_t - \beta_2 X_{2t})^2\}dS_t .$$

If Q_t belongs to the demand equation, the conditional density function of Q_t is:

$$Q_t = [f_1(Q_t).F_2(Q_t)] / [\int_{-\infty}^{\infty} f_1(Q_t).F_2(Q_t)].$$

The denominator is equivalent to $pr(D_t < S_t) = \pi_t$ so the conditional density function of $Q_t = [f_1(Q_t).F_2(Q_t)] / \pi_t$.

Given that Q_t belongs to the supply equation then:

$$\begin{aligned} Q_t &= [f_2(Q_t).F_1(Q_t)] / [\int_{-\infty}^{\infty} f_2(Q_t).F_1(Q_t)] \\ &= [f_2(Q_t).F_1(Q_t)] / (1-\pi_t) \end{aligned}$$

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 is:

$$\begin{aligned} f(Q_t | X_{1t}, X_{2t}) &= \pi_t[(f_1(Q_t).F_2(Q_t)) / \pi_t] + (1-\pi_t)[(f_2(Q_t).F_1(Q_t)) / (1-\pi_t) \\ &= f_1(Q_t).F_2(Q_t) + f_2(Q_t).F_1(Q_t) \end{aligned}$$

"That is to say, the PDF of Q_t is given by (a) the conditional PDF of Q_t when Q is demand constrained multiplied by the probability of being demand constrained *plus* (b) the PDF of Q_t when Q_t is supply constrained, multiplied by the probability of being supply constrained."[9]

Log likelihood: $L = \sum_{i=1}^{n} \log[f_1(Q_t).F_2(Q_t) + f_2(Q_t).F_1(Q_t)]$.

[9] Cuthbertson, Keith, Stephen G. Hall and Mark P. Taylor (1992), *Applied Econometric Techniques*, The University of Michigan Press, Michigan, p. 70.

Appendix 5.2 Data Sources and Definitions

Lending to business: (dX database) All banks: lending commitments: commercial: total.

Lending to persons: (dX database) All banks: lending commitments: personal: total.

Investment expectations: (ABS Cat. No. 5626.0, *Private new capital expenditure, Australia*) Expected new capital expenditure as reported by businesses. This quarterly survey contains expected new capital expenditure for the coming quarter plus expected new capital expenditure for the coming half year at June and December. As in BWG, monthly figures for quarterly data were obtained by interpolating quarterly data assuming that growth is constant throughout each quarter, and constraining the sum of three months' investment in each quarter to be equal to the total quarter's investment.

Overdraft rate: (dX database) Interest rates: banks: business indicator: large business.

Inflation expectations: (dX database) As in BWG, expected inflation is based on the total CPI. Monthly figures are 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.

Cost of equity finance: (Australian Stock Exchange, *Indices and Yields Book* and *Monthly Index Analysis*) As in BWG, the earnings/price ratio is adjusted by expected output growth to obtain a truer measure of the cost of equity finance where expected output growth is proxied by the rate predicted by a thirteenth order autoregressive model.

M3: (dX database)

Banks' capital: (dX database) All banks' assets less all banks' liabilities.

Non-farm GDP: (dX database) Seasonally adjusted.

Corporate net worth: (dX database) Share markets: Sydney market capitalisation: listed equity stocks.

Banks' share price: (dX database) Share markets: Australian share price indices: banks and finance.

All ordinaries share price: (dX database) Share markets: Australian share price indices: all ordinaries.

Relative bank share price variance: The ratio of the standard deviation (taken over the previous 24 months observations) of the banks and finance share price index and the standard deviation of the all ordinaries share price index.

Weighted cost of funds: (All data is either from the Reserve Bank of Australia, *Bulletin* or dX database.) This differs from BWG's measure and is calculated as described below where deposit liabilities = foreign currency liabilities + interest bearing deposit liabilities + total fixed deposit liabilities + certificates of deposit + investment savings and statement accounts + passbook accounts + other deposit liabilities (mostly cash management accounts). Only interest bearing deposit liabilities were taken into account in determining the weighted cost of funds.

Weighted cost of funds

= (foreign currency liabilities/deposit liabilities)*90 day bank bill rate

+ (Interest bearing deposit liabilities/deposit liabilities)* average of maximum and minimum interest rate for transaction and investment accounts over $10 000

+ (total fixed deposit liabilities/deposit liabilities)*bank interest rate on fixed deposits $5 000 to $100 000

+ (certificates of deposit/deposit liabilities)*certificate of deposit rate

+ (Investment savings and statement savings accounts/deposit liabilities)* predominant rate on investment savings accounts to March 1986, the average of the minimum and maximum interest rate on investment savings accounts from April 1986 to May 1990, and the average of the minimum rate on transactions and investment accounts of $2000 to less than $10 000 and the maximum rate on transactions and investment accounts of greater than $10 000 from June 1990.

+ (Passbook accounts/deposit liabilities)*average of minimum and maximum bank interest rates on passbook accounts

+ (Other/deposit liabilities)*rate on cash management trusts of other financial institutions (assumes that banks were competitive) from January 1985 to November 1989, and minimum interest rate of banks' cash management accounts $20 000 - $100000 from December 1989.

Household disposable income: (dX database) Total and seasonally adjusted. Monthly figures are obtained by interpolation of quarterly data assuming that the growth rate is constant throughout each quarter.

Unemployment rate: (dX database) Population survey: unemployment rate: persons.

Personal loan rate: (Reserve Bank of Australia, *Bulletin* and dX database) Maximum of overdraft rate for less than $100 000 for 1985 to November 1988. From December 1988, the rate is bank interest rate on personal instalment loans.

Household wealth: (dX database and ABS Cat. No. 5232.0, *Australian National Accounts, Financial Accounts*) Net capital stock: private unincorporated enterprises and dwellings owned by persons plus total financial assets: households and unincorporated enterprises. From 1988-89 to 1990-91 data was available on an annual basis for both the net capital stock and total financial assets. For these three years the net capital stock was equal to approximately 92 % of the value of total financial assets. For other years the same proportion was assumed to hold and annual data was interpolated to monthly data assuming a constant growth rate in each quarter.

Appendix 5.3 Tests for Unit Roots[(a)]

Sample Period: January 1986 to June 1994

Variable	ADF Statistic	ADF Statistic of first differenced variable
Cost of equity finance	-9.59210** (.000)	
Business interest rate	-4.49433** (.003)	
Investment expectations	-3.21202 (.088)	-9.10735** (.000)
Inflation expectations	-4.39590** (.000)	
Market capitalisation	-9.42417** (.000)	
Banks & finance share price index	-7.23033** (.000)	
M3 + bank capital	-9.17683** (.000)	
Business loan rate less CD rate	-9.29854** (.000)	
Bank share price variance	-5.20290** (.000)	
Business loan commitments	-12.4775** (.000)	
Personal loan interest rate	-9.78815** (.000)	
90 day bank adjusted bill rate	-7.73933** (.000)	
Relative bank share price variance	-7.32813** (.000)	
Business loan rate less weighted cost of funds	-6.27465** (.000)	
Personal wealth	-1.21939 (.93)	-9.74148** (.000)
Household income	-7.84233** (.000)	
Personal loan commitments	-12.1988** (.000)	

(a) The null hypothesis is that there is a unit root in the times series data. The augmented Dickey-Fuller statistics are presented with their corresponding P-values. If the null of a unit root is accepted, the ADF statistic is presented with its corresponding P-value for the first difference of the variable.
** Indicates significance at 1 %.

Appendix 5.4 Instrumental Variables

As in BWG, instrumental variables were applied to the loan interest rate, the spread between the loan interest rate and the certificate of deposit rate and the spread between the loan rate and the weighted cost of funds in case these variables were simultaneously determined with the quantity of credit. Instruments were also applied to the earnings price ratio.

The loan rate instruments:

- loan rate lagged one month
- expected inflation
- day bank bill rate
- non-farm GDP lagged one month
- the spread between the mortgage rate and the 13 week Treasury Note rate
- broad money lagged one month
- rediscount rate for Treasury Notes
- rediscount rate for Treasury Notes lagged one month
- all banks' capital
- time trend

Instruments applied to the spread between the loan rate and other interest rates:

- the total issue yield on certificates of deposit
- the rediscount rate for Treasury Notes
- the spread between the mortgage rate and the 13 week Treasury Note rate
- broad money lagged one month
- the issue yield on 13 week Treasury Notes lagged one month
- the loan rate lagged one month
- all banks' capital
- the monthly change in non-farm GDP

Instruments applied to the earnings price ratio were as for the spread between the loan interest rate with the addition of corporate net worth.

Appendix 5.5 Maximum Likelihood Estimates of Recursive Estimations for Business Loans[(a)]

		1986:1-93:1	1986:1-93:2	1986:1-93:3	1986:1-93:4	1986:1-93:5	1986:1-93:6	1986:1-93:7	1986:1-93:8	1986:1-93:9
DEMAND	Constant	450.231	458.257	458.666	461.624	445.383	447.408	452.948	453.869	460.206
		(4.619)**	(4.687)**	(4.755)**	(4.882)**	(4.625)**	(4.731)**	(4.856)**	(4.891)**	(4.965)**
	L^d_{t-1}	.364	.356	.355	.352	.379	.376	.366	.367	.356
		(2.642)**	(2.575)*	(2.610)**	(2.628)**	(2.794)**	(2.822)**	(2.794)**	(2.810)**	(2.734)**
	k^e_t	-.007	-.005	-.006	-.005	-.004	-.004	-.005	-.004	-.005
		(-1.024)	(-.797)	(-.854)	(-.824)	(-.607)	(-.627)	(-.705)	(-.615)	(-.730)
	$i_{tL,t}$	-3.289	-3.623	-3.668	-3.690	-3.454	-3.483	-3.560	-3.519	-3.573
		(-2.766)**	(-2.650)**	(-2.729)**	(-2.785)**	(-2.599)**	(-2.666)**	(-2.574)**	(-2.744)**	(-2.785)**
	π_t	41.071	43.477	42.893	43.837	43.439	43.602	43.393	43.910	44.302
		(2.682)**	(2.792)**	(2.812)**	(2.910)**	(2.758)*	(2.816)**	(2.839)**	(2.872)**	(2.919)**
	E_{pt}	7.346	6.408	6.632	6.529	5.619	5.698	6.026	5.774	6.067
		(2.362)*	(2.218)*	(2.337)*	(2.348)*	(2.142)*	(2.212)*	(2.377)*	(2.329)*	(2.462)*
SUPPLY	Constant	-1295.32	-1294.88	-1297.60	-1299.75	-1297.93	-1301.61	-1299.57	-1301.31	-1301.98
		(-5.001)**	(-5.118)**	(-5.080)**	(-5.101)**	(-5.198)**	(-5.175)**	(-5.142)**	(-5.177)**	(-5.142)**
	L^s_{t-1}	-.037	-.033	-.035	-.036	-.034	-.036	-.036	-.036	-.035
		(-.299)	(-.275)	(-.287)	(-.293)	(-.283)	(-.296)	(-.293)	(-.296)	(-.291)
	$ln\ D_{t-1}$	1.026	1.029	1.030	1.031	1.029	1.031	1.031	1.032	1.032
		(3.690)**	(3.716)**	(3.697)**	(3.691)**	(3.769)**	(3.754)**	(3.727)**	(3.734)**	(3.707)**
	$ln\ E_{t-1}$	.728	.723	.725	.727	.726	.728	.727	.728	.728
		(3.140)**	(3.121)**	(3.115)**	(3.117)**	(3.181)**	(3.172)**	(3.146)**	(3.153)**	(3.134)**

(a) Supply equation is continued on the next page.

	1986:1-93:1	1986:1-93:2	1986:1-93:3	1986:1-93:4	1986:1-93:5	1986:1-93:6	1986:1-93:7	1986:1-93:8	1986:1-93:9
$ln(e_b/e)_{t-1}$	1.502 (3.799)**	1.500 (3.823)**	1.503 (3.801)**	1.506 (3.804)**	1.505 (3.879)**	1.509 (3.859)**	1.506 (3.838)**	1.507 (3.852)**	1.509 (3.822)**
$(i_L-i_f)_t$	-32.168 (-5.361)**	-31.898 (-5.364)**	-31.961 (-5.359)**	-31.920 (-5.353)**	-31.839 (-5.404)**	-31.905 (-5.399)**	-31.892 (-5.371)**	-31.871 (-5.376)**	-31.837 (-5.369)**
$(i_L-i)_t$	11.414 (3.611)**	11.096 (3.575)**	11.154 (3.578)**	11.097 (3.567)**	11.026 (3.577)**	11.052 (3.579)**	11.058 (3.568)**	11.000 (3.559)**	11.001 (3.559)**
σ_t	-41.217 (-3.073)**	-41.367 (-3.131)**	-41.448 (-3.112)**	-41.504 (-3.122)**	-41.451 (-3.183)**	-41.531 (-3.167)**	-41.517 (-3.153)**	-41.526 (-3.168)**	-41.677 (-3.149)**
π_t	146.049 (7.163)**	144.701 (7.358)**	145.025 (7.298)**	144.836 (7.328)**	144.854 (7.424)**	145.085 (7.402)**	144.893 (7.357)**	144.796 (7.404)**	144.576 (7.383)**
sig2	12.563 (7.363)**	12.617 (7.297)**	12.490 (7.481)**	12.388 (7.638)**	12.632 (7.565)**	12.504 (7.767)**	12.428 (7.867)**	12.393 (7.914)**	12.386 (7.921)**
sig1	5.618 (4.156)**	5.647 (4.374)**	5.653 (4.331)**	5.668 (4.365)**	5.638 (4.406)**	5.653 (4.391)**	5.658 (4.383)**	5.666 (4.418)**	5.672 (4.423)**
Log likelihood	-310.831	-314.793	-318.276	-321.781	-326.516	-329.974	-333.604	-337.349	-341.355
No. of observations	85	86	87	88	89	90	91	92	93

Figures in parentheses are t-statistics. * Significant at 5 %. ** Significant at 1 %.

Appendix 5.5 Maximum Likelihood Estimates of Recursive Estimations for Business Loans (continued)[(a)]

		1986:1-93:10	1986:1-93:11	1986:1-93:12	1986:1-94:1	1986:1-94:2	1986:1-94:3	1986:1-94:4	1986:1-94:5	1986:1-94:6
DEMAND	Constant	467.964 (5.074)**	406.090 (4.570)**	441.082 (5.111)**	435.632 (5.169)**	435.841 (5.237)**	440.752 (5.318)**	440.171 (5.377)**	438.948 (5.441)**	436.489 (5.510)**
	L^d_{t-1}	.347 (2.674)**	.435 (3.497)**	.383 (3.194)**	.389 (3.308)**	.388 (3.345)**	.382 (3.309)**	.382 (3.342)**	.385 (3.415)**	.388 (3.515)**
	k^e_t	-.004 (-.635)	-.001 (-.158)	-.002 (-.225)	-.002 (-.229)	-.002 (-.245)	-.001 (-.172)	-.001 (-.172)	-.001 (-.149)	-.001 (-.125)
	i_{BLt}	-3.600 (-2.797)**	-2.694 (-2.033)*	-2.924 (-2.169)*	-2.844 (-2.156)*	-2.864 (-2.200)*	-2.872 (-2.190)*	-2.816 (-2.187)*	-2.826 (-2.219)*	-2.839 (-2.258)*
	π_t	45.674 (3.007)**	29.410 (2.083)*	29.979 (2.080)*	27.396 (2.006)*	27.840 (2.067)*	27.615 (2.033)*	26.398 (1.994)*	26.245 (2.002)*	25.574 (1.977)*
	E_{pt}	5.891 (2.414)*	4.742 (1.806)	5.600 (2.172)*	5.742 (2.254)*	5.766 (2.290)*	5.695 (2.267)*	5.756 (2.316)*	5.721 (2.338)*	5.741 (2.382)*
SUPPLY	Constant	-1299.91 (-5.191)**	-1276.17 (-5.306)**	-1268.91 (-5.326)**	-1275.30 (-5.253)**	-1277.71 (-5.240)**	-1272.93 (-5.290)**	-1279.06 (-5.238)**	-1280.55 (-5.243)**	-1283.12 (-5.274)**
	L^s_{t-1}	-.033 (-.277)	-.029 (-.253)	-.022 (-.199)	-.025 (-.217)	-.026 (-.229)	-.024 (-.212)	-.025 (-.224)	-.026 (-.231)	-.028 (-.248)
	$ln\ D_{t-1}$	1.031 (3.708)**	1.006 (3.935)**	1.001 (3.886)**	1.003 (3.871)**	1.005 (3.860)**	1.004 (3.887)**	1.006 (3.864)**	1.007 (3.871)**	1.009 (3.900)**
	$ln\ E_{t-1}$	.725 (3.125)**	.727 (3.401)**	.721 (3.323)**	.726 (3.346)**	.728 (3.337)**	.723 (3.333)**	.727 (3.338)**	.728 (3.346)**	.728 (3.381)**

(a) The supply equation is continued on the next page.

	1986:1-93:10	1986:1-93:11	1986:1-93:12	1986:1-94:1	1986:1-94:2	1986:1-94:3	1986:1-94:4	1986:1-94:5	1986:1-94:6
$ln(e_b/e)_{t-1}$	1.505	1.492	1.484	1.493	1.495	1.486	1.494	1.495	1.494
	(3.842)**	(4.119)**	(4.092)**	(4.061)**	(4.046)**	(4.082)**	(4.044)**	(4.050)**	(4.089)**
$(i_L-i_d)_t$	-31.742	-32.060	-31.843	-31.974	-32.011	-31.981	-32.019	-32.052	-32.151
	(-5.349)**	(-5.573)**	(-5.541)**	(-5.586)**	(-5.584)**	(-5.571)**	(-5.597)**	(-5.604)**	(-5.649)**
$(i_L-i)_t$	10.898	11.360	11.239	11.408	11.418	11.346	11.427	11.445	11.526
	(3.535)**	(3.663)**	(3.662)**	(3.692)**	(3.691)**	(3.678)**	(3.695)**	(3.695)**	(3.718)**
σ_t	-41.552	-40.439	-40.361	-40.597	-40.658	-40.426	-40.707	-40.705	-40.671
	(-3.170)**	(-3.265)**	(-3.261)**	(-3.224)**	(-3.217)**	(-3.242)**	(-3.214)**	(-3.218)**	(-3.243)**
π_t	144.085	146.325	145.067	146.094	146.227	145.868	146.441	146.677	147.283
	(7.458)**	(7.373)**	(7.476)**	(7.387)**	(7.370)**	(7.420)**	(7.370)**	(7.362)**	(7.361)**
sig2	12.399	13.662	13.799	13.715	13.601	13.666	13.574	13.502	13.420
	(7.891)**	(8.833)**	(8.977)**	(9.112)**	(9.271)**	(9.201)**	(9.348)**	(9.510)**	(9.691)**
sig1	5.683	5.440	5.454	5.435	5.445	5.444	5.440	5.440	5.422
	(4.483)**	(4.128)**	(4.258)**	(4.135)**	(4.129)**	(4.177)**	(4.177)**	(4.104)**	(4.054)**
Log likelihood	-345.324	-354.235	-358.912	-362.650	-366.212	-370.384	-374.045	-377.682	-381.316
No. of observations	94	95	96	97	98	99	100	101	102

Figures in parentheses are t-statistics. * Significant at 5 %. ** Significant at 1 %.

Appendix 5.6 Excess Demand for Business Loans

Estimate of excess demand for each month for each 'run' for sample period from January 1986 to :[a]

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1986:																		
Jan.	8.2	8.4	8.4	8.5	8.2	8.3	8.3	8.4	8.5	8.6	6.3	8.4	8.3	8.3	8.4	8.4	8.4	8.3
Feb.	4.0	4.4	4.4	4.4	4.2	4.2	4.3	4.3	4.5	4.6	1.9	4.0	3.9	3.9	4.0	4.0	3.9	3.8
Mar.	4.3	4.8	4.7	4.8	4.8	4.8	4.8	4.8	4.9	5.1	2.8	4.5	4.3	4.3	4.4	4.3	4.3	4.2
Apr.	0.0	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.6	-1.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1
May	1.2	1.5	1.4	1.5	1.6	1.6	1.5	1.6	1.6	1.6	0.1	1.4	1.3	1.3	1.4	1.4	1.3	1.3
Jun.	1.4	1.7	1.6	1.7	1.7	1.7	1.7	1.8	1.8	1.9	0.1	1.5	1.4	1.4	1.5	1.4	1.4	1.4
Jul.	5.9	5.9	5.9	5.9	5.7	5.7	5.8	5.8	5.9	5.9	3.8	5.6	5.5	5.5	5.5	5.5	5.5	5.5
Aug.	6.6	6.5	6.5	6.5	6.2	6.2	6.3	6.3	6.4	6.4	4.1	6.0	6.0	6.0	6.0	6.0	6.0	5.9
Sep.	3.8	4	4.0	4.0	3.8	3.9	3.9	3.9	4.0	4.1	1.8	3.5	3.4	3.4	3.4	3.4	3.3	3.3
Oct.	2.6	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	3.0	1.0	2.5	2.4	2.4	2.5	2.4	2.4	2.4
Nov.	1.3	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.8	-0.2	1.2	1.1	1.1	1.1	1.1	1.1	1.0
Dec.	-0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	-1.8	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6	-0.7
1987:																		
Jan.	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.6	-0.4	1.0	0.9	0.9	0.9	0.8	0.8	0.7
Feb.	3.8	4	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.5	3.8	3.7	3.7	3.7	3.7	3.7	3.7
Mar.	1.5	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.9	0.4	1.7	1.6	1.6	1.6	1.6	1.6	1.5
Apr.	0.0	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	-1.4	0.0	-0.2	-0.2	-0.1	-0.2	-0.2	-0.3
May	0.4	0.6	0.6	0.6	0.8	0.8	0.7	0.8	0.7	0.8	-0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.4
Jun.	1.3	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	0.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Jul.	-0.4	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-1.5	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Aug.	-1.5	-1.3	-1.4	-1.4	-1.2	-1.3	-1.3	-1.3	-1.3	-1.2	-2.7	-1.5	-1.7	-1.7	-1.6	-1.7	-1.7	-1.7
Sep.	-2.4	-2.1	-2.2	-2.1	-2.0	-2.0	-2.0	-2.0	-2.0	-1.9	-3.3	-2.1	-2.3	-2.3	-2.2	-2.3	-2.3	-2.3
Oct.	-2.7	-2.6	-2.7	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-3.8	-2.7	-2.8	-2.8	-2.7	-2.8	-2.8	-2.8
Nov.	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.1	-0.1	1.0	0.9	0.9	0.9	0.9	0.9	0.9
Dec.	-3.2	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-4.5	-3.3	-3.4	-3.4	-3.4	-3.5	-3.5	-3.5
1988:																		
Jan.	-2.2	-2.1	-2.1	-2.1	-1.9	-1.9	-2.0	-2.0	-2.0	-2.0	-3.0	-2.0	-2.1	-2.1	-2.1	-2.2	-2.1	-2.1
Feb.	-1.6	-1.6	-1.6	-1.6	-1.5	-1.6	-1.6	-1.5	-1.6	-1.5	-2.8	-1.6	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7

(a) Table is continued on next page

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1988																		
Mar.	-2.7	-2.6	-2.6	-2.6	-2.5	-2.5	-2.5	-2.5	-2.6	-2.5	-3.6	-2.6	-2.7	-2.7	-2.7	-2.8	-2.7	-2.7
Apr.	-3.1	-3.1	-3.1	-3.1	-3.0	-3.0	-3.1	-3.1	-3.1	-3.1	-4.1	-3.2	-3.2	-3.2	-3.2	-3.3	-3.3	-3.2
May	-3.2	-3.2	-3.2	-3.2	-3.3	-3.3	-3.3	-3.3	-3.3	-3.2	-4.5	-3.3	-3.4	-3.4	-3.3	-3.4	-3.4	-3.4
Jun.	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-4.9	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8
Jul.	-3.7	-3.6	-3.7	-3.7	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6	-4.6	-3.6	-3.7	-3.7	-3.6	-3.7	-3.7	-3.7
Aug.	-3.3	-3.3	-3.3	-3.3	-3.2	-3.2	-3.3	-3.2	-3.3	-3.3	-4.4	-3.3	-3.4	-3.4	-3.4	-3.4	-3.4	-3.4
Sep.	-2.7	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-4.0	-2.9	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Oct.	-3.1	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-4.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
Nov.	-4.1	-4.2	-4.2	-4.2	-4.3	-4.3	-4.2	-4.3	-4.2	-4.2	-5.4	-4.2	-4.3	-4.3	-4.2	-4.3	-4.3	-4.3
Dec.	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.3	-4.2	-5.3	-4.3	-4.3	-4.3	-4.3	-4.4	-4.4	-4.3
1989:																		
Jan.	-3.9	-4	-4.0	-4.0	-4.1	-4.1	-4.1	-4.1	-4.1	-4.1	-5.3	-4.1	-4.1	-4.1	-4.1	-4.1	-4.2	-4.1
Feb.	0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.3	-0.3	-0.4	-1.0	0.0	0.2	0.2	0.1	0.2	0.2	0.2
Mar.	-1.6	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.9	-1.9	-2.3	-1.3	-1.2	-1.2	-1.2	-1.2	-1.2	-1.1
Apr.	-3.0	-3.2	-3.1	-3.2	-3.3	-3.3	-3.2	-3.3	-3.2	-3.3	-4.1	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7
May	-2.5	-2.7	-2.7	-2.7	-2.8	-2.8	-2.8	-2.8	-2.8	-2.9	-3.8	-2.6	-2.5	-2.5	-2.5	-2.6	-2.6	-2.6
Jun.	-6.2	-6.1	-6.1	-6.1	-6.1	-6.1	-6.1	-6.1	-6.1	-6.1	-7.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.1
Jul.	-3.3	-3.3	-3.4	-3.4	-3.3	-3.3	-3.4	-3.4	-3.4	-3.4	-4.1	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
Aug.	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.2	-5.1	-5.1	-6.1	-5.0	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
Sep.	-2.7	-2.6	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7	-2.6	-2.6	-4.0	-2.7	-2.8	-2.8	-2.8	-2.8	-2.9	-2.9
Oct.	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Nov.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	-0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Dec.	-2.1	-2.1	-2.1	-2.1	-2.2	-2.2	-2.1	-2.2	-2.1	-2.1	-3.4	-2.0	-2.0	-2.0	-2.0	-2.0	-2.1	-2.1
1990:																		
Jan.	-5.3	-5.2	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-5.2	-6.4	-5.1	-5.2	-5.2	-5.2	-5.2	-5.2	-5.3
Feb.	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-5.9	-4.7	-4.8	-4.8	-4.7	-4.8	-4.8	-4.8
Mar.	-5.3	-5.2	-5.2	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-6.3	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
Apr.	-5.0	-5.0	-5.0	-5.0	-4.9	-4.9	-4.9	-4.9	-5.0	-5.0	-5.6	-4.6	-4.6	-4.7	-4.6	-4.7	-4.7	-4.7
May	-7.9	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-8.7	-7.5	-7.6	-7.6	-7.5	-7.6	-7.6	-7.6

Table is continued on next page.

