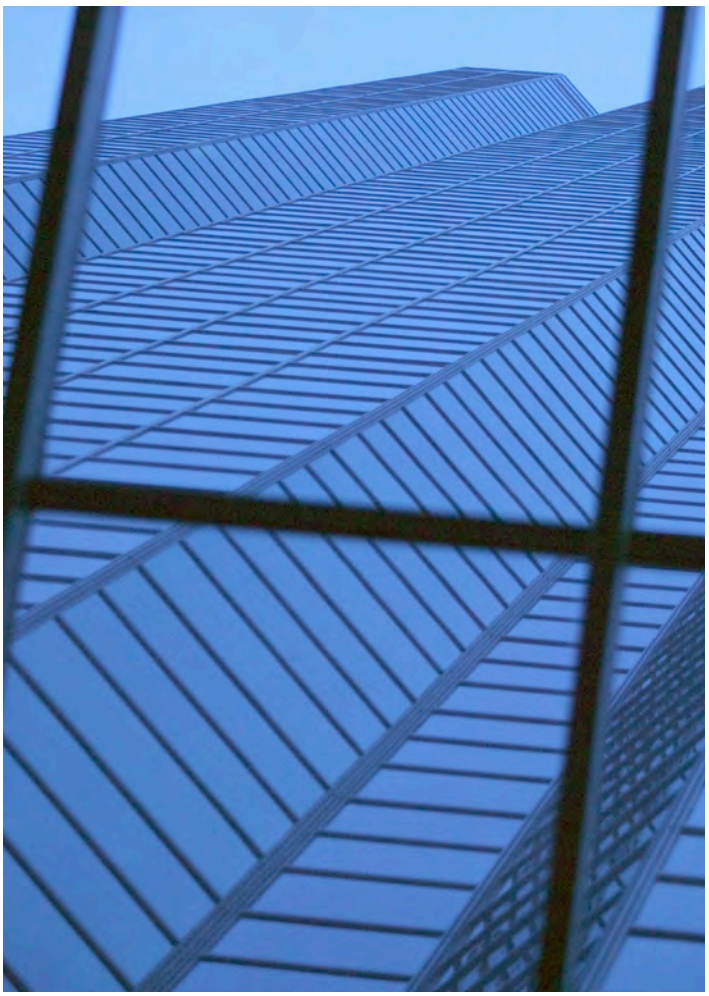
SVERIGES RIKSBANK

Appropriate capital ratio in major Swedish banks

– an economic analysis



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Appropriate capital ratio in major Swedish banks – *an economic analysis*

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Preface

The problems on the US housing market in 2007 set off a chain of events that during 2008-2009 led to the deepest economic recession that the world has seen since the end of World War II. Only extraordinary measures on the part of authorities and taxpayers made it possible to avoid a total economic collapse. At the time of writing, the repercussions of the financial crisis are still very much in evidence. This is the case not least in the EU, where in several countries the financial crisis has now become a political and public-finance crisis of a magnitude that seemed inconceivable only a few years ago.

In response to this crisis, far-reaching work is now underway throughout the world in order to strengthen the financial system. One thing that the crisis has taught us is that the banks need more capital to strengthen their ability to cope with losses and reduce the risk of a crisis at one bank spreading to other banks. This would strengthen the resilience of the entire financial system to new crises. This raises the important question of how much capital the banks need. From society's point of view this need is probably greater than from the point of view of an individual bank. How much capital the banks need also varies from country to country, as the banking systems and the risks they face are different. There is a substantial amount of research on how much capital is optimal for a bank from the point of view of the bank, its owners and creditors. However, there is not as much research on what capital ratios are appropriate from society's point of view. A number of international studies have been carried out in recent years, but none of these has aimed to analyse the prevailing conditions in the Swedish banking sector.

Against this background, staff at the Riksbank have conducted this study, in which the social benefits of higher capital ratios at the banks are weighed against the social costs, with the aim of determining a socially-appropriate capital ratio for the Swedish banks. Although there is a significant degree of uncertainty in the calculations, they nevertheless indicate that the socially-appropriate level is higher than the minimum requirements stipulated in the new regulatory framework for banks (Basel III).

The working group has been managed by Elias Bengtsson, who has conducted the study together with Magnus Jonsson, Kristian Jönsson, Hovick Shahnazarian, Jonas Söderberg and Per Åsberg-Sommar.[1] The working group has operated under the leadership of a steering committee consisting of Martin W Johansson, Jonas Niemeyer, Kasper Roszbach, Olof Sandstedt and Ulf Söderström. The steering committee was chaired by Mattias Persson. The editor was Johanna Fager Wettergren.

Mattias Persson
Head of the Financial Stability Department

1 The opinions expressed in this report are those of the authors and are not necessarily shared by the Riksbank or the Executive Board of the Riksbank. The authors would particularly like to thank Malin Alpen, Anders Bjällskog, Johanna Eklund, Johan Fogel, Susanna Grufman, Hannes Janzén, Emelie Mannefred, Per Mattsson, Kerstin Mitlid, Vanessa Sternbeck-Fryxell, Annika Svensson, David Vestin, Staffan Viotti and Karl Walentin for their views and assistance in various ways.

Summary

In the wake of the recent financial crisis, a widespread discussion has arisen as to how much capital banks need to hold to better withstand financial difficulties. With this in mind the Riksbank has studied the balance between the long-term benefits and costs to society of more capital in the banks. The results are presented in this report and indicate that, from a social perspective, the capital adequacy requirements in the Basel III Accord are too low for the Swedish banks.

Three years ago the global financial crisis hit at full force with extensive consequences for the global economy. One important reason why the consequences were so serious was that the banks had too little capital of sufficient loss absorbing capacity. The banks were thus ill-equipped to meet the unforeseen sequence of events that took place.

Extensive work is now in progress around the world to create a more stable financial system. An important part of this work is to tighten the requirements on how much "high quality capital" (common equity Tier 1 capital) the banks should hold.[2] It is clear that the capital requirements have until now been too lenient. In the future, higher capital levels in the banks should therefore reduce the probability of banking crises arising.[3]

HOW MUCH CAPITAL SHOULD THE BANKS HOLD?

How much capital should the banks hold? What is an appropriate level? The appropriate capital ratio from society's perspective is probably higher than that from the individual' bank's perspective. Since the bank's objective is to maximize returns for its shareholders, they endeavour to reduce their cost of capital. This is typically achived by relying on high level of debt-financing. From society's perspective the arguments are rather different. The banks supply a number of socially important functions, that may be disrupted if a bank runs into trouble. Such disruptions may have considerable consequences for society, both economic and social. This means that if banks hold higher levels of capital, society reaps benefits in the shape of reduced risk of negative social consequences. At the same time, there is an upper limit; if the banks hold too much capital, society faces costs

2 Common equity Tier 1 capital is defined in the capital adequacy regulations and covers (put simply) equity capital with some deductions, such as goodwill.

3 Capital level refers to a bank's amount of capital in relation to its risk-weighted assets expressed in per cent. Risk-weighted means that the value of each asset is adjusted on the basis of its inherent risk in accordance with the applicable capital adequacy regulations. A capital ratio of 14 per cent, for example, means that the bank's capital is equivalent to 14 per cent of the bank's risk-weighted assets.

in the form of reduced credit intermediation. The benefits of banks holding more capital needs to be weighed against the cost.

THE SWEDISH BANKING SYSTEM ENTAILS SPECIFIC RISKS

Since banking systems and their associated risks are different, the appropriate capital ratio for banks varies from country to country. The Swedish banks are large in relation to the size of the Swedish economy. This means that the potential consequences of a banking crisis are greater in Sweden than in countries with a smaller banking sector. Moreover, Swedish banks have extensive operations abroad, which is essentially positive. However, it also makes it more difficult to manage a bank in distress, as this involves more authorities and different legal frameworks.

In addition, the Swedish banks rely on foreign funding to a greater extent than comparable banks abroad. This means that the Swedish banks are vulnerable; unexpected negative events in the international financial markets can entail substantial problems for them. Another risk for Sweden is that the banking system is highly concentrated. A few major banks, Handelsbanken, Nordea, SEB and Swedbank, dominate the Swedish market and these banks regularly lend large amounts to one another. This means that problems in one bank could rapidly spread to the others.

THE RIKSBANK'S CALCULATIONS INDICATE THAN AN APPROPRIATE CAPITAL RATIO FOR THE SWEDISH BANKS IS 10-17 PER CENT

This report uses several different approaches to calculate the capital ratio for Swedish banks that is most appropriate from society's perspective, where the benefits of higher capital ratios are weighed against the cost. The calculations are based on methods and models in the relevant literature, that have been adjusted to Swedish conditions as far as possible.

However, estimating appropriate capital ratios is very complex and requires a number of assumptions regarding the advantages and disadvantages of higher capital ratios. Rather than resulting in a single figure, the calculations indicate that the socially-appropriate capital ratio for the Swedish banks is somewhere in the interval of 10 to 17 per cent of risk-weighted assets.[4]

Moreover, there are a number of aspects that are not captured in the calculations, and which point to the interval being probably slightly higher than indicated by the studies in this report. For example, no consideration has been given to the fact that authorities tend to prevent or alleviate the effects of a

4 The interval refers to the capital ratio in terms of Common Equity Tier 1 (CET1) in relation to risk weighted assets in accordance with the definitions in the Basel III rules.

banking crisis by means of various types of rescue action, which often entail significant costs for society. The most recent global financial crisis is only partly included when estimating the effects ofa crisis, which means that the benefits of avoiding a financial crisis are probably underestimated.

One conclusion is that the higher capital adequacy requirements of the international Basel III Accord appear too low for the Swedish banks.[5] According to Basel III, the lowest permitted capital ratio is seven per cent of risk-weighted assets. This is much lower than the 10 to 17 per cent concluded from the calculations in this report.

5 The financial crisis has shown that the current regulations for the banks, which are based on the Basel II Accord, do not adequately capture the risks for the banks. The Basel Committee has therefore drawn up a new standard for bank regulations, the Basel III Accord. The overall purpose of Basel III is to strengthen the banks' ability to withstand losses and reduce the probability of new financial crises. Basel III will mean that the banks will have to hold more capital of better quality and that entirely new requirements will be imposed regarding the banks' liquidity. The different parts of Basel III will be introduced gradually over the coming years, starting in 2013.

1 Introduction

During the global financial crisis in 2007-2009 it became clear that many banks had too little capital to be able to manage the serious crisis that had arisen. The banks were not able to sufficiently absorb the losses that arose and in this way ensure the market had confidence in them. The authorities had to undertake substantial rescue efforts to restore stability to the financial system and avoid detrimental consequences for the real economy. The crisis made clear that the regulations regarding the banks' capital substantially underestimated the amount of capital the banks need to be able to manage this type of problem. Extensive reforms have thus been initiated to get to grips with the deficiencies in the regulations.[6] This work focuses mainly on the question of how much capital the banks need to hold to be able to manage unexpected losses without the authorities needing to intervene to provide various types of financial support.

A number of international analyses have been made regarding a socially-appropriate capital ratio for the banks. However, these do not aim to analyse the conditions prevailing in the Swedish banking sector. There is thus a need to make calculations that are adapted to Swedish circumstances to ascertain what can be considered appropriate ratios for the Swedish banks.

The question of what is an appropriate capital ratio is complex and requires a number of aspects to be taken into consideration regarding the advantages and disadvantages of different capital ratios. To minimize the risk of the analysis being misleading, the Riksbank has made a number of calculations that complement one another as they are based on different methods and use different approaches and assumptions. Together the calculations indicate that the socially-appropriate capital ratio for Swedish banks is in the interval of 10 to 17 per cent of the banks' risk-weighted assets according to the definitions in Basel III ($CET1/RWA^{Basel\ III}$).[7]

The report is divided into three chapters. Chapter 1 discusses the socially valuable function of the banks' capital. It also contains a discussion of the social benefits and costs that arise when banks maintain different capital ratios. Chapter 2 reports the outcome of a number of calculations that estimate the social benefit and cost of higher capital ratios. Chapter 3 contains a discussion of the results of these calculations and some conclusions.

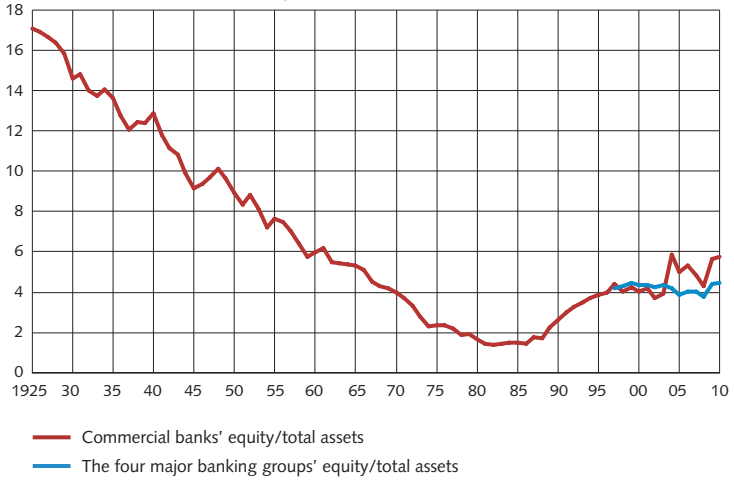
6 The ongoing reform work mainly concerns the Basel III Accord. For more details, see the article on Basel III in Sveriges Riksbank (2010a).

7 The result refers to the capital ratio in terms of Common Equity Tier 1 (CET1) in relation to risk-weighted assets in accordance with the definitions in the Basel III Accord. In this report the terms *capital ratios* and *capital adequacy* refer to the size of the banks' capital in relation to risk-weighted assets. However, the definitions of capital and risk-weighted assets vary. See also Section 1.2 and Appendix A for an in-depth discussion of definitions of capital.

1.1 Significance of capital in Swedish banks

In slightly simplified terms the concept of capital in a bank can be equated with equity capital, which includes nominal share capital and profits that have not been distributed to shareholders.[8] The percentage of the banks' assets funded by capital has declined over most of the twentieth century. Instead, an increasingly large percentage of assets has been funded by debt instruments and deposits (see Chart 1).

Chart 1. Swedish commercial banks' capital in relation to total assets 1925-2010 and the four major Swedish banking groups' capital in relation to total assets 1997-2010 (per cent)



Note. Commercial banks here refers to all Swedish banks except savings banks and cooperative banks. The data on the banks' capital and assets at group level refer to the four major Swedish banking groups' total capital and assets in Sweden and in foreign subsidiaries.

At present, around 6 per cent of the Swedish banks' total assets are capital-funded. The percentage is even lower if one only looks at the four major banking groups, where the corresponding figure is around 4 per cent. This distinguishes the banks from Swedish companies in other sectors, where capital often corresponds to at least 25 per cent of the assets.[9]

The following section contains a discussion of different explanations for the banks having allowed their capital ratios to decline. This is followed by an analysis of the social significance of the banks' capital ratios. Finally, a number of circumstances are discussed which indicate that Swedish banks choose capital ratios that are lower than the most appropriate ratios from a social perspective.

8 See Appendix A for the different definitions of capital and capital ratio used in this report.
9 Statistics Sweden (2011) Structural Business Statistics.

There are several explanations why the banks choose other sources of funding and why the percentage of capital-funded assets has thus gradually declined. The overall explanation is that the banks endeavour to minimise their total cost of capital and thus maximise shareholders' returns.[10]

It is often less costly for a bank to fund its operations through loans instead of capital. One reason for this is that lenders are given priority over shareholders in the event of a bankruptcy. Lenders thus demand less compensation for their risk-taking than shareholders, which makes the loans cheaper. Moreover, debt-financing is tax-subsidised since the banks can use pre-tax profits to pay interest expenses. In other words, the bank has an incentive to obtain a relatively large portion of its funding through loans.

