The small picture on the front cover shows the "Banker's" clock, which was designed by Arne Jacobsen for the Danmarks Nationalbank building.

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During the crisis, it has become more difficult to obtain bank loans since credit standards have been tightened from a lenient pre-crisis level. Firms with sound finances have found it easier to obtain loans than firms with poor economic performance. Only a limited share of firms have stated financial constraints as impediments to production, but the picture varies among industries. Many firms and households have opted for a consolidation path, and corporate confidence in the banking sector's willingness and ability to always meet the demand for credit and liquidity in an economic downturn may have weakened. This has dampened the demand for credit. There are no indications that the banks' lending capacity has generally been an impediment to the development in lending. Total credit remains high in a long-term perspective.

Over the last 10-15 years, Danish households have increased their net wealth as a ratio of income. At the same time, they have also expanded their balance sheets, i.e. both assets and liabilities. This article examines how net wealth and its composition have influenced growth and fluctuations in private consumption. We also investigate the effects of financial flows from household wealth on household income and hence the scope for consumption. The analyses show e.g. that house prices were the most important factor behind the surge in consumption during the boom in 2004-07 and the subsequent sharp fall. Moreover, it is demonstrated that the falling interest rates in recent years – in response to the marked international economic slowdown – have contributed substantially to cushioning private consumption.
Banks, Credit and Business Cycles

Kim Abildgren, Economics, and Andreas Kuchler, Statistics

1. INTRODUCTION AND SUMMARY

There is a close relationship between business cycles and banking activities. For example, there is a clear tendency for decline or low growth in bank lending during an economic downturn. This reflects both credit demand and supply. Credit demand is weak during downturns due to weak development in consumption and investment. The supply of bank credit will also be lower during downturns, since it is harder for borrowers to service their debt obligations when the economic situation is unfavourable, unemployment is rising and firms are increasingly threatened by default. As a result, banks typically increase their interest margins and tighten their credit standards in a downturn to reduce the risk of increased losses on loans.

This article discusses the interaction between business cycles and banks. Furthermore, it considers the relationship between lending by banks and mortgage banks over business cycles. Part 1 of this Monetary Review contains an overview article with a non-technical summary of the most important findings and conclusions of the article.

The analysis shows that it has become more difficult for firms to obtain bank loans during the crisis, since banks have tightened their credit standards from a lenient pre-crisis level. Firms with sound finances have found it easier to obtain loans than firms with poor economic performance. Overall, only a limited share of firms have stated financial constraints as impediments to production in recent years, but the picture varies among industries. In the industrial sector, the number of firms stating financial constraints as impediments to production has been very low during the recent crisis. As a result, unemployment remains relatively low in Denmark. In the domestically oriented sectors – construction and service – a larger share of firms state financial constraints as impediments to production during the crisis. Still, a considerably larger share of firms in the domestically oriented sectors state sluggish demand as an impediment to production.

Experience shows that banks generally tend to tighten their credit conditions and reduce their lending exposure during economic down-
turns, but there is no doubt that the recent financial crisis has given rise to a considerable additional loss of output in the Danish economy. In addition to the negative impact on the real economy caused by lending restraint in a crisis-stricken banking sector, the financial crisis has also adversely affected the economy in more general terms. The growing perceived uncertainty about the future economy and the economic outlook for households and the corporate sector brought about by the financial crisis may have led to lower consumption and investment and thus to lower house prices, output and demand for credit. Furthermore, corporate confidence in the banking sector’s willingness and ability to always meet the demand for credit and liquidity in an economic downturn may have weakened. This may have amplified consolidation and debt reduction by non-financial corporations and dampened demand for credit, investment activity and employment. Non-financial corporations show substantial savings surpluses, and the financial savings surpluses of Danish firms and households relative to the gross domestic product, GDP, have reached the highest levels since the start of the statistical series in the early 1970s. The savings surpluses are thus higher than during the deep recessions in the early 1980s and 1990s.

There are no indications that the banks’ lending capacity has generally been an impediment to the development in lending. Moreover, the rise in mortgage lending indicates that the mortgage-credit sector was able to meet part of the corporate and household credit needs. Combined with considerable government intervention during the financial crisis, this contributed to the fact that, during the recent crisis, total lending by banks and mortgage banks did not decline substantially relative to GDP. Total credit remains high in a long-term perspective.

2. BUSINESS CYCLES, BANKS AND THE SUPPLY OF CREDIT

Banks play a key role in the economy as suppliers of credit. Funds from households and firms with savings surpluses are deposited and relent to households and firms with consumption and investment needs.

Due to the close relations between the banking sector and the real economy, bank lending has a very large cyclical element. Chart 2.1 shows real growth in bank lending since the early 1920s. The grey markings indicate periods of economic downturn.

As seen, there is a clear tendency for decline or low growth in bank lending during periods of economic downturn. This reflects both credit demand and supply.

Credit demand is normally weak during downturns due to weak development in consumption and investment in real capital.
Likewise, credit supply will usually be smaller during downturns. Experience shows that it is harder for borrowers to service their debt obligations when the economic situation is unfavourable, unemployment is rising and firms are increasingly threatened by default. As a result, banks typically increase their interest margins and tighten their credit standards (e.g. by enhancing collateral requirements) in a downturn to reduce the risk of increased losses on loans, cf. Chart 2.2.

Similar to losses, there is considerable cyclical variation in the banks' loan impairment charge ratios, cf. Chart 2.3. There is a tendency for loan impairment charge ratios to be relatively high in years of economic downturn, while they are relatively low in years of high economic growth. In good times, with low unemployment and increasing corporate growth, there will be relatively few cases of non-performance of loan contracts etc., resulting in low loan impairment charge ratios. Conversely, there will be a relatively high number of defaults in an economic downturn, entailing high loan impairment charge ratios.

The cyclical variation in the banks' loss and loan impairment charge ratios is reflected in their interest margins when the underlying trend is taken into account, cf. Chart 2.4. Consequently, interest margins tend to be relatively low in periods of economic upturn and relatively high in periods of economic downturn, cf. Abildgren (2012b) and Drejer et al. (2011). The banks' expected losses and thus their loan impairment charges
DANISH BANKS’ LOSSES ON LOANS AND GUARANTEES 1975-2011

Chart 2.2


BANKS’ LOAN IMPAIRMENT CHARGES 1875-2012

Chart 2.3

Note: Annual observations. The grey markings indicate periods of economic downturn, cf. Abildgren et al. (2011). Loan impairment charges are stated net of reversal of loan impairment charges previously made as income. Negative figures for loan impairment charges indicate that loan impairment charges previously made are reversed as income. A data break occurs in the series of loan impairment charges in 2005 when the accounting policies were changed.
Source: Abildgren et al. (2011) and the website of the Danish Financial Supervisory Authority.
can be seen as a cost related to loans and guarantees in line with staff and IT costs, etc., which the banks need to recover by charging an appropriate interest premium which is added to funding and administration costs, cf. Baltensperger (1980) and Andersen et al. (2001).

The strong cyclical variation is clearly reflected in the banks' annual profits, cf. Chart 2.5, whereas it is not reflected in the banks' net borrowing/net lending as stated in the national accounts. Net borrowing/net lending is an expression of the banks' savings surpluses, i.e. gross savings less investment in real capital. Market price gains/losses, loan impairment charges and credit losses are not included in the calculation of net borrowing/net lending. Consequently, unlike annual profits, net borrowing/net lending was not negative in the early 1990s and in the period 2008-09. On the other hand, Chart 2.5 shows that net borrowing/net lending increases in periods of economic downturn. This reflects that banks increase their interest margins, etc. during a downturn in order to generate earnings to cover their large loan impairment charges and losses.

