
Real Economic Consequences of Financial Crises

Kim Abildgren, Economics, Birgitte Vølund Buchholst and Atef Qureshi, Financial Markets, and Jonas Staghøj, Statistics¹

1. INTRODUCTION AND SUMMARY

The Danish economy has been characterised by substantial fluctuations in recent years. The years prior to the Financial Crisis saw considerable overheating and soaring prices of both commercial and residential properties. The strong increases in house prices throughout the first part of the 2000s were to a large extent driven by the introduction of new loan types (adjustable-rate loans and deferred amortisation), and from the middle of the decade, the housing market became so frenzied that it can justly be described as a genuine house price bubble with unrealistic expectations of future house prices, cf. Dam et al. (2011).

The downturn in the housing market and an economic slowdown started in late 2007. In the 4th quarter of 2007 both house prices and seasonally adjusted quarterly real GDP fell. This means that the Danish economy was already slowing down before the global financial crisis and the recession in the world economy really took off. The global financial crisis originated in the USA, which had also seen a strong increase in house prices and a build-up of imbalances in the economy in the pre-crisis years. The same applied in several other countries.

The decline in the Danish housing market reinforced the contractive effects of the global financial crisis. Part of the banks' lending is collateralised on real property, and a number of banks have had to make substantial impairment charges on property-related exposures in step with the reversal of property prices. Many banks had also increased their lending far beyond the level of their deposits prior to the crisis, thereby accumulating considerable customer funding gaps. This meant that Danish banks had to rely on the financial markets as a source of financing, which made them particularly vulnerable in connection with the erup-

¹ The authors would like to thank Heino Bohn Nielsen, Department of Economics at the University of Copenhagen, for valuable suggestions and comments in connection with the preparation of the analyses in this article. Any inaccuracies in the article as well as the views and conclusions presented are attributable to the authors alone.

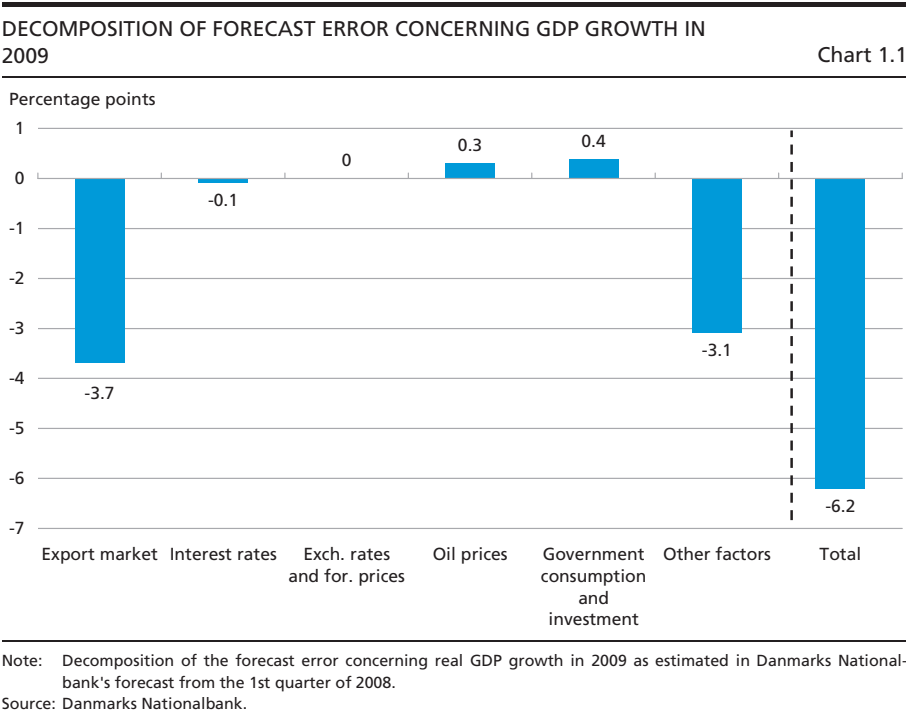
tion and global spreading of the international liquidity crisis. During the financial crisis in recent years, four out of Denmark's 15 largest banks have ceased to exist as independent firms, and the government has intervened extensively to support financial stability.

Due to the sharp aggravation of the international financial crisis in the autumn of 2008, real GDP growth in Denmark was around 6 percentage points lower in 2009 than forecast by Danmarks Nationalbank in the 1st quarter of 2008, cf. Chart 1.1. While around half of the forecast error could be attributed to lower export market growth, the other half primarily reflected "other factors". The "other factors" item covers many different circumstances, including those related to the Financial Crisis. They may include e.g. changes in private-sector consumption and investment behaviour in the wake of the global financial crisis that generally increased the uncertainty concerning the economic outlook and undermined confidence in the financial system. The "other factors" item may also reflect the effect of the banks' need to tighten their credit terms and widen their interest margins in view of the cyclical reversal. This should be viewed not least in light of the lenient credit standards prior to the Financial Crisis. Finally, the "other factors" item covers the effect of all other impacts on the economy and changes in the economic structure that cannot be attributed to changes in the other elements shown separately in the decomposition in Chart 1.1.

Historical experience from many other countries shows that economic downturns that coincide with financial crises are longer and deeper than other economic downturns, and that economic upswings following a banking crisis are weaker than normal, cf. Reinhart and Rogoff (2009a) and Reinhart and Reinhart (2010). The analyses in this article can be seen as an attempt to gain an impression of the extent to which financial crises have a negative impact on the Danish economy compared with business cycles without a financial crisis.

Section 2 in this article presents an overview of banking crises in Danish economic history. They include the Monetary Crisis 1857-58, the Savings Bank Crisis 1876-78, the Liquidity Crisis 1885, the Construction and Banking Crisis 1907-09, the Banking Crisis 1920-33, the Kronebank Crisis 1984-85, the seven-year slump 1987-93 and the Financial Crisis from 2007/08 onwards. Most of those crises were characterised by a substantial increase in the banks' write-down ratios and the resulting undermining of the banks' capital bases. This was the case in the 1920s in particular, and in accumulated terms more than 20 per cent of loans and guarantees were written down in the period 1920-33.

Section 3 compares the length and depth of economic downturns with and without banking crises in the past 200 years. Like studies from other



countries, our findings show a clear pattern of economic downturns with banking crises being deeper and longer than downturns without banking crises. The reason may be that economic downturns are aggravated by banking crises, but it may also merely reflect the fact that banking crises occur during deep economic downturns. Sections 5-7 will further discuss the extent to which effects of the former type apply.

Based on a number of summary calculations, section 4 discusses the size of the gross output loss suffered by the economy during an economic downturn with a banking crisis compared with a normal economic downturn. Furthermore, the size of the net output loss is calculated, deducting the higher output created during a prior credit expansion if the latter was at the root of the actual banking crisis. It is estimated that while the accumulated gross output loss during the economic downturn 2007-09 characterised by the Financial Crisis amounted to around 3.6-4.2 per cent of the gross domestic product, GDP, the net output loss was in the range of 2.2-4.2 per cent of GDP.

Section 5 seeks to quantify the extent to which recent years' financial crisis has had a negative impact on the business cycle. The calculations are based on a quarterly model for the Danish economy since 1948 that comprises a number of selected real economic as well as monetary and financial variables. The calculations indicate that in the period 2009-13

real GDP is on average 2.25-2.5 per cent below what it would have been in the absence of the Financial Crisis. This corresponds to a total accumulated output loss of around 12 per cent of GDP over the period 2009-13. An important question when reviewing the transmission process of the Financial Crisis is whether there have been periods showing signs of a general "credit crunch". A credit crunch may occur if the banks reduce the supply of credit considerably more than the weak economic development would warrant, making it difficult for creditworthy borrowers to obtain financing. This question cannot be answered on the basis of the above model calculation, as it requires supplementary information. Based on Statistics Denmark's confidence indicators, only a limited number of firms, particularly in manufacturing industry and building and construction, have reported financial constraints as impediments to production in recent years. This indicates that the Financial Crisis was not accompanied by a general credit crunch. Accordingly, the output loss caused by the Financial Crisis is, on the whole, attributable to the more general negative impact of the Financial Crisis on the economy. The calculations also show that the output loss occurred at the beginning of the crisis, i.e. at the end of 2008 and in the 1st half of 2009, followed by stabilisation. It would be natural to regard this stabilisation as an effect of the economic-policy measures (including the bank rescue packages).

The analyses in sections 2-5 are based on macroeconomic data. Sections 6-7 discuss the conclusions concerning the impact of banking crises that can be drawn from analyses of individual firms' financial statements.

Based on a failure-rate model, section 6 reviews whether the financial health of a firm's bank affected the firm's survival during the most recent financial crisis. The analysis indicates that the default risk for firms with a "weak" bank was higher in 2008-09 than for similar firms with a "sound" bank. The question is how those results should be interpreted. Firstly, the calculations are based on the assumption that the explanatory variables in the failure-rate model (return on assets, debt ratio, auditors' qualification, etc.) fully allow for the fact that the probability of default is higher for firms with "poor" finances than for firms with "healthy" finances. Where this is not the case, the impact of having a "weak" bank on a firm's probability of default will be overestimated because "weak" banks tend to have a higher share of "bad" customers. In such cases it cannot be ruled out that the calculations simply reflect the default of unprofitable firms during the Financial Crisis and that those firms were mainly customers of "weak" banks. Secondly, the calculations assume that in terms of the probability of default, the effect of having a "weak" bank is the same for all firms. In view of the fact that only a small number of firms in recent years have reported financial con-

straints as impediments to production, these results might indicate that dependence on "weak" banks affected only the probability of default for a small share of firms, while the probability of default for the majority of firms was not affected by the state of their banks.

To illustrate this issue, section 7 focuses on whether a negative effect of having a "weak" bank can be seen on the return on assets for the majority of non-defaulting firms during the Financial Crisis. There are no indications that the return on assets for non-defaulting firms during the Financial Crisis was dependent on the "soundness" of their banks. This is consistent with Statistics Denmark's confidence indicators, which indicate that only a limited number of firms have reported financial constraints as impediments to production during the Financial Crisis.

The analyses in sections 3-7 focus on the real economic consequences of banking crises in the short and medium term. Section 8 discusses the consequences of banking crises to economic growth and the income level in the economy in the longer term. For Denmark as well as other countries it is difficult to see any direct effect of previous banking crises on the long-term economic growth rate or income level per capita. Obviously, this does not mean that banking crises may not have any consequences for the long-term economic growth rate or income level. But it does imply that factors other than banking crises may be decisive for the economic growth rate and income level in the longer term.

In summary, the analyses in this article show that a financial crisis has a substantial negative impact on the real economy in the short and medium term. This highlights the importance of an economic policy aiming for stable economic development to avoid a massive build-up of imbalances in the economy followed by a crisis when the bubble bursts and the imbalances are redressed. The costs of financial crises should also be borne in mind when assessing the proposals for future regulation of the banking sector that are currently being prepared in international forums. Depending on the pace, the phasing-in of new capital and liquidity requirements may have some minor transitional consequences for the economy, cf. Christensen (2011). But, as shown by the analyses in this article, there will be large potential gains for the economy if the future regulation contributes to fewer and less serious financial crises in the future.

2. IDENTIFICATION AND DATING OF BANKING CRISES IN DANISH ECONOMIC HISTORY

An empirical analysis of the real economic consequences of banking crises requires identification of the periods during which crises and instabil-

BANKING CRISES IN DANISH ECONOMIC HISTORY SINCE 1857

Table 2.1

Crisis	Brief description	Extraordinary government measures	International dimension?
The Monetary Crisis 1857-58	Liquidity problems of Danish banks and trading houses that were dependent on foreign financing.	The government established a "Temporary Loan Fund", which provided loans to banks and commercial businesses.	International liquidity crisis that spread from the USA to Europe.
The Savings Bank Crisis 1876-78	Several savings banks and a few commercial banks experienced a crisis during a recession.	Danmarks Nationalbank had to provide extraordinary loans to a few banks.	In 1873 the global economy was hit by a prolonged recession.
The Liquidity Crisis 1885	During a wave of bankruptcies the banks' liquidity comes under pressure.	Liberal lending policy on the part of Danmarks Nationalbank.	No
The Construction and Banking Crisis 1907-09	Several medium-sized commercial banks and Denmark's largest savings bank experienced difficulties.	The government, Danmarks Nationalbank and a number of large private banks established a Banking Committee with a view to providing guarantees for depositors and other creditors in crisis-stricken banks. Denmark's largest savings bank is reconstructed with government help.	A US banking crisis in 1907 impeded international financing.
The Banking Crisis 1920-33	A large number of Danish banks, including the five largest, experienced difficulties.	Several large banks, including Scandinavia's largest bank – Landmandsbanken – received capital and/or liquidity support from the government and Danmarks Nationalbank.	The late 1920s and the early 1930s were characterised by financial, banking and currency crises in many countries (cf. the US stock market crash in 1929 and the collapse of the international gold standard system in 1931).
The Krone-bank Crisis 1984-85	Denmark's seventh largest bank, Kronebanken, experienced difficulties.	Danmarks Nationalbank and a number of large banks provided a guarantee aimed at depositors and other creditors in Kronebanken.	No
The seven-year slump 1987-93	A number of banks encountered difficulties, including Denmark's ninth largest bank, Varde Bank.	The government and Danmarks Nationalbank were involved in finding solutions for five distressed banks. In addition, the Faroe Islands experienced a banking crisis.	Currency crisis in the European Monetary System 1992-93. Systemic banking crises in Norway, Sweden and Finland.
The Financial Crisis from 2007/08 onwards	A number of banks experienced difficulties and had to cease as independent firms, including four of the 15 largest banks.	The government provided a safety net for the banks by way of a comprehensive government guarantee for depositors etc. In addition, the government provided capital injections to a large number of credit institutions and gave credit institutions the opportunity to purchase an individual government guarantee on debt issues. Danmarks Nationalbank established additional credit facilities and expanded the collateral base.	An international liquidity crisis spread from the USA to Europe in the second half of 2007, developing into a genuine global credit crisis in 2008.

ity in the financial sector may potentially have had a significant negative impact on the economy.

In the literature, several different approaches have been used to identify periods of such "systemic" banking crises. Reinhart and Rogoff (2009b) delimit banking crises to situations in which the government has intervened in various ways, while Bordo et al. (2001) classify banking crises as situations in which a large part of the banking sector's capital base is undermined.

In the literature, different approaches have also been used to pinpoint the start and end times of the banking crises. For example, some studies define the start of a banking crisis based on the timing of a significant drop in the stock indices for banks, the timing of a substantial fall in bank deposits or the timing of government intervention to support financial stability. In some studies the end time of a banking crisis is determined as the time when output growth is back at the pre-crisis trend level or as the time when government support measures expire.

Using the above methods of determination, it may often be difficult or even impossible to determine exactly when a banking crisis begins or ends. For example, there is the question of what is "significant" or "substantial". Furthermore, a banking crisis may have started well before the government intervenes. There may also be cases in which a crisis becomes critical after government intervention (or after the first intervention). Ultimately, the identification and delineation of periods of banking crises will always have elements of subjectivity and estimates, and often an "expert opinion" is also seen as a method of delineation.

Moreover, the impact of a banking crisis on the real economy may depend on the specific circumstances, e.g. whether it is an isolated banking crisis or a dual crisis combining a banking crisis and a currency crisis. It may also be of significance whether the crisis is national (a banking crisis in a single country) or international. Finally, the extent of government intervention to address the crisis is also relevant.