But at the same time, too much debt-financing can lead to a higher total cost of capital. Having a large share of funding through loans means by definition that the share of capital is low. This in turn restricts the bank's buffer against losses and increases the risk of bankruptcy. Neither debtors nor shareholders accept such an increase in risk without compensation – debtors require higher interest and shareholders higher yields.

This raises the question of how the banks have been able to reduce the capital-funded share of their assets without being penalised by the lenders. One explanation is that the banks' bankruptcy risk in general has declined. This is because the banks have become better at managing risk, for instance by better risk diversification and by using various risk-management tools.

Another explanation is that governments and authorities to an increasing extent have issued different kinds of state guarantees to prevent banks from defaulting. One example is the deposit guarantee provided by the state that guarantees the money deposited in accounts in banks and other financial institutions up to a certain limit.[11] Other examples include the measures taken by the Swedish

10 Total cost of capital refers to the combined cost of the banks' funding, that is both the cost of equity capital and cost of debt-funding. For a discussion of the banks' and their shareholders' view of the preferred capital ratio, see for example Berger et al. (1995).

11 A differentiation is usually made between implicit and explicit state guarantees. The latter comprise pre-determined protective mechanisms that are often statutory. One example is the deposit guarantee that implies that up to a limit the government guarantees the money deposited in accounts in banks and other financial institutions. The Swedish stability fund, which is to be used to finance the management of financial crises, is another. However, the authorities can to some extent prevent these explicit state guarantees from having an impact on the calculations of market agents. For example, the authorities can link the guarantees to risk-adjusted charges and taxes. The Swedish deposit guarantee system, for example, is funded by affiliated credit institutions through partly risk-adjusted charges. On the other hand the charges made by Swedish banks to finance the Swedish stability fund are not risk-adjusted.

Government and the Riksbank during both the Swedish banking crisis at the beginning of the 1990s and the global financial crisis in 2007-2009.[12]

As state guarantees reduce the risk of banks defaulting, the consequence is that lenders and other counterparties to the bank require less compensation when lending money to them or doing business with them. In this way, debt-financing can be said to be subsidised by the state. The fact that governments and authorities have time and time again showed a willingness to save banks in distress has also meant that the banks have been able to reduce their capital ratios without being penalised by lenders and other counterparties.[13]

1.2 The function of the banks and the role of capital in society

EXTERNAL EFFECTS OF BANKING OPERATIONS JUSTIFY SPECIAL REGULATION

The reason why authorities and governments tend to save banks in distress, despite the large associated costs, is the role that they play in the financial system and the economy as a whole. Functioning banks are necessary to maintain the three basic functions of the financial system – to mediate payments, to convert savings to investments and to manage risk. All these functions are central to the functioning and growth of the economy.[14]

When one bank experiences problems, there can be severe disruptions to these functions, which can ultimately have major consequences for the economy as a whole.[15] For example, a financial crisis can mean that the supply of credit declines substantially. This in turn reduces the companies' opportunities to invest, which slows down economic growth. Another example of potentially large consequences for the economy is if there is a major disruption in the financial system's central function for the efficient mediation of payments. A factor that makes things more difficult is that banks are often closely linked.[16] This in turn leads to problems in one bank easily spreading to other banks.

12 See for example Ingves and Lind (1996) for a discussion of rescue measures during the crisis of the 1990s, and Sveriges Riksbank (2011b) for an account of the Riksbank's support measures during the global financial crisis of 2007-2009.

13 The market agents' expectations that state guarantees reduce negative outcome are reflected, for example, in the credit rating agencies' support ratings. In such support ratings, most banks are given a better credit rating since expectations of state guarantees are taken into account.

14 For a discussion, see Sveriges Riksbank (2010b).

15 Here a banking crisis refers to a situation where banks are no longer able to fulfil their central economic functions. For example, a bank failure often causes a banking crisis, but a banking crisis can arise without any bank actually failing. For a discussion, see for example Reinhart and Rogoff (2009) and Brunnermeier (2009).

16 The connections between banks can be either direct or indirect. Direct connections arise for example through one bank funding another bank's lending or acting as a counterparty in a financial transaction. Indirect connections can arise through banks having similar exposures and thus being exposed to similar risks, or that market agents decide not to differentiate between banks but instead base their assessments of individual banks on the situation for the banking sector as a whole.

Apart from considerable effects for the economy, there will also be social consequences, which are often difficult to quantify. For example, banking crises not infrequently cause personal tragedies – workers lose their jobs, individuals become insolvent and are forced to leave their homes etc. On top of this comes the risk of increased social antagonism as a consequence.[17]

Given the major problems that can arise if a bank fails, there is a special regulatory system for banks. Its purpose is to avoid problems arising and to reduce the probability of the authorities needing to take rescue measures.[18] A central part of this regulation is what is known as capital adequacy requirements, which mean that the banks must attain certain capital ratios to be allowed to conduct banking operations.[19] As the capital adequacy requirements have historically been set at a low level, the reduction in the percentage of banks' assets that is capital-funded as discussed above can be said to have been sanctioned by the authorities.[20]

In the context of bank regulation and in the rest of this report, the term *capital ratio* refers to the percentage of a bank's risk-weighted assets that is capital-financed (as opposed to loan-financed funds), and is expressed as a percentage. A capital ratio of 14 per cent, for example, means that the size of the bank's capital is equivalent to 14 per cent of the bank's risk-weighted assets. Risk-weighted means that the value of each asset is adjusted according to its risk as stipulated by the applicable capital adequacy regulations. This means that the higher risk an asset has, the more capital is required. The coming capital adequacy requirements of the Basel III Accord mean that banks must maintain capital ratios higher than a minimum of seven per cent of risk-weighted assets to allow them to repurchase shares or make dividends without restriction.[21]

HIGHER CAPITAL RATIOS ENTAIL SOCIAL BENEFITS

A number of social benefits are achieved by ensuring that the banks maintain sufficient capital ratios. The most important effect is that the capital contributes

17 For a discussion of the effects of the crisis of the 1990s, see Swedish Ministry of Health and Social Affairs (2001).

18 The banks need a special permit to conduct operations and are subject to supervision by Finansinspektion, the Swedish Financial Supervisory Authority. Apart from promoting financial stability, consumer protection is another important reason for regulating the banking sector.

19 For a more detailed discussion of the purpose and functions of capital adequacy regulations, see for example Berger et al. (1995).

20 Since the early 1990s, the capital adequacy requirements have been based on the Basel I Accord, which requires capital ratios of at least eight per cent (although subordinated debt instruments have been partly approved as regulatory capital).

21 The work of reform in the Basel III Accord, which is not yet quite finalized, includes an increase in capital adequacy requirements. According to the Basel III Accord, the minimum requirement is 4.5 per cent. In addition, there is a capital conservation buffer of 2.5 per cent and a countercyclical buffer of 2.5 per cent. Further capital adequacy requirements for banks that are systemically-important will also be introduced. For more details, see the article on Basel III in Sveriges Riksbank (2010a). Appendix A contains an in-depth discussion of definitions of capital and risk-weighted assets, including definitions in the context of the Basel III Accord.

to reducing the probability of banking crises in the economy. This is because the capital constitutes a buffer against unexpected losses. Banks with high capital ratios are better able to maintain their operations without taking drastic measures, or in the worst case failing, when they suffer difficulties. If the banks were nevertheless to suffer such major problems that their operations must be closed down, the capital will function as a buffer to cover losses. Higher capital ratios can in this way also limit the size of the state capital injections needed and enable a smoother resolution.[22]

Another consequence of banks holding more capital is that their risk-taking declines. Higher capital ratios mean that the banks' total cost of capital increases (as capital-financing is more expensive than relying on loans).[23] A higher cost of capital in turn leads to the banks refraining from lending money to projects that are not expected to yield sufficient return to cover the higher cost, while simultaneously providing an adequate risk premium. The result is that the banks' total risk-taking declines, which in turn reduces the probability of a banking crisis.[24] The higher capital adequacy requirements could in this way be regarded as offsetting the possibility of higher risk-taking that government guarantees provide for.

Experience also indicates that banks with high capital ratios do not need to reduce their lending at times of financial stress to the same extent as banks with low capital ratios. High capital ratios thus contribute to limiting the risk of serious shortages in the supply of credit in an economic downswing, and thus also to alleviating cyclical fluctuations.[25]

All in all, higher capital ratios strengthen the banks' resilience and limit their risk-taking, which has positive consequences for the economy as a whole.

HIGHER CAPITAL RATIOS ENTAIL SOCIAL COSTS

However, if the banks increase their capital ratios it will not entail only positive social effects. One consequence of a bank funding itself to a greater extent through capital is that the bank's total cost of capital will increase, as capital is a more expensive source of funding than loans. If the banks choose to compensate

22 For example, capital offers some protection to lenders and depositors. This in turn reduces their inducements to reclaim the funds they have deposited, which enables an orderly winding down of a problematic bank, thus avoiding for example a sale of the banks' assets at severely discounted prices (so called fire-sales). The deposit guarantee system is thereby also protected. This reduces the contagion effects on other banks and limits the cost to the economy as a whole. The calculations in this report do not take into account the fact that the capital can offset the effects of a banking crisis; only that the probability of a banking crisis decreases if the banks' capital ratios increase (see further Chapters 2 and 3).

23 The effects of the capital structure on a company's total cost of capital are discussed in the well-known Miller-Modigliani theorem (Modigliani and Miller 1958). For a discussion of how the Miller-Modigliani theorem can be applied to banks, see Miller (1995).

24 See Berger et al. (1995) for a discussion.

25 For a discussion, see for example Gambacorta and Marqués-Ibañez (2011).

themselves for the increased cost by increasing their lending rates, and if the lending volumes thus decline, the level of GDP will be lower. This gives rise to a social cost.

However, the social cost may be alleviated since the risk for the banks' lenders and shareholders' declines when the banks are better capitalised. The reduced risk should be reflected in a lower required rate of return, which in turn will reduce the increase in the banks' total cost of capital.

One side effect of the banks holding more capital is that the total tax subsidy to the banks becomes lower. When the banks take loans they receive a tax subsidy, but with a smaller percentage of loans this subsidy will be lower. However, the consequence from society's point of view will only be a redistribution of wealth between the banks' shareholders and the tax-payers.

INTERNATIONAL RESEARCH INDICATES APPROPRIATE CAPITAL RATIOS OF BETWEEN 10 AND 20 PER CENT

A number of studies have investigated the social consequences of different capital ratios in banking systems around the world. A large number of these studies examine the temporary transition effects on the economy ensuing from the banks needing to adjust to the capital adequacy requirements stipulated in the Basel III Accord (see for instance, Sveriges Riksbank 2010a; 2011c; Jaffee and Walden 2010; Macroeconomic Assessment Group 2010; 2011; Institute of International Finance 2011).

Research into socially-appropriate capital ratios in the longer run has greater relevance to this report. A large portion of this is confined to observing that the capital adequacy regulations under Basel II led to capital ratios that were too low (see, for instance, Acharya 2009, Chan-Lau 2010, and Admati et al. 2011).

But there are also a number of surveys that are based on simple calculations or qualitative reasoning and that try to identify appropriate capital ratios. Bank of England (2010) presents a simple model, which indicates that 10-15 per cent is a socially-appropriate capital ratio. The European Economic Advisory Group (EEAG 2011) also notes, on the basis of a literature review of the research, that socially-appropriate capital ratios should be at least 13 per cent. Based on qualitative reasoning, Hellwig (2010) reaches the conclusion that capital ratios of 10 per cent of risk-weighted assets are probably an underestimation of the most appropriate ratio.

There are, additionally, some surveys that in a more systematic way try to measure the effects of different capital ratios in the banks and thus to identify at what level GDP will be highest. One example is the Basel Committee on Banking Supervision's (BCBS) report, "An assessment of the long-term economic impact of the new regulatory framework" (the LEI report), in which the BCBS estimates that

a capital ratio of between 13 and 15 per cent for the banks in an individual country would probably give the most favourable macroeconomic outcome in terms of GDP in the long run (BCBS 2010a). Miles et al. (2011) have also used empirical data to analyse the social benefit and cost in terms of GDP of higher capital adequacy requirements in the United Kingdom. According to that analysis the social benefit for the United Kingdom is maximised at a capital ratio of between 16 and 20 per cent.

It is important to point out that the capital ratios stated in most of the above surveys refer to a different definition than the one stated in the results of the Riksbank's calculations. The Riksbank's results are expressed in terms of capital ratios in accordance with the Basel III Accord's definitions of capital and risk-weighted assets (CET 1/RWA$^{\text{Basel III}}$). However, these definitions had not been established when several of the above surveys (for instance, BCBS 2010a) were made. For an in-depth discussion of how the different capital ratio definitions relate to one another, see Appendix A.

1.3 Significant circumstances when determining appropriate capital ratios in the major Swedish banks

The above-mentioned surveys investigate socially-appropriate capital ratios in general (BCBS2010a) or for the United Kingdom's banking system (Miles et al. 2011). However, the appropriate levels vary from country to country, as the banking systems have different structural and institutional characteristics and the inherent risks are not the same.

There are a number of circumstances indicating that the most socially-appropriate capital ratio is higher in Sweden than in many other countries. This relates to indications that both the risk of a banking crisis and its potentially negative consequences are relatively high in Sweden. This section discusses these circumstances, and to what extent developments in the Swedish banks' capital ratios reflect the risk for, and potential consequences of, a banking crisis in Sweden.

CIRCUMSTANCES INDICATE A HIGHER RISK OF A BANKING CRISIS IN SWEDEN THAN IN OTHER COUNTRIES

There are circumstances indicating that the risk of Sweden suffering a banking crisis is higher than the risk in many other countries. One is that the Swedish banks have an unusually large dependence on short-term market funding. Moreover, the banks rely to a great extent on foreign sources of funding. All in all, this entails a

substantial liquidity risk in the Swedish banking system, and ultimately a high risk to the economy as a whole.[26]

Moreover, Swedish banks are highly interconnected. For example, the major Swedish banks have substantial interbank exposures and hold large amounts of one another's covered bonds. This means that problems in one of the major banks could easily spread to the others and cause a banking crisis.[27]

Another circumstance to take into account is that market expectations of government guarantees have on the whole been reinforced as a result of the authorities' extensive rescue actions around the world during the global financial crisis.[28] Swedish authorities also applied rescue measures during the global financial crisis, which has probably increased expectations that the Swedish banks can rely on public rescue measures in the future.

These expectations mean in turn that the banks have been able to take greater risks without being "punished" by their creditors or other counterparties, which has in turn led to substantial profits in the banking sector.[29] For example, the Riksbank's estimates imply that as much as half of the major Swedish banks' profits in the period 2002-2010 were because they enjoyed cheaper borrowing thanks to implied government guarantees (se Appendix B).[30]

CIRCUMSTANCES THAT INDICATE COMPREHENSIVE NEGATIVE ECONOMIC EFFECTS FROM A SWEDISH BANKING CRISIS

Apart from the risk of a banking crisis probably being higher in Sweden than in many other countries, the potential negative effects of a Swedish banking crisis are probably also unusually great. This is indicated by the size of the Swedish banking system. In 15 years, the assets of the major Swedish banks, at group level, have grown from the equivalent of 109 per cent of Sweden's gross domestic product (GDP) to 340 per cent.[31] This means that the Swedish banking system is the third largest in Europe in relation to GDP.[32] The correlation between the size of a

26 For a discussion of this, see the article "The banks' liquidity risk in foreign currencies" in Sveriges Riksbank (2011a).