The real price of bank equities is shown in Chart 2.6. There is a tendency for the price to stagnate or fall during economic downturns when the banks' future earnings prospects deteriorate. It should be noted that the price drop was particularly pronounced in 2008-09, a period characterised by the worst crisis in the Danish banking sector since the 1920s.
BANKS’ ANNUAL PROFITS AND NET BORROWING/NET LENDING 1981-2011

Chart 2.5

Note: Annual observations. The grey markings indicate periods of economic downturn, cf. Abildgren et al. (2011). Banks’ net borrowing/net lending is calculated as net borrowing/net lending for other monetary financial institutions (excluding Danmarks Nationalbank) less mortgage banks’ annual profits.

Source: Statistics Denmark and Danish Financial Supervisory Authority.

REAL PRICE INDEX FOR BANK EQUITIES 1920-2012

Chart 2.6


Source: Statistics Denmark and Abildgren (2010).
Finally, Chart 2.7 illustrates that the number of employees in the banking sector is also characterised by very strong cyclical fluctuations. During the boom in the first half of the 1980s, the number of employees increased by more than 20 per cent. The cyclical reversal in 1987 and the banking crises until the mid-1990s shifted the focus back towards adjustment of costs and staff requirements. The number of employees fell from just under 55,000 in 1987 to around 40,000 in the second half of the 1990s. During the boom in 2005-07, the number of employees rose sharply once again before falling during the most recent economic downturn.

The tendency of banks to tighten their credit conditions and reduce their lending exposure during an economic downturn – and conversely to ease their credit conditions and increase their lending exposure during a boom – contributes, all else equal, to strengthening the cyclical fluctuations. In this connection, banking activities are said to have a procyclical effect. The procyclicality may even become particularly strong if credit standards are excessively eased during a lending boom in an overheated economy as seems to have been the case in Denmark prior to the financial crisis, according to indicators. This gave rise to additional tightening of credit standards during the crisis, and the tightening thus occurred at a fairly inconvenient time.

In the wake of the financial crisis, measures have been brought into focus that may reduce the procyclicality of the banking sector in future,
including by introducing countercyclical capital buffers. Such buffers are expected to be implemented in Europe with the coming Capital Requirements Directive, cf. Harmsen (2010). The purpose of countercyclical capital buffers is that they should be built up in times of excessive credit growth and reduced in bad times in order to avoid any future need for the government to provide general subsidy schemes and capital injections to protect financial stability. The Committee on Systemically Important Financial Institutions in Denmark has also made recommendations on regulation of systemically important financial institutions, SIFIs. Among other things, the Committee has recommended a crisis management buffer comprising debt instruments of 5 per cent of risk-weighted assets that must be convertible into Tier 1 capital or written down if a SIFI is hit by crisis. Finally, the Systemic Risk Council has been set up with a view to preventing and reducing systemic financial risks.

3. LENDING SURVEYS AND CREDIT STANDARDS

In a number of countries, quarterly lending surveys are conducted, asking the banks' credit managers to assess changes in the credit supply and demand in the last quarter, as well as expected changes in the coming quarter. The potentially most valuable information contained in the lending surveys concerns the question whether, in the banks' assessment, a given development in lending is attributable to changes on the demand or supply side. This information cannot be drawn from the balance-sheet statistics for banks, since an observed loan portfolio is the realised result of credit supply and demand.

The first lending survey was conducted in 1967 (in 1964 on a trial basis) by the US Federal Reserve. Over the last decade or so, several other central banks have introduced similar surveys, including the European Central Bank in 2002\(^1\) and the Bank of England in 2007, cf. Berg et al. (2005) and Driver (2007).

Danmarks Nationalbank introduced its quarterly lending survey in early 2009, cf. Jensen and Sass (2009) and Nielsen (2010). In the survey, the credit managers of a number of banks and mortgage banks are asked to assess changes in the credit supply and demand in the last quarter, as well as expected changes in the coming quarter, cf. Box 3.1.

\(^1\) The following 12 euro area member states have participated since end-2002: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.
Danmarks Nationalbank’s lending survey was introduced in the 4th quarter of 2008. It is a qualitative survey in which the credit managers of a number of banks and mortgage banks assess changes in the supply of and demand for loans in the last quarter, as well as expected changes in the coming quarter.

The lending survey is conducted as a questionnaire survey among the 15 or so largest Danish banks (the Danish Financial Supervisory Authority’s groups 1 and 2) and five largest mortgage banks. This population covers around 80 per cent of credit institutions’ household and corporate loans.

The questionnaires are divided into three parts. The first part covers changes in the banks’ credit policies. It discusses the factors contributing to the banks changing their credit policies and how they implemented the changes via their terms and conditions for loans. The second part of the questionnaires is about changes in the demand for loans from existing and new customers, respectively. The banks were asked to disregard seasonal fluctuations when answering the questions. The third part reviews changes in loan impairment charges and losses on outstanding loans.

For each question, there is a choice of five responses: “tightened/increased considerably”, “tightened/increased somewhat”, “unchanged”, “eased/declined somewhat” and “eased/declined considerably”. Developments in the current quarter and expectations for the coming quarter must be reported. Responses should always be based on an assessment of quarter-on-quarter changes, not on a long-term perspective.

To summarise the survey findings, the responses are quantified as net balances by assigning a value to each of the five options, i.e. “tightened considerably” = -100, “tightened somewhat” = -50, “unchanged” = 0, “eased somewhat” = +50 and “eased considerably” = +100. The net balance is achieved by weighting the value of the individual banks’ responses by their respective shares of total lending. The scale runs from -100 to +100. A negative net balance concerning credit policies indicates that the banks generally tightened their credit policies, thus making it more difficult to obtain loans, while a positive net balance indicates an overall easing of credit policies.

The Danish lending survey was inspired by similar foreign surveys conducted by the Federal Reserve, the Bank of Japan, the European Central Bank, the Bank of England and Norges Bank, among others. However, the individual countries use a number of different methods to weight the individual banks’ responses as total net balances. In Denmark, as mentioned above, the net balance is achieved by weighting the value of the individual banks’ responses by their shares of total lending in the sample population. The ECB weights the results of the individual euro area member states by their shares of total lending in the euro area. On the other hand, no weighting at the national level is used in the lending survey for the euro area.

The weightings of the individual response categories as net balances also vary. Data in the Danish lending survey are calculated in accordance with the Bank of England’s method, weighting all five response options as net balances. The ECB’s method, on the other hand, calculates net tightening, i.e. the share of banks that have tightened their credit policies less the share of banks that have eased their credit policies. Hence, in the ECB’s method, no distinction is made between banks answering “considerably” or “somewhat”.

1 Several of the euro area member states publish their own contributions to the bank lending survey for the euro area, including Germany (Deutsche Bundesbank, 2009) and Ireland (Kennedy, 2011).
The lending surveys in all countries are characterised by being based on responses from relatively few banks. The US lending survey is prepared on the basis of responses from around 60 banks, accounting for around 60 per cent of total lending by US banks. In total, there are around 8,000 banks in the USA. The ECB’s lending survey data are retrieved from around 120 banks in the euro area, accounting for approximately 50 per cent of lending activities in the euro area. There are around 7,500 credit institutions in the euro area. The Danish survey includes the 15 or so largest banks and the five largest mortgage banks, covering a total of around 80 per cent of credit institutions’ lending to households and the corporate sector. In 2011, there were a total of 113 banks and 8 mortgage banks in Denmark.

Danish lending survey is so new, however, that it cannot form the basis for a systematic statistical assessment of the development in credit standards over various parts of the business cycle. For the USA on the other hand, data covering several business cycles are available, so it is possible to disclose a number of "stylised facts" about the relationship between business cycles and credit standards, cf. Chart 3.1. In time, all other things being equal, the Danish survey is also expected to reflect those relationships.

Lown et al. (2000) find that US credit standards were tightened prior to most recessions. As mentioned in section 2, it is natural for banks to

---

**US BANKS’ NET TIGHTENING OF CREDIT STANDARDS**

![Chart 3.1](chart.png)

**Note:** Quarterly observations. Credit standards for lending to small and medium-sized enterprises. The grey markings indicate periods of economic downturn. The question of credit standards was not included in the US survey in the period 1984-1990.