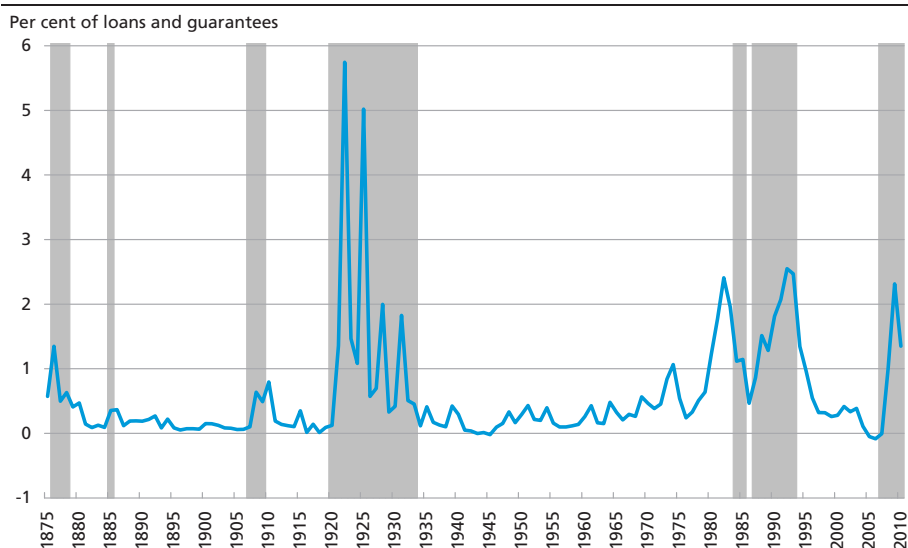
Table 2.1 provides a summary overview of the periods identified in Danmarks Nationalbank's "Monetary History of Denmark"¹ as periods of banking crises on which the analyses in this article will be based.

An impression of the extent of the individual crises can be gained by looking at the write-down ratios of the banking sector since 1875, cf. Chart 2.1. The chart should be used with some caution when comparing the write-down ratio levels over extended periods of time due to changes in accounting principles, etc. However, the chart clearly shows that most

¹ Cf. Hansen and Svendsen (1968); Hoffmeyer and Olsen (1968); Mordhorst (1968); Mikkelsen (1993); and Abildgren et al. (2010). The most recent financial crisis is discussed in Abildgren and Thomsen (2011).

THE BANKS' WRITE-DOWNS 1875-2010

Chart 2.1



Note: The grey markings indicate periods of banking crises, cf. Table 2.1.

For the period from 1921 onwards, the compilation covers all commercial banks and savings banks.

For the period 1893-1920, the table shows a weighted average of the write-down ratios for all savings banks and the write-down ratios for the three main commercial banks (Privatbanken, Landmandsbanken and Handelsbanken). The weightings used are the loans provided by all savings banks and all commercial banks, respectively. On average, the savings banks and the three main commercial banks accounted for around 80 per cent of the loans provided by all commercial banks and savings banks in the period 1893-1920.

For the period 1875-1892, the table shows a weighted average of the write-down ratios for the three main commercial banks and the write-down ratio for Den Lollandske Landbostands Sparekasse. The weightings used are the loans provided by all commercial banks and all savings banks, respectively. On average, the four banks accounted for around 27 per cent of the loans provided by all commercial banks and savings banks in the period 1875-1892.

Negative write-down figures indicate that previous write-downs are reversed as revenue.

Source: Calculated on the basis of data from Abildgren (2008, 2010b); Banktilsynet (1945); Christiansen et al. (1945); Hansen (1996); Hansen (1969); Statistics Denmark, *Statistical Yearbook*, various editions; and the website of the Danish Financial Supervisory Authority.

of the banking crises since 1875 (marked in grey in the chart) were characterised by a substantial increase in the banks' write-down ratios.

The highest write-down ratios could be seen in the 1920s, and in accumulated terms more than 20 per cent of loans and guarantees were written down in the period 1920-33. At the other end of the spectrum is the liquidity crisis in 1885, which was not characterised by any significant increase in the banks' write-downs.

Furthermore, it is worth noting that the period from the end of World War II until the early 1980s was characterised by pronounced stability in the Danish banking sector. The same trend is seen in a larger international perspective. Globally, there were no major banking crises during the Bretton Woods period from 1945-71, apart from a single banking crisis in Brazil in 1962, cf. Allen and Carletti (2008). For the period 1970-2007, on the other hand, a total of 42 systemic banking crises in 37 countries can be listed, cf. Laeven and Valencia (2008).

3. COMPARISON OF BUSINESS CYCLES WITH AND WITHOUT BANKING CRISES 1821-2009

This section compares the business cycles in Denmark with and without banking crises in the past almost 200 years.

In the USA¹ and the euro area² special committees have established and are maintaining a historic chronology of the troughs and peaks of the economy. Such a chronology is not available for Denmark and many other small countries. For those countries it is common to identify the business cycles based on the cyclical component of real GDP calculated using various statistical filtering techniques.

In this article the business cycles have therefore been identified based on the cyclical component of real GDP calculated using a filter, cf. Box 3.1. The quality of the historical national accounts data is questionable, cf. e.g. Mogensen (1987), but they are currently the best basis for assessment of the cyclical fluctuations in Danish economic history.

Table 3.1 shows the chronology calculated for the length and amplitude of Danish business cycles in the past almost 200 years. As illustrated, there are large variations in business cycle volatility over time. The inter-war period and the periods of the two world wars were characterised by particularly large cyclical fluctuations, whereas the fluctuations were relatively moderate during the gold standard period. This pattern is also seen in many other countries, cf. Bergman et al. (1998).

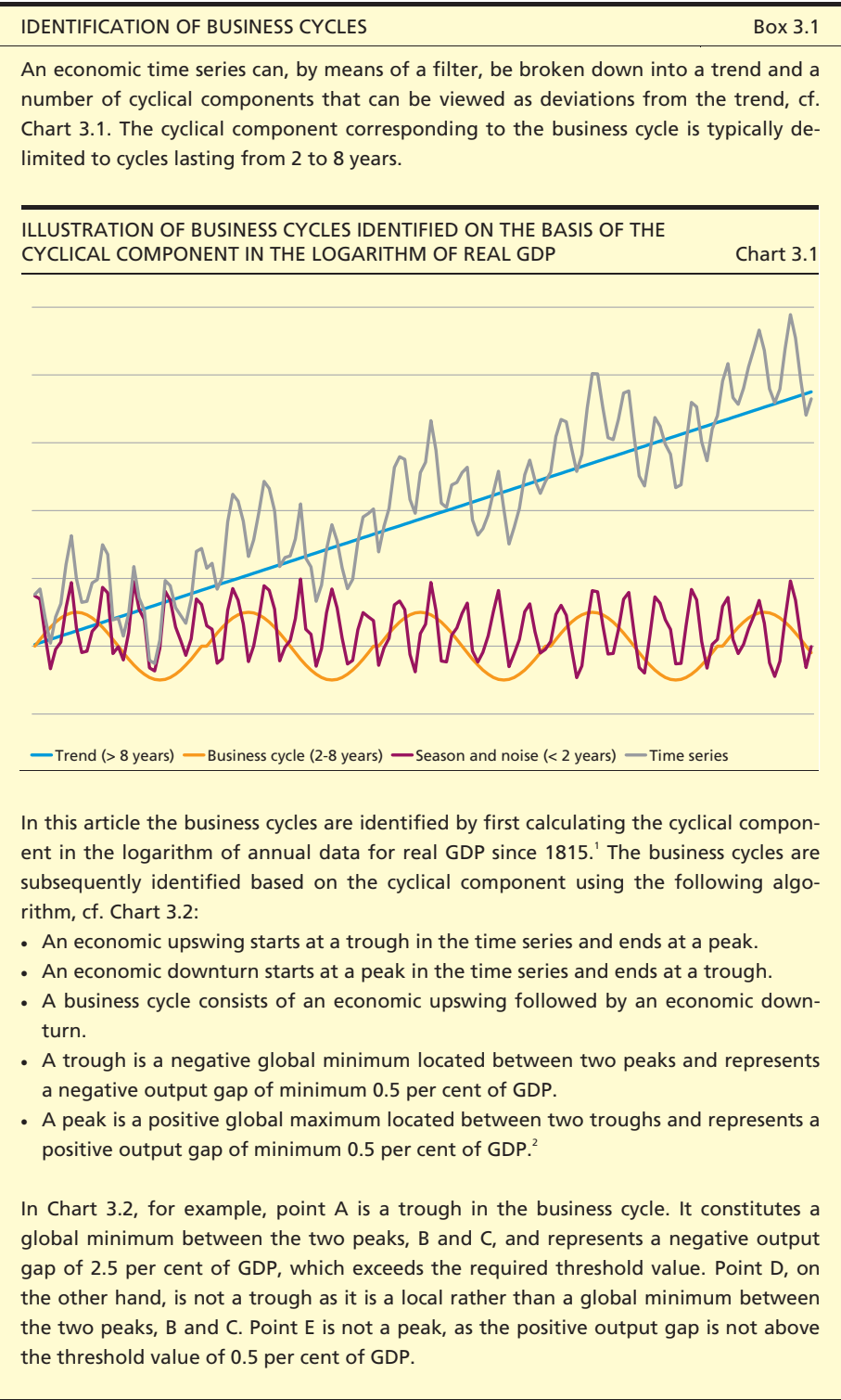
Since World War II, the Danish business cycles have tended to be longer on average, especially since the mid-1970s. Moreover, it should be noted that while the economic upturns and downturns prior to World War I were of more or less equal length, the economic downturns have been considerably shorter than the upturns during the subsequent period. The situation for the USA is fairly similar.

According to Zarnowitz (1992), the dampening of the cyclical fluctuations in the USA in the first four decades after World War II can be attributed to several factors, including a shift in the business structure from the more volatile primary and secondary sectors towards the less cyclically sensitive tertiary sectors (including public services) and the growing importance of automatic stabilisers³. Similar conditions may have contributed to the dampening of the cyclical fluctuations in Denmark in the post-war period compared with the inter-war period.

¹ NBER's Business Cycle Dating Committee.

² CEPR's Euro Area Business Cycle Dating Committee.

³ Automatic stabilisers refer to the fact that fiscal policy is automatically eased during an economic downturn as expenditure for e.g. unemployment benefits increases with rising unemployment. Furthermore, taxes are reduced when corporate and household earnings decline. On the other hand, fiscal policy is automatically tightened during an economic upturn by increased tax revenue and reduced expenditure for transfer payments.

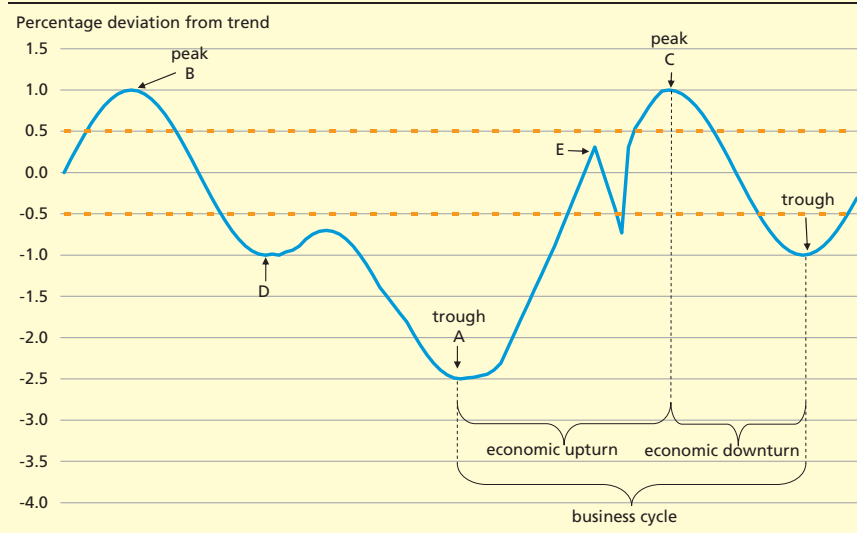


CONTINUED

Box 3.1

ILLUSTRATION OF BUSINESS CYCLES IDENTIFIED ON THE BASIS OF THE CYCLICAL COMPONENT IN THE LOGARITHM OF REAL GDP

Chart 3.2



¹ The calculations use a Baxter-King (1999) filter with the cyclical component delimited as fluctuations at a frequency of 2-8 years. The filter applies 3 observations on each side of the symmetrical average. By transforming the time series logarithmically before filtering, the cyclical component (when multiplied by 100) can be interpreted as the percentage deviation from the trend and thereby as an output gap. Applying a business cycle length of 2-10 years and 4 observations on each side of the symmetrical average does not provide substantially different results.

² The condition that a trough or a peak must be located ± 0.5 per cent from the trend is arbitrary, but it is consistent with e.g. Artis et al. (2003). The relevant literature talks about "amplitude censoring".

In Table 3.1 the business cycles characterised by the banking crises identified in Table 2.1 are highlighted in bold.

There is a clear pattern of economic downturns with banking crises being deeper or longer than economic downturns without banking crises:

- The economic downturn of 2007-09, which was characterised by the Financial Crisis, was the deepest downturn since World War II.
- The economic downturn of 1855-58, which included the Monetary Crisis, was the deepest downturn in the period 1821-1915.
- The economic downturn of 1876-77, which was characterised by the Savings Bank Crisis, was the deepest downturn in the gold standard period.
- The economic downturn of 1986-93, during which a number of banks experienced a crisis, is unique in that it was the longest economic downturn (7 years) since 1821. On the other hand, it was not much deeper than the average depth of the downturns since 1975.

CHRONOLOGY OF DANISH BUSINESS CYCLES 1821-2009

TABLE 3.1

Turning points			Length (years)			Amplitude (% of GDP)	
Trough	Peak	Trough	Upswing	Down- turn	Cycle	Strength of upswing	Depth of downturn
...	1821	1823	...	2	2.4
1823	1824	1825	1	1	2	1.7	1.3
1825	1828	1833	3	5	8	2.7	3.7
1833	1834	1836	1	2	3	3.7	3.3
1836	1840	1842	4	2	6	2.1	3.5
1842	1845	1847	3	2	5	4.0	4.3
1847	1850	1854	3	4	7	7.3	7.2
1854	1855	1858	1	3	4	8.8	8.8
1858	1859	1861	1	2	3	4.9	3.5
1861	1863	1864	2	1	3	4.1	3.3
1864	1865	1868	1	3	4	1.9	3.6
1868	1870	1871	2	1	3	3.6	2.1
1871	1872	1873	1	1	2	2.5	2.4
1873	1876	1877	3	1	4	2.0	4.3
1877	1879	1881	2	2	4	3.3	1.6
1881	1883	1885	2	2	4	2.6	3.1
1885	1887	1889	2	2	4	2.6	2.8
1889	1890	1894	1	4	5	3.0	2.9
1894	1896	1898	2	2	4	2.7	2.2
1898	1903	1906	5	3	8	2.6	2.1
1906	1911	1912	5	1	6	2.3	2.4
1912	1914	1915	2	1	3	6.0	7.0
1915	1916	1918	1	2	3	4.8	10.5
1918	1920	1921	2	1	3	10.3	8.0
1921	1923	1925	2	2	4	10.9	8.7
1925	1930	1932	5	2	7	6.5	5.8
1932	1939	1941	7	2	9	12.4	20.1
1941	1944	1945	3	1	4	15.4	12.8
1945	1950	1952	5	2	7	10.2	4.5
1952	1954	1958	2	4	6	2.9	3.1
1958	1961	1963	3	2	5	2.9	2.9
1963	1965	1966	2	1	3	3.0	2.3
1966	1973	1975	7	2	9	3.8	5.8
1975	1979	1981	4	2	6	5.3	4.5
1981	1986	1993	5	7	12	5.0	5.1
1993	2000	2003	7	3	10	3.9	2.8
2003	2007	2009	4	2	6	3.9	6.1

Average of monetary regimes:

1823-1842 ("Rigsdaler's return to par") ...	2.3	2.5	4.8	2.6	3.0
1842-1873 ("Silver standard")	1.8	2.1	3.9	4.6	4.4
1873-1912 ("Gold standard")	2.8	2.1	4.9	2.6	2.7
1912-1945 ("Wars and inter-war period")	3.1	1.6	4.7	9.5	10.4
1945-1975 ("Bretton Woods")	3.8	2.2	6.0	4.6	3.7
1975-2009 ("Post-Bretton Woods")	5.0	3.5	8.5	4.6	4.6

Total 1823-2009	2.9	2.2	5.2	4.9	4.9
-----------------------	-----	-----	-----	-----	-----

Note: The depth of an economic downturn is measured from peak to trough. The strength of an economic upturn is measured from trough to peak. The monetary regimes are stated in quotation marks as the breakdown into periods is based on whole business cycles and therefore may not coincide fully with the monetary regimes. The business cycles characterised by banking crises are highlighted in bold.

Source: Calculated on the basis of Hansen (1983), Hansen and Svendsen (1968), Abildgren (2010a), and Statistics Denmark. The data for 2011-12, which are included in the calculation of the cyclical component for 2008-09, are based on Danmarks Nationalbank's forecast.

