Cyclical prudence - credit cycles in Australia

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1. Introduction

Over the past 150 years, Australia has experienced four major cycles in credit - in the 1890s, 1930s, 1970s and 1990s. Each of these episodes combined cycles in the real economy with varying degrees of financial system instability. This association reflects the fact that the health of the financial system and the economy are inextricably linked. While the strength of economic activity influences the demand for credit, at the same time the health of the financial system affects the supply of credit, which in turn influences economic activity. However, of particular concern for policymakers is the potential for the behaviour of financial institutions and financial markets to amplify cycles in the real economy.

In this paper we suggest that the behaviour of lending institutions through the business cycle depends on their perceptions of risk and that periods of excess optimism can lead to amplification of the business cycle.[2] This implies the prudential regulator/supervisor needs to pay close attention to the state of the business cycle and lending institutions' attitudes to risk in order to avoid excessive risk building up in the financial system.

Careful management of banks' loan portfolios can help to ensure diversification of risks arising from the potential for individual borrowers to default. However, ultimately the financial system as a whole cannot avoid the risk implied by downturns in the economy. To understand how this risk changes through the business cycle, it is helpful to distinguish between the actual level of risk and the realisation of that risk.

The paper argues that risk tends to build up during the expansionary phase of the business cycle. That is, the potential for banks to experience substantial losses on their loan portfolios increases towards the peak of the expansionary phase of the cycle. Even so, towards the top of the cycle banks appear to be relatively healthy - that is, non-performing loans are low and profits are high, reflecting the fact that even the riskiest of borrowers tend to benefit from buoyant economic conditions. While the risk inherent in banks' lending portfolios peaks at the top of the cycle, this risk tends to be ***realised*** during the contractionary phase of the business cycle. At this time, banks' non-performing loans increase, profits decline and substantial losses to capital may become apparent. Eventually, the economy reaches a trough and turns towards a new expansionary phase, at which time the risk of future losses reaches a low point, even though banks may still appear relatively unhealthy at this stage in the cycle.

The way in which banks (and capital markets, more generally) perceive risk changing through the cycle is a key determinant of their prudential behaviour.[3] Banks may observe and respond to the pattern of risk described above. In this case, prudential behaviour will be procyclical - that is, provisions and capital ratios will tend to rise through the expansionary phase of the business cycle and fall during the contractionary phase in line with the pattern of actual risk. This will also imply that the risk premium charged to borrowers will be procyclical.

Alternatively, bank behaviour may be driven more by the realisation of risks than actual risk itself. This implies that banks are ***excessively optimistic*** during the expansionary phase of the cycle and ***excessively pessimistic*** during the contractionary phase. In this case, provisions and capital ratios

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[2] This paper is similar in many ways to Herring (1999), who examines the relevance of disaster myopia for financial stability.

[3] Bank behaviour is, of course, driven in part by the behaviour of capital markets. We deal with the role of capital markets later in the paper.

would tend to be countercyclical, as would the risk premium. Also, the risk of bank failure would be greater at the top of the cycle than would be the case under procyclical prudential behaviour.

Moreover, countercyclical prudential behaviour could lead to amplification of the business cycle. This occurs because the relatively low price and high supply of credit implied by this type of behaviour can lead to a mutually reinforcing increase in credit, asset prices and output during the expansionary phase of the cycle. From this it follows that the eventual correction in output is also likely to be larger than would otherwise be the case. In addition, the financial system becomes more vulnerable to a downturn in activity. When economic activity turns down, financial institutions are likely to incur substantial losses, which in turn can create an environment of excessive pessimism. This causes banks to adopt relatively cautious lending policies, which can lead to second-round reductions in economic activity.

Typically, amplification is triggered during the expansionary phase of cycles. Uncertainty regarding the size and persistence of positive shocks to the economy, when combined with an environment of heightened competition within the financial sector, can lead to the problem of excessive optimism. In such an environment, capital ratios will tend to drift downwards as the result of two sources of pressure. First, banks aiming to maintain market shares will strive to keep the growth of lending high. Second, shareholders' demands for high returns to equity will push banks to economise on their holding of capital. While debt markets can provide discipline for banks that take on excessive risks (relative to other banks), these markets are also susceptible to excess optimism that clouds their appreciation of system-wide risks.

An objective of policymakers charged with responsibility for financial system stability is to ensure that disturbances in any part of the financial system do not threaten the health of the economy more broadly.[4] Monetary policy plays a crucial role in protecting financial stability by maintaining low and stable inflation, thereby discouraging asset speculation financed by borrowing.[5] At the same time, there is scope for prudential/supervisory policy to respond to changes in risk facing financial institutions through the business cycle.

The paper proceeds as follows. Section 2 draws out the role that bank behaviour can play in the amplification of cycles by examining the Australian experience of major credit cycles over the past 150 years. A comparison of these cycles suggests that banks' attitude to risk - which plays a key role in determining their prudential behaviour - depends, in part, on the competitive and regulatory environment. The experience of the 1890s and 1990s episodes suggests countercyclical prudential behaviour can amplify the business cycle and contribute to more severe problems for financial institutions during economic downturns. In contrast, the 1930s episode suggests procyclical prudential behaviour reduces the potential for financial system instability even in the face of a significant downturn in economic activity.

Section 3 of the paper presents a stylised model describing how banks' prudential behaviour responds to changes in risk implied by the business cycle. The model demonstrates that forward-looking banks acting on the basis of actual risk (rather than realised risk) would adopt procyclical prudential behaviour. The model also demonstrates how alternative perceptions of risk can lead banks to adopt countercyclical prudential behaviour. By appealing to models that link cycles in credit, asset prices and output, our framework shows how countercyclical prudential behaviour can lead to amplification of the business cycle.[6]

The paper concludes in Section 4 with a brief discussion of the scope for prudential/supervisory policies to avoid situations in which banks' behaviour leads to financial system instability and amplification of the business cycle.

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[4] Policymakers also want to enhance the efficiency of the financial system. Excessive regulation of financial institutions, though potentially good for stability, could impede efficient intermediation and, therefore, be detrimental to long-term macroeconomic performance.

[5] Kent and Lowe (1998) suggest that in the absence of active prudential policy, a central bank with the objective of targeting inflation may attempt to burst an asset price bubble in order to avoid the risk that such a bubble expands even further. Bursting the bubble early would help to avoid financial instability, which would jeopardise the inflation target.

[6] Dow (2000) provides a recent review of some relevant models.

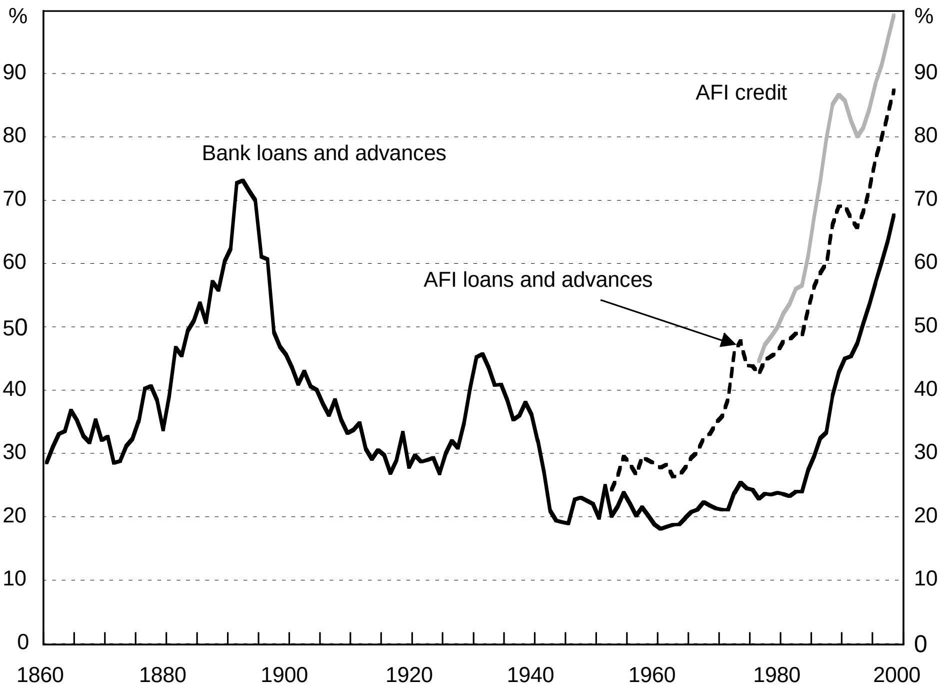
2. Four Australian credit cycles

Australia has experienced four major cycles in credit over the past 150 years, with turning points in credit during the depressions of the early 1890s and early 1930s and the recessions of the mid-1970s and early 1990s (Figure 1).[7] The four downturns in credit have also been associated with varying degrees of financial instability - across a number of measures, the 1890s and 1990s episodes were more severe than the 1930s and 1970s episodes. The experiences of these cycles are important for at least two reasons. First, the similarities between the episodes suggest there are a number of primary macro-indicators of financial system vulnerability - namely, rapid growth of output, credit and asset prices and increased concentration of investment/lending.

Figure 1

Credit in Australia

Per cent of nominal GDP



Note: AFI credit includes all banks and non-bank financial institutions.

Second, it is important to consider the role of prudential behaviour in driving these macroeconomic developments and determining the exposure of the financial system to the non-diversifiable risk inherent in the business cycle. Prudential behaviour during the 1890s and 1990s episodes is best characterised as having amplified the cycle in the real economy and exposed financial institutions to the risk of significant losses.[8] Capital ratios in the 1890s were clearly countercyclical, while they rose through the economic downturn of the 1990s episode. In contrast to these episodes, banks displayed relatively prudent behaviour during the lead-up to the 1930s depression - capital ratios were procyclical and banks suffered relatively minor losses during the depression. Further, we suggest that their lending behaviour did not exacerbate the downturn in the real economy. In the 1970s episode, mandated controls on banks' lending behaviour isolated the banking system from problems in the

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[7] Appendix B contains a detailed description of the data.

[8] The paper does not discuss the period over the second half of the 1990s, which saw significant structural changes. These included strong growth in credit to households with more moderate growth of lending to business, a general improvement in risk management practices within institutions and, increasingly, a more sophisticated regulatory environment. For a recent discussion of these developments, see Gizycki and Lowe (2000).

general economy, but this was not without cost. Namely, tight controls on banks impeded efficient financial intermediation and pushed risky lending activities outside the regulated system.

This section of the paper draws extensively on the existing Australian literature regarding the four episodes. Kent and Fisher (2000) compare the experience of the 1890s with the 1930s episode using a broad range of macroeconomic and prudential indicators, while Kent and Lowe (1998) compare the 1970s and 1990s episodes with emphasis on the behaviour of credit and asset prices. Pope (1991) compares the impact of “deregulation” of the financial system prior to the 1890s with the deregulation of the 1980s; Merrett (1993), in comparing the impact of the 1890s financial collapse on bank policies in the 1920s, also makes reference to the 1980s experience.[9]

2.1 Similarities across four episodes - macroeconomic indicators

The periods leading up to each of the four episodes of financial distress share a number of common features (see Figure 2). With the exception of the 1920s, each of the peaks in credit was preceded by an extended period of high economic growth.[10] Strong growth reinforced confidence and fuelled the expansion phase of the credit cycles. Each of the four credit cycles was also closely linked with a significant cycle in property prices. Credit-fuelled investment booms concentrated in the building and property development sector, especially in the 1880s and 1980s, left the financial system vulnerable to the unwinding of asset price bubbles.

1890s

Prior to the 1890s depression, investment was concentrated in construction, representing the biggest building boom in Australia’s history (Kent and Fisher (2000)). The enthusiasm for building activity, while primarily driven by urbanisation and rapid population growth, was also fuelled by rapid credit growth and the asset price bubble. Bank credit rose extremely rapidly (as did credit provided by non-bank financial institutions (NBFIs), although data on lending by NBFIs are not readily available). Property prices in Sydney and Melbourne (where the boom was concentrated) rose twofold between 1882 and their peak in 1891 and fell substantially thereafter.

1930s

The basic elements of the credit and property cycle were replicated in the 1920s and 1930s, though in many respects the cycle was more muted. The increase in the ratio of credit to GDP was more moderate and construction investment, though high, was lower as a share of GDP than it was in the 1880s. The cycle in commercial property prices was similar to that of the earlier episode, with property prices doubling between 1921 and 1930 before unwinding in the depression years.