27 See Sveriges Riksbank (2011a) for a discussion.

28 For a discussion of how the comprehensive rescue measures undertaken during the global financial crisis have fuelled expectations of implicit state guarantees, see Gropp et al. (2010).

29 See Angkinand and Wihlborg (2010) for a discussion of how implicit government guarantees increase the banks' risk taking.

30 These results appear to correspond to the results of studies in other countries of the subsidies from implicit government guarantees (see Appendix B). Research has also shown that expectations of state guarantees are increasing for banks in states with sound public finances (Demirgüç-Kunt and Huizinga 2010).

31 This 340 per cent can be broken down as follows: Nordea 157 per cent, SEB 66 per cent, Svenska Handelsbanken 65 per cent and Swedbank 52 per cent (Source: Sveriges Riksbank).

32 These calculations are based on data from the European Central Bank, the Swiss National Bank and Sveriges Riksbank.

banking system and the potential impact of a banking crisis have been confirmed by economic research.[33]

The main reason for the large increase in the major Swedish banks' assets is that they have expanded their operations abroad. It is essentially positive that their operations have become more international and cross-border, as this means the banks can diversify their business risks across several markets.[34] The internationalisation also means that the social consequences of a banking crisis may be reduced. The external effects may be less if they are spread across several countries and thereby a jointly larger macroeconomy. The potential costs of rescue actions may also be shared by several countries. At the same time, the internationalisation makes it more difficult to manage a crisis situation efficiently, as more authorities are involved and different legal systems apply. This may increase the consequences of a banking crisis. There is also a risk that Sweden will ultimately be forced to cover most of the costs of any potential crisis management. Chart 2 shows the commercial banks' assets in relation to GDP. It also shows the four major Swedish banks' assets in relation to GDP at group level (which corresponds to their total operations in Sweden and abroad).

DEVELOPMENTS IN THE MAJOR SWEDISH BANKS' CAPITAL RATIOS

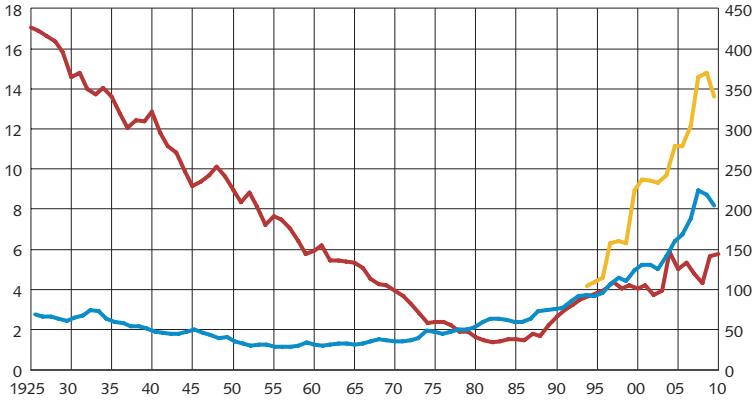
The development of the Swedish banking system has thus meant that both the risk of a banking crisis and its potentially negative economic effects have increased over the past decade. The fact that risks in the Swedish banking system are higher than in many other countries also means that the banks probably need to hold more capital.

However, despite the risks in the Swedish banking system having increased, the share of the banks' assets that is capital-funded has remained at a relatively constant level of around four to six per cent over the last fifteen years (see Chart 2). Moreover, at group level it has been lower for the past five years, and varied between 4 and 4.5 per cent (see Chart 1). As discussed earlier, this reflects the fact that the banks endeavour to maximise returns for their shareholders, but that they have few, if any, incentives to take into consideration the social effects of their actions.

33 Even if the size of the assets of a bank or banking system does not cover all aspects of how serious the effects of a potential banking crisis may be, the size of these assets covaries strongly with other indicators of potential effects that have been identified in economic research. For a discussion of this, see ECB (2006; 2007) and Goldstein and Veron (2011). Iceland's experiences of the global financial crisis provide a telling example of how the size of a country's banking system affects the cost of a banking crisis (Danielsson 2009; Carey 2009).

34 See the article "Foreign operations – a part of the banking groups" in Sveriges Riksbank (2011b).

Chart 2. Swedish commercial banks' capital in relation to total assets, assets in relation to GDP 1925-2010 and assets at group level in relation to GDP 1994-2010 (per cent)



Note. Commercial banks here refers to all Swedish banks except savings banks and cooperative banks. The data on the banks' assets on the group level refer to the four major Swedish banking groups' total assets in Sweden and in foreign subsidiaries.

Source: The Riksbank.

In the next chapter, we will present the results of a number of calculations that, by considering specific Swedish circumstances as far as possible, aim to estimate what is a socially-appropriate level of capital in Sweden.

2 What is an appropriate capital ratio for the major Swedish banks?

In order to determine an appropriate capital ratio for the Swedish banks, the social benefits of higher capital ratios need to be weighed against the social costs.

The benefits of the banks' holding more capital arise because the probability of bank crises declines. As bank crises have significant negative effects on the economy, a higher level of GDP is achieved in the long term if the probability of bank crises is reduced. The costs of higher capital ratios arise when the banks increase their lending rates and reduce their lending volumes. This in turn leads to a lower GDP level. Weighing the benefits against the costs makes it possible to estimate how the level of GDP is affected for each individual capital ratio.[35]

This chapter presents a number of calculations that estimate the long-term benefits and costs of higher capital ratios.[36] In the final section of the chapter, the social benefits of higher capital ratios are weighed against the social costs with the aim of identifying an appropriate level for the major Swedish banks. In these calculations, the appropriate capital ratio is that which will provide the highest level of GDP in the long term.

2.1 The social benefits of higher capital ratios

The social benefits of the banks holding more capital stem from the fact that the level of GDP will increase in the long term because the probability of a banking crisis will decrease. The relationship between higher capital ratios and the reduced probability of a banking crisis can be analysed in several ways. However, all of these ways are fraught with empirical problems of various kinds. One such problem is that there is a shortage of data as baking crises are relatively rare. There is also a lack of long, historical time series for the banks' capital ratios. In order to mitigate these problems and to achieve as high a level of reliability as possible, the Riksbank has carried out three different studies of how the annual probability of a bank crisis decreases when capital ratios increase. These studies, which are presented below, are based on different methods and use different approaches and assumptions. The presentation of the studies is followed by an outline of the Riksbank's assumptions regarding how a reduction in the probability of a banking crisis will affect the level of GDP in the long term.

35 This approach is largely in line with that used in the LEI report (BCBS 2010a) and Miles et al. (2011).
36 These calculations do not take into account the effects in connection with the implementation of higher capital ratios. For estimates of these effects for Sweden see Sveriges Riksbank (2010a; 2011c).

STUDY 1. PROBABILITY OF BANKING CRISES AT DIFFERENT CAPITAL RATIOS ACCORDING TO THE LEI REPORT

The first study uses the results of the Basel Committee's LEI report (BCBS 2010a). The LEI report analyses the probability of a banking crisis at different capital ratios for several different countries, and is based on six different methods.[37] Three of these study the historical link between the probability of a banking crisis and the capital ratio in a number of countries, including Sweden, between 1980 and 2008. The other three methods study more specifically the probability that individual banks will experience problems at different capital ratios. As the results of the six different methods vary, the LEI report presents an average. It is the average probability of a banking crisis presented in the LEI report that the Riksbank uses in this study.

The first study thus provides an estimate of the relation between the probability of a banking crisis and the banks' capital ratios in an international perspective. However, as discussed earlier, there are certain circumstances that suggest that the Swedish banking system differs from the banking systems of other countries. This indicates that there is a need to use more methods to investigate the nature of the relation in the Swedish banks.

STUDY 2. PROBABILITY OF A BANKING CRISIS AT DIFFERENT CAPITAL RATIOS ACCORDING TO MILES ET AL. (2011)

The Riksbank's second study is based on the results of the method used by Miles et al. (2011).[38] This method makes it possible to overcome the problem of a lack of suitable data series by making a simplifying assumption. This assumption is that banks make losses, primarily loan losses, in periods when GDP falls. The size of the losses as a percentage of the banks' risk-weighted assets corresponds to the percentage fall in GDP.[39] Experience from the Swedish crisis of the 1990s indicates that this assumption is a reasonable approximation for conditions in Sweden.[40] Miles et al. (2011) define a banking crisis as a situation in which the banks together make losses that exceed their total capital. Put another way, the method assumes that the banks must have capital ratios that exceed the losses in order not to become insolvent and cause a banking crisis.

By studying data on GDP changes over a period of 200 years, Miles et al. (2011) generate a distribution for the occurrence of various falls in GDP. In line with the

37 For a more detailed description of this study see Appendix D.

38 A more detailed description of the method used in Miles et al. (2011) and how it used to assess the probability of a banking crisis at different capital ratios is provided in Appendix E.

39 Miles et al. (2011) bases this assumption on historical experience, above all in the United Kingdom but in a number of other countries too.

40 The total loan losses of the Swedish banks as a percentage of the banks' loan stock amounted to 10.8 per cent between 1991 and 1993. GDP fell by 4.3 per cent during the same period (see also Appendix E).

method's basic assumption that a fall in GDP causes the equivalent losses at the banks, this distribution can thus also be assumed to relate to the probability of losses of a certain size. As the banks must have capital ratios that exceed the losses to avoid insolvency, the probability of the losses exceeding the banks' capital, and thus the probability of a banking crisis occurring, can be calculated for each capital ratio. In the second study, the probability of a banking crisis is thus given by the probability distribution produced by Miles et al. (2011).

However, this study has a number of limitations. For example, it is based on an assumption that is founded on an historical relation, which means that it does not take into account whether the probability of different falls in GDP has changed.[41] Another limitation of this method is that it does not capture specifically-Swedish conditions.

STUDY 3. PROBABILITY OF A BANKING CRISIS AT DIFFERENT CAPITAL RATIOS ON THE BASIS OF SWEDISH CONDITIONS

The third study captures circumstances that are specific to Sweden to a greater extent by taking conditions at the four major Swedish banks as its starting point.[42] In this study, the Riksbank has calculated the probability of a banking crisis at different capital ratios using a method developed specifically for this report. Among other things, this method takes into account how vulnerable the Swedish banking system is as a result of the interconnectedness between the banks (see Section 1.3), and the fact that it is therefore enough for *one* major bank to become insolvent for the Swedish banking system to be hit by a crisis.

In order to calculate the probability of a banking crisis, the Riksbank assumes in this study that a change in the value of the assets affects the capital. If the value of the assets falls to such an extent that the capital of at least one of the four major banks is wiped out and the bank therefore becomes insolvent, then a banking crisis will occur. The method therefore includes a simulation of changes in the banks' assets. In order to form a direct link to conditions at the Swedish banks, the method is estimated on the basis of bank data from 2010. The method thus captures, for example, the risks that the banks were exposed to at that particular time.

Consequently the third study provides an indication of the probability of banking crises on the basis of the situation at a particular point in time, rather than on the basis of an average taken from a long time series. This distinguishes the third study from the second. A "snapshot image" of a recent situation may provide

41 One argument for this is that the observations have been made over a long period of time, which means that structural breaks that may have occurred recently do not have a full impact on the results.

42 The four major Swedish banks are Nordea, SEB, Svenska Handelsbanken and Swedbank. For a more detailed description of the study see Appendix F.

a better indication of the actual probability of a banking crisis than probabilities generated using long historical relations. On the other hand, basing calculations on a snapshot image entails a risk that the results will be affected by specific but irrelevant circumstances that prevailed at a specific point in time.

As the third study is adapted as far as possible to specific Swedish conditions it acts as a complement to the other two studies. The first and second studies are based on international experience and thus on the implicit assumption that banking systems are largely the same in all the countries of the world. On the other hand, the first and second studies complement the third study in that they overcome the methodological difficulties that arise from the fact that banking crises do not occur on a frequent basis in individual countries.

RESULTS OF THE THREE STUDIES

As the three studies use different methods and approaches their results vary, but by and large their results are in line with each other. Table 1 provides an overview of the results of all of the studies. It shows how much the annual probability of a banking crisis decreases when the capital ratio (TCE/RWA$^{\text{Basel II}}$) increases by one percentage point.[43] This means, for example, that if the banks' capital ratio is increased from 6 per cent to 7 per cent of their risk-weighted assets, then the probability of a banking crisis will fall by 2.6 percentage points according to the first study (the LEI report), by 0.5 percentage points according to the second study (Miles et al. 2011) and by 2.0 percentage points according to the third study (on the basis of Swedish conditions).[44]

43 See Appendix A for an explanation of this definition of capital ratio.

44 The three studies use different methods to estimate the probability of a banking crisis at different capital ratios. However, to be able to estimate the benefit of increasing a certain capital ratio it is not of primary interest to analyse how probable a banking crisis is, but how much this probability decreases when the capital ratio increases. For this reason, the change in probability is presented in Table 1.

Table 1. Reduced annual probability of a banking crisis when the capital ratio increases by one percentage point according to the different studies

CAPITAL RATIO (PER CENT) AFTER INCREASE	STUDY 1 (LEI REPORT)	STUDY 2 (MILES ET AL) 2011)	STUDY 3 (SWEDISH CONDITIONS)
7	2.6	0.5	1.6
8	1.6	0.4	1.1
9	1.1	0.4	0.8
10	0.5	0.4	0.6
11	0.4	0.5	0.4
12	0.3	0.4	0.3
13	0.2	0.4	0.2
14	0.1	0.3	0.2
15	0.1	0.2	0.1
16		0.1	0.1
17		0.1	0.1
18		0.0	0.1
19		0.0	0.1
20		0.0	0.0

Note. The capital ratio is specified in the table as TCE/RWA$^{\text{Basel II}}$. The results in the table are calculated on the basis of Tables 10, 12 and 13 in Appendices D–F. The probability in the first study relates to the average for the six methods used in the LEI report (BCBS 2010a). The table does not specify any reductions in probabilities in connection with capital ratios above 15 per cent in this study as these probabilities are not reported in BCBS (2010a).

Two overarching conclusions can be drawn from the results. First, all of the studies show that the reduction in the probability of a banking crisis gradually declines when the capital ratio increases. Second, increases in capital ratios provide the most benefit when capital ratios are low. As the results differ from study to study, the Riksbank's calculations of what is an appropriate capital ratio for Swedish banks will result in an interval and not a specific figure (see Section 2.3).

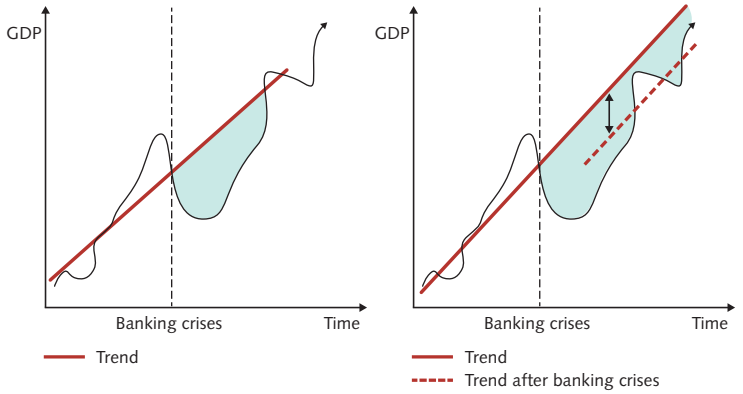
THE EFFECTS OF A BANKING CRISIS

To quantify the benefits that arise when the probability of a banking crisis declines, we need to make assumptions concerning the social consequences of banking crises in terms of how much GDP is lost. Several such estimates of the effects of a banking crisis have been made in economic research.[45] The consequences can be roughly divided into *temporary* and *permanent* losses of GDP. A temporary loss entails a decline in growth and a fall in GDP when the banking crisis occurs. However, the economy subsequently recovers and GDP eventually reaches the same level and the same growth path that would have been the case if the

45 A compilation of the results of this research can be found, for example, in the LEI report (BCBS 2010a). The LEI report reviews the research that studies banking crises from 1960 and onwards. Of this research, only Haldane (2010) includes the global financial crisis of 2007-2009, and then with a focus on the United Kingdom (see also Appendix C).

banking crisis had not occurred. A permanent loss, on the other hand, means that GDP will be at a lower level for the foreseeable future than if the crisis had not occurred (see Chart 3).[46]

Figure 3. Temporary and permanent effects of banking crises



Source: BCBS (2010a).

