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**BASLE COMMITTEE ON BANKING SUPERVISION  
WORKING PAPERS**

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**No. 1 – April 1999**

**CAPITAL REQUIREMENTS AND BANK BEHAVIOUR:  
THE IMPACT OF THE BASLE ACCORD**

**by a working group led by:**

**Patricia Jackson**

**and participation from:**

**Craig Furfine**

**Hans Groeneveld**

**Diana Hancock**

**David Jones**

**William Perraudin**

**Lawrence Radecki**

**Masao Yoneyama**

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**BANK FOR INTERNATIONAL SETTLEMENTS  
Basle, Switzerland**

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**Abstract**

The paper reviews the empirical evidence on the impact of the 1998 Basle Accord. It focuses on whether the adoption of fixed minimum capital requirements led some banks to maintain higher capital ratios than would otherwise have been the case and whether any increase in ratios was achieved by increasing capital or reducing lending. Moreover, it addresses whether fixed capital requirements have been successful in limiting risk-taking relative to capital as intended, or whether banks have been able to take actions to reduce their effectiveness, either by shifting to riskier assets within the same weighting band or through capital arbitrage. It looks at two possible side effects. Firstly, whether in some periods capital requirements may have had the effect of constraining bank lending thereby causing a credit crunch. Secondly, whether the introduction of fixed minimum requirements for banks affected their competitiveness relative to other forms of intermediation.

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\* For this paper support and drafting were provided by various members of the Bank of England staff, in particular Tolga Ediz and Andy Logan.

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## **Introduction and summary**

In the past 20 years, a wide range of countries have introduced formalised capital requirements. This development was spearheaded by the adoption of minimum capital requirements in particular countries (for example, the UK and the USA in 1981) but with the introduction of the Basle Accord in 1988 common minimum capital requirements were adopted by the G-10. The Accord has now been implemented by around 100 countries world-wide.

There were two main objectives behind the adoption, by the Basle Committee, of a single standard for internationally active G-10 banks. First, the Committee believed that the framework would help to strengthen the soundness and stability of the international banking system by encouraging international banking organisations to boost their capital positions. Second, the Committee believed that a standard approach applied to internationally active banks in different countries would reduce competitive inequalities. Importantly, the framework established a structure that was intended to:

- (1) make regulatory capital more sensitive to differences in risk profiles among banking organisations;
- (2) take off-balance-sheet exposures explicitly into account in assessing capital adequacy; and
- (3) lower the disincentives to holding liquid, low risk assets.

It is now ten years since agreement was reached on the Basle Accord and it is therefore important to consider whether the policy achieved the desired objectives. The Basle Committee asked the Research Task Force to set up a Working Party on Bank Capital and Behaviour to assess the empirical evidence on the impact of the 1988 Accord before work on amending the Accord was started. This Working Party has reviewed the available data on capital ratios for banks in the G-10, including the material collected by the Basle Committee, and the results of empirical research conducted by academics and research departments in the G-10 central banks and regulatory bodies in order to look at these issues. In all, the working party considered over 130 research papers.<sup>1</sup> This effort to produce an overall assessment of the impact of capital requirements also led to new research in some of the G-10 central banks.

Two main issues were considered by the Working Party. Firstly, whether the adoption of fixed minimum capital requirements led some banks to maintain higher capital ratios than would otherwise have been the case and whether any increase in ratios was achieved by increasing capital or reducing lending. Secondly, whether the fixed capital requirements have in fact been successful in limiting risk-taking by the banks relative to capital as intended, or whether banks have been able to take actions to

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<sup>1</sup> These papers are listed in the references but not all are cited in the text.

reduce their effectiveness either by shifting to riskier assets within the same weighting band or through capital arbitrage.

The Working Party also considered whether the introduction of fixed minimum capital requirements had unintended side effects, apart from encouraging capital arbitrage activity. Specifically, it has been suggested that in some periods, banks may be constrained by the capital requirements from increasing lending or may have to reduce lending, thereby causing a credit crunch and affecting the real economy. Another potential side effect is that the introduction of capital requirements for banks may have reduced their competitiveness in relation to other forms of intermediation. The Working Party looked at both of these issues.

The overall message from the empirical literature and the data is that, at least initially, the introduction of formal minimum capital requirements across the G-10 appears to have induced relatively weakly capitalised institutions to maintain higher capital ratios. At the same time, however, there is some evidence that bank capital pressures during recent cyclical downturns in the U.S. and Japan may have limited bank lending in those periods and contributed to economic weakness in some macroeconomic sectors. All of these effects may well have reflected both regulatory and market pressure on banks to maintain ratios at least as high as the minimum. In this context, a common structure of formal regulatory capital requirements across countries may have enabled financial markets to exert greater market discipline on undercapitalised banks than would otherwise have been the case. However, over time the banks have learnt how to exploit the broad brush nature of the requirements - in particular the limited relationship between actual risk and the regulatory capital charge. For some banks, this has probably started to undermine the meaningfulness of the requirements.

The conclusions the working group has drawn from the available literature are presented below.

***Did the introduction of fixed minimum capital requirements lead banks to hold higher capital ratios?***

Data on the capital ratios of G-10 banks indicate that the introduction of the Basle Accord was followed by an increase in risk-weighted capital ratios in a number of countries. The average ratio of capital to risk-weighted assets of major banks in the G-10 rose from 9.3% in 1988 to 11.2% in 1996. It is however, hard to discern whether these increases reflected the direct effects of the Basle Accord, as opposed to increased market discipline, since the introduction of consistent standards for bank capital probably worked to increase transparency and improves the market's ability to exert pressure. Nevertheless, several studies of the experience in the US and elsewhere, both pre- and post-Accord, suggest that firmly applied capital standards induce weakly capitalised banks to rebuild their capital ratios in various ways more rapidly than otherwise.

***Do banks adjust their capital ratios to meet the requirements by increasing capital or reducing risk-weighted assets?***

Banks' reactions to hitting regulatory constraints on their capital ratios are likely to vary according to the stage of the business cycle and the bank's own financial situation. In general, the research is consistent with the view that banks respond to capital ratio pressures in the manner they believe to be most cost effective. Raising new capital or boosting retained earnings may be easier in booms whereas cutting back loan books may be more cost effective in economic troughs. Similarly capital structure decisions by banks may well be sensitive to the higher cost of Tier 1 capital relative to Tier 2 capital. When the cost of raising Tier 1 capital is prohibitive, banks may attempt to meet capital requirements, where possible, through issuance of Tier 2 capital. Nonetheless in some countries banks have a richer mix of equity relative to Tier 2 than the capital regulations would require, probably because of market pressure. Available research suggests that, in order to meet minimum capital requirements, banks are likely to cut back lending when it would be too costly to raise new capital.

***Impact of capital requirements on risk-taking?***

Some theoretical papers have suggested that capital requirements applied uniformly across a broad class of assets may induce banks to substitute towards the riskier assets in the class, leading in some cases to an overall rise in the riskiness of the bank's portfolio. The broad nature of the Basle Accord risk classes does give considerable scope for substitution between more and less risky assets. Owing to the great difficulties in measuring bank risk-taking with available data, the very limited academic literature in this area is inconclusive.

***Have banks artificially boosted their capital ratios by engaging in capital arbitrage?***

The broad risk asset classes in the Basle Accord undoubtedly create a gap between the economic capital which banks feel they should be holding to back some loans - particularly the prime end of the book - and the regulatory capital they have to hold. Increasingly, innovations in the market have enabled banks from a variety of countries to make use of techniques to effectively arbitrage between these two amounts, increasing bank risk relative to minimum capital levels. One technique used is securitisation, although it should be emphasised that other factors besides capital arbitrage are often important drivers behind securitisation.

The volume of securitisation is substantial. At March 1998, outstanding non-mortgage securitisations by the ten largest US bank holding companies amounted to around \$200 billion (more than 25%, on average, of these banks' risk-weighted loans). European banks have also been using the US markets for securitisations and there is also evidence that securitisations performed outside the US have been growing exponentially. According to FitchIBCA new structured finance in Europe (bank and non-bank) increased from \$8.5 billion in 1995 to more than \$41 billion in 1997. Overall therefore with

increasing sophistication of the banks and the development of new innovative techniques in the market, the largest banks have started to find ways of avoiding the limitation which fixed capital requirements place on their risk-taking relative to their capital. For certain banks, this is undoubtedly starting to undermine the comparability and even the meaningfulness of the capital ratios maintained.

***Do fixed minimum capital requirements create credit crunches affecting the real economy?***

It is likely to be the case that in some periods banks in a particular country may find it difficult to maintain the fixed minimum capital requirements and therefore may be forced to cut back lending. It would in fact be strange if fixed minimum capital requirements did not bite in some periods, thereby constraining the banks, given that the purpose of bank requirements is to limit the amount of risk that can be taken relative to capital. However, for this to have an effect on output, it would have to be true that any shortfall in bank lending was not fully made up through lending by other intermediaries or by access to securities markets.

There is evidence that banks play a special role in financial markets, particularly in their lending to smaller companies, and that it may be difficult for such borrowers to find alternative sources of funding. For the US, there is some indication that particular sectors such as real estate or small companies, may have been affected by pressure on bank capital in the early 1990s. Currently, the weakness of the Japanese banks may be contributing to the weakness of the economy but more evidence is needed to assess this effect.

One difficulty in looking at this question is that periods in which banks are severely capital-constrained are likely to be those when they are making large write-offs or specific provisions (reducing capital), and in such periods it is also possible that loan demand will be weak. It is also possible that banks may cut back lending, not because of capital constraints, but because of concerns about lending to particular risky sectors.

A further issue, which is not examined in the paper, is the link between minimum capital requirements for banks and financial stability and thence output. Capital requirements for banks attempt to limit excessive risk-taking relative to capital, thereby reducing the likelihood of failures. If they are successful in this, the requirements could, overall, have a positive effect on output.

***Did the introduction of minimum capital requirements for banks harm their competitiveness?***

It is very difficult to look at this question given that long-term competitiveness of banking is driven by a wide range of factors. Most of these are unrelated to regulation. One approach, however, is to look at how the equity market reacted to the announcement of either the new capital requirements or equity issues by banks to meet regulatory standards, to see whether there was an expectation that banks' profitability would be harmed. Unfortunately no clear conclusions can be drawn from the papers

which examine this question and, even if clear conclusions could be drawn, it is not clear that the market's initial reaction to such issues would, in the long run, prove to be correct.

***Did the Basle Accord reduce competitive inequalities between banks?***

At this time, available research does not provide persuasive evidence, one way or another, as to whether the Accord has contributed to a significant levelling of the playing field for banks. There are likely to be many other factors besides regulatory capital requirements that are more important determinants of relative competitiveness in different product areas. These range from differences in accounting treatment, which affect the size of the calculated risk asset ratios, to differences in the cost of capital from one country to another.

## 1. The effects of capital requirements on banks' balance sheets

Since the introduction of the Basle Accord in 1988, the risk-based capital ratios in developed economies have increased significantly. Chart 1 gives a graphical account of the evolution of the capital to risk-weighted asset ratios from 1988 to 1996 (based on data from a wide range of banks from the FitchIBCA database and national supervisors as well as the Basle Committee). The charts show an increasing trend with the industry average capital ratio rising from 9.3% in 1988 to 11.2% in 1996. Most countries experienced increases in their capital ratios although those countries which were close to, or below, the Basle minimum capital adequacy ratio of 8% in 1988 evidenced a much higher overall increase than those which had historically high capital ratios.

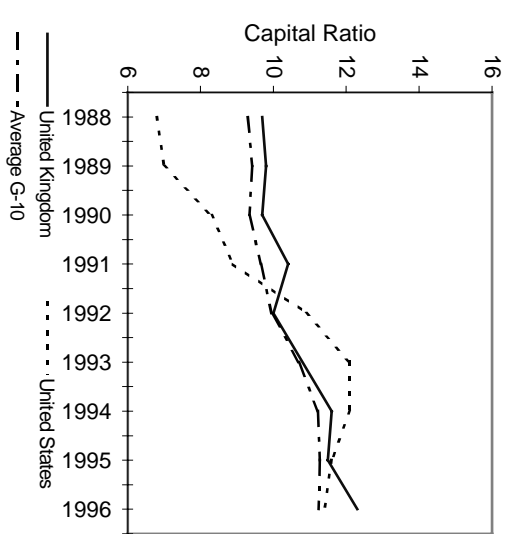
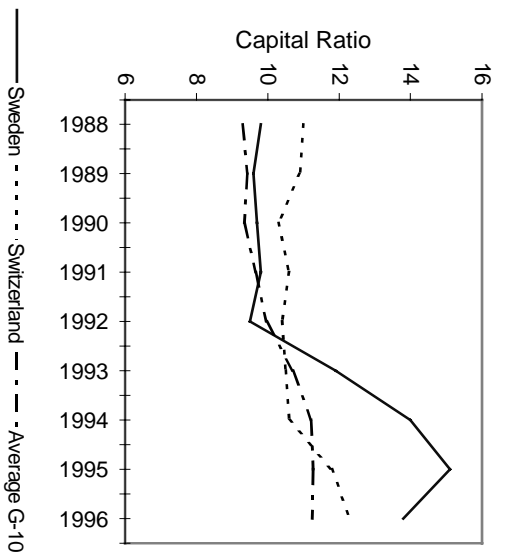
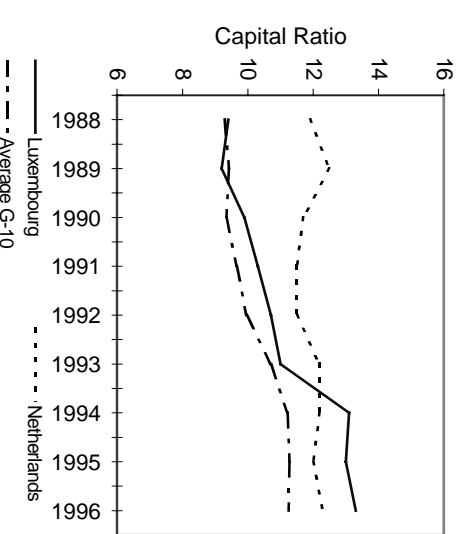
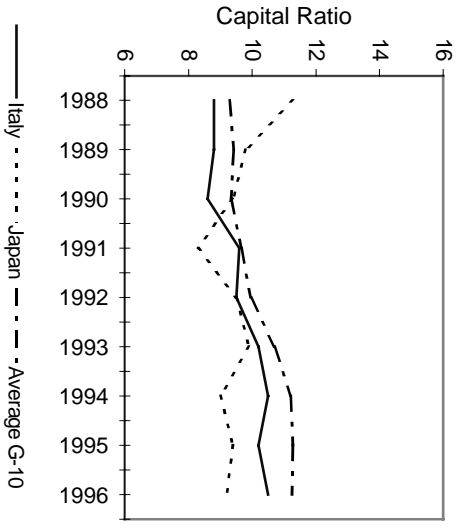
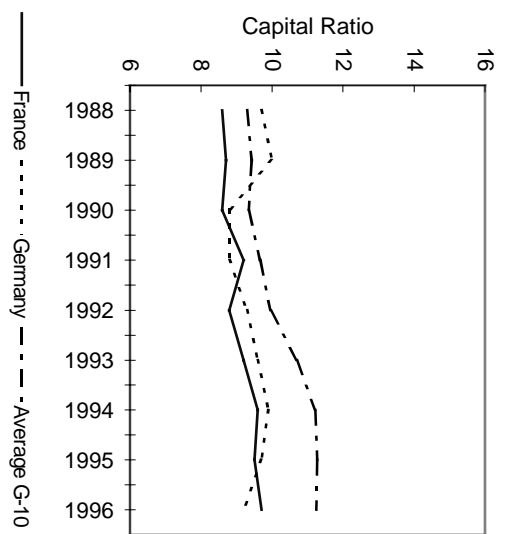
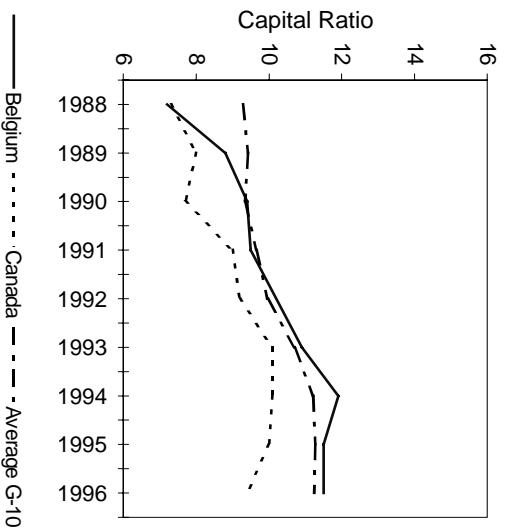
Although the data are not fully comparable across countries (due to such factors as differing tax regimes, accounting standards, industrial and regulatory factors and cultural differences) it is nonetheless clear that the introduction of the Basle capital adequacy ratios was followed by a significant increase in G-10 average capital ratios. One factor behind the level of capital ratios in some countries (e.g. the UK and the US) is that the supervisors set ratios, higher than the Basle minimum, bank by bank.

The fact that the introduction of the Basle capital adequacy requirements was followed by an increase in bank capital ratios is, however, insufficient evidence to conclude that they were the cause of this increase. It is possible that banks may have been subjected to market pressure to increase their capital ratios over this time period. Disentangling the effect that capital requirements have on capital ratios from that of market discipline is a complicated task that cannot be achieved by using simple descriptive statistics as presented in Chart 1. More detailed econometric analysis is required. Section 1.1 reviews empirical papers which address the question: *“Do capital requirements lead banks to increase their capital ratios?”*

Beyond establishing whether regulatory requirements have increased capital ratios, one may ask how the rise in ratios is achieved? Banks can increase capital ratios either by increasing the numerator (the level of regulatory capital) or by decreasing the denominator (total risk-weighted assets). Risk-weighted assets can be decreased through a reduction in assets or through a switch from higher to lower weighted assets and/or capital arbitrage practices such as securitisation.

Table 1.1 summarises how G-10 banks raised their capital ratios from 1989 to 1996. An increase in capital (C) boosts the capital ratio (CR) and is thus registered with a (+) sign in the corresponding column, whereas a rise in risk-weighted assets (A) reduces the capital ratio and is represented by a (–) sign. For example, in 1989, Belgian banks raised their capital (positive effect on the capital ratio) and risk-weighted assets (negative impact on capital ratios). The net effect was that the capital ratio increased by 1.6%.

Chart 1  
Capital ratios in G-10 countries



Source: Calculations by De Nederlandsche Bank.