1970s

Growth in credit in the late 1960s and early 1970s was also associated with the expansionary stage of a property price cycle. Commercial property prices more than trebled between 1968 and 1974. Much of the credit growth was driven by the rapid expansion of NBFIs. In addition, Daly (1982) highlights the increasing internationalisation of the Australian economy, the late 1960s mining boom, the development of Sydney as a major financial centre and generally positive business confidence as factors driving the property price boom. The property price cycle peaked in 1974, coinciding with a tightening in monetary policy and falling investment.

1990s

The cycle in property prices in the late 1980s and early 1990s shared many of the characteristics of earlier cycles. The ratio of credit to GDP grew rapidly over the second half of the 1980s, while

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9 See also Schedvin (1973), Merrett (1991), Crosby (1995), Grenville (1991) and Macfarlane (1989, 1990).

10 Real GDP grew by an average of at least 3% over the 10 years prior to the 1890s, 1970s and 1990s episodes. While GDP grew by an average of over 3% in the 1920s, this growth was concentrated in the first half of the decade with GDP remaining stagnant between 1925 and 1930.

commercial property prices doubled over the same period. Construction increased as a share of GDP throughout the 1980s, peaking at over 10% at the height of the asset price bubble in late 1989. The bubble burst with the recession of the early 1990s.

2.2 Banking behaviour - prudential indicators

Despite the many similarities between these four episodes, there were also a number of important differences, especially with regard to banking behaviour and the severity of financial system problems. Differences in the prudential behaviour of the banks across these four episodes were driven by regulatory developments and changes in market structure. The expansionary phases of the 1890s and 1990s cycles were characterised by heightened competitive pressures within the financial system and great optimism on the part of financial institutions - although in the 1880s, some older, more conservative banks had warned of the dangers of excessive lending. Competition between financial institutions was quite moderate through the 1920s and banks were relatively conservative. Competition within banking was moderated in the 1970s by restrictions on banks' activities, while competition was more vigorous within the unregulated non-bank financial sector.

2.2.1 Regulations and market structure

1890s

Prior to the banking crisis of 1893, the dominant banks were placed under increasing pressure by the emergence of a range of NBFIs, which grew quickly in tandem with the property price boom during the second half of the 1880s. In order to compete with the NBFIs, banks expanded the size of their branch networks, lowered their credit standards and became involved in speculative activities, including loans to the new land finance companies. These developments coincided with the relaxation of banking regulations, which had, amongst other things, prohibited property being taken as security against loans.

1930s

The structure of the financial system underwent considerable change over the period between the two depressions. The key changes were consolidation among the banks, the decline of NBFIs and the growing share of assets controlled by the conservative savings banks. Consolidation lessened competition in the banking sector at the same time as providing a vehicle for banks to diversify geographically. Merrett (1991) and Kent and Fisher (2000) provide evidence suggesting the experience of the 1890s crisis contributed to banks adopting more conservative prudential behaviour, lasting well into the 1920s.

1970s

After World War II, banks were heavily regulated. Constraints were placed on banks' deposit and lending interest rates and there were quantitative and qualitative restrictions on their lending activities (Grenville (1991)). Despite tentative steps in the early 1970s towards deregulation, banks remained heavily regulated with controls on interest rates and the structure of their balance sheets. While less heavily regulated NBFIs grew rapidly on the back of the property boom, the banks participated at arm's length through their ownership of NBFIs.

1990s

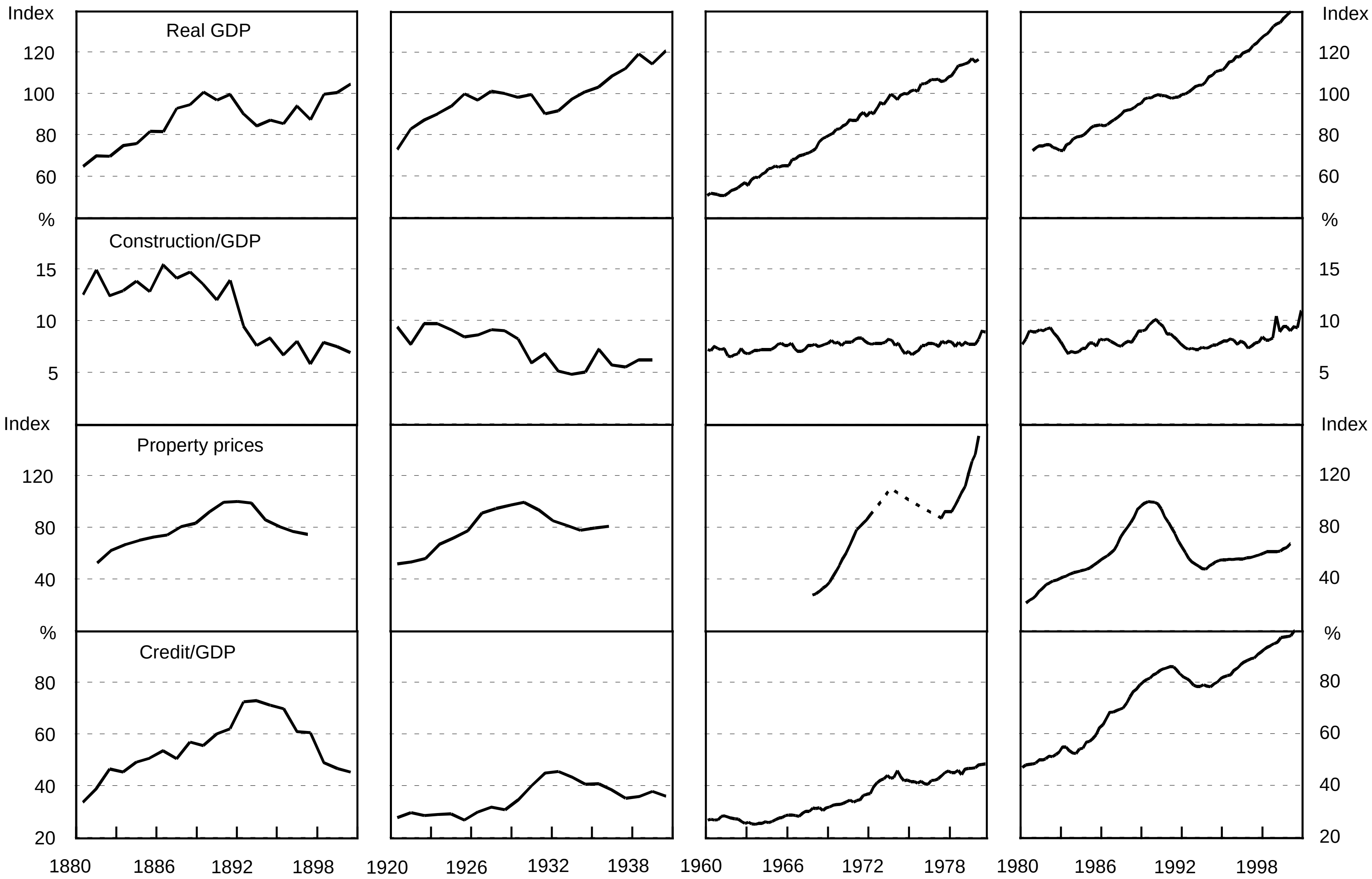
In many ways the 1990s episode was most like that of the 1890s - following an easing in regulatory controls in the early 1980s and faced with the threat of greater competition (this time from new foreign banks and new banks created from NBFIs), banks competed aggressively for market share. The rapid rise in credit was primarily driven by growth in lending to business. Increases in property prices were propelled by banks' appetite for property lending and the attractiveness of leveraged investments in the high-inflation environment.

2.2.2 Prudential behaviour

These differences in the competitive and regulatory environment contributed to variation in the prudential behaviour of banks as measured by a number of indicators.

Figure 2

Cycles in Australian output, construction, property prices and credit



1890s

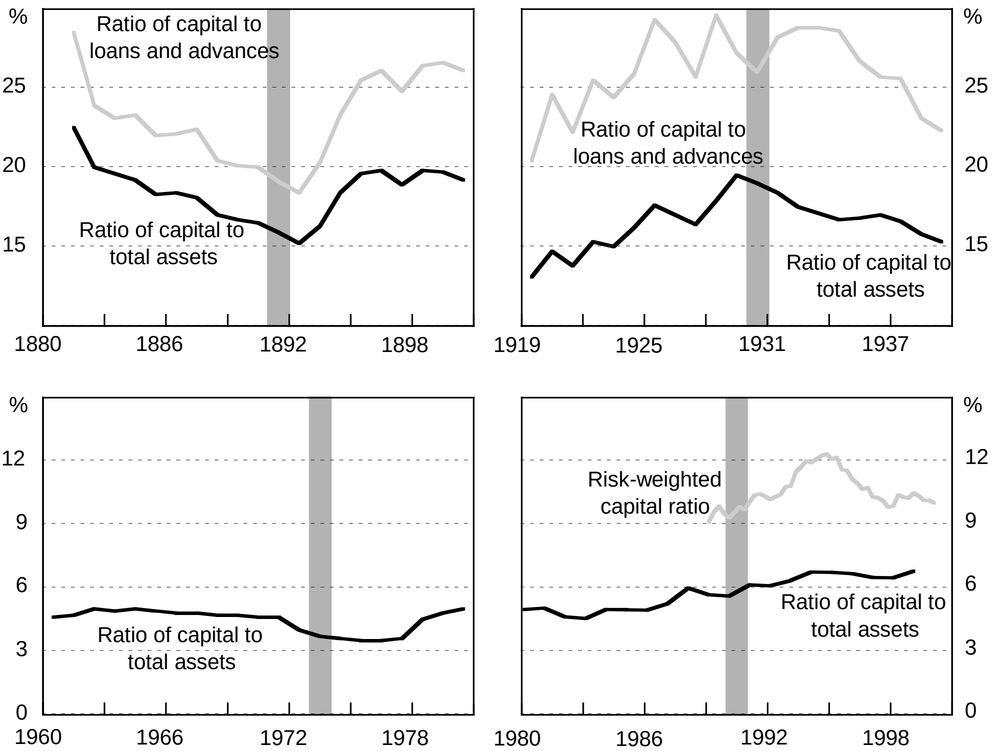
In response to greater competition in the 1880s, most banks reduced prudential standards and increased lending at a rapid rate. Declining prudential standards were in part inevitable as a result of the rapid increase in branch networks, which contributed to a loss of central control over lending policies. Banks built up many large exposures and permitted large insider loans (that is, loans to close business associates and even employees of the bank). They increased their reliance on short-term foreign liabilities at the same time as extending the maturity mismatch. Banks also allowed the rate of lending growth to outstrip the growth of capital. Figure 3 shows the decline in capital as a share of total assets and as a share of loans and advances (the latter ratio declining more rapidly). The combination of these factors left the banking system vulnerable to a downturn in the property sector, a loss of creditor confidence (especially among foreign creditors) and a general decline in the economy.

1930s

Prudential behaviour over the 1930s episode stands in stark contrast to that of the 1890s and 1990s episodes. Although banks allowed credit to grow quite rapidly towards the end of the 1920s, they maintained generally conservative lending policies; indeed, Merrett (1993) argues that banks may have been excessively cautious and, therefore, impeded the pace of industrialisation. Banks minimised their exposures to property, loans tended to be of relatively short maturity, and banks held a relatively high share of government securities. Another factor mitigating their overall risk profile was that banks held a net foreign asset position; however, falling liquidity became a significant problem towards the end of the 1920s. In addition to these factors, through the 1920s banks built up their capital positions; the ratio of shareholders' funds to total assets increased from under 15% in the early 1920s to nearly 20% in 1929 (Figure 3).

Figure 3

Capital ratios



Note: Shading indicates peaks in real GDP.

1970s

The ratio of shareholders' funds to total bank assets was lower during the 1960s and 1970s than during any of the other episodes (Figure 3). The ratio fell in the early 1970s at a time when credit was expanding quickly. While of itself this suggests prudential standards of the banking sector were low in the 1970s, heavy regulations placed on banks at the time, including on the structure of their balance sheets, enforced a considerable degree of conservatism. Of greater importance during this episode was the behaviour of NBFIs, including subsidiaries of banks, that were not subject to the same degree of regulation as the banks themselves.