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1990:																		
Sep.	-5.2	-5.3	-5.3	-5.4	-5.4	-5.4	-5.4	-5.5	-5.4	-5.4	-6.3	-5.1	-5.0	-5.1	-5.0	-5.1	-5.1	-5.1
Oct.	-4.5	-4.6	-4.6	-4.6	-4.7	-4.7	-4.6	-4.7	-4.6	-4.7	-5.7	-4.3	-4.3	-4.4	-4.3	-4.3	-4.4	-4.4
Nov.	-5.6	-5.6	-5.6	-5.6	-5.7	-5.7	-5.7	-5.7	-5.6	-5.6	-6.9	-5.7	-5.8	-5.8	-5.8	-5.9	-5.9	-5.9
Dec.	-6.0	-5.9	-6.0	-5.9	-6.0	-6.0	-6.0	-6.0	-5.9	-5.9	-7.6	-6.4	-6.5	-6.5	-6.5	-6.6	-6.6	-6.7
1991:																		
Jan.	-4.1	-4.0	-4.1	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-5.4	-4.2	-4.3	-4.3	-4.3	-4.4	-4.4	-4.4
Feb.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	-0.4	0.7	0.8	0.8	0.8	0.8	0.8	0.8
Mar.	0.5	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.3	0.2	-0.2	1.0	1.1	1.1	1.1	1.2	1.2	1.2
Apr.	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.2	1.5	1.5	1.5	1.5	1.6	1.6	1.6
May	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.5	0.0	1.3	1.4	1.4	1.4	1.4	1.5	1.5
Jun.	0.5	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.3	-0.3	1.1	1.2	1.2	1.2	1.3	1.3	1.3
Jul.	-0.9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.1	-1.9	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Aug.	-1.3	-1.4	-1.4	-1.4	-1.5	-1.5	-1.4	-1.5	-1.4	-1.5	-2.6	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
Sep.	-0.3	-0.3	-0.3	0.4	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4	-1.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Oct.	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.9	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Nov.	-3.0	-2.9	-2.9	-2.9	-2.9	-3.0	-2.9	-3.0	-2.9	-2.9	-4.0	-2.7	-2.7	-2.7	-2.6	-2.7	-2.7	-2.7
Dec.	-4.4	-4.3	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4	-4.3	-5.6	-4.3	-4.3	-4.4	-4.3	-4.3	-4.4	-4.4
1992:																		
Jan.	-6.5	-6.2	-6.3	-6.2	-6.1	-6.1	-6.2	-6.1	-6.1	-6.0	-7.0	-5.8	-5.9	-5.9	-5.8	-5.9	-5.9	-5.9
Feb.	-4.3	-4.1	-4.1	-4.1	-3.9	-3.9	-4.0	-3.9	-4.0	-3.9	-4.6	-3.4	-3.4	-3.4	-3.3	-3.3	-3.3	-3.3
Mar.	-3.0	-2.9	-2.9	-2.9	-2.8	-2.8	-2.8	-2.8	-2.9	-2.8	-3.5	-2.2	-2.2	-2.2	-2.1	-2.1	-2.1	-2.0
Apr.	-4.2	-4.0	-4.1	-4.1	-3.9	-3.9	-4.0	-3.9	-4.0	-3.9	-4.6	-3.3	-3.4	-3.4	-3.3	-3.3	-3.3	-3.3
May	-4.0	-3.8	-3.9	-3.8	-3.7	-3.7	-3.7	-3.7	-3.7	-3.6	-4.3	-3.0	-3.0	-3.0	-2.9	-2.9	-2.9	-2.9
Jun.	-4.0	-3.7	-3.8	-3.8	-3.6	-3.6	-3.6	-3.6	-3.7	-3.6	-3.9	-2.7	-2.7	-2.7	-2.6	-2.6	-2.6	-2.5
Jul.	-2.3	-2.3	-2.3	-2.3	-2.2	-2.2	-2.2	-2.2	-2.3	-2.3	-2.8	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.6
Aug.	-2.6	-2.6	-2.6	-2.6	-2.4	-2.5	-2.5	-2.5	-2.6	-2.5	-3.1	-2.1	-2.1	-2.1	-2.0	-2.1	-2.1	-2.0
Sep.	-1.3	-1.3	-1.3	-1.3	-1.1	-1.2	-1.2	-1.2	-1.3	-1.3	-1.8	-0.8	-0.8	-0.8	-0.7	-0.8	-0.7	-0.7
Oct.	0.0	0.1	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.0	-0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6
Nov.	-1.8	-1.7	-1.7	-1.7	-1.5	-1.5	-1.6	-1.5	-1.6	-1.6	-2.3	-1.2	-1.3	-1.3	-1.2	-1.3	-1.2	-1.2
Dec.	-5.8	-5.5	-5.6	-5.6	-5.3	-5.4	-5.5	-5.4	-5.5	-5.4	-6.2	-5.2	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3
1993:																		
Jan.	-5.6	-5.2	-5.3	-5.2	-4.8	-4.9	-5.0	-4.9	-5.0	-4.9	-5.4	-4.4	-4.5	-4.6	-4.4	-4.5	-4.4	-4.4

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1993:																		
Feb.		-6.0	-6.1	-6.1	-5.7	-5.7	-5.9	-5.7	-5.8	-5.7	-6.5	-5.4	-5.5	-5.5	-5.4	-5.4	-5.4	-5.4
Mar.			-7.0	-7.0	-6.6	-6.6	-6.7	-6.6	-6.7	-6.6	-7.5	-6.5	-6.6	-6.7	-6.5	-6.6	-6.6	-6.6
Apr.				-8.1	-7.8	-7.8	-7.9	-7.8	-7.9	-7.7	-8.8	-7.7	-7.8	-7.9	-7.7	-7.8	-7.8	-7.8
May					-5.9	-6.0	-6.1	-6.0	-6.1	-6.0	-6.6	-5.6	-5.7	-5.8	-5.6	-5.7	-5.7	-5.7
Jun.						-6.4	-6.6	-6.5	-6.6	-6.5	-7.0	-6.2	-6.3	-6.3	-6.2	-6.3	-6.3	-6.2
Jul.							-8.1	-8.0	-8.2	-8.0	-8.6	-7.7	-7.8	-7.9	-7.7	-7.8	-7.8	-7.8
Aug.								-9.5	-9.7	-9.5	-10.1	-9.2	-9.3	-9.3	-9.2	-9.3	-9.3	-9.2
Sep.									-9.2	-9.1	-9.5	-8.7	-8.8	-8.8	-8.7	-8.7	-8.7	-8.7
Oct.										-11.1	-11.8	-10.8	-11.0	-11.0	-10.8	-10.9	-10.9	-10.9
Nov.											-6.9	-6.1	-6.1	-6.1	-6.0	-6.0	-6.0	-5.9
Dec.												-8.9	-9.1	-9.1	-9.0	-9.1	-9.0	-9.0
1994:													-14.1	-14.1	-14.0	-14.1	-14.1	-14.1
Jan.														-9.2	-9.0	-9.1	-9.0	-9.0
Feb.															-10.9	-11.0	-11.0	-11.0
Mar.																-12.6	-12.6	-12.6
Apr.																	-10.3	-10.2
May																		-8.4
Jun.																		

Appendix 5.7 Maximum Likelihood Estimates of Recursive Estimations for Personal Loans[(a)]

		1986:1-93:1	1986:1-93:2	1986:1-93:3	1986:1-93:4	1986:1-93:5	1986:1-93:6	1986:1-93:7	1986:1-93:8	1986:1-93:9
DEMAND	Constant	-612.137	-603.880	-587.915	-528.348	-630.190	-618.879	-470.669	-492.331	-488.621
		(-2.041)*	(-2.095)*	(-2.161)*	(-2.242)*	(-2.456)*	(-2.616)**	(-2.668)**	(-2.839)**	(-2.793)**
	L^d_{pt-1}	-.043	-.029	-.026	-.002	-.033	-.038	.029	.002	-.018
		(-.266)	(-.183)	(-.166)	(-.016)	(-.205)	(-.234)	(.186)	(.013)	(-.117)
	y_{Lt}	1.387	1.371	1.356	1.284	1.408	1.401	1.207	1.247	1.253
		(3.872)**	(3.964)**	(4.070)**	(4.307)**	(4.341)**	(4.542)**	(4.818)**	(5.023)**	(4.978)**
	u_t	-6.300	-6.422	-6.698	-7.081	-6.727	-6.897	-7.344	-7.421	-7.520
		(-2.157)*	(-2.351)*	(-2.697)**	(-3.289)**	(-2.860)**	(-3.169)**	(-3.943)**	(-4.063)**	(-4.113)**
	i_{Lpt}	-4.595	-4.581	-4.574	-4.462	-4.766	-4.744	-4.306	-4.367	-4.285
		(-3.938)**	(-4.011)**	(-4.039)**	(-4.017)**	(-4.196)**	(-4.241)**	(-4.071)**	(-4.279)**	(-4.247)**
	π_t	-10.808	-11.194	-12.848	-16.647	-13.146	-13.835	-20.635	-20.621	-20.331
		(-.574)	(-.594)	(-.687)	(-.921)	(-.698)	(-.745)	(-1.203)	(-1.241)	(-1.242)
SUPPLY	Constant	-812.705	-822.658	-802.956	-775.969	-717.254	-720.220	-731.231	-727.32	-726.754
		(-3.199)**	(-3.217)**	(-3.172)**	(-2.949)**	(-2.670)**	(-2.702)**	(-2.477)*	(-2.524)*	(-2.520)*
	L^s_{pt}	.143	.134	.164	.192	.243	.292	.303	.307	.315
		(.732)	(.696)	(.900)	(1.064)	(1.309)	(1.684)	(1.612)	(1.671)	(1.717)
	$ln\ D_{t-1}$	1.114	1.128	1.097	1.057	.979	.968	.971	.966	.962
		(4.026)**	(4.086)**	(4.079)**	(3.840)**	(3.476)**	(3.471)**	(3.178)**	(3.232)**	(3.220)**
	$ln\ (e_L/e)_{t-1}$	-.166	-.219	-.266	-.303	-.326	-.329	-.365	-.360	-.359
		(-.534)	(-.705)	(-.855)	(-.939)	(-.995)	(-1.018)	(-1.025)	(-1.036)	(-1.037)

(a) The supply equation is continued on the next page.

	1986:1-93:1	1986:1-93:2	1986:1-93:3	1986:1-93:4	1986:1-93:5	1986:1-93:6	1986:1-93:7	1986:1-93:8	1986:1-93:9
$ln\ W_t$	52.322 (2.986)**	53.778 (3.087)**	53.906 (3.166)**	54.383 (3.043)**	53.914 (3.007)**	52.338 (3.059)**	53.925 (2.791)**	53.531 (2.896)**	53.470 (2.888)**
$(i_{Lp}-i_f)_t$	-4.486 (-.479)	-6.105 (-.674)	-7.7491 (-.842)	-7.776 (-.831)	-7.870 (-.800)	-10.503 (-1.184)	-10.389 (-1.070)	-10.355 (-1.095)	-10.460 (-1.106)
$(i_{Lp}-i)_t$	.964 (.155)	2.281 (.377)	3.688 (.624)	4.406 (.707)	4.930 (.756)	6.639 (1.126)	6.666 (1.025)	6.657 (1.051)	6.750 (1.066)
σ_t	-21.080 (-2.277)*	-18.843 (-2.231)*	-16.177 (-2.189)*	-14.443 (-1.908)*	-11.719 (-1.516)	-9.775 (1.430)	-9.864 (-1.296)	-9.908 (-1.338)	-9.907 (-1.332)
π_t	-36.607 (-2.328)*	-35.648 (-2.260)	-31.591 (-2.022)*	-27.054 (-1.695)	-23.879 (-1.450)	-24.602 (-1.451)	-23.953 (-1.289)	-23.795 (-1.313)	-24.208 (-1.331)
sig4	5.954 (4.211)**	5.986 (4.273)**	6.019 (4.345)**	6.067 (4.417)**	6.072 (4.358)**	6.059 (4.459)**	6.298 (4.688)**	6.118 (4.906)**	6.077 (4.955)**
sig3	11.692 (6.085)**	11.802 (6.044)**	11.950 (5.989)**	12.320 (5.762)**	12.598 (6.000)**	12.740 (5.957)**	13.544 (5.333)**	13.353 (5.713)**	13.342 (5.720)**
Log likelihood	-304.170	-308.304	-312.528	-316.748	-322.927	-326.753	-330.541	-333.288	-336.561
No. of observations	85	86	87	88	89	90	91	92	93

Figures in parentheses are t-statistics. * Significant at 5 %. ** Significant at 1 %.

Appendix 5.7 Maximum Likelihood Estimates of Recursive Estimations for Personal Loans (continued)[(a)]

		1986:1-93:10	1986:1-93:11	1986:1-93:12	1986:1-94:1	1986:1-94:2	1986:1-94:3	1986:1-94:4	1986:1-94:5	1986:1-94:6
DEMAND	Constant	-516.484 (-2.966)**	-536.394 (-3.112)**	-542.736 (-3.105)**	-618.193 (-3.593)**	-557.985 (-3.338)**	-539.031 (-3.375)**	-545.997 (-3.420)**	-551.534 (-3.229)**	-559.910 (-3.325)**
	L^d_{pt-1}	-.049 (-.321)	-.073 (-.486)	-.154 (-.948)	-.198 (-1.115)	-.080 (-.499)	-.039 (-.256)	-.019 (-.128)	-.011 (-.068)	-.022 (-.141)
	y_{Lt}	1.302 (5.149)**	1.336 (5.313)**	1.391 (5.221)**	1.493 (5.415)**	1.372 (5.292)**	1.327 (5.438)**	1.320 (5.507)**	1.332 (5.137)**	1.348 (5.529)**
	u_t	-7.571 (-4.169)**	-7.511 (-4.209)**	-7.667 (-4.016)**	-7.345 (-3.640)**	-7.981 (-4.273)**	-7.896 (-4.452)**	-7.716 (-4.505)**	-8.306 (-4.668)**	-8.339 (-4.778)**
	i_{Lpt}	-4.387 (-4.458)**	-4.413 (-4.604)**	-4.376 (-4.517)**	-4.667 (-4.819)**	-4.679 (-5.062)**	-4.634 (-5.237)**	-4.652 (-5.430)**	-4.929 (-5.526)**	-4.941 (-5.662)**
	π_t	-19.337 (-1.220)	-17.658 (-1.159)	-19.665 (-1.353)	-11.329 (-.847)	-18.961 (-1.481)	-19.102 (-1.502)	-16.583 (-1.301)	-18.355 (-1.330)	-18.366 (-1.362)
SUPPLY	Constant	-723.221 (-2.563)*	-722.818 (-2.604)**	-718.043 (-2.678)**	-715.297 (-2.741)**	-708.042 (-2.550)*	-707.250 (-2.493)*	-708.508 (-2.479)*	-689.831 (-2.364)*	-686.275 (-2.379)*
	L^s_{pt}	.318 (1.776)	.321 (1.817)	.329 (1.932)	.327 (1.984)*	.321 (1.831)	.315 (1.767)	.311 (1.734)	.310 (1.708)	.312 (1.733)
	$\ln D_{t-1}$	.957 (3.271)**	.956 (3.317)**	.948 (3.399)**	.948 (3.499)**	.943 (3.282)**	.945 (3.219)**	.948 (3.206)**	.932 (3.100)*	.929 (3.119)**
	$\ln (e_b/e)_{t-1}$	-.349 (-1.032)	-.338 (-1.016)	-.301 (-.952)	-.270 (-.887)	-.351 (-1.049)	-.361 (-1.056)	-.361 (-1.046)	-.379 (-1.069)	-.375 (-1.072)

(a) The supply equation is continued on the next page.

	1986:1-93:10	1986:1-93:11	1986:1-93:12	1986:1-94:1	1986:1-94:2	1986:1-94:3	1986:1-94:4	1986:1-94:5	1986:1-94:6
$ln\ W_t$	53.073	52.807	51.489	50.832	52.128	52.522	52.798	51.947	51.698
	(2.973)**	(3.039)**	(3.144)**	(3.232)**	(3.025)**	(2.961)**	(2.935)**	(2.854)**	(2.899)**
$(i_{Lp}-i_f)_t$	-10.308	-10.388	-10.615	-10.572	-10.285	-10.190	-10.073	-10.011	-10.066
	(-1.113)	(-1.142)	(-1.209)	(-1.226)	(-1.125)	(-1.097)	(-1.077)	(-1.050)	(-1.071)
$(i_{Lp}-i)_t$	6.634	6.671	6.805	6.648	6.639	6.592	6.480	6.486	6.542
	(1.070)	(1.097)	(1.163)	(1.161)	(1.086)	(1.060)	(1.034)	(1.010)	(1.035)
σ_t	-9.962	-9.981	-9.720	-9.746	-9.724	-9.757	-9.982	-9.475	-9.438
	(-1.373)	(-1.402)	(-1.413)	(-1.469)	(-1.362)	(-1.342)	(-1.351)	(-1.274)	(-1.287)
π_t	-24.359	-24.804	-24.734	-26.455	-24.132	-23.963	-24.644	-23.955	-23.836
	(-1.368)	(-1.412)	(-1.451)	(-1.570)	(-1.386)	(-1.346)	(-1.371)	(-1.311)	(-1.319)
sig4	5.917	5.750	5.583	5.544	5.976	5.975	5.945	6.200	6.085
	(5.174)**	(5.417)**	(5.511)**	(5.343)**	(5.274)**	(5.382)**	(5.462)**	(5.797)**	(6.011)**
sig3	13.164	13.026	12.686	12.502	13.058	13.257	13.344	13.486	13.412
	(6.055)**	(6.278)**	(6.738)**	(7.198)**	(6.414)**	(6.166)**	(6.048)**	(5.768)**	(5.934)**
Log likelihood	-339.296	-341.981	-345.168	-348.384	-352.428	-355.319	-358.178	-362.425	-365.161
No. of observations	94	95	96	97	98	99	100	101	102

Figures in parentheses are t-statistics. * Significant at 5 %. ** Significant at 1 %.

Appendix 5.8 Excess Demand for Personal Loans

Estimate of excess demand for each month for each 'run' for sample period from January 1986 to :

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1986:																		
Jan.	0.6	1.0	1.3	1.6	1.5	1.7	1.8	1.9	2.0	2.1	2.2	2.6	2.6	2.0	1.9	1.7	1.5	1.5
Feb.	1.9	2.0	2.3	2.4	2.8	3.1	2.7	2.9	3.2	3.5	3.8	4.8	5.3	3.6	3.2	3.0	2.7	2.8
Mar.	2.1	2.2	2.1	1.9	1.7	1.7	1.5	1.6	1.7	1.8	2.0	2.5	2.8	1.8	1.6	1.5	1.2	1.3
Apr.	2.0	2.0	1.8	1.7	1.3	1.0	1.0	1.1	1.2	1.3	1.4	1.7	1.7	1.2	1.1	1.0	0.8	0.8
May	2.8	2.8	2.8	2.7	2.4	2.4	2.4	2.5	2.6	2.8	2.9	3.4	3.5	2.8	2.6	2.4	2.2	2.3
Jun.	2.2	2.1	1.9	1.7	1.4	1.2	1.2	1.3	1.4	1.5	1.7	2.1	2.3	1.5	1.4	1.2	1.0	1.1
Jul.	3.7	3.8	3.7	3.6	3.2	3.1	3.1	3.2	3.3	3.3	3.4	3.8	3.9	3.2	3.1	3.0	2.7	2.7
Aug.	2.6	2.7	2.7	2.6	2.5	2.4	2.2	2.3	2.4	2.5	2.7	3.1	3.3	2.4	2.3	2.2	1.9	1.9
Sep.	3.0	3.1	2.9	2.7	2.7	2.6	2.3	2.4	2.5	2.7	2.9	3.4	3.9	2.6	2.4	2.4	1.9	2.0
Oct.	2.5	2.5	2.4	2.1	2.1	2.1	1.7	1.9	2.1	2.2	2.5	3.1	3.5	2.2	1.9	1.8	1.4	1.5
Nov.	2.4	2.3	2.0	1.6	1.6	1.6	1.1	1.2	1.5	1.7	2.0	2.7	3.3	1.7	1.4	1.3	0.8	0.9
Dec.	2.8	2.6	2.2	1.6	1.5	1.4	0.8	0.9	1.0	1.2	1.5	2.0	2.8	1.1	1.0	1.0	0.5	0.5
1987:																		
Jan.	2.3	2.3	2.2	1.8	1.9	2.2	1.6	1.7	2.0	2.2	2.5	3.3	4.0	2.2	1.9	1.8	1.4	1.4
Feb.	0.5	0.5	0.5	0.4	0.7	1.0	0.4	0.6	0.9	1.2	1.5	2.4	3.0	1.2	0.8	0.6	0.2	0.3
Mar.	-1.3	-1.3	-1.4	-1.6	-1.6	-1.5	-1.9	-1.8	-1.6	-1.5	-1.3	-0.7	-0.3	-1.6	-1.8	-1.9	-2.3	-2.2
Apr.	-0.9	-1.0	-1.3	-1.8	-1.9	-1.9	-2.4	-2.3	-2.2	-2.0	-1.8	-1.2	-0.7	-2.2	-2.3	-2.3	-2.8	-2.7
May	-1.2	-1.4	-1.6	-2.0	-1.9	-1.8	-2.3	-2.2	-2.0	-1.8	-1.6	-0.8	-0.3	-1.9	-2.1	-2.2	-2.6	-2.6
Jun.	-2.0	-2.0	-2.2	-2.3	-2.6	-2.6	-2.8	-2.8	-2.7	-2.7	-2.6	-2.1	-2.0	-2.8	-2.9	-3.0	-3.2	-3.2
Jul.	-3.5	-3.5	-3.8	-4.1	-4.2	-4.0	-4.5	-4.4	-4.4	-4.2	-4.1	-3.5	-3.1	-4.3	-4.4	-4.5	-4.7	-4.7
Aug.	-3.0	-3.1	-3.4	-3.8	-3.9	-3.7	-4.3	-4.2	-4.2	-4.0	-3.8	-3.2	-2.7	-4.0	-4.2	-4.3	-4.5	-4.5
Sep.	-2.4	-2.6	-2.9	-3.2	-3.3	-3.4	-3.9	-3.8	-3.8	-3.6	-3.5	-2.9	-2.5	-3.5	-3.7	-3.8	-3.9	-3.8
Oct.	-3.2	-3.3	-3.6	-3.9	-4.0	-4.0	-4.4	-4.3	-4.4	-4.3	-4.1	-3.7	-3.5	-4.2	-4.3	-4.4	-4.5	-4.5
Nov.	-3.7	-3.8	-4.0	-4.2	-4.4	-4.7	-5.0	-5.0	-5.1	-5.1	-5.0	-4.9	-4.7	-5.1	-5.0	-5.0	-5.1	-5.1
Dec.	-2.3	-2.2	-2.4	-2.5	-2.5	-2.7	-3.0	-3.0	-3.0	-2.9	-2.9	-2.7	-2.5	-2.9	-2.9	-2.9	-2.9	-2.9
1988:																		
Jan.	-1.6	-1.5	-1.6	-1.8	-1.7	-1.9	-2.3	-2.2	-2.3	-2.2	-2.1	-1.9	-1.7	-2.1	-2.1	-2.2	-2.1	-2.1
Feb.	-0.3	-0.3	-0.2	-0.4	0.0	0.1	-0.5	-0.3	-0.2	0.0	0.2	0.8	1.1	0.3	0.0	-0.1	-0.1	0.0

Table is continued on the next page.

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1988:																		
Mar.	-1.4	-1.2	-1.4	-1.6	-1.8	-2.1	-2.4	-2.4	-2.5	-2.5	-2.5	-2.6	-2.5	-2.5	-2.4	-2.4	-2.3	-2.3
Apr.	-1.0	-0.7	-0.8	-0.9	-0.9	-1.0	-1.4	-1.4	-1.5	-1.4	-1.4	-1.3	-1.1	-1.3	-1.3	-1.3	-1.2	-1.2
May	-0.6	-0.3	-0.2	-0.2	0.0	0.0	-0.4	-0.4	-0.4	-0.4	-0.3	-0.1	0.0	-0.2	-0.2	-0.3	-0.1	-0.1
Jun.	-1.3	-1.0	-1.0	-1.0	-1.0	-1.3	-1.5	-1.6	-1.7	-1.7	-1.7	-1.9	-1.8	-1.6	-1.5	-1.5	-1.3	-1.4
Jul.	-2.5	-2.2	-2.2	-2.2	-2.2	-2.2	-2.6	-2.5	-2.6	-2.5	-2.5	-2.4	-2.3	-2.3	-2.3	-2.4	-2.2	-2.1
Aug.	-2.3	-2.0	-2.0	-2.2	-2.2	-2.2	-2.6	-2.5	-2.6	-2.6	-2.5	-2.5	-2.3	-2.4	-2.4	-2.4	-2.2	-2.2
Sep.	-1.7	-1.5	-1.5	-1.6	-1.5	-1.5	-2.0	-1.9	-1.9	-1.8	-1.8	-1.6	-1.4	-1.6	-1.6	-1.7	-1.5	-1.5
Oct.	-1.3	-1.0	-0.8	-0.9	-0.8	-0.8	-1.1	-1.1	-1.1	-1.0	-1.0	-0.9	-0.8	-0.8	-0.8	-0.9	-0.7	-0.7
Nov.	-1.4	-1.1	-1.0	-1.0	-0.9	-1.0	-1.3	-1.2	-1.3	-1.2	-1.2	-1.2	-1.1	-1.0	-1.0	-1.0	-0.8	-0.8
Dec.	-1.4	-1.1	-1.1	-1.2	-1.0	-1.2	-1.6	-1.6	-1.6	-1.5	-1.5	-1.5	-1.3	-1.3	-1.3	-1.3	-1.1	-1.1
1989:																		
Jan.	-2.4	-2.0	-1.8	-2.0	-2.1	-1.9	-2.1	-2.1	-2.1	-2.1	-2.1	-2.1	-2.1	-2.1	-2.0	-2.0	-2.0	-1.9
Feb.	-3.6	-3.2	-2.9	-2.7	-2.7	-2.5	-2.6	-2.6	-2.6	-2.6	-2.6	-2.4	-2.6	-2.5	-2.4	-2.6	-2.4	-2.4
Mar.	-4.3	-4.0	-3.6	-3.4	-3.4	-3.4	-3.4	-3.4	-3.4	-3.4	-3.5	-3.5	-3.8	-3.3	-3.3	-3.4	-3.2	-3.1
Apr.	-3.4	-3.0	-2.6	-2.3	-2.1	-1.9	-2.0	-1.9	-1.8	-1.8	-1.8	-1.5	-1.7	-1.6	-1.6	-1.8	-1.6	-1.5
May	-3.4	-3.0	-2.7	-2.6	-2.5	-2.3	-2.5	-2.5	-2.4	-2.4	-2.3	-2.2	-2.2	-2.2	-2.2	-2.4	-2.2	-2.2
Jun.	-3.7	-3.4	-3.3	-3.3	-3.1	-3.1	-3.5	-3.4	-3.3	-3.2	-3.2	-3.0	-2.9	-3.1	-3.1	-3.1	-3.0	-3.0
Jul.	0.0	0.3	0.4	0.4	0.5	0.3	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4
Aug.	0.4	0.6	0.6	0.5	0.6	0.6	0.2	0.3	0.4	0.5	0.6	0.7	0.9	0.6	0.6	0.5	0.5	0.6
Sep.	2.4	2.4	2.1	1.8	1.7	1.5	1.0	1.1	1.2	1.4	1.5	1.7	2.0	1.5	1.4	1.4	1.3	1.4
Oct.	3.5	3.4	3.1	2.7	2.5	2.3	1.8	1.9	2.0	2.1	2.3	2.4	2.7	2.2	2.2	2.1	2.1	2.1
Nov.	3.1	3.0	2.9	2.8	2.7	2.6	2.2	2.4	2.5	2.7	2.8	3.1	3.2	2.8	2.7	2.6	2.6	2.6
Dec.	3.2	3.1	3.0	2.8	2.9	2.7	2.2	2.4	2.6	2.7	2.9	3.2	3.4	3.0	2.8	2.7	2.7	2.8
1990:																		
Jan.	2.5	2.5	2.4	2.1	2.2	2.0	1.5	1.7	1.8	1.9	2.0	2.2	2.4	2.1	2.0	1.9	1.9	2.0
Feb.	3.3	3.2	3.1	2.8	3.3	3.4	2.6	2.9	3.1	3.4	3.6	4.2	4.6	3.7	3.4	3.2	3.2	3.3
Mar.	2.2	2.2	2.1	1.9	2.1	1.9	1.4	1.6	1.7	1.8	1.9	2.1	2.3	2.0	1.9	1.8	1.9	2.0
Apr.	0.4	0.7	0.6	0.4	0.3	0.2	-0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	0.0	0.1	0.0	0.1	0.2
May	-0.2	0.0	0.3	0.2	0.6	0.8	0.2	0.4	0.5	0.6	0.7	1.0	1.1	0.8	0.7	0.6	0.7	0.7
Jun.	-0.7	-0.4	-0.3	-0.3	0.0	0.0	-0.4	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
Jul.	3.2	3.5	3.6	3.5	3.7	3.6	3.2	3.3	3.2	3.3	3.3	3.2	3.3	3.3	3.3	3.3	3.3	3.3
Aug.	2.8	3.1	3.1	3.1	3.3	3.1	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.9	3.0	2.9	2.8	2.9