**Source:** National Bureau of Economic Research and Federal Reserve Bank of St. Louis' FRED database.
tighten their credit standards in an economic downturn in order to reduce the risk of losses on loans. Such tightening may be in the form of higher interest margins and fees and more stringent collateral requirements.

According to Owens and Schreft (1991), the US surveys show that lending policies have been tightened much more frequently than they have been eased, which does not seem plausible. Fluctuations in the survey are also more pronounced in periods of tightening than in periods of easing. Hence, the lending policies may seem more restrictive than is actually the case, so the response "unchanged" must at times imply actual easing of credit standards.

Although Danmarks Nationalbank's lending survey is still relatively new, it has already played a central role in analyses and interpretations of credit trends in Denmark. This should be seen in the light of the fact that the survey was introduced in the wake of the collapse of the US investment bank Lehman Brothers in late 2008 and the resulting aggravation of the international and Danish financial crises.

At the aggregate level, most quarters show a relatively close relation between Danish banks' assessment of changes in credit standards and demand for credit and the actual development in lending to corporate customers, cf. Chart 3.2. The relationship is not quite as clear for lending to households, cf. Chart 3.3. During the financial crisis, the decline in lending to households has not been as strong as the decline in lending to corporate customers. One reason is that households have not been as hard hit, reflecting a considerably lower number of enforced sales and loan impairment charges in the mortgage credit sector compared with the early 1990s. This should be viewed in the light of the fact that despite an increase, unemployment remains at a relatively low level. Household finances have also benefited from the low level of both short-term and long-term mortgage interest rates calculated after tax, cf. Abildgren and Thomsen (2011).

Relatively speaking, there is also considerable variation in the demand for credit over time. On the other hand, banks primarily changed their credit standards immediately after the collapse of Lehmann Brothers in late 2008 and early 2009, and during the sovereign debt crisis in Southern Europe in late 2011 and early 2012. In both cases, credit standards were substantially tightened.

1 In addition to real changes in the supply of credit, the development in total lending to corporate customers in particular is affected by the timing of loans transferred from banks under the Financial Stability Company to units without a banking licence. Another factor is the timing of realisation of losses. Furthermore, foreign banks in Denmark have transferred loans to Danish firms to the parent bank in their home country. Finally, the joint funding agreement between BRFkredit and several banks in 2012 contributed to a small decline in bank lending.
Changes in Danish Banks’ Credit Standards and Demand, and Growth in Lending to Corporate Customers

Chart 3.2

Note: Credit standards and demand are measured on a scale from -100 (tightened/declined considerably) to +100 (eased/increased considerably).

Source: Danmarks Nationalbank.

Changes in Danish Banks’ Credit Standards and Demand, and Growth in Lending to Households

Chart 3.3

Note: Credit standards and demand are measured on a scale from -100 (tightened/declined considerably) to +100 (eased/increased considerably).

Source: Danmarks Nationalbank.
4. CREDIT STANDARDS OF INDIVIDUAL BANKS DURING THE FINANCIAL CRISIS

This section discusses the credit standards of individual banks and the factors affecting them. The analyses are based on the banks' responses to Danmarks Nationalbank's lending survey and a number of other sources. Due to considerable variation in the business models and balance-sheet structures between banks and mortgage banks, this analysis focuses on banks only. The population of banks included in Danmarks Nationalbank's lending survey varies slightly over time, as it consists of the banks in the Danish Financial Supervisory Authority's groups 1 and 2 at a given time.

Chart 4.1 shows the distribution of responses to the three key questions about credit standards included in the lending survey, i.e. changes in credit standards, prices and other terms and conditions (e.g. collateralisation). The chart is based on just over 200 observations relating to around 15 banks' lending survey responses over 15 quarters. As seen, the banks answered that they tightened their credit standards for lending to corporate customers somewhat or considerably in 22 per cent of the responses. The banks tightened their credit standards for lending to households slightly less, namely in 18 per cent of the responses.

According to the banks' responses, they generally tightened their prices more often than their credit standards, cf. Chart 4.1. As prices are often regarded as an element of credit standards, at least by customers, a possible interpretation may be that prices are not given much weight in the banks' overall credit standard assessment.

Initially, the relationship between the banks' characteristics and changes in credit policies can be illustrated graphically. Charts 4.2-4.4 are based on all observations in the lending survey. Like Chart 4.1, the charts are divided into three groups, each representing an element of the banks' credit standards. First, the general credit standards are considered as the main issue of the lending survey. Then changes in prices and collateral requirements are considered specifically. In each of the groups, three bars represent three equal groups of observations based on the explanatory variable. Chart 4.2 thus shows the change in credit standards for three groups as distinguished by the quarterly growth in the banks' loan impairment charges. The bar "highest growth in loan

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1 Data from the banks' regular reporting to Danmarks Nationalbank's balance-sheet, flow and interest-rate statistics and reporting to the Danish Supervisory Authority are used in addition to a number of cyclical indicators compiled by Statistics Denmark and Danmarks Nationalbank.
2 In the survey, it is possible to answer that prices, collateral requirements and other terms and conditions have been changed without this necessarily being reflected in the general question regarding changes in credit standards.
CHANGES IN CREDIT STANDARDS, PRICES AND COLLATERAL REQUIREMENTS

Chart 4.1

Note: The chart is based on individual banks’ responses to Danmarks Nationalbank’s lending survey over 15 quarters. Source: Kuchler (2012).

CHANGES IN BANKS’ CREDIT STANDARDS FOR LENDING TO CORPORATE CUSTOMERS: BANKS GROUPED BY QUARTERLY GROWTH IN LOAN IMPAIRMENT CHARGE RATIO

Chart 4.2

Note: The chart is based on all banks’ responses to Danmarks Nationalbank’s lending survey over 15 quarters. The breakdown is based on quarterly growth in loan impairment charges, ensuring that each group contains the same number of observations. For example, “highest growth in loan impairment charges” refers to that third of the observations in which banks saw the highest growth in loan impairment charges. Source: Kuchler (2012).
impairment charges" contains that third of the observations in which the banks saw the highest quarterly growth in loan impairment charges. The bar "lowest growth in loan impairment charges" contains the observations with the lowest growth in loan impairment charges, and the bar "medium growth in loan impairment charges" contains the remaining third. The charts relate only to lending to corporate customers. Similar charts concerning lending to households generally show the same, cf. Kuchler (2012).

There is a certain relationship between changes in credit standards and loan impairment charges, cf. Chart 4.2. The banks with the highest growth in the loan impairment charge ratio over the previous quarter had a more pronounced tendency to tighten their credit standards vis-à-vis the corporate sector. At the same time, the least solvent banks tended to tighten their credit standards to a higher degree than other banks, cf. Chart 4.3.

Chart 4.4 shows changes in the credit standards in groups based on the change in the interest-rate spread relative to the money-market interest rate that banks pay to borrow money from other monetary financial institutions (MFIs). Changes in the inter-MFI interest-rate spread have a fairly great impact on the banks' credit standards. Banks that have seen an increase in the interest-rate spread have also tightened their credit

Note: The chart is based on all banks' responses to Danmarks Nationalbank's lending survey over 15 quarters. The breakdown is based on the banks' solvency ratio, ensuring that each group contains the same number of observations. For example, "highest solvency ratio" refers to that third of the observations in which banks achieved the highest solvency ratio.

Source: Kuchler (2012).
standards to a higher degree, cf. Chart 4.4. On the other hand, similar charts show no clear relationship between credit standards and variables describing the banks’ pre-crisis characteristics (lending growth, size, exposure to industries), cf. Kuchler (2012).