1990s

Following deregulation, banks competed aggressively for market share prior to developing the internal credit controls necessary to control risk in a deregulated environment. The banking industry grew rapidly against the background of a boom economy and a business community where leveraged acquisitions of assets had become the orthodoxy (Macfarlane (1990)). Banks' exposure to property grew in tandem with the boom in this sector. Banks also entered the early 1990s with a high level of large exposures. The ratio of shareholders' funds to total assets rose slightly over the 1980s (Figure 3). This in part reflected an agreement between the banks and the Reserve Bank of Australia (the regulator at this time) to establish a minimum (unweighted) capital ratio. This minimum was subsequently raised and by the late 1980s the Australian banks complied with the minimum (risk-weighted) capital standards under the Basel Capital Accord (Reserve Bank of Australia (1989)). Following the turn in the credit and property price cycles, banks continued to increase their capital position in the early 1990s, especially as measured by the risk-weighted capital ratio, as they focused on repairing their balance sheets. This was driven, at least in part, by pressure from rating agencies and the capital markets more generally. Arguably this new-found conservatism, along with balance sheet repair in the non-financial corporate sector, contributed to the financial drag in the early stages of the economic recovery.

2.3 Severity of financial system problems

In this section of the paper we argue that differences in banks' behaviour during the growth phase of each episode helped to determine the relative severity of the financial system problems experienced during the downturn of each episode. A bank's own vulnerability depends on its prudential behaviour, while the behaviour of the financial system as a whole influences developments in, and the vulnerability of, the economy in general.

In short, financial system problems were mild in the 1970s episode, moderate during the 1930s (despite the severity of the depression), relatively severe during the 1990s and acute during the 1890s.

One way to gauge the severity of financial system problems is to compare the behaviour of credit as a share of nominal GDP (Figures 1 and 2). This measure supports the proposition that financial problems were acute during the 1890s, while those of the 1970s were relatively mild.[11] In contrast to the assertion above, the behaviour of credit suggests that the financial system problems of the 1930s were more severe than those of the 1990s. However, the interpretation of this measure (and other measures) of severity is clouded by the influence of demand side factors. That is, the decline in credit (as a share of GDP) partly reflects the effect of the downturn in the real economy (which was far greater in the 1930s) on financial system performance. Even so, other measures of severity confirm that the 1930s episode was in fact less severe than that of the 1990s.

2.3.1 Failures of banks

Another measure of severity is the number of financial institutions that failed or were forced to suspend payment. On this basis, the 1890s' financial problems clearly stand out as the most severe, with 13 of the 23 major banks forced to suspend payment in the first half of 1893.[12]

[11] Although the percentage point changes in the ratio of credit to GDP were larger in the 1990s cycle, the percentage change in the ratio was actually higher in the 1970s episode (Kent and Lowe (1998)).

[12] By August that year, 12 of these banks had reopened after a process of reconstruction which involved writing off capital, converting some deposits into equity and deferring the payment of the remainder of deposits.

Runs on banks during the 1930s were confined to smaller institutions; major banks survived the depression relatively unscathed. Only three smaller institutions suspended payment, the largest of which was the Government Savings Bank of NSW - although this was largely due to political influences which led to a run on deposits.

The financial problems of the mid-1970s eventually led to the failure of Bank of Adelaide in 1979 (due to losses incurred by its finance company subsidiary), which merged with ANZ Bank (one of the major Australian banks).

The 1990s saw the failure of two government-owned banks, the State Bank of South Australia and the State Bank of Victoria, which was the fifth largest bank in Australia at the time. Large losses at these institutions forced the injection of public funds by their respective state governments before they were eventually merged with other banks.

2.3.2 Losses incurred by banks

The performance of financial institutions provides a more comprehensive measure of financial system problems than failures of financial institutions. The poor performance of financial institutions during a period of financial system instability can be gauged in a number of ways. The most direct measure is the level of charges for bad and doubtful debts. A more general measure is the cumulative decline in profitability.

Accounting standards in the 1890s and 1930s make it difficult to separate out charges for bad and doubtful debts. Typically, when banks identified large losses on loans, these would lead to a writedown in shareholders' capital without first going through profit and loss statements (Royal Commission (1937)). From 1893 to 1909, these charges amounted to about 77% of the value of shareholders' funds at the outset of the depression. The Royal Commission identified no such losses for the 1930s. This may have reflected the fact that smaller losses could be "hidden" by reporting a lower level of profits. Banks did not incur substantial credit losses over the 1970s. Charges for bad and doubtful debt from 1990 to 1992 amounted to 82% of the value of shareholders' funds in 1989.[13]

An alternative to bad and doubtful debts is to cumulate the difference between profits during "normal" times and profits during periods of financial instability. For simplicity we choose "normal" profits based on the year prior to the first substantial fall in profits. (For the 1890s, we also add in separately identified charges for bad and doubtful debts in order to compare results with other episodes.) The results (Table 1) confirm that the financial crisis of the 1890s was the most severe with cumulative losses (from 1893 to 1904) of 108% of shareholders' funds in 1892.[14] For the 1930s, cumulative losses (from 1930 to 1936)[15] were moderate, amounting to only 19% of initial shareholders' funds. Losses for the 1970s were insignificant - amounting in 1974 to only 0.4% of shareholders' funds in the previous year. While banking losses were small during the 1970s, there were significant losses within the NBFI sector (see Section 2.3.4). Losses of the banking sector in the early 1990s were more in line with those of the 1890s than the 1930s - cumulated from 1990 to 1992 they amounted to 44% of initial shareholders' funds.

So, although the decline in general economic activity was far greater in the 1930s than the 1990s, the severity of financial system problems in the 1990s was significantly greater as measured by the decline in bank profitability.

2.3.3 Lending behaviour - impact on the economy

When measuring the severity of financial system problems, our primary interest is the extent to which the weakened financial system exacerbates the decline in the real economy.

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[13] See Gizycki and Lowe (2000) for a more detailed discussion of these losses.

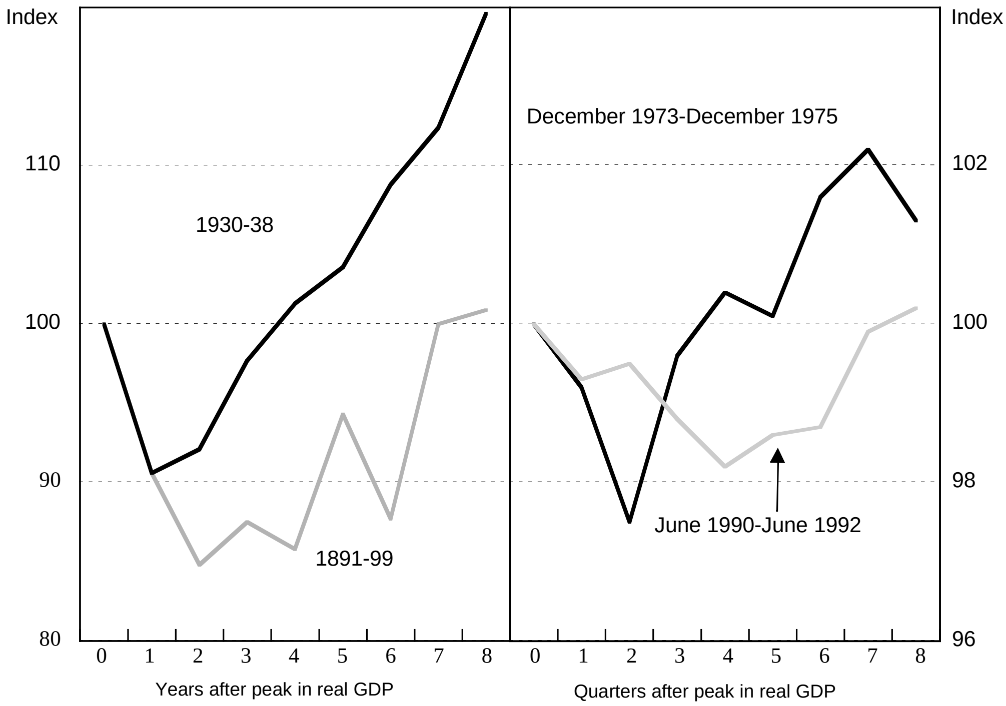
[14] The weakest banks made substantial calls on their shareholders in order to recapitalise (Kent and Fisher (2000)).

[15] Data on banks' profits are from Royal Commission (1937) and so do not extend beyond 1936.

Figure 4 compares the decline in output across the four episodes. Clearly, the depression of the 1890s was the most severe, the 1930s depression was relatively deep, while the 1970s recession was relatively mild. Finally, although the 1990s recession was also mild in comparison with Australia's depression experiences, actual output still remained below potential for a considerable period (Kent and Lowe (1998)).

It certainly appears that the severity of the 1890s banking crisis contributed to the depth and length of the decline in real output. Output fell by 10% in 1892. In 1893, when over half of the banking system collapsed, output fell by a further 7% and did not recover its earlier peak until the end of the decade. While output also fell by about 10% in the first year of the 1930s depression, it recovered thereafter - even though the decline in world output and that in the terms of trade were larger in the 1930s depression than the 1890s depression. This suggests the relative health of the financial system contributed to the 1930s depression being less severe than the 1890s depression.[16]

Figure 4
Australian real GDP during downturns



The relatively minor decline in output during the 1970s is consistent with the fact that losses of the financial system were also small. Kent and Lowe (1998) argue that the impact of the decline in the property sector through the mid-1970s was moderated by the fact that the general level of inflation was high. This meant the correction in real property prices was achieved via a moderate decline in nominal property prices (relative to the experience of the 1990s).

To emphasise the role of the property price correction in exacerbating the 1990s economic downturn, Kent and Lowe (1998) show that real GDP growth in Australia from June 1991 to December 1993 was significantly lower than growth as predicted by a model based on US GDP, Australian real interest rates and lags of Australian GDP growth.[17] This period of "unexplained" low GDP growth coincides

[16] Royal Commission (1937) describes the negative impact the financial problems in the 1890s had on the course of that depression. It also suggests that, although the banks were accused of adopting relatively tight lending policies through the 1930s episode, this had been true both before and after the depression. Kent and Fisher (2000) suggest differences in fiscal and monetary policies were not sufficient to explain the better performance of the banking system (and, indeed, the economy in general) in the 1930s compared with the 1890s.

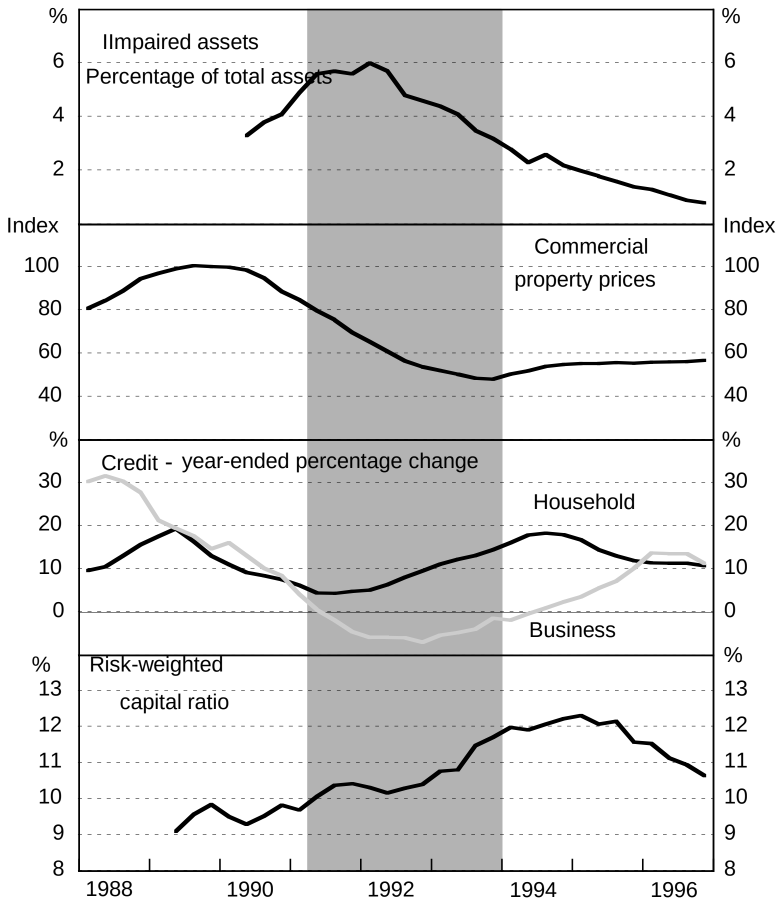
[17] Lack of quarterly data precludes this type of analysis for the 1890s and 1930s episodes.

with the period during which the banking system was very weak - non-performing assets were high, commercial property prices and business credit were falling and capital ratios were rising (Figure 5). This suggests the banking sector weakness explains the especially poor performance of the economy over this period.