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1990:																		
Sep.	3.5	3.7	3.9	3.9	4.3	4.4	4.0	4.1	4.2	4.3	4.4	4.8	4.7	4.4	4.3	4.1	4.1	4.1
Oct.	3.1	3.3	3.4	3.3	3.5	3.4	3.1	3.2	3.2	3.3	3.3	3.5	3.4	3.3	3.3	3.1	3.1	3.1
Nov.	5.2	5.1	4.9	4.5	5.2	5.1	4.2	4.4	4.5	4.8	5.0	5.4	5.9	5.0	4.8	4.7	4.5	4.6
Dec.	6.2	6.2	5.8	5.1	5.5	5.4	4.4	4.5	4.6	4.8	5.0	5.2	5.8	4.9	4.8	4.8	4.6	4.7
1991:																		
Jan.	6.3	6.1	5.8	5.1	5.7	5.8	4.7	4.9	5.0	5.4	5.7	6.2	7.0	5.6	5.3	5.2	4.9	5.0
Feb.	5.1	4.8	4.9	4.6	5.4	5.6	4.6	4.9	5.1	5.5	5.7	6.6	6.9	5.7	5.3	5.0	4.8	5.0
Mar.	3.6	3.4	3.5	3.5	4.0	4.0	3.4	3.7	3.7	3.9	4.0	4.6	4.6	4.0	3.8	3.5	3.4	3.5
Apr.	2.9	2.6	2.6	2.3	2.8	2.8	2.1	2.3	2.3	2.5	2.6	3.2	3.3	2.6	2.4	2.1	1.9	2.0
May	2.7	2.5	2.5	2.4	2.7	2.6	2.1	2.3	2.2	2.4	2.4	2.9	2.7	2.4	2.3	2.0	1.9	2.0
Jun.	3.3	3.3	3.4	3.4	3.7	3.7	3.3	3.5	3.5	3.6	3.6	4.1	3.9	3.7	3.5	3.2	3.1	3.2
Jul.	1.7	1.6	1.5	1.3	1.6	1.4	0.8	1.0	0.9	0.9	1.0	1.2	1.1	1.0	0.9	0.8	0.7	0.7
Aug.	3.6	3.5	3.3	2.8	3.2	3.1	2.3	2.4	2.4	2.6	2.7	3.1	3.2	2.7	2.5	2.4	2.2	2.3
Sep.	3.6	3.5	3.3	2.8	3.2	3.1	2.3	2.4	2.4	2.5	2.6	3.0	3.1	2.6	2.5	2.3	2.1	2.2
Oct.	3.3	3.1	2.9	2.5	2.8	2.7	2.0	2.1	2.1	2.3	2.3	2.8	2.8	2.3	2.2	2.0	1.8	1.9
Nov.	3.7	3.4	3.2	2.7	3.0	3.1	2.2	2.4	2.4	2.6	2.7	3.2	3.4	2.7	2.5	2.3	2.1	2.1
Dec.	3.3	3.2	2.7	2.1	2.2	2.0	1.2	1.3	1.2	1.3	1.4	1.6	1.7	1.3	1.3	1.2	1.0	1.0
1992:																		
Jan.	4.5	4.4	4.0	3.4	3.7	3.5	2.5	2.7	2.6	2.7	2.8	3.0	3.3	2.8	2.8	2.7	2.5	2.6
Feb.	4.8	4.5	4.5	4.1	5.0	5.1	3.9	4.2	4.2	4.6	4.8	5.5	5.8	4.9	4.5	4.3	4.1	4.3
Mar.	3.4	3.2	3.1	2.7	3.2	3.1	2.2	2.4	2.3	2.4	2.5	2.8	2.8	2.6	2.5	2.3	2.2	2.3
Apr.	3.3	3.1	2.9	2.5	2.9	2.6	1.7	1.9	1.7	1.9	1.9	2.2	2.2	2.0	1.9	1.8	1.7	1.8
May	3.7	3.5	3.4	3.0	3.7	3.7	2.7	2.9	2.9	3.1	3.2	3.8	3.9	3.3	3.1	2.8	2.8	2.9
Jun.	2.1	2.0	1.9	1.7	2.1	2.0	1.2	1.4	1.2	1.3	1.3	1.6	1.5	1.4	1.3	1.1	1.1	1.1
Jul.	2.3	2.2	1.9	1.6	1.9	1.5	0.7	0.8	0.6	0.6	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.6
Aug.	2.0	2.0	1.7	1.3	1.6	1.2	0.5	0.5	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.3	0.3	0.4
Sep.	2.4	2.2	1.9	1.5	2.0	1.6	0.8	0.9	0.7	0.8	0.8	1.0	1.0	0.9	0.9	0.8	0.8	0.8
Oct.	2.6	2.3	2.0	1.5	2.0	1.7	0.8	0.9	0.7	0.9	0.9	1.2	1.2	1.0	0.9	0.8	0.7	0.8
Nov.	2.7	2.5	2.1	1.5	1.8	1.4	0.5	0.6	0.3	0.4	0.5	0.6	0.7	0.5	0.5	0.4	0.3	0.4
Dec.	3.1	2.8	2.3	1.6	1.8	1.3	0.3	0.4	0.1	0.2	0.2	0.2	0.4	0.2	0.3	0.3	0.2	0.2
1993:																		
Jan.	5.4	4.9	4.4	3.7	4.2	4.0	2.8	3.0	2.9	3.2	3.3	3.8	4.1	3.4	3.2	3.0	2.9	3.0

	J:93	F:93	M:93	A:93	M:93	J:93	J:93	A:93	S:93	O:93	N:93	D:93	J:94	F:94	M:94	A:94	M:94	J:94
1993:																		
Feb.		5.6	4.9	4.1	4.6	4.2	2.9	3.2	3.1	3.4	3.5	4.0	4.4	3.6	3.4	3.2	3.1	3.2
Mar.			5.0	4.0	4.1	3.6	2.3	2.5	2.3	2.5	2.7	2.8	3.3	2.7	2.6	2.6	2.4	2.5
Apr.				4.1	4.3	3.8	2.6	2.8	2.6	2.8	2.9	3.0	3.4	2.9	2.9	2.8	2.7	2.8
May					4.0	3.5	2.4	2.6	2.4	2.5	2.5	2.6	2.8	2.6	2.6	2.5	2.5	2.5
Jun.						2.7	1.7	1.8	1.4	1.5	1.5	1.2	1.4	1.6	1.7	1.8	1.7	1.7
Jul.							-6.3	-6.2	-6.5	-6.3	-6.3	-6.3	-6.0	-6.1	-6.1	-6.1	-5.9	-5.9
Aug.								-6.5	-6.8	-6.6	-6.6	-6.5	-6.2	-6.3	-6.3	-6.4	-6.2	-6.1
Sep.									-6.8	-6.7	-6.7	-6.8	-6.6	-6.5	-6.4	-6.4	-6.2	-6.2
Oct.										-6.6	-6.5	-6.5	-6.2	-6.2	-6.2	-6.3	-6.0	-6.0
Nov.											-7.4	-7.4	-7.7	-7.0	-6.9	-7.1	-6.7	-6.6
Dec.												-7.0	-6.8	-6.5	-6.4	-6.4	-6.1	-6.0
1994:																		
Jan.													-5.4	-5.6	-5.6	-5.5	-5.2	-5.2
Feb.														-6.9	-6.8	-6.9	-6.5	-6.4
Mar.															-6.8	-6.8	-6.4	-6.4
Apr.																-6.3	-6.0	-5.9
May																	-5.5	-5.5
Jun.																		-6.0

Chapter 6 Keynesian Uncertainty in Credit Markets[1]

6.1 Introduction

New Keynesian analysis explains non-price credit rationing with appeal to the adverse selection and adverse incentive effects which arise from asymmetric information. Implicit contract theory can also explain quantity rationing if banks and customers base potential loans on risk-sharing arrangements. Post Keynesians are critical of the New Keynesian analysis because it is based on rational expectations and ignores the concept of fundamental uncertainty. Instead, the analysis is conducted with reference to situations of risk rather than to situations where the probability calculus does not apply. It is my belief that the behaviour of agents in financial markets can be better understood when there is some degree of reconciliation between the two approaches: at times banks will base loans on an assessment of calculated risks; at other times loan behaviour will become governed by the rules, conventions or whims which come into play when fundamental uncertainty rules economic behaviour.

This chapter seeks to reconcile the post Keynesian and New Keynesian explanations of credit rationing. It argues that this can be done if choice theory is made more

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[1] A shortened version of this chapter has been accepted for publication in the Spring 1996 issue of the *Journal of Post Keynesian Economics*, Vol. 18, No. 3, pp. 397-418. The shortened version explores the functioning of credit markets under uncertainty and seeks to provide a tighter behavioural foundation than currently exists for some of the post Keynesian analysis with respect to credit markets. I am grateful to Professor Paul Davidson and an anonymous referee for comments on the original version.

general than either post Keynesian or New Keynesian analysis currently allows by incorporating a *spectrum* of behaviour which stretches from behaviour based on decision-making in conditions of fundamental uncertainty as emphasised by the post Keynesians at one end of the spectrum, to behaviour based on decision-making in conditions of risk as emphasised by the New Keynesians at the other end of the spectrum. Thus, it argues that the positions currently taken by most post Keynesians and New Keynesians are special cases of a more general theory. The behaviour of financial institutions in making loans in the whole gamut of situations from those which are characterised by fundamental uncertainty to those which are characterised by pure risk are considered. The tensions between current post Keynesian and New Keynesian explanations of behaviour in loan markets and of non-price (i.e., quantity) credit rationing are explored.

A central tenet of post Keynesian monetary economics is that the money supply is endogenously determined by the demand for credit. Banks make loans and later look for reserves to support those loans. Post Keynesian economists who take a 'horizontalist' or 'accommodationist' approach to monetary economics (Kaldor, (1982), Moore, (1988), Lavoie (1992 and 1995)) argue that the central bank, in its role as lender of last resort and in order to avert financial crises, is prepared to fully accommodate any increase in the required reserves of the banking system. The central bank is thus perceived by these economists as having no option but to provide liquidity on demand to the banking system. The supply of credit money becomes infinitely elastic or 'horizontal' at some interest rate determined in relation to the central bank's base rate or rediscount rate.

Other post Keynesians (Wray (1990), Pollin (1991), Rousseas (1986)) argue that, while central banks may be prepared to accommodate increases in the demand for credit money for some period of time, an incipient fear of inflation may lead the central bank to refrain from full accommodation. Alternatively, the central bank may increase the supply price of liquidity to the banking system. For either of these reasons, or because of the increased competition for funds in financial markets in the absence of full accommodation, interest rates will rise and, in the short-run, the supply of credit money will become positively sloped with respect to the central bank's base rate or rediscount rate. Wray (1990) suggests that, in fact, the supply curve may ratchet upwards in a series of steps. Pollin (1991) has given the term, 'structuralists', to those post Keynesians who hold this view of the credit supply process where changes in credit demand are not necessarily fully accommodated by the central bank. In the longer-run, financial innovations and structural change in the financial sector will alter the velocity of circulation to such an extent that scarcity is no longer an issue in financial markets and the credit supply function again becomes infinitely elastic.

Whether post Keynesian economists are horizontalists/accommodationists or structuralists, all are agreed that crucial to analysis of financial markets is that changes in the demand for credit are the causal factor bringing about changes in the supply of credit money. The central bank does *not* exogenously change the money supply and the interest rate does not adjust to eliminate the excess demand or supply of money resultant upon a change in exogenous supply. It is changes in effective demand in the real sector and changes in the demand for credit to finance that effective demand which are crucial to the post Keynesian explanations of fluctuations in economic activity.

Activity in the real sector of the economy can not be divorced from the monetary sector. What goes on in the real sector both impinges upon, and is impinged upon by what goes on in the monetary sector.

Yet, despite acknowledging the importance of credit money, post Keynesians have failed to discuss credit rationing other than in an *ad hoc* way. One suspects that this is because of the influence of the accommodationists. If central banks are prepared to fully accommodate all increases in the demand for money it becomes difficult to explain either credit rationing or financial crises. However, both are empirically observed phenomena. Minsky (1975, 1978) and Wray (1992 and 1993), in emphasising the importance of rising liquidity preference as economic conditions become potentially unstable, argue that the banking system may become unwilling to lend. Wray goes further and argues that once the banks cut back lending, they are unable to maintain a rate of reflux, where reflux is defined as the return of issued liabilities to the issuer (Wray, 1990, p. 25), and 'an unwillingness to lend becomes converted into an inability to lend'.

Many of the post Keynesian monetary authors (Moore (1988), Wray, (1990), Dow and Saville (1990)) agree that non-price credit rationing occurs even in liberalised financial markets. However, their analysis is weak. It seems to amount to little more than some projects will not be deemed to be creditworthy at the going interest rate. If this is so, then these economists argue that the projects will not be deemed to be creditworthy at a higher interest rate. This is fine as far as it goes. No-one would argue with the proposition that non creditworthy borrowers should be rationed. This protects the solvency of both the potential borrowers and the financial institutions, and it also ensures that society is protected from the development of projects which have negative net values. What the post Keynesian analysis fails to explain is the type of credit rationing which occurs when banks grant loans to some customers at the going interest rate, but quantity ration other potential borrowers even though they are observationally indistinguishable from those customers who receive loans.

The remainder of this chapter is set out as follows. First, there is some discussion of whether post Keynesian monetary economics with its emphasis on uncertainty and New Keynesian monetary economics with its emphasis on risk can be made complementary. This is followed by a more comprehensive discussion of decision-making under uncertainty. Third, an integrated model of choice theory is developed which draws on previous work by Gerrard (1994), Heiner (1983), Gardenfors and Sahlin (1982), Vercelli (1991) and Guttentag and Herring (1984). The model adapts the work of these authors to reconcile the New Keynesian and post Keynesian analyses of the behaviour of agents in financial markets. Fourth, there follows a section which indicates both, how decision-making under uncertainty and financial instability are interlinked, and how the analysis provides a rationale for the *repetition* of financial crises. Fifth, determination of the default premium on loans when decision-making is characterised by uncertainty is discussed.

6.2 Complementarity in post Keynesian and New Keynesian monetary economics?

In post Keynesian monetary economics, the supply of liquidity to the banks is either not constrained by the central bank, or, at worst, is only partially constrained. This suggests that analysis of credit rationing in post Keynesian monetary economics must be based on theories that do not rely on scarcity of funds to the banking system. *New* Keynesian economics has a well developed theory of credit rationing where rationing arises from asymmetric information and not from a scarcity of funds (Stiglitz and Weiss, (1981, 1992), Jaffee and Stiglitz (1990)). Implicit contract theory, first applied in the context of financial markets by Fried and Howitt (1980), also suggests that risk sharing arrangements between banks and potential borrowers can lead to credit rationing in the absence of liquidity supply constraints, provided that banks are less risk-averse than potential borrowers. Both asymmetric information and implicit contract explanations of credit rationing are grounded in utility and profit maximisation principles based upon the rational expectations hypothesis. Most post Keynesians object to this probabilistic framework because, amongst other faults, it eliminates uncertainty from the analysis. Uncertainty, in this context, is used in the sense in which it was used by Knight (1921) and Keynes (1973a). Somewhat surprisingly, Wray (1990, pp. 179-184), a post Keynesian economist, appeals to the work which is both based on asymmetric information and grounded in profit and utility maximisation procedures as providing explanations for credit rationing.

However, some post Keynesians have called for a more general theory than either post Keynesian or New Keynesian analysis currently provides. Davidson (1991, pp. 142-143) in his discussion of whether probability theory is relevant for uncertainty concludes '...the postulate that economists must throw over is that individuals must use objective or subjective probability distributions to make economic decisions in the face of true uncertainty. The result is a more general theory, encompassing cases of both ergodic probability and nonergodic uncertainty.'[2] Dymski (1994, p. 102) states '[j]ust as they emphasize different types of uncertainty, the post- and new Keynesian approaches to financial structure emphasize different aspects of credit relations. Both types of uncertainty are clearly present in the world: so Keynesian analyses of financial structure should encompass the entire spectrum of uncertainty, from asymmetric information to Keynesian uncertainty.' It seems that these views are in sympathy with the following passage of Keynes (reproduced in O'Donnell, p. 257):

> "..human decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist; and that it is our innate urge to activity which makes the wheels go round, our rational selves choosing between the alternatives as best we are able, *calculating where we can*, but often falling back for our motive on whim or sentiment or chance." (emphasis added)

Some post Keynesians are vehemently opposed to the notion that calculations can ever be made because the future is always uncertain. Such reasoning leaves them open to the charge of nihilism. Crotty (1994, p. 117) argues that macrotheory which acknowledges the centrality of uncertainty need not be nihilistic if it incorporates analysis of "conventional" expectations and confidence formation, and the institutional structure of the economy and the society. The current chapter, drawing on other authors' work, attempts to draw out the implications of an integrated model of choice theory which does acknowledge the centrality of uncertainty. Behaviour becomes more predictable, rather than less predictable, as uncertainty increases. New Keynesian

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[2]The concept of ergodicity can be explained with reference to the following paragraph from Davidson (1994, p. 90):

> 'In an ergodic environment, knowledge about the future involves the projecting of calculated averages based on the past and/or current cross section and/or time series data to forthcoming events. *The future is merely the statistical reflection of the past.* Economic activities are timeless and immutable. There can be no ignorance of upcoming events for those who believe the past provides reliable statistical information (price signals) regarding the future, and this knowledge can be obtained if one is willing to spend the resources to examine the existing evidence regarding past patterns.'

results do depend upon strict mathematical expectation because probabilistic frameworks fail to take into account the impact of uncertainty as opposed to risk. Here, the theory may be mathematically tractable, but is open to the charge of being incapable of explaining actual behaviour. Both post Keynesian theory and New Keynesian theory could benefit from an examination of whether there are any complementarities between the two schools of thought. Further, both schools of thought will benefit if they recognise that they each, in fact, explains credit rationing and other economic behaviours with reference to special cases at either end of a spectrum which encompasses decision-making in situations where uncertainty is pervasive so that probability calculus can not be used, to situations where decisions are made on the basis of probabilistic assessments of risk.

Dymski (1992, pp. 318-319) states '[a]s developed to date, both New and Post Keynesian approaches to banking are .. incomplete. Post Keynesian models have either suggested that credit rationing does not occur (the neo-Banking school), or have not explicitly addressed the matter. New Keynesian models have not seriously considered the matter. The middle ground between these two Keynesian approaches may lead to a more complete model of banking.' Such a middle ground will only be found by integrating decision-making in situations of risk with decision-making in uncertain situations in a more general theory of choice. Only then will we have, in Davidson's words, 'a more general theory, encompassing cases of both ergodic probability and nonergodic uncertainty'.

Dymski (1992) proposes that a model which allows for both asymmetric information and Keynesian uncertainty might best describe banks' willingness to supply credit. The

New Keynesian model of credit rationing is risk based with stochastic variables motivating principal/agent tension but which has a well defined probability distribution. In contrast, Keynesian uncertainty envisions a world in which stochastic outcomes are governed by no parameters. Dymski goes on to suggest that post Keynesian analysis adds to New Keynesian analysis as the post Keynesians suggest that credit flows and economic activity will increase if banks are prepared to create credit by increasing their own exposure to default and liquidity risks. (Also see Wray, 1990.) Dymski argues for a synthetic model where agents may, in some circumstances (tranquil times), act as if their environment is probabilistic, yet, in other circumstances (turbulent times), act when 'the derivation of probability distributions is no longer possible *or is no longer trusted*' (Van Eees and Garretsen (1993, p. 42, emphasis added). This 'synthetic model' begs the use of a model of choice which integrates decision-making in risky situations with decision-making under uncertainty.

Van Ees and Garretsen (1993) are critical of Dymski's proposal for two reasons: 'The first issue, which concerns the incompleteness of information on the individual agent, has to do with the incompatibility of the rational expectations hypothesis, underlying the new Keynesian analysis of asymmetric information, with the Post Keynesian ideas on individual decision making under fundamental uncertainty'. The idea seems to be that, in New Keynesian analysis, a given amount of information is available to economic agents but is unequally distributed, whereas in post Keynesian analysis there is a lack of information throughout the economy. Credit rationing in the New Keynesian Stiglitz-Weiss model assumes that although the borrower knows the probability of the success of his project, the bank does not. Van Ees and Garretsen argue that action in accordance with the rational expectations hypothesis, as assumed by New Keynesians, supposes that probability distributions have both governed and will continue to govern events and that knowledge of these by at least some economic agents is difficult to reconcile with the concept of fundamental uncertainty applicable when there is an economy-wide lack of information. The obvious response to this is to reconcile the New Keynesian theory of choice with the post Keynesian theory of choice by introducing into New Keynesian choice theory, both behaviour based on the "weight" or "credence" agents place in known probability distributions, and behaviour based on unknown probability distributions or isolated events.

Gerrard (1994) argues that it is not the rational expectations hypothesis, *per se*, to which many Keynesians object, but two assumptions upon which the strong version of the rational expectations hypothesis is based. Namely, the agent has a complete information set on the 'true' deterministic component of the relevant economic structure, and the stochastic component of the economic structure is represented by a well-defined and known probability distribution (p. 329). He continues (p. 330), '[t]his is an argument for a 'weak' version of the REH in which the notion of rationality is retained but in the context of incomplete information sets and ill-defined probability distributions.' He proposes that a credence variable based upon Keynes' notion of weight[3] and the state of confidence be incorporated into a behavioural function. In the behavioural function, the agent's behaviour depends both on the rational expectations

[3]The notion of weight is outlined in the following quote from Keynes (1973b, p. 71):

> '[a]s the relevant evidence at our disposal increases, the magnitude of the probability of the argument may either decrease or increase, according as the new knowledge strengthens the unfavourable or the favourable evidence; but something seems to have increased in either case, - we have a more substantial basis upon which to rest our conclusion. I express this by saying that an accession of new evidence increases the weight of an argument. New evidence will sometimes decrease the probability of an argument, but it will always increase its 'weight'.'

of future states of the world and upon the credence which is placed on these rational expectations. However, Gerrard's proposal precludes an analysis of agents' behaviour based on fundamental uncertainty.

Similarly, Runde (1990) argues that the subjective expected utility approach avoids questions regarding the weight of probabilities or their reliability as a guide to conduct. He suggests that although it is not difficult to introduce weight into the subjective expected utility framework, Keynes is unlikely to have done so. Runde, however, leaves open the question of why not, if indeed a method can be found for dealing with situations of uncertainty as opposed to risk? He notes several authors, Gardenfors and Sahlin (1982), Levi (1967) and Cohen (1985) who have, in earlier work, in the philosophy and philosophy of science literature, attempted to extend the orthodox framework in order to incorporate decision making under uncertainty as opposed to decision making under risk. Gardenfors and Sahlin suggest that a measure of *epistemic reliability*, further discussed below, be used to order the "weight" agents place upon the confidence they have in decision alternatives.

The second issue to which van Ees and Garretsen refer in their criticism of Dymski is the implication of asymmetric information for the analysis of the economy as a whole. Asymmetric information in New Keynesian models generates price (interest rate) rigidities in credit markets which cause outcomes to deviate fom first-best (market-clearing) levels which would be attained if there was full information on both sides of the market. Van Eees and Garretsen claim that, from a post Keynesian perspective, these models assume what has to be proven, that price flexibility achieves first best results. This is a valid criticism as post Keynesians argue that the interest rate in deregulated financial markets is largely determined by the central bank's influence over the base rate or rediscount rate. There is no doubt that this is the *modus operandi* of the Reserve Bank of Australia. Thus, there is no market mechanism to ensure that market interest rates will automatically adjust to that interest rate which is consistent with the full employment level of output. (Also see Rogers (1989, pp. 169-70, p.175 and pp. 252-254).)

In post Keynesian economics, van Eees and Garretsen continue (p. 42), '.. the deliberate restraint of nominal price flexibility (money wage contracts, debt contracts) is looked upon as a means to cope with the existence of uncertainty'. Because economic agents do not know the outcome of an uncertain future they engage in forward contracts, legal agreements to perform specified actions at specified times, which are enforced by the state to organise production and exchange transactions (See Davidson, (1994, p. 49).) If the terms of a contract are not met by one of the contracting parties, penalties may be enforced which limit losses to the other party no matter what is the outcome in the uncertain future. That contracts are a means to deal with uncertainty is the position taken by most post Keynesian authors. Crotty (1994, p. 135) argues that although contracts may be a means to cope with uncertainty, they may also be a conduit to increased uncertainty: 'As agents precommit through contractual obligations ever larger percentages of their expected cash flows, the economy becomes, to use Minsky's phrase, "financially fragile." At some point in the growth process, then, contracts no longer reduce uncertainty; rather, they exacerbate it'.

6.3 Decision-making under uncertainty

Post Keynesian economists will argue, correctly, that adapting subjective expected utility theory to incorporate the notion of "weight" is an insufficient basis for a theory of decision-making in conditions of uncertainty. It is surprising, therefore, that they have not made more use of a paper by Heiner (1983) who argues that much behaviour is rule-governed. He argues that orthodox choice theory assumes that there is no gap between an agent's competence and the level of difficulty of problems that he encounters. In other words, optimisation theory assumes that agents are fully informed, utility maximising persons who make choices over well defined probability distributions (the post Keynesian criticism of New Keynesian choice theory). In reality, agents may not be fully informed, they may not have sufficient competence to deal with the information that they do have and the world may be evolving in a way that may produce situations that never before existed so that, in fact, probability distributions are not well defined. Heiner suggests that these situations lead to what he terms a C-D gap, that is, a gap between the *competence* of the agent to deal with the problem at hand and its level of *difficulty*, which introduces uncertainty into the analysis of decision-making. The C-D gap causes economic agents to limit the flexibility of their actions to situations which are relatively likely or recurrent, thus producing predictable or "rule-governed" behaviour (p. 561):

> 'In the special case of no uncertainty, the behaviour of perfectly informed, fully optimizing agents responding with complete flexibility to every perturbation in their environment would not produce easily recognizable patterns, but rather would be extremely difficult to predict. Thus, it is *in the limits to maximizing* that we will find the origin of predictable behaviour.' [emphasis added]

Note that Heiner recognises that decision-making is based on a spectrum of circumstances stretching from the special case of certainty emphasised by the New

Keynesians where agents maximise based on rational expectations, to 'the limits to maximizing' which occur when conditions are fundamentally uncertain as emphasised by the post Keynesians. Thus, in Heiner's work, there may perhaps be the beginnings of a theory of choice, which when integrated with the work on "weight" to be discussed below, can be used to reconcile the New Keynesian and post Keynesian analyses of the behaviour of agents in financial markets. The following discussion attempts such an integration. It draws in part upon Vercelli (1991). First, Heiner's model which gives rise to "rule-governed" behaviour where decision-making is subject to uncertainty is discussed. Next, Gardenfors and Sahlin's measure of epistemic reliability gives some means by which the notion of "weight" can be incorporated into a theory of decision-making. Heiner's model is then adapted for aversion to epistemic risk.

Of particular interest to the present discussion of choice theory set in the context of financial markets is Guttentag and Herring's (1984) model of credit rationing and financial disorder, subsequently discussed in Davis (1992), and which, in Davis' words (p. 137), 'assumes rationality of agents under normal cyclical circumstances, while showing how uncertainty can lead to mispricing of risk'. The parallels between Guttentag and Herring's and Heiner's models are drawn. Choice theory in this integrated model covers the whole gamut of situations from those of pure risk to those which are characterised by fundamental uncertainty. Examples of applications to decision-making in financial markets will be provided as the model is developed.

In general, an economic agent must decide whether to act or not act. For example, in the context of financial markets, the loans manager must decide whether or not to grant a loan to a particular individual for a specific project. The central bank must decide whether or not to adjust short-term interest rates, or whether intervention in some given circumstances is appropriate given its mandate to maintain the stability of the financial system. Gardenfors and Sahlin, in formalising their model of epistemic reliability, assume that in any decision situation there is a finite set of alternatives, $A = \{a_1, a_2, ..., a_n\}$. The uncertainty as to what the outcome of a chosen alternative will be is represented by different states of nature, $s_1, s_2, ...s_m$. The outcome of choosing a_i, if the true state of nature is s_j is o_{ij} to which is attached a value of the outcome to the decision maker, a utility measure, u_{ij}. To this point we have the orthodox choice theory of the New Keynesian and New Classical economists.