Table 1.1  
**Contribution of the change in the capital base and  
risk-weighted assets to the overall change in the capital ratio**

	1989			1990			1991			1992			1993			1994			1995			1996		
	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR	C	A	CR
Belgium	+	-	1.6	+	-	0.6	+	-	0.1	+	-	0.7	+	-	0.7	+	-	1.0	+	-	-0.4	+	-	0.0
Canada	+	-	0.7	+	-	-0.3	+	-	1.3	+	-	0.2	+	-	0.9	+	-	0.0	+	-	-0.1	+	-	-0.6
France	+	-	0.1	+	-	-0.1	+	-	0.6	+	-	-0.4	+	+	0.4	-	+	0.4	-	-	-0.1	+	-	0.2
Germany	+	-	0.3	+	-	-1.2	+	-	0.0	+	-	0.5	+	-	0.3	+	-	0.3	+	-	-0.2	+	-	-0.5
Italy	+	-	0.0	+	-	-0.2	+	-	1.0	+	-	-0.1	+	+	0.7	+	+	0.3	+	-	-0.3	+	-	0.3
Japan	+	-	-1.5	+	-	-0.4	-	+	-1.1	+	+	1.2	+	+	0.4	-	+	-0.9	+	-	0.4	-	-	-0.2
Luxembourg	+	-	-0.2	+	-	0.7	+	-	0.4	+	-	0.4	+	-	0.3	+	-	2.1	+	-	-0.1	+	-	0.3
Netherlands	+	-	0.6	+	-	-0.8	+	-	-0.2	+	-	0.0	+	+	0.7	+	+	0.0	+	-	-0.2	+	-	0.3
Sweden	+	-	-0.2	+	-	0.1	+	-	0.1	-	+	-0.3	+	+	2.4	+	+	2.1	+	+	1.1	-	+	-1.3
Switzerland	+	-	-0.1	+	-	-0.6	+	-	0.3	+	-	-0.2	+	-	0.1	+	+	0.1	+	+	1.2	+	+	0.5
United Kingdom	+	+	0.1	-	-	-0.1	+	-	0.7	+	-	-0.4	+	-	0.8	+	+	0.8	+	-	-0.1	+	-	0.8
United States	+	+	0.2	+	+	1.3	+	+	0.6	+	-	2.0	+	-	1.2	+	-	0.0	+	-	-0.5	+	-	-0.2

Notes: C, A and CR stand for the capital base, risk-weighted assets and the capital ratio, respectively. The symbols + and - denote the sign of the contribution of C and A to the change in the CR. For instance, a minus sign (-) in the column for the risk-weighted assets means that the development of the denominator has caused a drop in the capital ratio i.e. the risk-weighted assets have increased (ceteris paribus the level of the capital). The column labelled CR contains the actual change in the capital ratio during the year.

Source: Calculations by De Nederlandsche Bank based on data obtained from the Basle Committee, FitchIBCA and national supervisory authorities.

The table paints an interesting picture of the lending and capital decisions of banks. In 73% of cases, G-10 banks in the period covered increased both capital and risk-weighted assets. A mere 3% of banks decreased capital while also increasing risk-weighted assets. In total, 92% of banks increased their capital levels, while 76% raised their risk-weighted assets. Table 1.2 summarises these results.

Table 1.2  
**Number of cases where changes in capital and risk-weighted assets  
contributed positively (+) or negatively (-) to the change in capital ratio**  
(percentages in parentheses)

		Risk-weighted assets		
		+	–	Total
Capital	+	18 (19%)	70 (73%)	88 (92%)
	–	5 (5%)	3 (3%)	8 (8%)
Total		23 (24%)	73 (76%)	96 (100%)

Note: Each case represents the banking sector in one country in one year.

Source: Calculations by De Nederlandsche Bank based on data obtained from the Basle Committee, FitchIBCA or national supervisory authorities.

The descriptive statistics reveal clear variation between the capital/lending decisions of banks in different countries. This may reflect the financial circumstances of individual countries. For example, the declines in both capital levels and risk-weighted assets in Sweden in 1992 coincide with the beginning of that country's recovery from the serious banking crisis it experienced in the early 1990s. Risk-weighted assets were reduced (A+) and large-scale loan-loss provisions were made, entailing an erosion of the capital base (C-). In subsequent years, the decline in risk-weighted assets continued while banks' efforts to rebuild their capital levels (C+) were supported by the government.

Turning to other countries, in the United States, the combination of increased capital levels (C+) and reduced risk-weighted assets (A+) between 1989 and 1991 is often thought to have been a major factor behind the sharp decrease in economic growth experienced during that period. The remarkable movements in the constituent parts of the Japanese capital ratio can largely be ascribed to the well-known problems in its financial sector. In particular, the drop in capital in 1991 reflects the falling stock market. As banks are allowed to mark 45% of unrealised capital gains on their equity portfolios in Tier 2 capital, the continued fall of the Nikkei index since 1990 has considerably undermined their capital position.

On the whole, however, the descriptive statistics suggest that banks in G-10 countries have tended to augment their capital ratios both by raising capital and, in specific circumstances, by reducing their lending. But as with changes in capital ratios, determining what causes observed movements in capital

levels and risk-weighted assets requires a more complex econometric analysis than just looking at descriptive statistics. Section 1.2 examines the relevant empirical papers which address the *question* “*How do banks adjust their balance sheets to meet higher capital requirements*”? The remaining issue addressed in Part 1 is whether, as some theoretical papers have suggested, capital requirements have generated perverse shifts in banks’ portfolio choices, leading them actually to increase the riskiness of their assets. These empirical papers are examined in Section 1.3.

### **1.1 Capital requirements and capital ratio levels**

The first and most basic question we address in this section is whether regulatory capital requirements induce banks to hold higher capital ratios than would have otherwise been the case. Table 1.3 below lists papers which look at this question. Addressing this question empirically is a challenge. In particular, it is difficult to devise comparisons of bank behaviour with and without capital requirements, all other factors being held constant. Studies have attempted such comparisons in a time series dimension by looking at bank capital dynamics before and after a change in capital regulation. Alternatively, cross sectional studies have contrasted the behaviour of banks which are close to or distant from minimum levels of regulatory capital.

In studies exploiting time series variation, changes in behaviour may often be plausibly ascribed to causes other than a change in regulation. For example, US bank behaviour before and after the 1991 introduction of Basle Accord capital requirements also reflected the impact of a sharp decline in economic activity on loan demand and changes in other aspects of the supervisory environment.<sup>2</sup> (See Berger and Udell (1994) for a careful discussion of alternative hypotheses for changes in bank behaviour around this time.) Studies which exploit cross sectional variation by comparing banks at different distances from minimum levels of regulatory capital cannot supply fully conclusive answers either since market discipline will induce banks to try to rebuild their capital even without regulation.

Though the problems referred to above are serious, as we shall see below, the literature on the effectiveness of capital requirements does provide evidence that, since the introduction of formal regulatory capital requirements, when banks’ capital ratios have fallen below the regulatory minimums, on average such banks have subsequently tended to increase their capital ratios more rapidly than strongly capitalised banks. To interpret the literature correctly however, it is important to bear in mind several points. First, one may place more confidence in studies which seriously address the basic problem that desired bank capital targets with and without regulation are hard to observe. Second, studies covering periods in which capital requirements are rigorously imposed are likely to

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<sup>2</sup> During the 1990s, many observers argued that examination standards in the US had become tougher with the onset of the recession.

reach different conclusions from those which look at periods of comparatively informal capital regulation. Third, capital requirements are likely to affect banks differently at different stages of the business cycle. Fourth, capital requirements may influence bank capital dynamics either in the short or the long run. Fifth, banks will achieve their desired capital targets in the most cost-effective manner, thus market conditions are important.

Table 1.3  
**Capital ratios and regulation**

Peltzman (1970)	US banks 1963-65	ABC ratios <sup>1</sup>
Mingo (1975)	US banks 1970	ABC ratios
Dietrich and James (1983)	US banks 1971-75	ABC ratios
Shrieves and Dahl (1992)	US banks 1984-1986	1981 Standards
Keeley (1988)	US banks 1981-86	1981 Standards <sup>2</sup>
Jacques and Nigro (1997)	US banks 1990-91	Basle Accord
Aggarwal and Jacques (1997)	US banks 1991-93	Basle Accord plus Prompt Corrective Action
Hancock and Wilcox (1994)	US banks 1990-91	Basle Accord
Ediz, Michael and Perraudin (1998)	UK banks 1989-95	Basle Accord plus extra capital requirements set bank by bank
Rime (1998)	Switzerland banks 1989-95	Basle Accord but risk weights more stringent
Wall and Peterson (1987)	US banks 1982-84	1981 Standards
Wall and Peterson (1995)	US banks 1989-92	Basle Accord

<sup>1</sup> The “ABC” ratio was the ratio of actual bank capital to the capital desired by the appropriate regulator. The desired level of capital was derived by a complex numerical calculation and was decided on a case by case basis. See Peltzman (1970) for details. <sup>2</sup> In December 1981, the Federal Reserve and the Office of the Comptroller of the Currency (OCC) announced a common set of standards to apply to all the banks which they regulate. The Federal Deposit Insurance Corporation (FDIC) adopted these standards in 1985. No formal standards were set for the multinational banks. The 1981 standards set a minimum capital ratio of 7% for community banks and 6.5% for regional banks.

It is natural to expect that informal capital requirements implemented by supervisors in a merely indicative manner will have a relatively slight impact on bank behaviour. The early literature covering US bank behaviour prior to the introduction of formal requirements in that country in 1981 confirms this. Peltzman (1970), Mingo (1975) and Dietrich and James (1983) all regressed percentage growth in capital on a range of variables including the bank’s lagged ABC ratio, the ratio of the supervisor’s assessment of appropriate capital to capital actually in place. Peltzman (1970) using state-wide averaged data found insignificant effects of ABC ratios on subsequent bank capital changes. Mingo (1975) using bank level data found strong and statistically significant positive effects. Dietrich and James (1983) ran the same regressions on bank-level data from a different period and found significant

and, in some cases, perversely signed effects similar to those of Peltzman. They argue that Mingo's positive results reflect the impact of interest rate ceilings which were binding during the period covered by his dataset rather than capital regulation.<sup>3</sup>

Though inconclusive as studies of the effectiveness of firmly applied capital standards, the above studies did establish the basic approach that most subsequent analyses have followed; that is regressing a capital change variable (in the case of Pelzman, Mingo and Dietrich & James, simple percentage growth in capital) on conditioning variables describing the bank's financial state and the nature of its business. There are some important nuances here, however. First, subsequent research has mainly focused on changes in capital ratios (either leverage ratios or ratios of equity to risk-weighted assets RWA)) rather than changes in capital growth rates. Second, the early literature made no distinction between short-and long-run effects of capital requirements (since capital growth was regressed only on conditioning variables and not on lagged capital or capital growth). In contrast, most subsequent research has employed a partial adjustment specification in which if  $Y(t)$  is the actual capital ratio of an individual bank and  $YD(t)$  is the bank's capital target at time  $t$ , then  $Y(t)$  is assumed to follow the process:

$$Y(t) - Y(t-1) = \alpha(YD(t) - Y(t-1)) + u(t).$$

Here,  $u(t)$  is a random error and  $\alpha$  is a positive parameter. When  $Y(t-1)$  exceeds (is less than)  $YD(t)$ , the sign of  $\alpha$  implies that  $Y(t)-Y(t-1)$  is on average negative (positive). Hence, in the long run  $Y(t)$  will tend to converge towards  $YD(t-1)$  and the magnitude of  $\alpha$  reflects the rate at which such convergence occurs. Since the bank's desired capital ratio  $YD(t)$  is not observable, researchers have employed a proxy, typically replacing  $YD(t-1)$  in the above equation with a weighted sum,  $\sum \beta_i X_i(t)$ , where the  $X_i$  are lagged conditioning variables describing the state of the economy and the bank's financial situation and the  $\beta_i$  are constant parameters to be estimated.

Capital pressure as measured by proximity to minimum capital levels has been introduced into partial adjustment models of this kind (i) by including among the  $X_i$  conditioning variables a dummy variable which is unity when capital ratios are below some level and zero otherwise, (ii) by allowing such a dummy to interact with  $Y(t-1)$  (this permits the convergence parameter  $\alpha$  to vary according to whether banks are subject to regulatory pressure (whether such pressure is a result of regulatory or market discipline) or not), or (iii) by estimating entirely different models for banks subject to regulatory pressure and those which are not. Studies which adopt any or a combination of these methods are

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<sup>3</sup> Dietrich and James attribute Mingo's findings, which conflict with their own, to the fact that Mingo did not allow for the impact within his sample period of interest rate ceilings which they suggest led banks to compete for non-insured deposits by raising their capital.

effectively investigating whether undercapitalised banks tend to increase their capital ratios more rapidly than other banks.

Of course, the coefficient on a dummy variable may be influenced by any omitted variables that would distinguish undercapitalised banks from better capitalised banks. For example, suppose that undercapitalised banks are located in areas which have experienced a more severe downturn than those areas where better capitalised banks are located. If the researcher does not take the differences in macroeconomic conditions into account, then such a dummy variable could pick up the influence of differences in macroeconomic conditions, rather than an effect of capital regulation, *per se*. Furthermore, given the difficulty of controlling econometrically for all such factors, attributing the effects of a capitalisation dummy to its influence on a bank's long run target or its short run speed of adjustments are likely to be beyond the ability of the model to discern.

The main papers which investigated the impact of capital requirements on capital ratios using partial adjustment regression models are Keeley (1988), Shrieves & Dahl (1991), Jacques & Nigro (1997), Aggarwal & Jacques (1997) and Hancock & Wilcox (1997) using US data, Ediz, Michael & Perraudin (1998) which employed UK data and Rime (1998) which employed Swiss data.

Of these, all but Keeley and Shrieves & Dahl employ data from the 1990s and therefore focus on the impact of Basle Accord regulations (or of national variants of those regulations). Keeley's conclusions are hard to interpret as he does not condition on obvious non-regulatory influences on capital ratios. Shrieves and Dahl, using data on 1,800 FDIC-insured banks in the period 1983-1987, find that banks with a capital to assets ratio less than the 7% level applied by the US authorities at the time, increase their ratio on average by 140 basis points per annum more than do other banks.<sup>4</sup>

Aggarwal & Jacques (1997) repeat the analysis of Shrieves & Dahl (1992) using cross-sectional US bank data for 1991, 1992 and 1993. They are particularly interested in the impact on bank behaviour of the 1991 FDICIA legislation and the prompt corrective action provisions it laid down. These provisions obliged supervisors to take specific actions when a bank's capital ratios fell below certain trigger levels. Aggarwal & Jacques find that banks in the undercapitalised categories increase their

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<sup>4</sup> Shrieves and Dahl (1991) (and subsequent papers which followed the same approach like Jacques & Nigro (1997), Aggarwal & Jacques (1997) and Rime (1998)) condition on changes in banks' own demand for capital by including on the right hand side of their regressions changes in a risk-weighted index of the banks' assets. This variable is contemporaneous with the capital ratio change on the left hand side of the equation and hence must be instrumented to obtain unbiased estimates. Other papers to be discussed below such as Hancock and Wilcox condition on changes in the bank's own capital ratio targets by including variables which describe the level of economic activity in the region in which the bank is primarily operating. Each approach has strengths and weaknesses. Results obtained by instrumenting an endogenous right hand side variable may be quite sensitive to the instrumental variable chosen. Proxies for the level of economic activity may only pick up some of the variation in a bank's own internal target.

capital target ratios more quickly than other banks with higher initial capital.<sup>5</sup> Their estimates suggest that under-capitalised banks raise their capital ratios by between 200 and 800 basis per annum (depending on the year and the capital ratio in question) more than do well-capitalised banks. All these estimates are significant at a 5% level.

Only two papers that we survey here apply partial adjustment models to non-US bank capital ratio data, Ediz, Michael & Perraudin (1998) and Rime (1998). Ediz, Michael & Perraudin use quarterly data on 94 UK banks over the period Q4 1989 to Q4 1995, while Rime looks at annual data on 154 Swiss banks between 1989 and 1995. The two papers adopt somewhat similar specifications. In particular, both introduce among the  $X_i$  variables dummies for capital pressure which equal unity when a bank's capital ratio falls into a zone starting above the regulatory minimum. The gap between the starting point of the zone and the regulatory minimum varies across banks and is taken to be proportional to the time-series standard deviation of the bank's own capital ratio.<sup>6</sup> This specification captures the idea (i) that banks prefer to maintain a buffer level of capital over and above the regulatory minimum and (ii) that the width of the buffer will reflect the variability of a bank's ratio. Both papers find that regulation is effective in the sense that the dummy variables described above have statistically and economically significant coefficients. In the case of Rime, the impact of regulation (i.e., of a dummy for a capital ratio less than one standard deviation above the regulatory minimum) is statistically significant at a 1% level although the magnitude of the effect is very small. In the case of Ediz, Michael and Perraudin, the ratio of total capital to risk adjusted assets increased by 44 basis points per quarter more for banks in the regulatory pressure zone compared to adequately capitalised banks. Such findings could be consistent with increased regulatory, supervisory, or market pressure after the Accord.

Lastly, two studies which investigate the impact of capital requirements in a rather different way deserve mention. Wall & Peterson (1987) and (1995) suppose that, in any given period, the actual change in a bank's capital ratio is the maximum of a change implied by a "regulatory" model and a change implied by a "market model" reflecting market discipline. In their approach, whether a given observation is generated by one model or the other is not observed by the econometrician.<sup>7</sup> Both models consist of partial adjustment equations of the kind described above.

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<sup>5</sup> Their estimates suggest that under-capitalised banks raise their capital ratios by between 200 and 800 basis points per annum (depending on the year and the capital ratio in question) more than do well-capitalised banks. All these estimates are significant at a 5% level.

<sup>6</sup> This is feasible for these studies since the panel data they employ has much longer time series dimension than most of the samples employed by researchers who have looked at US bank.

<sup>7</sup> The econometrician maximises a likelihood consisting of a mixture of the likelihoods for the two sub-models.

The approach taken by Wall & Peterson treats regulation as a constraint on the dynamics of bank capital rather than as an influence on capital targets or convergence rates to such targets. However, their approach requires that one impose a substantial amount of structure on the data. For example, error terms are taken to be normally distributed and, to achieve identification, different variables are assumed to affect the capital targets embodied in the regulatory and market models. The results they obtain suggest that capital regulation has a very strong impact on bank capital dynamics. Indeed, their findings are in some aspects implausibly strong. For example, they find that the overwhelming fraction of individual bank-year observations are generated by the regulatory rather than the market model suggesting that banks' capital choices are constrained by regulation almost all the time. This result could reflect model misspecification given their strong identification assumptions.

### **Concluding remarks**

None of the papers surveyed in this section can claim to demonstrate conclusively that capital requirements lead banks to hold higher capital ratios than they otherwise would.<sup>8</sup> However, there is a broad consensus among the studies surveyed that, over the 1980s and 1990s, banks with relatively low capital ratios have tended subsequently to boost these ratios by more than did better capitalised banks. The studies do not provide evidence that this effect reflects capital regulation per se as opposed to increased supervisory or market discipline, but the two are likely to be closely interrelated - a clear regulatory capital standard that is actively enforced may make it easier for the market to exert pressure.