Figure 5

Banking sector weakness - 1990s

Shading indicates period of unexplained low output growth



Finally, returning to the comparison across the four episodes, capital ratios provide a summary measure of the extent to which weakness in the banking system may have created a drag on the macroeconomy (Figure 3). In particular, if weakened banks seek to rebuild or even raise their capital ratios, this will tend to restrict the supply of credit with attendant effects on the macroeconomy.

In the early stages of the 1893 depression, banks were forced to raise new capital to replace that which had been written off as a result of substantial losses. Subsequently, in order to convince both shareholders and depositors of their new-found conservatism, the banks were forced to raise the ratio of shareholders' funds to assets (and shareholders' funds to loans and advances). The behaviour of the (risk-weighted) capital ratio through the 1990s was not too dissimilar. Despite earlier increases in the capital ratio following the move to the Basel capital standard, banks' capital ratios continued to rise through and beyond the recession.[18]

While the ratio of shareholders' funds to assets fell through the 1930s depression, the banking system did not lose capital over this period. The ratio of shareholders' funds to loans and advances, though

[18] This general pattern is robust to the exclusion of outlying banks which suffered the largest losses.

quite volatile, remained around pre-depression levels during the early years of the depression, but then fell consistently from 1934 onwards.

2.3.4 Problems at non-bank financial institutions (NBFIs)

In addition to problems in the banking sector, it is also worth comparing the severity of problems within NBFIs across episodes. However, data availability makes this problematic. The most comparable data are changes in the number and assets of NBFIs.

Over the 1890s episode, NBFIs grew rapidly during the expansionary phase of the cycle and suffered substantial losses during the depression. The assets of building societies and pastoral finance companies (the most significant non-bank lending institutions) rose by 80% in the five years to 1891 and fell by 45% over the 1890s. Between 1891 and 1893, 54 deposit-taking NBFIs closed their doors, 60% of them permanently (Pope (1991)).[19]

The market share of non-bank lending institutions remained low through the 1920s - their assets rising only 30% in the five years to 1930. Their assets fell by only around 6% from 1930 to 1933, roughly in line with the decline in the number of building societies over this period.

Daly (1982) describes the key role played by finance companies in the commercial property boom and bust of the 1970s. Almost half of the largest 20 finance companies failed following the collapse of the commercial property market in the mid-1970s. Even so, assets of NBFIs in general did not decline (in nominal terms) through this period.[20]

Gizycki and Lowe (2000) provide a brief account of the problems experienced by NBFIs through the early 1990s. There were runs on a number of institutions, some of which were forced to close or merge with stronger institutions. More generally, there was a significant decline in credit provided by NBFIs (as a share of nominal GDP).

In summary, although limited data make the comparison of these episodes difficult, in terms of the problems experienced by NBFIs it appears that the 1890s episode was the most severe, followed by the 1970s and then the 1990s and 1930s.

2.4 Overview of four credit cycles

The Australian experience of credit cycles (which is by no means unique) highlights three important results. First, there are a number of macroeconomic developments, which, ***in combination***, provide an indication of financial system instability - namely, an extended period of rapid growth of credit and asset prices (particularly of assets used for collateral) and increased concentration of investment and lending.

Second, while macroeconomic performance clearly impacts upon the health of financial institutions, there is also evidence that prudential behaviour of lending institutions is an important determinant of the course of the business cycle. In particular, countercyclical prudential behaviour during the 1890s and 1990s episodes amplified the business cycle. These episodes were also associated with severe cases of financial system instability. In contrast, generally procyclical prudential behaviour of banks over the 1930s episode meant their losses were relatively minimal and readily absorbed despite the depth of the cycle in output. Also, bank behaviour does not appear to have contributed to the depth of the 1930s downturn.

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[19] In the late 1880s, there were approximately 120 building societies in NSW and Victoria.

[20] In 1974, the NBFIs had assets of about $17 billion, of which finance companies accounted for almost $9 billion. This compares with bank assets of $27 billion. Many of the finance companies were owned by domestic or foreign banks and allowed banks to get around the strict controls on their lending activities.

Table 1
Summary of the severity of financial system problems

		Episode			
		1890s	**1930s**	**1970s**	**1990s**
Fall in real GDP	Relative ranking[1]	1	2	4	3
Failures of banks	Number of banks "failing"	13	3	1	2
Bank credit losses	Cumulative bad and doubtful debts (share of initial capital)	77%	na	na	82%
Performance of banks	Cumulative decline in profits (share of initial capital)[2]	108%	19%	0.4%	44%
Fall in ratio of credit to nominal GDP	Relative ranking[1]	1	2	4	3
Problems at NBFIs	Change in the number and assets of NBFIs (relative ranking)[1]	1	4	3	2

Note: Includes building societies and pastoral finance companies in the 1890s and 1930s.

[1] Ranking in declining order of severity from 1 (the most severe) to 4 (the least severe). [2] Cumulative difference between profit before tax relative to profit before tax in the year prior to the onset of financial system difficulties.

Third, underlying variation in the type of prudential behaviour across these episodes were differences in the competitive and regulatory environment facing banks. Deregulation heightened competitive pressures in the lead-up to the 1890s and 1990s, whereas competitive pressures were relatively moderate prior to the 1930s. Finally, the 1970s experience demonstrates that, although rigid regulatory controls on lending behaviour can isolate banks from the effects of declining economic activity and sharp falls in asset prices, much of the risk was pushed outside the regulated institutions.

3. Cyclical prudential standards for banks

In this section of the paper we use a stylised model of the economy to examine in more detail some of the themes raised in Section 2. Our primary interests are to describe the two-way relationship between the business cycle and banks' prudential behaviour and to consider the potential for banking behaviour to lead to amplification of the business cycle and financial system instability. In doing so, we examine how different assumptions regarding banks' perceptions of risk can lead to procyclical or countercyclical prudential policies.

Banks can vary their prudential standards across a number of dimensions. However, we focus on their decisions regarding the approval of loans, the interest rate on loans and levels of provisions and capital. In broad terms, banks' decisions regarding prudential standards have two important effects. First, they determine the level of credit risk held by banks. Second, by influencing the availability and price of credit, they influence developments in the general economy.

We assume that banks make these decisions in a way that is consistent with the standard capital allocation model.[21] We extend these models by recognising that the interest rates on loans and deposits and the capital ratio are determined endogenously. We then consider the impact of the business cycle on the distribution of potential credit losses and the impact of this on interest rates, credit and the risk of bank failure.

[21] See Herring (1999) and Jones and Mingo (1998) for a recent discussion of this framework.

3.1 Model overview

In the standard capital allocation model banks have a one-year planning horizon.[22] At the start of each year, banks make new loans, set loan rates, make provisions and raise capital and deposits. Losses on the loan portfolio are revealed at the end of the year and depend on the realisation of idiosyncratic and common factors that affect the ability of each borrower to service their debt. Loans are assumed to have an initial maturity of at least one year. Interest rates on loans are variable and determined in a competitive market. The demand for loans is assumed to be negatively related to the cost of loans and positively related to output.

For simplicity we assume that banks face no costs other than those that arise from the cost of raising deposits and equity to fund their loan portfolio. In our model deposits are best thought of as wholesale funds, which earn a premium over the risk-free interest rate to compensate depositors for the risk of the bank defaulting. We assume that shareholders are risk neutral, while depositors are averse to bank failure because the process of extracting their deposits from a failed bank is assumed to be costly. Deposits and equity are assumed to be supplied to the banks in any quantity so long as expected returns are sufficiently high (that is, the supply of deposits and of equity capital is infinitely elastic).

Banks' potential loan losses are described by a probability distribution function (PDF), defined over the whole loan portfolio. Hereafter, we normalise losses, provisions and capital by total loans. Hence a bank's PDF, $f(l)$, is defined over $l \in [0,1]$, the share of total loans ***including interest payments*** which borrowers fail to repay the bank at the end of the period.[23] The PDF summarises the likelihood of borrowers defaulting and the likely losses given default (see Appendix A for details).

Banks will provide loans so long as the interest rate on the loan is sufficient to cover the cost of deposits and expected loan losses, and to provide shareholders with the required return on the economic (risk) capital allocated to cover unexpected losses. The minimum required return on shareholders' economic capital, $\overline{ROE}$, is assumed to be determined in the equity market and taken as given by banks. In equilibrium, the expected return on equity must equal the required return on shareholders' funds.

In short, the model determines the equilibrium loan and deposit interest rates, capital, provisions and the probability of bank failure (for a given PDF, $\overline{ROE}$, risk-free interest rate and bankruptcy cost). The interest rate at which loans are supplied then determines the level of credit in the economy according to the demand for loans.

At the centre of the model is the relationship between the capital ratio and the average cost of funds, which must be fully reflected in the interest rate charged to borrowers. As a bank's capital ratio increases, there are two effects working in opposite directions. First, the cost of funds rises with the capital ratio because the required return on equity, $\overline{ROE}$, is above the risk-free interest rate, *r*. Working in the other direction, the premium paid to depositors (over and above the risk-free rate) falls rapidly from a relatively high level (at very low capital ratios) towards the risk-free rate as the capital ratio increases. This reduction in the risk premium paid to depositors reflects the decline in the probability of bank failure as the capital ratio rises. Combining these two effects implies that the curve mapping out the relation between the loan rate and capital is u-shaped (see Figure 6 in Section 3.2). Competition in the loan market will drive the equilibrium interest rate on loans towards the minimum point on this curve - the supply curve for loans is infinitely elastic at this interest rate, given our assumptions regarding the supply of equity and deposits. This solution is mapped out more formally in the next section, before we consider the impact of the cycle in Section 3.3.

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[22] This is consistent with evidence from US banks (Jones and Mingo (1998)).

[23] That is, loan losses at the end of the period are $l\,L\,(1+i_L)$ where *L* is total principal lent by the bank at the beginning of the period and i_L is the interest rate charged on loans. This means the PDF for losses is independent of the interest rate on loans, which simplifies the solution of the model.

3.2 Model solution

Banks fail if their losses are so large that assets are insufficient to cover non-equity liabilities (that is, if actual loan losses are greater than the sum of provisions and capital). The return on equity (*ROE*) reflects the limited liability of shareholders as follows:

$$ROE = \begin{cases} -1 & \text{if } \; l > \mu + c \\ \{ i_L - i_D(1-c) - l(1+i_L) \} / c & \text{if } \; l \le \mu + c \end{cases} \tag{1}$$

where μ is equal to provisions (which are defined more precisely below), i_L is the interest rate on loans, i_D is the interest rate on deposits and *c* is capital (per unit of loans). (Deposits per unit of loans are equal to $(1-c)$.) The expected return on equity is therefore:

$$E(ROE) = \frac{1}{c}\left\{ (1-p)[i_L - (1-c)i_D] - (1+i_L)\int_0^{\mu+c} l \; f(l)\, dl \right\} - p \tag{2}$$

where $p \equiv \int_{\mu+c}^{1} f(l)\, dl$ is the probability of bank failure.

Banks will fund loans so long as the interest rate on loans is such that the expected return on equity is greater than or equal to $\overline{ROE}$. Competition in the loan market will drive down the interest rate on loans to the point at which the expected ROE is equal to $\overline{ROE}$. Combined with equation (2), this implies that in equilibrium:

$$i_L = \frac{c\,(\overline{ROE} + p) + (1-p)(1-c)\, i_D + \int_0^{\mu+c} l \; f(l)\, dl}{1 - p - \int_0^{\mu+c} l \; f(l)\, dl} \tag{3}$$

For a given interest rate on deposits, equation (3) describes the relationship between the capital ratio and the interest rate on loans - as the capital ratio increases, the interest rate on loans must rise to provide a constant expected rate of return. This reflects the relatively high cost of equity. However, in this model we assume that the interest rate on deposits is not constant - it depends on the potential for depositors to experience losses, which in turn depends on the capital ratio.