In seeking to explain whether an agent with a given repertoire of actions will perform better *if he is allowed the flexibility to choose an additional action*, Heiner (1983, p. 565) states: '[u]nder certain conditions, the new action will be more preferred than the other actions in the agent's repertoire (the "right" time to select the action), but otherwise it will be less preferred than one of those actions (the "wrong" time to select the action). For example, the imminent failure of a major bank due to insolvency through poor management practices may or may not lead to a contagious run on other banks. If it does so, the stability of the financial system is threatened through the threat to the viability of the payments mechanism. The central bank has the problem of deciding whether the imminent failure of a major bank is the "right" time or "wrong" time for lender of last resort intervention.[4] The problem for the central bank is that it

[4] This is a particularly important question given that many economists argue that the central bank should not intervene if a bank is insolvent. Rather, it should intervene only if a bank is illiquid. However, in a banking system such as Australia's where there are only four major commercial banks, I find it stretches credulity to imagine that the Reserve Bank would not intervene if one of those four commercial banks' insolvency led to the threat of a contagious run on the other banks. See also Goodhart's (1992, pp. 330-331 and 1995, pp. 288-289) discussion of systemic stability.

does not know in advance whether or not a contagious run is imminent, and so does not know in advance whether lender of last resort intervention is appropriate. The uncertainty attached to most decision-making processes, and, in particular, with reference to our example as to whether or not the central bank should act as lender of last resort in some particular circumstance, is Heiner claims (1983, p. 564) due to both 'environmental variables which determine the complexity of the decision problem to be solved by an agent' and 'perceptual variables which characterise an agent's competence in deciphering relationships between its behaviour and the environment'. In our example, the chief environmental variable is the interaction of the status of the threatened bank and depositor activity at other banks, and the chief perceptual variable is the central bank's ability to decipher what will happen if it does, or does not, act as lender of last resort.

The conditional probability of selecting and acting upon the correct probability distribution in the right conditions (for selection of a particular action) is represented by c, and the gain to the agent of this selection is represented by g.[5] The conditional probability of selecting and acting upon the wrong probability distribution given the same conditions and therefore not acting, implies that the given conditions are the wrong conditions for selection of non-action, and is represented by w. The loss to the agent of this selection is represented by l.[6] η is the probability of occurrence of the right conditions for selection of the action but η need not be known to the agent. The

[5] The notation I use in this chapter differs from Heiner's notation in order to avoid confusion with notation used in other chapters.

[6] The use of 'right' conditions and 'wrong' conditions refers to the phrase 'under certain conditions' of the previous quote from Heiner. Both Heiner and Vercelli lapse into this confusing terminology whereby they use the phrases, 'right decision in the right conditions' and 'wrong decision in the wrong conditions' to mean, respectively, the right decision given the conditions and the wrong decision given the conditions.

anticipated gain is dependent on the probability of making the correct choice of action in the right conditions and is equal to ηcg. The anticipated loss is dependent on the probability of choosing the wrong probability distribution given the conditions, and not acting, and is equal to $(1-\eta)wl$. In Heiner, the agent will only choose to act, therefore, if $\eta cg > (1-\eta)wl$ or $\eta cg - (1-\eta)wl > 0$.

Continuing with the above example of the central bank, assume, if the central bank does not act as lender of last resort, that there will be a contagious run on the major commercial banks. Then, the conditional probability that the central bank believes that there will be a contagious run and so undertakes lender of last resort intervention to forestall the run is represented by c, because the central bank correctly anticipates the run and acts appropriately on the basis of this expectation - that is, the central bank makes the right decision given the conditions it faces. The gain, g, to the central bank of lender of last resort intervention is the maintenance of the viability of the payments mechanism and continuing stability of the financial system. η is the probability that the contagious run will take place. Thus, the anticipated gain to the central bank of intervening as lender of last resort may be represented as ηcg. The conditional probability that the central bank does not believe that there will be a contagious run and so does not undertake lender of last resort intervention is represented by w. That is, the central bank chooses the wrong probability distribution (that there will be no contagious run) given the environment it faces and does not undertake lender of last resort intervention. The resultant loss of financial stability when the contagious run does take place may be represented by l. The anticipated loss of not acting as lender of last resort may be represented as $(1-\eta)wl$.

Heiner (1983, p. 566) restates the decision rule presented above as the *Reliability Condition* (although I have changed the notation):

$$\frac{c}{w} > \frac{l}{g} \cdot \frac{1-\eta}{\eta}.$$

The *Reliability Condition* states that the agent will only add the new action (in our example, the central bank acting as lender of last resort) to his repertoire of actions if the term on the left hand side, the *reliability ratio*, exceeds some minimum threshold, the term on the right hand side. The reliability ratio represents the probability of correctly responding with a given action under the "right" conditions (the conditions appropriate to that action) relative to the probability of mistakenly responding by not acting given those same conditions. The reliability ratio may be thought of as influencing decisions in the way Keynes used the term "weight" or Gerrard uses "credence". Only if the reliability ratio is sufficiently large will the agent act. The right hand side of the reliability condition is the lower bound or tolerance limit which the reliability ratio must exceed in order that the action be undertaken. This tolerance limit is called the *threshold* as the tolerance limit is, indeed, the threshold of action/inaction.

As the probability , η, of the "right" conditions for selection of the action falls, the threshold increases for any given loss/gain ratio. This means for sufficiently small η, or where agents have no knowledge of η, the *Reliability Condition* will be violated. Alternatively, agents may have no knowledge of η. In the absence of this knowledge, as I discuss further below, agents are unlikely to treat all outcomes as equally likely, but rather resort to decision-making based on convention, habit, custom or whim. This is formally equivalent to assuming that η is very small so that the *Reliability Condition* is violated. Violation of the reliability condition implies that it is not in the agent's interest to add the action to his repertoire of actions. This suggests that agents will limit their repertoire of actions for states of nature which have sufficiently large η and will act only in 'relatively likely or "recurrent" situations'. Agents will not act if a state of nature has only a small probability of occurrence because the threshold of action exceeds the reliability ratio. This means that some actions, *although they are appropriate in those states of nature which have a small probability of occurrence*, are excluded from the agent's repertoire of actions. A limited number of actions, appropriate to states of nature which have a relatively high probability of occurrence, are maintained in an agent's repertoire. Behaviour becomes governed by rules appropriate to 'normal' circumstances. Heiner (1983, p. 567) thus claims to 'have a formal characterization of the pervasive association of both human and animal behaviour with various connotations of "rule-governed" behaviour, such as instinct, habits, routines, rules of thumb, administrative procedures, customs, norms, and so forth.' Further (p. 568), '... rule-governed behaviour means that an agent must ignore actions which are actually preferred under certain conditions' and, '... the resulting behaviour patterns are not an approximation to maximizing so as to always choose most preferred alternatives'. This rule-governed behaviour characterises the post Keynesian position with respect to decision-making under uncertainty when no account is taken of the influence of "weight" on decision-making.

Neither the left hand side nor the right hand side of the *Reliability Condition* need be known in a measurable way to the agent. Undertaking the additional action suggests only that the agent assesses that the anticipated gains of acting outweigh the anticipated losses of not acting. Not undertaking the additional action means that the agent limits the number of potential actions. Limiting the flexibility of one's behaviour is akin to imposing rules on that behaviour. The *Reliability Condition* supplies a framework where decision-making in situations of risk, as emphasised by the neo-Keynesians, New Keynesians and neoclassical economists, where g, l, and η are known; and decision-making in situations of uncertainty, as emphasised by the post Keynesians, where g, l and η are not known, is integrated.

Greater uncertainty reduces the probability of the agent's choosing the right probability distribution given the conditions and increases the probability of the agent choosing the wrong probability distribution given the conditions so that the reliability ratio, c/w, falls as uncertainty increases. This limits the repertoire of actions which exceed the tolerance threshold, and so greater uncertainty leads to an increase in rule-governed behaviour or behaviour based on custom or convention as does smaller η. A fall in the expected gain of acting in the right circumstances relative to the expected loss of not acting given the circumstances leads to an increase in the tolerance threshold. This also reduces the gap between the reliability ratio and the threshold so that fewer actions remain within the agent's repertoire of actions.

Although Heiner's model provides a formal framework into which post Keynesian analysis of why behaviour becomes governed by rules and conventions when conditions are fundamentally uncertain may be integrated, the model takes no account of "weight". Both the amount and quality of information a decision maker has about aspects relevant to the decision is important in making the decision. Gerrard (1994, p. 335) argues that behavioural functions need to be augmented by a credence variable where 'credence represents the 'weight' of evidence which, in turn, determines [the agent's assessment of] the completeness of the information set and the shape and fuzziness of the probability distribution'. In Gardenfors and Sahlin (1982), an action is only undertaken if it exceeds some minimum measure of epistemic reliability ("weight"). Epistemic reliability is the confidence or weight that decision-makers attach to the amount and quality of information relevant to the decision.

Beliefs about the possible states of nature relevant to the decision can be represented by a set *P* of probability measures. The set, *P*, includes *all* the states of nature which the decision-maker believes possible although he may give higher "weight" to some states of nature than to others. *Each* state of nature, s_j, can be associated with a set of probability values $P(s_j)$ where $P \in P$. The set *P* contains all states of nature to which any "weight" can be given. In response to this notion of epistemic reliability, Gardenfors and Sahlin introduce a measure, τ,[7] which allows the epistemic reliability of the probability measures in *P* to be ordered. A higher τ implies that the decision-maker gives greater weight to the state of nature associated with that τ, than to a state of nature associated with a lower τ. Once the concept of epistemic reliability or "weight" is introduced, Gardenfors and Sahlin (1982, p.373) claim that their decision theory 'covers the area between the traditional theories of 'decision making under

[7] In fact, Gardenfors and Sahlin use ρ to indicate the level of epistemic reliability but I am using τ to avoid confusion of notation with the risk-free interest rate.

uncertainty' and 'decision making under risk' and it has these theories as limiting cases.' When fundamental uncertainty prevails, there will be no information with respect to the probability distributions of the possible states of nature and τ will be at its lower bound. Conversely, when there is complete information, the decision-maker is faced with a risky rather than an uncertain environment, and τ is at its upper bound.

Gardenfors and Sahlin provide an example of decision making under uncertainty where the concept of "weight" matters in the context of whether a woman should bet on the outcome of the winner of 3 tennis matches. In one match she has a lot of information with respect to both the players and the conditions of play which suggests that the players are very evenly matched and that, given the conditions, the match is likely to be very close. In another, she has no information relevant to either player's ability or any other factors which might affect either of the player's chances of winning or losing the game. With respect to the third match, the woman has information to suggest that one player is very good and that the other is not. The former player is likely to win the match convincingly but the woman has no information to allow her to determine which of the two players is the better player. In each of the three cases, orthodox choice theory suggests that, given risk neutrality, the woman should be prepared to place an each way bet on the outcome of the tennis match. However, Gardenfors and Sahlin argue that the woman may be more reluctant to bet on the result of the second and third matches than on the result of the first match. This is because the information with respect to the first match is perceived as being more "epistemically reliable" or having higher "weight" than is the information pertinent to the other two matches.

A decision in Gardenfors and Sahlin's model is made first by restricting the set, P, to a set of probability measures with a 'satisfactory' degree of epistemic reliability (p. 369), that is, $P|\tau_0$ can be regarded as the set of probability decisions that the agent takes into consideration in making the decision. It may be the case that the woman in the above example believes that the epistemic reliability of the information with respect to the match with no information on the players and the match where one player is much better than the other is too low to be satisfactory. The set of beliefs about the states of nature that the agent takes into account in making her decision will exclude those with an unsatisfactory level of epistemic reliability. This is equivalent to saying that the agent will exclude from the decision-making process those states of nature to which she attaches either no weight or too little weight. Behaviour, as in Heiner's model, becomes governed by situations where the probability of correctly acting given the state of nature (environment) is relatively high compared with the probability of wrongly acting (or not acting) in the same circumstances, that is, where the reliability ratio is relatively high. If a decision-maker attaches too little weight to the probability of occurrence of a particular state of nature, she will exclude actions based upon that state of nature. Actions become based upon states of nature to which decision-makers attach sufficient weight, that is states of nature which decision-makers believe sufficiently reliable. This means that decisions must be made on some basis other than a consideration of probability distributions if the decision-maker believes that no probability distribution has a sufficient degree of epistemic reliability. Probability analysis is inapplicable.

$P|\tau$ is the set of probability distributions that are taken into account in making the decision. Gardenfors and Sahlin state (p. 370) '[a]n obvious requirement on the chosen level of reliability is .. that there be *some* distribution in *P* which passes the level.' This requirement is not as obvious as Gardenfors and Sahlin make out. In their example, Gardenfors and Sahlin state that the epistemic reliability of the epistemically possible distributions in the case where there is no information with respect to either player is *more evenly spread out* than in the case where the woman has a lot of information about two evenly matched tennis players. In the latter case the woman is prepared to take the small risk that the only probability distribution which needs to be considered is that each player has a 50 % probability of winning. Where there is no relevant information, 'all probability distributions over the states [of nature] are epistemically possible and .. they have equal epistemic reliability' (p. 372). To say that the epistemic reliability is more evenly spread out when the woman has *no* relevant information, and yet not insist upon *zero* epistemic reliability, reduces the decision to a probabilistic one based upon 'the principle of insufficient reason' where, in the absence of any relevant information, all states of the world are considered equally likely (McKenna, 1986). The 'principle of insufficient reason' is applicable to situations of risk rather than to decison making based upon fundamental uncertainty (complete ignorance) as specified in setting up the problem of whether to accept or reject the bet when given no relevant information. Not knowing is *not* the same as believing that all states of the world are considered equally likely. One simply does not know whether to assume that all states of the world are equally likely or if one or more of the states is more likely or less likely than another. One can not ascribe any level of epistemic reliability whatsoever to such situations or, rather, one should ascribe zero epistemic reliability to these situations.

The loan decision with reference to any individual borrower can be couched in terms of Gardenfors and Sahlin's model as follows. The decision alternatives to the bank in making a loan are to lend the whole of the requested amount to the potential borrower, to lend only part of the requested amount or not to lend. The possible states of nature are that the project to which the borrowed funds are applied generates sufficient funds to cover repayment, that the project only generates funds to meet part repayment or that the project generates no funds with which to make any repayment. A set of probability values is attached to each of these states. The possible outcomes are full repayment, part repayment and no repayment. For simplicity, assume that the outcomes are independent of decision alternatives. In practice, the likelihood of repayment may well depend upon the decision as to whether the loan should be sufficient to fully or only partially fund the project.

To each of the probability distributions, the loans officer must attach some degree of epistemic reliability made upon the basis of information relevant to the loan decision such as previous loan history, prospective income, existing leverage and even the state of the economy. This epistemic reliability whilst having some basis in information may well be subjective. However, it does allow the loans officer to order the reliability of the probability distributions attached to different potential borrowers' prospects for repayment. Assume that the bank's objective function is to maximise profits. Gardenfors and Sahlin's decision criterion is that the bank should maximise the minimum expected utility (profits in this case). This assumes risk aversion. Gardenfors and Sahlin themselves note (p.379) '... it may be argued that using a maximin principle is unnecessarily risk aversive. ... when restricting P to $P|\rho_0$ $[P|\tau_0]$, the agent is already taking a risk and his choice of $P|\rho_0$ $[P|\tau_0]$ indicates that he is not willing to take any further epistemic risks.'

Vercelli (1991) suggests that the concept of aversion to epistemic risk can be used to extend Heiner's analysis. The original decision to act was based on the agent's assessment of anticipated gains versus anticipated losses: $\eta cg - (1-\eta)wl > 0$. Vercelli suggests that this inequality as it stands depends only upon environmental factors and agents' perceptual abilities and that it should be adjusted for agents' aversion to epistemic risk thus: $\eta cg - (1-\eta)wl > k$ where k depends on the aversion to epistemic risk. If k equals zero, as in Heiner's work where the anticipated gains and losses depend only on the environment and perceptual abilities, the agent is fully averse to epistemic risk. For an agent to be able to take no epistemic risk requires that he have full information. If the agent operates in an uncertain environment in Knight's sense, he may well be prepared to accept some degree of epistemic risk so that k becomes positive. If agents are less than fully averse to epistemic risk, anticipated gains versus anticipated losses must exceed some positive number, k, rather than exceed zero. We can then restate the *Reliability Condition* as:

$$\frac{c}{w} > \frac{k}{gw}.\frac{1}{\eta} + \frac{l}{g}.\frac{(1-\eta)}{\eta}$$

As the additional term, $\frac{k}{gw\eta}$, is positive, the threshold of action increases for any given reliability ratio. This means that, when the concept of aversion to epistemic risk is introduced into the analysis, the Reliability Condition is more likely to be violated so that agents limit their actions to fewer potential actions and thus engage in more rule-governed behaviour. "Weight", that is the amount and quality of information, matters for decision-making.

If the reliability ratio that the lender attaches to the potential borrower exceeds the threshold adjusted for aversion to epistemic risk, the bank will lend. If the *Reliability Condition* is violated, the bank will not lend. Thus, the potential borrower is credit rationed. It may be that the potential borrower has a high objective probability of repayment. However, in the absence of a credit history the bank will not know this objective probability; it will only know the objective probability of repayment based on current and previous borrowers. If, in fact, the borrower has a high but unknown objective probability of repayment, the reliability ratio will be underestimated, whereas if the borrower has a low but unknown objective probability of repayment, the reliability ratio is overestimated. This implies that, in conditions of uncertainty, where lenders cannot distinguish between potential borrowers, those borrowers with higher objective probabilities of repayment are more likely to be credit rationed than those with lower objective probabilities of repayment.

It is difficult to conceive of many loan situations where loans are actually made when the lender has no access to any information whatsoever with respect to the characteristics of the potential borrower relevant to his prospects of loan repayment. This is so, because in the absence of this information, the decision threshold approaches infinity and the loans officer attaches zero epistemic reliability to any possible probability distribution associated with making the loan. When this occurs, there is no calculable basis upon which to make the loan decision and the loans officer must resort to some other device to make the decision. Risk aversion will generally dictate that in these cases where there is no relevant information, the 'rule-governed' decision will be to refuse the loan, because in refusing the loan, the lender will not sustain losses, although he will not make gains.

As we have just seen, in many cases, agents are forced to act in the absence of *any* relevant information and so should attach zero epistemic reliability to any possible probability distribution. This is the case of true uncertainty. In these cases, agents will certainly not act as though all outcomes are equally likely but will fall back on modes of decision making which are not based on probabilistic assessments of outcomes weighted by measures of epistemic reliability but where the modes of decision making are dictated by convention, habit, custom, or whim as in Heiner's model when the *Reliability Condition* is violated. The use of the *Reliability Condition* and the measure of epistemic reliability in a theory of choice overcomes the problem referred to by Weintraub (1975, p. 532), '[a] high probability does not entail more certainty than a low one, since uncertainty is primarily characterized by a lack of confidence in probabilities high or low. One is only acting rationally in using probability as "a guide to life" if those probabilities are held with confidence.'

Dymski suggests (1993, p.53): '... depending upon the amount of dissonance between anticipations and outcomes, agents may interpret their environment as either risky or as Keynesian-uncertain. In effect, there is feedback between outcome turbulence, agents' degree of risk aversion, and their wariness of illiquid commitments' and '[h]ow agents behave depends jointly, in effect, on *both* the nature of their environment and on how agents *assess* their environment'. (See also Runde (1990 and 1994)). It seems to me that this assessment of agents' behaviour is consistent with the integrated model of choice theory outlined above. Dymski's interpretation is consistent with decision making in Gardenfors and Sahlin's model if, unlike them, we allow that, at times, decision makers attach zero epistemic reliability to all possible probability distributions so that some other basis of behaviour must be found. Decision making is indeed made in response to Keynesian uncertainty when decision makers find no probability distributions sufficiently reliable to be used as the basis of their behaviour. This opens the way for the use of Heiner's *Reliability Condition* in a theory of choice provided that an extension is made for agents' aversion to epistemic risk.

At other times, when expectations have been largely realised, decision makers do have some degree of confidence in the information on which they are basing their decisions. Therefore, they perceive themselves to have some knowledge of the likely outcomes of their actions so that they may interpret their environment as risky rather than uncertain and act in accordance with the predictions of the rational expectations hypothesis.

Vercelli (1991, pp. 89-90) suggests that Heiner's analysis of rule-governed behaviour under conditions of uncertainty is a study in *atemporal* flexibility in the behaviourist tradition while another paper, Jones and Ostroy (1984) which also discusses the relationship between flexibility and uncertainty, is a study of *intertemporal* flexibility in the Keynesian tradition. Vercelli suggests that the two approaches can be reconciled in a broader framework offered by a two-stage theory of intertemporal decision. In the first stage, Heiner's analysis suggests that as uncertainty in Knight's and Keynes' sense increases, an agent's behaviour will become less flexible as he limits his repertoire of actions. In the second stage, Jones and Ostroy suggest that, as uncertainty increases, the agent has to choose within the smaller repertoire, an action which leaves open a wider possible repertoire of actions for the future than was desired when conditions were more certain. That is, whilst an increase in uncertainty leads to reduced atemporal flexibility, it also leads to increased intertemporal flexibility. The post Keynesians argue that a rise in liquidity preference will occur when conditions become increasingly uncertain. Implicit in the argument is that increased liquidity gives rise to increased intertemporal flexibility. Davidson (1994, p. 109) states: 'There will be a demand for liquidity, as long as members of the economy believe that future events are not actuarially predictable and they expect the existing money contractual system for organizing production and exchange to continue.' The next section considers how analysis in the behaviourist tradition which heavily influences the post Keynesians has been integrated with an analysis of loan behaviour in financial markets that is consistent with New Keynesian analysis.

6.4 An Application of Integrated Choice Theory to Financial Markets

Guttentag and Herring (1984) have led the way in an application of an integrated model of choice theory to financial disorder. They draw upon the Stiglitz-Weiss analysis of credit rationing in markets characterised by asymmetric information and moral hazard and upon empirical work based on decision-making under uncertainty.

Guttentag and Herring's model may be formally characterised thus:[8] The lender makes a loan, L, for which he charges interest rate, r. Thus, the promised return to the banker

[8] Again, note that the notation differs somewhat from Guttentag and Herring's notation in order to maintain consistency of notation with other chapters.

is $L(1+r)$. Let the promised return be represented by Z, and $(1+r)$ be represented by R. The expected return to the borrower from the project into which the borrowed funds are invested is X. Project specific risk is represented by ω. If $X<Z$, then that part of the borrower's capital which has been pledged as collateral, K, must be applied to repayment of the loan. The incorporation of collateral in the analysis has effects on the behaviour of both lenders and borrowers. The banker makes a loss if $Z<X+K$. The probability of loss is:

$$\Pr(X<(Z-K))=F((Z-K),\omega)$$

where the term on the right-hand side is the objective probability that nature will draw an unfavourable outcome from the project specific distribution. Expectations are rational in the sense of Muth (1961). Lenders' subjective probabilities of loss converge on the objective probabilities of default. If this were not so, some lenders would suffer losses and be forced to withdraw from the market.

Guttentag and Herring (1984) argue that it is possible that nature will draw investment returns from a 'disastrous' situation, for example, war or sudden change in monetary policy regime. Guttentag and Herring (1984, p. 1361) characterise disastrous distributions thus: 'infrequent shocks that have less-than-catastrophic direct consequences on real economic activity, but which, if not anticipated by lenders, have devastating financial consequences that substantially exacerbate the impact of the shock on real economic activity'. The implication of a disastrous situation is that a large number of borrowers will default. These 'disastrous' situations occur so infrequently that agents have (p. 1362) 'no *a priori* knowledge of the distribution that governs whether nature draws from the disastrous distribution nor do they have sufficient evidence to infer the parameters of the distribution from the historical record'. This leads to the need for a theory of decision-making under uncertainty as opposed to orthodox choice theory where decision-making is characterised by risk. In these cases, expectations are not "rational" in Muth's sense of the term as there is too little information for subjective probabilities to be able to converge on objective probabilities. Let the subjective probability of nature drawing on the disastrous distribution equal $1-\eta$ where $0 \leq \eta \leq 1$.[9] Then, the subjective probability of loss is:

$$\Pr(X < Z - K) = \eta F(Z - K, \omega) + (1 - \eta).$$

That is, the subjective probability of loss is a weighted sum of the objective probability that nature will draw on an unfavourable outcome for the project specific distribution and the subjective probability that nature will draw from the disastrous distribution. The problem is then to explain how expectations are formed when situations are characterised by the possibility of nature drawing on a 'disastrous' distribution.

Two heuristics, drawn from the work of cognitive psychologists and decision scientists, are employed by Guttentag and Herring to explain the formulation of expectations in conditions of uncertainty. The first is the *availability* heuristic which is employed when agents estimate frequencies or probabilities by the ease with which similar circumstances are brought to mind. As ease of association falls, subjective

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[9]Note that I am using $1-\eta$ to represent the subjective probability of nature drawing on a disastrous distribution to keep the notation consistent with Heiner's model in which $1-\eta$ is the probability of wrong conditions for selection of the action. In their work, Guttentag and Herring use π to represent the subjective probability of nature drawing on a disastrous distribution.

probabilities will fall below objective probabilities. Thus, agents may assess that the subjective probabilities of nature drawing on the 'disastrous' distribution may approach or become zero for highly infrequent events. The term given to this phenomenon is *disaster myopia*. Disaster myopia does not mean that the probability of loss is precluded from the agent's assessment of future outcomes. It means merely that the agent discounts the possibility of nature drawing on the disastrous distribution so that only the unfavourable outcomes for the project specific distribution are considered when the agent makes his decision.

The second heuristic is the threshold heuristic: Sometime after the occurrence of a disaster, the subjective probability of nature drawing on a disastrous distribution may be treated by agents as if it is zero. Guttentag and Herring (p. 1363) argue that '[t]his is an example of the *threshold* heuristic - an implicit rule through which decision-makers allocate one of their scarcest resorces- managerial attention.'

Guttentag and Herring's model has obvious parallels with Heiner's model. Guttentag and Herring suggest that the availability heuristic causes the agent's subjective probability of disastrous situations to fall as time passes following crises. When the subjective probability has fallen so low that it reaches a threshold where it is ignored for the purposes of decision-making, agents ignore actions appropriate to disastrous circumstances. They limit the flexibility of their actions to those appropriate to "normal" circumstances. Applying the availability heuristic to Heiner's model will have the effect of reducing c, the conditional probability of the agent selecting and acting upon the correct probability distribution given the conditions, and increasing w, the conditional probability that the agent will select and act upon the wrong probability distribution given the conditions. The availability heuristic therefore means that the reliability ratio, $\frac{c}{w}$, will fall as time passes following crises without any change in the threshold. Behaviour will become less flexible and dominated by behaviours that are appropriate to relatively likely or recurrent situations. The availability and threshold heuristics also have implications for the determination of the default premium on loan interest rates because the possibility of those distributions which may generate some financial crisis become disregarded by the lender. This issue is to be further discussed below.

The bank's capacity to withstand shocks that lead to borrowers' default is determined by its capital, K_c. The greater the amount of capital, the less likely is the bank to become insolvent. The probability of insolvency is $\Pr(X < Z - K - K_c)$. It can be seen from this expression that if the borrowers' expected returns fall, the amount lent or the loan interest rate rises, or the borrowers' or the bank's capital position falls, then the probability of the bank's insolvency rises. (Recall that $Z = L(1+r)$). The probability of the bank's insolvency also rises if $1-\eta$, the subjective probability that nature will draw on a disastrous distribution rises. Taking into account the subjective probability that nature may draw on a disastrous distribution, the probability of the bank's insolvency may be rewritten as:

$$\Pr(X < Z - K - K_c) = \eta[F(Z - K, \omega) - K_c] - (1-\eta)K_c.$$

If the bank is characterised by disaster myopia, the subjective probability that nature will draw on a disastrous distribution will decline with the time which has elapsed since the previous financial crisis. This will cause the last term in the above expression to fall. The bank will assess that the probability of its own insolvency has declined over time. Thus, the bank will be prepared to make loans to borrowers with lower capital positions, or loans of greater size or at higher loan interest rates, when more time has passed than at the time immediately following a financial crisis, without increasing the subjective probability of its own insolvency. With a decline in the subjective probability that nature will draw on a disastrous distribution, the bank will also be prepared to make the same volume of loans as it did prior to a fall in its capital position even though its own capital position is weakening. This analysis provides a rationale for the *repetition* of financial crises. Kindleberger (1978, p. 15) notes that "[a]long with other observers, we note the spacing of crises ten years apart in the first half of the nineteenth century (1816, 1826, 1837, 1847, 1857, 1866) before the timing became more ragged. We make no attempt to explain this rythym, beyond suggesting that some time must elapse after one speculative mania that ends in crisis before investors have sufficiently recovered from their losses and disillusionment to be willing to take a flyer again". Disaster myopia, and the availability and threshold characteristics lead to an explanation of why it is that financial crises repeat themselves.