The above graphical analyses of the relationship between bank-specific variables and credit standards are partial. For example, the banks with the highest growth in loan impairment charges may also experience a higher increase in funding costs and thus be represented in the lowest third measured by both dimensions. Cyclical elements may also impact on the credit standards and are therefore important to include in the analysis. All other things being equal, economic slowdown means that bank customers find it harder to service their debt obligations, which may cause the banks to tighten their credit standards. The following therefore presents the results of an econometric analysis of the relationship between bank characteristics and changes in credit standards.

A logistic regression model is used to investigate the bank-specific, cyclical variables that influence the banks’ credit standards, cf. Box 4.1. The model estimates the impact of the various factors on the probability of a
The analysis of banks’ credit standards is based on a logistic regression model estimating the impact of various bank-specific and cyclical factors on the probability of credit standards being tightened\(^1\).

The logistic regression model is given as:

\[
P(Tight_{it} = 1 | x_{it}, b_i, m_t) = f(\alpha + \beta x_{it} + \gamma b_i + \lambda m_t),
\]

where \(Tight_{it}\) indicates that bank \(i\) tightened its credit standards somewhat or considerably in quarter \(t\), \(x_{it}\) is a vector with bank-specific time-varying explanatory variables (see Box 4.2), \(b_i\) is a vector with bank-specific characteristics before the crisis, and \(m_t\) is a vector with macroeconomic indicators. \(f\) is the logistic function given as:

\[
f(z) = \frac{\exp(z)}{1 + \exp(z)}
\]

The model is estimated separately for lending to households and the corporate sector. Due to a wish to examine the effect of variables not varying over time (or only varying slowly), dummy variables are not included for the individual banks (bank fixed effects). The calculation of standard errors takes into account that observations from a given bank over time can be correlated.

Based on the estimated coefficients, equation (1) can be used to estimate the probability that a specific bank tightens its credit standards in a specific quarter. The results of the analysis are presented as marginal effects of the explanatory variables on the probability of credit standards being tightened. The marginal effects are calculated for average values of the explanatory variables. A marginal effect of 0.10 can be interpreted to the effect that, all else equal, an increase of one unit in the explanatory variable means an increase in the probability of credit standards being tightened of 10 percentage points.

\(^1\) The econometric analysis is amplified in Kuchler (2012), which also presents additional findings.
ate customers. Similarly, growth in the number of enforced sales is included in the model of lending to households.

The results of the econometric analysis are presented in Table 4.1. These results confirm several of the relationships indicated by the above charts. The inter-MFI interest-rate spread significantly affects the bank’s credit standards. The bank’s excess capital adequacy also affects credit standards, but the effect becomes insignificant when adjusted for the macroeconomic (cyclical) situation.

Generally, the bank’s pre-crisis characteristics (at end-2007) do not affect credit standards during and after the crisis. The banks’ lending growth, size and exposure to industries before the financial crisis do not contribute significantly to explaining the bank’s credit standards. It

<table>
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<th>CENTRAL VARIABLES INCLUDED IN THE ANALYSIS</th>
<th>Box 4.2</th>
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<td>The econometric analysis includes a series of characteristics of each bank and a number of economic indicators:</td>
<td></td>
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<tr>
<td>Dependent variables:</td>
<td></td>
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<tr>
<td>- Indicator(^1) for tightening of credit standards for lending to the corporate sector (households)</td>
<td></td>
</tr>
<tr>
<td>- Indicator(^1) for tightening of prices for lending to the corporate sector (households)</td>
<td></td>
</tr>
<tr>
<td>- Indicator(^1) for tightening of collateral requirements for lending to the corporate sector (households)</td>
<td></td>
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<tr>
<td>Bank-specific variables:</td>
<td></td>
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<tr>
<td>- Change in percentage points in share of loans in accounts for which interest accrual has been suspended</td>
<td></td>
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<tr>
<td>- Change in percentage points in excess capital adequacy (capital need – solvency ratio)</td>
<td></td>
</tr>
<tr>
<td>- Change in percentage points in inter-MFI interest-rate spread (the bank’s interest rate on loans from monetary financial institutions (excluding central banks) less the money-market interest rate)</td>
<td></td>
</tr>
<tr>
<td>- Average annual lending growth 2005-07 in per cent p.a.</td>
<td></td>
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<tr>
<td>- Total lending, kr. billion at end-2007 (logarithmically transformed)</td>
<td></td>
</tr>
<tr>
<td>- Lending by sector, percentage points at end-2007 (share of total lending made up of lending to building and construction, real property, agriculture and households, respectively)</td>
<td></td>
</tr>
<tr>
<td>Cyclical indicators:</td>
<td></td>
</tr>
<tr>
<td>- Quarterly growth in per cent in seasonally adjusted GDP</td>
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<tr>
<td>- Quarterly growth in percentage points in the money-market interest rate</td>
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<tr>
<td>- Quarterly growth in per cent in the number of defaults (seasonally adjusted)</td>
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<tr>
<td>- Quarterly growth in per cent in the number of enforced sales</td>
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</tbody>
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\(^1\) Indicator variables (dummy variables) have the value 1, if the condition is met, and otherwise 0.
should be noted, however, that three banks originally included in the lending survey were excluded from the survey in the course of 2009 and 2010 as they were no longer independent firms. Those banks were generally characterised by relatively high lending growth before the crisis and high exposure to real property. The banks are only included in the analysis in the periods during which they report to the lending survey. This entails a risk of underestimation of the effect of strong lending growth and exposure to real property.

As expected, macroeconomic developments affect the banks' credit standards. GDP growth is thus significant in the models of credit standards for lending to households and the corporate sector. All else equal, an increase in quarterly GDP growth of 1 percentage point reduces the probability of credit standards for lending to the corporate sector being tightened by 11 percentage points and by 6 percentage points for lending to households.

<table>
<thead>
<tr>
<th>LOGISTIC REGRESSION MODEL OF CREDIT STANDARDS TIGHTENING</th>
<th>Table 4.1</th>
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<tr>
<td>Dependent variables</td>
<td>(1)</td>
</tr>
<tr>
<td>Independent variables</td>
<td>Lending to the corporate sector</td>
</tr>
<tr>
<td>Bank-specific variables</td>
<td></td>
</tr>
<tr>
<td>Change in accounts for which interest accrual has been suspended</td>
<td>3.686</td>
</tr>
<tr>
<td>Change in excess capital adequacy spread</td>
<td>*3.607</td>
</tr>
<tr>
<td>Change in inter-MFI interest-rate spread</td>
<td>***0.425</td>
</tr>
<tr>
<td>Time-invariant bank-specific variables</td>
<td></td>
</tr>
<tr>
<td>Annual lending growth, 2005-07</td>
<td>-0.003</td>
</tr>
<tr>
<td>Log (total lending, 2007)</td>
<td>-0.006</td>
</tr>
<tr>
<td>Lending by industry (end-2007):</td>
<td></td>
</tr>
<tr>
<td>-Building and construction</td>
<td>1.193</td>
</tr>
<tr>
<td>-Real property</td>
<td>-0.163</td>
</tr>
<tr>
<td>-Agriculture</td>
<td>-1.095</td>
</tr>
<tr>
<td>-Households</td>
<td></td>
</tr>
<tr>
<td>Economic indicators</td>
<td></td>
</tr>
<tr>
<td>Growth in GDP</td>
<td>***-0.111</td>
</tr>
<tr>
<td>Change in money-market interest rate</td>
<td>***0.091</td>
</tr>
<tr>
<td>Growth in defaults</td>
<td>***0.009</td>
</tr>
<tr>
<td>Growth in enforced sales</td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>209</td>
</tr>
</tbody>
</table>

Note: Marginal effects of logistic regression. Significance test is based on robust standard errors. Significance of coefficient estimates: *** p<0.01, ** p<0.05, * p<0.1.

Source: Kuchler (2012). The variable refers to lending to the sector in question. For example, "annual lending growth, 2005-2007" is annual growth in lending to the corporate sector in models (1) and (2) and annual growth in lending to households in models (3) and (4).
Growth in the number of defaults also significantly affects credit standards for lending to corporate customers, while growth in the number of enforced sales is not significant in the model of lending to households.