## **1.2 Capital requirements and balance sheet adjustment**

The second question we address in this section is, if capital requirements do induce banks to adjust their capital ratios to a significant degree, how do they achieve this? A capital-asset ratio may be changed by altering either the numerator or the denominator in the ratio. Depending on the ratio concerned (leverage ratio, Tier 1 to Risk-weighted Assets (RWA) or total capital to RWA), the numerator may be changed by retaining earnings, issuing equity or issuing other quasi-equity securities such as subordinated debt. Similarly, the denominator may be adjusted by cutting back loans or, in the case of ratios to RWA, by shifting into assets that bear a relatively low risk weight such as residential mortgages, short-term interbank exposures or government securities. Table 1.4 lists studies which focus on these questions.

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<sup>8</sup> Difficulties in comparing banks with and without regulation, while holding other factors constant, prevent a conclusive demonstration.

The approach that banks take in adjusting their balance sheet to capital pressure is, of course, likely to vary over time, depending particularly on the stage of the business cycle. During booms, banks will find it easy to raise equity capital and potential earnings retentions will be high. During downturns, with declines in loan demand and increased default risks, banks may prefer to cut back their loan base. (The interaction of loan demand and bank capital targets is further discussed in Section 3 below.)

Most studies which shed light on these issues are primarily concerned with changes in the denominator of capital ratios. One interesting paper which looks instead at banks' decisions to adjust the numerator, i.e., capital levels, is Dahl & Shrieves (1990). This paper analyses net equity issues greater than 5% of a bank's equity base. Dahl & Shrieves model whether or not banks make such issues in a given year using a logit model with conditioning variables that include, among others, return on assets, asset growth, and deposit growth. Dahl & Shrieves apply this approach to data on all FDIC-insured banks at year end 1985 and 1986. To investigate the differential responses of undercapitalised banks they segregate their observations into those for which bank capital lies below the regulatory minimum of 7% and those for which it does not and estimate their model on the two subsamples.

Their findings suggest that, for undercapitalised banks, the degree of undercapitalisation is a substantial influence on the probability of equity market issues and market conditions are less important. One should not conclude, however, that regulatory pressure strongly affects equity issues. Of banks with capital ratios less than 7% in a given year, a mere 12% received such equity infusions. Moreover, a disproportionate fraction of those undercapitalised banks which were issuing equity were independent banks that were not members of larger organisations, which tend to be relatively small or closely-held institutions whose behaviour may not be representative of internationally active banks. Again, the Dahl & Shrieves study suffers from the fact that the sample employed does not also include data from a period in which banks were not regulated so there is no true control group.

Other research that sheds light on how capital-deficient banks adjust their balance sheets includes those partial adjustment model papers listed above which estimate separate models for Tier 1 and total capital ratios. For example, Aggarwal & Jacques find that the impact of FDICIA regulation on banks' long-term targets for the Tier 1 ratio actually exceeds that for total capital and that convergence of the Tier 1 ratios to its long-run average is somewhat quicker. Since total capital includes Tier 1, this finding implies that broadly speaking the entire impact of regulation on long-term capital targets, according to the Aggarwal & Jacques paper, operates through Tier 1. However, this result should be interpreted with caution since there is some evidence that, in the period covered by the Aggarwal & Jacques study (1991-1993), US banks were more constrained by their leverage ratios than by the

Basle-Accord Tier 1 and Tier 2 ratios. If true, this would of itself explain why capital ratios based on narrow-equity measures appear to react more than broad-equity-based measures such as the Tier 2 ratio.<sup>9</sup>

Ediz, Michael & Perraudin (1998) in their study of UK bank data similarly conclude that regulation affects a bank's long-term Tier 1 capital targets more than its long-run Tier 2 target. However, they find that when an individual bank's capital requirement is augmented (which is possible in the UK system where capital targets are bank-specific), initially the bank tends to raise its Tier 2 capital with Tier 1 adjusting subsequently. In their vector autoregression study of the impact of stock market fluctuations on Japanese bank balance sheet behaviour, Ito & Sasaki (1994) find evidence that subordinated debt issuance (i.e. adjustments in Tier 2 capital) reacts strongly.

On adjustments to the denominator in capital ratios, numerous studies have examined whether capital ratio shortfalls induce banks to change their asset holdings. One may distinguish here between the possibility that banks react to capital requirements by cutting their total assets or alternatively that they react by switching from highly risk-weighted assets to those with a lower risk weighting.

Studies of US data in the early 1990s reach varied conclusions as to whether banks reduced the total size of their balance sheets in response to capital ratio regulations. For example, Hall (1993) runs cross sectional regressions of growth in loans by US banks in 1990 and 1991 and finds that the lagged total risk based capital ratio exerts a statistically and economically significant positive influence. His demonstration would be more persuasive if his sample also included data from before the implementation of the Basle regulations, which could act as a control. Another problem with Hall's approach is the fact that he does not condition for the influence on loan demand of different levels of economic activity. Using a large sample of data on US banks over the period 1979 to 1992, Berger & Udell (1994) in a careful study regress real quarterly growth rates for several asset categories on variables which regulators might regard as indicators of financial weakness and other conditioning variables (both regional and national) that proxy for changes in loan demand. The indicators of financial weakness include Tier 1 ratios, total capital to risk-weighted asset ratios, leverage ratios, and commercial real estate lending and non-performing loans as a fraction of total loans. The growth rates they employ as dependent variables include those on commercial and industrial loans, commercial real estate loans, US Treasuries, loans receiving 100% weight in risk-based capital calculations and loans receiving a zero weight.

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<sup>9</sup> Interpretation of this result might also appear to be sensitive to the fact that apart from the largest banking organizations, other US banks hold relatively little Tier 2 capital. The Aggarwal & Jacques data set includes FDIC-insured banks with asset values greater than \$100 million.

Table 1.4  
**Capital requirements and balance sheet adjustments**

Berger and Udell (1994)	US banks 1979-92	Basle Accord
Hancock, Laing and Wilcox (1995)	US banks 1984-93	Basle Accord
Hall (1993)	US banks 1990-91	Basle Accord
Jacques and Nigro (1997)	US banks 1990-91	Basle Accord
Ediz, Michael and Perraudin (1998)	UK banks 1989-95	Basle Accord plus extra capital requirements set bank by bank
Kim and Moreno (1994)	Japanese banks 1970-92	Basle Accord
Peek and Rosengren (1997)	Japanese banks 1988-95	Basle Accord
Ito and Sasaki (1998)	Japanese banks 1990-93	Basle Accord
Rime (1998)	Swiss banks 1989-95	Basle Accord but risk weights more stringent
Dahl and Shrieves (1990)	US banks 1986-87	1981 Standards
Hancock and Wilcox (1994)	US banks 1990-91	Basle Accord
Haubrich and Wachtel (1993)	US banks 1990-92	Basle Accord
Aggarwal and Jacques (1997)	US banks 1991-93	Basle Accord plus Prompt Corrective Action

Berger & Udell find that for several categories, the coefficient values in their regressions are inconsistent with the proposition that capital pressure was the origin of the US credit crunch in the early 1990s. For example, in the case of commercial real estate lending, the declines in growth rates which occurred in the credit crunch period of the early 1990s were actually larger for banks which had high capital ratios than for those which had not. In just three of the six loan categories Berger & Udell examined were parameter signs consistent with capital pressure being the source of the credit crunch. They also find that the  $R^2$ s in their regressions are extremely low, being between 1 and 6%.

In contrast to the results of Berger and Udell, Hancock & Wilcox (1994) find that estimated proxies for banks' internal capital targets better explain changes in lending than do regulatory capital ratios. They argue that regulatory capital requirements may have influenced banks' internal targets and hence may have had an indirect impact on the downturn in lending of the early 1990s.

Papers by Shrieves and Dahl (1992), Nigro & Jacques (1997), Aggarwal & Jacques (1997), and Rime (1998) provide some evidence that banks change the composition of their assets when they face a binding regulatory capital constraint, substituting away from high risk-weighted assets. Using partial adjustment models, these papers look at the effects of lagged capital ratios on banks' long-run targets for the ratio of risk-weighted to total assets. The broad conclusion that emerges from most of these papers is that some banks substitute towards low risk-weighted asset categories when their capital

ratios are low.<sup>10</sup> It should be acknowledged, however, that such substitution, rather than being a response to binding capital requirements, might reflect the efforts of financially troubled banks to rebuild liquidity, either at the behest of supervisors or to counter the threat of deposit outflows.

Lastly, several papers look at the impact on bank lending of shocks to capital. Kim & Moreno (1994) and Ito & Sasaki (1994) apply vector autoregression models to Japanese data on aggregate and individual bank lending respectively, allowing for interaction with stock market prices. Since a sizeable fraction of Japanese banks' Tier 2 capital consists of unrealised capital gains on equity portfolios, falls in the stock market imply negative shocks for bank capital. Both studies conclude that stock market falls translate into significant declines in lending. These studies are hard to interpret, however, since there is no obvious way to separate the impact on lending of (i) equity-market induced capital shocks and (ii) deteriorations in loan demand which are also likely to be associated with stock market declines.<sup>11</sup> An interesting paper by Peek & Rosengren (1997) circumvents this problem by looking at the impact of declines in the Japanese stock market on lending by subsidiaries and branches of Japanese banks in the US. Peek & Rosengren conclude that capital squeezes due to equity declines in the Japanese market do influence lending in the US especially by branches.

### **Concluding remarks**

Papers which examine how banks adjust their balance sheets when their capital ratios are constrained by regulation are varied in their conclusions. This is not surprising since the approach banks take to adjusting capital ratios is likely to depend on the business cycle and the bank's financial situation. Nevertheless, there is evidence that in some cases undercapitalised banks raise new equity capital. There is also evidence that weakly capitalised banks sometimes substitute away from high risk-weighted assets and reduce their lending, although the studies reviewed generally have difficulty distinguishing the effects of regulation from market discipline or other factors. On balance, it seems reasonable to conclude that banks attempt to respond in the least costly way to binding capital constraints. Whether or not banks raise Tier 1 or Tier 2 equity may depend in part on which capital constraint is most binding. When it is costly to increase capital, it appears that banks may adjust the composition or level of lending.

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<sup>10</sup> Unlike the partial adjustment models described previously, these papers include contemporaneous changes in risk-weighted to total asset ratios on the right hand side of their capital ratio change regressions. This complicates interpretation of the dynamic effects of regulation dummies.

<sup>11</sup> The dynamics of loan demand are further discussed in Section 3 below.

### **1.3 Capital requirements and risk-taking**

The third question we examine in this section is whether banks increase the riskiness of their asset portfolios in response to the imposition of regulatory capital requirements. The motivation for investigating this issue is a series of theoretical papers which have debated the possible effects on banks' portfolio choices of imposing a uniform capital requirement. Although capital requirements with differentiated weights will quite probably give banks an incentive to shift towards lowly-weighted asset categories (as was discussed in Section 1.2), for any category of assets which bear the same proportional capital charge, banks may be induced to shift towards the more risky assets in the category. This idea was analysed by Koehn & Santomero (1980) and Kim & Santomero (1988) who showed that such substitution effects were possible within a simple portfolio model. Their analysis was criticised by Keeley & Furlong (1989) and (1990) and Rochet (1991) who argued that if banks possessed diversified portfolios, the effects of capital requirements would be a reduction in risk-taking.

Papers that have attempted to measure the impact on risk-taking of capital regulation have so far failed to come up with convincing evidence either way. Details of these are given in Table 1.5. Furlong (1988) looks at data on 98 large US bank holding companies in the pre-Basle period 1975 to 1986. His approach starts from the insight of Black & Scholes (1973) that the equity market capitalisation of a bank may be regarded as the value of a call option written on the bank's underlying asset value with deposits being interpreted as the option strike price. One may then infer the volatility of underlying asset values by inverting the call option pricing formula. Furlong finds that asset risk measured in this way actually doubled in 1981-86, the part of his sample in which banks faced capital requirements, compared with the earlier period. However, banks which were well-capitalised in 1981 before the capital ratio constraint was introduced experienced the same rise in volatility as those which were not.

If the levels of bank capital in 1981 represented desired or equilibrium capital levels, Furlong's findings would be inconsistent with the Kim & Santomero analysis since well-capitalised banks would not have been subject to any additional constraint. On the other hand, it is possible that, through the effects of capital requirements on market discipline, the introduction of fixed capital standards led to increased target capital rates for both highly capitalised and weakly capitalised banks. In this event, Furlong's finding might be seen as consistent with Kim & Santomero.

Sheldon (1996) performs a somewhat similar analysis of the equity and asset volatilities of 219 banks from several G-10 countries over the period 1987 to 1994 in which the Basle regulations came into force. His results suggest that bank asset volatility in US banks rose and that this was the case both for banks which increased their capital ratios and for those which did not. In Japan, asset volatility fell although most banks raised their capital ratios. As with the Furlong study, the reasonableness of Sheldon's findings depends on whether one believes that the Accord tended to raise target capital

ratios not only for banks having relatively low reported capital prior to the Accord, but also for banks having relatively high reported ratios. Sheldon's own conclusion is that his results provide little evidence that the implementation of the Basle guidelines had a risk-increasing impact on bank portfolios.

In any case, neither Furlong nor Sheldon satisfactorily controls for the host of other influences which affected risk-taking through the sample periods they examine so conclusions they reach should, to say the least, be treated with caution.

Table 1.5  
**Empirical papers on the effect of capital requirements on risk-taking**

Furlong (1988)	US banks 1981-86	1981 Standards
Sheldon (1996)	G-10 banks 1987-1994	Basle Accord

### **Concluding remarks**

There is no reliable evidence one way or the other as to whether capital requirements do encourage banks in some periods to increase risk taking, as implied by some theoretical models. One difficulty is that available data do not provide a direct measure of the risk profile of lending within the broad Basle risk buckets. This means that the question has to be examined in terms of the effect which capital requirements have on the riskiness of the whole portfolio of the bank. The few papers which have attempted to look at this question suggest that capital requirements may have led to some increase in risk-taking, but because they have relied on an options pricing formula and make no attempt to condition on factors other than capital ratios, it is difficult to place much reliance on the results, which in any case are not strong.

## **2. Regulatory capital arbitrage**

Banks in a number of countries are using securitisation to alter the profile of their book. This may make a bank's capital ratio look artificially high, relative to the riskiness of the remaining exposures, and in some cases may be motivated by a desire to achieve exactly this. The very broad risk categories in the Basle Accord give scope for banks to arbitrage between their economic assessment of risk and the regulatory capital requirements. As discussed below, securitisation is an important technique for undertaking such capital arbitrage. But while opportunities for capital arbitrage may encourage certain forms of securitisation, it should be emphasised that other factors besides capital arbitrage are often important - and in many cases, the sole - drivers of securitisation.

- Section 2.1 outlines the motivation for regulatory capital arbitrage and how regulatory capital arbitrage is carried out in practice (with examples of transactions given in appendices);
- Section 2.2 provides some empirical evidence;
- Section 2.3 concludes.

Due to the limited academic literature, the following discussion draws heavily from market sources of information, such as rating agencies, and from information collected by US regulators through on-site examinations.

## **2.1 Factors motivating regulatory capital arbitrage**

Regulatory capital arbitrage reflects banks' efforts to keep their funding costs, inclusive of equity, as low as possible.<sup>12</sup> Since the cost of equity is generally perceived to be much greater than the cost of debt, when banks are required to maintain equity cushions exceeding what they would otherwise choose it is natural for banks to view capital standards as a form of regulatory taxation. As with other forms of taxation, regulatory taxes encourage banks to develop methods for serving customers that avoid or minimise these taxes. Capital arbitrage - like traditional tax arbitrage - is costly. To reduce the regulatory tax consequences of binding capital requirements, banks must incur up-front legal, administrative, and other structuring costs.<sup>13</sup> Decisions about whether to engage in capital arbitrage, and on what scale, therefore reflect a cost-benefit analysis in which these structuring costs are weighed against the perceived reduction in the bank's cost of funds. As discussed below, financial innovation is working dramatically to reduce structuring costs over time.<sup>14</sup>

In practice, capital arbitrage exploits the large divergences that can arise between a portfolio's true economic risks and the Accord's measure of risk (total risk-weighted assets). At present, four major types of capital arbitrage appear to predominate<sup>15</sup>:

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<sup>12</sup> For related academic studies, see Cumming (1987), Baer and Pavel (1988), and Pavel and Phillis (1988), Koppenhaver (1989), Berger and Udell (1993), Jagtiani, Saunders, and Udell (1995), Allen, Jagtiani and Landskroner (1996).

<sup>13</sup> Note that, even if a bank's current capital ratios exceed the regulatory minima, it may wish to engage in capital arbitrage to generate a regulatory capital "cushion" so that any future losses would be less likely to evoke a supervisory call for additional, dilutive, equity issuance.

<sup>14</sup> While capital arbitrage generally seeks to reduce a bank's required equity, in limited amounts the Accord's total capital measure admits less expensive Tier 1 components (e.g. in some countries, step ups are permitted in Tier 1 instruments), as well as Tier 2 capital components (e.g. subordinated debt). To preserve operating flexibility, and in response to market discipline, banks typically set internal targets for the ratio of Tier 1 capital to total risk-weighted assets that substantially exceed the Accord's 4% explicit minimum for this ratio.

<sup>15</sup> For simplicity and specificity, the following discussion and supporting material in the appendix discuss capital arbitrage within the context of the U.S. implementation of the Basle Accord.

(i) ***Cherry-picking***

This is the oldest form of capital arbitrage. Within a particular risk-weight category, such as 100% risk-weighted assets, cherry-picking is the practice of shifting the portfolio's composition toward lower quality credits. For example, in order to boost its return on equity, a bank may decide to originate fewer BBB-rated loans in favour of more BB-rated loans. In this case, the bank's total risk-weighted assets and regulatory capital ratios would appear unchanged, even as its overall riskiness increased.

(ii) ***Securitisation with partial recourse***

For many banks, securitisation is a more cost-effective approach to capital arbitrage than traditional cherry-picking. Securitisation involves the sale of assets to a "special purpose vehicle" (SPV), which finances this purchase through issuance of asset-backed securities (ABSs) to private investors. For bankruptcy, accounting and regulatory purposes, SPVs generally are treated as legally separate from the sponsoring bank, and so are not consolidated into the sponsor's financial statements and regulatory reports. In many cases, a bank can treat securitised assets as "true sales" for accounting and regulatory purposes, even though the bank retains most of the underlying risks through credit enhancements it provides to the ABSs.