The return on deposits, *ROD*, depends on the extent of bank losses as follows:

$$ROD = \begin{cases} \dfrac{b(1-l)(1+i_L)}{1-c} - 1 & \text{if } \; l > \mu + c \\ i_D & \text{if } \; l \le \mu + c \end{cases} \tag{4}$$

where, if the bank fails, $b \in (0,1]$ is the share of any remaining bank assets available for distribution to depositors after allowing for the costs of bankruptcy. The expected return on deposits is, therefore:

$$E(ROD) = (1-p)\, i_D + \frac{b(1+i_L)}{1-c}\left[p - \int_{\mu+c}^{1} l \; f(l)\, dl \right] - p \tag{5}$$

We assume that depositors are willing to supply banks with funds so long as the expected return on deposits is equal to the risk-free interest rate (which is less than the minimum required return on equity, $\overline{ROE}$). This can be justified in one of two ways, either:

(a) depositors are risk neutral but are willing to accept a lower expected return than equity holders because deposits provide a unique service, say liquidity or payment services; or

(b) depositors are risk averse and therefore willing to accept lower expected returns than equity holders because of the relative security provided by deposits. This aversion to losses can be captured by the term (1-*b*)>0 which describes the losses arising from bankruptcy. This may reflect the actual monetary cost of bankruptcy proceedings. It may also reflect the monetary value of the disutility associated with bankruptcy due to the loss of liquidity and wealth.[24]

Given that, in equilibrium, the expected return on deposits is equal to the risk-free interest rate, from equation (5) it can be shown that:

$$i_D = \frac{(r+p)}{1-p} - \frac{b(1+i_L)}{(1-c)(1-p)}\left[p - \int_{\mu+c}^{1} l \; f(l)\, dl \right] \tag{6}$$

The loan rate curve describing the relation between the interest rate on loans and the capital ratio can now be obtained by substituting equation (6) into equation (3):

$$i_L = \frac{c\,\overline{ROE} + (1-c)\,r + (1-b)\left[p - \int_{0}^{\mu+c} l \; f(l)\, dl \right] + E(l)}{1-(1-b)\left[p - \int_{0}^{\mu+c} l \; f(l)\, dl \right] - E(l)} \tag{7}$$

The two square-bracketed terms in equation (7) represent the effect of the premium that must be paid to depositors to compensate for the potential costs of bankruptcy. If there were no bankruptcy costs (that is, *b* equal to one), equation (7) would be greatly simplified. The expected return on the average loan, $i_L(1-E(l))$, would equal the cost of funds plus expected losses per loan, $c\overline{ROE} + (1-c)r + E(l)$. In this case, there would be a positive linear relationship between the loan rate and the capital ratio. In equilibrium the banks would fund all of their loans with deposits, which are cheaper than equity.

With *b* non-zero, the loan rate reflects not only the expected losses on the loan portfolio, but also compensation for depositors who face the potential costs associated with bankruptcy. At sufficiently high capital ratios (for well-behaved PDFs), the probability of bank failure is very low. At this point, the two square-bracketed terms in equation (7) tend to zero and the interest rate on deposits is close to the risk-free interest rate. It is only when capital is low to moderate and the probability of bank failure not insignificant that these terms become important.

To illustrate the main features of the model we provide a numerical solution based on a specific PDF and a set of parameters.[25] However, before solving the model we need to be more explicit about the conditions under which banks fail. We assume that a bank will fail if its assets at the end of the year are less than its debt liabilities, that is, if:

[24] The utility function implied by equation (4) is unsatisfactory to the extent that, conditional on bank failure, the depositor is then risk neutral with respect to losses. A more comprehensive form of risk aversion could be specified but this would complicate the solution without altering the main result - that is, that depositors are more averse to losses than equity holders and are willing to accept lower expected returns in exchange for greater security and/or liquidity. Moreover, depositors must be duly compensated when the probability of bank failure is relatively high (Figure 6).

[25] The parameters are: $r = 0.06$; $\overline{ROE} = 0.15$; $b = 0.9$; and the PDF is a Chi-squared distribution with three degrees of freedom defined over 50*l* (which has a mean of 0.0305). To derive the numerical solution we search over values of *l* from zero to one, increasing in increments equal to 0.001. The numerical solution should not be interpreted as approximation of reality; rather it serves to demonstrate the main features of the model.

$$(1-l)(1+i_L) < (1+i_D)(1-c) \tag{8}$$

$$\Leftrightarrow \qquad l > c + \mu \text{ where } \qquad \mu \equiv \frac{(1-c)(i_L - i_D)}{1+i_L}$$

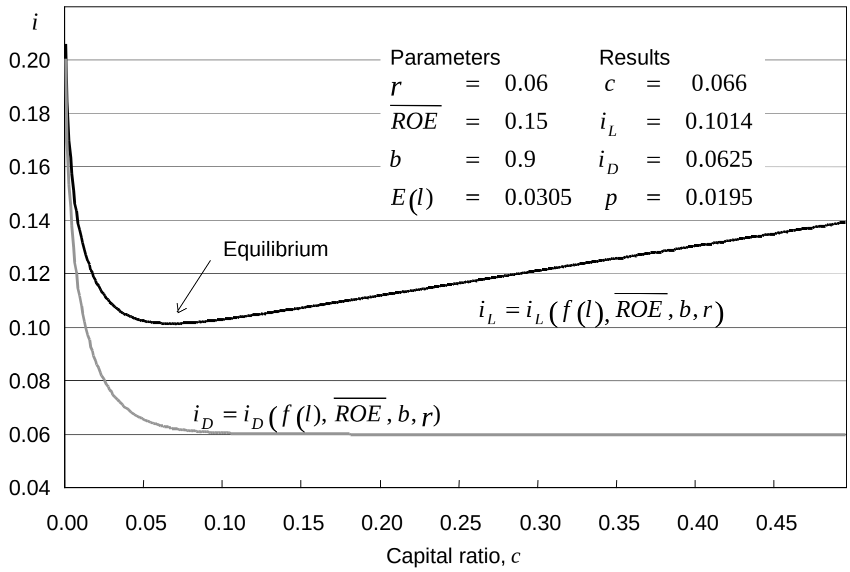
This defines the level of provisions, μ, which act as a buffer against losses. This buffer increases the greater is the differential between interest rates on loans and deposits.

The solution of the model is made more difficult by the fact that the failure condition depends on the interest rate on loans and deposits. This is because equations (6) and (7) both involve integrals with boundaries that depend on the endogenous interest rate variables. This requires us to solve the model using an iterative process whereby in the first instance we assume μ is constant (and equal to the expected value of *l*).[26] We then solve equations (6) and (7) for i_L and i_D and use these values to compute a new series for μ according to equation (8). This series is then used to find a new solution for i_L and i_D and so on until convergence.[27]

The numerical solution is summarised in Figure 6, which illustrates the relationship between the deposit rate and the capital ratio, and between the loan rate and the capital ratio (that is, equations (6) and (7) respectively). Banks can satisfy both the debt and equity markets by choosing any point along the (black) loan rate curve - however, competition in the market for loans will drive banks to the point at which the interest rates on loans is minimised. If capital ratios were to rise above this point, pressure to maintain the required return on equity would require a higher interest rate on loans. At lower capital ratios, the higher probability of bank failure requires banks to pay higher interest rates on deposits; this cost must be passed on to borrowers to maintain the required return on equity. Given the equilibrium capital ratio, the interest rate on deposits is given by the (grey) deposit rate curve.

Figure 6

Numerical solution of the model



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[26] This assumption is relatively accurate around the equilibrium.

[27] We used 60 iterations of this process, which was more than sufficient for convergence.

3.3 Impact of the cycle on losses

In this section we consider the impact of the state of the business cycle on the distribution of losses on a bank's loan portfolio and examine how this affects capital ratios, interest rates, the probability of bank failure and aggregate lending.

We start by assuming that the ability of each borrower to service their debt depends on the state of the real economy. We characterise output as cycling around a trend - which can be thought of as potential output. Although uncertain, output is assumed to have a predictable component and while shocks to the ***growth rate*** of output are persistent, output has a tendency to return to potential over time. Figure 7 indicates our stylised version of the business cycle. One way to derive this type of behaviour is to assume that output growth follows a Markov-switching process - switching from above average to below average growth rates (relative to potential growth).[28] Shocks to growth rates are persistent, but as output moves beyond potential, the probability of a reversal in economic fortunes increases. This means that bad times are more likely to follow an extended period of good times and vice versa.

The risk of losses in the loan portfolio increases through the expansionary phase of the business cycle for a number of reasons:

i. as output moves further away from potential, the probability of switching to a contractionary phase increases. This implies an increasing risk that borrowers will face difficulty in generating income sufficient to service their debts. In addition to the increased incidence of default during a contractionary phase, the loss given default will also tend to be higher at this time;

ii. while in the early stages of the expansion there is a large pool of investment opportunities, resource constraints in the economy (including the finance sector) prevent all of these opportunities being pursued at once. Entrepreneurs tend to pursue the high-return and low-risk projects first. As the expansion progresses and the capital stock grows, remaining investment opportunities and new additions to the capital stock become increasingly marginal, making the financing of these projects increasingly risky for banks;

iii. further, as interest rates rise through the expansionary phase of the cycle, the problem of adverse selection increases (Mishkin (1997)). This has the effect of biasing banks' potential customers to those with larger downside risk;

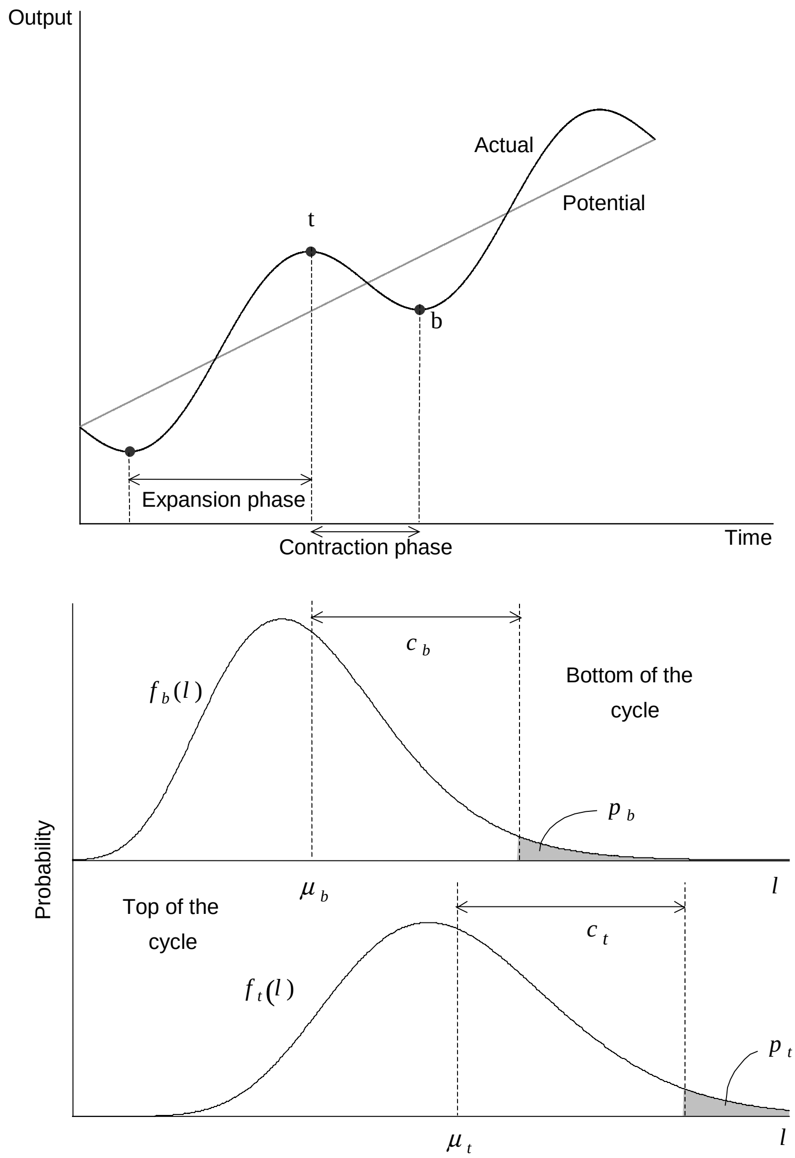
iv. there is also evidence that loan default rates have a distinct time profile, with default rates peaking when loans are a few years old (Carey (2000)). This suggests there is a build-up of risk during the upswing stage of the business cycle, when banks are writing a large number of new loans.