Table 4.2 shows similar results for two more specific dependent variables, namely tightening of prices and collateral requirements. Macroeconomic developments also have a major impact on whether these terms are tightened, as the figures for growth in GDP and in the number of defaults are significant in the models. While the inter-MFI interest-rate spread has a relatively great impact on the price of loans, it affects the banks’ collateral requirements to a lesser extent.

Overall, the analysis shows that primarily cyclical developments and thus developments in the customers’ credit standing have affected de-
velopments in the banks' credit standards in recent years. The individual bank's own "market-related credit standing" – measured by its money-market borrowing rate less the average money-market interest rate – has also had some impact. It reflects the individual bank's funding conditions compared with conditions for the banking sector as a whole. Since the analysis controls for the individual bank's solvency situation and the general macroeconomic development, the market-related credit standing reflects the market assessment of the quality of the individual bank's loan portfolio compared with the banking sector as a whole and the specific cyclical developments within the bank's customer segments. Hence, the market-related credit standing primarily reflects the quality of the loan portfolio.

Contrary to expectations, other bank-specific conditions such as the banks' solvency situation have not had any substantial effect when controlling for the business cycle. This should no doubt be viewed in the context of comprehensive government intervention during the financial crisis which, e.g. via Bank Rescue Package 2, enabled government capital injections into banks.

5. SUPPLY AND DEMAND FACTORS CONTRIBUTING TO BANK LENDING GROWTH DURING THE FINANCIAL CRISIS

The potentially most valuable information contained in the lending surveys is related to the question of whether a given development in lending is attributable to changes on the demand or supply side. Lacroix et al. (2010) quantify, on the basis of lending surveys, the respective contributions of supply and demand effects to French banks' lending growth during the financial crisis. They find that the fall in lending to corporate customers in France from 2008 was initially triggered by a tightening of credit standards and subsequently by reduced demand. Del Giovane et al. (2011) use Italian data at bank level to construct a similar decomposition and also find that supply factors had a particular impact during the financial crisis.

Although only a short time series is available for the Danish lending survey so far, it may be interesting to similarly decompose lending developments in Denmark during the financial crisis. This makes it possible to analyse the contributions of demand and supply factors to the credit development during the crisis as seen from the banking sector's point of view.

The analysis in this section is based on the individual banks' responses to Danmarks Nationalbank's lending survey. This has the advantage that demand and supply factors can be linked more directly to the relevant
measures of lending growth. In addition, the use of microdata allows the use of panel data methods that are less sensitive to unobserved characteristics of individual banks, which might otherwise affect the estimated contributions of supply and demand factors.

Table 5.1 presents a number of estimations of a model of bank lending growth as described in more detail in Box 5.1. Lending to corporate customers has the expected signs, although, due to the relatively low number of observations, several estimations are unable to establish statistically significant relationships. Growth in lending to corporate customers can be explained by a combination of supply and demand factors. For banks reporting declining corporate demand in the lending survey, growth in lending to corporate customers has been 2-2.5 per cent lower on average than for other banks. This result is not statistically significant in all models, however.

Table 5.1 also illustrates that lending growth for banks tightening their credit standards for lending to corporate customers is around 3 percentage points lower than for other banks. Coefficient estimates for the other supply variables generally have the expected signs. The most important result of the models applying other supply variables is that when funding costs or constraints due to the bank’s balance-sheet structure are cited as the reason for tightening, lending growth is reduced by
The analysis in this section focuses on the effect of changes in credit standards and demand for loans from the individual bank. We use a fixed effects panel data model. The model utilizes the fact that the same bank is observed in several consecutive quarters:

\[ y_{it} = \alpha_i + y_{it-1} + \beta D_{it} + \gamma CS_{it} + \epsilon_{it}, \]  

(5.1)

where \( y_{it} \) is bank \( i \)'s seasonally adjusted lending growth in quarter \( t \), \( D_{it} \) is a vector with dummy variables for changes in credit demand, \( CS_{it} \) is a dummy variable indicating whether the bank tightened its credit standards in the course of the quarter, and \( \alpha_i \) is a bank-specific effect. Including the bank-specific term in the model ensures that characteristics of the individual bank that are constant over time do not affect results.

The models do not include explanatory variables other than changes in credit standards and demand, the reason being that other explanatory variables may be related to both supply and demand factors, thus making a simple interpretation difficult.

For lending to the corporate sector where the empirical justification of the model seems to be the strongest, lending growth is subsequently decomposed into contributions from supply and demand factors using the model. This decomposition is made by setting up two alternative (counterfactual) scenarios. The first scenario assumes that demand remains unchanged throughout the period, while credit standards vary in accordance with the lending survey responses. The second scenario assumes that credit standards remain unchanged throughout the period, while demand varies in accordance with the lending survey responses. The estimated lending growth in each of the two scenarios is then compared with the estimated lending growth in the actual scenario, from which an estimate of the effect of demand and supply factors, respectively, can be derived.

The estimated contributions from supply and demand factors do not necessarily add up to the actual development in lending for several reasons. Firstly, the individual bank's lending growth may be driven by factors other than changes in supply and demand that are sufficiently significant to be mentioned in the lending survey. Secondly, the model used assumes that the estimated coefficients do not vary over time. Hence, there is a difference between actual lending growth in individual periods and the growth estimated in the model.

Some time is likely to elapse from a bank decides to change its credit standards until the change has been implemented. Consequently, models of lending growth in various specifications are also estimated which allow for some delay from the bank tightens its credit standards until this is reflected in lending. The results are not clear, and there is generally no effect of previous tightening of credit standards, cf. Kuchler (2012). Presumably, part of the explanation is that a sufficiently long time series of lending surveys is not yet available for that type of analysis to provide reliable results.

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1 An indicator of easing of credit standards is not included as few banks have eased their credit standards over individual quarters in the course of the period the lending survey has been conducted.
approximately 2 percentage points, although the reduction is not statistically significant.

It is more difficult to interpret the results for lending to households, and no clear relationship is seen between supply and demand factors and lending growth. This should be interpreted in light of the fact that the corporate sector has been harder hit by the recent crisis than the household sector. A clear relationship is seen between tightening due to funding costs and lower lending growth, but the result is not statistically significant. Furthermore, banks tightening their credit standards due to competitive pressure tend to show higher lending growth. A possible explanation of the latter may be that in such cases a bank tightens its credit standards less than its competitors, thus gaining market shares despite the tightening.

The results in Table 5.1 can be used to decompose total lending growth into supply and demand factors, cf. Chart 5.1. As seen, both supply and demand factors affect banks’ credit standards. Bank lending growth is very much driven by demand factors. Credit standards had a particular impact after the collapse of Lehman Brothers and during the flare-up of the debt crisis in Southern Europe in late 2011 and early 2012.

**CONTRIBUTIONS FROM NEGATIVE DEMAND SHOCKS AND TIGHTENING OF CREDIT STANDARDS TO QUARTERLY GROWTH IN LENDING TO THE CORPORATE SECTOR**

<table>
<thead>
<tr>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

Chart 5.1

Note: The contributions are calculated as the difference between the fitted values from model 4 in Table 5.1 and fitted values calculated by setting the variables expressing lower demand and tightening of credit standards, respectively, to 0. The results are weighted on the basis of the individual banks’ volume of lending to the corporate sector. Lending growth is calculated on the basis of the banks participating in Danmarks Nationalbank’s lending survey, adjusted for banks that are excluded from the population, and shown as a 4-quarter moving average due to considerable volatility and seasonal effects.

Source: Updated version of chart in Kuchler (2012).
The model fails to explain the fall in lending in recent quarters, the reason being that relatively few banks stated changes in credit standards and demand in the last two quarters.