The post Keynesians, in particular, Minsky and Wray, argue that loans to borrowers with lower capital positions, or loans of greater size will be made when most loans are profitable so that, as loans are validated, lenders feel secure in taking greater risks. Post Keynesians reject the idea that behaviour is based on an assessment of even subjective probabilities. In the context of loans, Dow and Saville (1988, p. 19) state that '[a]ssessment of credit worthiness cannot be an objective procedure; lenders cannot hope to obtain enough information to assess prospective borrowers' prospects in each probable future state of the world, or to calculate the probability of each state;

nor consequently, are they able to summarize the result of their evaluations in terms of the probable expected distribution of returns on possible loans'. However, this view seems somewhat extreme. In making loan decisions, banks are able in practice to gather at least *some* information relevant to (near) future states of the world and the repayment prospects of each potential borrower, and are able to sort potential borrowers into classes of borrowers for like purposes, for example, housing, personal or business loans. Banks are usually able to further sort potential borrowers by perceived riskiness of activity for which the loan is made at some level, at least in an ordinal sense even if not in a cardinal sense. It is hard to conceive that most bank managers, if pressed, could not say that one loan is perceived to be less risky or more risky than another in terms of the prospects for repayment. Dow and Saville's position, it seems to me, is too extreme a position to take with respect to loan decisions where there are many applicants with similar characteristics including, in many cases, the expected returns to their prospective projects so that decisions become based on routine assessments. (That the expected return to many projects is similar explains why loans often become concentrated in particular economic activities. These are usually the most profitable economic activities taking place when the loan is made. The concentration of loan activity in the commercial property market in Australia in the late 1980s provides a good example.) Dow and Saville continue: (p. 20), '[a]s with other decisions that have to be made in the face of great uncertainty, banks, for want of anything better, are driven to apply rules of thumb in making such [loan] decisions'. In practice, a very important rule of thumb in making the decision as to whether to grant a loan or not is the existing debt to equity (leverage) ratio of the borrower. The reason for this is that the potential borrower who is already highly leveraged is assessed as having a lower probability of loan repayment than is the borrower who has similar characteristics relevant to the loan decision in all other respects, but whose existing debt to equity ratio is lower. He also has a greater amount of capital upon which the bank may be able to claim should the borrower default. In fact, the bank places a higher weight or greater epistemic reliability on repayment when the borrower is less highly leveraged than when he is highly leveraged, *ceteris paribus*.

As stated earlier, the post Keynesians believe that creditworthiness is determined by expected returns and collateral. Some of them argue that interest rates will rise as leverage ratios rise so that banks must be compensated for greater risk. It appears, at least when economic conditions are stable, and so relatively certain, that the post Keynesians should be prepared to accept that decision-makers, either implicitly or explicitly, base their decisions upon subjective probability calculus. At other times, when uncertainty increases, agents may resort to other modes of decision-making.

According to the availability heuristic, the decision-maker's subjective probability of a shock has declined when much time has passed since the previous shock; but the objective probability of a shock has not declined. Thus, a change in the bank's lending behaviour brought about by the decline in the subjective probability of a shock increases its vulnerability to default by borrowers. Guttentag and Herring (1984, p. 1367), but using different notation, show that the expected return to a bank, $E(\pi_b)$, on a loan with a loan interest rate of *r* to a borrower who has pledged an amount, *K*, of capital as collateral against full or partial default is:

$$E(\pi_b) = (1-\eta)\frac{K}{L} + \frac{\eta}{L}\int_0^{Z-K}(K+X)f(X,\omega)dX + \eta\frac{Z}{L}\int_{Z-K}^{X_M} f(X,\omega)dX .$$

The first term in the above expression is the collateral as a proportion of the loan amount which is the bank's expected return should nature draw on a disastrous distribution. The second term is the return to the project plus the pledged collateral should the project for which the funds have been borrowed not generate sufficient funds to repay the loan with interest when nature draws on a non-disastrous distribution. The third term is the expected return to the bank when nature draws on a non-disastrous distribution and the borrower repays the loan in full with the promised amount of interest. [X_M is the maximum return over the cumulative distribution of investment returns.]

Similarly, the expected return to the borrower, $E(\pi_i)$, is:

$$E(\pi_i) = -\frac{(1-\eta)K}{L} - \frac{\eta K}{L}\int_0^{Z-K} f(X,\omega)dX + \frac{\eta}{L}\int_{Z-K}^{X_M}(X-Z)f(X,\omega)dX .$$

The first term is the loss of capital to the borrower should nature draw on a disastrous distribution. The second term is the loss to the borrower should he be forced to default when there is a non-disastrous distribution of investment returns, and the third term indicates the expected return to the borrower should there be a non-disastrous distribution so that he is able to fully repay his loan.

Guttentag and Herring draw on the analysis of Stiglitz and Weiss (1981) to show that a rise in interest rates causes the more risk-averse borrowers to drop out of the market for loans (adverse selection effect), so that borrowers are faced with less risk-averse borrowers who undertake riskier projects (adverse incentive effect). In contrast to Stiglitz and Weiss' analysis, the return to the borrower and the return to the lender also depend upon the subjective probability that nature will draw on a disastrous distribution. Thus, the expected returns depend upon the way in which these subjective probabilities are formulated. This is, according to Guttentag and Herring, dependent upon the availability heuristic and the threshold heuristic. The availability heuristic, they argue in a technical appendix to their paper, is consistent with the Bayesian approach to the formulation of subjective probabilities. Thus, the economists who take a risk-based approach to decision-making should find analysis of behaviour based on subjective probabilities acceptable. The threshold heuristic maintains that the subjective probability that nature will draw on some disastrous distribution may fall to some low level, where for the purposes of decision-making it is ignored. Yet, the threshold characteristic is consistent with decision-making which is governed by rules, habits, convention or whim, as argued by the post Keynesians. When uncertainty increases to such an extent, as in situations following financial crises, that the subjective probability that nature will draw on a disastrous distribution rises above the objective probability, the threshold increases so that banks make fewer loans and ration credit. This latter behaviour is based not on an objective assessment of potential profitability but on a desire to keep themselves liquid to guard against an uncertain future as in post Keynesian analysis.

In terms of the model, by extending Heiner's analysis with reference to the C-D gap by incorporating the concept of "weight" and the availability and threshold characteristics; crises will cause a rise in the threshold and a fall in the reliability ratio, due to the increase in uncertainty. This will reduce the boundaries between which economic agents act with flexibility. Behaviour becomes less flexible, and economic agents must resort to methods other than probabilistic assessments as a guide to behaviour. The post Keynesians should find this analysis acceptable as it is consistent with the post Keynesian emphasis on decison-making under uncertainty where decisions are made with reference to rules, conventions, habits or whim. In terms of the loan decision, an increase in the threshold will reduce the number of loans which are made and credit will be rationed. Loans will be made, not based upon probability calculus, but on rules of thumb which give priority to maintenance of the bank's liquidity.

6.5 Decision-making under uncertainty and the default premium

Banks, if profit maximisers, must equate the expected yields across all assets in their portfolios. Thus, the expected risk-adjusted yields on loans must equal the expected yields on risk-free government securities. In setting loan interest rates, the banks will incorporate a default premium that will reflect the risk associated with making the loan rather than purchasing a risk-free government security. Lenders will ensure that the expected yield from the loan equals the expected yield from the risk-free security. As Guttentag and Herring (1984, pp. 1372-73) demonstrate (and recalling that I am using $(1-\eta)$ to indicate the subjective probability that nature will draw on a disastrous distribution):

$$r = \rho = (1-\eta)\frac{K}{L} + \eta r - \frac{\eta}{L}\int_0^{Z-K} F(X,\hat{\omega})dX \,.$$

Solving for the loan interest rate, r gives:

$$r = \frac{\rho}{\eta} - \frac{(1-\eta)K}{\eta L} + \frac{1}{L}\int_0^{Z-K} F(X,\hat{\omega})dX \,.$$

The loan interest rate depends upon the probabilities that nature will draw on a disastrous or non-disastrous distribution, the risk-free interest rate (the opportunity cost of loan funds), the borrower's capital position relative to loan size and the expected returns to the project which are drawn from a project specific distribution, e.g., the expected returns to investment in commercial property.

The default premium equals the difference between the loan interest rate and the risk-free rate:

$$r - \rho = \frac{(1-\eta)\rho}{\eta} - \frac{(1-\eta)K}{\eta L} + \frac{1}{L}\int_0^{Z-K} F(X,\hat{\omega})dX \,.$$

The default premium depends positively on the subjective probability that nature will draw on a disastrous distribution, negatively on the capital position of the borrower and positively on the distribution governing project-specific returns.

If the subjective probability that nature will draw on the disastrous distribution approaches zero (and lenders behave in accordance with the threshold heuristic), the first two terms in the above equation drop out and the default premium is decided with reference to only the project specific distribution of returns and loan size. The availability and threshold heuristics suggest that as time passes following some financial crisis, agents' assessments of the probability of a similar crisis falls as does their assessment of the importance of the borrowers' capital positions in deciding upon the default premium. Immediately following crises, the subjective probability that nature will draw on a disastrous distribution will rise. This will also cause the borrowers' capital positions to have a much increased role in determination of the default premium incorporated into the loan interest rate. For both these reasons, the default premium will rise following crises.

Formally, if the subjective probability that nature will draw on a disastrous distribution approaches zero, the default premium becomes:

$$r - \rho = \frac{1}{L}\int_0^{Z-K} F(X, \hat{\omega})dX .$$

As the *objective* probability of nature drawing on a disastrous distribution has not declined as has the subjective probability when some time has elapsed since the previous financial crisis, the default premium falls below the default premium warranted by the objective probability. In terms of the analysis presented in Chapter 5, the probability of default calculated by the lender falls. Guttentag and Herring's analysis suggests that this change in the calculated probability of default is due to changes in the subjective probability that nature will draw on a disastrous distribution, and changes in the borrower's capital position relative to loan size. Lenders will be less inclined to ration credit as the subjective probability of default falls as time passes following crises. This analysis implies that the upswing of the business cycle is magnified beyond that warranted by objective probabilities due to easy access to credit. Also, lenders will be more inclined to ration credit once crisis sets in so that the downswing of the business cycle is also magnified. Thus, the unregulated lending behaviour of financial intermediaries, predicated to a large extent upon expectations, manifests itself in macroeconomic instability.

6.6 Conclusion

The economic analysis of decision-making in loan markets when situations are characterised by risk so that probabilistic assessments of loan repayments can be made, has been integrated with the post Keynesian analysis of decision-making in loan markets under conditions of uncertainty when probabilistic assessments can not be made so that banks must resort to rules of thumb in making loans. This was achieved by drawing on Heiner's work concerning the conditions necessary for flexible behaviours and rule governed behaviours, adjusted for Gardenfors and Sahlin's concept of epistemic risk, to more formally characterise the post Keynesian position with respect to decision-making under uncertainty when "weight" matters. This analysis was then extended by incorporating the availability and threshold heuristics discussed by Guttentag and Herring. This extended model provides a tighter behavioural foundation for post Keynesian analysis of decision-making under conditions of fundamental uncertainty than currently exists. The model also explains why financial crises are recurring events. Guttentag and Herring argue that subjective probabilities may fall so far that the possibility that nature will draw on a disastrous distribution is ignored. Banks become less cautious in their lending behaviour, basing lending behaviour only on relatively likely or recurrent situations. Credit is less likely to be rationed. Lack of caution in lending behaviour may lead to the endogenous creation of a financial crisis when nature does draw on a disastrous distribution, as a large number of borrowers may be unable to repay loans creating liquidity and solvency problems for the lenders. In response, lenders resort to credit rationing, as they perceive there to be increases in both the objective probability of default and increases in the subjective probability that nature will draw on a disastrous distribution. More borrowers, unable to obtain funds with which to make loan repayments, default. Debt deflation may result as assets are sold in an attempt to gain liquidity, both by borrowers seeking to repay loans and by lenders who are liquidating collateral called against borrowers' outstanding loans.

The analysis of this chapter is applicable to the liberalised Australian financial sector of the 1980s and 1990s. The next chapter considers the interrelations between decision-making under uncertainty, credit rationing and financial instability with particular reference to the development of financial fragility in Australia in the late 1980s and early 1990s.

Chapter 7 Financial Instability and Decision-Making Under Uncertainty

7.1 Introduction

This chapter considers the interrelations between decision-making under uncertainty, credit rationing and financial instability. Kindleberger (1978, p. 23) argues that both Keynesian and monetarist analysis is incomplete "if it leaves out the instability of expectations, speculation and credit." In the previous chapter, we saw that abrupt changes in expectations can lead to credit rationing. If, as a result, firms are unable to obtain sufficient finance with which to carry on business they may renege on their debts or sell assets. Should financial intermediaries be overexposed to these firms or assets in their loan portfolios, financial instability may result. Davis (1992, p.117) defines 'systemic risk' or 'financial instability' as "a disturbance in financial markets which entails unanticipated changes in prices and quantities in credit or asset markets, which lead to a danger of failure of financial firms, and which in turn threatens to spread so as to disrupt the payments mechanism and capacity of the financial system to allocate capital."[1] Although there was a failure of some financial firms in Australia in the late

[1] Another more comprehensive definition is provided by Sundararajan and Balino (1991, p. 3): " ... financial crisis is defined as a situation in which a significant group of financial institutions have liabilities exceeding the market value of their assets, leading to runs and other portfolio shifts, collapse of some financial firms, and government intervention. Thus the term crisis refers to a situation in which an increase in the share of nonperforming loans, an increase in losses (because of foreign exchange exposure, interest rate mismatch, contingent liabilities, etc.), and a decrease in the value of investments cause generalized solvency problems in a financial system and lead to liquidation, mergers, or restructuring. These events usually follow a shock to the economy, and reinforce the subsequent declines in output (or slowing of economic growth) and balance of payments

1980s and early 1990s - Pyramid Building Society, Beneficial Finance, Tricontinental and rescue of other financial firms in trouble - State Bank of South Australia, State Bank of Victoria, Tasmania Bank and State Bank of NSW for example; fortunately, the failures and rescues were on a small enough scale that disruptions to the payments mechanism and disturbances to the allocation of capital were minimised. However, banks and policymakers should take stock of the lessons of these episodes in order to understand those conditions which promote the development of financial fragility, i.e., increased vulnerability to economic shocks. They may then be able to minimise the development of financial fragility which, in turn, can lead to financial instability. If successful, banks and policymakers will be able to both minimise the future risk to the payments mechanism and more generally promote macroeconomic stability.

The outline of the remainder of this chapter is as follows. First, there is some discussion of the relationship between financial and macroeconomic instability. Second, I discuss Minsky's and Wray's work on how decision-making by financial institutions can lead to increasing financial fragility when conditions are uncertain, with reference to how their work may be integrated with the work on decision-making under uncertainty discussed in the previous chapter. It is in the post Keynesian literature rather than in the New Keynesian or neo-Keynesian literature that one finds an emphasis on financial fragility. Although Minsky and Wray are post Keynesians, Wray, at least, also draws on the New Keynesian analysis of imperfect information and adverse selection and adverse incentive effects to explain credit rationing as uncertainty increases. Third, I draw on some evidence from researchers at the Reserve Bank of

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problems." Financial intermediaries in Australia suffered many of these problems in the late 1980s and early 1990s leading to a sharp increase in the degree of financial fragility.

Australia to provide empirical support for Minsky's and Wray's hypotheses. Fourth, I discuss the interrelations between liquidity preference and liquidity premiums, both of which rise as uncertainty increases. Fifth, I discuss how increasing asset prices pointed to an increase in the degree of financial fragility in the Australian economy in the second half of the 1980s. I conclude with some case studies of those financial institutions in Australia which both contributed to increasing financial fragility, and failed or nearly failed in the late 1980s and early 1990s as a consequence of increasing financial fragility; and point to the lessons of those case studies for the actions of both financial institutions and the monetary authorities.

7.2 Financial and macroeconomic instability

Argy (1995, p.31) states "it is easy to see **why** financial market instability has the potential to accentuate **short-term** economic instability: it affects people's wealth perceptions, their capacity to borrow against collateral, the expectations of business, unions and consumers about future interest rates and inflation, the cost of debt and equity and the level of general business confidence or uncertainty." He continues " ... increased financial market volatility has the potential to affect the **underlying long-term** growth of the economy - by raising the required risk premium on longer term securities and financial investments (the more volatile the market the greater the risk) and hence the average level of real interest rates; by discouraging foreign trade and investment; by altering the perceptions of policy advisers and makers as to what is a sustainable rate of economic growth or level of unemployment; and by inducing "short-termism", i.e., a preference for liquidity and portfolio flexibility. So, financial instability can affect both short-term and long-term macroeconomic stability. There is thus a need to minimise financial instability so as to achieve greater macroeconomic stability, which, after all, is the pre-eminent goal of macroeconomic policy. Policy-makers came to believe in the 1980s that liberalisation of markets, including financial markets, would enhance macroeconomic stability.

Hogan (1992) suggests that, although the Campbell Committee had warned of the dangers of increased volatility in financial markets with their deregulation, between 1983 and 1986 system stability became identified with market efficiency. Efficient markets, based on the assumption of perfectly competitive markets, should converge to equilibrium. Convergence in asset markets occurs when the rate of growth of asset prices is less than the expected future rate of return, the latter being the rate of discount giving rise to the asset's or market portfolio's net present value. If this condition does not hold, agents are currently willing to hold assets with prices greater than the discounted values of the expected future returns of the same assets. This must mean that agents anticipate that, in future, asset prices will be even greater relative to the discounted values of the expected future returns than they are currently. In other words, non-convergence implies the presence of speculative bubbles. Symptoms of non-convergence in equity markets are a sustained rise in the price-earnings ratio and a sustained fall in the dividend-earnings ratio. Indicators point to non-convergence to equilibrium in asset markets in Australian markets in the late 1980s and early 1990s.

The problem for banks is that a sustained increase in the price-earnings ratio signals an increase in the net worth of potential borrowers and thus signals an increased ability on the part of those potential borrowers to service debt. In many cases, in Australia, the additional debt was taken on by firms in order to invest in assets where the expected future returns were based upon speculative capital gains, with the increased demand further increasing the prices of those assets. This additional credit was made readily available by the banks and by the subsidiaries of the banks, because the officers of these banks believed that maintaining and increasing market share rather than maximising short-term profits was the key to long-term profitability. The result was an increase in financial fragility in the Australian economy. Subsequent failure or near-failure of some financial institutions then led to an increase in uncertainty in financial markets and so to an increase in credit rationing, at least to some sectors of the economy. Credit rationing exacerbates the downturn of the macroeconomy by being a conduit additional to interest rates through which the monetary policy transmission works as discussed in Chapter 3.

7.3 Uncertainty, credit rationing and financial instability

There are a variety of Keynesian approaches to the analysis of credit rationing and financial instability which emphasise the existence of uncertainty in decision-making processes. Minsky in a series of papers and books (see, for example Minsky (1972, 1977, 1982a, 1982b, 1985 and 1986)) emphasises a rise in profit expectations endogenous to the capitalist economy which leads to a speculative boom as the precursor to credit rationing and financial instability; Kindleberger (1978) draws on Minsky's work to outline the anatomy of a typical crisis; Wray (1990) emphasises rising liquidity preference in response to riskier leverage ratios; Guttentag and Herring (1984) emphasise the decline in subjective probabilities that nature will draw on a disastrous distribution as the time elapses following the previous financial crisis as discussed in Chapter 6; and the implicit contract theory of the New Keynesians (discussed in Chapter 4) suggests that credit rationing will be greater, the higher and *more variable* is the opportunity cost of funds to the banking system. To be discussed now, as representative of contemporary Keynesian analysis of *financial crises* which may result in credit rationing, are Minsky's and Wray's work on decision-making by financial institutions when conditions are uncertain with reference to how their work may be integrated with the work on decision-making under uncertainty discussed in the previous chapter. As indicated earlier, it is in the post Keynesian literature that one finds an emphasis on financial crises even though others draw on the post Keynesian analysis. (See, for example, Mullineaux (1990)).

7.3.1 An application of the integrated model of decision-making under uncertainty to Minsky's financial instability hypothesis

Minsky suggests that capitalism by its very nature will breed periods of instability. When conditions in financial markets are tranquil, firms become increasingly willing to borrow as the demand price of capital assets rises above their supply price and banks are keen to lend.[2] Investment increases. Profits reward the decisions of both borrowers and lenders which encourages even more investment. Minsky uses the term *hedge finance* to describe the finance positions of those firms where cash flows in the short term more than exceed short-term commitments. Tranquil times are characterised by a high proportion of firms which are engaged in hedge finance as defined above.

[2] The demand price of a capital asset may be thought of as the net present value of the discounted expected returns available from the use of the asset plus its disposal value, while the supply price is the minimum price at which the asset will currently be made available.

In tranquil times, in the terms of the integrated model of decision-making under uncertainty, the reliability of the lender choosing the right probability distribution given the conditions relative to choosing the wrong probability distribution given the conditions is very high. In addition, because the probability of the occurrence of the right conditions is also high (times are tranquil), the threshold which the reliability ratio must exceed for the lender to be prepared to lend is very low. Thus, most potential borrowers will receive loans. The leverage ratios of both the banks and the borrowers rise (assuming that profits generated by loan funds are not ploughed back into equity to a greater extent than they are used to repay debt as Lavoie (1995) argues is likely). As activity increases, there is also likely to be an increase in asset prices of those assets to which the borrowed funds are being applied. The net worth of firms will apparently be increasing so that banks will become even more willing to lend against what appears to be an improved collateral position on the part of borrowers. (Also see Mishkin, (1992).) Although the demand for credit money and thus the supply of credit money is increasing, interest rates are unlikely to be rising in the early stage of the cycle because inflation is unlikely to be so great as to warrant action by the central bank with respect to the base rate or rediscount rate. In addition, in the early stage of the cycle there is likely to be sufficient liquidity to meet the increase in the demand for credit money without placing upward pressure on short-term interest rates because of the increase in the competition for funds.

As time progresses, and firms investment and profits increase, so also is there likely to be both an increase in speculative activity and inflation. Increased competition for funds or the concern of the central bank with respect to inflation will lead to an increase in interest rates. It becomes more difficult for some firms to meet repayments of principal out of short-term cash flows although cash flows are expected to cover commitments in the long-term. Short-term cash flows allow the current servicing of debt. However, some firms must refinance their loans. These firms, in Minsky's terminology, are engaged in *speculative finance*. Speculative activity may lead to an increase in asset prices which may continue to rise for some time, exacerbating inflationary pressures.

The rise in short-term interest rates causes both the supply price of capital goods to rise and an increase in long-term interest rates. The increase in long-term interest rates leads entrepreneurs to reassess downwards the potential profit stream from the ownership of capital assets. The demand price for capital assets falls. As the demand price of capital goods is falling at the same time as the supply price is rising, investment will fall as will profits. It becomes more difficult for firms to meet debt commitments. Some hedge finance units will become speculative finance units, and some speculative finance units will become *Ponzi finance* units, where the latter are defined as those units whose short-term cash flows are insufficient even to meet the servicing costs of their debts so that they must *increase debt* in order to meet their current debt obligations.

To this point, few defaults will have occurred so there will not have been an increase in the subjective probability of default as assessed by lenders. To the contrary, the availability heuristic suggests that as the memory of the last crisis fades with time, the subjective probability of default will progressively fall below the objective probability as will the threshold which the reliability ratio must exceed in order for loans to be made. Banks will become increasingly willing to make loans. This tendency is reinforced as asset prices rise, because along with the rise in asset prices is the rise in potential borrowers' apparent net worth.

Interest rates may rise further, due, for example, to the central bank's concern with asset price inflation as a result of speculative activity or as a result of the increased competition in the market for funds. If this occurs when a large number of firms or a sufficiently large number of large firms have become Ponzi finance units, the probability of default of at least some of these firms increases as the rise in interest rates causes expected future profits to fall and leads to some firms being refused further credit by their bankers. These firms attempt to sell assets but find that the price these assets will fetch is too low to meet payment commitments as the increased supply of assets on the market, arising from Ponzi units which are unable to refinance their positions, lowers their price below their cost of production as an investment good. Some firms default. Lenders will perceive that the probability of choosing the right probability distribution given the conditions has fallen relative to the probability of choosing the wrong probability distribution given the conditions. Thus, the reliability ratio falls. With a reduction in the subjective probability of making the right choice given the conditions, the threshold rises and banks will be prepared to lend to fewer potential borrowers (or classes of borrowers). Banks will limit the repertoire of their actions to those actions which are perceived to be more reliable and will ration credit.

If there is then some "crisis" event in the financial markets such as the collapse of a large financial institution or a stockmarket crash, both banks and firms will be seeking more liquid positions. The sale of assets will lead to debt deflation and lower the net worth of firms. More firms will default as they are unable to obtain the funds necessary to meet short-term repayment commitments. Banks will ration credit as they themselves attempt to become more liquid. Banks will be unwilling to raise the interest rate to clear the excess demand for loans because of the loan interest rate's effect on the probability of default (as discussed in Chapters 4 and 5). The subjective probability that nature will draw on a disastrous distribution is likely to rise above the objective probability. The reliability ratio will fall as the threshold rises. The banks will resort to rule-governed behaviour and lend only to their most established customers.

Defaults and debt deflation may lead to financial crisis as credit is rationed, and economic activity is curtailed. Even if financial crisis does not ensue, the fact that long-run profit expectations fall due to increases in long-term interest rates will cause the demand price of capital assets to fall, while the increase in long-term interest rates will cause the supply price of capital assets to rise so that entrepreneurs will be less willing to invest, and bankers will be less willing to extend credit. Both entrepreneurs and bankers will desire balance sheets that have a smaller proportion of speculative finance. The financial mix in the balance sheet is very important to Wray's discussion of credit rationing and financial instability to which I now turn.

7.3.2 Wray on financial instability

Wray argues that credit rationing is a normal feature of a capitalist economy as loans are normally only made to those who are extremely likely to repay them. He is first careful to distinguish between money demand and liquidity preference. An increase in liquidity preference is a desire for assets with greater liquidity. Money is the most liquid of all assets. Wray (1990, p. 20) uses 'the term money demand to indicate a willingness to issue debt, or a willingness to expand one's balance sheet in order to spend on goods, services or assets. This definition clearly distinguishes money demand from liquidity preference. Liquidity preference is a preference to exchange illiquid items on a balance sheet for more liquid items, or even to decrease the size of a balance sheet by retiring debt.' He argues (1990, p. 16) that 'it can be measured by the premium required to induce someone to exchange a liquid asset for an asset with less liquidity. A rise in liquidity preference means that this premium rises.'

The distinction between money demand and liquidity preference may be made with reference to an example of a firm which takes out a loan from a bank. The bank, in the first instance, writes the loan as an increase in the firm's deposit account. As deposit liabilities have risen, the money supply has increased endogenously in response to an increase in the demand for credit money as argued by the post Keynesians. However, liquidity preference has fallen. The firm has placed itself in a situation of greater illiquidity as it has increased the debt to equity ratio of its balance sheet. The bank has also become more illiquid as its ratio of 'risky' assets to equity has increased (risky in the sense of being more subject to default than a goverment security, for example). Wray takes a structuralist approach to post Keynesian monetary economics. He argues that although increases in the demand for credit money may be accommodated for some period of time without any rise in interest rates, that ultimately the increasing risk associated with the balance sheets of both banks and borrowers as lending and borrowing activity increases causes the bank to charge a higher interest rate on loans to compensate for the increased risk. The bank is concerned with the ratio of safe assets to equity because, should borrowers default, liquidation of safe assets allows banks to meet payment commitments, at least temporarily, whilst equity allows banks to absorb loan losses. Even if additional loans can be made that are not any riskier than loans made previously, banks will charge higher interest rates to compensate themselves for riskier leverage ratios. Firms, by increasing debt are increasing their own leverage ratios, so that their probability of default is increasing.[3]

Apart from the emphasis on the distinction between money demand and liquidity preference, Wray draws on Minsky's financial instability hypothesis to explain credit rationing and financial instability. Initially, when most firms are hedge finance units, firms are willing to borrow on the basis of future profit expectations and banks are equally willing to lend. The liquidity preference of both firms and banks is falling at these times. However, the leverage ratio of both banks and firms is increasing. An increase in interest rates, either because the banks wish to compensate for increased risk or because the central bank increases base rates or rediscount rates in order to stem activity, shifts firms towards being speculative and Ponzi financing units. If there should then be a collapse of profit expectations so that some firms default, Wray argues that there will be a run to liquidity, that is, an increase in the demand for more liquid assets. The liquidity preference of both banks and borrowers will rise. Banks will be reluctant to lend to other than their most established customers. This curtailment of loan activity will lead to a fall in the rate of reflux where reflux is defined as the return of issued liabilities to the issuer so that an unwillingness to lend because of the bank's rising liquidity preference becomes converted into an inability to lend. This point is clearer when reference is made to Wray (1993) where he argues that for a given level

[3] Wray implicitly assumes that profits arising from activities financed by debt are not ploughed back into equity. If it is the case that profits lead to an increase in equity, increased debt need not necessarily lead to an increasing debt/equity ratio.

of economic activity to be sustained, the banks must increase the amount of credit money supplied by the amount of interest commitments so that firms do not default on their debt commitments. If, in fact, the banks reduce the supply of credit money, then there will be some firms which will be unable to meet their debt commitments because they will be unable to raise the required monies through asset sales, and these firms will default on their loans. In addition, when there is a run to liquidity, banks cannot meet the demand for liquidity because they also become demanders of reserves to meet the run on deposits (Wray, 1990, p. 94, footnote 1).