Furthermore, with regard to the above four economic downturns it should be noted that while the two deepest downturns (1855-58 and 2007-09) were characterised by international financial crises, the banking crises in the two other periods (1876-77 and 1986-93) were of a more national (or Nordic) nature.

Table 3.1 paints a more mixed picture in terms of the length and strength of economic upturns following downturns with banking crises. For example, the economic upturn in the period 1993-2000 following the seven-year slump was very long, but it was weaker than the average economic upturns since World War II. On the other hand, the economic upturn 1877-79 following the Savings Bank Crisis was shorter but stronger than the average economic upturns during the gold standard period.

Finally, it should be noted that the banking crisis in the 1920s and the early 1930s lasted for a very long time, and that the economy was characterised by strong upturns as well as deep downturns during this period.

The above results are generally in line with international studies in this field. For example, Bordo et al. (2001) analyse data for 21 countries for the period 1880-1997. They find that, on average, economic downturns characterised by banking and currency crises have been deeper and lasted longer than economic downturns without banking crises. Kannan et al. find similar results for 21 industrialised countries for the period 1960-2008 and also point out that upswings following economic downturns with banking crises tend to be weaker than normal.

As previously stated, it should be noted that the causality between economic trends and banking crises can go either way. So in principle, based on the above analysis, it may simply be concluded that economic downturns with banking crises are longer and deeper than normal. The reason may be that economic downturns are aggravated by banking crises, but it may also merely reflect the tendency for banking crises to occur during deep economic downturns. Sections 5-7 will further discuss the extent to which effects of the former type apply.

4. SUMMARY COMPILATION OF GROSS AND NET OUTPUT LOSSES DURING AN ECONOMIC DOWNTURN WITH A BANKING CRISIS

One of the methods to quantify the output loss in connection with banking crises is to compare the development in actual real GDP during a period characterised by a banking crisis with the development in hypothetical real GDP if there had been no banking crisis. This can be done in several ways.

Some studies define output loss in connection with banking crises as the accumulated difference between actual real GDP and potential real GDP during the course of the banking crisis while disregarding the impact, if any, of the banking crisis on potential GDP. Such a method is used in e.g. Hoggarth et al. (2002).

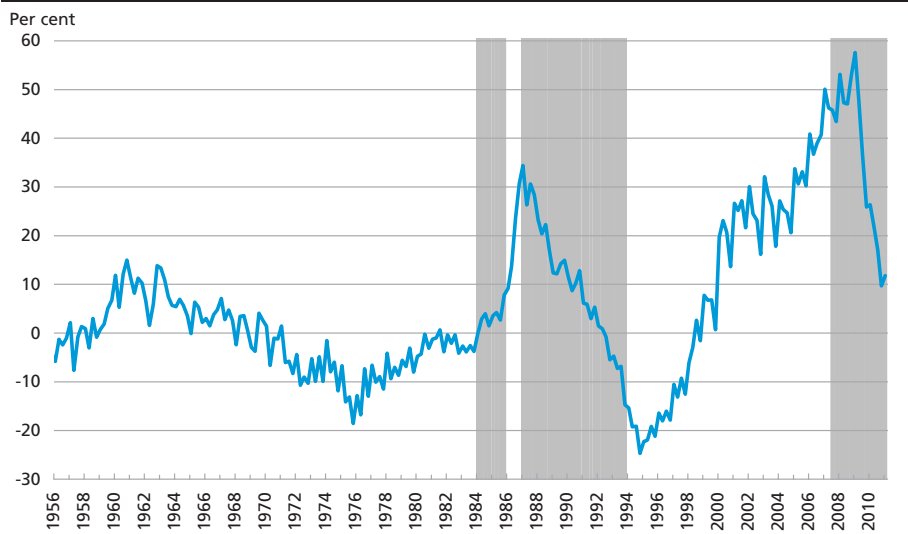
However, the above types of calculations tend to overestimate the output loss caused by banking crises because they disregard the fact that banking crises often occur during recessions where the output level is usually lower than the potential level – even if there is no banking crisis. Some of the calculations in Hoggarth et al. (2002) seek to address this problem by calculating the output loss based on the difference between the actual development in real GDP during the banking crisis and the development expected in economic forecasts one year prior to the onset of the crisis. The weakness of this method is that it will attribute all unexpected shocks to the economy that were not included in the pre-crisis forecast to the banking crisis – even if they are not actually related to the banking crisis.

Serwa (2010) summarises a number of studies in this field. The studies find an average accumulated output loss during a banking crisis of 4-20 per cent of GDP. The methods applied in the studies vary, however, so these estimates should be used with some caution. The wide interval of the estimated losses also reflects that calculations of this type are subject to great uncertainty and should be regarded as rough estimates only.

Schwierz (2004) argues that studies should not be restricted to review the lower output that may result from a distressed financial sector's reluctance to provide loans (gross output loss). Calculations of the output loss should set off the higher output created during a prior credit expansion if the latter was at the root of the actual banking crisis, thereby producing the net output loss of the banking crisis. This approach might also be motivated with reference to Chart 4.1, which shows the development in lending by banks as a ratio of GDP since the mid-1950s. There are only two periods during which lending as a ratio of GDP increased to a level considerably above the trend. This was the case in the 2nd half of the 1980s prior to the seven-year slump 1987-93 and in the years after the millennium rollover prior to the Financial Crisis from 2007/08 onwards.

The terms gross and net output losses can be illustrated as in Chart 4.2. Here, the net output loss figures are based on two calculations of the development in real GDP. One calculation concerns the actual development in real GDP, while the other concerns the development in real GDP, assuming that the banking crisis did not occur (the counter-factual development). The gross output loss is then calculated as the accumulated

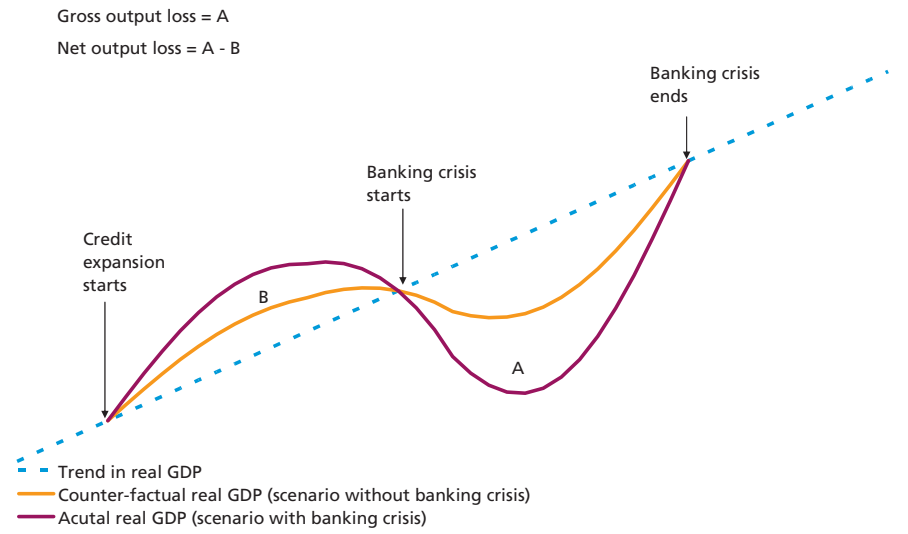
LENDING BY BANKS AS A RATIO OF GDP 1956-2011, DEVIATION FROM TREND Chart 4.1



Note: The grey markings indicate periods of banking crises, cf. Table 2.1. Lending concerns the banks' domestic loans to non-MFIs. Lending and GDP are in current prices. The trend is calculated as a 32-quarter moving average.
Source: Abildgren (2010b) updated with new and revised figures.

difference between counter-factual real GDP and actual real GDP during the banking crisis years (area "A" in Chart 4.2). The net output loss is calculated as the gross output loss less the accumulated percentage dif-

GROSS AND NET OUTPUT LOSS IN A BANKING CRISIS Chart 4.2



OUTPUT LOSS DURING THE ECONOMIC DOWNTURN IN 2007-09
CHARACTERISED BY THE FINANCIAL CRISIS

Table 4.1

Per cent of GDP	Gross output loss	Net output loss
Benchmark: The period since World War II	4.2	4.2
Benchmark: The period since 1973.....	3.6	2.2

Source: See main text.

ference between actual real GDP and counter-factual real GDP during the boom years prior to the banking crisis (area "A – B" in Chart 4.2).

Table 4.1 shows the result of a number of summary calculations of gross and net output losses during the most recent economic downturn 2007-09, which was characterised by the Financial Crisis. The calculations compare the length and depth of the economic downturn with a "normal" economic downturn without a banking crisis based on the cyclical component of real GDP as described in section 3. This means that the calculations are based on the implied assumption that the Financial Crisis was the only reason why the economic downturn 2007-09 became deeper than normal. It is therefore a very "broad" definition of the "effects of the Financial Crisis".

The length of the economic downturn from 2007 to 2009 (2 years) was more or less in line with the average for economic downturns without banking crises since World War II (2.3 years). In the period 2007-2009 the average annual decline in the cyclical component of real GDP was 3.0 per cent. If the annual decline had been in line with the average for economic downturns without banking crises since World War II, the average annual decline would only have been 1.6 per cent. The gross output loss in connection with the Financial Crisis can thus be stated at $3.0 - 1.6 = 1.4$ per cent of GDP in the first year and $1.4 + (3.0 - 1.6) = 2.8$ per cent of GDP in the second year, or $1.4 + 2.8 = 4.2$ per cent of GDP in total. The length and strength per boom year of the previous cyclical upswing in 2003-07 were largely in line with the average for other economic upturns since World War II (excluding economic upturns prior to banking crises). As a consequence, the net output loss corresponds to the gross output loss of 4.2 per cent of GDP.

The strength per boom year of the cyclical upswing in 2003-07 exceeded the average for other economic upturns since 1973 (excluding economic upturns prior to banking crises). Moreover, the average annual decline in the cyclical component of real GDP has been slightly larger for economic downturns since 1973 than for economic downturns after World War II. If the period after 1973 rather than the period after World War II is used as a benchmark, calculations in line with the above

will produce slightly lower gross and net output losses during the economic downturn, cf. Table 4.1.

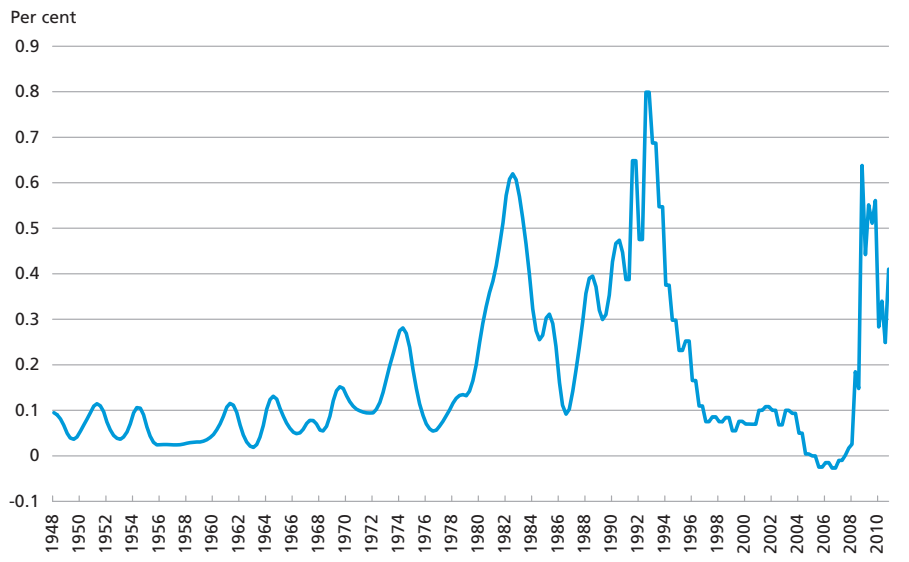
It should be noted that the calculations in Table 4.1 are restricted to the output loss during the actual economic downturn in 2007-09. In order to calculate the total output loss relating to a banking crisis, it is necessary to consider the question of whether an economic upswing immediately after a downturn with a banking crisis is weaker or stronger than normal. It must also be considered whether a banking crisis has any impact on growth and income levels in the longer term. These questions will be discussed in more detail in sections 5 and 8, respectively.

5. MACROECONOMIC ANALYSIS OF THE REAL ECONOMIC CONSEQUENCES OF FINANCIAL CRISES

Due to the complicated interaction between the real and financial parts of the economy it is difficult to quantify the extent to which a financial crisis aggravates a business cycle compared with a business cycle without a financial crisis.

This can be illustrated on the basis of Chart 5.1, which shows the banks' write-down ratio since 1948. Usually, the banks' write-downs

THE BANKS' QUARTERLY WRITE-DOWN RATIO 1948-2010 Chart 5.1



Note: Write-downs as a ratio of loans and guarantees.
The quarterly write-down ratio is not annualised and before the 3rd quarter of 2007 it is interpolated on the basis of half-year and full-year data.
Negative write-down figures indicate that previous write-downs are reversed as revenue.
Source: Abildgren (2010b) and the Danish Financial Supervisory Authority.

increase in connection with a recession – whether there is a banking crisis or not. Accordingly, write-downs rose in connection with the first oil crisis in the mid-1970s, in connection with the downturn related to the second oil crisis in the late 1970s and early 1980s, during the seven-year slump in the late 1980s and early 1990s and finally in the period from 2008 onwards.

The write-downs increase in connection with a downturn because poor sales opportunities and rising unemployment reduce the earnings base of firms and households and thus their ability to service their bank loans. Furthermore, downturns may be accompanied by falling stock and house prices, which reduces the value of the collateral for the bank loans. They may also lead to a higher level of write-downs in the banking sector. Finally, write-downs may rise during a slump if the banks become more cautious in their lending portfolio quality assessment.

Normally, a downturn will also be accompanied by a decline or low growth in the demand for credit due to weak development in consumption and investment ("demand effect"). To counter the risk of losses on loans, the banks will often widen their interest-rate margins and tighten their credit standards in connection with a slump. Viewed in isolation, this also reduces bank lending ("supply effect").

Therefore, a slump typically implies increasing write-downs in the banking sector and lower lending volumes, regardless of whether there is a financial crisis or not.

During a financial crisis, however, the banks' write-downs may increase more than warranted by the general economic development. Thus, the write-downs are indicators of the impact of the financial crisis on the economy. For example, the write-downs may grow more than warranted by the general cyclical development because a financial crisis leads to extraordinarily high uncertainty about the future economy and thereby the future finances of bank customers. Write-downs may also increase more than usual because the banks become extra cautious in their lending portfolio quality assessment.

A calculation of the real economic effects corresponding to such "extraordinary" increases in the banks' write-downs during a financial crisis can be interpreted as an expression of the negative impact of the financial crisis, viewed in isolation, on the business cycle. Below, such a calculation will be made on the basis of a summary model (a vector autoregressive (VAR) model) for the Danish national economy.

Abildgren (2010b) estimates a VAR model based on quarterly data for Denmark for the period 1948-2010, cf. Box 5.1. Chart 5.2 shows the development in real GDP, house prices and lending corresponding to an "extraordinary" increase in the Danish banking sector's write-down ratios

VAR MODEL FOR THE DANISH ECONOMY 1948-2010

Box 5.1

VAR models appear to be particularly suited for illustrating the complicated interaction between the financial sector and the real economy due to the few *a priori* restrictions imposed on such models. In recent years, VAR models have been applied to illustrate how the macroeconomy is affected by shocks to the robustness of the banking sector, cf. Anari et al. (2005), Kupiec and Ramirez (2008), Marcucci and Quagliariello (2008), Österholm (2010), Monnin and Jokipii (2010), Berrospide and Edge (2010) as well as Puddu (2010).

In general terms, an unrestricted, reduced-form VAR model can be written as

$$Y_t = CD_t + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + E_t, \quad (5.1)$$

where Y_t is a vector of endogenous variables; A_i ($i=1, \dots, p$) are coefficient matrices; and E_t is a vector of serially uncorrelated residuals (unexpected "shocks") with zero means and a time-invariant variance-covariance matrix. Constant terms, time trends and seasonal dummies are included on the right-hand side of equation (5.1) via the term CD_t . The model assumes a linear relationship between the variables, and the coefficients are assumed to be constant over time. Once (5.1) has been estimated, it is possible to analyse how an unexpected shock to one of the endogenous variables at time t affects the other variables in the system at time t , $t+1$, $t+2$, etc. (impulse response analysis).