6. QUESTIONNAIRE STATISTICS ON FIRMS' PERCEIVED FUNDING CONDITIONS DURING THE FINANCIAL CRISIS

Danmarks Nationalbank's lending surveys give an impression of the conditions for household and corporate access to bank credit as seen from the banks' point of view, cf. sections 4 and 5.

Questionnaire surveys on firms' perceived conditions for access to bank credit are also conducted at regular intervals, cf. Table 6.1. The results of different surveys may vary, depending on the corporate population and the specific wording of the questions.

Statistics Denmark's confidence indicators are based on questionnaires completed by firms in the trade, building and construction and service sectors. The advantage of the surveys concerning the industrial and building and construction sectors is that they are available for the last 10 years, thus covering different periods of the business cycle.

On average, only a limited share of firms, around 10 per cent, have stated financial constraints as impediments to production in recent years according to Statistics Denmark's confidence indicators, but the picture varies between industries, cf. Chart 6.1.

In the industrial sector, the number of firms stating financial constraints as impediments to production according to the confidence indicators has been very low during the recent crisis. As a result, unemployment remains relatively low in Denmark compared with other countries. The confidence indicator for industry covers firms with minimum 20 employees, such firms accounting for 85 per cent of total employment in the industrial sector.

In the domestically oriented sectors – construction and service – a higher share of firms have stated financial constraints as impediments to production during the crisis. Still, considerably larger shares of firms in the domestically oriented sectors have stated sluggish demand as an impediment to production.

For construction and service, the confidence indicators also cover small firms with as few as 5-10 employees. If small firms have generally tended, to a higher degree than large firms, to be subject to financial constraints during the crisis, this may affect structural developments in the economy, but the effect cannot be unambiguously determined as positive or negative. A number of studies find that the innovative return on research and development, in terms of e.g. the number of patents per
Danish krone spent, is higher in small firms than in large ones, cf. Andersen and Spange (2012). In spite of this, most studies find that large firms invest relatively more in research and development than small ones.

Statistics Denmark has also conducted a separate, detailed survey of small and medium-sized enterprises' access to funding during the finan-

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Period</th>
<th>Population of firms</th>
<th>Sample size</th>
<th>Design of questions, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics Denmark's confidence indicator for the industrial sector</td>
<td>Since 2003</td>
<td>Firms with minimum 20 employees</td>
<td>Around 500. The individual firms' responses are included with a weighting corresponding to the number of employees.</td>
<td>Firms are asked to state whether they have experienced constraints or impediments to production and, if so, the causes thereof. &quot;Financial constraints&quot; is one cause, and it is possible to state more than one cause of impediments to production.</td>
</tr>
<tr>
<td>Statistics Denmark's confidence indicator for building and construction</td>
<td>Since 2003</td>
<td>Firms with minimum 5 employees</td>
<td>Around 850. The individual firms' responses are included with a weighting corresponding to the number of employees.</td>
<td>Firms are asked to state whether they have experienced constraints or impediments to production and, if so, the causes thereof. &quot;Financial constraints&quot; is one cause, and it is possible to state more than one cause of impediments to production.</td>
</tr>
<tr>
<td>Statistics Denmark's confidence indicator for the service sector</td>
<td>Since 2011</td>
<td>Firms with minimum 10 employees</td>
<td>Around 3,600. The individual firms' responses are included with a weighting corresponding to the number of employees.</td>
<td>Firms are asked to state whether they have experienced constraints or impediments to production and, if so, the causes thereof. &quot;Financial constraints&quot; is one cause, and it is possible to state more than one cause of impediments to production.</td>
</tr>
<tr>
<td>Statistics Denmark's survey of small and medium-sized enterprises' access to funding (part of a major European survey coordinat ed by Eurostat)</td>
<td>2007 and 2009/10$^1$</td>
<td>Firms with 5-249 employees in 2005 and 5 or more employees in 2009</td>
<td>2,265. The firms' responses are included with a weighting based on turnover and number of firms in the industry.</td>
<td>Detailed survey of a series of aspects concerning the firms' funding, including whether the firms' applications for bank loans were fully or partially rejected.</td>
</tr>
<tr>
<td>The European Commission and the ECB's &quot;Survey on the Access to Finance of Small and Medium-sized Enterprises&quot; (SAFE)</td>
<td>2009 and 2011</td>
<td>Firms with 1-249 employees.</td>
<td>The survey comprises around 500 Danish firms. The firms' responses are weighted so as to be representative of the population.</td>
<td>Detailed survey of a series of aspects concerning the firms' funding, including whether the firms' applications for bank loans were fully or partially rejected.</td>
</tr>
</tbody>
</table>

$^1$ The responses concerning 2007 were retrieved in connection with the responses for 2009/10. The years 2009/10 concern the period April 2009 - March 2010.
cial crisis as part of a major European survey coordinated by Eurostat. The survey concerns 2007 and 2009/10, and unlike the confidence indicators, it focuses on small and medium-sized enterprises. Hence, the population comprises firms with as few as 5 employees – including in the industrial sector.

According to this survey, the share of small and medium-sized enterprises whose applications for bank loans were rejected increased from 3 per cent in 2007 before the financial crisis really erupted to 20 per cent in 2009/10. The share of small and medium-sized enterprises whose applications for bank loans were only partially accepted, increased from 5 to 24 per cent during the same period, cf. Table 6.2.

Notably, Table 6.2 also shows that the share of firms whose applications for bank loans were rejected during the financial crisis was lower for the building and construction sector than for the industrial sector. The survey thus provides a different picture of firms' perceived access to credit in the various industries, compared with the confidence indicators. This may be attributable to the weighting of the firms' responses in all the surveys according to number of employees or turnover combined with the fact that large firms with minimum 250 employees are only included in the confidence indicator for the industrial sector. A low
weighted share of financially constrained firms in the confidence indicator for the industrial sector may therefore mask the fact that firms with minimum 250 employees, which account for the greater part of employment in the Danish industrial sector, are not subject to any major financial constraints.\footnote{In 2009, firms with more than 100 employees accounted for more than 60 per cent of employment in the industrial sector, although such firms constituted only 3 per cent of the total number of industrial firms.}

In relation to Table 6.2, it should also be noted that only around 20-25 per cent of firms applied for loans from banks or other funding sources in both 2007 and 2010. This reflects that e.g. mortgage credit is an important funding source for Danish firms and also that Danish firms use retained earnings as a primary source of funding, cf. Petersen and Risbjerg (2009).

As seen from Table 6.3, Statistics Denmark's survey of small and medium-sized enterprises' funding access shows that the rejection rate for loan applications from firms with 100-249 employees tended to be lower than the rejection rate for firms with less than 100 employees. On the
other hand, there are no substantial differences in the rejection rates according to firm size when only considering firms with less than 100 employees. It should be noted, however, that among the smallest firms with 5-9 employees, the share of firms whose loan applications were fully rejected was lower than for firms with 10-99 employees.

The European Commission in collaboration with the ECB also conducted surveys of credit access for the member states' small and medium-sized enterprises in 2009 and 2011, including Danish enterprises. The European Commission's surveys include the very smallest enterprises with as little as 1 employee.

According to these surveys, 6 per cent of the small and medium-sized enterprises' applications for bank overdraft facilities were rejected in 2011, cf. Table 6.4. 18 per cent of applications for bank loans were rejected in 2011 against 26 per cent in 2009.
7. ANALYSIS OF INDIVIDUAL FIRMS’ PERCEIVED ACCESS TO BANK LOANS BEFORE AND DURING THE CRISIS

There may be several reasons why a firm’s application for a bank loan is rejected. Ministry of Economic and Business Affairs (2011) presented a summary analysis of small and medium-sized enterprises’ access to funding in 2009/10 based on firm-level survey data, cf. Statistics Denmark (2010). The analysis compares the outcome of firms’ applications for loans from banks and mortgage banks with firms’ financial results. It shows that the firms whose credit applications were accepted in full in 2009/10 were characterised by higher profit ratios, higher solvency ratios, higher returns on equity and lower leverage than the firms which obtained only part of the credit they applied for or whose loan applications were rejected.