Credit rationing is therefore due to a rise in liquidity preference. Wray (1990, p.165) states: "When liquidity preference is low, banks meet the demand for credit by expanding their balance sheets. As liquidity preference rises, banks become increasingly unwilling to meet the demand for credit, so that credit rationing replaces accommodative behavior". Dow and Dow (1989, p. 161) state that '[b]anks, facing the prospect of default by borrowers in financial difficulties and capital losses on their own investments, may begin rationing credit, implicitly, if not explicitly, by exaggerated risk aversion.' This is equivalent to the effect of an increase in the subjective probability that nature will draw on a disastrous distribution in the integrated model of decision-making under uncertainty which causes default premiums to rise (as discussed in Chapter 6). Thus, processes endogenous to the capitalist system with a well-developed financial market may lead to systemic instability as borrowers, who are unable to repay loans because they are unable to obtain further credit or raise sufficient monies with asset sales, default. Wray argues that this point will be reached sooner if the central bank tightens monetary policy so that interest rates increase and the banks find it even harder to meet the demand for liquidity. In this case, firms and banks may be forced into the sale of assets and debt deflation may ensue. Ultimately, this may endanger the solvency of some institution that is large enough to threaten systemic instability should it become insolvent.

Debt deflation is a particular threat to systemic stability because it increases the real value of debt commitments by firms which are now in a position where they are less likely to be able to meet those payment commitments, and it increases the real value of deposit liabilities of banks when the real value of their asset portfolios are falling. This makes it even more likely that a major bank could become illiquid or insolvent. Contagion could then spread through the financial system and threaten systemic instability.

7.4 Australian Evidence

In recent years a group of researchers at the Reserve Bank of Australia have been conducting research into the evolution of corporate financial structure in Australia. They have been examining the relations between the allocation of credit and agency costs, leverage ratios, interest cover, investment and economic stability. Their findings provide some support for the analysis in the previous section when applied in the Australian context. Lowe and Shuetrim (1992) provide empirical evidence which indicates that following a period of stability in the 1970s when debt accounted for just over 50 % of total assets, the gearing or leverage ratios of firms rose substantially in the 1980s, as financial markets were deregulated, so that debt accounted for about 66 % of total assets by 1990. (Leverage in their work is measured as the ratio of debt to total assets. They indicate that this measure is less subject to fluctuations than is the debt to equity ratio, particularly when the starting values for equity are low.) Concurrent with the increase in gearing during the 1980s was a decline in interest cover where interest cover is defined as the number of times that interest payments can be met out of gross profits. These two factors when taken together indicate that the probability of insolvency was increasing for most firms in the 1980s almost certainly as a consequence of increased access to credit due to deregulation of financial markets as was the risk that firms' financial structures could lead to an endogenous rise in macroeconomic instability.

The authors (pp. 29-30) indicate that there are three key transmisssion mechanisms through which corporate balance sheets can affect macroeconomic stability, the first two relating to the willingness of financial intermediaries to ration credit:

- Financial intermediaries perceive that as a firm's leverage increases so also does its probability of insolvency. This makes financial intermediaries less willing to lend so that some projects which have positive net present values will not be able to be undertaken due to the constraint on finance.
- If some firms which have borrowed from financial intermediaries do become insolvent, those insolvencies will mean a reduction in the equity of the financial intermediaries. They may then be less willing, or even unable, to undertake further risky lending.
- The incentives of managers are a function of the firm's financial structure. If highly geared firms are perceived by managers to be at greater risk of insolvency, the managers themselves may not have sufficient incentive to undertake all projects with positive net present values even where access to finance is not a problem for the firm.

Shuetrim, Lowe and Morling (1993) present empirical evidence to the effect that firm size, growth, collateral and cash flow are important microeconomic determinants of Australian firms' leverage ratios; and real asset prices are an important macroeconomic determinant, at least since financial markets have been deregulated. Pre-deregulation, they find no role for asset prices as a determinant of leverage ratios and argue that rising asset prices would simply have led to an increase in the length of the queue of borrowers, because independently of any change in firms' net worth, there were restrictions on interest rates that could be charged and quantitative lending controls which led to credit rationing. Lowe and Rohling (1993, p. 38) find that '... even after controlling for expected general business conditions, both asset price inflation and an increase in corporate equity lead to firms perceiving that finance is easier to obtain' so that there is support for the view that '... increases in collateral play an important role in the availability of finance'. The former paper, in addition to providing empirical evidence for Australia as to the determinants and effects of increasing corporate leverage, owes an (unacknowledged) intellectual debt to Minsky which is evident from the conclusion from which I quote at length (Shuetrim, Lowe and Morling (1993, p. 36)):

> 'Following deregulation, increases in asset prices stimulated firms to increase their leverage and to increase the size of their balance sheets. Firms, observing that the rates of return from assets were increasing, accelerated their asset accumulation and largely financed their purchases using credit. These newly purchased appreciating assets were then used, in many cases, as collateral when applying for further credit. Because market values were increasing so rapidly, and because, to a large extent, these market values were being used when evaluating credit worthiness, the increasing asset prices sparked rising dependence upon debt and a corresponding increase in exposure to economic shocks.'

Mills, Morling and Tease (1994) present empirical evidence to the effect that financial factors are important in influencing investment decisions in Australian firms which are highly leveraged and small. (Small firms have more difficulty in obtaining access to capital markets than do large firms.) In an earlier paper on balance sheet restructuring and investment, Mills, Morling and Tease (1993, p. 36) conclude that the early 1990s has been a period of balance sheet repair, a process which '...exacerbated the effects of other factors holding back investment'. These papers and those other Reserve Bank papers cited above all indicate that lack of access to finance can constrain investment.

This is explicit. What is implicit in the analysis is that monetary policy and credit rationing through its impact on corporate financial structure, which then affects the willingness of financial intermediaries to lend and the willingness of firms to borrow, has an impact on the real economy.

The Reserve Bank research provides us with some indication that financial deregulation led to an increase in the degree of financial fragility in the Australian economy for reasons which had been previously discussed by authors such as Minsky and Kindleberger. Wray suggests that an increase in the degree of financial fragility will lead to a rise in liquidity preference and thus to a rise in the liquidity premium.

7.5 Liquidity preference and liquidity premiums

Keynes (1973, p. 166) defines an individual's liquidity preference as "... given by a schedule of the amount of his resources, valued in terms of money or of wage-units, which he will wish to retain in the form of money in different sets of circumstances". Further, Keynes (1973, p. 167) argues that "the rate of interest is the reward for parting with liquidity for a specified period" and "is a measure of the unwillingness of those who possess money to part with their liquid control over it". Keynes then went on to argue that a necessary condition for liquidity preference for holding money rather than an interest-bearing asset was that *uncertainty* exist with respect to the term structure of interest rates, otherwise people would always hold interest-bearing assets. This suggests that as the level of uncertainty increases, peoples' desire to be more liquid increases so that they wish to hold more money (the short-term asset in Keynes' analysis). That is, an increase in uncertainty shifts the liquidity preference schedule.

The post Keynesians have generalised Keynes concept of liquidity preference so that an increase in liquidity prefence has now come to mean a desire to hold more liquid rather than less liquid assets; not just cash versus interest-bearing assets, as cash has become of less importance in economies with financial institutions which have become much more well-developed than at the time of Keynes' writing. Mott (1985-86, p. 230) "emphasises that liquidity preference is a theory of the desire to hold short- versus long-term assets" as do Dow and Dow (1989). Wray's work suggests that a rise in liquidity preference can be measured by the liquidity premium, that is, by the premium required to induce someone to exchange a liquid asset for an asset with less liquidity. Wray (1990, p.164) states that "[l]iquidity preference can be measured as the interest rate differential required to induce surplus units to exchange bank deposits for long term bonds (or as the interest rate differential required to induce banks to purchase long term bonds on the basis of an issue of shorter term liabilities)", and defines the liquidity premium (Wray (1990, p.161)) as "the differential between interest rates on short term and long term assets". As liquidity preference increases, *ceteris paribus*, the demand for shorter-term assets also increases, so that there is a rise in the price of these assets, and yields on short-term assets fall relative to yields on longer-term assets. Thus, as liquidity preference increases, so too does the liquidity premium.

Whether this was the case in Australia in the 1980s and early 1990s is a difficult matter to determine empirically for several reasons. First, the difference between long-term and short-term interest rates not only reflects liquidity preference but also the effects of monetary policy. The Reserve Bank of Australia tightens monetary policy by operating in the short-term money market to bring about a rise in the official cash rate. This rise then causes other short-term interest rates to increase relative to long-term interest rates. Tightening monetary policy, therefore, appears to cause the liquidity premium to fall independently of any change in liquidity preference if the liquidity premium is to be measured as the interest rate differential between long-term and short-term interest rates. In fact, tightening monetary policy brings about an increase in liquidity preference in the sense that higher short-term interest rates generate an increased demand for short-term assets relative to long-term assets; but has the paradoxical result of causing the liquidity premium to fall as the interest rate differential between long-term and short-term interest rates falls. Therefore, to measure liquidity preference using the liquidity premium is operationally ineffective over time periods when central banks are intervening in financial markets. Second, as Mott (1985-86, p. 230) notes: "There remains, though, a problem of sorting out pressure on rates coming from changes in supplies of and demands for differing maturities due to attempts to play the yield curve *following expectations* rather than liquidity considerations" (emphasis added). Expectations themselves may be influenced by monetary policy. The pure expectations theory of the interest rate demonstrates that the yield curve is made up of short-term interest rates expected to be prevailing at future dates. Thus the yield curve is very heavily influenced by expectations of monetary policy. The Hicksian risk premium model, also known as the liquidity premium model, argues that the yield curve is influenced by expected future short-term interest rates but also by risk premiums demanded on longer-term assets because of the risks of capital losses associated with holding longer-term assets. Juttner (1990, p. 486) notes that "[s]uch premiums are also known as *liquidity* or *term* premiums". This notion of the liquidity premium is consistent with Keynes' definition rather than the definition put forward by the post Keynesian economists as the difference between the yields on long-term and short-term assets. However, because Hicks' liquidity or term premiums depend upon the state of expectations and uncertainty which are unobservable variables, that part of long-term interest rates which is due to the expected future short rate can not be separated from that part of the interest rate which is due to the risk or liquidity premium without a survey of market expectations as was done, for example, by Benjamin Friedman (1979).

Given previous analysis, we anticipate a rise in the liquidity premium at times of increasing uncertainty. In periods of rising liquidity preference, as evidenced by a rising liquidity premium, it is to be expected that there will be an increasing preference for short-term assets, that is, assets with greater liquidity. Thus, a higher liquidity premium must be paid to induce investors to hold longer-term assets when liquidity preference is rising; and a lower liquidity premium can be paid on longer-term assets when liquidity preference is falling. Liquidity preference tends to rise as economic conditions become more uncertain. Recession leads to an increase in uncertainty. To guard against an uncertain future by holding open as many options as possible, economic agents attempt to become more liquid. Their increased liquidity preference is reflected in an increase in the liquidity premium.

Wray also suggested that as liquidity preference increases, banks become increasingly unwilling to meet the demand for credit, so that credit rationing replaces accommodative behaviour. We can see from the empirical analysis of Chapter 5 that the banks rationed credit for business loans in 1986 and to a small extent in 1987; and in 1991. Personal loans were rationed in 1986, and from mid 1989 through mid 1993.

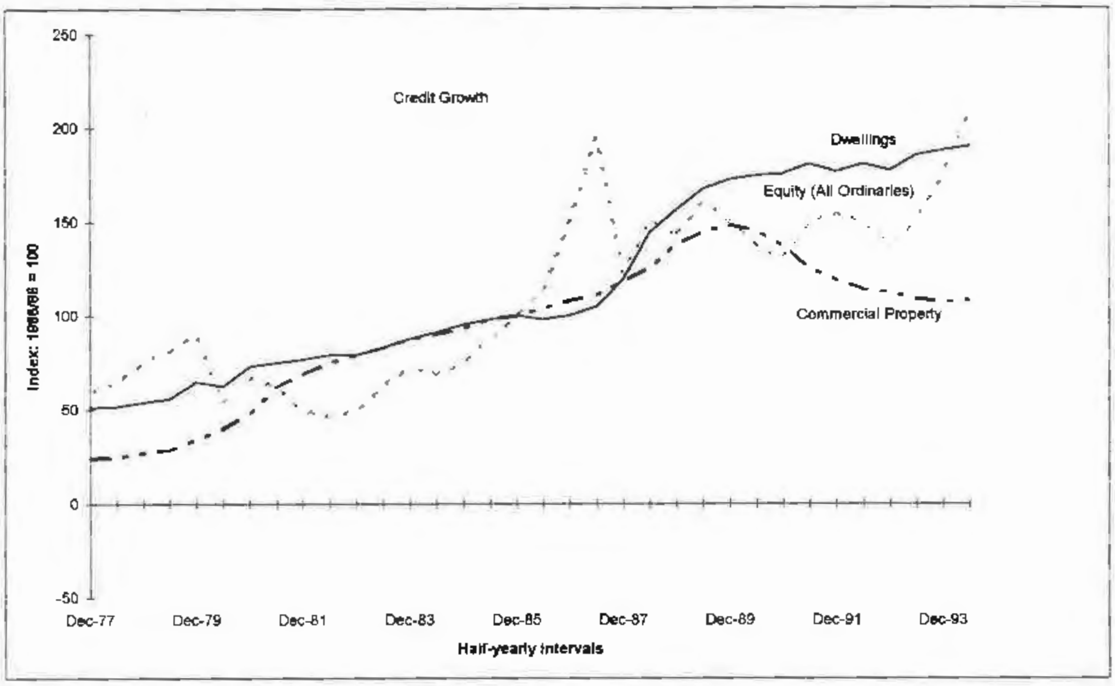
Therefore, discounting the experience of 1986, the limited empirical evidence available suggests that credit rationing occurs in Australia during recession when liquidity preference is rising. It may be the case that with an initial increase in liquidity preference, banks cut back the rate at which they are prepared to expand credit so that some potential borrowers are rationed. Figures 5.3 and 5.9 of Chapter 5 indicate that the supply of business and personal loans fell in 1990 during the early stages of the recession which was almost certainly associated with a rise in liquidity preference. As liquidity preference continues to rise, two further effects may be at work. First, the liquidity preference of potential borrowers is also likely to be rising as is the banks', so that potential borrowers are not as prepared to take on debt as they were earlier in the cycle. Second, potential borrowers may realise that the probability of being rationed has increased, and so may not even bother to apply for credit. This is almost certainly at least part of the reason for the decline in the demand for business loans from 1990 through 1992 (illustrated in Figure 5.3). The decline in the demand for loans may, however, limit the amount of credit rationing that actually occurs. As indicated earlier in this chapter, credit rationing promotes financial fragility when debtors become unable to roll-over or repay loans.

7.6 Asset prices and financial fragility

Mentioned in the introduction to this chapter was that non-convergence to equilibrium in asset markets is indicative of speculative bubbles which tend to be the forerunners of financial fragility. Speculative activity in the housing market, the commercial property market and the share market in the late 1980s all pointed to an increase in financial fragility in Australia as lending institutions became overexposed to these sectors in which prices rose well above the values dictated by 'fundamentals.' Figure 7.1, reproduced from Argy (1995, p. 25) illustrates asset prices in these markets from the second half of 1977.

Figure 7.1 shows that the commercial property market crashed in late 1989. Housing prices rose rapidly from 1987 but the rate of growth in the housing market has slackened since 1990 rather than crashed. This may be because the banks became very reluctant to lend other than for housing so that growth in housing credit actually increased when there was a sharp downturn in business and personal credit growth as indicated by Figure 2.1 in Chapter 2.

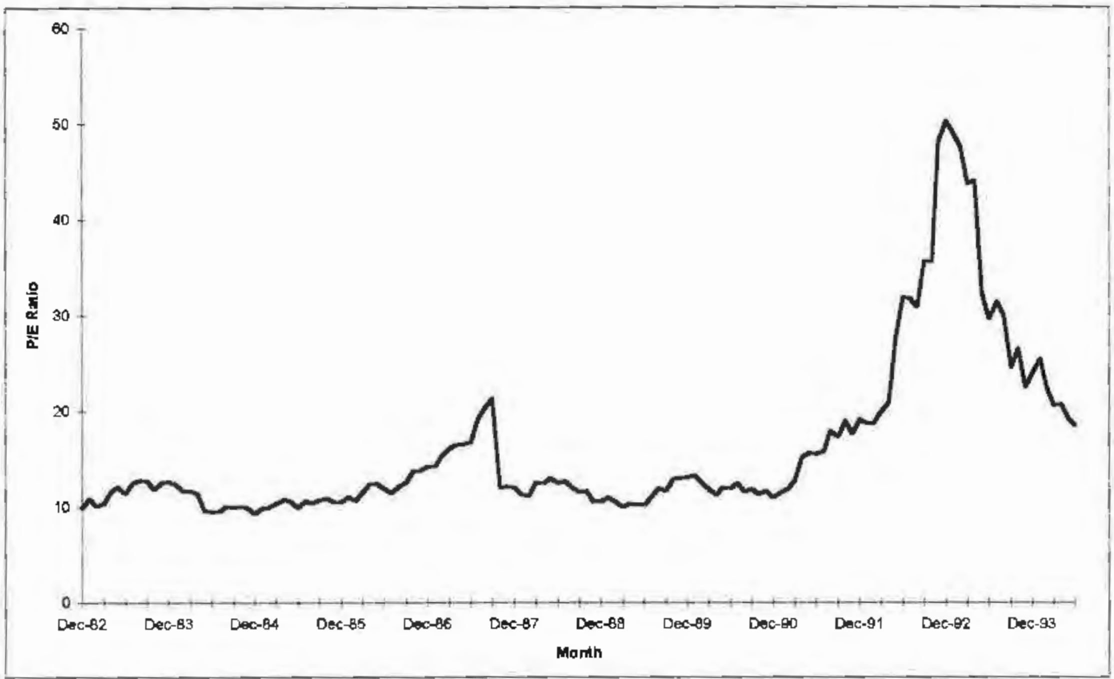
Figure 7.1 Asset price Indexes: 1985-86 = 100



Source: Derived from Argy (1995, p. 25).

Apparent from Figure 7.1 is that equity prices boomed in 1986 and 1987 and burst in the stock market crash of 1987; but boomed again in 1992 and 1993. A symptom of non-convergence to equilibrium in the equities market is a sustained rise in the price-earnings ratio. Figure 7.2 which illustrates the price-earnings ratio from 1982 shows that euphoria was apparent in Australian stock markets in 1986 and 1987, and again in 1992 and so provides additional support for the existence of speculative bubbles. O'Hara (1993) argues that asset prices must rise at least equal to a rate which compensates investors for the risk-free rate, a risk premium and a bubble premium. If investors believe that the rate of return will not be sufficient to return a bubble premium, then asset sales will result, the bubble will burst and asset prices will crash.

Figure 7.2 The all-ordinaries price-earnings ratio: December 1982 to June 1994



If, as previously suggested in this thesis, financial deregulation can be considered to have been largely completed by the beginning of 1984, Figure 7.1 suggests that large increases in asset prices have followed upon financial deregulation. It is unlikely that, had financial markets not been deregulated, economic agents would have had sufficient access to credit to have been able to finance speculative activity to the extent that has occurred since 1986. This suggests that financial deregulation did, in fact, contribute to financial fragility.

Mullineux (1990) describes how Revell (1978 and 1986) is struck by the similarity of bank failures in Europe and the United States. Revell suggests the possibility of a common cause, this being the relaxation of structural controls over the banking system which engendered increasing competion in the banking sector, and which was accompanied by accelerating inflation and general euphoria. Davis (1992) is similarly struck by the relaxation of structural controls as the harbinger of financial instability across countries. Villaneuva and Mirakhor (1990) argue that macroeconomic stability is a prerequisite for successful financial liberalisation otherwise the accelerating inflation and general euphoria pointed to by Revell will lead to financial instability and systemic problems.

Financial liberalisation in Australia can be said to have occurred when macroeconomic conditions were not particularly stable. The early part of financial deregulation took place in the early 1980s when the economy was in recession but was also experiencing high rates of inflation when compared with our major trading partners. Although, as financial liberalisation progressed, the economy expanded rapidly, inflation remained comparatively high. There was an explosion in the amount of credit created even though interest rates rose to levels which were very high by historical standards. Many loans were made to high risk borrowers who were engaging in speculative activity further exacerbating the instability arising from high inflation. Many of these loans were made by subsidiaries of the banks which, in some cases, deliberately pursued policies of high margin (and thus risky) business where the probability of default on loans was high.

Although financial liberalisation meant in its initial stages that credit rationing became less of an issue, part of the reason lay in the derailment of implicit contracts which occurred because loans became largely variable-rate rather than fixed-rate loans,[4] and part of the reason lay in the severity of moral hazard where the dubious loans made by some banks and bank subsidiaries resulted in the necessity for intervention by state governments, in particular, to overcome threats to systemic stability posed by large-scale defaults. Some of these episodes are discussed in the following section.

7.7 An Australian episode of financial fragility

In the late 1980s and early 1990s Australia suffered an episode of financial fragility, which given the previous analysis of this thesis, could have been avoided with the use of more prudent banking practices and, perhaps, stronger regulatory controls over the non-bank financial institutions as well as the banks. Sykes (1994, p.607) indicates that the rough total of write-offs and provisions made between 1989 and 1991 by the four major banks, the state banks and foreign banks was $28 billion and estimates that $20 billion of this was due to imprudent lending. These imprudent lending practices were largely due, as the review of banking and deregulation, *A Pocket Full of Change* (1991, p. 217) pointed out, to the tendency of banks to become excessively exposed to speculative commercial property involvement and other asset-price speculation. The cases of the State Bank of Victoria (SBV) and its merchant bank subsidiary, Tricontinental, and the State Bank of South Australia (SBSA) and its finance subsidiary Beneficial Finance will now be considered as case studies representative of

[4] Recall from Chapter 4 that the existence of implicit contracts implies that banks will hold loan interest rates more stable than the opportunity cost of funds to banks, but that this implies the possibility of credit rationing.

the actions of financial institutions which led to the development of financial fragility in Australia in this period.

The SBV first purchased a share in Tricontinental in 1978[5], when banks were prevented by regulation from competing with merchant banks in the short-term money market. Following the abolition of this rule in 1984, the SBV considered selling its share but an investigation of Tricontinental by Touche Ross found that Tricontinental had a very risky loan portfolio which caused potential buyers to back off. The SBV then purchased the remaining 75 % of Tricontinental in 1985 although the board of SBV recognised that Tricontinental had several loans which were so large that if only one of these loans failed, Tricontinental's capital base would also be wiped out. A large proportion of loans was for property development, and loans in arrears had not been closed off because of the implications for the value of the underlying security. Tricontinental's takeover by SBV meant that Tricontinental's credit rating improved so that it could borrow more in wholesale markets at lower cost and thus expand its already dubious asset portfolio. Because of the increasingly competitive nature of banking, the managing director of Tricontinental decided to forego fine-margin business and pursue higher-margin, higher-risk business, and offset the risk by lending on security which subsequently proved to be of little value. Sykes (1994, p. 446) states that: "[c]redit risk evaluation never included a formal statement of the degree or nature of credit risk associated with a loan proposal". To make things worse, there was no interaction between officers of Tricontinental and the SBV. Thus, the SBV did not know that Tricontinental was lending to clients to whom the SBV had refused credit or

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[5] The facts of the case studies are largely based on the discussion in Sykes (1994).

to whom it had also made loans. Further, Sykes (1994, p. 448 and p. 450) indicates that by 1986, Tricontinental's largest exposure to a client was three times its capital base, and 43 % of the entire SBV's group capital base. Tricontinental's four largest credit exposures exceeded the SBV's capital base.

In 1988 it was proposed by SBV that Tricontinental be sold to the Australian Bank. However, the Reserve Bank felt that Tricontinental had an undue concentration of risk in its lending portfolio and that its capital adequacy was very low. The Reserve Bank thus withheld consent for the takeover unless Tricontinental met certain conditions related to the degree of exposure to clients, provision for doubtful debts, and a minimum risk-weighted capital adequacy ratio of 10 %. Later in 1989, the Reserve Bank became concerned that Tricontinental could not meet the criteria necessary for it to become a bank. Consequently, the Victorian government integrated Tricontinental into the SBV which was to fully guarantee Tricontinental's liabilities. However, the losses arising from Tricontinental's loan portfolio were too large for the SBV to absorb, and the Victorian government first supported the SBV by injections of capital, and then subsequently sold the SBV to the Commonwealth Bank in 1990.

Tricontinental acted in accordance with the neo-Keynesian view of how financial institutions will operate in deregulated financial markets. Although loans were made to risky customers, higher interest rates and lending against collateral were supposed to offset the risks posed to the merchant bank, and through it, the SBV. Tricontinental formed quite specific rules of thumb with respect to whom it would grant credit and its manner of dealing with targeted clients which reflects the post Keynesian position of how the credit process works. Post Keynesians tend to argue that creditworthiness is determined by expected returns on projects and the value of collateral. (See, for example, Basil Moore (1988).) Loans were concentrated in property where in the mid to late 1980s expected returns were high and increasing; and secured against property or shares, the value of which rose with the asset-price inflation which occurred in the 1980s, which by increasing the borrowers' net worth enabled them to borrow even more heavily. A large proportion of these loans was invested in speculative activity. The leverage ratios of both the borrowers and Tricontinental increased making them more susceptible to adverse shocks such as the stock market crash in 1987 and the later property market crash which reduced the value of much of the security available to Tricontinental when some of its major borrowers defaulted on their loans. This description is consistent with the description of the development of financial instability posited by Minsky's financial instability hypothesis.

The lessons to which the experience of Tricontinental and the SBV point are lessons to which this thesis has previously referred. First, adequate loan assessment procedures should always imply the possibility of credit rationing no matter how high an interest rate the potential borrower is prepared to pay. Charging high-risk borrowers high interest rates will not adequately compensate financial institutions for the risks taken on with risky loans. Rather, the high interest rates charged will increase the probability of default on loan repayments.

Second, when borrowers do default *en masse* over a relatively short period of time as occurred with Tricontinental and across most financial institutions at the time, the collateral that borrowers have pledged as security against loans tends to lose value as first the borrowers and then the financial institutions attempt to liquidate the assets, in order to meet loan repayments or servicing costs in the case of debtors, or recover their losses in the case of financial institutions. Asset price and debt deflation resulted in Australia in the late 1980s in the manner described by Minsky. Thus, a pledge of collateral even to 100 percent of the value of a loan is insufficient to compensate financial institutions for making particularly risky loans because the future value of the collateral should it be called to book will be subject to uncertainty.

Third, risk-weighted capital adequacy requirements should be in place. As previously discussed, capital allows financial institutions to absorb some losses, and should ensure that shareholders place some constraints on the riskier loan activities proposed by these organisations. Appropriate capital adequacy requirements will ensure that a financial institution does not become overly exposed to one or several risky clients as did Tricontinental and the SBV such that if only one, or several, of these clients defaults, the capital base of the financial institution will be wiped out. In addition, risk weightings will enable financial institutions to more effectively assess the relative risks of various client groups.

The SBSA provides another case study to which the above lessons are pertinent. The SBSA pursued a deliberate policy of expanding market share at the expense of short-run profitability, so as to ensure long-run profitability. This was to be achieved by expanding geographically, both interstate and overseas, as the small South Australian and Northern Territory markets allowed only limited scope for growth. The SBSA's 1985-90 strategic plan was to procure 30 % of the corporate and international business in South Australia, in addition to all other available interstate and overseas business, to aim for profitability equal to 70 % of the profitability of the four major Australian commercial banks, and to cover a range of fringe banking activities through the acquisition of subsidiaries. Beneficial Finance was one subsidiary which was to be largely responsible for SBSA's downfall. In 1991, the SBSA announced a billion dollar loss. Three subsequent bail-outs by the South Australian government finally totalled more than $3 billion.