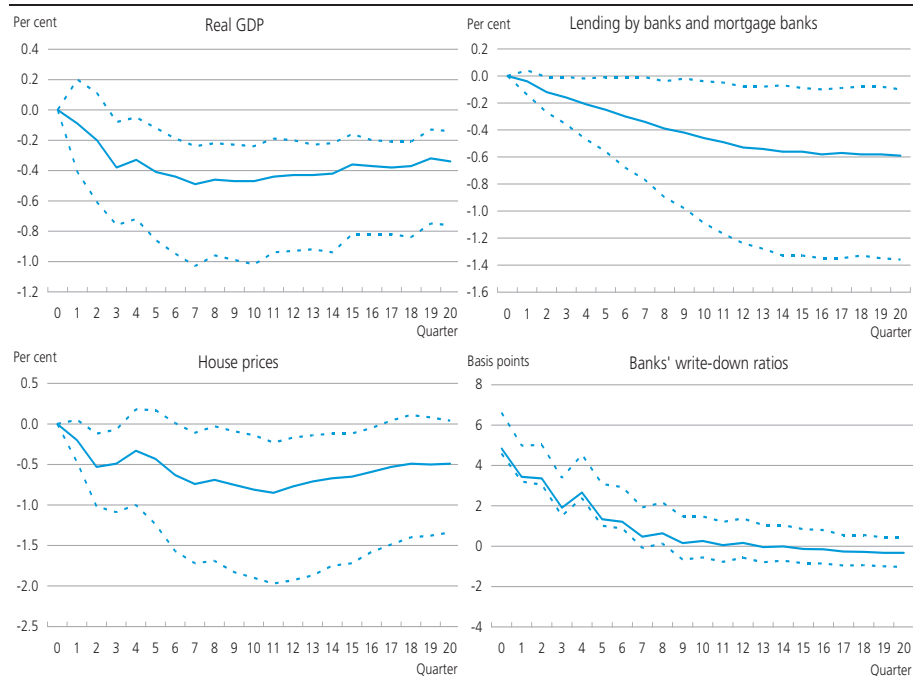
Abildgren (2010b) estimates a VAR model like (5.1) based on quarterly data for Denmark for the period 1948-2010. The model includes the following nine endogenous variables: real GDP, consumer prices, short-term interest rates (Danmarks Nationalbank's discount rate), yields on long-term government bonds, share prices, the money supply (M2), domestic credit provided by Danish banks, house prices and the banks' write-down ratios. The endogenous variables are included with five lags in the model, which also contains constant terms, time trends and seasonal dummies, and all the endogenous variables are included in levels (possibly following logarithmic transformation). The impulse response functions shown in this article are based on residuals orthogonalised via a Cholesky decomposition where the variables are included in the above order. This means that the block of monetary and financial variables is placed after the block of real economic variables, whereby the model allows the monetary and financial variables to react immediately to shocks to the real side of the economy. Including the banks' write-down ratios at the end of the causal structure also ensures that the estimated effects of a shock to the banks write-downs are, insofar as possible, "adjusted" for shocks to and movements in the other endogenous variables in the model. This provides the most conservative estimates of the effect that shocks to the banks' write-down ratios has on the other variables in the model.

Abildgren (2010b) describes a number of robustness checks for the model. For example, estimations of the model have been made on the basis of first differences of seasonally adjusted series, and the impact of alternative orderings of the endogenous variables has also been examined. The model results are generally robust to such alternative model specifications. Furthermore, the model seems to be econometrically well-specified on the basis of different misspecification tests and tests for structural breaks.

The data basis of the model version used for the calculations in this article has been revised and updated compared with Abildgren (2010b).

DEVELOPMENT IN REAL GDP, HOUSE PRICES AND LENDING CORRESPONDING TO AN EXTRAORDINARY INCREASE IN THE BANKS' WRITE-DOWN RATIOS

Chart 5.2



Note: The charts show the response in case of an extraordinary increase in the write-down ratio of a single standard deviation. For real GDP, lending and house prices, the charts show the deviations from the baseline scenario in per cent. For write-downs, the chart shows the deviation from the baseline scenario in basis points.

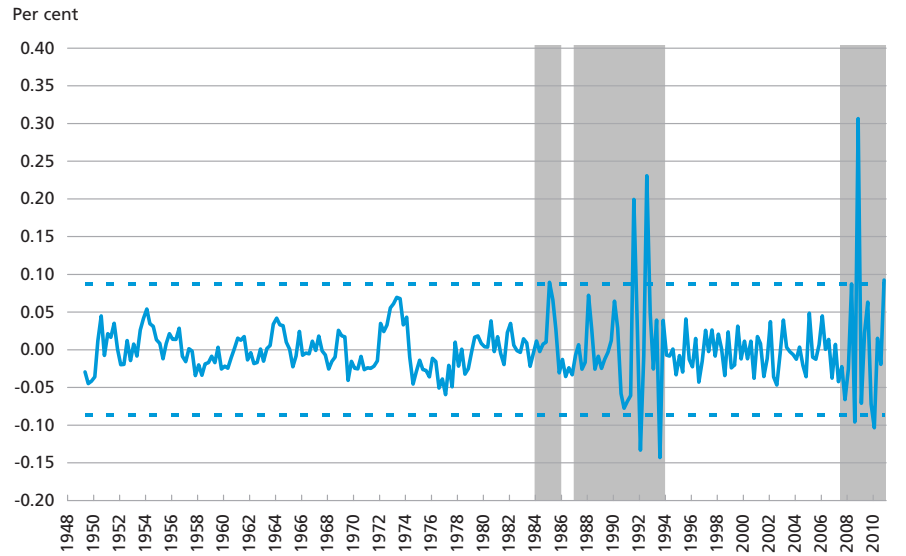
Source: Abildgren (2010b) updated with new and revised figures.

as indicated by historical experience. The solid curves show the estimated consequences (responses) of the increase (impulse), and therefore the curves are also called impulse responses. The broken curves show 95 per cent confidence bounds for the estimated impulse responses. Viewed in isolation, the extraordinary rise in the banks' write-down ratios coincides with a prolonged fall in lending, house prices and real GDP.

The question is how often such extraordinary increases in the Danish banking sector's write-down ratios have occurred, and how large they have been. This is illustrated in Chart 5.3. The chart shows that since the late 1940s the Danish banking sector has only experienced two periods of such extraordinary growth in their write-down ratios that clearly differ significantly from zero when calculated at a significance level of 5 per cent. One was in the early 1990s – a period characterised by banking and currency crises. The other occurred in 2008 during the Financial Crisis. On the other hand, according to the model the only cause of the majority of the high write-down ratios in the early 1980s was the negative economic development in the wake of the second oil crisis. In early

EXTRAORDINARY INCREASES IN THE WRITE-DOWN RATIO OF DANISH BANKS
1949-2010

Chart 5.3



Note: Stated as percentages of loans and guarantees. The dotted lines indicate two standard deviations and may be seen as 95 per cent confidence bounds around 0. The grey markings indicate periods of banking crises, cf. Table 2.1.

Source: Calculated on the basis of Abildgren (2010b) updated with new and revised figures.

1985, however, the minor extraordinary increase in write-downs coincided with the Kronebank Crisis.

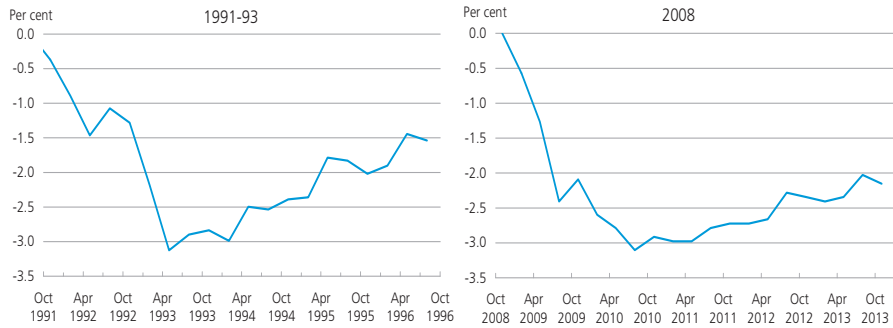
Chart 5.3 also shows a very substantial extraordinary hike in the banking sector's write-downs in the 4th quarter of 2008, i.e. just after the suspension of payments by the US investment bank Lehman Brothers in September 2008. The crisis in the early 1990s, on the other hand, was characterised by a higher number of smaller extraordinary increases in write-downs dispersed over a number of years.

Chart 5.4 estimates the development in real GDP five years ahead, corresponding to the extraordinary increases in the Danish banking sector's write-downs in 1991-93 and 2008. Viewed in isolation, the extraordinary growth in the banks' write-downs in 2008 was equivalent to real GDP in the 1st half of 2010 being around 3 per cent lower than in a baseline scenario without a financial crisis. Similarly, the extraordinary increases in the banking sector's write-downs in 1991-93 became – over a few years – equivalent to a level of real GDP that was around 3 per cent lower than in the baseline scenario.

A VAR model of the above nature does not involve explicit modelling of all the economic correlations that are assumed to exist. Instead, it is a time series model which summarises the correlations and cross correlations that can be drawn from a historical data set. As the period since

DEVELOPMENT IN REAL GDP CORRESPONDING TO THE EXTRAORDINARY INCREASES IN THE BANKS' WRITE-DOWN RATIOS IN 1991-93 AND 2008

Chart 5.4



Note: The charts show the deviations from the baseline scenario in per cent. The left-hand chart concerns the effects corresponding to the extraordinary increases in the banks' write-down ratios in the period from the 3rd quarter of 1991 to the 3rd quarter of 1993, while the right-hand chart concerns the effect corresponding to the extraordinary increase in the banks' write-down ratios in the 4th quarter of 2008. The effects shown are related to non-seasonally adjusted variables.

Source: Calculated on the basis of Abildgren (2010b) updated with new and revised figures.

1948 has been characterised by very few banking crises, caution should be exercised when drawing conclusions from projections based on the model. With these reservations, the model calculations in Chart 5.4 indicate that in the period 2009-13 real GDP is on average 2.25-2.5 per cent below what it would have been in the absence of the Financial Crisis. This corresponds to a total accumulated output loss of around 12 per cent of GDP over the period 2009-13.

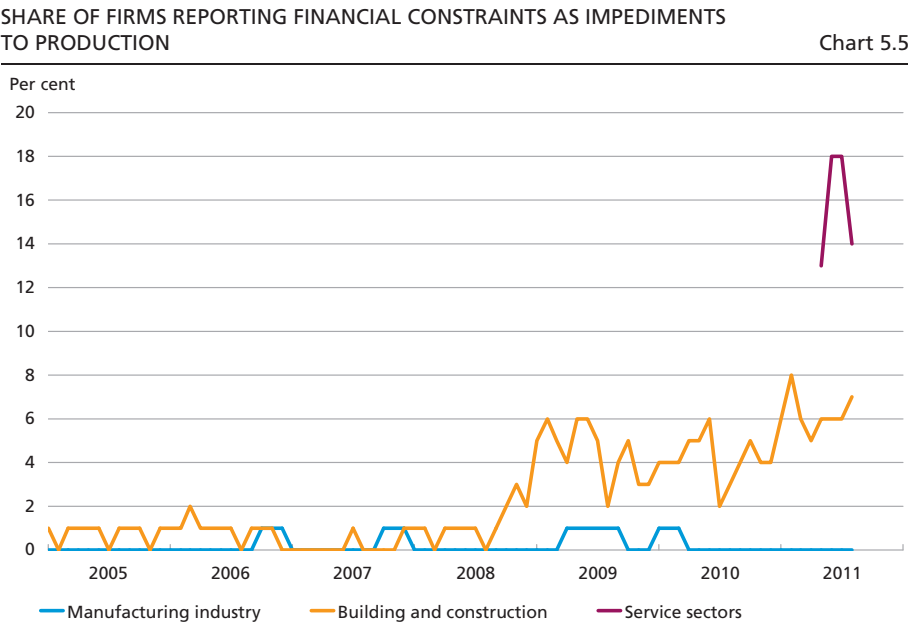
The transmission mechanism involved in connection with the Financial Crisis cannot be derived from the simple model, so the transmission mechanism is open to interpretation. A possible ("supply-related") interpretation of the development in Chart 5.2 might be that an extraordinary increase in the banks' write-down ratios is followed by a period of lending restraint with a view to restoring capital adequacy in the banking sector. The lending reduction affects the rest of the economy via lower consumption and investment and thereby lower output. Another possible ("demand-related") interpretation is that the extraordinary increase in the banks' write-downs reflects the growing uncertainty about the future economy and the economic outlook for households and the corporate sector caused by the Financial Crisis, which has led to lower consumption and investment and thus lower house prices, output and demand for credit.

An important question when interpreting the calculation results is whether there have been periodic signs of a general credit crunch during the Financial Crisis. A credit crunch may occur if the banks reduce the supply of credit considerably more than the weak economic develop-

ment would warrant, making it difficult for creditworthy borrowers to obtain financing, cf. Danmarks Nationalbank (2009).

This question cannot be answered on the basis of the above model calculation. Firstly, it is not possible to decompose the results of the calculations into impacts caused by changes in the supply of and demand for credit, respectively. Secondly, the customers' creditworthiness is not part of the calculation basis. Supplementary information is therefore necessary to assess the credit crunch issue. Based on Statistics Denmark's confidence indicators, only a limited number of firms, particularly in manufacturing industry and building and construction, have reported financial constraints as impediments to production in recent years, cf. Chart 5.5. This indicates that the Financial Crisis was not accompanied by a general credit crunch. Accordingly, the output loss caused by the Financial Crisis according to Chart 5.4 is on the whole attributable to the more general negative impact of the Financial Crisis on the economy. A case in point is the extraordinary impact of the crisis on the saving behaviour of households and firms due to weakened confidence in the banking sector.

This does not mean that some firms or firm segments have not found it more difficult to raise bank loans during the financial crisis in recent years. According to a study from Statistics Denmark, the share of rejected loan applications from small and medium-sized enterprises increased from 4 per cent in 2007 to 23 per cent in 2010, while the share



Source: Statistics Denmark.

of partially rejected loan applications from small and medium-sized enterprises increased from 6 to 24 per cent during the same period, cf. Statistics Denmark (2010). The Danish Ministry of Economic and Business Affairs (2011) made a more detailed analysis of these figures by linking them with the firms' financial results. The analysis shows that the firms whose credit applications were granted in full were characterised by higher profit ratios, higher returns on equity and lower gearing than the firms that obtained only part of the credit they applied for or none at all. Also Statistics Denmark's survey of small and medium-sized enterprises' access to financing seems therefore not to indicate the existence of a general credit crunch where creditworthy borrowers were unable to obtain loan financing. If anything, it reflects that the banks tightened their credit standards during the Financial Crisis in view of the customers' reduced payment ability as a consequence of the weak economic development.

Both before and after the most recent financial crisis, Denmark's real economy has been in a better state than in the early 1990s. According to the calculations in Chart 5.4, the financial crisis in recent years has caused an output loss of the same magnitude as seen as a result of the banking and currency crises in the early 1990s. This covers two opposite effects. The financial crisis from 2007-08 onwards was of a completely different nature and far more serious than the crisis in the early 1990s. This is offset, however, by the fact that the economic-policy measures (including the bank rescue packages) introduced during the most recent financial crisis were much more comprehensive than the crisis intervention in the early 1990s.