Abildgren, Drejer and Kuchler (2012) present a more detailed analysis of the outcome of firms’ applications for bank loans in 2009/10 and the creditworthiness of the firms applying for loans based on a data set containing the data used by Ministry of Economic and Business Affairs (2011). The analysis also incorporates the firms’ responses to the outcome of their loan applications in 2007, thereby making it possible to illustrate the banks’ rejection rates both before and during the crisis. Finally, the analysis includes information on the firms’ bankers. The data basis behind the analysis is described in more detail in Box 7.1. It should be noted that the information on the outcome of firms’ loan applications in 2007 was collected via a firm-level questionnaire in 2010. The firms’ answers regarding 2007 should therefore be interpreted with some caution.

The analysis is based on answers from around 2,000 firms with 5-249 employees in 2005 and with 5 or more employees in 2009. The firms are divided into five main groups:
- Firms whose applications for bank loans were accepted in full.
- Firms whose applications for bank loans were partially accepted.
- Firms whose applications for bank loans were not accepted.
- Firms that have applied for debt funding other than bank loans, i.e. loans from mortgage banks and loan funding from owners/directors.
- Firms that have not applied for loan funding. Firms that have not applied for loan funding use equity funding or other forms of funding, e.g. overdrafts, trade credits, leasing, factoring, etc.

Chart 7.1 shows the percentage distribution of the firms on the five categories. As seen, the majority of the firms did not apply for any loan funding in 2007 or 2009/10. It can also be seen that around 10 per cent
The data set behind the analysis in Abildgren, Drejer and Kuchler (2012) is arrived at by linking firm-level information from five different data sources.

**Questionnaire survey of firms’ funding conditions**

The responses in Statistics Denmark’s survey of small and medium-sized enterprises’ access to funding in 2007 and 2009/10 are at the core of the data basis, cf. Statistics Denmark (2010). The survey comprises 2,265 firms with 5-249 employees in 2005 and 5 or more employees in 2009. It is a detailed survey of a series of aspects concerning the firms’ funding, including whether the firms’ applications for bank loans were fully or partially rejected. The responses concerning 2007 were retrieved in connection with the responses for 2009/10. The years 2009/10 concern the period April 2009 - March 2010.

**Accounts statistics**

Employment data from Statistics Denmark are available for practically all firms (around 2,240) included in the questionnaire survey of firms’ funding conditions. For the majority of the firms participating in the questionnaire survey of firms’ funding conditions, certain accounts data are also available from Statistics Denmark’s accounts statistics (including on turnover, ordinary profits before funding and extraordinary assets, equity and total assets/liabilities). This applies to around 2,000 firms for which accounting information is retrieved from the registers of the Danish tax authority (SKAT). They are firms with annual turnover of kr. 0.5-100 million and sole proprietors with annual turnover of kr. 0.3-25 million, which are required to report accounting information to SKAT’s registers. For some of the firms it is also possible to obtain accounting information from Statistics Denmark’s accounts statistics, including on short-term debt, total debt, interest costs and liquid assets. This applies to around 1,000 firms for which the information was obtained via questionnaires.

**Statistics on firms**

For around 1,000 firms it is possible to obtain information on the export share of turnover based on Statistics Denmark’s statistics on firms.

**Firms’ principal bankers**

For 60-65 per cent of the firms that have applied for a bank loan according to the questionnaire survey, information collected by Experian A/S is available about the individual firms’ principal bankers. The firms for which such information is available are all public or private limited liability companies. No information is available about the bankers of sole proprietors.

**Banks’ key financial ratios**

Information on a number of key financial ratios is available for all the banks stated as the firms’ principal bankers. The information is published on the website of the Danish Financial Supervisory Authority.
of the firms experienced a total or partial rejection of their applications for bank loans in 2009/10 compared with 2 per cent in 2007.\footnote{In the analysis in this article, the firms’ answers are non-weighted unlike the results presented in Statistics Denmark (2010), where the answers of individual firms are included with weights based on turnover and the number of firms in the industry, cf. Box 7.1.}

As mentioned above, overdrafts are not regarded as loan funding in Statistics Denmark’s survey. It is possible, however, to analyse the firms’ overdraft funding on the basis of the data material. The main findings concerning overdrafts do not differ from the findings concerning bank loans that are reviewed below, cf. Abildgren, Drejer and Kuchler (2012).

Chart 7.2 illustrates the relationship between the outcome of the firms’ applications for bank loans in 2007 and 2009/10 and the firms’ solvency ratios in the year preceding the loan applications. The solvency ratio and the other key financial ratios used in this section are defined in Table 7.1.

As illustrated by Chart 7.2, the median of the firms’ solvency ratios in 2008 was considerably lower in the groups whose applications for bank loans were fully or partially rejected in 2009/10, than in the group of firms whose applications for bank loans were accepted in full. It was also lower than in the groups of firms which did not apply for loan funding, or firms which applied for loan funding other than bank loans. The same picture emerges as regards the firms’ applications for bank loans in 2007.
The fact that the solvency ratio for the median firm in all groups of firms in 2009/10 was higher than in 2007 should be viewed in the light of the general tendency towards consolidation in the business sector during the crisis, cf. Brandt et al. (2012).

<table>
<thead>
<tr>
<th>Key financial ratio</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvency ratio</td>
<td>Equity as a ratio of total liabilities at the end of the year.</td>
</tr>
<tr>
<td>Profit ratio</td>
<td>Result before financial and extraordinary items as a ratio of turnover.</td>
</tr>
<tr>
<td>Short-term debt ratio</td>
<td>Short-term debt as a ratio of total assets at the end of the year.</td>
</tr>
<tr>
<td>Liquidity ratio (narrow)</td>
<td>Cash and deposits, etc. as a ratio of total assets at the end of the year.</td>
</tr>
<tr>
<td>Liquidity ratio (broad)</td>
<td>Securities, equity investments and cash and deposits as a ratio of total assets at the end of the year.</td>
</tr>
<tr>
<td>Implied interest costs on gross debt</td>
<td>Interest costs etc. relative to total gross debt at the end of the year.</td>
</tr>
<tr>
<td>Number of employees</td>
<td>Number of full-time employees.</td>
</tr>
<tr>
<td>Export share</td>
<td>Export turnover in per cent of total turnover.</td>
</tr>
</tbody>
</table>

**Memo:**

Median

The middle observation in a series of numbers arranged according to size.
Moreover, it can be said that the median change in the firms' solvency ratios over the period 2006-08 was negative in the groups of firms whose applications for bank loans were fully or partially rejected in 2009/10, cf. Chart 7.3. Conversely, the median change in the firms' solvency ratios in the period 2006-08 was positive in the group of firms whose applications for bank loans in 2009/10 were accepted in full in 2009/10.

Chart 7.4 examines the outcome of the firms' applications for bank loans broken down by their solvency ratios. The chart clearly shows that...
the most solvent firms in 2009/10 had higher acceptance rates than firms with low solvency ratios.

The rejection rates were considerably higher in 2009/10 than in 2007, reflecting the business cycle. In 2007, firms found themselves at the end of a boom with the expectation of a "soft landing", while 2009/10 represented the bottom of the deepest recession since World War II. The rise in rejection rates from 2007 to 2009/10 is consistent with the fact that, according to Danmarks Nationalbank's lending survey, banks tightened their credit standards during the financial crisis.

The above analysis points to a relationship between the firms' solvency ratios and the outcome of the banks' consideration of loan applications during the crisis. A similar impression is obtained when considering the firms' profit ratios. The median of the firms' profit ratios in 2008 was lower in those groups of firms whose applications for bank loans were fully or partially rejected in 2009/10 than in the group of firms whose applications for bank loans were accepted in full or which did not apply for bank loans, cf. Chart 7.5. It is also evident from Chart 7.6 that the acceptance rates for firms with high profit ratios were higher than for firms with low profit ratios.