To maintain the Reserve Bank's required capital adequacy ratio at the time of 5 % as SBSA expanded from 1985, capital was injected by the South Australian government through the South Australian Financing Authority (SAFA). However, the injection of capital was really in the form of debt rather than equity because it carried a fixed interest rate. This meant that to pay interest, the bank had to increase reported profits so that there was an incentive to understate the provisions for bad and doubtful debts. This incentive for imprudent management practices with respect to the monitoring of the loan portfolio was exaggerated because of the fact that the SBSA was required to pay dividends to the state budget so that the state Treasurer had little incentive to closely monitor the bank. Too close a check on SBSA practices could have reduced state revenues.

Beneficial Finance was significantly exposed to the property market when the stock market crashed in 1987. Officers at the SBSA recognised that the crash was likely to precipitate a downturn in economic growth to the detriment of the property market and the quality of SBSA's loan portfolio and that of its subsidiaries. A lending quality review pointed to the need for improved credit procedures, but the recommendations of the review were subsequently ignored in SBSA actions. Some very large and dubious loans were made to Equiticorp, one through Beneficial Finance, because for

SBSA to have carried out the deal itself would have placed SBSA over the Reserve Bank's prudential limit for capital adequacy. SBSA support was sought and given either by itself or through it to Beneficial Finance and SGIC for loans for property developments which were massively overvalued at the time such as the State Bank centre, the East End markets, the Myer-REMM centre, and 333 Collins Street in Melbourne. The SBSA also became exposed to the London and New Zealand property markets. The commercial property market crashed exposing Beneficial Finance, SGIC and the SBSA to such an extent that the SBSA had to be bailed out by the state government. One billion dollars of SBSA's losses derived from Beneficial Finance. The SBSA was subsequently divided into a 'bad' bank and a 'good' bank, with the bad bank taking on all the bad and doubtful debts. The 'good' bank was sold in 1995 to Advance Bank.

The experiences of both the SBV and the SBSA point to the importance of adequate monitoring and prudential supervision. Legislative responsibility for, and thus responsibility for monitoring and control of, state banks lay with state governments and not with the Reserve Bank. However, state banks were subject to voluntary Reserve Bank supervision. This division of responsibilities seems to have worsened the problems experienced by the state banks for two reasons. First, state governments "appeared to believe the Reserve Bank could be relied upon to protect the capital of the bank. However, in its normal supervisory procedures the Reserve is charged with protecting the depositors, not the shareholders".[6] Second, the Reserve Bank seems to have been unaware of the extent to which state governments were relying on the

[6] *A Pocket Full of Change* (1991, p. 190).

supervision of the Reserve Bank, and the Reserve Bank treated the state banks more leniently than it would have private banks because the supervisory arrangements with the state banks were voluntary. Although the Reserve Bank monitored the SBV and the SBSA, and were aware of their difficulties prior to the respective state governments knowing of the difficulties, the Reserve Bank had no effective power to wield over the state banks.

The elements giving rise to financial instability are apparent in the two brief case studies described above. On the demand side, deregulation gave potential borrowers much easier access to credit than they had previously enjoyed. Much of the borrowed money was used for the purchase of assets based on the prospect of speculative gains in an inflationary environment. The increased demand for these assets led to further asset price inflation which increased the net worth of borrowers so that they looked to banks and other financial institutions to have strong capital positions and valuable collateral against which loans could be secured. The apparent improvement in borrowers' capital and collateral positions both reduced the default premiums on loan interest rates and enhanced their borrowing capacity.

On the supply side, financial deregulation led to increased competition amongst financial institutions and the pursuit of market share. Because market share was perceived to be more important than profits, and because there was an understanding that the higher interest rates which deregulation allowed would compensate financial institutions for increased risk, they took on riskier loan business. Inadequate credit assessment procedures and lack of prudential supervision led to a blow-out in bad and doubtful debts and inadequate capital adequacy with which to buffer the financial institutions from the losses incurred by bad debts. Tight monetary policy imposed on the economy by the Reserve Bank in 1988 and 1989 in order to reduce asset price inflation led to a sharp reduction in the value of property to which most banks and their subsidiaries had become overexposed. Large-scale loan defaults occurred. Banks became reluctant to lend other than for housing, reducing the supply of loans as is illustrated in Chapter 5. Because the demand for loans also shifted in, credit rationing was not much of an issue at an aggregate level other than in the market for personal loans. However, there was anecdotal evidence to the effect that small business was finding it very hard to obtain debt finance.

A move to credit rationing by lenders was to be expected in terms of the analysis with respect to decision-making under uncertainty discussed in Chapter 6. All of the ingredients likely to lead to financial fragility were in place. A regulated environment until the early 1980s meant that Australia had not experienced conditions of financial fragility for many years. Thus, the subjective probability of the banks that nature would draw on a diasastrous distribution approached zero. As indicated in Chapter 6, this will have caused the banks to assess that their own probabilities of insolvency had fallen, so that they were prepared to make loans to borrowers with lower capital positions, or loans of greater size or at higher loan interest rates; and deregulation allowed the banks themselves sufficient access to wholesale funds to be able to do these things. Asset price inflation exaggerated the capital positions of borrowers and project specific returns experienced by them so that banks became even more willing to make loans. When nature did draw on a disastrous distribution - monetary policy was tightened much more harshly than anyone could have envisaged prior to deregulation - the probability of the banks' insolvencies rose dramatically because of the negative impact on project-specific returns, capital positions and collateral leading to a large-scale increase in loan defaults. In terms of the Reliability Condition, $\frac{c}{w} > \frac{k}{gw}\frac{1}{\eta} + \frac{l}{g}\frac{1-\eta}{\eta}$, economic conditions at the end of the 1980s meant that the Reliability Ratio, $\frac{c}{w}$, was falling, as the threshold which the reliability ratio needed to exceed in order that banks make loans to most potential borrowers was increasing. With the decline in the gap between the reliability ratio and the threshold, banks became less flexible in behaviour so that loan behaviour became more governed by conventions and rules of thumb. This led to a reduction in the supply of loans and to a potential increase in credit rationing. That credit was not rationed particularly severely in Australia was due to the fact that the demand for loans also fell. Banks, in fact, tightened lending criteria quite considerably in the early 1980s.

The discussion above, although confined to the case studies of Tricontinental and the SBV, and the SBSA and Beneficial Finance where the consequences of credit activity were very severe, is representative of the loan behaviour of most other financial institutions in Australia at the time. Most banks became overexposed to the commercial property market and made insufficient provisions for bad and doubtful debts. *A Pocket Full of Change* (1991, p. 245) states: "The results for the major banks, the State banks and many of the new entrants has seen an abrupt reversal in the fortunes of those organisations which can be illustrated by the significant leap in unproductive accounts, bad debts and the impact on profits". Furthermore, evidence given by bankers to the review of banking and deregulation indicate that banks 'forgot the risks we were taking on'.

Increasing financial fragility, however, did not lead to systemic instability in Australia in the late 1980s and early 1990s. Although the collapse of the Pyramid Building Society in Victoria, which had also become heavily exposed to the commercial property market, led to contagious runs on two former building societies, the Metway Bank and the Bank of Melbourne, the problem did not become system wide. Where banks became unsound as with the SBV and the SBSA, orderly exit from the banking arena was assisted by the state governments involved. That systemic instability did not eventuate was probably due to several major factors. First, the fact that the capital adequacy ratios of the four major commercial banks in Australia which are responsible for by far the major proportion of banking business always remained above the Basle ratio of 8 % so that deposits at these banks were never threatened. Second, there was a public perception that it is the responsibility of either the Reserve Bank, or the state governments in the case of state banks, to protect the interests of bank depositors. This prevented the contagion which could have resulted from the necessity to bail-out the state banks.

7.8 Conclusion

This chapter considered the interrelations between decision-making under uncertainty, credit rationing and financial instability. Because it is mostly the post Keynesian literature from which the analysis of financial crises derives (other than that based on historical surveys), this chapter considered Minsky's financial instability hypothesis and Wray's analysis with respect to financial instability as representative of contemporary Keynesian analysis of financial crises. A survey of recent research from the Reserve

Bank lent some support to the view that, in Australia, financial fragility was rising in the second half of the 1980s for the reasons cited by Minsky and Wray such as increasing asset prices and rising debt-equity ratios. It was considered that an increase in the degree of financial fragility will lead to a rise in liquidity preference and so to an increase in the liquidity premium. However, to make the concept of the liquidity premium operationally effective for empirical work requires that the difference between yields on short-term and long-term assets be separated into two components: one due to the difference between current and expected future short-term interest rates, and the other due to the risk or term premium demanded on long-term assets because of the risk of capital losses associated with holding these assets due to uncertainty about the future. This separation, difficult because it depends on unobservable expectations and uncertainty, was not attempted in this chapter. However, the model of decision-making under uncertainty discussed in Chapter 6 was applied to Minsky's and Wray's work to show that as uncertainty increases, liquidity preference rises so that credit rationing replaces accommodative behaviour by banks.

Two case studies, those of the SBV and the SBSA, were presented to illustrate the circumstances which led to increasing financial fragility in Australia; and to indicate the means by which financial stability can be promoted. These measures are taken up in the next chapter where the issues for monetary policy and prudential control that are indicated by this and previous chapters are further discussed.

Chapter 8 Issues for Monetary Policy and Prudential Control

8.1 Introduction

The issues for monetary policy and prudential control arising from this thesis are related to the central bank's major functions. Central banks are, in general, charged with four major functions, these being the maintenance of the overall stability of the financial system, maintenance of a viable payments mechanism, price stability and counter-cyclical operations. The first two of these functions are very closely linked. A viable payments mechanism relies on the maintenance of financial stability and financial stability is arguably the most important of the central bank's roles. Price stability and counter-cyclical operations also have ramifications for financial stability. In this thesis, I have dealt with three major issues that have implications for the central bank's implementation of monetary policy and prudential control: the transmission mechanism of monetary policy, credit rationing as a component of the transmission mechanism, and the impact of uncertainty upon liquidity preference and the implications of that for credit rationing and financial instability.

This chapter proceeds by first discussing the role of the central bank in the transmission mechanism based on the work in Chapter 3 and concludes that monetary policy, because it relies on the use of instruments which are not particularly adequate as control variables, has a very imprecise role in counter-cyclical operations. The inadequacies arise because changes in the target variables both cause, and are caused by, changes in the instruments of monetary policy. That is, there is two-way causality between the target variables and the instrument variables so that there is some difficulty in determining the effects of monetary policy. It is suggested that to improve the transmission mechanism where interest rates are the instrument of monetary policy requires the announcement of changes in interest rates together with the reasons for those changes and that changes in interest rates be made in larger steps than hitherto.

Second, credit rationing as a component of the monetary policy transmission mechanism is discussed. The implication for the monetary authorities of much of the analysis of credit rationing upon which this thesis is based is that the central bank can unintentionally increase the amount of non-price credit rationing by tightening monetary policy so that base interest rates become higher and less stable. This can exacerbate the downturn of the economy beyond the downturn which would occur in the absence of non-price credit rationing, and may therefore lead to financial fragility.

Since it is the role of the central bank to prevent financial fragility from developing into systemic instability, the next section of this chapter discusses measures, in particular, capital adequacy requirements and deposit insurance, which either inhibit the development of financial fragility or prevent it from developing into systemic instability. I suggest either that the current legislation be changed so as to give the Reserve Bank of Australia *legislative* responsibility for financial stability, or that deposit insurance be introduced into Australia so as to *ensure* the depositor protection which is currently enshrined in the legislation, but for which no provision has been made in the event of insolvency of one or more major banks.

Because, as Chapter 7 demonstrated, financial fragility and systemic stability is affected not only by the behaviour of the banks but also by the behaviour of the NBFIs, I conclude the chapter with some discussion as to whether the *Financial Corporations Act 1974* which extends the Reserve Bank's regulatory controls to the NBFIs should have been proclaimed.

8.2 The role of the central bank in the transmission mechanism

The functions of the central bank which generally receive most attention are those of price stability and counter-cyclical operations. The central bank seeks to achieve these goals through its implementation of monetary policy. The Granger causality tests in Chapter 3 on the transmission mechanism which concentrated on counter-cyclical operations indicate that, since financial markets have been deregulated in Australia, M3, broad money and credit all display two way causality with nominal income and nominal private final demand. That is, there are feedback effects which exist between these variables and income. For example, M3 leads to changes in income *and* changes in income lead to changes in M3. There was also two way causality between broad money and private final demand. The policy implication of these Granger causality tests is that the Reserve Bank of Australia can't conduct monetary policy by systematically reacting to observed movements in either of these monetary aggregates or credit, all variables which have two way causality with nominal GDP and nominal PFD. The Granger causality tests also suggested that nominal short-term interest rates and the yield spread show two way causality with nominal GDP and nominal private final demand.

Grenville (1995, p. 20) suggests the following classifications for the transmission mechanism of monetary policy: intertemporal substitution, the exchange rate, cash flow, wealth/assets effects, and credit rationing effects; and tells us that the cash flow channel has become more prominent in the Reserve Bank's thinking. This thesis has touched on all of these channels other than the exchange rate channel. An increase in interest rates can lead to currency appreciation, thereby reducing net exports and economic activity. However, at other times in Australia, the Reserve Bank has responded to what it thinks an inappropriately undervalued exchange rate by increasing interest rates. The former implies a positive correlation between interest rates and the exchange rate, and the latter a negative correlation. As indicated by Grenville, separation of these two effects is difficult.

Suppose that the Reserve Bank wishes to tighten monetary policy.. The transmission channels suggested above lead one to believe that higher cash rates which then feed through into higher interest rates at the short end of the maturity spectrum will impact negatively on aggregate demand in the following ways. First, higher interest rates in the present should create an incentive for current saving and create a disincentive for current consumption which will lead to a reduction in aggregate demand. However, for this effect to work, private final demand must be sensitive to changes in the interest rate, something that is not apparent, other than with respect to the nominal 2 year Treasury bond yield, when reference is made to the Granger causality tests, the results of which are presented in Chapter 3.

Second, higher interest rates will lead to a nominal appreciation of the Australian dollar which, if it brings about a real appreciation, will reduce net exports and aggregate demand. However, changes in the real exchange rate are notoriously difficult to achieve in Australia when reliance to achieve them is placed on changes in the nominal exchange rate. This is because Australia is so heavily reliant upon imported goods and nominal changes in the value of the currency feed into changes in the price level so that any nominal appreciation (depreciation) is offset by negative (positive) changes in the domestic price level so that the real exchange rate remains constant.

Third, high nominal interest rates, because they increase debt servicing costs, reduce the cash flow available to firms and this tends to impact negatively on aggregate demand through reduced investment if higher interest rates are combined with a liquidity constraint so that firms can't borrow to meet the higher cash flows required to service their debts.

Fourth, high interest rates will impact negatively on bond prices and thus also have an impact on equity prices in the way described by Tobin's portfolio balance model discussed in Chapter 3. However, price movements in assets, particularly in equities and in property are often based more on expectations than any change in monetary policy. This means that goods price inflation and asset price inflation may not move in tandem and monetary policy which has the aim of dealing with goods price inflation may be inappropriate policy to deal with asset price inflation and *vice versa.*

Fifth, tight monetary policy may cause bank loan rates to rise to the optimal interest rate, as discussed in Chapters 4 and 5. Rather than further raising interest rates in the face of an excess demand for loans, banks will ration credit by non-price means. Chapter 5 presented some evidence that this may have occurred in a small way in Australia in the market for personal loans.

All of the above points suggest that, in fact, monetary policy based on changes in interest rates may not be all that effective in bringing about changes in aggregate demand unless the changes in interest rates are relatively large so that they impact upon expectations. Thus, it was suggested in Chapter 3 that all changes in interest rates and the reasons for those changes should be announced. This has been the case in Australia in recent years. Changes in interest rates should be made in larger steps than hitherto, otherwise the Reserve Bank may be changing interest rates only in the region in which expenditures are interest-rate inelastic in which case monetary policy is ineffective. Unless both of these actions are undertaken, any initial variation of interest rates may be ineffective necessitating further actions by the Reserve Bank, increasing the lag between the implementation of monetary policy and its impact upon economic activity.

As indicated in Chapter 3, no simple Keynesian description of the transmission mechanism is adequate to the explanation of the interaction between monetary policy and nominal or real activity in Australian financial markets since deregulation. At best, monetary policy can temper fluctuations in the business cycle according to Grenville (1995, pp. 31-32): "For all the imprecision, monetary policy still has a role to play. .... The issue is: can policy contribute to buffering the swings of the business cycle and keeping a good degree of price stability? ... There seems to be no substitute for grappling with the changing, imprecise relationships between the monetary policy instrument - short-term interest rates - and the final objectives".

It was also concluded in Chapter 3 that, because there is two-way causality between changes in credit and changes in nominal activity, a credit channel as distinct from a money or interest rate channel is also part of the transmission mechanism. This suggests that quantitative and qualitative controls over the amount and type of credit lending may be an appropriate tool of monetary policy. These issues are taken up below.

8.3 Credit rationing as a component of the transmission mechanism

As discussed in Chapter 4, the Campbell Committee held the neo-Keynesian view that removal of regulatory impediments from banks would eliminate non-price credit rationing as banks could raise interest rates to compensate for making riskier loans. Thus, non-price credit rationing was to be eliminated as part of the monetary transmission mechanism. The Committee demonstrated little awareness of the issues pointed to by the New Keynesian and post Keynesian analyses of credit markets which demonstrate that, even in deregulated financial markets, non-price credit rationing will still arise if banks are profit maximisers provided that there is not too great an incentive for them to engage in morally hazardous behaviour.

The New Keynesian analysis of credit rationing canvassed in Chapter 4 based on asymmetric information and adverse selection and adverse incentive effects suggested that non-price credit rationing should still be a part of the monetary policy transmission mechanism even when financial markets are deregulated. This is because it is not always profitable for banks to further raise interest rates to compensate for making riskier loans as the increase in interest rates may increase borrowers' probabilities of default to such an extent that the banks' expected returns fall as a result of the rise in interest rates. The higher the loan interest rate, the greater are borrowers' probabilities of default. The implication of this for monetary policy is that if central banks use interest rates as the instrument of monetary policy, then they should expect that banks will increase the amount of non-price credit rationing as the central bank tightens monetary policy. As the official cash rate rises, so too will loan interest rates be similarly affected in most cases. Higher loan interest rates lead to a backward bending loan supply curve which raises the possibility of non-price credit rationing. Thus, the negative impact on aggregate demand of tighter monetary policy may work directly through interest rates but may also be accentuated by credit rationing. This is even more likely when tightening monetary policy raises the level of uncertainty in the economy so that the banks' subjective assessment of the probability of default of their customers is that this will rise, so that banks resort to a greater amount of rule-governed behaviour and ration credit rather than making loans to all potential borrowers who are prepared to pay high loan interest rates.

The New Keynesian analysis of credit rationing based upon implicit contracts suggested that profit-maximising banks will keep loan interest rates more stable than the opportunity cost of funds to the bank, but that the trade-off for potential borrowers was a possibility of being non-price credit rationed. The analysis showed that credit rationing was less likely, the lower and more stable the opportunity cost of funds to the banks, which since deregulation of Australian financial markets has largely been determined by monetary policy actions of the Reserve Bank. Recall from Chapter 4 that the stability of a given loan interest rate depends upon the banks' perception of the *range* of cost of funds at which they will provide loans at a given rate. Banks will become less willing to maintain a stable lending rate as they become increasingly uncertain with regard to the future cost of funds. Because implicit contracts give rise to more stable borrowing rates than do loans negotiated in spot markets, investment plans can proceed more smoothly if the monetary authorities ensure stability in financial markets. In addition, credit rationing will also decrease if fiscal and monetary authorities engage in actions which increase the expected return to investment projects. Financial markets have been far more unstable since deregulation than prior to deregulation. In addition, tight monetary policy raised interest rates to very high levels in 1988 and 1989. Both of these factors combined to increase the level of uncertainty, reduce the use of implicit contracts and reduce the expected returns to investment projects.

Post Keynesians argue that loans are allocated to customers on the basis of creditwortbiness. Whether a particular customer is creditworthy is determined with reference to conventions. In 'normal' or 'tranquil' times, most potential borrowers will receive loans as banks find it profitable to expand their balance sheets. However, increasing debt-equity ratios for both banks and borrowers may lead to an increase in the degree of financial fragility in the economy. This will cause an increase in uncertainty and a rise in liquidity preference; and will thus cause lenders to engage in a greater amount of rule-governed behaviour and ration credit more heavily than prior to the rise in liquidity preference. Thus, even in the absence of any monetary policy actions on the part of the central bank, the normal workings of a capitalist economy can lead to loan behaviour which promotes the development of financial fragility as discussed in Chapter 7. As the development of financial fragility progresses, credit rationing will ultimately arise. There is a possibility that the increase in financial fragility will spill over into systemic instability if, in response to the increase in financial fragility, the central bank tightens monetary policy. As it is one of the most important roles, and arguably the central role, of the central bank to maintain financial stability, the central bank must look to other measures to either inhibit the development of financial fragility; or if it does arise to prevent it from being transformed into systemic instability. Some of these measures are discussed in the next section.

8.4 The role of the central bank in maintaining financial and macroeconomic stability

The behaviour of banks is affected by the behaviour of the central bank based upon the latter's functions of maintaining financial stability and maintaining the viability of the payments mechanism. Chapter 4, with reference to the New Keynesian theory of credit rationing based upon asymmetric information demonstrated that when lenders do not have access to lender of last resort facilities, they ration credit. When lenders do have access to lender of last resort facilities, they may increase interest rates above the bank optimal interest rate which applies when adverse selection and adverse incentive effects are present, and make an increased number of riskier loans. However, even when lender of last resort facilities are available, so that banks are increasing the number of loans above the number warranted by the risk of default of borrowers, banks do not achieve the Walrasian equilibrium indicated by the point where the loan demand schedule intersects the backward bending loan supply schedule. Lender of last resort facilities, therefore, cause banks to engage in riskier behaviours than otherwise would occur. Should, then, central banks, abolish lender of last resort facilities, or heavily penalise access to those facilities, or encourage deposit insurance?

Without overall stability of the financial sector, the central bank will be hard pressed to achieve its other functions. Although not directly stated in the legislation, the Reserve Bank of Australia recognises that it has (Reserve Bank evidence cited in *A Pocket Full of Change*, p. 184) 'responsibility for ... the integrity of the payments system and overall stability of the financial system'. The *raison d'etre* for central banks is financial stability. Without orderly financial markets, economic agents lose faith in financial institutions leading to a costly flight of funds away from the financial sector, costly both in terms of imposing additional transactions costs on agents and in terms of imposing additional risks on those who borrow and lend. Financial instability leads to the threat of contagion, where the illiquidity or insolvency problems being experienced by one financial institution can spread to other essentially sound institutions as depositors withdraw funds from these latter institutions and cause them, in turn, to become illiquid and ultimately, insolvent. Ultimately, it is only the central bank in its role as lender of last resort which can stem contagion. It can do this because it can issue liabilities of fixed nominal value even though there is no asset backing to these liabilities and will know that the private sector will accept these liabilities upon the basis of its guarantee. Although commercial banks can and do issue liabilities of fixed nominal value with limited asset backing, they can't be certain that other agents will be prepared to accept their liabilities.

Goodhart (1987 and 1988) argues that central bank lender of last resort support is necessary because banks make loans of fixed nominal value to borrowers as information costs prevent an accurate assessment of the returns to projects for which the loans were made. Thus, both banks and borrowers prefer that liabilities be denominated in fixed nominal terms - banks, because there will be a high degree of covariance between the values of assets and liabilities denominated in fixed nominal terms, and borrowers, because the costs associated with monitoring bank behaviour are lessened and the incentives for banks to perform well are increased. However, as Goodhart (1988, p. 100) goes on to say: "The combination of the nominal convertibility guarantee, together with the uncertainty about the true value of bank assets, also leads, however, to the possibility of runs on individual banks and systemic crises". It is this possibility which makes central bank supervision and support necessary.

Thus, the case for the central bank's role as lender of last resort rests on its ability to maintain financial stability. Gardener in Gardener (1986, p. 21) describes the role well: "The central bank's responsibility as lender of last resort is to prevent the generalized fall in asset values occasioned by the position-making actions of private economic units who have become increasingly dominated by units with more risky financing positions". The central bank can undertake this responsibility, and the commercial banks cannot, because, as indicated above the central bank can issue liabilities of a fixed nominal value and have the private sector accept these liabilities on the basis of its guarantee.

Wray (1990) argues that, because of the importance of financial stability to the macroeconomy, the central bank should act as a willing lender of first resort, rather than as lender of last resort, because if the central bank constrains the amount of reserves that are available to the banks, their leverage ratios are likely to be increasing as they expand on the basis of a smaller liquid base so that they become at even greater risk of failure. Furthermore, Chapter 6 showed that as time passes following financial crises, the subjective probability that another crisis will occur falls below the objective probability so that banks engage in lending behaviour not warranted by objective probabilities. The increased number of riskier loans leads to an increasing risk for the banks of solvency and liquidity problems. Because illiquid and/or insolvent banks can lead to systemic crises, there is a need for central banks to first put in place regulatory mechanisms which minimise the risks of banks becoming illiquid and/or insolvent. Such mechanisms include capital adequacy requirements, some degree of supervision, liquidity requirements and limits on large credit exposures. Second, central banks should provide access to lender of last resort facilities. In Australia, the Martin report on banking and deregulation, *A Pocket Full of Change* (1991, p. 199), notes: "These [lender of last resort] loans are no longer available to banks as a right but can be made by the Reserve at its discretion. To maximise the incentive for banks to conduct their affairs in a prudent manner, it is not desirable for the Reserve Bank to spell out the conditions under which it is willing to make such loans. It should, however, re-affirm that the power exists." Wray does recognise that the central bank acting as lender of first or last resort will give rise to morally hazardous behaviour, and so he argues that the central bank should police the quality of bank assets. In Australia, this is done through the Reserve Bank's prudential supervision of banks outlined in Prudential Statements. The main aspects covered by these Prudential Statements relevant to the quality of assets are (Council of Financial Supervisors, (1995), p. 41):

- minimum capital requirements;
- liquidity management, including the Prime Assets Requirement ratio;
- limits on large credit exposures; and
- identification and reporting of impaired assets.

The principal regulatory constraint now imposed on Australian banks is the capital adequacy requirement.

8.4.1 Capital Adequacy

Australian banks are currently required to have a ratio of capital to risk-weighted assets of not less than 8 per cent, with at least 4 per cent in core capital which mostly comprises shareholders' funds. The current capital adequacy requirements relate to *credit* risk, principally the probability of default of the counterparty; and not interest rate, exchange rate and liquidity risks although there are currently moves afoot for the capital adequacy requirements to be revised so as to take these risks into account in determination of risk weightings.

Capital adequacy requirements have become perhaps the most prominent prudential requirement of liberalised financial markets; and because they constrain the growth of bank balance sheets to some extent, they have replaced LGS ratios and quantitative and qualitative lending guidance given to banks when financial markets were regulated as the means by which the Reserve Bank's prudential objectives can be achieved. The Reserve Bank is charged in the Banking Act with 'protecting the interests of depositors' and has an implicit charter, as indicated previously, to ensure the stability of the financial system. The ability to achieve both these objectives depends on banks being able to remain solvent.

Chapter 6 outlined an equation for the probability of a bank's insolvency: $\Pr(\mathcal{X} < \mathcal{Z} - \mathcal{K} - \mathcal{K}_c)$, which shows that the probability of insolvency falls as the bank's capital position improves. This occurs first, because bank capital acts as a buffer which banks can use to absorb losses; and second, because shareholders' interests in maintaining and increasing the amount of bank capital should act as a constraint on bank management undertaking high-risk activities. As bank capital reduces the probability of a bank becoming insolvent, it also helps in maintaining depositor confidence in banks, and so reduces the potential for contagious runs and the development of systemic instability.