To simplify the analysis of the business cycle, consider two extreme points in the cycle: the top point of the cycle, state *t*; and the bottom point of the cycle, state *b*. Given the assumptions regarding the predictability of the cycle and the implications of the cycle for likely future loan losses, we can say something about the PDF for future losses at points *t* and *b*. Namely, $f_t(l)$ will imply greater expected losses than $f_b(l)$. In addition it seems reasonable to assume that the bad-tail of the loss distribution $f_t(l)$ also lies further from its respective mean than is the case for $f_b(l)$. Figure 7 illustrates these two points.

[28] The seminal paper to use Markov-switching processes to describe the business cycle is Hamilton (1989). For a recent discussion of this literature, see Kontolemis (1999).

Figure 7

The business cycle and PDF for losses



These assumptions are consistent with the findings in Carey (2000), who provides empirical evidence regarding bad-tail loss rates using Moody's bond-default database from 1970 to 1998. He shows that bad-tail events in bond portfolios are more likely to occur during times of general economic distress and that to protect against losses at the 99th percentile, capital ratios in bad years must be about 175% of those needed in good years. Further discussion of the relevance of the cycle for the loss distribution is provided in Appendix A.

Given the partly predictable nature of the cycle and the implied changes in the loss distribution, it makes sense for banks to condition their expectations regarding future losses according to the current state of the cycle. In this way, banks can adjust prudential standards in the light of changes in risk over their planning horizon. It is not necessary for banks to be able to predict the course of the cycle with a high degree of accuracy, only that they respond appropriately to the increasing probability of a downturn in the business cycle, even if this probability remains small.

In summary, the risk of large losses is greatest at the extreme peak of the cycle, whereas risk at the bottom stage of the cycle is relatively moderate. So long as the cycle is at least partly predictable, it makes sense for banks to use conditional PDFs when setting their prudential standards.

3.4 Solution based on conditional PDFs - Case 1

To illustrate how banks should respond to changes in risk through the cycle, we compare differences in their behaviour across the extreme points in the cycle. In this section we assume that banks perceive actual risk as implied by the PDFs conditional on the state of the cycle.

The PDF $f_t(l)$ implies higher expected loan portfolio losses than $f_b(l)$. By itself this implies a vertical shift in the loan rate curve, without altering the level of capital at which the interest rate is minimised. However, the PDF $f_t(l)$ also has a more prominent bad-tail than $f_b(l)$. This means that at each level of capital, banks must pay depositors a higher interest rate to compensate for increased probability of bank failure. This has the effect of shifting the loan rate curve up and to the right. In other words, the equilibrium interest rate on loans and the capital ratio are both higher at the top of the cycle. This is demonstrated by the numerical examples shown in Figure 8. The parameters and the results for the two equilibria are summarised in Table 2.

Figure 8
Equilibrium based on conditional PDFs

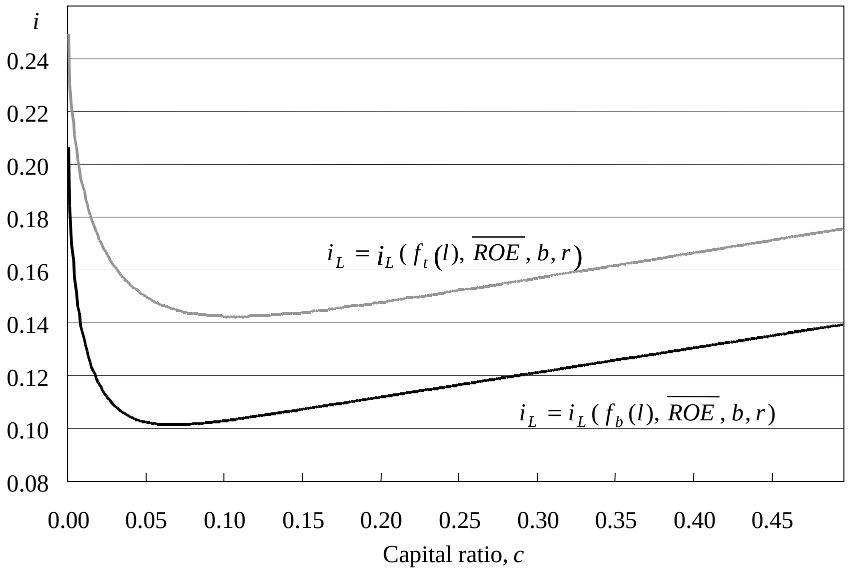


Table 2
Summary of equilibria for the conditional PDFs

		$f_b(l)$	$f_t(l)$
Capital ratio	c	0.066	0.107
Interest rate on loans	i_L	0.101	0.142
Interest rate on deposits	i_D	0.063	0.066
Probability of bank failure	p	0.020	0.040
Provisions	μ	0.033	0.060

Note: The PDFs, $f_b(l)$ and $f_t(l)$ are Chi-squared distributions defined over 50*l* and 100*l* respectively (with means of 0.0305 and 0.0605), both with 3 degrees of freedom. Underlying parameters are $b = 0.9, r = 0.6,$ and $\overline{ROE} = 0.15$.

These results also show that provisions and the probability of bank failure are both higher at the top of the cycle than at the bottom of the cycle. That is, depositors share some of the additional risk at the top of the cycle (though they are duly compensated for this risk through higher deposit rates). It is optimal for depositors and shareholders to share (albeit unevenly) this increased risk.

Because of the problem of adverse selection, banks may be reluctant to raise interest rates too much towards the top of the cycle. Instead, they may choose to reduce their exposure to borrowers by lowering the loan-to-valuation ratio or requiring a greater level of collateral. In either case, the impact on the demand for loans will be similar to a rise in the interest premium.

In summary, we have suggested the risk of borrower default and loss given default rises towards the top of the business cycle and falls at the bottom of the cycle. If the cycle is at least partly predictable, forward-looking behaviour by banks will lead them to increase capital ratios at the top of the business cycle and allow capital ratios to fall as they move to the bottom of the cycle. In equilibrium, interest rates will also be higher at the top of the cycle relative to the bottom of the cycle, as will the probability of bank failure.

3.5 Amplification of the cycle

In this section of the paper we investigate a number of reasons why banks might deviate from the type of behaviour described in Case 1 and the consequences for financial system stability of these alternative behaviours. Our primary interest is in the potential for banking behaviour to lead to amplification of the business cycle, both in terms of the amplitude of output cycles around potential and the duration of cycles.

In order to account for the potential for banks' lending decisions to influence the state of the cycle we need to make explicit the link between the supply of credit and the business cycle. A number of models do this by recognising that the health of borrowers will determine banks' willingness to lend, which in turn affects borrowers' ability to invest and consume and, therefore, the state of the general economy. The influence of the state of the economy on the health of borrowers completes the circular link between all of these factors.[29]

Other things equal, banks are more willing to lend to borrowers that can provide sufficient collateral or indicate more generally their willingness and ability to repay loans and avoid excessive risk-taking. Borrowers have to indicate to banks their financial strength in order to alleviate the problems of adverse selection and moral hazard, which arise due to asymmetric information. Collateral helps to protect the bank against loss and provides borrowers with some incentive to avoid excessive risk. The ***willingness*** and ***ability*** of firms to repay their debts and avoid excessive risk can also be indicated by a relatively high share of equity in total liabilities and by high profitability relative to the cost of debt servicing.

Suppose that at any point in the cycle the banking system as a whole were to ease lending conditions, leading to a fall in the interest premium and a rise in the level of credit. This should lead to some increase in output as borrowers take advantage of cheaper credit to undertake greater consumption and/or investment expenditure. The price of assets will also rise, as some of the additional credit is channelled into asset markets. An improvement in the economic outlook will be reflected in the value of firms' collateral, their share prices and profitability. Because these developments improve the financial position of firms, they can lead to a further easing of credit conditions.

Of course, the same amplification mechanism between output, credit and asset prices will also work in the opposite direction. For example, a negative shock to asset prices will reduce the willingness of banks to lend, which will impair the ability of borrowers to invest and consume. This in turn will have a negative influence on output and asset prices, further reducing banks' willingness to lend.

[29] One relevant model is that of Kiyotaki and Moore (1997), who describe the relationship between cycles in output, credit and asset prices and emphasise the role of collateral. Suarez and Sussman (1997) outline a model of financially driven business cycles. They imply the possibility of financial frictions amplifying the effect of external shocks in an unbounded manner. Holmstrom and Tirole (1997) present a model based on the lending channel, in which the health of banks' balance sheets determines the availability of intermediated finance for firms. See Dow (2000) for a recent review of these and other relevant models. Bernanke et al (1998) provide a survey of the literature on amplification arising through the financial sector.

3.5.1 Banks ignore the cycle - Case 2

The first alternative to Case 1 we consider is that banks (and the capital markets) are unable to predict the likely course of the business cycle and, therefore, base their lending decisions on the unconditional PDF $\bar{f}(l)$, rather than the conditional PDFs, $f_t(l)$ and $f_b(l)$.

If banks base their decisions on the unconditional PDF, they have no reason to vary their prudential standards through the cycle. If we ignore amplification effects for a moment, then under Case 2 provisions, capital and interest rates will all be constant through the cycle at levels between the extremes implied by $f_t(l)$ and $f_b(l)$. Banks will not have an incentive to deviate from this equilibrium since expectations regarding the return on equity and the return on deposits are constant through the cycle. However, while the banks (and markets) perceive the probability of failure to be constant throughout the cycle, the probability of failure will actually be higher at the top of the cycle and lower at the bottom of the cycle (reflecting differences in the actual PDF across the cycle).

In Case 2, banks are undercapitalised at the top of the cycle and interest rates are "too low" to account for the true level of risk implied by $f_t(l)$; the opposite is true at the bottom of the cycle. This also means the supply of credit is too great at the top of the cycle and too low at the bottom of the cycle compared to Case 1.

If we now attempt to account for amplification effects described above, the fact that interest rates are too low at the top of the cycle under Case 2 (relative to Case 1) implies an expansion in credit and hence an expansion in output (and asset prices). Again, the opposite is true at the bottom of the cycle. In other words, the cycle will display greater amplitude (and longer expansions and contractions) under Case 2 than Case 1. This amplification will also increase the risk of bank failure at the top of the cycle through its second-round impact on the conditional PDF, $f_t(l)$ - that is, the further output is above potential, the more likely it is that the economy will switch to a (long) contractionary phase. In this way, risk is accentuated by the interaction of the banks' beliefs and the amplification mechanism linking credit and output.

3.5.2 Excessive optimism - Case 3

The third case we consider is an extension of Case 2. Suppose banks perceive that risk is low (or even falling) during the expansionary stage of the cycle - that is, they are excessively optimistic relative to the true state of the world.

This behaviour can be explained as a form of myopia whereby the banks' (and the capital market's) expectations are driven by their more recent experiences[30] - that is, they base their assessment of risk on the (recent) realisation of risk. This means that during the expansionary phase of the cycle, when losses tend to be low, banks assume risk going forward is also low. Similarly, during the contractionary phase of the cycle, when losses tend to be high, banks assume that risk going forward is high (see Section 3.5.3).

Another possibility is that excessive optimism could arise because of uncertainty regarding potential output. Structural change can lead to a period during which potential (and actual) output is rising more rapidly than it has in the past. Ordinarily, above average growth rates for actual output cannot be sustained without leading to increasing risk of an economic downturn sometime in the near term. However, when potential output is also rising faster than average, this is no longer true. This implies that the conditional PDF for losses will not be shifting right to the same extent (if at all).

The risk, however, is that banks are excessively optimistic regarding how long this structural change will last and/or the extent to which potential output growth has increased. So long as they perceive risk to be relatively low they will increase lending and hold less capital than would have been the case in the absence of structural change. However, if the rate of growth of potential output slows (after structural change runs its course), then the risks will be rising over time to the extent that actual output is still growing strongly.

[30] Herring (1999) provides a detailed discussion of myopia and its relevance for financial stability.