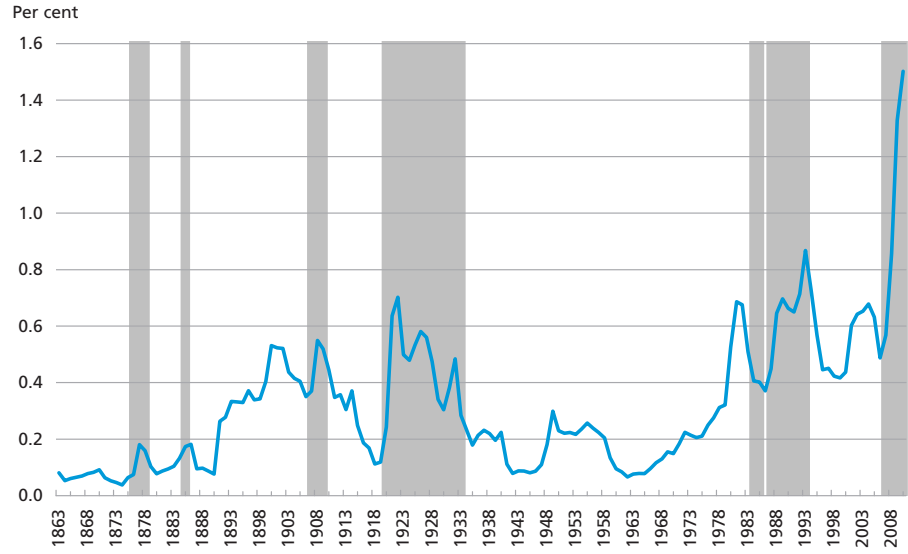
The calculations also show that the output loss caused by the Financial Crisis occurred at the beginning of the crisis, i.e. at the end of 2008 and in the 1st half of 2009, after which the development stabilised. It would be natural to regard this stabilisation as an effect of Bank Rescue Package 1 (a general government guarantee for depositors and unsecured claims in banks) and Bank Rescue Package 2 (public capital injections in credit institutions) in October 2008 and February 2009, respectively.

6. BANKS AND DEFAULTING FIRMS DURING THE FINANCIAL CRISIS FROM 2007/08 ONWARDS

Chart 6.1 shows the failure rate in the Danish business sector over the past 150 years. Although adjustment has been made for various data breaks resulting from differences in the compilation methods used in the underlying statistics, experience shows that caution should be exercised when comparing levels over time in a long time series such as this

FAILURE RATE OF DANISH FIRMS 1863-2010

Chart 6.1



Note: The grey markings indicate periods of banking crises, cf. Table 2.1.

The failure rate is calculated as the number of defaulting firms as a ratio of the total number of firms.

The total number of firms is calculated on the basis of VAT statistics since 1969. The total number of firms prior to 1969 is interpolated from business counts, census information on the heads of small and medium-sized enterprises in trade and industry, and the number of agricultural establishments. Adjustment has been made for a number of data breaks.

Source: Statistics Denmark, Hastrup (1979), Johansen (1985), and Olsen (1962).

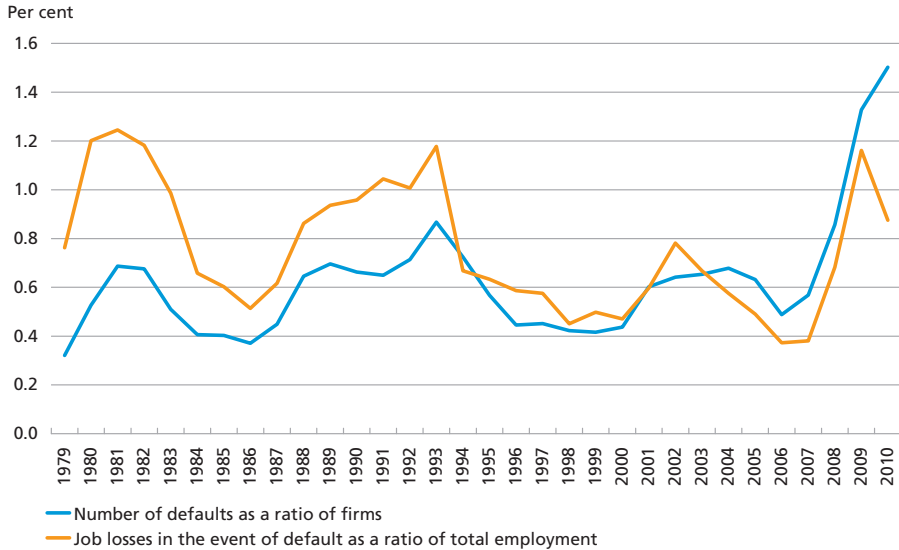
one. In addition, the failure rate level over time will depend on the development in the structure of the business sector, e.g. the classification of firms by industry or legal form of ownership (sole proprietorships, limited liability companies, etc.). However, the chart clearly shows that the failure rate (i.e. the number of defaulting firms as a ratio of the total number of firms) is high during periods characterised by banking crises.

The financial crisis in recent years has greatly affected the Danish business sector, which has experienced the highest failure rates over a number of years. This applies to the failure rate and the number of jobs lost as a result of defaults as a ratio of total employment (the share of job losses), cf. Chart 6.2. While the share of job losses declined in 2010, the failure rate increased. The reason is that, on average, the firms that defaulted in 2010 had fewer employees than the ones that defaulted in 2009.

Danmarks Nationalbank's lending surveys indicate that during the most recent financial crisis the banks needed to tighten their credit standards, particularly for corporate customers, in order to adjust to the cyclical reversal, cf. Nielsen (2010). The question is whether the high failure rate in the last few years was caused by cyclical developments

FAILURE RATE AND JOB LOSSES IN CONNECTION WITH DEFAULTS
1979-2010

Chart 6.2



Note: Job losses in connection with defaults are measured by the number of employee claims submitted to the Employees' Guarantee Fund (Lønmodtagernes Garantifond – LG).

Source: Statistics Denmark and LG.

alone, or if part of the increase can be attributed to the tightening of credit standards and the lower propensity to provide credit for some banks that have been under financial pressure.

The literature comprises several studies indicating that firms with a "weak" bank perform less well than firms with a "sound" bank. For example, some studies show that firms with a "weak" bank have fewer real economic investments (Gibson (1995, 1997); Minamihashi (2011)), fewer direct investments (Klein et al. (2002); Ushijima (2008)), and higher failure rates (Joeveer (2004); Akashi et al. (2009)) than firms with a "sound" bank. A "weak" bank may have fewer options to meet the credit and liquidity needs of corporate customers than a bank with "sound" finances, and for individual firms it may be both difficult and costly to switch to another bank at short notice, because the bank's knowledge of the individual firm is important in connection with the extension of credit. Unlike a potential new bank, the firm's existing bank has such knowledge. In the academic literature on banks this is referred to as "asymmetrical information".

This issue will be discussed below, based on the analysis in Abildgren, Buchholst and Staghøj (2011), whose point of departure is a modified version of Danmarks Nationalbank's failure-rate model¹. On this basis,

¹ Cf. Danmarks Nationalbank (2003, 2007), Lykke et al. (2004), and Dyrberg (2004).

the article examines whether the failure rate for Danish firms with a "weak" bank has tended to be higher during the financial crisis in recent years than for similar firms with a "sound" bank.

The data basis of the analysis is a database consisting of all published financial statements for non-financial public or private limited liability companies (excluding holding companies, agricultural establishments and government-guaranteed entities) with a balance sheet exceeding kr. 150,000, compiled by Experian A/S. Sole proprietorships are not comprised by the database. Around 50 per cent of the firms in the database state the name of their main bank, and this part of the database forms the basis for the estimations below. The result is a data set consisting of around 550,000 financial statements presented by 37,000 firms on average for the financial years 1995-2009. The number of defaulting firms presenting their last financial statement as an active firm in 2009 is based on preliminary data.¹

The basic model describes the probability that firm j will default in year t ($PD_{j,t}$) based on information on the firm's return on assets, debt, etc. in year $t-1$ ($X_{1,j,t-1}, \dots, X_{k,j,t-1}$). As explanatory variables the model also includes a number of other firm-specific details such as age, geographical location, etc. in year t as well as industry-specific time dummy variables intended to capture cycles and more structural development trends for the individual industries ($Z_{1,j,t}, \dots, Z_{m,j,t}$). More formally, this can be written as:

$$PD_{j,t} = F \left(b_0 + \sum_{i=1}^k b_i X_{i,j,t-1} + \sum_{i=1}^m a_i Z_{i,j,t} \right), \quad (6.1)$$

where b_0 is a constant term, and $b_1, \dots, b_k, a_1, \dots, a_m$ are parameters. The explanatory variables in the basic model are described in more detail in Table 6.1.

The analysis uses a "broad" definition of the term "default". A firm is regarded as having defaulted if one of the following events has occurred: (a) The firm is being liquidated or is subject to compulsory liquidation; (b) the firm has been compulsorily dissolved or is in a process towards compulsory dissolution; (c) the firm has been granted a write-down of debt by confirmation of compulsory composition or is subject to compulsory composition; or (d) the firm has been subject to an enforced sale.

¹ This is not expected to significantly influence results, unless the breakdown of firms by firms with "weak" and "sound" banks for not yet registered defaulting firms with 2009 as the last financial year differs systematically from the breakdown of already registered defaulting firms with 2009 as the last financial year.

EXPLANATORY VARIABLES IN (6.1)-(6.2)

Table 6.1

Explanatory variables	Expected impact on failure rate	Description
<i>Included with a lag:</i>		
Return on assets	-	The firm's return on assets less the median return on assets for the relevant sector. The return on assets is calculated as the firm's profit for the year before interest (primary operating result) as a ratio of its total assets at year-end.
Debt ratio (short-term)	+	Short-term debt as a ratio of total assets at year-end.
Debt ratio (long-term)	+	Long-term debt as a ratio of total assets at year-end.
Size	-	The logarithm of total assets at year-end deflated by the GDP deflator (1995=1).
Capital base reduction	+	The dummy variable is set at 1 if the firm has had a deficit in the last year, and if a repetition thereof would lead to the firm's equity capital falling below the statutory capital adequacy requirement for new firms. Otherwise, the dummy variable is set at 0.
Critical auditors' qualification.....	+	The dummy variable is set at 1 if the annual financial statements include one or more critical auditors' qualifications. Firms without auditors' qualifications constitute the reference group for which the dummy variable is set at 0.
<i>Included without a lag:</i>		
Form of ownership	+	The dummy variable is set at 1 if the firm is a private limited liability company at the beginning of the year. Public limited liability companies constitute the reference group (at value 0). The statutory capital adequacy requirement is higher for the establishment of public limited liability companies than for private limited liability companies.
Age	-	Dummy variable representing the age of the firms measured as the number of whole years at the beginning of the year. The reference group (at value 0) is made up of newly-established firms that are less than 1 year old.
Municipality group	-	Dummy variables ranking the firms' registered offices at the beginning of the year by municipality group with Greater Copenhagen as the reference group (at value 0). Greater Copenhagen is normally more sensitive to economic fluctuations than other districts.
Time dummies for each sector	+/-	The time dummy variables for each of the seven industries in the data basis (manufacturing industry is the reference category). These dummy variables are to capture the cyclical development as well as more industry-specific trends in each industry.

As regards the timing of defaults in the data base used for the estimated equations in this section, the following should be noted: All defaults are attributed to the year immediately after the end of the year for which the firm presented its last financial statements as an active firm. On average, however, 1.5 years elapse from the time a firm presents its last financial statement as an active firm until its default is officially confirmed, cf. Lykke et al. (2004). In effect, several of the defaults attributed to year t in the data basis therefore concern the following year.

In purely econometric terms the basic model in equation (6.1) is estimated as a logistic regression model¹, and the result appears from Table 6.2. The response variable is the logarithm of the so-called odds ratio, i.e. the probability of "exit by default" relative to the probability that the firm "will continue as an active firm". This "relative default risk" is simply referred to as "default risk" in the following.

In view of the large number of observations, it can be argued that the coefficient estimates should be assessed at a significance level lower than the traditional 5 per cent. All the estimated coefficients shown in the basic model are significant at a significance level of 1 per cent, and the signs are as expected, cf. also Table 6.1. The model illustrates e.g. that the larger a firm's return on assets and the lower its debt, the lower its default risk will be.

Table 6.2 also shows the change in the odds ratio in case of a one-unit change in the explanatory variable. Table 6.2 shows e.g. that the default risk of a firm with a critical auditors' qualification is around three times higher than the default risk of a similar firm without a critical auditors' qualification.

In order to assess whether a firm's dependence on a "weak" bank during the financial crisis increased its probability of default, a number of dummy variables are added to the basic model in equation (6.1) as follows:

$$PD_{j,t} = F \left(b_0 + \sum_{i=1}^k b_i X_{i,j,t-1} + \sum_{i=1}^m a_i Z_{i,j,t} + d_{04} D04_{j,t} + \dots + d_{10} D10_{j,t} \right). \quad (6.2)$$

For example, the dummy variable $D10_{j,t}$ in equation (6.2) is 1 in 2010 if firm j had a "weak" bank at the beginning of 2010. For other years the variable is 0. The other dummy variables are defined in the same way. A

¹ The model has been estimated using maximum likelihood. The estimation uses a multinomial logit model with four outcomes ("active firm", "exit by default", "exit by voluntary liquidation" and "exit by merger"). The base category of the model is "active firm", cf. Abildgren, Buchholst and Staghøj (2011) for further details.

ESTIMATION OF FAILURE-RATE MODEL (6.1) – THE BASIC MODEL

Table 6.2

	Coefficient estimate	Standard error	Change in the odds ratio in case of a one-unit change in the explanatory variable
Constant term	-2.816***	0.0857	...
Return on assets	-0.00125***	0.000205	0.999
Debt ratio (short-term)	0.359***	0.0132	1.431
Debt ratio (long-term)	0.322***	0.0297	1.380
Size	-0.217***	0.00753	0.805
Critical auditors' qualification	1.168***	0.0218	3.214
Form of ownership	0.354***	0.0228	1.425
Capital base reduction	1.281***	0.0218	3.599

Note: The response variable in the estimated equation is the logarithm of the so-called odds ratio, i.e. the probability that a firm will "exit by default" divided by the probability that it will "continue as an active firm". The figures in the column under the heading "Change in the odds ratio in case of a one-unit change in the explanatory variable" are produced by taking the antilogarithm of the figures in the column of coefficient estimates.

In addition to the variables shown in the table, the estimated model includes dummy variables for municipality group and age. Other variables include time dummies for each industry. The model is estimated on the basis of 554,425 annual financial statements for the period 1995-2009.

* indicates that a coefficient is significantly different from zero at a significance level of 10 per cent.

** indicates that a coefficient is significantly different from zero at a significance level of 5 per cent.

*** indicates that a coefficient is significantly different from zero at a significance level of 1 per cent.

Source: Abildgren, Buchholst and Staghoj (2011).

positive value of e.g. the parameter d_{10} reflects that a firm with a "weak" bank was more likely to default in 2010 than a similar firm with a "sound" bank. Parameters of the other dummy variables for the firms' banks in equation (6.2) can be interpreted in the same way.

If the estimated dummy variable parameters for the firms' banks in the period from 2007/08 onwards differ significantly from zero and are positive, this may indicate that firms with a "weak" bank have been subject to a higher default risk during the Financial Crisis than similar firms with a "sound" bank. As a robustness check, equation (6.2) also includes a number of additional dummy variables for the firms' banks relating to the years preceding the Financial Crisis. *A priori* the parameters for those dummy variables must be expected not to differ significantly from zero.

How to operationalise the term "weak" bank is a different matter. This can be done in several ways.

One possibility is to take as a starting point the "Supervisory Diamond" for banks introduced by the Danish Financial Supervisory Authority (FSA) on the basis of the common features characterising banks in difficulties during the most recent and previous banking crises, cf. Danish Financial Supervisory Authority (2010). The Supervisory Diamond includes a number of benchmarks for what must be defined as banking activity subject to heightened risk. The benchmarks of the Supervisory Diamond concern lending growth, property exposure, large exposures, excess liquidity cover and funding ratio. Against this background, a bank

ENDOGENEITY PROBLEMS IN RELATION TO EQUATION (6.2)

Box 6.1

Reverse causality

The model assumes that the causality goes from the dummy variables for a "weak" bank to the probability of default of the individual firm – and not vice versa – so reverse causality will not be a problem. This seems to be a fair assumption if the default of an individual firm has no impact on whether its main bank is classified as "weak" or not. The degree to which this assumption is fulfilled in practice depends on the specific definition of a "weak" bank. If a "weak" bank is defined on the basis of data relating to the period prior to the financial crisis, the firms' probabilities of default during the crisis (which are the object of the analysis) will not affect the definition of a "weak" bank. This means the problem of reverse causality is avoided. However, this is not the case for definitions of a "weak" bank based on data relating to the period during the financial crisis.

The definitions of a "weak" bank according to the Supervisory Diamond for banks or to excess capital adequacy based on data for the period preceding the financial crisis from 2007/08 onwards do not give rise to any problems of reverse causality because defaulting firms during the financial crisis using these definitions do not influence whether a bank is classified as "weak" or not.