The results of the research on the effects of banking crises vary considerably depending on whether the crises are assumed to lead to a permanent or temporary loss of GDP.[47] The assumption chosen will thus have a great deal of influence on the estimate of benefits. Current economic research notes that banking crises usually have permanent effects on the economy.[48] There are a number of arguments that support the belief that the effects are permanent (for a discussion see Appendix C). One example of a banking crisis that had permanent effects, according to the literature, is the crisis in Sweden in the early 1990s.[49]

The LEI report (BCBS 2010a) presents estimates of how much the level of GDP can be assumed to increase in the long term if the probability of a banking crisis declines. In the report, the effect of a banking crisis is assumed to be either a *small*

46 Permanent effects thus mean here that either they are entirely permanent, that is that GDP will never return to the level it would have had if the banking crisis had not occurred, or enduring, that is it will take a very long time to return to this level. As the effects are discounted at a relatively high discount rate (5 per cent), whether they are entirely permanent or only long lasting will only have a very marginal effect on the results.

47 For example, the Institute of International Finance (2011) has questioned the results of studies that have attempted to quantify the effects of higher capital ratios at the banks by claiming that these studies assume to far too great an extent that banking crises have permanent effects.

48 Research that captures the permanent effects of banking crises includes Cerra and Saxena (2008), Turini et al. (2010), IMF (2009), Furceri and Zdzienicka (2010), Furceri and Mourougane (2009), Barrel et al. (2010), Boyd et al. (2005) and Haldane (2010).

49 Cerra and Saxena (2005) study the long-term effects of the Swedish banking crisis in the early 1990s. They found that this banking crisis led to a permanent fall in GDP per capita which can largely explain why Sweden's GDP fell in comparison with that of other OECD countries between the 1960s and the early 2000s.

permanent effect or a *large permanent effect*.[50] In the event of small permanent effect the report finds that if the annual probability of a banking crisis is reduced by one percentage point then a welfare gain in the form of a 0.63 per cent higher level of GDP will arise in the long term. In the event of a large permanent effect the gain will be a 1.58 per cent higher level of GDP.

The Riksbank's calculations of the benefits are based on these two estimates of the welfare gain (see Table 3). Using two different estimates of the welfare gain, which in turn differ by almost one percentage point in terms of the increase in GDP, also provides an indication of how sensitive the final results are to different assumptions about the effects of a crisis.

Table 2. Percentage increase in GDP as a result of a reduction in the annual probability of banking crises

REDUCTION IN THE PROBABILITY OF BANKING CRISES (IN PERCENTAGE POINTS)	BANKING CRISIS HAS LITTLE PERMANENT EFFECT ON GDP	BANKING CRISIS HAS LARGE PERMANENT EFFECT ON GDP
1	0.63	1.58
2	1.26	3.16
3	1.89	4.74

Source: BCBS (2010a).

Using the data in Table 2, the results of the three studies in terms of the reduced probability of banking crises at increased capital ratios can be transformed into social benefit in the form of a long-term higher level of GDP. For example, the probability of a banking crisis falls by 2.6 percentage points in the first study if the capital ratio increases from 6 to 7 per cent (see Table 1). The benefit of this capital-ratio increase is therefore that the level of GDP will increase in the long term by 1.6 per cent (2.6 percentage points * 0.63 per cent), in the case of a banking crisis with a small permanent effect. If it is assumed that a banking crisis has large permanent effects, then the benefit will be an increase in GDP of 4.1 per cent (2.6 percentage points * 1.58 per cent).

2.2 The social costs of higher capital ratios

In this section an estimate of the social costs, in terms of a lower long-term level of GDP, that arise as a result of the banks increasing their capital ratios is presented.

50 *Small permanent effect* in this case comprises the median of the effects of a banking crisis in the research that documents both the temporary and permanent effects of crises. *Large permanent effect* comprises the median of the results in the research that only documents the permanent effects of crises (see further Appendix C). The LEI report also presents the temporary effect of a banking crisis, that is on the basis of the research that only documents the *temporary effects of banking crises*. In this report this assumption is not used as there are strong arguments that support the belief that banking crises have permanent effects (see Appendix C).

A MACROECONOMIC MODEL FOR THE CALCULATION OF SOCIAL COSTS

To calculate the costs of a higher capital ratio the Riksbank uses a model based on Meh and Moran (2010). The model has been adapted to Swedish conditions by estimating it on Swedish data.[51] It limits itself to determining the real-economic cost in the long term or, formally speaking, the cost of increased capital ratios in the model's long-term equilibrium (or steady state). The Riksbank has previously presented what the costs of increased capital ratios could be when the new capital adequacy regulations in the Basel III agreement are introduced.[52]

The social costs of increased capital ratios arise since it is more expensive for the banks to rely on equity instead of funding their operations with loans.[53] The banks pass on the increase in the cost of capital to the customers by increasing their lending rates. This reduces lending and investment, which in turn leads to a fall in production and reduces GDP.[54] The costs of higher capital ratios thus consist of a reduction in the level of GDP.

On the other hand, the model does not take into account the reduction in the risk of banks defaulting when capital ratios increase. In other words, it does not take into account that the required rate of return of shareholders and creditors should decrease when capital ratios increase.

THE SOCIAL COSTS OF A HIGHER CAPITAL RATIO IN SWEDISH BANKS

The results of the Riksbank's calculations show that an increase in the capital ratio of one percentage point will lead to a reduction in the level of GDP of approximately 0.16 per cent (see the column "High social cost" in Table 3).[55] GDP falls because the increase in the capital ratio leads the banks to raise their lending rates, which in turn leads to a fall in lending volumes. If the capital ratio increases by one percentage point, it is calculated that the lending margin will increase by up to approximately 13 basis points and that lending will fall by almost one per cent according to the model. This is in line with the results previously presented by the Riksbank.[56]

The results are presented as "low social costs" and "high social costs." The reason for this is that the capital ratio can be defined in different ways, which in turn affects the results.[57] If capital is defined as equity in relation to total assets

51 For a more detailed description of the model see Appendix G.
52 See Sveriges Riksbank (2011b).
53 See Section 1.2 for an explanation of why equity capital is more expensive than debt financing.
54 Note that monetary policy does not affect the results in the Riksbank's calculations as it is assumed that monetary policy has no real effects in the long term.
55 This has little to do with what capital ratio one starts from. In other words, an increase of the capital ratio from, for example, five per cent to six per cent yields approximately the same result as an increase from 15 per cent to 16 per cent.
56 See Sveriges Riksbank (2010b).
57 For a discussion of the relationship between different definitions see Appendix A.

then the social cost, according to the model, will be approximately one third as large as when capital is defined as TCE/RWA$^{\text{Basel II}}$. Depending on how the capital ratio is defined, the cost can thus vary between 0.06 and 0.16 per cent in reduced GDP when the capital ratio is increased by one percentage point. Using two different estimates of the social costs provides an indication of how sensitive the Riksbank's calculations of appropriate capital ratios are to different assumptions about the costs of higher capital ratios.

Table 3. The real-economic cost of an increased capital ratio in terms of reduced GDP

INCREASE IN CAPITAL RATIO (PER CENT)	LOW SOCIAL COST (PER CENT)	HIGH SOCIAL COST (PER CENT)
1	0.06	0.16
2	0.12	0.32
3	0.18	0.48

Note. The capital ratio is specified in the table as TCE/RWA$^{\text{Basel II}}$.

There are several international studies (see for example Barrell et al. 2009; Jaffee and Walden 2010; and BCBS 2010a) that have calculated the social cost of increased capital ratios.[58] The estimates in these studies vary from zero up to 0.14 per cent. This is somewhat lower than the upper limit of the cost interval calculated in this report, that is 0.16 per cent for each percentage point increase in the capital ratio.

2.3 Appropriate capital ratio for major Swedish banks

In this section the long-term, net economic effect of various capital ratios at the Swedish banks is analysed. The approach is based on weighing the benefit against the cost of different capital ratios on the basis of the calculations presented in the previous section. The appropriate ratio is determined by identifying at what capital ratio the GDP level will be highest in the long term.

THE APPROPRIATE CAPITAL RATIO MAXIMISES THE NET SOCIAL EFFECT

Each of the studies of the probability of a banking crisis result in four appropriate capital ratios depending on whether the underlying assumption is that the effects of a crisis will be small or large (see Table 2) and whether the social cost is assumed to be high or low (see Table 3). The appropriate capital ratio according to the respective studies can thus be specified using an interval in which the lower limit is given by the *high social cost* and *small permanent effect* of a crisis and the upper limit by the *low social cost* and *large permanent effect* of a crisis (see Table 4).

58 For a review of these studies see Appendix G.

Table 4. Appropriate capital ratios according to the different studies of the probability of a banking crisis depending on the assumptions regarding the effects of banking crises and the costs of higher capital ratios

	SMALL PERMANENT EFFECT OF CRISIS		LARGE PERMANENT EFFECT OF CRISIS	
PROBABILITY OF A BANKING CRISIS	HIGH SOCIAL COST	LOW SOCIAL COST	HIGH SOCIAL COST	LOW SOCIAL COST
Study 1 (LEI report)	12	14	13	>15
Study 2 (Miles et al. 2011)	14	16	16	18
Study 3 (Swedish conditions)	12	16	16	20

Note 1. The capital ratio is specified in the table as $TCE/RWA^{Basel\ II}$. As the LEI report (BCBS 2010a) does not calculate the probability of a banking crisis at higher capital ratios than 15 per cent it cannot be used to generate a more precise estimate of the appropriate capital ratio in the low social cost and large permanent effect case.

Note 2. If the GDP level is highest between two capital ratios, the lower of these two capital ratios is always presented as the appropriate capital ratio in Table 4.

The appropriate capital ratio depends on the method used in the underlying calculation of the benefit of higher capital ratios. The appropriate capital ratio is highest when the probability of a banking crisis is calculated according to the third study, that is the study based on Swedish conditions.

If a banking crises is assumed to have a large permanent effect then the appropriate capital ratio is on average a couple of percentage points higher than if the effect is assumed to be small. And if the social cost of a higher capital ratio is low then the appropriate capital ratio is between two and five percentage points higher than if the social cost is high. The appropriate capital ratio thus depends to largely the same extent on the assumption made about the capital cost and the effect of a banking crisis as on the study used to analyse the relation between the two.

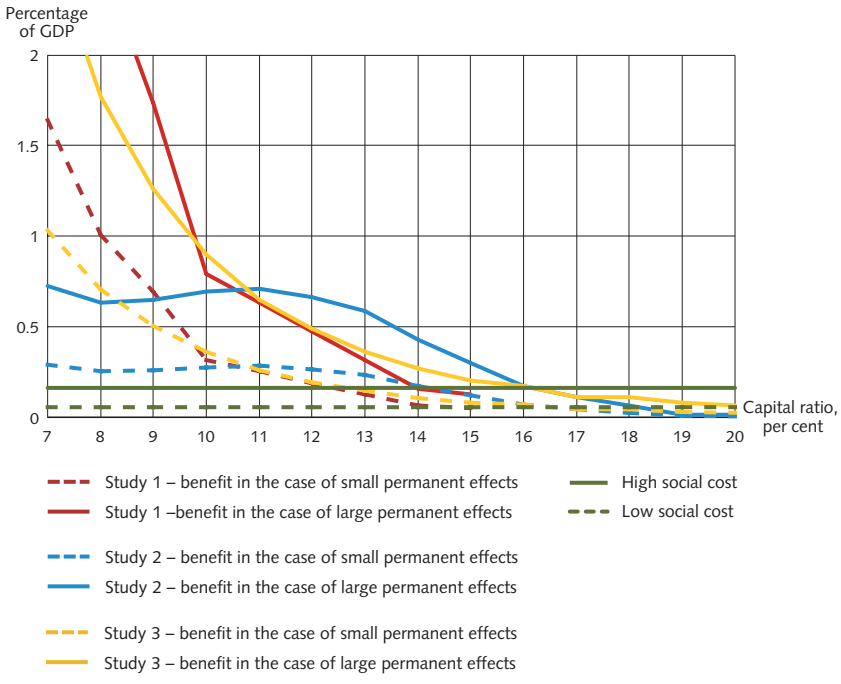
ILLUSTRATION OF HOW THE APPROPRIATE CAPITAL RATIO IS IDENTIFIED

There are two ways of illustrating how the appropriate capital ratios presented above have been identified. The first shows when the benefits and costs of increasing the capital ratio are equal. The second shows when the total net social effect is greatest (see Chart 4 and Charts 5 a-b).

Chart 4 illustrates when the benefits and costs of increasing the capital ratio are equal.[59] The chart shows the results according to the different studies when it is assumed that a banking crisis can have small or large effects respectively, and also shows the upper and lower limits for the social cost of higher capital ratios. The appropriate capital ratio is the ratio at which the benefit curve crosses the cost curve. For example, Chart 4 shows that the first study gives 13 to 14 per cent as the most appropriate capital ratio under the assumption of large permanent effects and high social costs for increased capital ratios.

59 Appendix H illustrates the benefits and costs of increasing the capital ratio according to the different studies in separate charts.

Figure 4. Benefits and costs of increasing the capital ratio by one percentage point in terms of GDP according to the three studies



Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$. Note that the first study does not specify any benefit from increasing the capital ratio above 15 per cent. The reason for this is that the LEI report does not address the probability of banking crises for capital ratios above this level.

Charts 5a-b instead illustrate the net social effect. The chart shows show the total change in GDP when the capital ratio increases from 6 per cent to higher capital ratios.[60] This is illustrated for all of the studies under the assumptions of the low (Chart 5a) and high (Chart 5b) social costs of higher capital ratios, and of the small and large permanent effects of banking crises.[61] The appropriate capital ratio is identified in this chart as the capital ratio for which the change in GDP is greatest, which in turn generates the highest, long-term level of GDP.[62] For example, the change in the level of GDP is greatest in the first study between 13 to 14 per cent, under the assumption of large permanent effects and high costs.

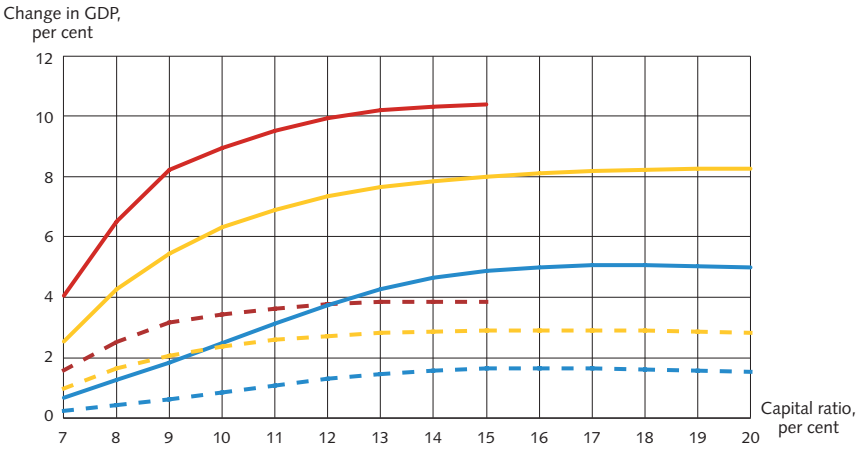
60 The total net effect of increasing the capital ratio from 6 per cent to capital ratios at higher levels is obtained by adding the different benefits and costs respectively of each increase of the capital ratio by one percentage point up to the capital ratio concerned. To obtain the net effect of such an increase, the total benefit is weighed against the total cost.