In cases when securitised assets have been previously "owned" by the bank, its credit enhancement is treated as "recourse," which normally incurs an effective 100% (dollar-for-dollar) regulatory capital requirement. That is, the bank's total regulatory capital requirement ratio is calculated as if the recourse position was immediately written off. Arithmetically (see appendix), this treatment implies that as long as the assets are of sufficiently high-quality that the amount of recourse is less than 8% of the securitised pool (termed "partial recourse"), the bank's Tier 1 and total regulatory capital requirement ratios will increase, regardless of whether any significant risk has been shifted to the ABSs.<sup>16</sup> (The appendix provides some examples of how securitisation may be used to reduce a bank's effective capital requirement.) In substance, most securitisations with partial recourse are nothing more than sophisticated cherry-picking whereby a bank sells off not merely its higher quality assets,

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<sup>16</sup> Typically, recourse incurs a total risk-based capital requirement equal to the lesser of (a) the amount of recourse provided ("low-level recourse"), and (b) 8 percent of the enhanced assets (i.e. equivalent to assigning a 100 percent risk-weight to the amount of *enhanced assets*). Within the United States, low-level recourse treatment is implemented by applying an add-on amount to total risk-weighted assets (exclusive of the recourse amount). For most banks, this add-on amount equals  $RA/(C-R)$ , where R = the amount of low-level recourse, A = total risk-weighted assets excluding low-level recourse exposures, and C = total risk-based capital. This add-on produces a total risk based capital ratio equal to (i) total capital *less* the amount of low-level recourse *divided by* (ii) total risk-weighted assets exclusive of low-level recourse exposures. In effect, this treatment implies a dollar-for-dollar capital charge against the amount of recourse; that is, an effective 100 percent total risk-based capital requirement.

but the most senior claims to these assets. This form of capital arbitrage is used extensively by banks not only from the United States, but also from other G-10 countries.

The impact of securitisation on a bank's regulatory capital ratios can be substantial. In securitisations of consumer and higher-quality commercial loans, for example, retained recourse amounting to less than 4% of the underlying loan pool may be sufficient to achieve investment-grade ratings on the asset backed securities sold to investors. Although these ratings usually imply that very little credit risk is actually transferred to investors, as shown in the appendix, such securitisations nevertheless can reduce the bank's regulatory capital requirement dramatically (in the example in the appendix by more than half) relative to its requirement had the whole loans remained on its balance sheet.

In general, banks have the greatest incentive to securitise high-quality loans whose required economic capital is much less than the regulatory requirement. Securitised asset pools tend to exhibit more predictable loss rates and very high diversification. Since a bank's remaining on-balance sheet portfolio may display greater loss volatility and less diversification than the loans it has securitised, a concern is that, for a bank that is heavily engaged in securitisation activities, reported capital ratios could be a misleading indicator of its true financial condition.

*(iii) Remote origination*

Many banks achieve even lower effective regulatory capital requirements (thus, higher capital ratios) by structuring their securitisation programmes so that credit enhancements are treated as "direct credit substitutes," which incur only an 8% capital requirement, rather than recourse. This is accomplished simply by having the SPV, rather than the bank itself, originate the securitised assets - a process termed "remote origination." Even though the bank is exposed to much the same risk as in a traditional securitisation, since the bank never formally owns the underlying assets, the credit enhancement is treated as a direct credit substitute. Remote origination is commonly associated with asset-backed commercial paper (ABCP) programmes.

*(iv) Indirect credit enhancements*

Under the Accord, in some instances it is possible to provide the economic equivalent of a credit enhancement in ways that are not recognised as financial instruments subject to any formal capital requirement. Investors are often willing to accept "indirect credit enhancements," such as early amortisation and fast-payout provisions, in lieu of traditional financial guarantees. When this is possible, the use of indirect credit enhancements reduces even further a bank's regulatory capital charges against securitised assets, in some cases to zero, thus increasing the amount of capital freed up through securitisation.

Several recent developments point to continued rapid growth - if not an acceleration - in capital arbitrage over the coming years. A recent surge in CLOs has been propelled by innovations, including credit derivatives, that now permit banks to securitise the cash flows of business loans without damaging customer relationships. Credit derivatives also are the basis for a new class of capital arbitrage techniques (“synthetic securitisations”) having substantially lower structuring costs than traditional securitisations. These products are reshaping the economics of capital arbitrage, making it more cost-effective, and more accessible to a broader range of banks, than has been the case historically.

The Accord’s 1997 Market Risk Amendment is also contributing to capital arbitrage activity. Under the Amendment, the regulatory capital requirements for certain instruments may now be much less if the position is housed in the trading account, rather than the banking book. Thus, a bank potentially can reduce its regulatory capital requirement merely by originating and holding credit risk positions through its trading account. For example, three month lending to a prime company would carry a capital requirement of 8%: however, if the bank held that company’s three-month commercial paper in its trading account, the capital requirement would be substantially lower (0.25% for specific risk under the Basle standard approach to market risk). It is, however, too early to say whether this has had a substantial effect on bank balance sheets.

It is also possible that the risk weighting for under 1 year interbank loans for Zone B banks may have encouraged greater short-term lending. By reducing the term of an interbank loan for a Zone B country from 13 months to 11 months the weighting would fall from 100% to 20%. There is no capital incentive for short term lending of this kind for Zone A countries. Pairwise comparisons of lending to equally rated Zone A and Zone B countries do indicate a greater concentration of short term lending to Zone B.

## **2.2 Empirical evidence**

For most banks, neither public financial statements nor regulatory reports disclose sufficient information to measure the full extent of capital arbitrage. To provide a rough gauge of the potential scale of capital arbitrage, Federal Reserve staff have estimated the outstanding non-mortgage-related ABSs and ABCP issued through programmes sponsored by the ten largest US bank holding companies. These securitisation activities tend to be motivated heavily by capital arbitrage considerations. They do not, however, track certain forms of capital arbitrage, such as traditional cherry-picking through whole loan sales, cherry-picking induced by uncompetitive bids for high-quality assets, securitisations that are privately placed or not publicly rated, and arbitrage effectuated through credit derivative arrangements that do not result in ABS issuance.

On the basis of the available information, the securitisation activities of these companies loom large in relation to their on-balance sheet exposures. As of March 1998, outstanding non-mortgage ABSs and ABCP issued by these institutions exceeded \$200 billion, or more than 12% (25%), on average, of the institutions' total risk-weighted assets (loans). For several institutions, the combined issuance of ABSs and ABCP approached 25% (50%) of total risk-weighted assets (loans).

Although similar data are not available for non-US banks, market reports suggest that significant amounts of securitisation-related capital arbitrage have been undertaken by Canadian, European, and Japanese banks - particularly through collateralised loan obligations (CLOs) and ABCP. Much of the securitisation activities of these banks appears to be funded in the United States, reflecting the greater size and liquidity of US markets.

While the European ABS market is nowhere near as liquid as the US market, with the increase in ABS issuance and the overall development of capital markets in post-EMU Europe, it is expected that such weaknesses will be overcome. Indeed, available evidence suggests that securitisation activity structured outside the United States has been growing exponentially. This is especially true in Europe where, according to FitchIBCA, new structured finance (bank and non-bank) - though still quite small compared to the US - has increased from \$8.5 billion in 1995 to more than \$41 billion in 1997.

Looking at the other types of regulatory arbitrage, it is too early following the introduction of the Accord to say much about the effect of the Market Risk Amendment to the Accord. There is also little empirical evidence on whether banks have substituted interest rate exposure for credit exposure in the banking book although anecdotal evidence does not indicate that this has occurred to any extent. Allen, Jagtiani and Landskroner (1996) look at this question for US banks but have not allowed for other features of bank books (like off balance sheet positions) making it difficult to interpret their results.

### **2.3 Concluding remarks**

The available evidence suggests, therefore, that the volume of regulatory capital arbitrage is large and growing rapidly, especially among the largest banks. Securitisations are motivated by a number of factors including taking advantage of increased economies of scale, reduced costs of debt financing, and better diversification of funding sources. But there are indications that in many cases the effect is to increase a bank's apparent capital ratio relative to the riskiness of its actual book, which is making the ratios more difficult to interpret and in some cases less meaningful.

### **3. The effects of capital requirements on the macroeconomy**

#### **3.1 General issues**

A concern raised from time to time is that fixed minimum capital requirements can affect the real economy through reductions in lending when banks are capital constrained. Part 1 showed that in certain countries in some periods banks may have cut back lending to achieve higher capital requirements or maintain existing requirements. The periods when banks are likely to be most capital constrained are those when they are making substantial write-offs or provisions. These are also the periods when the demand for loans may be weak and/or when credit supply is reduced because of banks' concern that overall credit quality has deteriorated. Disentangling these effects can be difficult.

Even if some banks do cut back lending because of capital constraints, for this to affect the real economy the reduction must, for some reason, not be fully offset through increased lending either by better capitalised banks or by other financial intermediaries or by credit markets. Some observers argue that at least for some borrowers bank lending cannot be offset by other sources of credit because such loans are unique.<sup>17</sup> Such 'uniqueness' of bank loans stems from the fact that financial markets are characterised by imperfect information (i.e. some participants have an informational advantage over others). In this environment, banks can help to overcome these information problems and can facilitate the flow of credit into its most productive uses by screening borrowers, and by providing information-intensive lending to those private sector borrowers that cannot cost effectively access the capital markets, and by monitoring the actions of borrowers.<sup>18</sup> If information imperfections are important, then the inability of banks to perform these activities would disrupt the flow of credit.<sup>19</sup>

At issue is whether an excess demand for credit at banks that are capital constrained can be redistributed to the external capital markets or to other intermediaries that have sufficient capital for increased lending. If this redistribution of the excess demand for credit is costly, then the distribution of capital holdings across banks could be macroeconomically important. To the extent that the evolution of financial markets reduces the segmentation of lending markets, it would be expected that such costs may be falling over time.

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<sup>17</sup> In the UK, Mayer (1988) finds that bank lending is the dominant form of external finance.

<sup>18</sup> It is costly for savers to inform themselves about borrowers, to monitor whether borrowed funds are invested efficiently, and to ascertain whether borrowers are fulfilling their commitments. Diamond (1984) and Williamson (1986) focus on these costs and develop rationales for why banks play a unique role in an economy with imperfect information.

<sup>19</sup> To firmly establish this link, the possibility that other financial intermediaries (e.g. finance companies and insurance companies) fill the void left by a drop in bank lending must be ruled out. Fama (1985) suggests that the depositor relationship may give banks an informational advantage over other lenders. Alternatively, banks may have a cost advantage over other intermediaries because of the safety net provided by deposit insurance. Banks may then crowd out

Empirical support for the importance of banks compared to other financial intermediaries has been found in a number of countries. Much of this support has focused on borrower relationships with specific banks. For example, using data on 300 US firms, James (1987) finds that announcements of new bank credits result in significant positive abnormal returns on firm equity, whereas corresponding announcements of bond issues do not result in such responses. More recently, Slovin, Sushka, and Poloncheck (1993) examine stock market returns for firms that dealt with Continental Illinois Bank around the time of its near-failure and subsequent rescue by the Federal Deposit Insurance Corporation. During the period when the viability of Continental Illinois was in question, these authors find that those firms with business dealings with Continental Illinois had negative excess returns. When it became clear that Continental Illinois was going to be bailed out, those firms had positive excess returns. Also using US data, Petersen and Rajan (1994) show that small firms that have a close relationship with a bank have greater access to credit than firms without such a relationship.<sup>20</sup>

In Japan, where there is a “main bank” system of corporate finance, it appears that a firm’s investment is sensitive to the financial health of its main bank, particularly if the firm has never issued bonds.<sup>21</sup> Using cross-sectional data on Japanese non-financial firms for the periods 1991-1992 and 1994-1995, Gibson (1995, 1997) finds that investment is considerably lower at firms that have one of the lowest-rated banks as their main bank after controlling for their stock market valuation and cash flow.<sup>22</sup> Using the later sample, tests indicate that this reduction in investment is only statistically significant for firms that have never issued bonds.

Hence, it appears that bank-firm relationships are important.<sup>23</sup> These relationships may create a strong link between the lending activity of banks and the performance of the macroeconomy. For example, reductions in bank lending may not be perfectly offset by alternative sources of credit. Should that be the case, then reductions in lending by capital constrained banks could reduce output in both the short

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other financial intermediaries in certain credit markets. The fixed costs of entering a market when bank lending drops off may prevent other intermediaries from providing credit when bank lending declines.

<sup>20</sup> Small firms are defined as those with fewer than 500 employees. Interestingly, bank-firm relationships do not materially affect the price of credit for the firm.

<sup>21</sup> If a firm gets into financial distress, then its main bank oversees its restructuring by providing funds and management expertise. If the bank itself is in financial distress, then it is less able to fulfill these responsibilities. Gibson (1995) argues that a higher probability of future problems in its main bank should affect a firm’s behaviour today, as the “safety net” provided by the bank will be weaker when the main bank itself is in a weakened state. See Aoki, Patrick and Sheard (1994) for more discussion about the role of the main bank. Using data from an earlier time period, Hoshi, Kashyap, and Scharfstein (1991) find that Japanese firms that are “keiretsu firms” display less sensitivity to cash flow than other Japanese firms.

<sup>22</sup> The predicted aggregate effect on investment arising from difficulties in the banking sector was estimated to be in the 2.5% range. This is small considering that business investment in Japan fell 21% from its peak in 1991 to the first quarter of 1995.

<sup>23</sup> Although much of the evidence is for the US and Japan, if it is true in a countries where there is a very well developed capital market it is also likely to be true in other countries where the capital markets are less well developed.

run and the long. By either cutting off bank-dependent borrowers or by forcing them to employ more costly forms of credit, a reduction in bank lending can lead to a decline in investment demand. Holding other things constant, this decline in investment demand would be contractionary for the macroeconomy in the short run as firms might delay investment plans and shed workers.<sup>24</sup> Since future output is a function of current investment, foregone investment would reduce future output as well.

Having established the theoretical link between bank lending and the macroeconomy, it remains to be examined whether changes in bank lending resulting from capital requirements have been sufficient to cause significant macro-economic effects. This is the focus of the next section.

### **3.2 The effect of capital requirements on output**

The key issue addressed in this section is whether pressure to meet capital requirements has in some periods caused macroeconomic effects. There is some evidence for the US that certain sectors, particularly real estate, may have been affected by constraints on bank capital. Hancock and Wilcox (1997) and Peek and Rosengren (1997a, 1997b) examine the impact of an unexpected reduction in bank capital on credit availability and real activity in US real estate markets. In addition, Hancock and Wilcox (1998) examine the impact of bank capital shocks on credit availability and real activity in the small business sector. In the US, each of these sectors has traditionally relied on bank financing.

Hancock and Wilcox (1997) estimate a (state-level) bank portfolio adjustment model that relates state-wide growth in real estate lending (for single-family and for commercial real estate) to a measure of capital pressures on banks in that state (the average capital shortfall/surplus relative to an assumed 4.75% leverage ratio standard), indicators of national economic conditions, indicators of state-wide economic conditions, and other variables. Their empirical findings are consistent with the hypothesis that commercial real estate lending is much more vulnerable to negative capital shocks than is single-family residential lending. The authors argue that this vulnerability may result from the fact that the residential mortgages market is more liquid than is the commercial mortgages market.<sup>25</sup>

These authors also estimate models that relate various types of residential real estate activity (e.g. permits, housing starts, construction, and final sales) to the volume of bank lending and various proxies for the level of aggregate demand in that sector. Their empirical findings suggest that the early stages of real estate development tend to be more sensitive to the availability of bank lending than are the latter stages of development.

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<sup>24</sup> The aggregate demand effects of a reduction in bank lending are discussed in Bernanke and Blinder (1988), Romer and Romer (1990), Kashyap, Stein, and Wilcox (1991), and Bernanke and Lown (1991).

Peek and Rosengren (1997a) also examine the commercial real estate sector. They document that lending by US branches and subsidiaries of Japanese banks over the period 1988-1995 was highly sensitive to the parent's regulatory capital positions. Semi-annual loan growth at US branches and subsidiaries of Japanese banks was related to the parent's beginning-of-period risk-based capital ratios, measures of the financial conditions of the branch or subsidiary (such as problem assets), various proxies for the strength of loan demand in the United States and Japan, and other variables.<sup>26</sup>

Qualitatively similar findings are reported by Peek and Rosengren (1997b). Using the fact that the decline in Japanese commercial real estate prices over the 1988 to 1995 period was external to the US credit markets, they are able to identify an exogenous shock to the supply of bank loans to the commercial real estate sector in 3 spatially separated state markets (California, New York and Illinois). It appears that branches and subsidiaries of Japanese banks with high concentrations of problem loans reduced their lending to each of these commercial real estate markets, despite the fact that each market had substantially different market conditions during the sample period. This suggests that capital constraints were the important factor rather than the reduction in loan demand or creditworthiness of the borrowers. Peek and Rosengren (1997b) provide evidence that the overall reduction in real estate lending by Japanese banking organisations contributed to the decline in US real estate construction activity during the 1990s. They regress various measures of construction activity that occurred in the three spatially separated states on the regulatory capital ratios of the Japanese parents, indicators of the financial condition of the branch or subsidiary (such as problem loans), proxies for the strength of demand for commercial real estate in the US, and various other control variables.<sup>27</sup>

These findings are consistent with emerging evidence that the distribution of capital among banks, not merely the aggregate capital ratio in the economy, can have an important effect on macroeconomic activity.<sup>28</sup> As noted above, there is empirical support that borrower relationships with specific banks in the US and Japan can create a strong link between the lending activity of banks and the performance of the macroeconomy. Further, the fact that some sectors that are believed to be particularly bank-

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<sup>25</sup> The authors did not explicitly evaluate whether the much lower risk-based capital requirement on residential mortgages compared to the risk-based capital requirement on commercial mortgages influenced their findings.

<sup>26</sup> Their sample included 11 Japanese city banks, 3 long-term credit banks, 5 trust banks, and 10 of the largest regional banks.

<sup>27</sup> These findings are consistent with those of Hancock and Wilcox (1997).

<sup>28</sup> Even state-level data may not be sufficient to hone in on the distributional aspects of bank capital. For example, Bernanke and Lown (1991) use state-level bank capital-to-asset ratios to determine whether changes in state lending growth induced by a variation in capital-to-asset ratios have significant predictive power for economic activity in the state. Using a regression model, they find that the relationship between state employment growth and bank lending was not statistically significant during the 1990-1991 period. The authors interpret this finding as suggesting that the contraction in bank lending may not reduce the overall supply of credit.

dependent have experienced difficulties when banks have experienced difficulties suggests that the distribution of capital across banks can affect investment and macroeconomic activity more generally.

There is also evidence that reductions in lending by capital constrained small banks in the US were not fully offset by lending by large banks and that the distribution of capital across large banks and small banks has had macroeconomic effects. It is generally believed that the small business sector of the US economy is particularly bank dependent<sup>29</sup> and that many of these small businesses rely on small banks for financing.<sup>30</sup> Therefore a reduction in lending by small banks could adversely affect the small business sector. Hancock and Wilcox (1998) use annual state-level banking data for the period 1988-1992 to assess whether any reductions in business loan supply at small banks (total assets less than \$300 million) are offset by increases in loan supply at large banks, and vice versa. Regressions are estimated that explain real business lending growth at each size category of bank with average capital ratios of each size category of banks and general indicators of economic conditions (such as an index of consumer sentiment). Business loans at large banks show some tendency to rise when capital falls at small banks. The converse is also true. These offsets, however, are only partial. Further, these authors also estimate whether state-wide economic activity (measured by gross state product, employment and payrolls) during the US credit crunch period is influenced more strongly by changes in capital at large banks or by changes in capital at small banks. Their empirical findings suggest that a \$1 reduction in capital at small banks has a much larger effect on various measures of economic activity than a \$1 capital reduction at large banks.