Parameter estimation bias as a result of leaving out variables

Another problem concerns the risk of leaving out variables of relevance to a firm's probability of default which are also correlated with the dummy variables for a "weak" bank. Assume that there is a tendency for firms with a high debt ratio to be customers mainly of "weak" banks. Furthermore, assume that while a high debt ratio increases the probability of default of a firm, the strength of its bank has no influence on its default risk. If the debt ratio is not among the explanatory variables, the high debt ratio's effect on the default risk when estimating equation (6.2) will be misattributed to the "weak" bank. It is sought to address this risk of *parameter estimation bias as a result of omitting variables* by including all those variables in equation (6.2) which impact the firm's probability of default according to Danmarks Nationalbank's failure-rate model. This is a way to ensure that any positive and significant dummy variable parameters for "weak" banks during the years of financial crisis in equation (6.2) are not merely a reflection of "weak" banks having "weak" firms with high probabilities of default as their customers.

The vast majority of firms stick with the same bank year after year. Of the firms that have switched to other banks over time, several firms tended to switch to "weak" banks during the period leading up to the Financial Crisis, and several firms tended to leave the "weak" banks during the Financial Crisis. Model (6.2) is not affected by firms switching between "sound" and "weak" banks over time if the explanatory variables include all the firm characteristics that are key to the firm's probability of default. If, on the other hand, relevant explanatory variables are left out, there is a risk of parameter estimation bias as a result of the firm switching to another bank. The vast majority of firms have remained with the same bank before and during the Financial Crisis, however.

might be defined as being "weak" if, based on data from the period immediately prior to the most recent financial crisis (i.e. mid-2007), the bank exceeded the FSA threshold values for four out of the five variables in the Supervisory Diamond. Of the slightly more than 100 Danish banks stated by the firms as their banks, 14 banks would be defined as "weak" according to that definition, including 3 medium-sized and 11 small banks.

Another possibility is to perceive a bank as "weak" if it is among the 10 per cent of the banks having the lowest excess solvency ratio (relative to the individual capital need) in 2007. Of the slightly more than 100 Danish banks stated by the firms as their banks, 11 banks would thus be defined as "weak", including 3 medium-sized banks. Only 2 of the 11 banks coincide with those described as "weak" according to the Supervisory Diamond. Therefore, it may be useful to make estimations of equation (6.2) using more alternative definitions of the term "weak" bank in order to check the robustness of the results.

If the parameter estimates for the bank variables in equation (6.2) are to be interpreted as an expression of how a firm's dependence on a "weak" bank impacts its probability of default, the model must take fully into account the differences in the firms' credit quality. If not, the positive coefficient dummy variables for a "weak" bank may merely reflect that "weak" banks have a customer portfolio characterised by a predominance of unprofitable firms with a high probability of default. For this reason it must be ensured that the explanatory variables reflect all the financial and structural differences between the firms that affect the probability of default of the individual firm, and adjustment must be made accordingly. For example, the failure rate of a firm with a high debt ratio must be expected to be higher than that of a firm with a low debt ratio. However, this should be captured by the explanatory variables in equation (6.2), so the effect of a high debt ratio on the probability of default is not misattributed to the dummy variable for the firm's bank, cf. the discussion of endogeneity problems in Box 6.1.

Table 6.3 shows a comparison of a number of key ratios for firms with "sound" or "weak" banks – weak banks being defined on the basis of the Supervisory Diamond for banks and excess capital adequacy, respectively (both definitions are based on data from mid-2007). In the period 2007-09, the failure rate for firms with a "weak" bank was, on average, higher than that for firms with a "sound" bank, but this was also the case before the Financial Crisis, although to a lesser extent. "Weak" banks thus tend to have a higher share of "bad" customers. Moreover, there are several systematic differences between firms with a "sound" and "weak" bank, respectively. Firms with a "weak" bank are generally

COMPARISON OF KEY RATIOS FOR FIRMS WITH A "SOUND" AND "WEAK" BANK, RESPECTIVELY

Table 6.3

	Average 1995-2006				Average 2007-09			
	"Weak" bank defined on the basis of the Supervisory Diamond		"Weak" bank defined on the basis of excess capital adequacy		"Weak" bank defined on the basis of the Supervisory Diamond		"Weak" bank defined on the basis of excess capital adequacy	
	Sound bank	Weak bank	Sound bank	Weak bank	Sound bank	Weak bank	Sound bank	Weak bank
Failure rate (per cent)	2.5	3.8	2.6	2.8	2.9	4.5	2.9	5.3
Return on assets (per cent) .	5.6	3.8	5.4	6.2	4.8	3.6	4.7	4.8
Primary operating result (kr. million)	2.1	0.5	2.1	0.8	3.1	0.5	2.9	1.0
Assets (kr. million)	36.2	12.0	35.3	11.9	67.0	19.4	65.1	16.6
Equity capital (kr. million) ...	15.4	3.6	15.0	4.1	27.5	6.4	26.7	6.2
Short-term debt as a ratio of assets (per cent)	54.0	60.2	54.4	52.9	59.8	65.4	60.1	60.1
Long-term debt as a ratio of assets (per cent)	12.2	12.5	12.2	15.2	10.5	10.7	10.4	13.5
Number of employees	25.6	11.2	25.0	12.6	34.0	14.5	33.1	15.8
Age of firm (years)	17.5	15.3	17.4	16.1	21.2	18.3	21.0	19.5
Capital base reduction (share of firms, per cent)	14.3	18.8	14.5	15.0	16.3	21.3	16.5	18.2
Critical auditors' qualification (share of firms, per cent)	7.8	10.1	7.9	9.6	11.0	14.8	11.1	13.5
<i>Geographical location of firms (per cent)</i>								
Copenhagen and Frederiksberg	13.4	28.3	14.5	5.2	12.2	28.4	13.5	4.6
County of Copenhagen ...	11.6	23.1	12.5	2.8	10.5	23.0	11.7	1.7
Counties of Frederiksborg and Roskilde	12.7	24.4	13.7	2.7	11.8	23.2	12.9	3.1
Other urban municipalities	19.8	5.3	18.8	21.7	20.8	7.1	19.8	19.6
Rural districts	42.6	18.9	40.5	67.7	44.7	18.2	42.1	71.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<i>Break-down of firms by industry (per cent)</i>								
Trade, etc.	32.3	31.0	32.3	29.8	34.9	32.0	34.9	30.5
Construction	12.4	14.4	12.5	15.3	14.0	15.7	14.1	16.9
Real estate	23.0	25.8	23.2	21.1	20.5	25.5	20.9	19.0
Manufacturing	18.1	14.7	17.9	19.9	17.6	13.6	17.3	20.3
Transport, etc.	5.3	4.2	5.2	4.9	8.9	8.5	8.9	8.0
Other	8.9	9.9	8.9	9.0	4.1	4.5	4.0	5.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of observations	430,843	27,662	446,627	11,878	89,435	6,485	93,293	2,627

Source: Calculated by Abildgren, Buchholst and Staghoj (2011) on the basis of data from Experian A/S.

smaller than firms with a "sound" bank in terms of the value of their total assets, equity capital and number of employees. On average, firms with a "weak" bank are also slightly younger than firms with a "sound" bank.

All in all, table 6.3 highlights the need to adjust for systematic differences between the firms when attempting to estimate the effect of having a "weak" bank rather than a "sound" bank on their financial performance during the most recent financial crisis.

Table 6.3 also illustrates that the geographical location of firms with "weak" banks is highly dependent on the definition of a "weak" bank. If the Supervisory Diamond is used to define "weak" banks, firms with a "weak" bank will to a great extent be located in large towns. On the other hand, if excess capital adequacy is used to define "weak" banks, firms with a "weak" bank will to a great extent be located in rural districts. This highlights the need to make estimations of the model (6.2) using several different definitions of the term "weak" bank in order to ensure the robustness of the results.

Table 6.4 shows the results of estimations of equation (6.2) using two different definitions of a "weak" bank. If a "weak" bank is defined on the basis of the Supervisory Diamond in mid-2007, the parameters of the dummy variables *D08-D09* differ significantly from zero at a 1 per cent significance level, and the sign is as expected. According to the calculations, and all other things being equal, the default risk in 2008-09 for firms with a "weak" bank was around 40 per cent higher than for similar firms with a "sound" bank. The parameter estimates relating to the period prior to the Financial Crisis (*D04-D06*) do not differ significantly from zero, which is also in accordance with expectations. In the years prior to the Financial Crisis, the firms' choice of bank did not affect their probabilities of default.

The results based on excess capital adequacy in mid-2007 indicate more or less the same pattern, although the bank variable has a somewhat stronger effect on the probability of default. It should also be noted that with this definition of a "weak" bank, the effect on the probability of default in 2007 differs significantly from zero at a 1 per cent significance level. This may seem to be a very early stage of the Financial Crisis, but the effect should be seen in the light of the fact that, on average, 1.5 years elapse from the time a firm presents its last financial statement as an active firm until its exit by default is officially confirmed. So in effect, several of the defaults attributed to 2007 in the data basis concern the following year.

It is also worth noting that there are no indications of the strength of a firm's bank having had any impact on its probability of default in 2010. This applies regardless of the definition of a "weak" bank. Accordingly, the effect of a "weak" bank can only be traced in the crisis years up to and including 2009. This is consistent with the results in section 5, which indicated that the negative impact on real GDP caused by the

ESTIMATION OF FAILURE-RATE MODEL (6.2) INCLUDING DUMMY VARIABLES
FOR THE FIRMS' BANKS

Table 6.4

	Coefficient estimate		Standard error		Change in the odds ratio in case of a one-unit change in the explanatory variable	
	"Weak " bank defined on the basis of the following:					
	The Supervisory Diamond	Excess capital adequacy	The Supervisory Diamond	Excess capital adequacy	The Supervisory Diamond	Excess capital adequacy
Constant terms	-2.825***	-2.821 ***	0.0857	0.0857
Return on assets	-0.00126***	-0.00126 ***	0.000205	0.000205	0.999	0.999
Debt ratio (short-term)	0.358***	0.358 ***	0.0132	0.0132	1.431	1.431
Debt ratio (long-term)	0.322***	0.321 ***	0.0297	0.0297	1.379	1.379
Size	-0.217***	-0.217 ***	0.00753	0.00753	0.805	0.805
Critical auditors' qualification	1.167***	1.167 ***	0.0218	0.0218	3.211	3.214
Form of ownership ..	0.354***	0.353 ***	0.0228	0.0228	1.424	1.424
Capital base reduction	1.280***	1.282 ***	0.0218	0.0218	3.596	3.602
D10	-0.00842	0.195	0.170	0.241	0.992	1.216
D09	0.337***	0.763 ***	0.106	0.147	1.400	2.144
D08	0.323***	0.711 ***	0.105	0.152	1.382	2.035
D07	0.302**	0.752 ***	0.128	0.174	1.352	2.122
D06	-0.121	0.268	0.160	0.233	0.886	1.307
D05	0.124	0.219	0.133	0.212	1.132	1.245
D04	0.108	0.011	0.122	0.195	1.114	1.011

Note: For a further description of the two definitions of a "weak" bank, see the main text.

The response variable in the estimated equation is the logarithm of the odds ratio, i.e. the probability that a firm will "exit by default" divided by the probability that it will "continue as an active firm". The figures in the column under the heading "Change in the odds ratio in case of a one-unit change in the explanatory variable" are produced by taking the antilogarithm of the figures in the column of coefficient estimates.

In addition to the variables shown in the table, the estimated model includes dummy variables for municipality group and age. Other variables include time dummies for each industry. The model is estimated on the basis of 554,425 annual financial statements for the period 1995-2009.

* indicates that a coefficient is significantly different from zero at a significance level of 10 per cent.

** indicates that a coefficient is significantly different from zero at a significance level of 5 per cent.

*** indicates that a coefficient is significantly different from zero at a significance level of 1 per cent.

Source: Abildgren, Buchholst and Staghøj (2011).

Financial Crisis occurred at the beginning of the crisis, after which the development stabilised in parallel with the implementation of Bank Rescue Packages 1 and 2.

In summary, the above analysis indicates that the default risk for firms with a "weak" bank was higher in 2008-09 than that for similar firms with a "sound" bank. The question is how these results should be interpreted. Firstly, the calculations are based on the assumption that the explanatory variables in the failure-rate model (return on assets, debt ratio, auditors' qualification, etc.) fully allow for the fact that the probability of default is higher for firms with "poor" finances than for firms

with "healthy" finances. Where this is not the case, the impact of having a "weak" bank on a firm's probability of default will be overestimated. The reason is that, as mentioned above, "weak" banks tend to have a higher share of "bad" customers. In such cases it cannot be ruled out that the calculations simply reflect the default of unprofitable firms during the financial crisis and that those firms were mainly customers of "weak" banks. Secondly, the calculations assume that in terms of the probability of default, the effect of having a "weak" bank is the same for all firms. In view of the fact that, as mentioned in section 5, only a small number of firms in recent years have reported financial constraints as impediments to production, it would be natural to see this result as indicating that dependence on "weak" banks affected only the probability of default for a small share of firms, while the probabilities of default of the majority of firms were not affected by the state of their banks. To illustrate this issue, section 7 below focuses on whether a negative impact of having a "weak" bank can be seen on the return on assets for the non-defaulting firms during the Financial Crisis.

7. BANKS AND THE RETURN ON ASSETS OF NON-DEFAULTING FIRMS DURING THE FINANCIAL CRISIS FROM 2007/08 ONWARDS

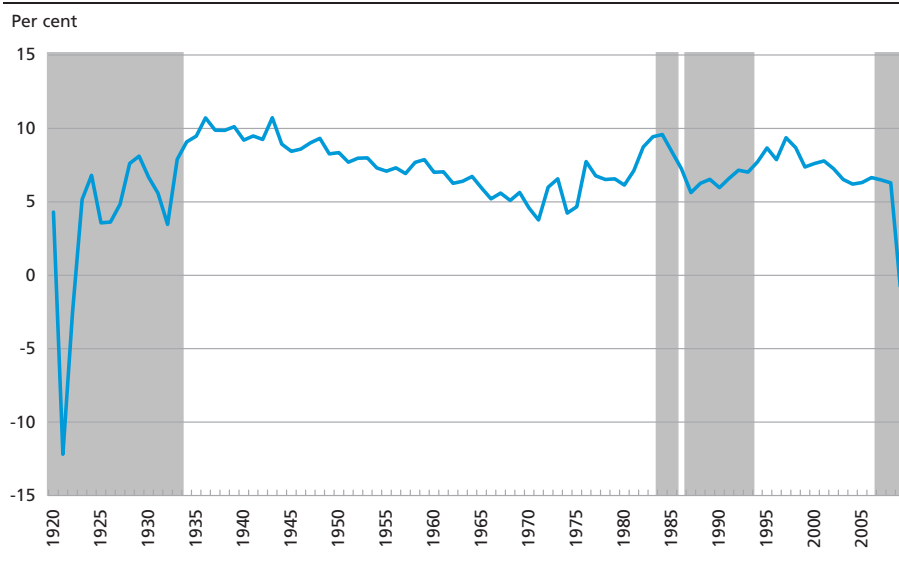
The financial strength of a firm's bank may not only affect the firm's survival during a financial crisis. In more general terms, the bank may also affect the financial performance of non-defaulting firms. As mentioned in section 6, a "weak" bank may have fewer options to meet the credit and liquidity needs of corporate customers than a bank with "sound" finances. If a firm with a "weak" bank finds it difficult to obtain alternative funding, it may have to reduce its activity level, divest assets or refrain from making profitable investments. This may have a negative impact on the firm's financial performance, even if it does not cause it to fail. While credit constraints may cause firms with poor liquidity to default in the short term, it may be argued that a potential impact on the return on assets of non-defaulting firms will only be seen in the slightly longer term.

Chart 7.1 shows the return on assets in the Danish industrial sector over the past 80 years. The return on assets is a measure of a firm's primary operating result (i.e. the profit for the year before interest) as a ratio of its total assets. It thus reflects the firm's ability to generate a return on assets which is used to pay taxes and to achieve a return on the firm's liabilities, including its equity capital.

The development in the return on assets over time is not affected by the business cycle alone, but also by structural changes in the business

RETURN ON ASSETS IN MANUFACTURING INDUSTRY 1920-2009

Chart 7.1



Note: The grey markings indicate periods of banking crises, cf. Table 2.1.