61 Appendix H illustrates the total net effect of increasing the capital ratio in accordance with the different studies in separate charts.

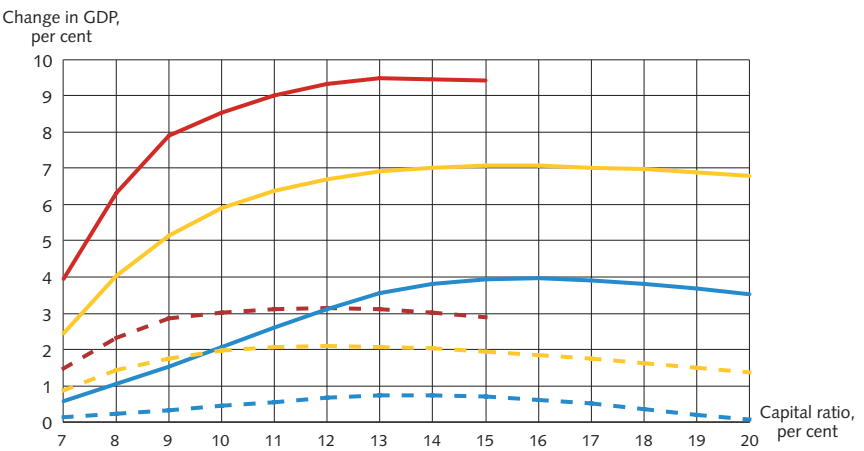
62 The fact that the net effect is presented in this chart in comparison to 6 per cent has no impact on the results. If a higher capital ratio had been chosen as the reference point the appropriate capital ratio would still have been the same.

Charts 5a-b. Net effect in terms of higher GDP of increasing the capital ratio from 6 per cent in the three different studies

5a. Low social cost



5b. High social cost



Study 1 – small permanent effects
Study 1 – large permanent effects
Study 2 – small permanent effects
Study 2 – large permanent effects
Study 3 – small permanent effects
Study 3 – large permanent effects

Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$. Note that the first study does not specify any benefit from increasing the capital ratio above 15 per cent. The reason for this is that the LEI report doe not address the probability of banking crises for capital ratios above this level.

THE RIKSBANK'S RESULTS ARE IN LINE WITH INTERNATIONAL STUDIES

The Riksbank's results (see Table 4) are generally in line with the conclusions of previous research. For example, the results in the first study are line with the capital ratio identified in BCBS (2010a) of between 13 and 15 per cent. This is to be expected as the methods are largely identical. However, the results in the Riksbank's second study are lower than the 16 and 20 per cent that Miles et al. (2011) find appropriate, despite the fact that the same method has been used to estimate the probability of a banking crisis. This can largely be explained by the fact that the Riksbank's calculations yield higher social costs for increased capital ratios. In the third study, however, which is based on Swedish conditions, the upper limit for the most appropriate ratio (under the assumption of low costs and large permanent effects) lies outside the interval presented in BCBS (2010a). In addition, the Riksbank's results show that the lowest appropriate capital ratio in all of the studies lies between 12 and 13 per cent, which is in line with the conclusions in EEAG (2011). All in all, the Riksbank's results confirm the validity of Hellwig's (2010) argument that appropriate capital ratios are probably above 10 per cent. On the other hand, the Riksbank's results exceed the ratios of 10 and 15 per cent presented in the Bank of England's (2010) simple model.

APPROPRIATE CAPITAL RATIOS IN TERMS OF BASEL III

So far, the appropriate capital ratios have been calculated in terms of Basel II, that is in accordance with the capital-ratio definition TCE/ $RWA^{Basel\ II}$. The reason is that much of the previous research on which the Riksbank's report is based uses this definition. With the help of a conversion key (see Appendix A), the appropriate capital ratios have been converted so that they are expressed in terms of the definition used in the Basel III agreement (CET 1/ $RWA^{Basel\ III}$). The results are presented in Table 5.

Table 5. Appropriate capital ratios in per cent in terms of CET 1/ $RWA^{Basel\ III}$

	SMALL PERMANENT EFFECT OF CRISIS		LARGE PERMANENT EFFECT OF CRISIS	
PROBABILITY OF A BANKING CRISIS	HIGH SOCIAL COST	LOW SOCIAL COST	HIGH SOCIAL COST	LOW SOCIAL COST
Study 1 (LEI report)	10	12	11	>15
Study 2 (Miles et al. 2011)	12	14	14	15
Study 3 (Swedish conditions)	10	14	14	17

Note. The capital ratio is specified in the table as CET 1/ $RWA^{Basel\ III}$. As the LEI report (BCBS 2010a) does not present the probability of a banking crisis at capital ratios higher than 15 per cent it has not been possible to convert the ratio for the assumption of a large permanent effect of the crisis and low social costs in terms of CET 1/ $RWA^{Basel\ III}$.

When the capital ratios are redefined according to the definitions in the Basel III Accord, the appropriate capital ratios are two to three percentage points lower. This is a consequence of the fact that the definitions of capital and risk-weighted assets in the Basel III-agreement are stricter than the definitions used in the Riksbank's calculations.[63] However, all of the Riksbank's studies arrive at appropriate capital ratios that are significantly higher than the 7 per cent that the Basel III Accord sets as a minimum requirement and capital conservation buffer (see also Section 1.2).

The conversion to the new definition of capital shows that the appropriate capital ratio lies in the interval between 10 and 17 per cent. The difference between the highest and the lowest appropriate capital ratio is thus 7 percentage points. This result is discussed in more detail in the next chapter with the aim of generating a number of conclusions regarding the appropriate capital ratio for the major Swedish banks.

63 See Appendix A for further discussion of how the different definitions of capital ratios relate to each other.

3 Conclusions and comments

This report aims to analyse what is the most appropriate capital ratio for the major Swedish banks from society's point of view. The calculations presented in the previous chapter reach the conclusion that the appropriate capital ratio is somewhere in the interval of 10 to 17 per cent, in terms of a definition based on the Basel III Accord.

THE SOCIAL BENEFIT OF HIGHER CAPITAL HAS PROBABLY BEEN UNDERESTIMATED

However, there are factors indicating that the socially-appropriate ratio for the Swedish banks is probably somewhere in an interval that is slightly higher than the interval of 10 to 17 per cent indicated by the Riksbank's calculations. This is because the calculations are based on assumptions that probably underestimate the benefits of higher capital and underestimate its cost to society.

The following aspects indicate that the benefits of higher capital are underestimated:

- When the effects of a banking crisis are calculated in this report, only limited consideration is given to the effects of the global financial crisis of 2007-2009 (see Appendix C). If the Riksbank's calculations gave greater consideration to the effects of this crisis, the estimated benefit of reducing the probability of a banking crisis would probably be even higher. Developments in terms of the size and complexity of the banking sector also indicate that future banking crises could be even more costly than those the world has experienced so far.
- Governments and central banks tend to prevent or alleviate the effects of banking crises through various forms of rescue action (see Section 1.2). Without these, the effects of the crises would probably have been much worse. However, the calculations in this report have not taken these measures into account. The actual effect of a banking crisis, without state intervention, is therefore probably much higher. It is reasonable that the calculations on an appropriate capital ratio should be based on state rescue actions not being necessary. Nor do the Riksbank's calculations include the negative effects state rescue actions often have on public finances.
- The Riksbank's studies assume a very strict definition of banking crises, where a banking crisis is not assumed to arise until banks become insolvent. In reality, however, banking crises often arise long before banks become insolvent. For example, during the recent financial crisis, many banks

suffered substantial problems in getting access to market funding, although many of them were far from insolvent.[64] When the banks' capital ratios fall or the banks experience problems obtaining market funding, they often reduce their lending.[65] This type of credit crunch in turn has very negative effects on society, but would not be classified as a banking crisis in the studies. The probability of a banking crisis occurring is thus probably higher than is concluded by the studies.

- Higher capital ratios do not just mean that the probability of a banking crisis declines, but also that the effects of the banking crisis will probably be smaller. However, this type of effect is not included in the Riksbank's calculations, as there is very limited research into how higher capital ratios influence the effect of a banking crisis.[66]
- One positive consequence of higher capital ratios is that they probably reduce fluctuations in the economy. A more stable development of the economy reduces incorrect allocations, which in turn increases society's production capacity. This aspect is not captured in the Riksbank's calculations.

THE SOCIAL COST HAS PROBABLY BEEN OVERESTIMATED

However, it is likely that not only has the benefit of the increased capital ratios been underestimated; a number of aspects indicate that the social costs of higher capital ratios have been overestimated. Firstly, the Riksbank's estimates of the cost are higher than what other surveys have indicated (see Section 2.2). Moreover, the following aspects point to the cost of higher capital ratios being overestimated:

- The cost of higher capital ratios is calculated under the assumption that the shareholders' required rate of return on bank capital remains unchanged when the capital ratio increases. However, the required rate of return should probably decline if the banks hold more capital and in this way reduce their risk of default. If the required rate of return on the banks declines, the banks need not transfer all of the increased cost of capital to their customers through higher lending rates. The social cost in terms of GDP would then be lower.[67]

64 See, for instance, Brunnermeier (2009) and Krishnamurthy (2010).
65 See, for instance, Woodford (2010).
66 Angkinand (2009) finds in a study that the effects of a banking crisis are less if the capital adequacy regulations are more stringent. However, by stringent capital adequacy regulations Angkinand (2009) not only refers to the requirements regarding the actual capital ratio, but also requirements as to definitions of eligible capital and how strictly the financial supervisory authority ensures that regulations are followed.
67 To quantify the effect of a lower return on equity (ROE), the cost of increasing the capital ratio by one percentage point is calculated, at the same time as the ROE for bank capital is reduced by one percentage point. The lower required ROE is calculated to lead to a relatively modest change in the production level, around 0.01 percentage points, which nevertheless means that the cost of increasing the capital ratio is slightly overestimated in this report.

- For the same reason, the banks' borrowing costs should decline as the capital ratio increases, which should have the corresponding effect. The model used to calculate the cost of higher capital ratios does not take this aspect into account.
- The implicit government guarantees discussed in Section 1.2 have most significance when the banks' capital ratios are low, since low ratios increase the probability of the banks needing to use them. This should mean that the cost of increasing the capital ratio by one percentage point is higher with lower capital ratios and that the cost then decreases as capital ratios increase. However, in this report the cost of increasing the capital ratios by one percentage point is assumed to remain constant regardless of the banks' original capital ratios.
- The banks are probably unable to transfer the whole of the increased cost of capital to borrowers as competition means that other banks would be given an opportunity to gain market shares.

FURTHER ASPECTS

There are also a number of further aspects to take into consideration. For instance, one cannot rule out the possibility of higher capital levels leading to the functions important to society that have traditionally been supplied by the banks being taken over to an increasing degree by financial companies that are covered by less stringent regulations or under less intensive supervision (so called shadow banks). If the authorities and legislative bodies fail to take note of such a potential development, the risk of serious disruptions in the financial system and the economy as a whole may remain unchanged, despite the capital ratios in the banks increasing.

Another aspect is that the probability of a banking crisis and its effects in a particular country may be smaller if that country has recently experienced a severe banking crisis. The experiences from a crisis increase the motivation to improve supervision and crisis management, which would enable the authorities to more easily avoid a future crisis or alleviate its effects. A crisis can also lead to structural changes in the banking sector, which may strengthen resilience to crises and make the banking system more efficient.[68] For example, it is often said that one reason why Sweden was not as hard hit as other countries by the global financial crisis in 2007-2009 was that Sweden had lived through a deep domestic financial crisis in the 1990s. This could mean that the report overestimates the effects of banking crises, which in turn means that the usefulness of higher capital ratios is also overestimated in the Riksbank's calculations.

68 See, for example, Demirgüç-Kunt et al. (2006) for a discussion of the improvements in the efficiency of the banking system that can follow on from a banking crisis.

One can also note that the appropriate capital ratio ought to change if there are structural changes in the banking sector or if the banks' institutional surroundings change. This means that the banks and also the authorities and legislative bodies can take various measures to affect what capital ratios are regarded as the most socially appropriate in the long term.

A number of circumstances particular to the Swedish banking system, which indicate that the socially-appropriate capital ratios for the major banks in Sweden are higher than those for the banks in many other countries, were discussed earlier. Although the calculations presented in this report have taken Swedish conditions into account as far as possible, they have not included all of these circumstances. For example, the calculations do not take into account the major Swedish banks' relatively large dependence on market funding, nor the fact that the Swedish banking system is unusually large in relation to GDP. However, the Riksbank's calculations in the third study, which take into account the fact that the Swedish banks are highly interconnected, nevertheless confirm that the appropriate capital ratios in Sweden exceed the upper limit for appropriate capital ratios generated in the LEI report (BCBS 2010a), which is based on a large sample of countries.

ARGUMENTS INDICATE THAT THE INTERVAL IS HIGHER THAN 10 TO 17 PER CENT

It is not possible to measure exactly how much the above aspects will affect the most socially-appropriate interval for the major Swedish banks' capital ratios. But as they point to the benefit of higher capital ratios probably being underestimated, and to the cost probably being overestimated, one can note the following: The interval is probably higher than the 10 to 17 per cent shown in the Riksbank's calculations.

If one regards the current banking system in Sweden in the light of this result, two conclusions become clear. Firstly, the results indicate that in recent years the Swedish banks' capital ratios have mostly been below the most socially-appropriate level.[69] Secondly, the results indicate that the coming capital adequacy requirements following on from the Basel III Accord are not sufficient to ensure that the Swedish banks maintain the capital ratios that are most appropriate for the Swedish economy.[70]

69 Chart 1 shows that the large banking groups' capital in relation to total assets has varied between 3.9 and 4.5 per cent over the past ten-year period. This corresponds to a capital ratio according to CET 1/$RWA^{Basel\ III}$ of 10 to 11 per cent (see Appendix A).

70 Although the work on the Basel III regulations is not complete, it is not likely that the Accord will entail the major Swedish banks needing to attain capital ratios that approach the levels that are most socially-appropriate. See further Section 1.2.

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Appendix A – Definitions of capital ratios and conversion methods

This appendix discusses how the different capital ratios used in the report relate to one another and estimates the capital ratios of Swedish banks based on the different definitions. This estimate can be used to convert the results of the various calculations in the report depending on the definition of capital ratio used.

Definitions of capital ratios

The term capital ratio refers to a bank's capital in relation to risk-weighted assets. Risk-weighted is defined as the value of a bank's assets adjusted according to the assets' risk as stipulated by the applicable capital adequacy regulations, which is to say that the higher risk an asset has, the more capital is required.

In the report, three definitions of capital are used: Equity, Tangible Common Equity and Common Equity Tier 1.

EQUITY

Equity consists of nominal share capital and retained earnings (i.e. profits that the bank has not distributed but rather retained in its balance sheet).

TANGIBLE COMMON EQUITY

Tangible Common Equity (TCE) refers to the banks' equity after deductions corresponding to the value of intangible assets and is calculated as follows:

TCE = equity – (planned dividends + goodwill + intangible assets)

TCE gives a better estimate of the capital a bank can use to absorb losses than the definitions of capital set out in previous and current regulations (based on the Basel I and Basel II accords).[71] TCE forms the basis of several of the studies of appropriate capital ratios that are presented in this report (for example BCBS 2010a).