These papers on the effect of a capital induced reduction in bank lending on particular sectors of the US economy indicate that regulatory capital requirements may well have macroeconomic effects in some periods. Researchers have, however, been rather less successful at identifying an impact at the aggregate economy level, although some papers have identified a link between pressure on capital requirements and output.

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<sup>29</sup> Oliner and Rudebusch (1996) use data for the U.S. manufacturing sector to examine the relationship between internal funds and business investment for large and small firms. Their empirical findings suggest that the association between internal funds and investment tightens significantly after a monetary contraction, indicating a scarcity of external finance. In contrast, for large firms, there is no change in the linkage between internal funds and investment after a tightening of monetary policy. They argue that a broad credit channel exists for the transmission of monetary policy, and it operates through small firms. In a separate paper, Oliner and Rudebusch (1995) do not find much evidence for a bank lending channel for monetary policy. Small and large firm bank debt behaved little differently from non-bank debt after a monetary contraction. These authors stressed that their results did not rule out the possibility of “credit crunches” in the banking sector brought on by increased capital requirements, more stringent regulatory practices, or a sharp deterioration in bank balance sheets.

<sup>30</sup> Hancock and Wilcox (1998) estimate that changes in small bank lending have much less of an effect on employment at businesses with greater than 500 employees, than on businesses that employ fewer than 500 employees, particularly in the 1989-1990 period. In contrast, lending at large banks has more of an effect on businesses with more than 500 employees than on smaller businesses. In general, firms of all sizes reduce their payrolls, though not always by statistically significant amounts, when bank capital declines. In general, the estimated effects on payrolls of capital losses at small banks are larger than those of capital losses at large banks.

Since negative shocks to bank capital could potentially affect macroeconomic activity through their effects on bank lending, the academic research that investigates whether aggregate bank lending affects a proxy for macroeconomic activity, such as GNP or national income, is relevant for considering the macroeconomic impact of bank capital requirements. Several studies have made time-series comparisons of aggregate bank lending with national income. These studies have suggested that bank lending leads national income for all G-7 countries except Canada, particularly during those periods when quantitative controls on bank credit or deposit rates were in force.<sup>31</sup> For the US and Japan, this continued to be the case when innovations in a broad monetary aggregate were also included in the time-series model.<sup>32</sup> These findings are consistent with the hypothesis that bank lending affects output. King (1986) and Ramey (1993), however, do not find conclusive evidence that bank lending – or other credit measurement variables, such as bank holding of securities relative to loans or differences in the growth rate of short-term debt of small and large firms – caused US postwar output in a statistical sense.<sup>33</sup> These studies find that monetary aggregates, rather than bank lending aggregates, have a superior statistical relationship with GNP. Such findings suggest that money may decline immediately after a tightening of monetary policy, but bank lending may drop off after some time. In that case, changes in money would cause changes in output rather than changes in bank loans causing changes in output.<sup>34</sup> More generally, the high correlation between money and credit aggregates makes it difficult to statistically disentangle their separate effects from reduced-form time series correlations.<sup>35</sup>

Even with a structural model that incorporates both capital shocks and monetary policy shocks, aggregate time-series data may not be particularly useful for detecting a relationship between bank capital and macroeconomic activity.<sup>36</sup> This is because aggregate data may mask changes in the distribution of capital holdings across banks over time. For example, aggregate bank capital may remain constant or even increase, despite significant reduction in capital at some banks that may affect their lending to bank-dependent borrowers. In this case, at an aggregate level it would appear that bank capital shocks are negatively correlated with movements in bank lending and investment. Such an

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<sup>31</sup> See Blundell-Wignall, Browne, and Manasse (1990) and O'Brien and Browne (1992).

<sup>32</sup> See O'Brien and Browne (1992). Using Finnish private fixed investment data Saarenheimo (1995) finds that bank credit exerts a significant independent effect on investment even after controlling for the contribution of the money stock and the loan rate.

<sup>33</sup> Both statistical significance tests and variance decompositions are used in King (1986).

<sup>34</sup> Studies by Bernanke and Blinder (1992), Gertler and Gilchrist (1993) and Romer and Romer (1990) report that money leads output and bank lending moves contemporaneously with output after a monetary contraction.

<sup>35</sup> For more discussion on this point see Blinder and Stiglitz (1983).

<sup>36</sup> See Friedman and Kuttner (1993).

empirical finding would, of course, not be sufficient to reject the theoretical model for why bank capital shocks may be macroeconomically important.<sup>37</sup>

The country where there is currently the greatest concern about a credit crunch is Japan. Pressure to meet fixed minimum capital ratios, following the introduction of the Basle Accord, appears to have had some effects on bank lending (although lending to Japanese industry only began to decline recently). Almost from the introduction of the Accord, the Japanese banks were affected by the reduction in their latent profits (included in Tier 2 capital<sup>38</sup>) caused by the fall in the Nikkei. The proportion of Tier 2 accounted for by latent capital gains was 93% in 1988 but had fallen to 70% by 1990 and 40% by 1992. In 1991 banks cut exposures to the financial sector (by 4%) and international sector (by 2%) apparently in order to improve their capital ratios. In 1993 international exposures were cut by a further 10% and in 1994 by 18%. Lending to domestic industry was flat from 1994 onwards and fell in the first half of 1998 by 3% (see Table 3.1). However, in this latest period it is difficult to disentangle reduced demand, caused by the weakness in the economy from the reduced supply of credit.

Econometric studies also indicate that the health of the Japanese banking sector may have contributed to the long stagnation of the Japanese economy during the 1990s. The empirical models of Kim and Moreno (1994), Miyagawa (1997) and Brunner and Kamin (1998)<sup>39</sup> suggest that stock market fluctuations have an important effect on Japanese bank lending. Kim and Moreno (1994) estimate a vector autoregression (VAR) model for the Japanese economy using monthly data for two samples: 1970:M1-1983:M12 and 1984:M1-1992:M12. They find that stock prices played a negligible role in explaining fluctuations in bank lending in the first period, but a much more important role in the second period. Stock prices appear to have contributed to an unexpectedly rapid increase in bank lending during the late 1980s and to unexpectedly slow growth in bank lending in the early 1990s. Changes in stock prices can affect Japanese bank lending through two channels. In the late 1980s the result may have simply reflected the boom which affected both the Nikkei and bank lending. The result for the early 1990s probably reflected the effect of the latent profits on the capital position on the banks. Using data for the 1975-1997 period, the Economic Planning Agency (1998) determines that Japanese bank lending is more sensitive to movements in the risk-based capital ratio as the risk asset ratio approaches the regulatory floor. Miyagawa (1997) reports that bank lending fluctuations in

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<sup>37</sup> See Friedman and Kuttner (1993).

<sup>38</sup> Japanese banks are allowed to count up to 45% of unrealised gains on their equity holdings.

<sup>39</sup> Brunner and Kamin (1998) developed and estimated an econometric model of the Japanese economy that included a market for bank loans and a role for financial factors. This econometric model was based on the Bernanke and Blinder (1988) model. In all, there were 7 structural equations that described the behaviour of banks, households/firms, and a monetary authority. Data for the 1971:Q1-1991:Q1 period was used to estimate their structural model. See also Brunner and Kamin (1996).

turn significantly affect investment by small- and medium-sized firms in Japan. In contrast, Brunner and Kamin (1998) estimate that the contraction in loan supply by Japanese banks lowered output in the period 1990-1993 by only a small degree.

Table 3.1  
The Nikkei, bank capital and lending in Japan<sup>1</sup>

	Nikkei	Tier II	Tier I	Risk-weighted assets	Lending to:		
					industry	Financial sector	Inter-national sector
1988	28.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1989	22.5	- 15.6	27.4	22.8	20.0	21.1	5.7
1990	- 63.2	- 0.1	4.3	0.5	5.0	2.6	2.8
1991	- 3.87	- 24.1	3.8	- 0.1	2.7	- 4.1	- 1.9
1992	- 35.8	21.2	1.5	- 4.1	1.9	0.5	4.6
1993	2.8	0.6	1.3	- 3.0	22.1 <sup>2</sup>	31.3 <sup>2</sup>	- 9.6
1994	11.7	- 20.2	- 1.6	- 1.0	0.0	3.4	- 18.0
1995	0.7	32.1	- 7.7	2.7	0.1	0.6	- 5.5
1996	- 2.6	- 7.1	3.3	1.4	0.4	- 5.9	2.1
1997	- 26.9	- 3.0	- 4.0	- 7.8	0.0	1.5	1.3
1998 first half <sup>3</sup>	n.a.	- 5.4	- 1.7	3.0	- 3.2	- 3.8	1.0

<sup>1</sup> The capital data is on a fiscal year basis and the lending data on a calendar year basis. <sup>2</sup> There was a break in the statistics in this year with overdrafts included for the first time. <sup>3</sup> March-September for capital data, December-June for lending data.

Miyagawa (1997) estimate a vector autoregression (VAR) model using data for the 1983:Q1 to 1995:Q3 period for the Japanese economy based on a modified Bernanke and Blinder (1988) model. Movements in the stock market price index are interpreted as shocks which affect the banking sector. Also incorporated into the model are financial sector shocks from changes in high-powered money. Large firms are defined as those with more than 100 million yen in capital. Small and medium-sized firms have 10 to 100 million yen in capital. A causal relationship (in a Granger sense) is found from bank loans to investments made by small to medium-sized firms. Further, investment responses at these firms are influenced by bank lending and by the stock market price index.

Supporting Miyagawa's findings, an investment function for Japan estimated by the Economic Planning Agency (1998), which used annual data for the 1975-1997 period, indicates that bank lending attitude affects investment by small firms, while investment by large firms is statistically unaffected by this variable. Using firm-level data, Gibson (1995, 1997) provides a contrasting perspective. Gibson (1997) estimates that the health of the banking sector had a very small aggregate effect on business investment in 1994-1995. One reason why this may be the case is that other types of financial

institutions, such as the Japan Finance Corporation for Small Business, the People's Finance Corporation, and life insurance companies may have increased their lending as bank lending was reduced or declined. In the Bank of Japan 1997 Annual Report, it is argued that lending by these institutions absorbs the demand for funds not met by the private-sector financial institutions. However in the first half of 1998 there has been a fall of almost 3% in total lending. This may indicate that non-commercial bank intermediaries are no longer fully making up any shortfall in lending by commercial banks. Alternatively, it may imply that the weakness of the economy is causing a reduction in the demand for loans.

### **3.3 Concluding remarks**

Theory suggests that changes in bank capital and their effects on bank lending may be important. There is some empirical evidence in the US, UK and Japan that banks have a special role and therefore that reductions in bank lending may not be fully offset by increases in lending from other financial intermediaries or markets.

The key issue is whether there is empirical evidence that constraints on bank capital requirements have in some periods led to lower output. Some papers indicate that particular sectors in the US in the early 1990s may have been affected by pressure on the capital of some banks (although there was not, in general, pressure on all banks). Currently, the weakness of the Japanese banks may be contributing to the weakness of the economy but more evidence is needed to assess this effect.

This section has not, however, addressed another aspect of the effect of capital requirements on macro-economic activity which is that, by promoting financial stability, overall their effect on economic growth may be positive.

## **4. The effects of capital requirements on the long-run competitiveness of banks**

Various concerns have been raised over whether the competitiveness of banks has been harmed by the introduction of fixed minimum capital requirements. These concerns fall into three types:

- (i) whether banks have been disadvantaged compared with securities markets or securities firms;
- (ii) whether the overall profitability of banks has been affected; and,
- (iii) whether the Basle Accord has levelled the playing field among internationally active banks.

#### **4.1 Banks versus securities markets/firms**

An issue raised in some markets is whether banks, because of the fixed minimum capital requirements and broad risk weighting bands in the Basle Accord, have found it difficult to compete against the securities markets as providers of funds. Many countries have seen a shift from provision of funding to prime corporates by banks to provision of funding by commercial paper markets or securities markets more generally but it is difficult to assess how much of this shift was driven by the capital requirements of the banks and how much by innovation and greater sophistication of the borrowers. Banking business has in fact been changing in a variety of ways over a long period. To take the US as an example, for some time bank deposits have been a declining share of the household sector's financial wealth and bank loans have been a declining share of short-term business credit. These trends predate higher capital standards. Moreover, various authors have hypothesised that these effects may be related to: (1) the removal of deposit rate ceilings, (2) improvements in information technology and financial innovation, and (3) increased competition from foreign lenders who enjoy less burdensome regulation in their home countries.<sup>40</sup> It would therefore be wrong to conclude from the changes in banks' long term share of various markets that they have been driven by the effect of capital requirements on banks' competitiveness.

A further issue raised in some markets was whether banks were placed at a disadvantage by the Accord compared with some other players. At the time of its introduction the capital requirements of non-bank securities houses in the US and UK, and later Japan and France, were considerably more fine-tuned<sup>41</sup> than the requirements faced by banks. This gave rise to concerns on the part of some banks that they were disadvantaged in their securities trading compared with securities firms. However, an exercise carried out by the Bank of England in the late 1980s showed that neither group had a clear advantage. Whether a bank or a securities house carried more capital for the same trading book depended on the nature of the book. Although the banking requirements were high for long positions in prime corporate securities, there were no banking capital requirements for short positions, positions in government securities in many markets (although not the UK) and the position risk of off balance sheet instruments.

The Market Risk Amendment to the Basle Accord in 1997 brought the capital treatment of banks' trading book exposures much closer to that of securities houses under the standard approach but banks were also given the opportunity of using VaR models to calculate the requirements whereas US securities houses were not.

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<sup>40</sup> See Boyd and Gertler (1993), Boyd and Gertler (1994), Kaufman and Mote (1994), and Edwards and Mishkin (1995).

<sup>41</sup> They were based on the price volatility of different securities.

It would therefore be wrong to conclude from the changes in banks' long term share of various markets that they have been driven by the effect of capital requirements on banks' competitiveness.

#### **4.2 The effect of capital requirements on banks' profitability**

It is possible that the introduction of minimum regulatory capital requirements may have harmed the competitiveness of the banking industry. If capital standards require a bank to maintain an equity position in excess of what it would hold voluntarily, or in response to market pressure, then these standards constitute an external constraint on a bank's operations. In theory, any kind of external interference with the activities of a business firm could harm its short-run profitability or growth and possibly undercut its long-run viability. It is of course equally possible that capital requirements for banks could be viewed in a positive light by the markets and therefore improve their funding costs.<sup>42</sup>

While we would like to investigate directly the effect of capital standards, there is probably little value in attempting to do this by examining the profitability or growth of the banking industry immediately following the imposition of new capital standards. Over any relatively short period, the industry's performance is highly dependent on the state of the economy. During the past several years, for example, banks in a number of countries have enjoyed high profitability, good asset growth, and a strong capital position due to especially favourable macroeconomic conditions. In addition, banks have probably achieved efficiency gains through mergers and acquisitions. It would thus be a mistake to conclude from the industry's recent good performance that capital standards have no effects on its long-run competitiveness.

##### ***Event studies on the effects of the Basle Accord on banks' share prices***

One way to look at the possible effect of minimum regulatory capital requirements on banks' profitability is to look at the market perception of the impact. Several studies have done this by examining the effect of announcements on banks' share prices. (These event studies are listed in Table 4.1.) If the introduction of fixed minimum capital standards was expected by the market to harm bank profitability, the adverse effect should be reflected in banks' share prices. If investors incorporate all relevant information as soon as it becomes available, the stock market effect should occur at almost exactly the time minimum capital standards were imposed or at the times of important announcements leading up to their imposition. By focusing on a very short interval around important announcements, the effects of minimum capital standards should show through and not be distorted by macroeconomic and financial conditions or long-run factors.

Table 4.1

**Table of empirical papers on the impact of capital requirements on banks' share prices**

Authors	Coverage of the study	Have capital requirements reduced the share prices of banks?
Eyssell and Arshadi (1990)	US stock prices of large banks 3 announcements (1986-1988)	Yes
Madura and Zarruk (1993)	US stock prices of banks 3 announcements (1987-1988)	Yes
Cornett and Tehranian (1994)	US security offerings by banks (1983-1989)	No
Laderman (1994)	US common stock issuance (1989- 1992)	No
Cooper, Kolari and Wagster (1991)	Equity share prices of banks in Canada, Japan, UK and US  12 announcements (Jan 1987- July 1988)	Yes
Wagster (1996)	Equity share prices in original 4 plus Germany, The Netherlands and Switzerland  18 announcements (Jan 1987 - July 1988)	No

The studies of announcement effects surrounding the Basle Accord produce rather mixed results in terms of the market expectations concerning an effect on the profitability of banks. Even if these studies had consistently found a significant effect, one would still question whether the instantaneous reaction of investors is a meaningful way to evaluate the actual long run effect on banks' competitiveness.

***Review of individual studies***

Using an event study methodology, Eyssell and Arshadi (1990) find statistically significant negative abnormal returns for three events preceding the imposition of risk-based capital requirements: (1) the Federal Reserve's release of proposed risk-based capital standards (24 January 1986); (2) the Federal Reserve-Bank of England joint statement of an intent to establish minimum risk-based capital requirements (8 January 1987); and (3) the signing of the Accord (11 July 1988). The negative impact of these events on the stock prices of 27 large banks may imply that the banking sector's long-term profitability was harmed by the imposition of higher capital requirements. (They also find that the

<sup>42</sup> An alternative explanation for the decline in a bank's stock price is that it can no longer extract the maximum benefit from the official safety net.

abnormal returns for those banks that would find the requirements more binding are significantly more negative, but only for the first event.)

Madura and Zarruk (1993) conduct a study that overlaps a great deal with Eysell and Arshadi's. They find that the negative stock price reaction in their sample is concentrated among the largest banks.

In a study by Cornett and Tehranian (1994), the focus shifts from reactions to announcements of minimum capital standards to the effect of announcements of equity issuance undertaken to meet the standards. They thus examine differences in stock market price reactions following voluntary capital injections by banks in the form of either new equity or new debt driven by business needs and involuntary capital injections needed to reach or exceed the capital standards. It can be argued that, if capital standards significantly alter a bank's capital structure from what is optimal, issuing new shares or new debt to meet higher requirements should produce a negative stock price reaction. Alternatively, while a bank's voluntary issuance of new shares may be a signal that its owners think its prospects are poor, issuance of new shares (or new debt) simply to meet higher standards may not signal anything about its future prospects and may not elicit a negative reaction. Therefore, the anticipated effect of higher capital standards is ambiguous.

Cornett and Tehranian construct a sample of 491 security offerings by 176 different banks during the period June 1983 to December 1989. A capital ratio of 7% is used to distinguish between voluntary and involuntary issuance during a period in which the minimum set by supervisors was first 5.5% and later 6.0%. They find that, on average, involuntary common stock issuance undertaken to meet minimum capital requirements is met with a significantly less negative investor reaction than voluntary common stock issuance. Furthermore, the negative reaction to involuntary issuance is not statistically significant. To be more certain of their findings, the authors also consider the possibility that involuntary issuance of equity is anticipated by investors better than voluntary issuance. If involuntary issuance is better anticipated, the negative effects of issuance may already be impounded in the stock price of capital deficient banks by the time the new issuance is formally announced. According to the authors, looking up to 60 days before issuance, the average share price of banks issuing common stock involuntarily does no better or worse than non-issuing banks, which means that capital standards do not greatly distort a bank's capital structure.