The relative increase in risk will depend on the extent of banks' optimism. At the extreme, banks may believe actual output is likely to continue to rise at a rapid rate well into the future, in which case they might base their decisions on a conditional PDF that is close to a distribution like $f_b(l)$, while the truth is much closer to a distribution like $f_t(l)$. In this case, there will be greater amplification of the cycle than for Case 2 and an even greater build-up of risk during the expansionary phase of the cycle. Such a scenario is made more likely by the fact that excessive optimism can be self-sustaining. Banks may interpret the fact that growth is continuing at a fast pace (in part, because of amplification) as indicative of the strong growth in potential output.

Rapid growth of asset prices (particularly those that form the basis of collateral) has been an important element in many financial crises - both in Australia and elsewhere. Like output, asset prices can also be driven up by structural change. Excessive optimism with regard to future performance of the economy can drive asset prices well above their "fundamental" level. Banks lending on the basis of rapid rises in the value of borrowers' collateral are exposed to the risk of a reversal in market sentiment, which leads to a rapid decline in asset prices. This would then imply greater losses for banks in the event of borrowers defaulting.

This direct link between asset prices and banks' risk could be captured more explicitly within our framework by allowing the PDF for losses to be conditioned on asset prices. For example, rapid growth of asset prices above some threshold level would suggest larger losses are more likely (the PDF shifts right).

Excessive optimism will be more likely in a climate of relatively intense competitive pressure within the financial system, during which banks and other financial institutions compete aggressively for market share. Although excessive lending (driven in part by undercutting competitors' prices) will increase the risk of failure over the longer term, in the short term, during an expansionary phase, it may appear to be a profitable strategy. In part, this reflects the fact that default rates peak when loans are a few years old (Carey (2000)).

It may also be difficult for a single bank to deviate from other banks by displaying more conservative behaviour. If the capital market is subject to the problem of herding, the lone conservative bank may be unduly penalised.[31] That is, when markets care about relative returns, it may be hard for a bank to convince the market of the value of a conservative strategy when all other banks are lending aggressively. This is especially true if the market is focused on realised risk (as reflected in reported profits) rather than actual risk.

These arguments are certainly consistent with the Australian evidence. Indeed, the financial deregulation of the 1980s which led to increased competitive pressures was arguably also a factor leading to an improved outlook for the economy - that is, the end of financial repression led to financial deepening and, presumably, an improvement in the ability of financial institutions to direct funds to the most productive uses. The difficult question at the time was: how much and how rapidly could the economy absorb an increase in credit without a sharp rise in risk? Ex post, the pace was clearly too great, though it was still nothing like the experience of 100 years earlier.

3.5.3 Excessive pessimism - Case 4

Setting a minimum regulatory capital ratio that is invariant to the business cycle may be problematic for at least two reasons.

First, a fixed minimum capital ratio has to be set relatively high in order to protect (uninformed) depositors from very bad outcomes that are more likely during extreme economic distress. In the context of the model, this means capital would need to be set according to the PDF for losses, $f_t(l)$. However, this implies inefficient use of capital at the bottom of the cycle, when capital should be lower, according to $f_b(l)$. In this respect, Case 4 is similar to Case 2, which also had a fixed level of capital throughout the cycle.

[31] Devenow and Welch (1996) provide a brief summary of the literature on regarding rational herding models.

Second, when the economy experiences a very sharp downturn, banks are likely to lose a substantial amount of capital. The rigid minimum capital ratio forces banks to recapitalise to a relatively high level. As Hellwig and Blum (1995) show, the rigidity implied by a fixed minimum capital ratio can lead to amplification of large negative shocks to the banking system.

So far, our model has implicitly assumed that after experiencing a loss of capital, a bank is able to recapitalise - this follows from the assumption that banks view the one-year planning horizon as sufficiently long. However, following a sharp downturn in the economy, the capital market may well become excessively pessimistic. Having suffered significant (unexpected) losses, banks may find that the equity market is unwilling to provide additional funds under the same conditions as previously. This could be captured in the context of our model as a rise in the required return on equity, leading to an increase in the capital ratio and interest rates on loans.

Similarly, debt markets may become less willing to fund banks that experience significant losses. This could be captured in the context of our model as a rise in the required return on equity, leading to a fall in the capital ratio and higher interest rates on loans.

In our model, we have implicitly assumed that so long as the expected ROE and the interest rate on deposits are sufficiently high then equity and deposits will be supplied in whatever quantities the banks demand. However, in the real world, when banks suffer large losses, capital markets may be reluctant to fund banks, even at very high expected rates of return. If banks face limited access to funding, they will be forced to restrict lending, or even liquidate assets, in order to increase capital ratios. This will have a detrimental impact on output, credit and asset prices, leading to amplification of the cycle during its downturn phase.

If we allow for the possibility of pessimism, large losses at, or even the failure of, one bank can have a detrimental impact on the health of other banks. This follows from the negative impact of such losses on asset prices and the confidence of capital markets more generally. The difficulties created by these effects will be compounded if a number of institutions experience difficulties at the same time. Such an outcome is clearly more likely to occur during a downturn in the macroeconomy - especially if banks enter the downturn undercapitalised. This suggests the risk of a bank running into difficulties will depend not only on its own behaviour and the state of the business cycle, but also on the behaviour of other banks.

However, while it seems plausible that banks act according to a PDF conditional on the state of the business cycle, it is unlikely they will account for the condition of other banks. Essentially this implies there is a market failure causing banks to take on too much risk at the top of the business cycle. In a way the problem is one of liquidity for the system as a whole - that is, markets can cope with one bank failing during good times but fail to anticipate the failure of many institutions during bad times.

3.5.4 Backward-looking provisions - Case 5

It is a principle of sound prudential behaviour for banks to provide for ***expected*** losses in a forward-looking manner. In our model, banks (implicitly) make provisions according to their expectations of future loan losses. In theory, the key is not that banks make provisions, but rather that they charge an interest rate on loans sufficient to cover the cost of deposits as well as expected future losses on the loan portfolio. Having done this, making provisions is only important to the extent that the timing of interest payments and the revelation of loan losses may not be coincident. However, unless the bank has appropriately priced its lending it will be unable to make sufficient provisions and still satisfy the demands of the equity market.

In practice, loans may be priced on the basis that the current loan rate only needs to cover the current provisioning charge. However, this may be problematic if current provisioning levels are being set in a backward-looking fashion so as to cover the losses that are currently in the process of being realised. In this case, at the top of the cycle when current losses tend to be low, the charge to profits for provisions will be low at a time when credit risk is actually high (according to the conditional PDF at the top of the cycle, which implies relatively high expected losses going forward). This is problematic because the bank is likely to have to increase provisions in the future at a time when its interest income will be insufficient to cover expected losses. In practice, backward-looking provisioning may arise because the accounting standards and tax laws under which banks operate dictate their provisioning. Accounting standards (and bank supervisors) usually require banks to make specific provisions against non-performing loans that have been identified (that is, against losses in the process of being realised).[32] This means the charge to profit and loss for specific provisions would be too low at the top of the cycle when the realisation of non-performing loans is low - and too high at the bottom of the cycle when the realisation of non-performing loans is high. This may also be reflected in banks' decisions regarding loan rates.

Ideally, banks would make general provisions in a forward-looking way so as to compensate for the countercyclical path of specific provisions. General provisions would be built up during the expansionary phase of the business cycle when future expected losses are increasing and charged against during the downturn when the losses are realised. Presumably interest rates on loans would also vary to reflect these changes in provisioning. However, the accounting standards require that general provisions be made against non-performing loans not specifically identified, but which the bank believes to be present in the balance sheet at the balance date. Thus, strictly interpreted, general provisions will not be forward-looking. In practice, there is some scope for general provisions to be forward-looking because of the subjective nature of the decision to determine the level of non-performing loans not yet identified. In Australia and some other countries, general provisions are not tax-deductible, which also acts to discourage banks from being forward-looking when making general provisions. Nevertheless, major Australian banks have adopted a dynamic-provisioning methodology which attempts to set general provisions in a forward-looking manner.

If, during the expansion, general provisions and specific provisions are less than actual expected losses, then banks will be underprovisioned. With no compensating increase in capital, this means the likelihood of failure is also too high, as is profitability - banks are not pricing loans in such a way that they can afford to set aside sufficient revenue to cover expected losses. Debt markets may provide the discipline that forces banks to hold additional capital to compensate for the shortfall in provisions. However, if the debt markets suffer from excessive optimism, there may be a role for supervisors to ensure adequate capital is held to offset the problem of backward-looking provisions.

4. Policy implications

The results of Sections 2 and 3 of the paper suggest that countercyclical prudential behaviour of banks can lead to the build-up of excessive risk during the expansionary phase of the business cycle. Furthermore, this behaviour can amplify the business cycle and reduce financial system stability. The build-up of excessive system-wide risk through the expansionary phase of the business cycle is indicated by a combination of developments, including: rapid and sustained growth in credit and asset prices; increased concentration of investment and lending; declining capital ratios; and a downward drift in risk premia. This countercyclical prudential behaviour may indicate the presence of excess optimism among banks and within capital markets.

The paper also suggests, however, that countercyclical prudential behaviour is by no means inevitable, as demonstrated by Australia's experience over the 1920s and 1930s. In this case, procyclical prudential behaviour meant that, even when faced with a sharp decline in economic activity, banks' losses were relatively minor and readily absorbed.

These results have at least two important implications for policymakers concerned about the failure of financial institutions and the stability of the financial system more generally:

1. supervisory authorities need to play close attention to macroeconomic developments; and
2. supervisory authorities need to ensure that lending institutions' prudential behaviour responds appropriately to changes in risk through the business cycle.

[32] This is driven by accounting standards that seek to remove subjective elements from the banks' accounts by preventing banks from incorporating forecasts into their reported provisions.

Cyclical capital ratios

Perhaps the most obvious policy for supervisors to adopt is to ensure that lending institutions adjust capital ratios through the cycle - raising the ratio as risk increases through the expansionary stage of the cycle and then allowing the ratio to decline as risk dissipates through the contractionary phase of the cycle.[33]

One possibility is for the supervisor to make informal recommendations on an institution-by-institution basis regarding changes in the margin between actual capital and the regulatory minimum through the cycle.[34] The wholesale funding market may assist the supervisor in determining the margin of capital that banks hold over and above the minimum - in particular, the market plays an important role in determining the relative position of individual banks above the regulatory minimum.[35]

While such a system of informal (one-on-one) recommendations may cope with moderate business cycles, it may be less effective during more extreme periods characterised by very rapid growth of credit and asset prices. In these circumstances, financial institutions and markets are susceptible to excessive optimism and, therefore, may not appreciate, and may even be contributing to, the build-up of risk across the system. At the same time, informal recommendations by the supervisor may lack credibility and transparency. In contrast, a more formal system of announced adjustments to system-wide capital requirements would make the supervisor more accountable and provide a clear signal of the supervisor's assessment of risk in the system.

While this paper has argued that prudential standards should vary over the course of the cycle to account for changes in risk implied by the business cycle, this does not mean that prudential policy should be used to dampen the course of an "average" business cycle. Rather, it should seek to ensure developments within lending institutions do not amplify the business cycle and reduce financial system stability.

Uncertainty

Perhaps the most significant difficulty associated with a cyclical policy of this type is the uncertainty regarding the business cycle on the part of the supervisor. Uncertainty on the part of the lending institutions may lead to excessive risk at the top of the business cycle in the first place. It is not clear that the policymaker would have significantly better information than financial institutions. An ill-informed supervisor runs the risk of adjusting regulatory policy by the wrong amount, in the wrong direction or at the wrong time, thereby impeding efficiency and, worse still, amplifying the cycle itself.

Despite these problems, one advantage the supervisor has over financial institutions is immunity to the competitive pressures which can lead to excessive optimism. In addition, the supervisor is in a position to consider the system-wide implications for risk of individual banks' prudential behaviour.

With regard to the difficulties raised by uncertainty, it is also worth drawing a parallel with monetary policy, which faces many of the same problems. Uncertainty regarding the state of the cycle, the impact of structural changes and the effectiveness of interest rate changes suggests that monetary policy needs to be discretionary (rather than rules-based). In order to be effective, discretionary monetary policy needs to have the features of transparency and clear accountability. A cyclical regulatory policy framework would also need to incorporate these features. Like monetary policy, cyclical regulatory policy would also have to be forward-looking given the time it takes to adjust capital ratios (that is, to raise capital or adjust asset portfolios).