71 For more information on the definitions of capital in the Basel I and Basel II accords, see BCBS (2006).

COMMON EQUITY TIER 1

Common Equity Tier 1 (CET1) is a definition of capital that is based on the Basel III accord.[72] CET1 is calculated as follows:

CET1 = equity – (planned dividends + goodwill + some intangible assets + investments in other financial institutions (above a certain limit) + certain surplus provisions for pension commitments + some deferred tax assets + a number of other deduction items)

Since more items are deducted in CET1, capital ratios expressed as CET1 are, in most cases, lower than the capital ratios expressed as TCE. Since the banks' balance sheets vary, the difference between the capital definitions will also vary among the banks.

The report uses two different methods for calculating the value of the banks' Risk Weighted Assets (RWA). The first, $RWA^{Basel\ II}$, is based on the Basel II accord. The second, $RWA^{Basel\ III}$, calculates risk weights in accordance with the Basel III accord and has, in general, higher risk weights. The risk-weighted assets are therefore also higher in the calculations that are based on the Basel III accord. Since most international research was conducted before agreement was reached on the Basel III accord, most of it uses $RWA^{Basel\ II}$.

CONVERSION BETWEEN DIFFERENT DEFINITIONS OF CAPITAL RATIO FOR SWEDISH BANKS

The various calculations in the report use different definitions of the banks' capital and different ways of calculating the value of the risk-weighted assets. This means that the definition of capital ratio varies. But by starting from the Swedish banks' balance sheets and calculating the relationship in capital ratio according to the different definitions, converting between the different definitions is simple.

Table 6 shows the Swedish banks' capital ratios in the first quarter of 2011, according to various definitions. The calculations are based on the banks' quarterly reports.[73] The calculation of CET 1 and $RWA^{Basel\ III}$ is based on Sveriges Riksbank's calculations and has been verified by the banks.[74]

72 The definition of CET1 is here described as a simplification of the regulatory framework based on the Basel III accord. For more information, see BCBS (2010b).

73 Under the framework of this report, the relation of capital ratios to each other in quarterly reports for periods other than Q1 2011 has also been investigated. As the difference is only marginal, conversion has only been reported for quarterly reports for Q1 2011.

74 These capital ratios for the Swedish banks are also reported in Sveriges Riksbank (2011a).

Table 6. Capital ratios in per cent according to CET1/RWA$^{\text{Basel III}}$ and TCE/RWA$^{\text{Basel III}}$ for the Swedish banks, Q1 2011

	TCE/RWA$^{\text{Basel III}}$	CET1/RWA$^{\text{Basel III}}$	DIFFERENCE
Handelsbanken	13.6	12.9	0.7
Nordea	10.4	9.7	0.7
SEB	11.6	10.9	0.7
Swedbank	14.6	14.2	0.4
Average	11.8	11.1	0.7

Note. In both cases the risk weights are based on the Basel III accord.

The table shows that the banks' capital ratios vary based on which definition of capital and risk weighted assets is used. However, the capital ratio under CET1/RWA$^{\text{Basel III}}$ for Swedish banks is always lower than the capital ratio under TCE/RWA$^{\text{Basel III}}$. To convert the capital ratio according to TCE to CET1, the average capital ratio for the banks in Table 6 is used as follows:

$$\frac{CET1}{RWA^{\,Basel\ III}} \Big/ \frac{TCE}{RWA^{\,Basel\ III}} = \frac{11.1\%}{11.8\%} \rightarrow \frac{CET1}{RWA^{\,Basel\ III}} = 0.94 * \frac{TCE}{RWA^{\,Basel\ III}}$$

The following relations between definitions can be achieved by applying the same approach:

- CET1 and equity:

$$CET1 = 0.83 * Equity$$

- Risk-weighted assets RWA under the Basel III accord (RWA$^{\text{Basel III}}$) and the Basel II regulatory framework (RWA$^{\text{Basel II}}$):

$$RWA^{\,Basel\ III} = 1.10 * RWA^{\,Basel\ III}$$

- Risk-weighted assets RWA under the Basel III accord (RWA$^{\text{Basel III}}$) and total assets:

$$RWA^{\,Basel\ III} = 0.33 * Total\ assets$$

The above relations are used to generate the results in Table 7, which demonstrate the relationship between the different capital ratios used in this report: TCE/RWA$^{\text{Basel II}}$, CET1/RWA$^{\text{Basel III}}$ and equity in relation to total assets.

Table 7. Relationship between different capital ratio definitions for Swedish banks (per cent)

TCE/RWA[Basel II]	CET1/RWA[Basel III]	EQUITY/ TOTAL ASSETS
6.0	5.1	2.0
7.0	6.0	2.4
8.0	6.8	2.7
9.0	7.7	3.1
10.0	8.5	3.4
11.0	9.4	3.7
12.0	10.2	4.1
13.0	11.1	4.4
14.0	12.0	4.8
15.0	12.8	5.1
16.0	13.7	5.4
17.0	14.5	5.8
18.0	15.4	6.1
19.0	16.2	6.5
20.0	17.1	6.8

Appendix B – Value of implicit guarantees for major Swedish banks

Research has shown that implicit guarantees by the state can generate substantial profits for the banking sector, among other reasons because the guarantees lead to lower funding costs for the banks. The calculations in this appendix are aimed at estimating the value of the subsidy that major Swedish banks (Nordea, SEB, Svenska Handelsbanken and Swedbank) have received as a result of implicit guarantees during the period 2002-2010.

The method used estimates to which extent these subsidies have improved the profits of the major Swedish banks by using ratings issued by the major credit rating agencies as a starting point. The credit ratings agencies conduct two different types of assessment of the banks that are relevant in this context. The first rating takes into account that different types of support measures decrease the bank's risks – this is known as support rating.[75] The second rating assesses the bank on its own merits – this is known as stand-alone rating.

This method consists of three steps. First, the difference in credit rating between the major banks' stand-alone and support ratings are compared. Second, the average difference in interest levels for instruments with an equally large difference in credit ratings is observed. Third, the value of the subsidy is estimated by multiplying major banks' borrowing by the average difference in interest between instruments with equally large differences in credit ratings as the difference between the major banks' stand-alone and support ratings. The result is an estimate of the extent to which the subsidy affects the banks' net profits on an annual basis.

Table 8 presents the results of these calculations in three dimensions: interest rate differential, value of the subsidy in SEK and value of the subsidy in terms of pre-tax profits for the year. As the table shows, the average interest discount from implicit government support during the period has been about 86 basis points. Converted into SEK, this interest discount amounts to an average of SEK 30 billion per year, corresponding to about half of the four major banks' joint annual pre-tax profit over the entire period 2002-2010. As the interest rate differential has varied over the period 2002-2010, a mean value has been calculated for the subsidy. This means that there are both upward and downward deviations around the mean value.

75 Support ratings normally include not only state support but also potential support from parent companies. Since the report's study is based on credit ratings at the group level, the support rating in this case only includes state support.

Table 8. Estimated value of implicit guarantees for major Swedish banks 2002-2010

	MEAN VALUE
Profit before tax (SEK billion)	58
The banks' securities financing (SEK billion)	2 800
Value of support (number of basis points)	86
Value of support (SEK billion)	30
Value of support in relation to profit	55%

Note: The figures refer to securities financing and profits in the four major Swedish banks at the group level. The calculations are based on how many notches of support the credit rating agencies give the banks due to implicit guarantees. It has been possible to estimate the value of the banks' government guarantees on the basis of these notches.

Sources: Iboxx and the Riksbank.

These results correspond with the results of studies on banks in the United States, Norway and the United Kingdom. In the United States, the subsidy is estimated to lead to interest discounts in the order of 10-100 basis points (Baker and McArthur 2009), and among the largest global banks to an average of 65 basis points (Ueda and di Mauro 2010). The subsidy to the British banks in 2007-2009 is estimated by Haldane (2010) to amount to GBP 50 billion, which is equivalent to the average annual profit for the British banking system as a whole in the years leading up to the crisis of 2007-2009. In Norway, it is noted that the subsidy to DnB Nor is about 10-40 per cent of the bank's annual profit (NOU 2011:1).

Appendix C – Permanent effects of banking crises

This appendix presents a number of arguments for why banking crises have permanent effects on the economy. In addition, it summarises the economic research forming the basis of the assumed effects of a banking crisis that are presented in section 2.1.

ARGUMENTS FOR WHY THE EFFECTS OF A BANKING CRISIS BECOME PERMANENT

The main arguments suggesting that the effects of a banking crisis are permanent are as follows:

- In banking crises, the willingness and ability of the banks to provide loans often decline, which can lead to a credit crunch.[76] This means that investments that would otherwise have been profitable are not made and that the existing capital stock can therefore not be replaced at the desired rate when the capital stock depreciates. Credit crunches have a particularly severe impact in countries with financial systems in which households and companies are highly dependent on bank funding. Sweden is an example of such a country.[77]
- Banking crises are often preceded by major investments in various business sectors, such as commercial property.[78] As economic activity declines in a banking crisis, these investments may turn out to be excessive because there is no longer any demand for the goods and services they were designed to produce. Credit crunches therefore contribute to a situation in which the capital stock at society's disposal over a long period becomes ineffectively distributed.[79]
- As production decreases, demand for labour decreases.[80] There is thus a risk that unemployment will become entrenched at a high level for a long time.

76 See Woolford (2010) for a discussion of why there is a credit crunch in the event of a banking crisis.
77 Krosznera et al. (2007) and Dell'Ariccia et al. (2008) have both found that sectors that are dependent on bank loans for funding are impacted more severely than other sectors in the event of a banking crisis. This research also includes evidence suggesting that this is true to a greater extent in developed countries such as Sweden.
78 A great deal of research has shown that banking crises are preceded by large investments. For a survey of this research, see, for example, Leaven (2011).
79 See, for example, Leaven (2011) for a review of the research documenting that a banking crisis leads to the capital stock being inefficiently allocated.
80 According to Reinhart and Rogoff (2008), unemployment increases by an average of 7 percentage points during a banking crisis.

This could imply that the proportion of people working in the population is falling, as many of those who are unemployed for a longer period find it difficult to find their way back into employment.[81] This reduces society's production capacity for a long time to come.[82]

- Moreover, both the increase in unemployment and the management of a banking crisis impose a burden on public finances. Public expenditure increases and needs to be financed by means of increased borrowing, cuts in welfare spending or distorting taxation.[83] The effect of a banking crisis does not therefore simply disappear when the government intervenes to deal with the problems. Instead, there is a risk that the crisis will develop from a banking crisis into a sovereign debt crisis, which recently happened in Ireland, for example.

RESEARCH FORMING THE BASIS OF ASSUMPTIONS OF THE EFFECTS OF A BANKING CRISIS

In the research, the effects of a banking crisis are usually measured as the discounted cumulative loss of GDP, which in turn is measured as deviations from the trend of the pre-crisis growth path. The results are stated in terms of lost GDP in relation to the GDP at the beginning of the banking crisis. As permanent effects lead to a lower level of GDP for a longer time, the period over which GDP losses are discounted becomes very long. In this way, the effect can amount to levels exceeding 100 per cent of prevailing GDP.

Section 2.1 of the report specifies an interval for the effect of a banking crisis, in which the lower limit is given by the *small permanent effect* of a crisis and the upper limit by the *large permanent effect* of a crisis. The assumption of small permanent effects includes research documenting both temporary and permanent effects. According to the research that documents temporary effects (Hoggart et al. 2002; Leaven and Valencia 2008; Haugh et al. 2009; Cecchetti et al. 2009), a banking crisis is calculated to lead to a cumulative loss of between 16 and 21 per cent of pre-crisis GDP.[84] In the research that documents the permanent effects of banking crises (Cerra and Saxena 2008; Turini et al. (2010), IMF (2009), Furceri and Zdzienicka (2010), Furceri and Mourougane (2009), Barrel et al. (2010), Boyd et al. 2005; Haldane 2010), the loss of GDP due to a banking crisis is calculated

81 One example of this is the crisis in the 1990s, which led to an increase of structural unemployment in Sweden. See Haugh et al. (2009).

82 This is verified by research into this area. For example, Abiad et al. (2009) have found that the effect of a banking crisis is, to a large extent, a consequence of increasing unemployment.

83 Experience shows that the rate of growth declines by one percentage point when the sovereign debt exceeds 90 per cent of GDP, for example in connection with a rapid increase in public expenditure and a loss of income due to a banking crisis (Reinhart and Rogoff 2011).

84 See BCBS (2010a) for a more detailed description of how these results have been obtained from the research.

to amount to between 42 and 302 per cent of the GDP level that prevailed before the banking crisis.

The mean value of all research of the effects of a banking crisis amounts to a cumulative loss of 63 per cent of the pre-crisis GDP level. This mean value forms the basis of the assumption of small permanent effects in section 2.1. The mean value of this research is a cumulative loss of 106 per cent of the pre-crisis GDP level. The mean value of the research that only documents permanent effects, and which forms the basis for the assumption of large permanent effects in section 2.1, amounts to a cumulative loss of 158 per cent of the pre-crisis GDP level. The mean value of the research that only documents permanent effects is a cumulative loss of 145 per cent.

In the research cited above, only Haldane (2010) has estimated the effects of the global financial crisis of 2007-2009. Haldane (2010) calculates the effects of this crisis both in the United Kingdom and globally. Using GDP loss in 2009 as a base, Haldane concludes that the United Kingdom lost between 130 and 520 per cent of annual GDP as a result of the banking crisis. The lower limit for this effect represents a case where 25 per cent of the GDP loss is permanent and the upper limit represents a case where 100 per cent of the GDP loss is permanent. The consequence in terms of global GDP loss as a result of the current financial crisis is estimated at 90 per cent of annual GDP if 25 per cent of the GDP loss is permanent. When 100 per cent of the GDP loss is assumed to be permanent, the effect is 350 per cent of annual global GDP (see Table 9).

Table 9. GDP loss as a result of the global financial crisis with different degrees of permanency

	FRACTION OF GDP LOSS THAT IS PERMANENT		
	25%	50%	100%
United Kingdom	130	260	520
Global	90	170	350

Source: Haldane (2010).

The effects of a banking crisis estimated by Miles et al. (2011) are not included in the research forming the basis of the figures used in this report. Miles et al. (2011) estimated that the consequences of a banking crisis in the form of GDP loss amount to about 140 per cent of the present annual level of GDP, with 25 per cent of the GDP loss assumed to be permanent.

Appendix D – Study 1. Probability of banking crises at different capital ratios according to the LEI report

The report uses various studies to estimate the link between banks' capital ratios and the probability of a banking crisis (see Section 2.1). This appendix describes the first study, which is based on the LEI report (BCBS 2010a). The LEI report uses six different methods to study how the probability of a banking crisis has varied historically with the capital ratio, together with the probability that individual banks will encounter problems at different capital ratios.[85] Using the results of the different methods, an average probability of a banking crisis at different capital ratios is calculated.

Three of the methods used in the LEI report use a larger selection of crises around the world to study how the probability of a banking crisis has varied historically with the capital ratio in 14 countries, including Sweden, between 1980 and 2008.

The other three methods more specifically study the probability that individual banks will experience problems at different capital ratios. These methods assume that a bank has problems when it either enters into bankruptcy or experiences such serious difficulties that a bankruptcy is imminent. Two of these methods define a banking crisis as a situation in which 4 of 51 global banks encounter problems, and one method as a situation in which two out of five British banks encounter problems. Furthermore, these three methods assume that the banks' asset values are correlated. This means that, if the value of Bank A's assets decrease, the value of Bank B's assets will also decrease. By including this correlation in the calculation, the methods capture the interconnectedness between banks.