Laderman (1994) applies the Cornett-Tehranian analysis to a later period, covering the implementation of risk-based capital requirements in the US. She looks at 44 common stock issuances over the period 1989-92. On average, the announcement of a new common stock issuance causes returns to decrease by 1.6%, which is statistically significant, while the announcement of a new issuance of other types of securities has no statistically significant effects. Looking at just the ten announcements of common stock issuance by low-capital banks, the effect of an announcement is to reduce returns 2.74%. These results imply that the new capital requirements are perceived as being detrimental to the long-run

viability of the banking sector, although the size of the effect seems small and may not be economically meaningful.

### *Cross-country comparisons of the stock market's near-term reaction*

In order to make cross country comparisons of the stock market's near term reaction, Cooper, Kolari, and Wagster (1991) estimate the effects that a series of twelve announcements of the progress being made on establishing international capital standards had on the equity share prices of 27 large banks in Canada, Japan, the UK, and the US. The first announcement considered is a joint Bank of England-Federal Reserve statement (8 January 1987); the last marks the signing of the Accord (11 July 1988). The paper's main finding, based on patterns in abnormal returns, is that investors perceived Canadian, UK, and US banks to be adversely affected, with the stock prices of US banks showing the greatest declines. Investors apparently could not determine the impact on Japanese banks, perhaps because of uncertainty regarding the handling of their equity holdings.

Wagster (1996) re-estimates the effects of these announcements. This study improves upon the earlier study in several ways:

- eighteen announcements are used (although the earliest and latest announcements are the same as in the earlier study);
- 57 banks from seven countries are included (the original four plus Germany, the Netherlands, and Switzerland);
- the market model is more sophisticated;
- a more elaborate estimation method is used (the equations are estimated as a system of seemingly unrelated regressions); and
- a longer time period to estimate the market reaction is used.

Wagster find that at least one of the eighteen events had a statistically significant effect on the stock prices of internationally active banks in each of the seven countries. The overall effect, however, is significant only for Japanese banks: a cumulative wealth gain of 32%. The author interprets this to mean that the Accord was perceived by the market as being essentially a ratification by the G-10 countries and the EC countries of the market share gains made by Japanese banks, and thus the Accord diffused an increasingly politically hostile environment. If the Japanese banks were forced to raise some capital on account of the Accord, the cost of doing so was far outweighed by the side benefits of the Accord. Thus, the findings of the Cooper-Kolari-Wagster study are overturned.

In summary, the six papers on domestic and international competitiveness provide mixed evidence on the impact that new capital requirements had on banks, as measured by abnormal returns in their stock prices. Three papers that analyse the reactions to announcements made by regulators are able to detect

that the market expected that the new requirements might reduce profitability (an effect which is statistically significant), but the results from a fourth and more detailed study of regulatory announcements imply no effect. And the two papers that analysed the reactions to voluntary and involuntary equity issuance of new equity conflict with each other.

### 4.3 Has the Basle Accord levelled the playing field between banks internationally?

During the 1980's, banks in some countries claimed they were at a competitive disadvantage relative to banks in other countries and "levelling the playing field" internationally was one goal behind the Basle Accord. Several factors, however, determine the extent to which the introduction of minimum capital requirements actually narrows international differences in competitiveness. One factor is differences in accounting treatment across countries; another is differences in the cost of capital. In fact there is a wide literature on costs of capital and definite conclusions are difficult to draw. But some papers have pointed to substantial differences between countries.

For example, Zimmer and McCauley (1991) investigate differences in banks' cost of equity. They find that during the period 1984-90, the cost of equity faced by internationally active banks varied considerably across Canada, Germany, Japan, Switzerland, UK, and US. The highest cost of bank equity (calculated in real terms using expected profits) was estimated to be in the US at 12.0%, and lowest in Japan at 3.2%. For these estimates of substantial differentials in the cost of equity across countries to be meaningful, capital markets must have been less integrated in the 1984-90 period than often supposed. A home-country bias on the part of both investors and issuers of securities may underlie the sizeable differentials.

The authors go on to show that banks in Germany, Japan, the UK and the US face a cost of equity that is similar to the cost of equity faced by all firms in the same country. In other words, German banks and Japanese banks pay a low price for equity as do German and Japanese non-bank firms, and US banks pay a high price for equity as do US non-bank firms. (See table below).

Table 4.2  
Comparison of cost of equity for industry and banking (1984-88)

	Cost of equity for all industries (%)	Cost of equity in banking (%)	Banks' advantage over other firms in same country
Germany	7.8	6.9	0.7
Japan	4.5	3.2	1.3
US	11.2	12.0	- 0.8
UK	6.4	10.0	- 3.6

Some possible sources of differences in the cost of equity may include: national saving behaviour, macroeconomic stabilisation policies, industrial organisation, and taxes.

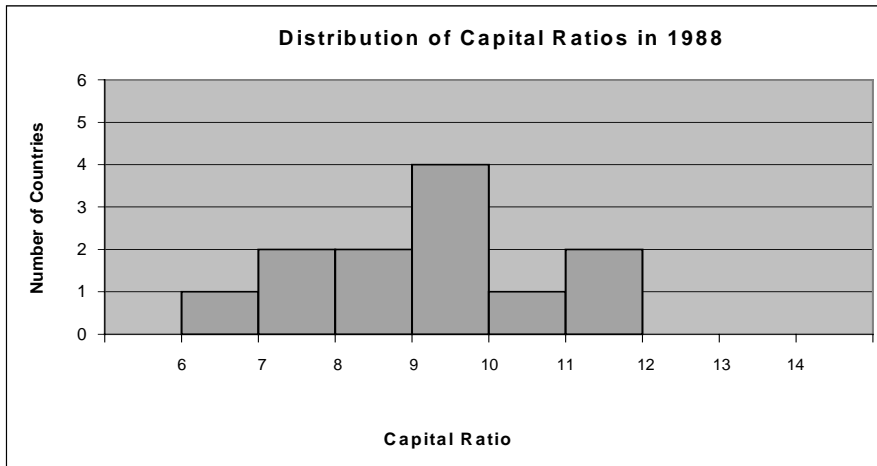
Differences in the protection afforded by the safety net could also affect a bank's cost of equity. Suppose that, in some countries more than others, the safety net supports a weak bank and market discipline is less effective. Then a bank with a strong safety net stretched beneath it should be at a comparative advantage: because shareholders are at lower risk, they are willing to provide equity finance at a lower cost. Furthermore, the size of the benefit a bank derives from a better safety net increases as its level of capital falls. In this setting, by imposing comparable capital standards on banks across countries, the value of having a stronger safety net is diminished and, to some extent, banks' cost of capital should converge on that paid by non-bank firms in the same country. Through this channel it is possible that internationally agreed minimum capital standards would narrow international cost-of-equity differentials for banks.

Undue weight should probably not be placed on the cost of capital in terms of international competitiveness because the overall cost of funding is probably even more important. However, if banks in some countries are trying to achieve a much higher return on equity than banks in other countries it will affect the margins at which they can carry out various activities, effectively encouraging them to withdraw from low margin activities if those activities do not carry commensurately low capital charges.

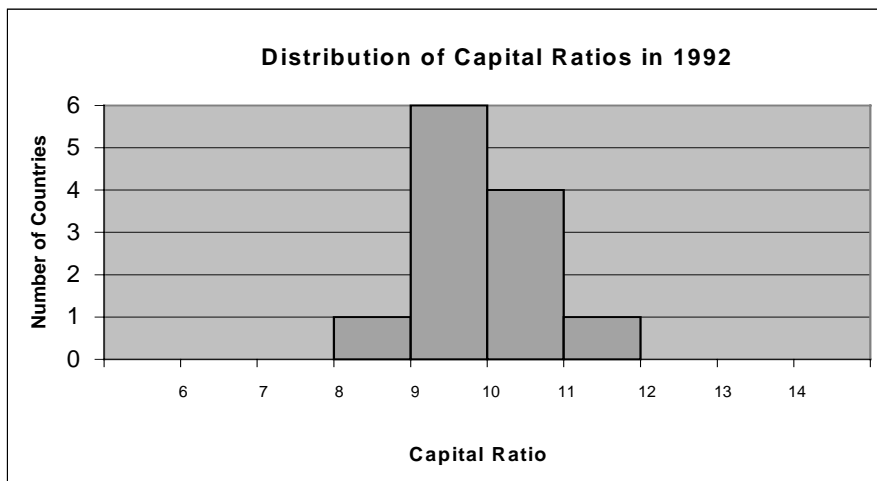
It is also of interest to determine whether bank capital ratios have in fact converged since the introduction of the Accord. The evidence in Part 1 showed that capital ratios increased following the introduction of the Accord but it is also worth looking at dispersion. Chart 2 shows the distribution of capital ratios for all the G-10 banks in the sample created by the Nederlandsche Bank. Interestingly, although the standard deviation of the capital ratios for this sample of banks did narrow from 1.6 to 0.8 between 1988 and 1992, it widened again to 1.6 in 1996.

Differences between capital ratios of internationally active banks across different countries may reflect competitive issues such as the perceived magnitude of the safety net or might reflect other issues such as the nature of the activity carried out by banks in the particular country. Banks with very large wholesale activities generating substantial exposures between large players (such as swaps) may well perceive a need to carry more capital because of its influences on the magnitude and cost of business that they can carry out. Dispersion will also be affected by the supervisory approach in the particular country. In some countries supervisors require banks to hold capital above the Basle requirement.

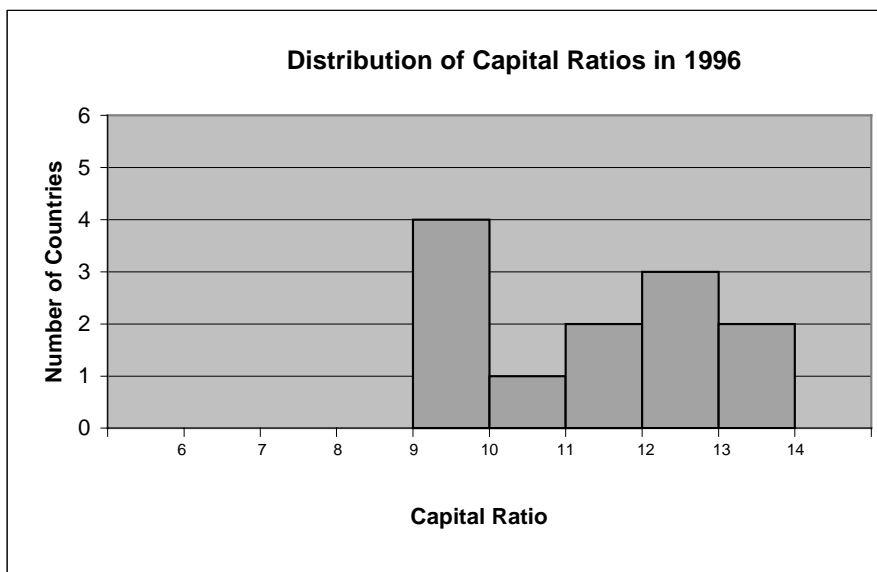
## CHART 2 CAPITAL RATIOS IN 1988, 1992 AND 1996



Mean	9.3
Std.Dev.	1.6
Min	6.8
Max	11.9



Mean	9.6
Std.Dev.	0.8
Min	8.8
Max	11.5



Mean	11.2
Std.Dev.	1.6
Min	9.2
Max	13.8

#### **4.4 Concluding remarks**

It is very difficult to draw any firm conclusions from the available studies about the impact of capital requirements on the competitive position of banks. Empirical studies have not thus far attempted to test this directly. The evidence from event studies on the stock market reaction to announcements of the introduction of requirements is generally mixed and therefore does not indicate an overwhelming reaction one way or the other regarding the expected effect on profitability.

On the question of whether the Accord levelled the competitive playing field between internationally active banks, it must be borne in mind that other important differences remain such as the cost of capital and the perceived magnitude of the safety net.

# Appendix 1

## Regulatory capital arbitrage: Examples

### A. Benchmark Scenario: On-balance Sheet Loans

#### Exhibit A1

#### Benchmark Scenario: On-Balance Sheet Loans

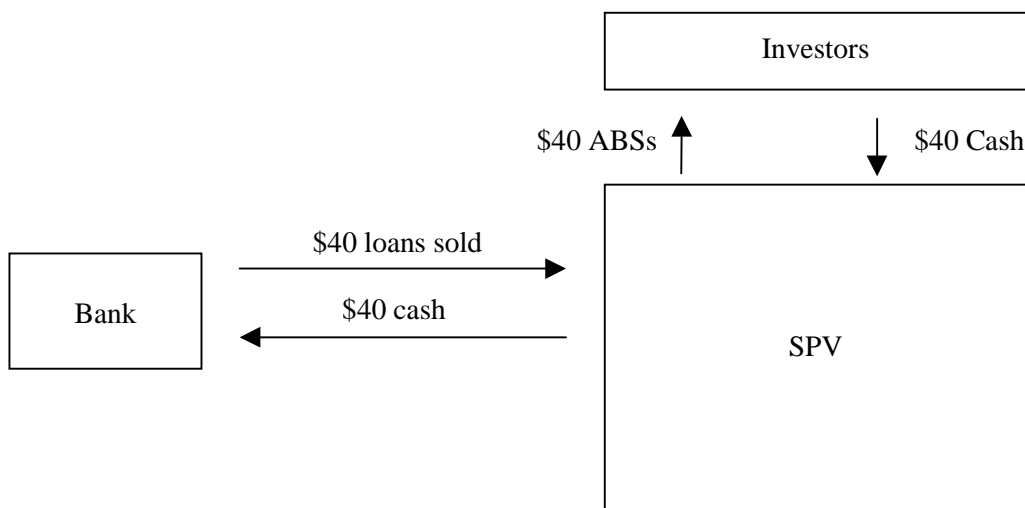
##### Bank Balance Sheet

Loans	200.00	Deposits	176.00
Less Reserves	(2.00)	Equity	22.00
Total Assets	198.00		
Total Risk-weighted Assets	=	200.00	
Tier 1 Capital	=	22.00	
Total Capital	=	24.00	
Tier 1 Risk Based Capital Ratio	=	11%	
Total Risk Based Capital Ratio	=	12%	

To contrast the implications of various forms of regulatory capital arbitrage, we shall compare their regulatory capital implications to the benchmark scenario shown in Exhibit A1, where all loans are held directly on the balance sheet. In this scenario, the credit risk portfolio is assumed to consist of \$200 in gross loans, which are funded with \$176 in deposits and \$22 in equity capital. The loan loss reserve is assumed to equal the portfolio's expected credit loss. Ignoring tax effects, the bank's Tier 1 and total regulatory capital ratios would equal 11.0%, and 12.0%, respectively.

**B. Review of Securitisation without Retained Risks**

Exhibit A2  
**Securitisation without Retained Risks**



**SPV**

Loans	40.00	ABSs	40.00
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**Bank**

Loans	160.00	Deposits	136.00
Less Reserves	(2.00)	Equity	22.00
Total Assets	158.00		

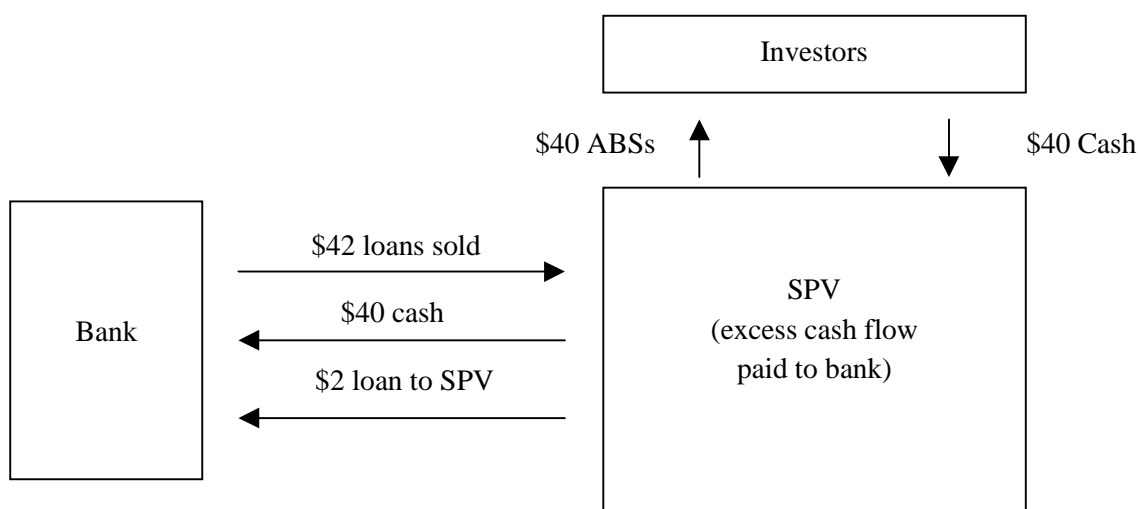
Total Risk-weighted Assets	=	160.00
Tier 1 Capital	=	22.00
Total Capital	=	24.00
Tier 1 Risk Based Capital Ratio	=	13.8%
Total Risk Based Capital Ratio	=	15.0%

Exhibit A2 assumes the above bank securitises \$40 of loans from its balance sheet by selling the assets without recourse (at par) to a bankruptcy-remote Special Purpose Vehicle (SPV). The SPV, in turn, funds this purchase by issuing \$40 of asset-backed securities to third-party investors. Relative to the benchmark scenario, this securitisation without retained risks results in the bank transferring all the credit risk of the securitised loans to investors. Commensurate with this risk reduction, the bank's total risk-weighted assets are reduced, increasing its Tier 1 and total regulatory capital ratios to 13.8% and 15.0%.<sup>43</sup>

<sup>43</sup> This example assumes proceeds from the sale of asset backed securities are used to reduce the bank's outstanding deposit liabilities. For simplicity, the asset backed securities assume no change in reserves at either the bank or SPV.

**C. Securitisation with Recourse**

Exhibit A3  
**Securitisation of Term Loans with Recourse**



<b>SPV</b>			
Loans	42.00	ABSs	40.00
		Subordinated bank loan	2.00
<b>Bank</b>			
Loans	158.00	Deposits	136.00
Loan to SPV	2.00	Equity	22.00
Less Reserves	(2.00)		
Total Assets	158.00		
Total Risk-weighted Assets*	= 172.36		
Tier 1 Capital	= 22.00		
Total Capital	= 24.00		
Tier 1 Risk Based Capital Ratio	= 12.8%		
Total Risk Based Capital Ratio	= 13.9%		

\* Calculation of total risk-weighted assets applies the low-level recourse rule.