The return on assets is calculated as the firm's profit for the year before interest ("primary" or "ordinary" operating profit) as a ratio of its total assets at year-end. Data for the period 1920-75 are based on all industrial firms organised as public limited liability companies (A/S) or private limited liability companies (ApS) with minimum 20 employees. Data for the period 1990-94 are based on all industrial firms (excluding oil extraction) with minimum 20 employees. Since 1995, the series has been based on all industrial firms (excluding oil extraction). Adjustment has been made for various data breaks.

Source: Statistics Denmark and Experian A/S.

sector (e.g. shifts between individual industrial sectors). Furthermore, a shift in the statutory accounting rules implies that caution should be exercised when comparing levels over time.¹

However, the chart clearly shows that the return on assets during the most recent financial crisis was characterised by an extraordinarily strong decline. The question is, however, whether this decline was caused by cyclical developments alone, or if part of the decline in the return on assets can be attributed more directly to the tightening of credit standards and the lower propensity to provide credit of some banks that have been under financial pressure during the Financial Crisis.

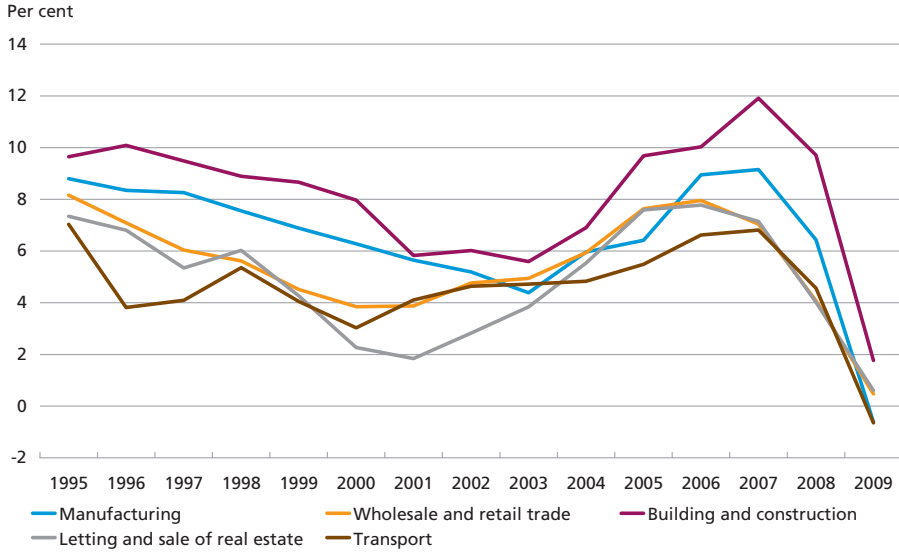
This issue is discussed below based on an analysis in Abildgren, Buchholst and Staghøj (2011). The analysis is based on the same firm-specific data from Experian A/S as those used in connection with the failure-rate analysis in section 6.

Chart 7.2 shows the average return on assets for different industries in the period 1995-2009 in the data base used for the analysis. The devel-

¹ The accounting principles actually applied may also impede comparisons over time. During periods of high inflation, for example, there will be a tendency to underestimate firms' return on assets if capital gains on the firm's assets are not fully recognised in the operating result, cf. Waagstein (1985).

RETURN ON ASSETS IN SELECTED INDUSTRIES 1995-2009

Chart 7.2



Note: A simple average of returns on assets for firms in the various industries. The return on assets is calculated as the firm's profit for the year before interest ("primary" or "ordinary" operating profit) as a ratio of its total assets at year-end.

Source: Calculated on the basis of data from Experian A/S.

opment is characterised by a substantial decline in the return on assets for all industries in the period 2008-09. Moreover, a tendency towards level differences in the return on assets across industries is noted. Among other factors, this can be attributed to industry-related differences in capital intensity and corporate structure.

The analysis focuses on the financial statements for non-defaulting firms.¹ A simple basic model is estimated for firm j 's return on assets in year t , $Y_{j,t}$, based on information about the size, debt ratio, etc. of the firm in year $t-1$ ($X_{1,j,t-1}, \dots, X_{k,j,t-1}$). As explanatory variables the model also includes a number of other firm details such as exports, geographical location in year t as well as industry-specific time dummy variables intended to capture cycles and more structural development trends in the individual industries ($Z_{1,j,t}, \dots, Z_{m,j,t}$), cf. equation (7.1):

$$Y_{j,t} = b_0 + \sum_{i=1}^k b_i X_{i,j,t-1} + \sum_{i=1}^m a_i Z_{i,j,t}, \quad (7.1)$$

where b_0 is a constant term, and $b_1, \dots, b_k, a_1, \dots, a_m$ are parameters.

¹ The financial statements of defaulting firms that presented their last financial statements as an active firm in year t are included in the data material with financial statements up to and including year $t-1$.

In addition, an extended model is estimated with dummy variables indicating whether the firm's bank is "weak" or not, cf. equation (7.2):

$$Y_{j,t} = b_0 + \sum_{i=1}^k b_i X_{i,j,t-1} + \sum_{i=1}^m a_i Z_{i,j,t} + d_{05} D05_{j,t} + \dots + d_{09} D09_{j,t}. \quad (7.2)$$

The dummy variable $D09_{j,t}$ in equation (7.2) is 1 in 2009 if firm j had a "weak" bank at the end of 2009. For other years the variable is 0. The other dummy variables for the firms' banks are defined in the same way. A significant, negative value of e.g. d_{09} indicates that a firm with a "weak" bank had a lower return on assets in 2009 than a similar firm with a "sound" bank.

The explanatory variables in (7.1) and (7.2) are stated in Table 7.2 and seek to adjust for differences in the firms' characteristics.¹ As largely the same variables are included in the failure-rate model in section 6, this means that adjustment is also made for differences in the firms' credit quality. This is a way to ensure that a significant, negative value of e.g. d_{09} in model (7.2) is not merely a reflection of the "weak" banks having "weak" firms as their customers.

Equation (7.2) also includes a number of dummy variables for the firms' banks relating to the period preceding the financial crisis. They act as a robustness check of whether a possible difference in the return on assets caused by a "weak" bank only had an effect during the crisis, or whether this was also the case before the Financial Crisis.

It should also be noted that the analysis is based on a comparison of the differences in the return on assets of firms with "weak" and "sound" banks, respectively. In this way the analysis seeks to identify a possible negative effect on the return on assets during the banking crisis of having a "weak" bank as compared to having a "sound" bank. On the other hand, this analysis approach cannot be used to estimate the negative effects, if any, of a general tightening of credit standards during the financial crisis by "weak" and "sound" banks alike.

Table 7.3 shows the results of a basic model estimation (7.1).² The results show e.g. that the return on assets of a firm with a critical auditors'

¹ The variables "debt ratio (short-term)", "debt ratio (long-term)", "size" and "capital base reduction" are included with a lag in (7.1) and (7.2) to avoid any endogeneity issues. The first three variables include the firm's total assets, which is also used to calculate the return on assets. The capital base reduction variable includes information on the profit for the year and therefore cannot be included contemporaneously in the model.

² The model is estimated using pooled ordinary least squares (OLS). This means that the error term is considered to be independent between different observations, conditional on the explanatory variables. It has been sought to model the heterogeneity of firms by including a large number of explanatory variables.

EXPLANATORY VARIABLES IN EQUATIONS (7.1) AND (7.2)		Table 7.2
Explanatory variables	Description	
<i>Included with a lag:</i>		
Debt ratio (short-term)	Short-term debt as a ratio of total assets at year-end.	
Debt ratio (long-term)	Long-term debt as a ratio of total assets at year-end.	
Size	The logarithm of total assets at year-end deflated by the GDP deflator (1995 = 1).	
Capital base reduction	The dummy variable is set at 1 if the firm has had a deficit in the last year, and if a repetition thereof would lead to the firm's equity capital falling below the statutory capital adequacy requirement for new firms. Otherwise, the dummy variable is set at 0.	
<i>Included without a lag:</i>		
Critical auditors' qualification	The dummy variable is set at 1 if the annual financial statements include one or more critical auditors' qualifications. Firms without auditors' qualifications constitute the reference group for which the dummy variable is set at 0.	
Form of ownership	The dummy variable is set at 1 if the firm is a private limited liability company at year-end. Public limited liability companies constitute the reference group (at value 0). The statutory capital adequacy requirement is higher for the establishment of public limited liability companies than for private limited liability companies.	
Age	Dummy variable representing the age of the firms measured as the number of whole years at year-end. The reference group is made up of firms that are 1 year old.	
Exports	The share of the firm's revenue made up by exports.	
Municipality group	Dummy variable ranking the firms' registered offices at year-end by municipality group with Greater Copenhagen as the reference group (at value 0). Greater Copenhagen is normally more sensitive to economic fluctuations than other districts.	
Time dummies for each industry	The time dummy variables for each of the seven industries in the data basis (manufacturing is the reference category). These dummy variables are to capture the cyclical development as well as more industry-specific trends in each industry.	

qualification is around 5 percentage points lower than that of a similar firm without a critical auditors' qualification.

Table 7.4 shows the results of model (7.2) for the firms' return on assets, including dummy variables for the firms' banks in the period 2005-09. The estimated parameters of the explanatory variables do not change noticeably when incorporating dummy variables for "weak" banks in the model. The model is estimated separately for two different definitions of a "weak" bank on the basis of the Supervisory Diamond and excess capital adequacy, respectively (both definitions are based on data from mid-2007), cf. section 6.

ESTIMATION OF MODEL (7.1) FOR RETURN ON ASSETS – THE BASIC MODEL

Table 7.3

	Coefficient	Standard error
Constant	2.792***	0.484
Critical auditors' qualification	-4.870***	0.137
Form of ownership	0.582***	0.085
Exports	0.018***	0.002
Size	-0.239***	0.029
Debt ratio (short-term)	0.051***	0.001
Debt ratio (long-term)	0.033***	0.002
Capital base reduction	-13.194 ***	0.123

Note: The response variable in the estimated equation is the return on assets calculated as the firm's profit for the year before interest ("primary" or "ordinary" operating profit) as a ratio of its total assets at year-end. In addition to the variables shown in the table, the estimated model includes dummy variables for municipality group and age. Other variables include time dummies for each industry. The model is estimated on the basis of 463,158 annual financial statements for the period 1995-2009.

* indicates that a coefficient is significantly different from zero at a significance level of 10 per cent.

** indicates that a coefficient is significantly different from zero at a significance level of 5 per cent.

*** indicates that a coefficient is significantly different from zero at a significance level of 1 per cent.

Source: Abildgren, Buchholst and Staghoj (2011).

The results in Table 7.4 give no indications that the return on assets for non-defaulting firms during the Financial Crisis was dependent on the "soundness" of their banks. This may reflect that non-defaulting firms

ESTIMATION OF MODEL (7.2) FOR THE RETURN ON ASSETS INCLUDING DUMMY VARIABLES FOR THE FIRMS' BANKS

Table 7.4

	"Weak" bank defined on the basis of			
	The Supervisory Diamond		Excess capital adequacy	
	Coefficient	Standard error	Coefficient	Standard error
Constant	2.811***	0.484	2.791***	0.484
Critical auditors' qualification	-4.869***	0.137	-4.869***	0.137
Form of ownership	0.583***	0.085	0.583***	0.085
Exports	0.018***	0.002	0.018***	0.002
Size	-0.239***	0.029	-0.239***	0.029
Debt ratio (short-term)	0.051***	0.001	0.051***	0.001
Debt ratio (long-term)	0.033***	0.002	0.033***	0.002
Capital base reduction	-13.194***	0.123	-13.194***	0.123
D09	0.286	0.602	-0.328	0.937
D08	-0.929	0.572	-0.679	0.887
D07	-0.440	0.552	1.474*	0.858
D06	-0.901 *	0.539	-0.883	0.838
D05	-0.455	0.532	-0.071	0.824

Note: The response variable in the estimated equations is the return on assets calculated as the firm's profit for the year before interest ("primary" or "ordinary" operating profit) as a ratio of its total assets at year-end. In addition to the variables above, the estimated model includes dummy variables for municipality group and age. Other variables include time dummies for each industry. The model is estimated on the basis of 463,158 annual financial statements for the period 1995-2009.

* indicates that a coefficient is significantly different from zero at a significance level of 10 per cent.

** indicates that a coefficient is significantly different from zero at a significance level of 5 per cent.

*** indicates that a coefficient is significantly different from zero at a significance level of 1 per cent.

Source: Abildgren, Buchholst and Staghoj (2011).

with "weak" banks were not affected by a possible tightening of credit standards by those banks during the financial crisis, or that the firms had no difficulties finding alternative funding sources where the "weak" banks were unable to meet the firms' credit needs in a satisfactory manner.

Obviously, it cannot be ruled out that a potential effect of having had a "weak" bank during the Financial Crisis on the return on assets will affect the firms that did not default during the crisis only in the slightly longer term. A firm which is prevented from expanding or making the desired investments due to credit constraints may thus possibly obtain a lower return on assets in the slightly longer term without this necessarily having any effect on the return on assets in the short term, as illustrated by model (7.2). On the other hand, the result that the strength of the firms' banks has not affected the firms' return on assets is consistent with Statistics Denmark's confidence indicators mentioned in section 5, which indicate that only a limited number of firms have reported financial constraints as impediments to production during the Financial Crisis.

8. CONSEQUENCES OF BANKING CRISES FOR LONG-TERM GROWTH AND INCOME LEVEL

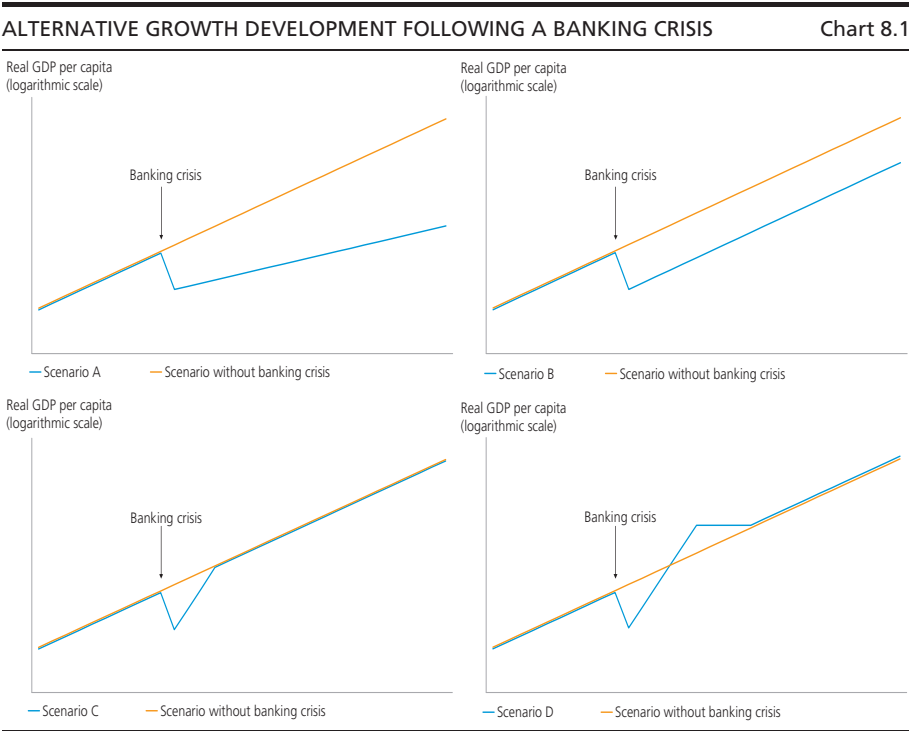
The previous sections focused on the real economic consequences of banking crises in the short and medium term. This section discusses the effects of banking crises in the longer term.

In principle, there are (at least) four possible scenarios for the development in real GDP per capita after a banking crisis, cf. Chart 8.1. In scenario A the trend growth after the banking crisis is permanently lower than before the crisis. This not only implies that it will never be possible to recover the output loss suffered during the banking crisis; it also means that the loss will increase over time compared to a situation without a banking crisis.

In scenario B the trend growth reverts to the pre-crisis level. The output loss suffered during the crisis is never recovered, however, and the income level after the banking crisis is permanently lower than it would have been if there had been no banking crisis.