Table 10 shows the LEI report's estimates of the probability of a banking crisis in one year with various capital ratios. The first column presents the average probability of a banking crisis based on the average of the six methods described above. The second and third columns present the highest and lowest probability of a banking crisis at each capital ratio identified in the six methods. Like the LEI report, the Riksbank's analysis of the appropriate capital ratio only uses the average probability of a banking crisis. In other words, the analysis disregards probabilities calculated by each individual method in the LEI report.

85 For a more detailed description of the methods used to generate the probabilities, see Annex 2 of the LEI report (BCBS 2010a).

Table 10. Annual probability of a banking crisis at different capital ratios according to the six methods in the LEI report

CAPITAL RATIO (TCE/RWA$^{Basel\ II}$), PER CENT	AVERAGE PROBABILITY OF A BANKING CRISIS, PER CENT	HIGHEST PROBABILITY OF A BANKING CRISIS, PER CENT	LOWEST PROBABILITY OF A BANKING CRISIS, PER CENT
6	7.2	12.8	3.2
7	4.6	6.0	2.5
8	3.0	4.3	1.9
9	1.9	3.4	0.8
10	1.4	2.7	0.3
11	1.0	2.1	0.1
12	0.7	1.7	0
13	0.5	1.3	0
14	0.4	1.0	0
15	0.3	0.8	0

Note. The probabilities for capital ratios greater than 15 per cent are not presented in the table since the LEI report only reports probabilities at capital ratios up to 15 per cent. The first study uses the average probability of a banking crisis.

Source: BCBS (2010a).

Appendix E – Study 2. Probability of a banking crisis at different capital ratios according to Miles et al. (2011)

This appendix describes the second study used in the report to estimate the link between the banks' capital ratios and the probability of a banking crisis (see section 2.1), and which is based on the method used in Miles et al. (2011).

The method is based on the assumption that a country's banks will experience losses, primarily loan losses, in relation to their risk-weighted assets (RWA) in the same proportion as that country's GDP decreases.[86] Using data from British banks as a starting point, Miles et al. (2011) present results that show that this assumption corresponds well with historical experiences.

Experiences from the Swedish banking crisis in the 1990s indicate that the assumptions of Miles et al. (2011) are also a reasonable approximation of Swedish circumstances. The Swedish banks' level of loan losses, i.e. their total loan losses as a percentage of the stock of loans, amounted to 10.8 per cent between 1991 and 1993.[87] During the same period, GDP in Sweden fell by 4.3 per cent. On the other hand, the assumptions are partly contradicted by the Swedish banks' experiences in the global financial crisis of 2007-2009, when their loan losses amounted to 1.2 per cent while the total decline of GDP was 5.9 per cent (see Table 11). However, it is important to note that, while the crisis of the 1990s was a domestically-generated "traditional" loan loss crisis, the last crisis was an internationally-generated liquidity crisis that was worsened by unease among the banks' debtors that the Swedish banks would be impacted by extensive loan losses, especially in the Baltic countries.

Both the results of Miles et al. (2011) and the Swedish experiences of the crisis of the 1990s thus indicate a link between the development of the real economy and the total amount of the banks' losses.

86 However, an increase of GDP does not result in any losses for the banks.

87 It should be added that, in this context, losses are equivalent to loan losses. However, losses can also arise for the banks as a result, for example, of adverse market fluctuations (primarily interest rates and currencies) and in the banks' own trading of financial assets. Furthermore, this disregards the fact that the banks may have earnings before loan losses that can absorb a part of these loan losses. According to Miles et al. (2011) the assumption holds true even if these components are taken into account. Furthermore, they claim that the loan losses incurred by the banks during historical GDP declines are in proportion to the total assets, rather than with the risk-weighted assets. As the total assets make up about one third of the risk-weighted assets (see Appendix A), this should mean that the banks are incurring loan losses in proportion to the risk-weighted assets of a magnitude three times that of the decrease in the country's GDP.

Table 11. The Swedish banks' loan losses and the variation of GDP in Sweden

Total loan losses 1991-1993 in relation to loan stock 1990	10.8%
Change of real GDP 1991-1993	-4.3%
Total loan losses 2008-2009 in relation to loan stock 2007	1.2%
Change of real GDP 2008-2009	-5.9%

Source: The Riksbank.

Miles et al. (2011) use data from a large group of countries over a period of 200 years to obtain a distribution of historically-observed GDP growth.[88] From this, the probability of GDP (on an annual basis) falling by a certain percentage can then be calculated (see table 12).[89] According to the method's assumptions, the banks incur losses in relation to their risk-weighted assets that correspond with the percentage fall in GDP. That is to say, if GDP falls by 7 per cent, the banks' total losses will amount to 7 per cent in relation to the risk-weighted assets. So, the distribution of GDP changes also gives the probability that the banks' losses in relation to risk-weighted assets will amount to a certain size.

Miles et al. (2011) define a banking crisis as a situation in which the banks together incur losses that exceed their total amount of capital in terms of TCE.[90] From the method's assumptions, it thus follows that, if the banks have a capital ratio below the fall in GDP, a banking crisis will occur. The distribution of GDP changes therefore also gives the probability that there will be a banking crisis at any specific capital ratio. According to the distribution that Miles et al. (2011) have produced, there is a probability of 3.9 per cent that GDP will decrease by 7 per cent or more. From the assumptions made in the method, it follows that, in the event of such a decrease of GDP, the banks would incur losses in relation to the risk-weighted assets of an equivalent magnitude. In turn, this means that the banks must have a capital ratio ($TCE/RWA^{Basel\ II}$) of at least 7 per cent to avoid a banking crisis developing. Consequently, according to this method, there is a 3.9

88 See Miles et al. (2011) for a detailed description of how this distribution was obtained. The distribution that Miles et al. (2011) have produced has the same mean value (1.8 per cent), standard deviation (5.9 per cent), skewness (-2.65) and kurtosis (20) as the observed real development of GDP. In addition, the risk of extreme events has been captured by the distribution.

89 Miles et al. (2011) only give the probability of a banking crisis at isolated capital ratios. However, for the analysis in this report, estimates of the probability of a banking crisis are needed at more capital ratios than those reported in Miles et al. (2011). Consequently, a breakdown of the change of GDP has been generated, using the parameters presented by Miles et al. (2011) as a starting point. However, it should be added that, in this case, the expected value and standard deviation are of roughly the same size as Miles et al. (2011) calculate. But their allocation is both more skewed and more pointed than the allocation generated here. This is probably only the result of chance.

90 To be in accordance with the other studies, this study defines capital ratio as $TCE/RWA^{Basel\ II}$. Miles et al. (2011) do not explicitly state which definition of capital ratio their method refers to. However, they do state that their definition primarily corresponds with $CET1/RWA^{Basel\ III}$. If table 12 is recalculated from the definition according to $CET1/RWA^{Basel\ III}$ to $TCE/RWA^{Basel\ II}$, this would mean that the appropriate capital ratios according to study 2 would have to be higher.

per cent probability that there will be a banking crisis if the banks' capital ratio is 7 per cent.

Table 12 shows the probability of a banking crisis at different capital ratios, obtained from the method in Miles et al. (2011). Consequently, this is also the probability of a banking crisis at different capital ratios according to the second study.

Table 12. Annual probability of a banking crisis at different capital ratios according to the second study

CAPITAL RATIO (TCE/RWA$^{\text{Basel II}}$), PER CENT	PROBABILITY OF A BANKING CRISIS, PER CENT
6	4.4
7	3.9
8	3.5
9	3.1
10	2.6
11	2.2
12	1.8
13	1.4
14	1.1
15	0.9
16	0.8
17	0.8
18	0.7
19	0.7
20	0.7

Appendix F – Study 3. Probability of a banking crisis based on the conditions in Sweden

The third study uses a method that, as far as is possible, takes actual conditions in the four major Swedish banks (Nordea, SEB, Svenska Handelsbanken and Swedbank) into account when calculating the probability of a banking crisis (see sections 1.3 and 2.1).

The method is based on the assumption that, for various reasons, the value of a bank's assets changes from one period to the next. The value of a bank's assets may increase if, for example, the bank in question generates profits that are not distributed. The asset value may decrease if the bank suffers credit losses, for example as a result of an unfavourable economic development. As banks, just like other companies, are affected by unforeseen events, it is difficult to predict changes in the value of assets. Consequently, the method assumes that the value of assets will largely develop randomly.

In this method, a banking crisis is defined as a situation in which the value of the bank's assets decreases to such an extent that the value of the bank's liabilities exceed the value of its assets, and the bank's capital is thereby wiped out. However, by having a higher capital ratio, a bank will less frequently find itself in a situation in which its asset values have changed to such a degree that its continued operations are jeopardised. Within the framework of the method in question, higher capital ratios decrease the probability of banking crises. As the method used in this study is based on conditions that apply for individual banks, and a banking crisis is defined as a situation in which at least one bank's capital is erased, the variation of the probability of a banking crisis at different capital ratios can be calculated.

In order to study the occurrence of banking crises at different capital ratios based on the value of the banks' assets and changes in this value, it is necessary to have i) an initial value of the banks' assets, ii) an assumption about the change in the assets' value from one year to the next, and iii) a definition of what constitutes a banking crisis. These steps are described below:

i. To determine the initial value of the four major Swedish banks' assets, the average market value of the banks' assets for 2010 is used.[91] This is

91 It can be noted that the average market value for 2010 is very close to the average book value of the banks' assets.

calculated by using data obtained from the Creditedge database provided by the company Moody's KMV. The calculations are based on the market value of the four banks' assets on a daily basis.[92]

ii. In addition to needing to know in advance the market value of the assets, the method also requires an assumption about how the assets' market value will change from year to year. In this study, it is assumed that changes can be *expected* or *unexpected*. The expected change is the change in assets that can be expected, given a historical average over a period of many years. This change is assumed to be positive and is intended, for example, to capture the profits a bank is expected to make on average over a period of many years. The unexpected change is assumed to be zero on average, but includes a random element that captures, for example, the varied economic circumstances that can contribute towards the change in the assets' value being higher or lower than average in a certain year. Credit losses that are larger than expected are one example of a factor that is captured by the unexpected change. The random element that is used in the calculations is calibrated to the randomness that is observed in empirical data. Given this, the assets' value is expressed in equation (1) below.

$$T_1 = (1+g/100)\,T_0 + \varepsilon \qquad (1)$$

T_0 is the assets' initial value, year 0, while g is the expected percentage development of the assets between year 0 and year 1. The non-expected change in asset value is designated ε. Finally, T_1 designates asset value, year 1.

The expected development of the banks' assets, which is to say the return on the bank's assets, is set at 0.73 per cent in this report. This value corresponds with the return Swedish banks have had on their assets since the mid-1990s.[93]

In addition to the expected change in the assets (return), it is also necessary to analyse a unexpected change in the assets. The results of this study are based on simulations of a large number of unexpected changes in

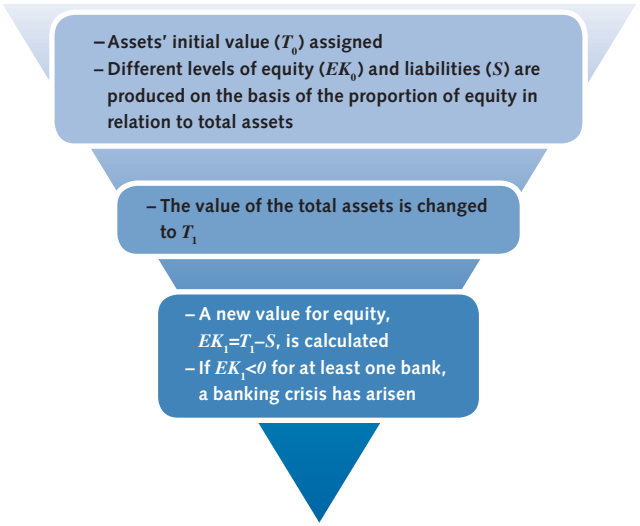
92 Daily observations of the market value of the assets are calculated using the book value of the banks' liabilities, the market value of outstanding shares and Moody's KMV's estimation of the volatility in the asset value. The banks' liabilities and the volatility of the market value of the assets are interpolations of monthly data to daily data.

93 The return on assets is based on the average for profits in relation to total assets for commercial banks in the United States in the period 1934-2010. This data was obtained from www.fdic.gov. This return is of a similar magnitude to that found in the short-term Swedish data series. The return on assets is also consistent with the required return on equity frequently mentioned by banks and other market agents.

the asset value.[94] The simulations generate unexpected changes in the asset value corresponding to the volatility in the observed changes in the asset values during 2010.[95]

iii. In order to study the probability of banking crises given the development in the assets' value according to the above description, it is necessary to also define when a banking crisis has occurred. As is mentioned above, the definition used in this study is when the value of at least one bank's assets is lower than the value of that bank's liabilities. By creating variations in the bank's equity and liabilities and observing when the value of the assets is lower than that of the liabilities, it is possible to estimate the probability of a banking crisis. This is done in practice by repeatedly simulating the changes in the assets at different capital ratios multiple times using the Monte Carlo method and studying how frequently at least one bank finds itself in a situation where the value of its assets is lower than the value of its liabilities. The steps that are conducted using the Monte Carlo simulation are described schematically in Figure 1.

Figure 1. Schematic description of Monte Carlo simulations of banking crises



94 The non-expected changes are generated according to a t-distribution with four degrees of freedom and with a correlation corresponding to the correlation found in the asset changes during 2010. Similar distribution assumptions are for example present in BCBS (2010a).

95 If a comparison is made between the volatility in the change in the assets' market value in 2010 and in other periods, it becomes apparent that the volatility is lower in 2010 than it was in 2008 and 2009. However, the volatility is higher in 2010 than in 2007. Compared to the volatility of the entire available sample, from February 2006 to August 2011, the volatility for 2010 is slightly lower.

Based on the assumptions presented in Figure 1, it is possible to simulate the occurrence of banking crises at different levels of equity in relation to total assets. Since it is possible to convert this ratio into TCE/RWA$^{\text{Basel II}}$ (see Appendix A), it is possible to produce a relationship between this capital ratio and the probability of a banking crisis. Table 13 shows the relationship between TCE/RWA$^{\text{Basel II}}$ and the probability of a banking crisis that was simulated using the method described in this appendix. This is thus the probability of a banking crisis according to study 3.

Table 13. Annual probability of banking crises at different capital ratios (TCE/RWA$^{\text{Basel II}}$) according to the third study

CAPITAL RATIO (TCE/RWA$^{\text{Basel II}}$), PER CENT	PROBABILITY OF A BANKING CRISIS, PER CENT
6	5.9
7	4.3
8	3.2
9	2.4
10	1.8
11	1.4
12	1.1
13	0.9
14	0.7
15	0.6
16	0.4
17	0.4
18	0.3
19	0.3
20	0.2

Appendix G – The macro model used to calculate the social cost of higher capital ratios and prior research

This appendix describes the macro model used to estimate the cost of higher capital ratios presented in section 2.2. In addition, a brief presentation of the results of prior research on the costs of increased capital ratios is given.

THE MACRO MODEL USED TO ESTIMATE THE SOCIAL COST OF HIGHER CAPITAL RATIOS

The macro model is a so-called dynamic general equilibrium model that, in many aspects, is similar to the Riksbank's macro model, Ramses.[96] Unlike Ramses, this model contains an explicit banking sector.

The actors in the model include households, firms, banks and a central bank. The households decide how much they want to consume and work to maximise utility over their lifetime. They are also lenders and therefore deposit their savings in the banks.