Exhibit A3 illustrates regulatory capital arbitrage in which a bank securitises \$42 of on-balance sheet term-loans, which support issuance of \$40 in asset backed securities by the SPV. Unlike the preceding example, however, in this case the bank seeks to improve the credit ratings on the asset backed securities by providing credit enhancement to the investors. In practice, such credit enhancements can take many forms. For example, typically the SPV would be structured so that contractual principal and interest payments on the securitised loans exceed the expected costs of administering the SPV and the contractual interest on the asset backed securities. So long as principal and interest payments on the securitised loans are sufficient to cover these costs, any excess cash flow of the SPV (termed “excess

servicing”) would be returned to the sponsoring bank. However, if cash inflows to the SPV are insufficient to cover its costs, nothing would be paid to the bank. Thus, a positive expected level of excess servicing provides a form of credit enhancement to the asset backed securities investors - functioning much like an equity position in the SPV.<sup>44</sup>

In addition to subordinating any excess servicing to asset backed securities investors, banks often provide direct credit enhancements to asset backed securities investors in the form of standby letters of credit or the acquisition of subordinated interests in the SPV. The amount of direct credit enhancement required by the rating agencies will tend to increase with the desired credit rating on the asset backed securities, and will tend to decrease with the credit quality of the underlying securitised loans. Exhibit A3 assumes this direct credit enhancement takes the form of a \$2 subordinated loan to the SPV. In practice, credit enhancements are often structured so that the asset backed securities receive relatively high investment-grade ratings (often AA/AAA). Often it can be inferred from such ratings that very little, if any, credit risk is actually transferred from the bank to investors in the asset backed securities in these transactions.

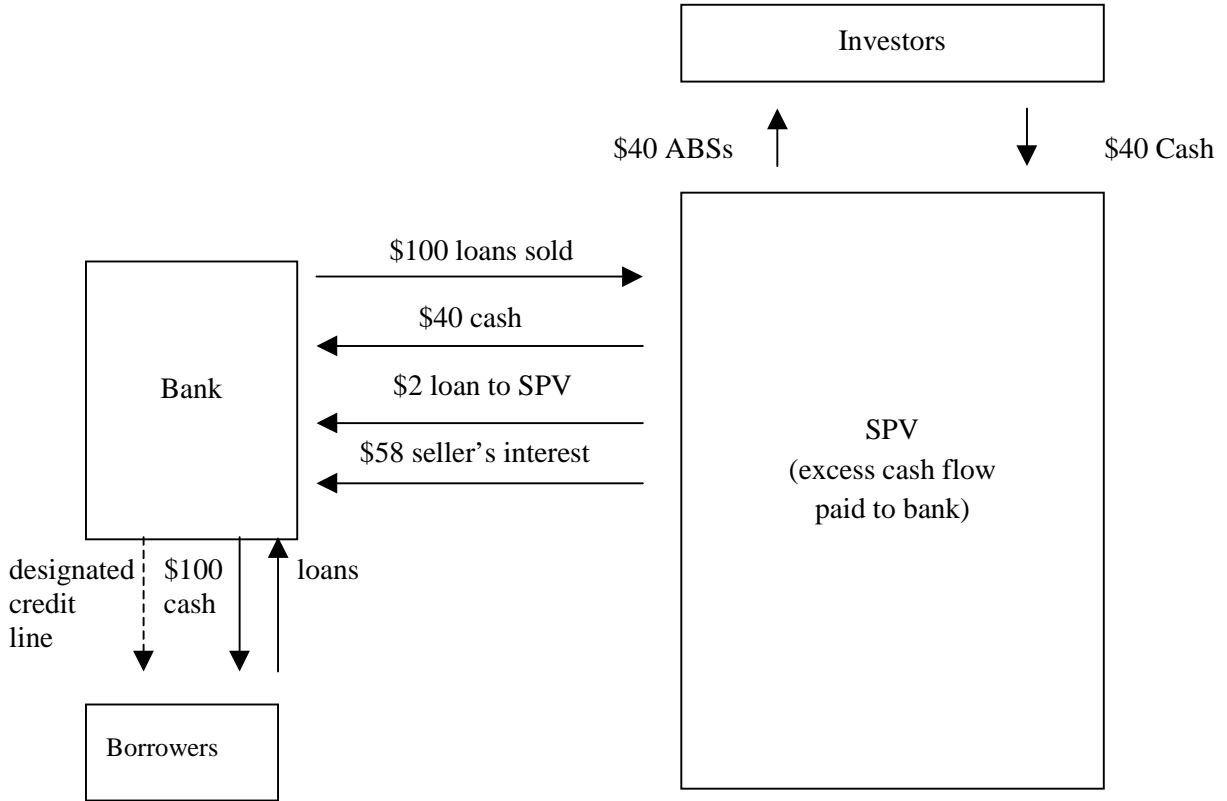
For regulatory capital purposes, the bank’s loan to the SPV would be treated as recourse, and subject to a 100% regulatory capital requirement. Even so, despite transferring little credit risk to the asset backed securities investors, the loan securitisation increases from the base case in exhibit A1 the bank’s Tier 1 and total regulatory capital ratios to 12.8% and 13.9%. In effect, these increases are achieved by “concentrating” the credit risk of the securitised loans into another financial instrument (the subordinated bank loan to the SPV) having a maximum potential credit loss that is much smaller than that associated with the underlying securitised loans - \$2 compared with \$42. Although the subordinated loan is treated as recourse and receives an effective 100% regulatory capital requirement, the bank’s regulatory capital ratios nevertheless increase, provided the amount of *recourse per dollar of securitised assets* is less than 8%. Since the required direct credit enhancement demanded by the rating agencies will tend to be inversely related to the quality of the underlying securitised assets, this example illustrates how the Accord encourages banks to securitise their highest quality assets.

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<sup>44</sup> Typically, the fair value of this excess servicing would be recorded as an asset on the bank’s balance sheet, and would be treated as recourse (subject to a 100% capital charge) for regulatory capital purposes. Since the value of excess servicing tends to be very small in relation to the overall size of securitisation transactions undertaken by major banks, for simplicity the GAAP accounting treatment of excess servicing is ignored in the examples below.

**D. Securitisation of Revolvers with Recourse**

Exhibit A4  
**Securitisation of Revolvers with Recourse**



**SPV**

Loans	100.00	Investors' interest	40.00
		Seller's interest	58.00
		Subordinated bank loan	2.00

**Bank**

Loans	158.00	Deposits	136.00
Loan to SPV	2.00	Equity	22.00
Less Reserves	(2.00)		
Total Assets	158.00		

Total Risk-weighted Assets*	=	172.36
Tier 1 Capital	=	22.00
Total Capital	=	24.00
Tier 1 Risk Based Capital Ratio	=	12.8%
Total Risk Based Capital Ratio	=	13.9%

\* Calculation of total risk-weighted assets applies the low-level recourse rule.

Exhibit A4 illustrates the securitisation of draw-downs under revolving credit facilities (e.g. credit cards or revolving business lines of credit), which are among the fastest growing forms of regulatory

capital arbitrage. In these arrangements, a bank “designates” certain lines of credit to the SPV. All draw-downs under the designated credit lines are required to be “sold” to the SPV. The SPV, in turn, funds these purchases by issuing, in this example, (a) asset backed securities in the amount of \$40 to investors, and (b) a *para passu* seller’s interest (for the residual amount) to the sponsoring bank. Thus, if draw-downs under the designated credit lines equalled \$100, the investors’ interest would amount to a 40% share in these loans. (Under current Generally Accepted Accounting Principles, the \$60 sellers’ interest generally would be reported as “loans” by the sponsoring bank).

Importantly, the seller’s interest is *not* directly subordinated to the investors’ interest. That is, the sponsoring bank is entitled to its *pro rata* shares of principal and interest payments received by the SPV on the underlying loans,<sup>45</sup> and is required to absorb only its *pro rata* share of any credit losses (e.g. charge-offs) on the loan pool. Principal and interest payments on the securitised loans that are not allocated to the sellers’ interest are available to support the SPV’s obligations to the asset backed securities investors. Ordinarily, the investors’ share of principal payments would be reinvested by the SPV in new loans.

Under this structure, the sponsoring bank generally would provide sufficient credit enhancements to obtain investment-grade ratings on the asset backed securities - again implying that little credit risk is actually transferred to the asset backed securities investors. In the exhibit, the bank is assumed to provide two forms of credit enhancement similar to those provided in the preceding example: subordination of the excess servicing to the asset backed securities investors, and a separate \$2 subordinated investment in the SPV, booked as a loan.

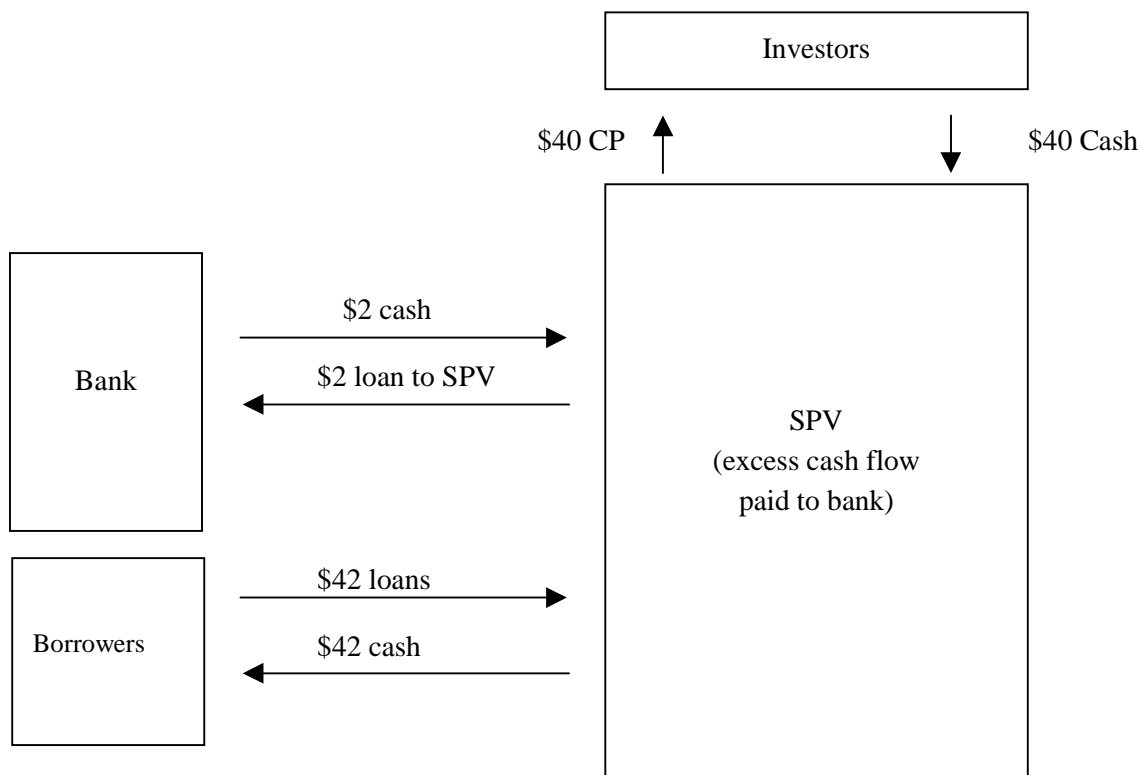
For financial accounting and regulatory capital purposes, the results of this securitisation are similar to the securitisation of term loans discussed above. That is, even though the subordinated loan is treated as recourse and the bank sheds little credit risk, both the bank’s Tier 1 and total regulatory capital ratios increase, provided the amount of *recourse per dollar of securitised assets* is less than 8%.

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<sup>45</sup> If interest payments on the securitised loans allocated to support the investors’ interest (less the investors *pro rata* share of charge-offs) exceeds the amount due on the asset backed securities, this surplus is treated as excess servicing and is returned to the sponsoring bank.

**E. Remote-Origination**

Exhibit A5  
**Remote-Origination Vehicles: Loan-Backed ABCP**



<b>SPV</b>																							
Loans (Originated by SPV)	42.00	CP Subordinated bank loan	40.00 2.00																				
<b>Bank*</b>																							
Loans	158.00	Deposits	136.00																				
Loan to SPV	2.00																						
Less Reserves	(2.00)	Equity	22.00																				
Total Assets	158.00																						
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">Total Risk-weighted Assets*</td> <td style="width: 10%; text-align: right;">= 160.00</td> <td style="width: 40%;"></td> <td style="width: 10%;"></td> </tr> <tr> <td>Tier 1 Capital</td> <td style="text-align: right;">= 22.00</td> <td></td> <td></td> </tr> <tr> <td>Total Capital</td> <td style="text-align: right;">= 24.00</td> <td></td> <td></td> </tr> <tr> <td>Tier 1 Risk Based Capital Ratio</td> <td style="text-align: right;">= 13.8%</td> <td></td> <td></td> </tr> <tr> <td>Total Risk Based Capital Ratio</td> <td style="text-align: right;">= 15.0%</td> <td></td> <td></td> </tr> </table>				Total Risk-weighted Assets*	= 160.00			Tier 1 Capital	= 22.00			Total Capital	= 24.00			Tier 1 Risk Based Capital Ratio	= 13.8%			Total Risk Based Capital Ratio	= 15.0%		
Total Risk-weighted Assets*	= 160.00																						
Tier 1 Capital	= 22.00																						
Total Capital	= 24.00																						
Tier 1 Risk Based Capital Ratio	= 13.8%																						
Total Risk Based Capital Ratio	= 15.0%																						

\* Assumes bank makes \$42 fewer loans directly to borrowers because such loans are extended, instead, by SPV.

More sophisticated methods of regulatory capital arbitrage can reduce the amount of equity capital that is freed up through securitisation programmes. One increasingly common technique involves altering the structure of the programme so that direct credit enhancements provided by the sponsoring bank are treated as direct credit substitutes, rather than recourse, thereby reducing the bank's total regulatory capital requirement from 100% to 8% of the credit enhancement's Maximum Potential Credit Loss. This is achieved by having the SPV, rather than the bank itself, originate the underlying securitised assets (a process termed "remote-origination"). Since the securitised assets will not have been owned or sold by the bank, any credit enhancement provided by the bank to the asset backed securities investors (such as subordinated loan or investment in the SPV) are treated as recourse.

Virtually all asset-backed commercial paper programmes are structured as remote-origination vehicles. Exhibit A5 illustrates the structure of a hypothetical Asset Backed Commercial Paper that invests in loans originated by the SPV. In this example, the direct credit enhancement provided by the bank is again assumed to take the form of a subordinated loan to the SPV. Note that through the remote-origination and securitisation of commercial loans, a sponsoring bank generally can increase its reported capital ratios beyond those achievable by securitising loans from its own balance sheet, even though the overall risk implications for the bank are essentially the same in both cases.

## References

- Aoki, M, H Patrick and P Sheard (1994): "The Japanese Main Bank System: An Introductory Overview," in M Aoki and H Patrick eds. *The Japanese Main Bank System*, New York: Oxford University Press.
- Aggarwal, R and K Jacques (1997:) "A Simultaneous Equations Estimation of the Impact of Prompt Corrective Action on Bank Capital and Risk," in *Financial Services at the Crossroads: Capital Regulation in the 21st Century*, Conference, 26-27 February 1998, Federal Reserve Bank of New York.
- Allen, Linda, Julapa Jagtiani and Yoram Landskroner (1996): "Interest Rate Risk Subsidization in International Capital Standards," *Journal of Economics and Business*, August, pp. 251-67.
- Atle Berg, Sibjorn (1993): "The Banking Crises in the Scandinavian Countries," *Proceedings, 29th Annual Conference on Bank Structure and Competition*, May, pp. 441-449.
- Avery, R B and A N Berger (1991): "An Analysis of Risk-Based Capital and Its Relation to Deposit Insurance Reform," *Journal of Banking and Finance*, 15 September, pp. 847-874.
- Baba, Naohiko (1996): "Empirical Studies on the Recent Decline in Bank Lending Growth," *Institute for Monetary and Economic Studies Discussion Paper 96-E-10*, Bank of Japan.
- Banca Commerciale Italiana (1991): "The Italian Economy: Selected Issues," 13 April.
- Bank of England (1991): "Is There a Credit Crunch?" *Bank of England Quarterly Bulletin*, May.
- Bank of Japan (1991): "Recent Developments in Lending Rates," *Special Paper No. 206*, September.
- Bank of Japan (1998): "Annual Review of Monetary and Economic Developments in Fiscal 1997," *Public Relations Department*, Tokyo, Japan.
- Banque de France (1991): "Les Comptes Financiers du Longement en 1990," *Bulletin Trimestriel*, Third Quarter.
- Berger, Allen N, Anil Kashyap and Joseph Scalise (1995): "The Transformation of the U.S. Banking Industry: What A Strange Trip It's Been," *Brookings Papers on Economic Activity*, 2, pp. 55-218.
- Berger, Allen N and Gregory Udell (1992): "Some Evidence on the Empirical Significance of Credit Rationing," *Journal of Political Economy*, 100, pp. 1047-1077.
- Berger, Allen N and Gregory Udell (1993): "Securitisation, Risk, and the Liquidity Problem in Banking," in M Klausner and L White (eds.) *Structural Change in Banking (Business One Irwin)*, pp. 227-308.
- Berger, Allen N and Gregory Udell (1994): "Did Risk-Based Capital Allocate Bank Credit and Cause a "Credit Crunch" in the United States?" *Journal of Money, Credit, and Banking*, 26, pp. 585-628.
- Berkovec, J A and J Nellie Liang (1991): "Changes in the Cost of Equity Capital for Bank Holding Companies and the Effects on Raising Capital," *Finance and Economics Discussion Series No. 160*, Board of Governors of the Federal Reserve System (June).
- Bernanke, Ben S (1983): "Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review*, 73, pp. 257-276.
- Bernanke, Ben S and Alan S Blinder (1988): "Is it Money or Credit, or Both, or Neither?" *American Economic Association Papers and Proceedings*, 78, pp. 435-439.
- Bernanke, Ben S and Alan S Blinder (1992): "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, 82, pp. 901-21.