In scenario C the trend growth reverts to the pre-crisis level in the long term, and, during a transition period, the growth level is higher than the pre-crisis trend growth. The long-term level of real GDP per capita in scenario C is not affected by the banking crisis, but there will still be a period of output loss during the banking crisis.

Finally, scenario D illustrates a situation where the trend growth reverts to the pre-crisis level in the long term, while, during a transition



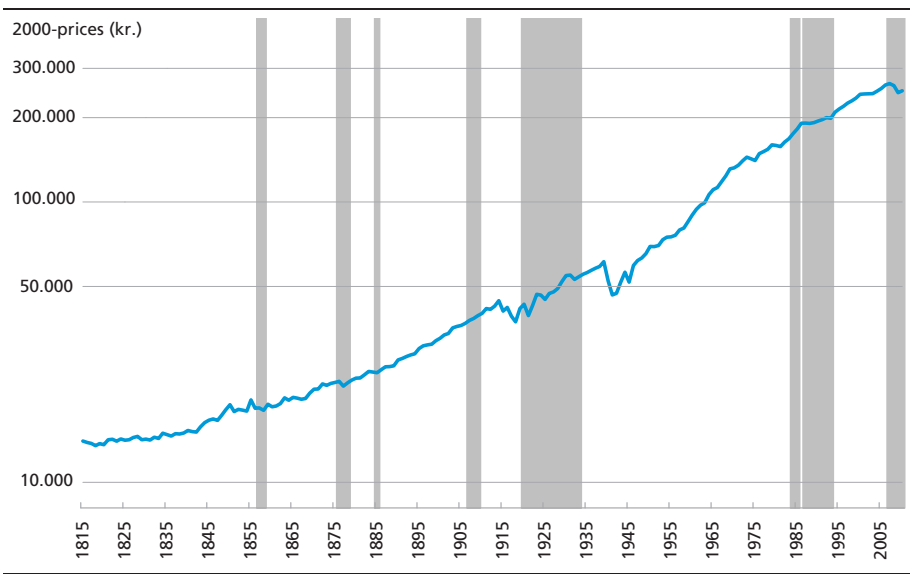
period, the growth level is sufficiently higher than the pre-crisis trend growth to compensate for the temporary loss of income during the banking crisis.

An empirical analysis of the long-term real economic consequences of banking crises can take as its starting point Chart 8.2, showing real GDP per capita in Denmark for the period after 1815. As illustrated, it is difficult to see any direct effect of previous banking crises on the long-term economic growth rate or income level per capita. Obviously, this does not mean that banking crises may not have any consequences for the long-term economic growth rate or income level. But the chart implies that factors other than banking crises may be decisive for the economic growth rate and income level in the longer term.

Chart 8.3 gives the same impression, showing the development in real GDP per capita in 22 other countries since 1870. Those 22 countries accounted for just under half of the worldwide output in 2008. As was the case for Denmark, it is also difficult to see any effect of major international financial crises on the long-term economic growth or income level per capita.

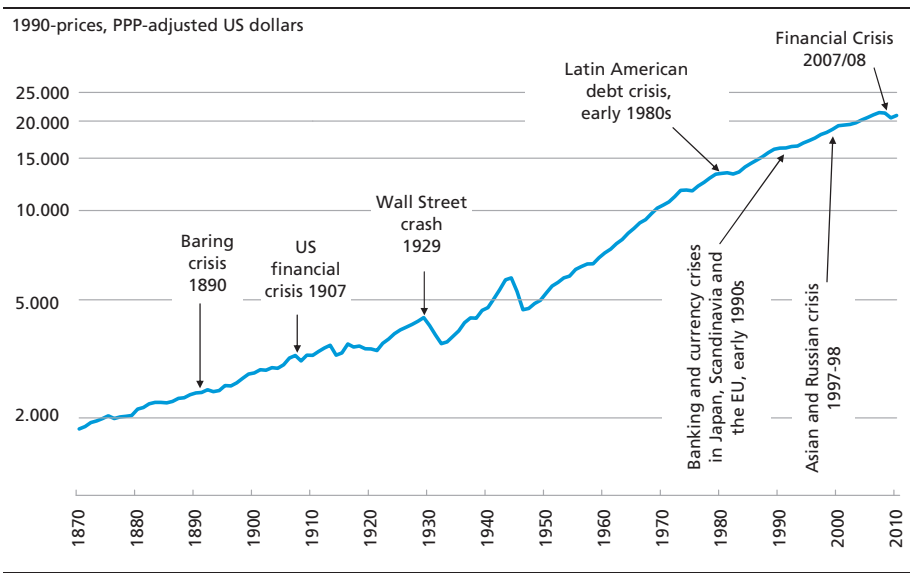
A more detailed analysis of the impact of the financial crisis in recent years on Denmark's potential output can be found in Andersen and Rasmussen (2011).

REAL GDP PER CAPITA IN DENMARK 1815-2010 Chart 8.2



Note: The grey markings indicate periods of banking crises, cf. Table 2.1. Adjustment has been made for the return of Southern Jutland to Denmark in 1920.
Source: Calculated on the basis of data from Hansen (1983), Hansen and Svendsen (1968), Abildgren (2010a), and Statistics Denmark.

REAL GDP PER CAPITA IN 22 COUNTRIES 1870-2010 Chart 8.3



Note: The countries include Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, UK, Portugal, Spain, Australia, New Zealand, Canada, USA, Brazil, Chile, Uruguay, Japan and Sri Lanka.
Source: Balakrishnan et al. (2009), IMF (2010) and Maddison (2010).

10. LITERATURE

Abildgren, Kim (2008), A 'first go' on financial accounts for Denmark 1875-2005, *Scandinavian Economic History Review*, Vol. 56(2).

Abildgren, Kim (2010a), Consumer prices in Denmark 1502-2007, *Scandinavian Economic History Review*, Vol. 58(1).

Abildgren, Kim (2010b), Business cycles, monetary transmission and shocks to financial stability – empirical evidence from a new set of Danish quarterly national accounts 1948-2010, *Danmarks Nationalbank Working Papers*, No. 71, November.

Abildgren, Kim and Jens Thomsen (2011), A tale of two Danish banking crises, Danmarks Nationalbank, *Monetary Review*, 1st Quarter, Part 1.

Abildgren, Kim, Bodil Nyboe Andersen and Jens Thomsen (2010), *Monetary history of Denmark 1990-2005*, Danmarks Nationalbank.

Abildgren, Kim, Birgitte Buchholst and Jonas Staghøj (2011), Bank-firm relationships and the performance of non-financial firms during the financial crisis 2008-09 – microeconomic evidence from large-scale firm-level data, *Danmarks Nationalbank Working Papers*, No. 73, September.

Akashi, Kentaro, Shinichi Fukuda and Munehisa Kasuya (2009), Impaired bank health and default risk, *Pacific-Basin Finance Journal*, Vol. 17.

Allen, Franklin and Elena Carletti (2008), Financial system: shock absorber or amplifier? *BIS Working Papers*, No. 257, July.

Anari, Ali, James Kolari and Joseph Mason (2005), Bank asset liquidation and the propagation of the U.S. Great Depression, *Journal of Money, Credit and Banking*, Vol. 37.

Andersen, Asger Lau and Morten Hedegaard Rasmussen (2011), Potential output in Denmark, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter, Part 2.

Artis, Michael J., Massimiliano Marcellino and Tommaso Proietti (2003), Dating the euro area business cycle, *CEPR Working Papers*, No. 3696, January.

Balakrishnan, Ravi, Petya Koeva Brooks, Daniel Leigh, Irina Tytell and Abdul Abiad (2009), What's the damage? Medium-term output dynamics after financial crises, *IMF World Economic Outlook*, October.

Banktilsynet (1945), *Banktilsynet 1920-1945 (Supervision of the Danish banking sector 1920-1945 – in Danish only)*.

Baxter, Marianne and Robert G. King (1999), Measuring business cycles: approximate band-pass filters for economic time series, *Review of Economics and Statistics*, Vol. 81(4).

Bergman, U. Michael, Michael D. Bordo and Lars Jonung (1998), *Historical evidence on business cycles: The international experience*, in Jeffrey C. Fuhrer and Scott Schuh (eds.), *Beyond shocks: What causes business cycles*, *Federal Reserve Bank of Boston Conference Series*, No. 42, June.

Berrospide, Jose M. and Rochelle M. Edge (2010), The effects of bank capital on lending: What do we know, and what does it mean? *International Journal of Central Banking*, Vol. 6.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel and Maria Soledad Martinez-Peria (2001). Is the crisis problem growing more severe? *Economic Policy*, Vol. 16.

Christensen, Anders Møller (2011), Macroeconomic impacts of financial regulation, Danmarks Nationalbank, *Monetary Review*, 1st Quarter, Part 1.

Christiansen, C., Marius Hansen and O. Himmelstrup (1945), *Den Lolland-ske Landbostands Sparekasse gennem 75 aar (Den Lollandske Landbostands Sparekasse through 75 years – in Danish only)*.

Dam, Niels Arne, Tina Saaby Hvolbøl, Erik Haller Pedersen, Peter Birch Sørensen and Susanne Hougaard Thamsborg (2011), The housing bubble that burst: Can house prices be explained? And can their fluctuations be dampened?, Danmarks Nationalbank, *Monetary Review*, 1st Quarter, Part 1.

Danmarks Nationalbank (2003), Box 6: Model for quantification of failure rates, *Financial stability*.

Danmarks Nationalbank (2007), Danmarks Nationalbank's failure-rate model, KIM, *Financial stability*.

Danmarks Nationalbank (2009), Recent economic and monetary trends, *Monetary Review*, 3rd Quarter.

Statistics Denmark (2010), Funding access for small and medium-sized enterprises, *TemaPubl*, No. 1, December.

Dyrberg, Anne (2004), Firms in financial distress: an exploratory analysis, *Danmarks Nationalbank Working Papers*, No. 17.

Danish Financial Supervisory Authority (2010), *Finanstilsynet introducerer 'Tilsynsdiamanten' for pengeinstitutter (The Danish Financial Supervisory Authority introduces the 'Supervisory Diamond' for banks – in Danish only)*, 25 June.

Gibson, Michael S. (1995), Can bank health affect investment? *Evidence from Japan*, *Journal of Business*, Vol. 68(3).

Gibson, Michael S. (1997), More evidence on the link between bank health and investment in Japan, *Journal of the Japanese And International Economies*, Vol. 11.

Hansen, Per H. (1996), *På glidebanen til den bitre ende. Dansk bankvæsen i krise 1920-1933 (On the slippery slope to the bitter end. Danish banks in crisis 1920-1933 – in Danish only)*, Odense Universitets Forlag.

Hansen, Svend Aage (1969), Kreditmarkedsstatistik (Credit market statistics – in Danish only), *Statistics Denmark Statistical surveys*, No. 24.

Hansen, Svend Aage (1983), *Økonomisk vækst i Danmark. Bind II: 1914-1983 (Economic growth in Denmark. Volume II: 1914-1983 – in Danish only)*, 3rd edition, Akademisk Forlag.

Hansen, Svend Aage and Knud Erik Svendsen (1968), *Dansk pengehistorie 1700-1914 (Monetary history of Denmark 1700-1914 – in Danish only)*, Danmarks Nationalbank.

Hastrup, Bjarne (1979), *Håndværksrådets økonomiske historie (The economic history of the Trades Council – in Danish only)*, Håndværksrådets Forlag.

Hoggarth, Glenn, Ricardo Reis and Victoria Saporta (2002), Cost of banking system instability: some empirical evidence, *Journal of Banking and Finance*, Vol. 26(2).

Hoffmeyer, Erik and Erling Olsen (1968), *Dansk pengehistorie 1914-1960 (Monetary history of Denmark 1914-1960 – in Danish only)*, Danmarks Nationalbank.

IMF (2010), *World Economic Outlook October 2010*.

Joeveer, Karin (2004), Does bank failure affect client firms? Micro evidence from Estonia, *CERGE-EI Working Paper*, No. 224, May.

Johansen, Hans Chr. (1985), *Dansk økonomisk statistik 1814-1980 (Danish economic statistics 1814-1980 – in Danish only)*, Gyldendal.

Kannan, Prakash, Marco E. Terrones and Alasdair Scott (2009), From recession to recovery: how soon and how strong?, *IMF World Economic Outlook*, April.

Klein, Michael W., Joe Peek and Eric S. Rosengren (2002), Troubled banks, impaired foreign direct investment: the role of relative access to credit, *American Economic Review*, Vol. 92(3).

Kupiec, Paul H. and Carlos D. Ramirez (2008). Bank failures and the cost of systemic risk: Evidence from 1900-1930. *CFR Working Papers*, No. 9, March.

Laeven, Luc and Fabian Valencia (2008), Systemic banking crises: A new database, *IMF Working Papers*, No. 224, November.

Lykke, Morten, Kenneth Juhl Pedersen and Heidi Mølgaard Vinther (2004), A failure-rate model for the Danish corporate sector, *Danmarks Nationalbank Working Papers*, No. 16.

Maddison, Angus (2010), *Historical statistics of the world economy: 1-2008 AD*, University of Groningen.

Marcucci, Juri and Mario Quagliariello (2008), Is bank portfolio riskiness procyclical? Evidence from Italy using a vector autoregression, *Journal of International Financial Markets, Institutions and Money*, No. 18.

Minamihashi, Naoaki (2011), Credit crunch caused by bank failures and self-selection behavior in lending markets, *Journal of Money, Credit and Banking*, Vol. 43(1).

Mikkelsen, Richard (1993), *Dansk pengehistorie 1960-1990 (Monetary history of Denmark 1960-1990 – in Danish only)*, Danmarks Nationalbank.

Mogensen, Gunnar Viby (1987), *Historie og økonomi (History and economics – in Danish only)*, Akademisk Forlag.

Monnin, Pierre and Terhi Jokipii (2010), The impact of banking sector stability on the real economy, *Swiss National Bank Working Papers*, No. 5, April.

Mordhorst, Kirsten (1968), *Dansk pengehistorie. Bilag (Monetary history of Denmark. Appendix – in Danish only)*, Danmarks Nationalbank.

Nielsen, Torben (2010), Danmarks Nationalbank's lending survey – the first results, *Finans/Invest*, No. 2.

Olsen, Erling (1962), *Danmarks økonomiske historie siden 1750 (Economic history of Denmark since 1750 – in Danish only)*, Copenhagen: GADs Forlag.

Puddu, Stefano (2010), *Real sector and banking system: real and feedback effects. A non-linear VAR approach*, paper presented at the IEA Annual Conference, 23-25 April.

Reinhart, Carmen. M. and Kenneth S. Rogoff (2009a), The aftermath of financial crises, *American Economic Review: Papers & Proceedings*, Vol. 99(2), 466-472.

Reinhart, Carmen. M. and Kenneth S. Rogoff (2009b), *This time is different*, Princeton University Press.

Reinhart, Carmen M. and Vincent R. Reinhart (2010), *After the fall*, paper presented at the Jackson Hole Economic Policy Symposium of the Federal Reserve Bank of Kansas City, 26-28 August, Jackson Hole, Wyoming.

Schwierz, Christoph (2004), *Economic costs associated with the Nordic banking crisis*, chapter 4 in: Moe, Thorvald G., Jon A. Solheim and Bent Vale (eds.), *The Norwegian banking crisis, Norges Bank Occasional Papers*, No. 33, May.

Serwa, Dobromi (2010), Larger crises cost more: impact of banking sector instability on output growth, *Journal of International Money and Finance*, Vol. 29(8).

Waagstein, Thorbjørn (1985), Er industries afkastningsgrad fejlvurderet? (Has the return on assets of industry been miscalculated? – in Danish only), *Nationaløkonomisk Tidsskrift*, Vol. 123.

Ushijima, Tatsuo (2008), Domestic bank health and foreign direct investment, *Journal of the Japanese and International Economies*, Vol. 22(3).

Zarnowitz, Victor (1992), Business cycles: theory, history, indicators, and forecasting, *National Bureau of Economic Research Studies in Business Cycles*, Vol. 27, January.

Österholm, Pär (2010), The effect on the Swedish real economy of the financial crisis, *Applied Financial Economics*, Vol. 20(4).

Danish Ministry of Economic and Business Affairs (2011), Investeringer og virksomhedernes kredivilkår (Investments and corporate credit standards – in Danish only), *Økonomisk analyse*, No. 2, 30 March.