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[33] During the downturn phase of the cycle the capital market's attitude to risk may force institutions to hold a higher level of capital than the supervisor believes to be necessary (as suggested in Section 3.5.3).

[34] This is consistent with guidelines proposed by the Basel Committee on Banking Supervision (1999).

[35] There is a debate regarding the ability of ratings agencies to act in a forward-looking manner. For a brief summary of this debate, see Jackson and Perraudin (1999).

Current research regarding financial system stability suggests there is no single set of indicators or a satisfactory model to guide prudential policy in a mechanistic way (Davis (1999)).[36] However, the history of financial crises demonstrates that risks in the financial system are greatest when a period of rapid economic growth is combined with strong credit growth on the back of rapid inflation of asset prices. These developments are of even greater concern during a period of heightened competition or a period of structural change in the economy, since in this environment financial institutions and markets are more susceptible to excessive optimism.

Central banks' involvement in financial markets and their macroeconomic responsibilities give them a broad system-wide perspective. Therefore, where the supervisory authority is separate from the central bank (as is the case in Australia and many other countries) it is important to ensure strong links exist between the two institutions. This has been guaranteed in Australia by the fact that the Governor and another senior executive of the Reserve Bank of Australia are on the Board of the Australian Prudential Regulation Authority, while the Chief Executive Officer of APRA is on the Payments System Board of the Reserve Bank. In addition, there are less formal links between the two institutions. For example, a high-level joint Coordination Committee meets on a monthly basis to oversee the day-to-day relationship between the RBA and APRA.

This level of formal communication with the central bank can help to provide the supervisory authority with a sound assessment of the current state of the business cycle, enabling it to more accurately assess the level of system-wide risk going forward so that policies can be determined accordingly.

[36] Though monetary policy is arguably more developed in this regard, it is still subject to model uncertainty and data problems.

Appendix A
Micro foundations for the PDF for losses

In Section 3.3 of the paper we assumed that $f_t(l)$ will imply greater expected loan losses than $f_b(l)$ ***and*** that the bad-tail of the loss distribution $f_t(l)$ lies further from its respective mean than is the case for $f_b(l)$, that is, the variability of potential losses would be greater for $f_t(l)$ than for $f_b(l)$. In this appendix we demonstrate how this type of behaviour regarding the PDF for losses on a bank's lending portfolio can be generated from independent binomial distributions. These describe the likelihood of default of an individual loan and the distribution of the loss given default.

An increase in either the probability of default on individual loans, or the probability of a large loss given default, shifts the PDF for losses on a bank's portfolio to the right, increasing both the expected loss and the variability of losses. This supports our assumption in Section 3.3 that the PDF shifts to the right at the top of the business cycle. The greater probability of default during the downswing stage of the business cycle may be thought of as representing the effect of slack demand on firms' profitability and the impact of higher unemployment on households' financial position. The higher probability of a larger loss given default may be thought of as a simple attempt to capture the effects of falling asset prices during the downswing stage of the business cycle on value of bank collateral. During benign economic conditions banks will be able to recover more of the value of defaulting loans than during a macroeconomic downturn.

We start by defining the average loss on a portfolio of *n* loans:

$$l = \frac{1}{n}\sum_{i}^{n} l_i$$

where l_i is the loss on loan *i* (expressed as a share of the value of the loan, including contracted interest payments).[37] We assume that loss on a loan is conditional on default - that is, there are no "restructured loans" in our model. The loss on an individual loan is described by a binominal distribution,

$$l_i = \begin{cases} 0 & \text{with probability} \quad (1-d) \\ \lambda & \text{with probability} \quad d \end{cases}$$

where λ is the loss-given default and $d \in (0, 1)$ is the probability of default (which is constant across borrowers). We assume that default probabilities for individual loans are independent; we briefly discuss the implications of this simplifying assumption below. The loss given default, λ, is also assumed to be described by a binomial distribution,

$$l_i = \begin{cases} 0.5 & \text{with probability} \quad (1-g) \\ 1 & \text{with probability} \quad g \end{cases}$$

where $g \in (0, 1)$ is the probability that, given default, the bank recovers nothing from the loan. The case where $\lambda = 0.5$ represents a situation where the bank is able to retrieve half of the principal (plus interest) because the loan is partly collateralised.

Table A1 and Figure A1 show the results of Monte Carlo simulations using three different combinations of *d* and *g*. Each portfolio contained 100 loans and PDFs for the portfolio were generated by repeating the simulation 10,000 times.

[37] If we allow the size of loan portfolios to increase over the expansionary phase of the cycle, this will reduce the variability of the PDF for the average loss on the portfolio. However, so long as the increase in the size of the economy (that is, the number of borrowers) is not too large, this effect will not offset the impact of the increased probability of default and loss given default at the top of the cycle.

Figure A1
Simulated PDFs for losses

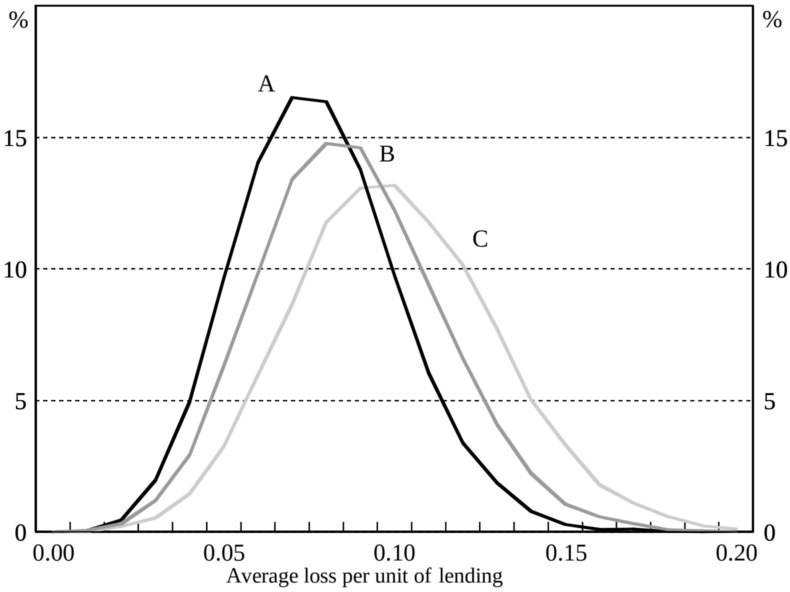

Table A1
Simulated PDF characteristics

PDF	A	B	C
Parameters	$d = 0.1$ $g = 0.5$	$d = 0.1$ $g = 0.8$	$d = 0.15$ $g = 0.5$
$E(l)$	0.075	0.090	0.1125
"Required capital"	0.060	0.070	0.067

Note: Required capital is defined such that the probability of losses greater than the sum of expected losses and required capital is 2.5%.

The results show that increasing either the probability of default (moving from A to B) or the probability of larger losses given default (moving from A to C) increases both the expected loss on the portfolio and the variability of potential losses. This means that both the level of provisions required to cover expected loss and the level of capital required to cover unexpected loss will increase in both cases.

So far we have assumed that the default probabilities for individual borrowers are independent. This is likely to be an unrealistic assumption as it does not take account of the interdependence between firms (and households) in the real economy. The failure of one firm is likely to have knock-on effects for other firms - increasing the probability that they also default on their loan. This will increase the correlation in defaults among the individual borrowers in a bank's loan portfolio. While incorporating these effects would change the shape of the PDFs - shifting more mass into the bad-tail - it would not alter the key results. Increasing the probability of default and loss given default for individual borrowers would still increase the expected loss and the capital required to cover unexpected losses on the bank's loan portfolio.

Appendix B
Data

Figure 1: Credit in Australia

Bank loans and advances: 1861-1945 sum of trading bank advances, Occasional Paper 4A, Table 1 and savings bank mortgage loans, Occasional Paper 4A, Table 53(i); trading bank data include the Commonwealth Bank from 1913 onwards; trading banks included in this series are the banks of note issue; 1946-52 sum of trading bank loans and advances and savings bank loans and advances, Pope, 1986; for 1953-76 total bank loans and advances, Occasional Paper 8, Table 3.2; 1977-99 total bank loans and advances, *Bulletin*, Table D2.

AFI loans and advances: 1953-99 sum of bank loans and advances and NBFI loans and advances; 1953-76 NBFI loans and advances are taken from Occasional Paper 8, Table 3.2; 1977-99 NBFI loans and advances, *Bulletin*, Table D2.

AFI credit: 1977-99 sum of AFI loans and advances and bank bills on issue, *Bulletin*, Table D2.

Nominal output: 1861-1900 GDP at market prices from Butlin, N G (1962), "*Australian domestic product, investment and foreign borrowing, 1861-1938/9"* (ADP), Table 1, p 6, col 2; 1901-59 from Vamplew, W (ed), "*Australian historical statistics"* (AHS), Table ANA 129; 1960-99, GDP(E) current prices, ABS 5206, Table 13.

Figure 2: Cycles in Australian output, construction, property prices and credit

Real GDP: 1880-99 and 1920-39 nominal output is deflated by the GDP price deflator index in AHS, Table PC 79 and indexed to equal 100 in the peak output years of 1891 and 1930; 1960-79 and 1980-99 real GDP(E) chain-linked, ABS Cat 5206, Table 5, indexed to equal 100 in the peak output quarters of December 1973 and June 1990.

Construction to nominal GDP: 1880-99 and 1920-39 output of the construction industry is taken from ADP, Table 2; 1960-79 and 1980-99 construction output is taken as the sum of private gross fixed capital investment - dwellings and private gross fixed capital - other buildings and structures, ABS Cat 5206, Table 13.

Property prices: 1882-97 and 1921-36 average of the capital value of rateable property in Melbourne and Sydney, indexed to 100 in 1891 and 1930, Kent and Fisher (2000); March 1968-June 1980 capital value indicator for Sydney CBD property indexed to 100 in March 1973, Jones Lang Wootton (JLW); September 1980-June 1999 spliced series indexed to 100 in 1989/1990; September 1980-June 1985 capital value indicator for Sydney CBD property and September 1985-June 1999 weighted average capital value indicator for capital city CBD property, JLW.

Credit to GDP: 1880-99 and 1920-39 as in Figure 1; 1960-79 and 1980-99 ratio of AFI credit to nominal output as in Figure 1.

Figure 3: Capital ratios

Capital: 1881-1900 and 1921-39 the sum of trading bank shareholders' funds and "reserves" as reported on banks' balance sheets, Occasional Paper 4A, Table 3 (prior to 1893 paid-up capital consists of paid-up ordinary capital, from 1893 paid-up capital is the sum of ordinary capital and preference capital); 1960-79 and 1980-99 capital is total shareholders' funds from banks' balance sheets, *Bank Annual Reports*.

Bank loans and advances: 1881-1900 and 1921-39 as in Figure 1.

Total assets: 1881-1900 and 1921-39 total assets of trading banks, Occasional Paper 4A, Table 1; 1960-79 and 1980-99 total assets from banks' balance sheets, *Bank Annual Reports*.

Risk-weighted capital ratio: ratio of regulatory capital base to total risk-weighted assets of locally incorporated banks, APRA.

Figure 4: Australian real GDP during downturns

Real GDP: as in Figure 2.

Figure 5: Banking sector weakness - 1990s

Impaired assets as a percentage of total assets: pre-September 1994 impaired assets included non-accrual items and accrual items greater than 90 days, APRA; post-September 1994 impaired assets include non-accrual items, restructured items and real estate and other items acquired through security enforcement. Past due items include housing loans and other items past due for 90 days or more which are well secured and portfolio facilities past due for 90-180 days, APRA. Total assets is total consolidated on-balance sheet assets (including assets of foreign bank branches), APRA.

Commercial property prices: as in Figure 2.

Credit growth: break-adjusted year-ended percentage change in AFI credit to the household and business sectors. Breaks include securitisation, entry/exit of institutions and changes in reporting by institutions (RBA calculations).

Risk-weighted capital ratio: as in Figure 3.

Table 1: Summary of severity of financial system problems

Bank credit losses: calculated as described in text; 1890s and 1930s data are from Royal Commission (1937); 1990s data are the charge for bad and doubtful debts from banks' profit and loss statements and capital from banks' balance sheets, *Bank Annual Reports*.

Performance of banks: calculated as described in text. For 1990s data are profit or loss from banks' profit and loss statements and capital from banks' balance sheets, *Bank Annual Reports*.

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