Note that the analysis of Chapter 6 does not suggest that capital adequacy requirements will be sufficient to prevent financial crises. An unchanged amount of capital, when the bank's subjective probability that nature may draw on a disastrous distribution is changing, will change the bank's assessment of its probability of insolvency. Thus, capital of an amount adequate to prevent insolvency when agents' subjective probabilities that nature will draw on a disastrous distribution is high as occurs soon after financial crises, may be inadequate some years later when 'disaster myopia' has set in so that the subjective probability of nature drawing on a disastrous distribution approaches zero. As we saw in Chapter 6, with an unchanged amount of capital, the bank will be prepared to make loans to borrowers with lower capital positions, or loans of greater size or at higher loan interest rates, when more time has passed than at the time immediately following financial crisis. These loans will increase borrowers' probabilities of default and thus the probability of the bank's insolvency. Making the additional loans which lead to these conditions will be easier for banks if they have some amount of 'free' capital at the beginning of an economic cycle above the amount required by the capital adequacy requirements so that they are not constrained from expansion. However, this is not strictly necessary. At the start of a cycle, the bank may have no 'free' capital. However, should the price of equity rise, the value of the bank's capital base may increase relative to that of its risk-weighted assets so that it is free to expand. In times of asset price inflation this may be a self-perpetuating phenomenon.

Ferguson (1991, p. 157) argues that in times of *asset price* inflation: "Capital availability tends to exert a pro-cyclical rather than anti-cyclical influence". This is because the value of equity may be revised upwards relative to the value of other assets, so that banks can expand balance sheets by extending more loans and undertaking more off-balance sheet activities even though the capital adequacy requirement remains unchanged. Also, as profits increase, expectations of further increases in profits are raised and equity capital, therefore, becomes more readily available to the banks. It is apparent from Chapters 6 and 7 that increases in loans financed by such increases in the value of capital can fuel the asset price inflation, and precipitate an increase in the degree of financial fragility in the economy. Ferguson (1991) further argues that in cycles dominated by conditions in the *real* economy, capital adequacy requirements are probably anti-cyclical as they limit the expansion of bank lending. These views are also held by Goodhart (1992, p. 229): "During recessions, bad debts will be high, profits low. Capital adequacy requirements will bite, prolonging the downturn, weakening the recovery. Per contra, they will be slack in booms, and have no constraining effect. The same feature will tend to hold more, or less, for most other prudential requirements, e.g. collateral margins, liquidity requirements, etc."

The two brief case studies in Chapter 7 of the relationship between SBV and Tricontinental, and SBSA and Beneficial Finance which are indicative of patterns of loan activity in other financial institutions in the late 1980s indicated that very large exposures to only a few clients is sufficient to wipe out the capital base of the lending institution. Such large exposures were the reason for the demise of Tricontinental and Beneficial Finance. Exacerbating the problem was that, at the time, the capital adequacy requirements imposed upon the banks did not encompass their subsidiaries, so that the effective protection from insolvency implied by the capital adequacy requirements was much lower than intended. When their subsidiaries failed, the capital of SBV and SBSA was insufficient to prevent them along with some other smaller banks, from exiting the market by being absorbed into other larger banks. These problems have since been rectified to some extent with the Reserve Bank's prudential guidelines requiring banks to limit their large exposures relative to the capital base of the consolidated group (see Prudential Statement PS E1), and ensuring that the focus of capital adequacy is on the consolidated global operations of a bank and its subsidiaries (see Prudential Statement PS C1). However, the Reserve Bank could go further to promote financial stability by placing greater weight on the nature of the loan portfolio in determining risk weightings, as suggested by Chirinko and Guill (1991) for example amongst others, so that over-exposure of banks to a particular sector such as the commercial property sector is made more transparent.

The capital adequacy requirement is now the principal prudential regulation in Australia. As the underlying purpose of the requirement is to minimise the necessity of access to the 'depositor protection' of the Reserve Bank, some argue that deposit insurance would be a more appropriate prudential requirement than is the capital adequacy requirement which imposes constraints on the nature of a bank's asset portfolio. (See, for example, the discussion attached to Ferguson's (1991) paper.)[1]

8.4.2 Deposit Insurance

Australia currently does not have a system of deposit insurance for bank depositors. Section 12 of the Banking Act requires the Reserve Bank to ".. exercise its powers and functions ... for the protection of the depositors of the several banks". However, as *A Pocket Full of Change* (1991, p. 184) notes this does not mean the Reserve Bank guarantees deposits in banks, that a bank cannot fail or that shareholders can not lose funds. The Australian banking system is dominated by four large banks. Although the Reserve Bank argues against the doctrine of 'too big to fail', it is difficult to countenance a situation, in Australia, where the Reserve Bank would not support one of the four large banks if necessary even if it was found that the bank was likely to be insolvent rather than illiquid, because of the possibility of a contagious run. In any case, as Goodhart (1995 and 1993) argues in several places, a bank which turns to the

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[1] In contrast, Goodhart (1993) argues: "A (risk-weighted) capital adequacy requirement would support, and could even replace, deposit insurance, since the available equity would provide a safety buffer for the depositor. This route still leaves problems of trying to find the right balance, both in setting and calibrating the required ratios (too much causes disintermediation, too little involves higher risk) and in dealing with those cases where actual capital falls below the required ratio." My assessment of this view is that it is overly optimistic in that a capital adequacy ratio sufficiently large to replace deposit insurance where the insurance is high enough to prevent contagious runs and systemic crises would almost certainly lead to disintermediation.

central bank for lender of last resort assistance, is almost certainly assessed by the market to be insolvent rather than illiquid because, if illiquid, other banks or private lenders will usually be prepared to lend against the security of its assets. Thus, by turning to the central bank as lender of last resort, the bank is signalling, in fact, a high probability of insolvency. It is to prevent such situations by constraining the banks' assumption of risks that risk-weighted capital adequacy requirements have been imposed upon Australian banks. An alternative, and more direct, stratagem to protect the interests of depositors is to provide a system of deposit insurance.

Three major arguments for deposit insurance were put before the 1991 review into banking and deregulation, *A Pocket Full of Change*. First, deposit insurance was argued to be necessary for small depositors who require safe havens for their transactions and savings balances. Many of these depositors were unlikely to be in a position where they could effectively assess the risks in dealing with a particular bank, or diversify their portfolios.

Second, deposit insurance is designed to prevent the event insured against, i.e., it is designed to prevent contagious runs on banks by guaranteeing that at least a proportion of deposits will be returned to the depositor even if the depositor's bank fails. Depositors are therefore less likely to withdraw funds should there be a rumour that a bank is in difficulty, and as a consequence reduce the likelihood of the bank becoming illiquid. In this way, deposit insurance reduces the probability of bank failure.

Third, in the absence of deposit insurance, large banks may find it easier to compete for funds than small or new banks, because it may be difficult for the latter to establish a reputation giving rise to public confidence. However, a less competitive banking system may enhance depositor protection and systemic stability. Support for the systemic stability implied by having a few larger banks dominating the Australian banking system rather than many smaller banks comes from Ferguson (1991, p. 162): "Our [banking] oligopoly ... greatly assisted our supervisors through the 1980s in limiting the extent to which they needed to intrude into banking. ... The more fragmented an industry, the more likely is there to be strong competitive pressure and vulnerable financial institutions". Ferguson (1991, p. 159) points to the experience of six out of sixteen foreign banks which established subsidiaries in Australia following deregulation and which lost all or most of their initial capital plus retained earnings. He argues:

> "It is certain that if these banks had not had the benefit of overseas ownership and had still suffered these losses, the systematic consequences would have been extremely serious. In effect, the foreign banks demonstrate the benefit of a banking oligopoly from a safety of the system viewpoint. The foreign banks had no franchises and no ability to cross-subsidise as did the domestic banks, therefore there was no buffer beyond their capital to cover their catastrophic losses".

Despite the advantages of deposit insurance referred to in the previous discussion, deposit insurance does give rise to an increase in moral hazard. Chapter 4 demonstrated that access to lender of last resort facilities or fixed-premium deposit insurance leads to banks making an increased number of loans at higher interest rates than they would in the absence of these support facilities. It was also demonstrated in Chapter 4 that there is a positive correlation between loan interest rates and the riskiness of borrowers' activities. Therefore, the existence of deposit insurance will lead to an increase in the probability of borrowers' default over the default probability pertaining in the absence of deposit insurance. Deposit insurance also reduces the incentives for borrowers and shareholders to monitor banks' risk-taking activities; and increases the incentives for the banks to undertake riskier activities. Banks which are prepared to lend to riskier borrowers to whom other banks won't lend can finance their increased lending by raising their deposit rates relative to the deposit rates of other banks so as to attract the necessary additional funds. Banks benefit from higher loan interest rates should borrowers' projects be successful, but most of the costs in the event of failure are borne by the insurer and not by the bank. Thus, the mere existence of deposit insurance increases the probability of the *development* of those conditions which lead to financial fragility in a way which capital adequacy requirements do not; but decreases the probability of systemic instability by preventing destabilising runs on banks.

The previous statement seems almost paradoxical. Nevertheless, deposit insurance will lead to banks undertaking riskier activities even when the insurance is experience related, and so can precipitate an increase in the degree of financial fragility. Yet, even though financial institutions become more fragile, there are unlikely to be any system-wide consequences should even a large depository institution fail because deposit insurance set at a large enough percentage of deposits should prevent a run on the failing bank and contagious runs on other banks. The outcome is that deposit insurance leads to an increase in the degree of financial fragility; but a decrease in the probability of systemic instability. Financial fragility will not spill over into financial or systemic instability.

On the other hand, capital adequacy ratios of a sufficient magnitude *inhibit* the development of financial fragility by reducing the risks that banks are able to assume. Nevertheless, capital adequacy requirements at an acceptable level will be *unable to prevent* the development of financial fragility; which if it does occur is more likely to lead to a system-wide crisis than if deposit insurance had been in place, because depositors are not protected in the event of bank failures. There is, therefore, every incentive for depositors to withdraw funds at the first hint of trouble.

Deposit insurance may take on a number of different forms. The simplest is to fix the insurance premium at a fixed percentage of deposit liabilities as the FDIC did in the United States. Flannery (1982, p. 258) argues that a fixed-rate premium structure for insurance is unusual and constitutes the *raison d'etre* for other banking regulations, because most insurers set a premium structure which reflects the risks associated with each contract, and which will provide adequate funds to cover anticipated future losses. Since fixed-premium deposit insurance achieves neither of these objectives, banks which have fixed-premium deposit insurance must be constrained from assuming so much risk that they need recourse to deposit insurance by the imposition of other banking regulations such as risk-weighted capital adequacy requirements. This is also the view of Goodhart (1993, p. 414): "It is practically impossible to calculate banking risk *ex ante*, so deposit insurance premiums cannot be *objectively* related to risk. This leads to moral hazard problems, and thus provokes direct regulatory constraints on the assumption of risk".

Fixed-premium deposit insurance, if it gives 100 % explicit or *de facto* coverage, will exacerbate moral hazard problems because the financial institution does not have to pay a premium according to risk; and there is therefore no incentive to refrain from making additional risky loans. In addition, the depositor bears no cost should the financial institution make losses and thus has no incentive to monitor its activities. The loan supply function becomes a monotonic and increasing function of interest rates as illustrated in Figure 4.1 of Chapter 4. Credit rationing is unlikely to be a feature of countries with fixed-premium deposit insurance schemes. In contrast, financial fragility is likely to be a feature of countries with fixed-premium deposit insurance schemes, as was indicated by the S&L debacle in the United States.

The moral hazard created by fixed-premium deposit insurance with 100 % coverage suggests that a preferable alternative would be to either impose on financial institutions a risk-related premium with a view to achieving more efficient and equitable outcomes; or to impose co-insurance so that in the event of losses, depositors bear some of the losses, and so have an incentive to monitor the risk-taking activities of their depository institutions. The major problem in imposing risk-related premiums as Horvitz (1983, p. 276) notes: "... is the difficulty of measuring risks *ex ante*, i.e., before they result in losses" and "[i]f the riskiness of certain activities or assets is recognized by the premium system only *after* they have resulted in loss, then the premium structure has not served its purpose of inhibiting risk-taking". Goodhart (1993 and 1995) also refers to the notorious difficulty in devising risk-weighted premia which can be effectively implemented in practice. He suggests that attention is better directed to devising the optimal amount of co-insurance, where large depositors at least, because they do not receive 100 % protection of deposits, bear some of the losses of the financial institution, and hence have an incentive to monitor the risk-taking activities of those institutions so as to limit moral hazard.

The Reserve Bank currently has *legislative* responsibility for the protection of depositors and only an *implied* responsibility for the integrity of the payments system and overall stability of the financial system. This suggests that one of two things should happen in Australia. Either the capital adequacy ratio should be replaced or supplemented with deposit insurance so as to *ensure* depositor protection; or the Banking Act should be amended to give the Reserve Bank explicit legislative responsibility for the maintenance of the overall stability of the financial system. The current position appears to be that depositor protection is enshrined in legislation as a goal that is superior to the maintenance of systemic stability. *A Pocket Full of Change* (1991, p. 211) suggests that contagious runs on Australian banks have been prevented "... by a number of factors that enhance confidence in Australian banks. These include government guarantees, the absence of bank failures this century, the supervision of banks by the Reserve Bank and the perception that some banks are 'too big to fail' ". None of these factors (with the possible exception of government guarantees for government banks) *guarantees* that depositors won't lose money in the event of bank failure, or that there will not be contagious bank runs in the future. There is still a very real possibility, in Australia, of contagious runs which may precipitate systemic instability.

If the choice pertaining to depositor protection is to be between risk-weighted capital adequacy requirements and deposit insurance, the former should be chosen if more weight is to be given to minimising moral hazard, and the latter if more weight is to be given to ensuring systemic stability. There would be few who would argue that systemic stability should not be the overriding goal of the central bank. However, stability of the financial sector, and through it, the stability of the real economy, is not influenced only by the behaviour of banks but also by the actions of the non-bank financial institutions.

8.5 Non-bank financial institutions and the Financial Corporations Act 1974

In the early 1970s, the increasing importance of the non-bank financial institutions (NBFIs) in financing economic activity led to the development of the *Financial Corporations Act 1974*, only Part IV of which has ever been proclaimed. The Act recognised that it was the responsibility of the government to monitor and *control where necessary* the activities of the NBFIs (*Financial Corporations Act 1974*, Paragraph 3(b), p. 131) ".. for the purpose of contributing to economic stability, the maintenance of full employment, the efficient allocation of productive resources, the ensuring of an adequate level of finance for housing and the economic prosperity and welfare of the people of Australia". The Act sought to achieve control of the activities of the NBFIs by empowering the government to extend the types of controls used with respect to the banks - asset ratios, qualitative and quantitative lending policies, and interest rate controls - to NBFIs which were over a certain size.

The Fraser government in 1979 established the *Committee of Inquiry into the Australian Financial System* (the Campbell Committee); the terms of reference required the committee to make recommendations on the regulation and control of the financial system and in particular to consider whether regulations should be extended [as envisaged by the *Financial Corporations Act 1974*] to NBFIs or whether the banking system should be deregulated. A focus of the committee's examination was the heavy reliance on direct banking controls in the pursuit of monetary policy. Paragraph 4.3 of the report argued the case against regulation of the banking system:

> "In brief the arguments in favour of deregulation flow from the effects of controls on the allocational and operational efficiency of the financial sector, their long-run ineffectiveness as instruments of monetary policy (since they tend to transfer business to competing intermediaries and securities markets) and the differential effects they have on various financial institutions."

The recommendations of the Campbell Committee's report and the Martin Committee's review of that report led to dismantling of most non-prudential controls over the banking system from 1980 to 1985. In December 1980 interest rate ceilings on all trading and saving bank deposits were removed, allowing the banks to effectively compete with NBFIs in attracting deposits. In June 1982 the Reserve Bank announced the end of quantitative bank lending guidance, freeing the banks to pursue increased liquidity through the expansion of credit.

Instead of proclaiming the *Financial Corporations Act* so that the government through the Reserve Bank could control the activities of all financial intermediaries, the government decided to remove the controls on banks so that they could compete on a more equal basis with other financial intermediaries. The Campbell Committee in Appendix 4 to Chapter 4 of its report argued that interest rate and portfolio controls were likely to lead to *more instability rather than less* because those controls limit the ability of banks to adjust in accordance with their individual circumstances. It was argued that banks which were limited in their ability to compete effectively with NBFIs were likely to be more prone to instability in their deposit flows. Further, if banks were limited by controls from investing in the most profitable avenues otherwise open to them, it was argued they were likely to invest in riskier higheryielding assets in order to recoup some of this loss. The banks ultimately united and argued for deregulation rather than an extension of controls to NBFIs, the latter certainly not arguing for an extension of controls to be applied to themselves. This meant, in fact, that there was little support for the proclamation of the *Financial Corporations Act*.

The Campbell Committee argued that allocative efficiency was to be achieved with the removal of controls over interest rates because differentials among interest rates would be allowed to adjust in a way that led to funds being allocated for purposes which offered the highest risk-adjusted rates of return. Further, non-price credit rationing as a means of allocating funds between alternative uses was to be eliminated with the removal of controls over interest rates and excessive reliance on collateral was to be reduced so that funds could flow to those areas with the highest risk-adjusted rates of return.

With hindsight, it is apparent that raising interest rates did not, and could not, compensate banks and other financial institutions sufficiently for the risks associated with some potentially high-yielding loans. As the analysis of Chapters 4 and 5 showed, merely raising interest rates in response to riskier loans will not compensate for the increased risks, because the higher loan interest rates will increase the probability that borrowers will default on their loans. It was demonstrated in Chapter 5 that there is some optimal interest rate for banks to charge where the direct increase in revenue brought about by a rise in the interest rate is exactly offset by the fall in revenue due to the increase in probability of default arising from the increase in the interest rate. It was further demonstrated in Chapter 5 that, in fact, Australian banks have been getting better at setting this optimal interest rate over time. At this interest rate the loan supply schedule turns backward, becoming negatively sloped and banks ration credit by non-price means should the demand for loans exceed the supply of loans.

The Campbell Committe argued that if controls on interest rates were eliminated, funds would flow to purposes with the highest economic returns after adjustment for risk. In making this argument, the Committee ignored the impact that deregulation of interest rates might have on speculative activity. What is now quite apparent is that the Campbell Committee had no inkling of the explosion of credit that deregulation would unleash. (See for example Valentine (1991).) Valentine suggests that this is because the committee did not take into account the interaction of a deregulated financial environment with the prevailing tax regime in an inflationary environment which, because it allowed deduction of nominal interest payments and taxed nominal interest receipts, encouraged over-investment and discouraged saving. In addition, capital gains were not taxed, so that there was an incentive to borrow for the purpose of speculating on assets and profiting from the untaxed capital gains. These two factors contributed, in large part, to the asset price boom of the late 1980s discussed in Chapter 7. Other contributing factors were the ease with which financial intermediaries could access funds offshore following deregulation (see, for example, Marzouk (1990)); the emergence of near-banks such as merchant banks and finance companies which were keen to increase market share by financing speculative activity and yet had very weak credit assessment procedures; and the switch from asset management to liability management by the banks following deregulation. The availability of credit, and not the interest rate as a cost, became of most importance to intending borrowers.

Interest rates and interest rate differentials did rise following deregulation. Chapter 6 showed that the default premium on interest rates depends positively on the subjective probability that nature will draw on a disastrous distribution, and negatively on the capital position of the borrower and on the distribution governing project-specific returns. However, as is apparent from Chapter 7, all of these things and so risk adjustments on interest rates are affected by earlier loans. As earlier loans are invested in profitable activities and fully repaid, the subjective probability that nature will draw on a disastrous distribution tends to fall and project specific returns in certain activities will increase inducing further entry into those activities. Because of increased demand, the value of assets in those activities will increase leading to a rise in the capital position of borrowers. Banks become increasingly willing to make credit available to both existing and new borrowers. Borrowers, if interest rates rise either because of increased competition for funds or because of the Reserve Bank's concern with inflation or the pace of economic activity either overall or in certain sectors, will be increasingly drawn into Ponzi finance. There will come a point where banks will refuse to further increase the loan monies available to certain borrowers so that they default, asset sales eventuate depressing their prices and at the same time the capital positions of most borrowers, and returns from project specific distributions fall. If these consequences of higher interest rates are severe enough, the banks will assess that the subjective probability that nature will draw on a disastrous distribution has increased and will raise the default premium in response and more severely ration credit. These responses, whilst justifiable from the bank's point of view, are the least appropriate responses given their impact on the macroeconomy when the economy is already going into decline, and an increased availability of credit is required to prevent further contraction.

The previous paragraph suggests that macroeconomic stability is a prerequisite for stable and low interest rates and little non-price credit rationing; and that the loss of interest rate controls combined with the loss of quantitative lending guidance may have led to increased instability. This begs the question of whether it would have been preferable for the authorities to have maintained these controls over the banking sector and extended them to the NBFIs through the proclamation of the *Financial Corporations Act*. That the Act has not been proclaimed suggests that the government either believed that the benefits of deregulation outweighed the costs, or alternatively, that there were forces acting on the economy which made deregulation unavoidable.

The Campbell Committee (paragraph 4.4, p. 66) referred to evidence submitted to it suggesting that direct controls may assist the speed of implementation of policy and possibly cushion the effects of policy on interest rates and financial markets. The chapters in this thesis with respect to credit rationing suggest that the banks will control interest rates and lending to some extent of their own accord. However, for reasons discussed in the previous two paragraphs, such control may be limited to periods of low asset price inflation and times where there has been some sort of financial crisis in the recent past. In addition, the implicit guarantee to the banks from the Reserve Bank as lender of last resort tempers the restraint the banks might otherwise impose upon their lending activities.

Another benefit which might be mooted for direct interest rate and quantitative lending controls is that they can be targeted to areas of specific concern to authorities. For example, the Reserve Bank in 1994 was very concerned at the pace of growth in housing credit. This was because of the implication that when business turned to banks for credit rather than using retained earnings or equity issues for finance, the requisite credit may not have been available as banks at this time perceived housing loans to be safer and more profitable than business loans. Activities which are the most profitable from the banks' point of view are not necessarily consistent with those activities the authorities consider most desirable from a macroeconomic perspective. Quantitative and qualitative lending guidance can be useful in directing credit to the sectors where it is considered expansion will assist the macroeconomic policy objectives, and inhibiting expansion in those sectors that are considered to be overheating. Similarly, interest rate controls on finance to particular sectors can change the relative prices between sectors by changing the relative risk-reward combinations available to both borrowers and banks so that investment in activities more consistent with the overall macroeconomic policy objectives is encouraged.

A further benefit of interest rate controls combined with quantitative lending guidance is that, provided an offsetting increase in credit is not provided by an unregulated sector, a given change in interest rates will have a larger effect on the macroeconomy than the same change in interest rates in deregulated financial markets. Milbourne (1990) and Dow and Saville (1990) make the point that in a deregulated world all interest rates tend to move together, reducing both the interest elasticity of the demand for money and portfolio adjustments between money and other assets, muting the impact of monetary policy induced changes in base interest rates on the macroeconomy. This may account, in part, for why the Granger causality tests of Chapter 3 found no clear evidence that interest rates predict economic activity in deregulated financial markets.

Chapter 3 with respect to the transmission mechanism suggested that when financial markets were regulated, changes in interest rates Granger caused changes in economic activity. This may be because the interest elasticity of demand and portfolio adjustments between money and other assets was larger then than now. Furthermore, when monetary policy was tightened in regulated markets, not only were interest rates raised but so also were stricter quantitative lending guidelines and higher asset ratios and reserve requirements imposed. These changes *in combination*, all positively correlated, had a dampening effect on economic activity by restricting the access of persons and business to bank credit. However, financial innovations led to an increasing velocity of circulation in the late 1970s, so that control over the banking sector hecame less effective; and to disintermediation so that the Reserve Bank was losing control over the activities of an increasingly large part of the financial sector. As previously indicated, the government responded by deregulating financial markets. Argy (1995) argues that the government could not have done otherwise because of the increasing integration of world financial markets (financial globalisation) and rapid advances in technology and communications. Likewise, he suggests that despite the contribution of financial deregulation to rising macroeconomic instability in Australia - something he accepts, the option of re-regulation is not open to the government. The argument hinges on the impact of financial globalisation on capital flows, and the impact of improved technology and communications on innovation - the two principal causes of deregulation. In contrast to Marzouk (1990) who believes that the government should impose an incremental variable deposit requirement on offshore borrowing to control capital flows as was done when financial markets were regulated (which would also have the effect of lowering Australian interest rates), Argy does not believe that Australia could devise an effective system to control international capital flows. As to innovation undertaken by financial intermediaries so as to avoid regulation, the escalation of improved technology and communications in the 1990s would require that the government cast an ever wider regulatory net as financing shifts from the re-regulated banks and newly regulated NBFIs to unregulated sources of finance, for example, direct trade credit.

8.6 Conclusion

The objectives of this thesis were to assess contemporary Keynesian descriptions of the monetary policy transmission mechanism, with particular reference to credit rationing, to Australia's experience with deregulated financial markets and the allocation of credit; and to discuss the implications thereof for financial stability and the conduct of monetary policy and prudential control in Australia. In addition, a reconciliation of the New Keynesian and post Keynesian explanations of credit rationing in a more general theory of choice than currently adhered to by either school was attempted.

The first major conclusion of this thesis was that neither the neo-Keynesian, New Keynesian or post Keynesian schools of thought adequately describe the monetary policy transmission mechanism of Australian financial markets since deregulation. The results of the Granger causality tests reported in Chapter 3 show that the neo-

Keynesian and New Keynesian view of causation running *from* money *to* activity is incorrect, and that the post Keynesian view of causation running *from* interest rates *to* activity is also incorrect for Australia since financial markets were deregulated. Chapter 3 demonstrated that, in deregulated financial markets, there is either two way causality between monetary aggregates, credit, interest rates and the yield spread as the instruments of monetary policy, and GDP and PFD as the targets of monetary policy; or that changes in GDP and PFD Granger cause, i.e., predict changes in the instrument variables. The *only* case where an instrument was shown to Granger cause the target variable was that of changes in the 2 year Treasury bond rate Granger causing changes in nominal PFD. At best, there is two-way causality between instruments and targets which makes it difficult for the monetary authorities to judge the appropriate level for the instrument, and also makes it difficult for economic agents to judge the success or otherwise of monetary policy. Monetary policy seems to be very imprecise in its effects on changes in activity and income.

The Campbell Committee accepted the neo-Keynesian view that the removal of regulatory impediments from Australian financial markets would lead to the elimination of non-price credit rationing. In contrast, the second major conclusion of this thesis is that, despite deregulation, non-price credit rationing is still likely to be a feature of financial markets, and has occurred in Australia in the period since deregulation. These conclusions are based on the theories of the New Keynesians and the post Keynesians discussed in Chapter 4 and on empirical tests, the results of which are discussed in Chapter 5. New Keynesians argue that non-price credit rationing arises because of asymmetric information and implicit contracts, and post Keynesians argue that credit rationing is due to fundamental uncertainty. The empirical work I conducted for Australia provides support for the non-price credit rationing hypothesis.

The third major conclusion of this thesis, closely related to the second, is that banks have been getting better over time at setting the optimal interest rate. That is, there has been an improvement in the banks' abilities to set the interest rate at which the direct increase in profits generated from a rise in the interest rate is exactly offset by the negative effects on profits of the increase in the probability of default brought about by the rise in interest rates as demonstrated in Chapter 5. The optimal interest rate is the interest rate at which the loan supply schedule becomes backward-bending, and so the empirical work in relation to the optimal interest rate provides further support for the non-price credit rationing hypothesis. However, the empirical work of Chapter 5 whilst providing support for the non-price credit rationing *hypothesis* also indicates that credit rationing of this type has been on such a small scale that it has been of little *macroeconomic* consequence in Australian financial markets.

The fourth major conclusion of this thesis is that the New Keynesian theory of choice based on rational expectations and probabilistic assessments of risk can be integrated with the post Keynesian theory of choice based on fundamental uncertainty to generate a more general theory of choice. As explained in Chapter 6, this more general theory of choice can be used to explain the changes in circumstances which cause economic agents to shift from loan behaviour which is based on a probabilistic assessment of risks to behaviour which becomes governed by rules and conventions as agents respond to fundamental uncertainty. Thus, the theory also provides a further reason for the existence of non-price credit rationing in deregulated financial markets.

The integrated theory of choice presented in Chapter 6 also explains why it is that financial crises are a *recurring* phenomenon. Chapter 7 applies this theory of choice to the financial instability hypothesis and notes its applicability to Australian financial markets since deregulation. Because systemic stability is arguably the most important role of the central bank, the current chapter has drawn out some of the issues for monetary policy and prudential control pointed to by the previous chapters and their conclusions.

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