- Bernanke, Ben S and Cara S Lown (1991): "The Credit Crunch," *Brookings Papers on Economic Activity*, 2, pp. 205-239.
- Besanko, David and George Kanatas (1996): "The Regulation of Bank Capital: Do Capital Standards Promote Bank Safety?" *Journal of Financial Intermediation*, 5, pp. 160-183.
- Blinder, Alan S (1987): "Credit Rationing and Effective Supply Failures," *Economic Journal*, 97, pp. 327-352.
- Blinder, Alan S and Joseph E Stiglitz (1983): "Money, Credit Constraints and Economic Activity," *American Economic Review, Papers and Proceedings*, 73, pp. 297-302.
- Blum, Jürg and Martin Hellwig (1995): "The Macroeconomic Implications of Capital Adequacy Requirements for Banks," *European Economic Review*, 39, pp. 739-749.
- Blundell-Wignall A, Frank Browne and P Manasse (1990): "Monetary Policy in the Wake of Financial Liberalization," *OECD Working Paper No. 77*, April.
- Boyd, John H and Mark Gertler (1993): "U.S. Commercial Banking: Trends, Cycles and Policy," in *NBER Macroeconomics Annual*, pp. 319-68.
- Boyd, John H and Mark Gertler (1994): "Are Banks Dead? Or Are the Reports Greatly Exaggerated?" *Federal Reserve Bank of Minneapolis Quarterly Review (Summer)*, pp. 2-23.
- Brunner, Allan D and Steve B Kamin (1996): "Determinants of the 1991-1993 Japanese Recession: Evidence from a Structural Model of the Japanese Economy," *Japan and the World Economy*, 8, pp. 363-399.
- Brunner, Allan D and Steve B Kamin (1998): "Bank Lending and Economic Activity in Japan: Did "Financial Factors" Contribute to the Recent Downturn?" *International Journal of Finance and Economics*, 3, pp. 73-89.
- Carbo, Santiago (1994): "The Impact of Regulation on Bank Capital Augmentation in Spain," *Institute of European Finance Working Paper*, 94/1.
- Carey, Mark (1995): "Are Bank Loans Mispriced?" mimeo, *Board of Governors of the Federal Reserve System*, 21 March.
- Chhikara, R K and S D Hanson (1993): "Competitive Pricing of Farmer Mac's Mortgage-Backed Securities and Its Future Viability: A Contingent Claims Analysis Approach," *Review of Agricultural Economics*, 15, No. 3, pp. 547-566.
- Cooper, Kerry, James Kolari and John Wagster (1991): "A Note on the Stock Market Effects of the Adoption of Risk-based Capital Requirements on International Banks in Different Countries," *Journal of Banking and Finance*, 15, pp. 367-381.
- Cornett, Marcia Millon and Hassan Tehranian (1994): "An Examination of Voluntary versus Involuntary Security Issuance By Commercial Banks," *Journal of Financial Economics*, 35, pp. 99-122.
- Cumming, C (1987): "The Economics of Securitisation," *Federal Reserve Bank of New York Quarterly Review*, pp. 11-23 .
- Dahl, D and M F Spivey (1995): "Prompt Corrective Action and Bank Efforts to Recover from Undercapitalisation," *Journal of Banking and Finance*, 19, pp 225-243.
- Dahl, D and R E Shrieves (1990): "The Impact of Regulation on Bank Equity Infusions," *Journal of Banking and Finance*, 14, pp. 1209-28.
- Diamond, Douglas (1984): "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51, pp. 393-414.
- Dietrich, J K and C James (1983): "Regulation and the Determination of Bank Capital Changes," *Journal of Finance*, 38, pp. 1651-1658.

- Donahoo, K K and S Shaffer (1991): "Capital Requirements and the Securitisation Decision," *Quarterly Review of Economics and Business*, 31, pp. 12-23.
- Economic Planning Agency (1998): "White Paper on Japanese Economy: 1997-1998," *Ministry of Finance Printing Bureau*, December.
- Ediz, S, I Michael and W Perraudin (1998): "Bank Capital Dynamics and Regulatory Policy," *Bank of England*.
- Edwards, Franklin R and Frederic S Mishkin (1995): "The Decline of Traditional Banking: Implications for Financial Stability and Regulatory Policy," *Federal Bank of New York Economic Policy Review*, July, pp. 27-45.
- Eyssell, Thomas and Nasser Arshadi (1990): "The Wealth Effects of the Risk-based Capital Requirement in Banking: The Evidence from the Capital Markets," *Journal of Banking and Finance*, 14, pp. 179-197.
- Fama, Eugene (1985): "What's Different About Banks?" *Journal of Monetary Economics*, 6, pp. 39-57.
- Federal Reserve System Task Force on Internal Credit Risk Models: "Credit Risk Models at Major U.S. Banking Institutions: Current State of the Art and Implications for Assessments of Capital Adequacy," *Board of Governors of the Federal Reserve System* (May 1998).
- Friedman, Benjamin (1980): "Postwar Changes in the American Markets," in *The American Economy in Transition*, edited by Martin Feldstein, Chicago: *University of Chicago Press*, pp. 9-78.
- Friedman, Benjamin (1982): "Debt and Economic Activity in the United States," in *The Changing Roles of Debt and Equity in Financing U.S. Capital Formation*, edited by Benjamin Friedman, Chicago: *University of Chicago Press*, pp. 91-110.
- Friedman, Benjamin and Kenneth N Kuttner (1992): "Money, Income, Prices, and Interest Rates," *American Economic Review*, 82, pp. 472-492.
- Friedman, Benjamin and Kenneth N Kuttner (1993): "Economic Activity and the Short-term Credit Markets: An Analysis of Prices and Quantities," *Brookings Papers on Economic Activity*, 2, pp. 193-283.
- Furlong, F (1988): "Changes in Bank Risk-Taking," *Federal Reserve Bank of San Francisco Economic Review*.
- Furlong, F and M C Keeley (1989): "A Re-examination of Mean Variance Analysis of Bank Capital Regulation: A Note," *Journal of Banking and Finance*, 13, p. 883-91.
- Gertler, Mark and Simon Gilchrist (1993): "The Role of Credit Imperfections in the Monetary Transmission mechanism: Arguments and Evidence," *Scandinavian Journal of Economics*, 95, pp. 43-64.
- Gibson, Michael S (1993): "Long-term Banking Relationships in General Equilibrium," *International Finance Discussion Paper No 452*, Board of Governors of the Federal Reserve System.
- Gibson, Michael S (1995): "Can Bank Health Affect Investment? Evidence from Japan," *Journal of Business*, 68, pp. 281-308.
- Gibson, Michael S (1997): "More Evidence on the Link Between Bank Health and Investment in Japan," *Journal of the Japanese and International Economies*, 11, pp. 296-310.
- Giddy, Ian (1985): "Regulation of Off-Balance Sheet Banking," in *The Search for Financial Stability: The Past Fifty Years*, Federal Reserve Bank of San Francisco, pp. 165-177.
- Goldfeld, Steven M (1966): *Commercial Bank Behaviour and Economic Activity: A Structural Study of Monetary Policy in the Postwar United States*, Amsterdam: North Holland.
- Hall, B (1993): "How Has the Basle Accord Affected Bank Portfolios?" *Journal of the Japanese and International Economies*, 7, pp. 8-440.

- Hancock, Diana, Andrew J Laing and James A Wilcox (1995): "Bank Capital Shocks: Dynamic Effects on Securities, Loans, and Capital," *Journal of Banking and Finance*, 19, pp. 661-677.
- Hancock, Diana and James A Wilcox (1997): "Bank capital, Non-bank Finance, and Real Estate Activity," *Journal of Housing Research*, 8, pp. 75-105.
- Hancock, Diana and James A Wilcox (1998): "The "Credit Crunch" and the Availability of Credit to Small Business," *Journal of Banking and Finance*, forthcoming.
- Hancock, D and J A Wilcox (1994): "Bank Capital, Loan Delinquencies, and Real Estate Lending," *Journal of Housing Economics*, 3, pp. 121-146.
- Hancock, D and J A Wilcox (1994): "Bank Capital and the Credit Crunch: The Roles of Risk-Weighted and Unweighted Capital Regulation," *Journal of the American Real Estate and Urban Economics Association*, 22, pp. 59-94.
- Haubrich, J and P Wachtel (1993): "Capital Requirements and Shifts in Commercial Bank Portfolios," *Federal Reserve Bank of Cleveland Economic Review*, 29, pp. 2-15.
- Horiuchi, Akiyoshi and Shimizu, Katsutoshi (1996): "The Deterioration of Banks' Balance Sheets in Japan: Risk-Taking and Recapitalization," *University of Tokyo Discussion Paper*, 96-F-13.
- Hoshi, T, Anil Kashyap and D Scharfstein (1991): "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups," *Quarterly Journal of Economics*, 106, pp. 33-60.
- Ingves, Stefan and Goran Lind (1997): "Loan Loss Recoveries and Debt Resolution Agencies - The Swedish Experience," in *Banking Soundness and Monetary Policy*, edited by Charles Enoch and John H Green, International Monetary Fund, Washington, DC.
- International Swap Dealers Association (1998): *Credit Risk and Economic Capital* (March).
- Ito, Takatoshi and Yuri Nagataki Sasaki (1998): "Impacts of the Basle Capital Standard on Japanese Banks' Behaviour," *Discussion Paper Series A No 356*, The Institute of Economic Research, Hitotsubashi University, Tokyo, Japan.
- Jacques, K T and P Nigro (1997): "Risk-Based Capital, Portfolio Risk and Bank Capital: A Simultaneous Equations Approach," *Journal of Economics and Business*, 49, pp. 533-547.
- Jaffee, Dwight M (1971) *Credit Rationing and the Commercial Loan Market*, New York: Wiley.
- Jagtiani, Julapa and Anya Khanthavit (1996): "Scale and Scope Economies at Large Banks: Including Off-balance Sheet Products and Regulatory Effects," *Journal of Banking and Finance*, 20, pp. 1271-1287.
- Jagtiani, J, A Saunders and G Udell (1995): "The Effect of Bank Capital Requirements on Bank Off-Balance Sheet Financial Innovations," *Journal of Banking and Finance*, 19, pp. 647-658.
- James, Christopher (1987): "Some Evidence on the Uniqueness of Bank Loans," *Journal of Financial Economics*, 19, pp 217-235.
- James, Christopher (1988): "The Use of Loan Sales and Standby Letters of Credit by Commercial Banks," *Journal of Monetary Economics*, 22, pp. 395-422.
- Kashyap, Anil K, Jeremy C Stein and David W Wilcox (1991): "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance," *Board of Governors of the Federal Reserve System*, March.
- Kaufman, George G and Larry R Mote (1994): "Is Banking a Declining Industry? A Historical Perspective," *Federal Reserve Bank of Chicago Economic Perspectives*, May/June, pp. 2-21.
- Keeley, M C (1988): "Bank Capital Regulation in the 1980s: Effective or Ineffective?" *Federal Reserve Bank of San Francisco Economic Review*, Winter.
- Keeton, W R (1988): "Substitutes and Compliments in Bank-Risk-Taking and the Effectiveness of Regulation," *Federal Reserve Bank of Kansas City*, December, pp. 1-44.

- Kim, Sun Bae and Ramon Moreno (1994): "Stock Prices and Bank Lending Behaviour in Japan," *Federal Reserve Bank of San Francisco Economic Review*, 1, pp. 31-42.
- Kim, D and A M Santomero (1988): "Risk in Banking and Capital Regulation," *Journal of Finance*, 43, p. 1219-33.
- King, S (1986): "Monetary Transmission: Through Bank Loans or Bank Liabilities?" *Journal of Money, Credit, and Banking*, 18, pp. 290-303.
- Koehn, M and A M Santomero (1980): "Regulation of Bank Capital and Portfolio Risk," *Journal of Finance*, 35, p. 1235-50.
- Koppenhaver, G D (1989): "The Effects of Regulation on Bank Participation in the Guarantee Market," in G Kaufman (ed.), *Research in Financial Services: Private and Public Policy*, 1, pp. 165-180.
- Laderman, Elizabeth S (1994): "Wealth Effects of Bank Holding Company Securities Issuance and Loan Growth under the Risk-based Capital Requirements," *Federal Reserve Bank of San Francisco Economic Review*, 2, pp. 30-41.
- Lind, Göran and Anna-Karin Nedersjö (1994): "The Banking Sector in 1993," *Sveriges Riksbank Quarterly Review*, 2, pp. 24-35.
- Litterman, Robert and Laurence Weiss (1985): "Money, Real Interest Rates, and Output: A Reinterpretation of Postwar U.S. Data," *Econometrica*, 53, pp. 129-156.
- Mayer, Colin (1988): "New Issues in Corporate Finance," *European Economic Review*, 32, pp. 1167-1183.
- Madura, Jeff and Emillio R Zarruk (1993): "Market Reaction to Uniform Capital Adequacy Guidelines in the Banking Industry," *Journal of Economics and Finance*, Spring, pp. 59-72.
- Merton, R C (1995): "Financial Innovation and the Management and Regulation of Financial Institutions," *Journal of Banking & Finance*, 19, pp. 461-481.
- Mingo, J (1975): "Regulatory Influence on Bank Capital Investment," *Journal of Finance*, 30, pp. 1111-1121.
- Miyagawa, Tsutomu (1997): "Financial Fragility and Investment Behaviour in Japan," *Financial Review*, 42, June, Ministry of Finance, Japan. [English summary available, paper in Japanese only].
- Morgan, D P (1998): "The Credit Effects of Monetary Policy : Evidence Using Loan Commitments," *Journal of Money, Credit, and Banking*, 26, pp. 87-101.
- Moore, Robert (1987): "Three Essays on Asymmetric Information and Financial Contracting, Ph.D. Dissertation," University of Wisconsin.
- O'Brien, Paul Francis and Frank Browne (1992): "A "Credit Crunch?" The Recent Slowdown in Bank Lending and its Implications for Monetary Policy," *Economics and Statistics Department Working Papers No 107*, Organisation for Economic Co-operation and Development, Paris.
- Oliner, Stephen D and Glenn D Rudebusch (1996): "Is There a Broad Credit Channel for Monetary Policy?" *Federal Reserve Bank of San Francisco Economic Review*, 1, pp. 3-13.
- Oliner, Stephen D and Glenn D Rudebusch (1995): "Is There a Bank Lending Channel for Monetary Policy?" *Federal Reserve Bank of San Francisco Economic Review*, 2, pp. 3-20.
- Passmore, W (1992): "Can Retail Depositories Fund Mortgages Profitably?" *Journal of Housing Research*, 3, Issue 2, pp. 305-340.
- Pavel, C A and D Phillis (1987): "Why Commercial Banks Sell Loans: An Empirical Analysis," *Economic Perspectives*, *Federal Reserve Bank of Chicago*.
- Peek, Joe and Eric S Rosengren (1997a): "The International Transmission of Financial Shocks: The Case of Japan," *American Economic Review*, September, pp. 495-505.

- Peek, Joe and Eric S Rosengren (1997b): "Collateral Damage: Effects of the Japanese Real Estate Collapse on Credit Availability and Real Activity in the United States," *Working paper, Federal Reserve Bank of Boston*, August.
- Peek, J and E Rosengren (1995): "Bank Regulation and the Credit Crunch," *Journal of Banking and Finance*, 19, pp. 679-692.
- Peek, J and E Rosengren (1997): "The International Transmission of Financial Shocks: The Case of Japan," *American Economic Review*, 87, pp. 495-505.
- Peltzman, S (1970): "Capital Investment in Commercial Banking and Its Relation to Portfolio Regulation," *Journal of Political Economy*, 78, pp. 1-26.
- Pennacchi, G G (1988): "Loan Sales and the Cost of Bank Capital," *Journal of Finance*, XLIII, No. 2.
- Picer, S and M D Dierdorff (1997): "Understanding Structured Liquidity Facilities in Asset-Backed Commercial Paper Programs," *Asset-Backed Commercial Paper Market Review*, First Quarter, Moody's Investors Service.
- Pettway, Richard H, Takashi Kaneko and Michael Young (1991): "International Bank Capital Standards and the Costs of Issuing Capital Securities by Japanese Banks," *Journal of Banking and Finance*, 15, pp. 559-580.
- Petersen, M A and R G Rajan (1994): "The Benefits of Firm-Creditor Relationships: Evidence From Small Business Data," *Journal of Finance*, 49, pp. 3-37.
- Ramey, Valerie (1993): "How Important is the Credit Channel in the Transmission of Monetary Policy?" *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 1-45.
- Rime, Bertrand (1998): "Capital Requirements and Bank Behaviour: Empirical Evidence for Switzerland," *Swiss National Bank*.
- Rochet, Jean-Charles (1992): "Capital Requirements and the Behaviour of Commercial Banks", *European Economic Review*, 36, pp. 1137-1178.
- Romer, Christina D and David H Romer (1990): "New Evidence on the Monetary Transmission Mechanism," *Brookings Papers on Economic Activity*, 1, pp. 149-198.
- Saarenheimo, T (1995): "Credit Crunch Caused Current Investment Slump? An Empirical Analysis Using Finnish Data," *Bank of Finland Discussion Paper 6/95*.
- Samolyk, K (1994): "Banking Conditions and Regional Economic Performance: Evidence of a Regional Credit Channel," *Journal of Monetary Economics*, 34, pp. 259-278.
- Sheldon, George (1996): "Capital Adequacy Rules and the Risk-Seeking Behavior of Banks: A Firm-Level Analysis," *Swiss Journal of Economics and Statistics*, 132, pp. 709-734.
- Shome, D K, S Smith and A A Heggstad (1986): "Capital Adequacy and the Valuation of Large Commercial Banking Organisations," *Journal of Financial Research*, 9 (Winter), pp. 331-41.
- Shrieves, R E and D Dahl (1992): "The Relationship Between Risk and Capital in Commercial Banks," *Journal of Banking and Finance*, 16, pp. 439-457.
- Sims, Christopher (1980): "Comparison of Interwar and Postwar Business Cycles: Monetarism Reconsidered," *American Economic Review*, 70, pp. 250-257.
- Slovin, M B and Marie E Sushka (1983): "A Model of the Commercial Loan Rate," *Journal of Finance*, 38, pp. 1583-1596.
- Slovin, M B, M E Sushka and J A Polonchek (1993): "The Value of Bank Durability: Borrowers as Bank Stakeholders," *Journal of Finance*, 48, pp. 247-266.
- Sofianos, George, Paul A Wachtel and Arie Melnik (1990): "Loan Commitments and Monetary Policy," *Journal of Banking and Finance*, 14, pp. 677-689.

- Solttila, H and V Vihriälä (1992): "Banks' Capital Adequacy and Supply of Credit" (in Finnish), Bank of Finland, *Discussion Paper 28/92*.
- Stiglitz, Joseph and Andrew Weiss (1981): "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71, pp. 393-410.
- Swindle, C Sloane (1995): "Using CAMEL Ratings to Evaluate Regulator Effectiveness at Commercial Banks," *Journal of Financial Services Research*, 9, pp. 123-141.
- Thakor, Anjan V (1996): "Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence," *Journal of Finance*, 51, pp. 279-324.
- Thakor, Anjan V and Patricia Furlong Wilson (1995): "Capital Requirements, Loan Renegotiation and the Borrower's Choice of Financing," *Journal of Banking and Finance*, 19, pp. 693-711.
- Vihriälä, Vesa (1997): "Banks and the Finnish Credit Cycle 1986-1995," *Bank of Finland Studies E7*, Bank of Finland, Helsinki.
- Wagster, John D (1996): "Impact of the 1988 Basle Accord on International Banks," *Journal of Finance*, 51, pp. 1321-1346.
- Wall, L D and D R Peterson (1995): "Bank Holding Company Capital Targets in the early 1990s: The Regulators versus the Markets," *Journal of Banking and Finance*, 19, pp. 563-74.
- Wall, L D and D R Peterson (1987): "The Effect of Capital Adequacy Guidelines on large Bank Holding Companies," *Journal of Banking and Finance*, 11, pp. 581-600.
- Williamson, Stephen D (1986): "Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing," *Journal of Monetary Economics*, 18, pp. 159-179.
- Zimmer, S A and R N McCauley (1991): "Bank Cost of Capital and International Competition," *Federal Reserve Bank of New York Quarterly Review*, Winter, pp. 33-59.39