There are two types of firms, both of which maximise profit. The first type of firm uses labour and capital to produce consumer goods. These firms operate on a market characterised by monopolistic competition. The market consists of a large number of competing firms that sell similar but not identical products to a large number of buyers. This means that the firms can influence the market price. The second type of firm (which can be called entrepreneurs) produces capital goods. These goods are used by the first type of firm as input in the production of consumer goods.

An important assumption in the macro model is that the entrepreneurs need external funding in order to be able to maintain operations. Households provide this funding by depositing their savings with banks. In turn, the banks lend these funds to the entrepreneurs. The banks thus fulfil a function as financial intermediaries.

The banks' role as a financial intermediary between the households and entrepreneurs is hampered by two types of moral hazard problem. The first problem is related to the relationship between the banks and entrepreneurs. The entrepreneurs can choose to invest in different types of risk projects. They can

96 A detailed and formal description of the model is given in Meh and Moran (2010). See Christiano et al. (2011) for a description of Ramses.

invest in projects that have a low probability of success but offer private benefits or in projects that have a high probability of success. The banks do not have full transparency into the entrepreneurs' operations. Therefore, they cannot be sure that the entrepreneurs are choosing projects that have a high probability of success. Consequently, the macro model assumes that the banks produce agreements that prescribe that the entrepreneurs must invest their own funds in the projects to receive a bank loan. This gives the entrepreneurs an incentive to select projects that have a high probability of success.

The second moral hazard problem is that it is costly for the banks to monitor the entrepreneurs and that the households (the banks' lenders) do not have full transparency into the banks' operations. This means that the banks can face incentives to be less thorough when monitoring projects and allow the lenders to shoulder the consequences if the projects should fail. Consequently, the model also assumes that households design agreements that prescribe that the banks must invest their own funds in their lending transactions so as to have incentives to monitor the entrepreneurs. This gives the banks a vested interest in monitoring the operations of the entrepreneurs.[97]

The agreements also state which solvency requirements the banks must meet in order to be able to attract new depositors. The solvency requirements are reflected in a market-based capital ratio that is dependent on the return on bank capital and the banks' financing costs.

The households prefer to lend to banks with a large share of equity since these banks face greater incentives to monitor the entrepreneurs' operations. In other words, it is easier for banks with high capital ratios to receive funding. This has an impact on lending and thereby also on investments and economic activity.

The role of the central bank in the model is to determine the monetary policy by deciding the policy rate. The policy rate is assumed to follow the Taylor rule and is dependent on the actual inflation's deviation from the inflation target and the deviation of production from its trend.

THE SOCIAL COST OF HIGHER CAPITAL RATIOS IN PRIOR RESEARCH

There is prior research that has estimated the social cost of increased capital ratios. The LEI report (BCBS 2010a) presents results that were calculated using a general equilibrium model with bank capital similar to the model used in this report. According to the model in the LEI report, GDP decreases by around 0.14 per cent if the capital ratio increases by one percentage point. The LEI report also presents the results of empirically-based models, which are called VECM models (Vector Error Correction Models). As a rule, the costs in these models are lower. The

97 The actual monitoring of the entrepreneurs consists of activities such as inspecting their cash flows and balance sheets and verifying that they meet the terms and conditions of the loans.

average cost of an increased capital ratio based on these theoretical and empirical models presented in the LEI report is a decrease in GDP of 0.12 per cent. The LEI report also calculates the cost using the method proposed in Van den Heuvel (2008). If this method is used, the cost will be 0.1 per cent lower GDP.

Miles et al. (2011) estimate the cost of an increased capital ratio based on different empirical connections. According to this report, an increase of one percentage point in the capital ratio leads to an increase in the banks' lending margin of 0.05 percentage points and a decrease in production of only 0.04 per cent. Barrell et al. (2009) use NiGEM, which is a relatively large econometric model developed by the National Institute of Economic and Social Research in the United Kingdom. The results of the study show that the lending margin increases by 0.22 percentage points and production decreases by 0.10 per cent if the capital ratio increases by one percentage point.

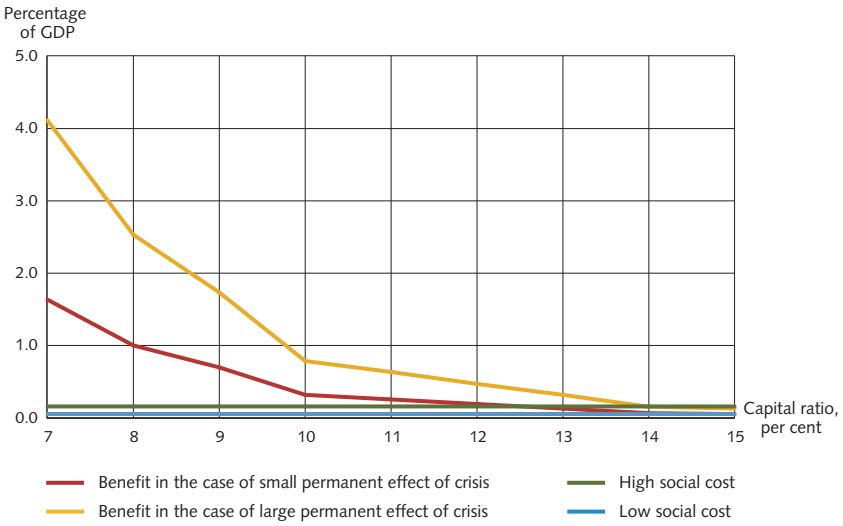
Jaffee and Walden (2010) evaluate the calculations of social costs of increased capital requirements under the Basel III framework. They use as a base a general equilibrium approach and assert that several of the capital costs that are associated with increased capital requirements cannot be viewed as costs from a social perspective. The increased capital costs can also be offset by appropriate state intervention. Their conclusion therefore is that the increased capital requirements have only marginal effects on the long-term production.

Appendix H – Illustration of the utility and cost of increasing the capital ratio

This appendix illustrates in charts the report's calculations of the benefit and cost of increasing the capital ratio by one percentage point. In addition, it illustrates the total net effect on GDP of an increase in the capital ratio in accordance with the various studies.

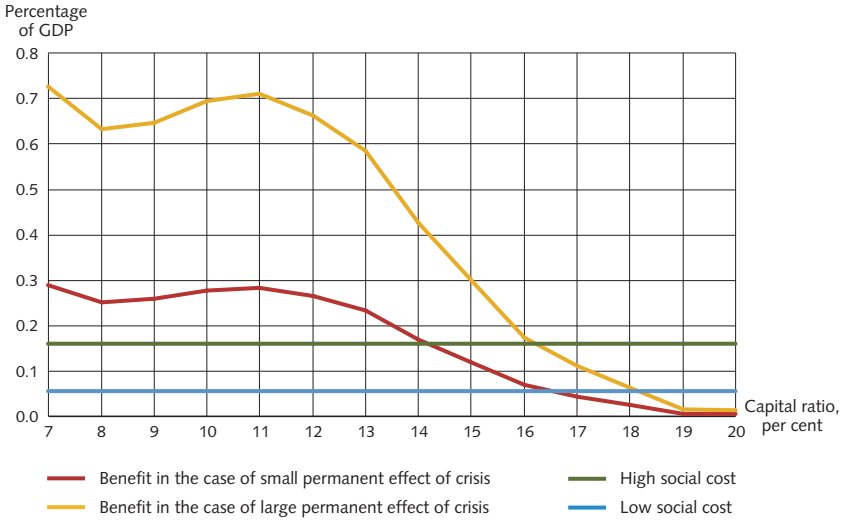
Charts 6a, b and c show the benefit of an increased capital ratio when the permanent effect of a banking crisis is assumed to be small or large respectively, and the cost of an increased capital ratio when it is either low or high. The appropriate capital ratio in these charts is the point where the utility curve intersects the cost curve. The capital ratio is specified in the Charts as TCE/RWA$^{\text{Basel II}}$.

Chart 6a. The benefit and cost of increasing the capital ratio by one percentage point for different capital ratios according to study 1 (the LEI report)



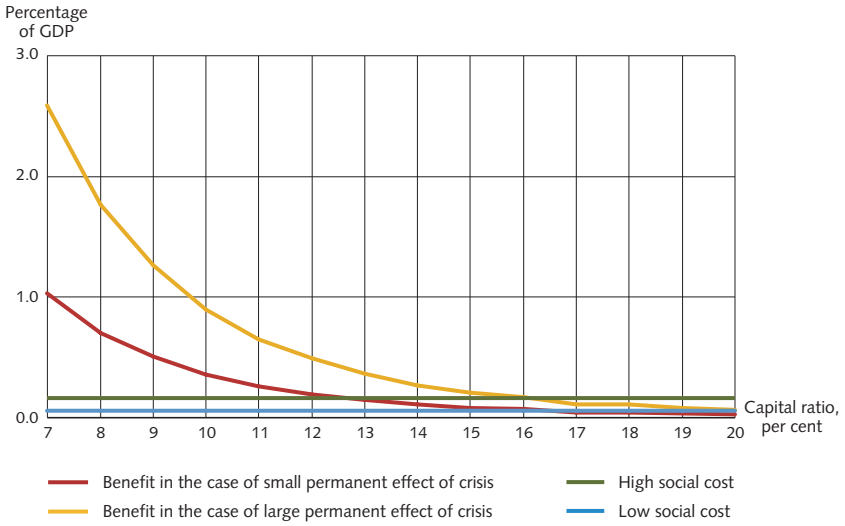
Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$.

Chart 6b. The benefit and cost of increasing the capital ratio by one percentage point for different capital ratios according to study 2 (Miles et al. 2011)



Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$.

Chart 6c. The benefit and cost of increasing the capital ratio by one percentage point for different capital ratios according to study 3 (Swedish conditions)

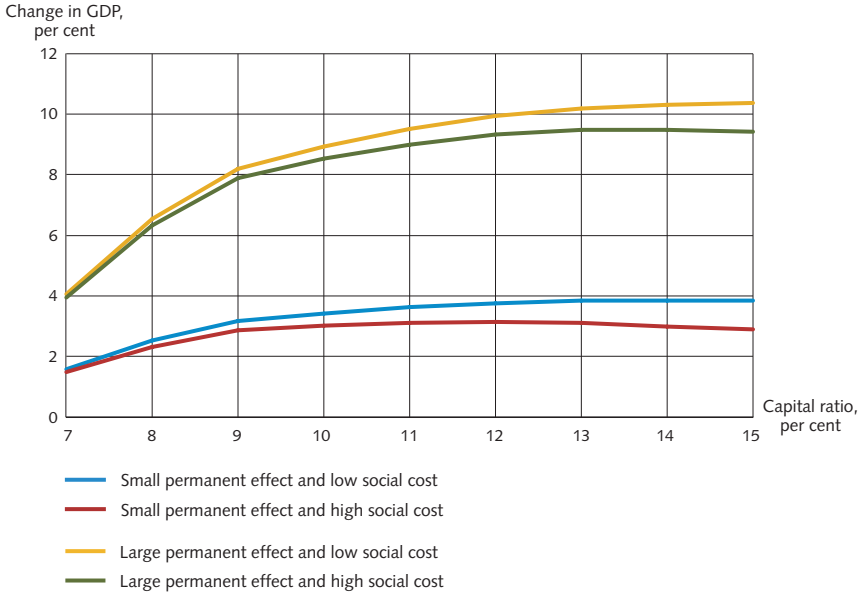


Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$.

Charts 7a-c show the total net effect in terms of the change in GDP when the capital ratio increases from 6 per cent to higher capital ratios. The net effect of these charts is shown as a changed GDP level as a result of higher capital ratios when the utility is put in relation to the cost. The appropriate capital ratio in these

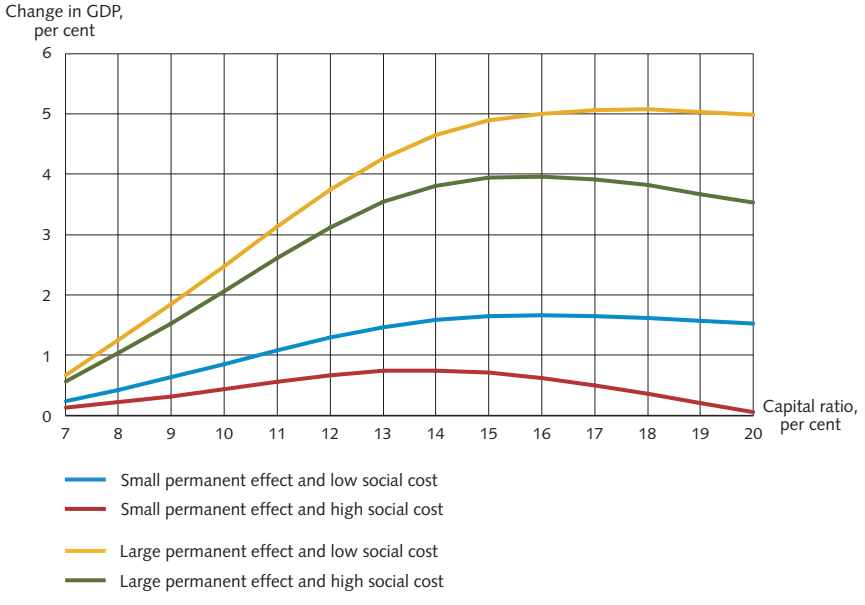
charts is the capital ratio where the change in GDP is the greatest. The chart gives the capital ratio as TCE/RWA[Basel II].

Chart 7a. The net effect of increasing the capital ratio from 6 per cent for different capital ratios according to study 1 (the LEI report)



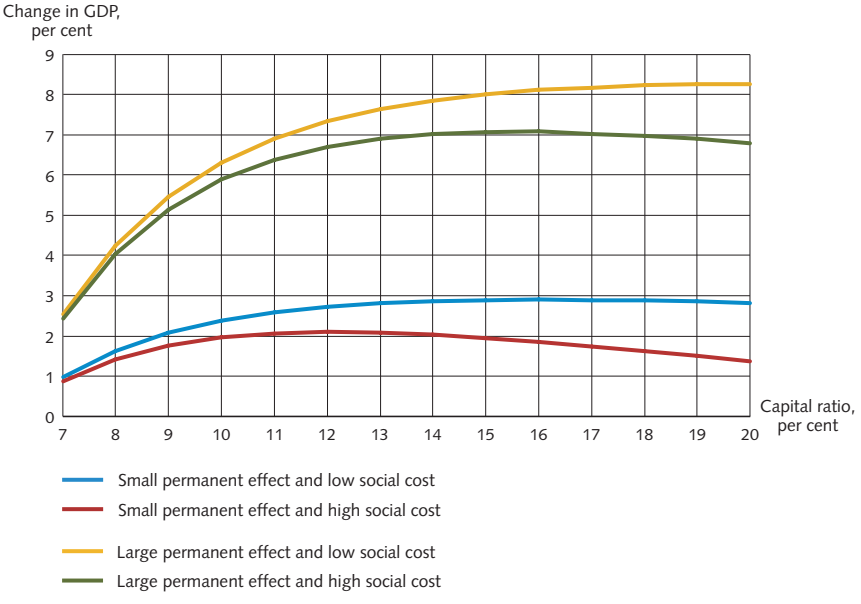
Note. The capital ratio is expressed in the chart as TCE/RWA[Basel II].

Chart 7b. The net effect of increasing the capital ratio from 6 per cent for different capital ratios according to study 2 (Miles et al. 2011)



Note. The capital ratio is expressed in the chart as TCE/RWA[Basel II].

Chart 7c. The net effect of increasing the capital ratio from 6 per cent for different capital ratios according to study 3 (Swedish conditions)



Note. The capital ratio is expressed in the chart as TCE/RWA$^{\text{Basel II}}$.

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