Furthermore, it is seen, measured by the median, that the groups of firms whose applications for bank loans were fully or partially rejected...
in 2009/10 were characterised by a higher short-term debt ratio and a lower liquidity ratio than the other groups, cf. Abildgren, Drejer and Kuchler (2012). Moreover, the median of implied interest costs on gross debt in the groups of firms whose applications for bank loans were fully rejected in 2009/10 was higher than in the other groups of firms. This also suggests that firms whose applications for bank loans were rejected were characterised by a lower credit standing than other firms.

The median of corporate employment in the various groups does not suggest any systematic relationship between firm size and the outcome of an application for a bank loan in 2007 or 2009/10. This is supported by Chart 7.7, which shows the outcome of firms' applications for bank loans broken down by the number of employees. It is worth noting, however,
that the smallest firms with 5-14 employees experienced the highest acceptance rates during the financial crisis in 2009/10. Although it should be kept in mind that questionnaire surveys are always subject to some uncertainty, at least there are no indications that small firms have been subjected to particularly high rejection rates when applying for bank loans during the financial crisis. Presumably, this reflects the fact that a relatively larger share of the assets of firms with 5-14 employees are in buildings and plots that are easy to pledge as collateral. Moreover, the small firms applying for bank loans have higher profit ratios than larger firms applying for bank loans.

Small and medium-sized enterprises are normally very domestically oriented. For around 70 per cent of the firms in the analysis, exports constitute less than 1 per cent of total sales. As seen from Chart 7.8, there seems to be no systematic relationship between the firms’ export share and the outcome of applications for bank loans.

For around 60-65 per cent of the firms that applied for bank loans, information is available about the firm’s principal banker. There are no indications that the rejection rate for loan applications was higher for banks in the Danish Financial Supervisory Authority’s groups 2-4 than for banks in the Danish Financial Supervisory Authority’s group 1, cf. Chart 7.9, although banks in groups 2-3 have generally had substantially larger loan impairment charges during the financial crisis than banks in group 1. Hence, in 2009, the loan impairment charge ratio for banks in group 1 was 1.5 per cent of loans and guarantees, while the corresponding ratios for banks in groups 2 and 3 were 5.6 and 4.2 per cent, respectively, cf. Danish Financial Supervisory Authority (2010). This may indicate that rather than the banks’ own solvency situation, the credit quality of the...
firms applying for loans and the banks’ credit standards have been the decisive factors for the outcome of the individual banks’ consideration of loan applications. We can also take a closer look at the firms that refrained from applying for loan funding during the financial crisis, because they expected their applications to be rejected or expected high interest rates (an example of "self-selection"). As illustrated by Chart 7.10, firms that refrained from applying for loans in 2009/10 for fear of rejection or high interest rates were characterised by considerably lower

Note: Bank loans do not include access to overdrafts. Source: Abildgren, Drejer and Kuchler (2012).
profit ratios than firms that applied for loan funding. A similar impression is obtained when considering solvency ratios, liquidity or short-term debt ratios. Before the financial crisis, very few firms refrained from applying for loan funding for fear of rejection or high interest rates.

Overall, the above descriptive analysis points to a close relationship, especially during the crisis, between the individual firms’ financial results and the outcomes of loan applications. Moreover, the analysis indicates that banks tightened their credit standards during the financial crisis, which is consistent with the analysis in section 4.

With a view to testing the statistical sustainability of the above descriptive findings, Abildgren, Drejer and Kuchler (2012) estimate an econometric model of the relationship between firm characteristics and the probability that a loan application is accepted. The econometric model used allows for the selection regarding applications for bank loans seen in Chart 7.9, among others. This is particularly important because we want to compare the outcomes of loan applications during and before the financial crisis, although the firms applying for bank loans in the two periods may be characterised by differences in e.g. key financial ratios. The method used is described in Box 7.2.

---

**MODEL OF THE OUTCOME OF FIRMS’ LOAN APPLICATIONS**

Box 7.2

Abildgren, Drejer and Kuchler (2012) estimate an econometric model of the outcome of firms’ applications for bank loans in 2007 and 2009/10, respectively. The firms applying for bank loans are not a randomly selected group of firms. Furthermore, the characteristics that cause a firm to apply for a loan are not necessarily identical in the two periods. To take this into account, a bivariate probit model with sample selection is estimated for each period.

The model is based on a standard probit model:

\[ P(y_1 = 1 | x) = \Phi(x \beta), \]  

(7.1)

where \( y_1 \) is a binary variable that assumes the value 1 if the firm’s loan application is accepted, and the value 0 if the application is not accepted. Furthermore, \( x \) is a vector with explanatory variables, and \( \Phi \) is the cumulated standard normal distribution function.

We can only observe the variable \( y_1 \), if a firm has applied for a bank loan, however. If we let \( y_2 \) be a binary variable with the value 1, if the firm has applied for a bank loan, and 0 if it has not, a further probit model can be constructed:

\[ P(y_2 = 1 | z) = \Phi(z \delta), \]  

(7.2)
In 2007, a firm’s characteristics had no significant effect on the outcome of an application for a bank loan, cf. Table 7.2. This reflects the fact that the applications of most of the firms in the sample applying for bank loans in 2007 were accepted. This could indicate that the high lending growth in the pre-crisis years was at the expense of the credit quality of the loan portfolio.

Conversely, a firm’s key financial ratios are seen to have a fairly great impact on the probability of the loan application being accepted in 2009-10. Firms with higher profit ratios, solvency ratios and liquidity ratios are thus more likely to have their loan applications accepted.

Table 7.2 also shows that firms applying for bank loans generally have poorer key financial ratios than firms that do not apply. Compared with the information from Chart 7.10, this indicates that the majority of firms that do not apply for loans are characterised by having sound finances, although the financial ratios of a small group of firms are so poor that the firms refrain from applying in the expectation of their application being rejected. The group of firms that do not apply for loans due to expectations of being rejected is relatively small compared with the group of firms that do not apply for other reasons.

As mentioned in Box 7.1, information about the firm’s principal banker is available for approximately two thirds of those firms in the sample
that apply for bank loans. In order to test whether the outcome of a loan application is primarily affected by the firm's or the bank's situation or a combination thereof, a number of indicators of the banks' size and loan impairment charge and solvency situation are included in the regression analysis below. Due to the reduced number of observations, these findings are shown separately in Table 7.3.

Contrary to expectations, the bank's situation has only a limited impact on the outcome of a loan application. There is a slight tendency for firms that are customers in banks with higher loan impairment charge ratios to be a little less likely to have their loan applications approved, but the relationship is only marginally significant. There are no indications, however, that the banks' solvency situation has significantly affected the outcome of a firm's loan application. This should be viewed against the backdrop of the public capital injections into banks as part of Bank Rescue Package 2 of February 2009.

**MODEL OF ACCEPTANCE OF FIRMS' BANK LOAN APPLICATIONS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>2007 Coefficient estimate</th>
<th>2009-10 Marginal effect</th>
<th>2007 Coefficient estimate</th>
<th>2009-10 Marginal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of acceptance of a bank loan application</td>
<td><strong>0.214</strong></td>
<td>0.022</td>
<td><strong>0.797</strong></td>
<td>0.186</td>
</tr>
<tr>
<td>Solvency ratio</td>
<td><strong>-0.018</strong></td>
<td><strong>-0.002</strong></td>
<td><strong>1.534</strong></td>
<td>0.357</td>
</tr>
<tr>
<td>Profit ratio</td>
<td>-0.103</td>
<td>-0.011</td>
<td>-1.986</td>
<td>-0.463</td>
</tr>
<tr>
<td>Implied interest</td>
<td>0.035</td>
<td>0.618</td>
<td><strong>1.830</strong></td>
<td>0.426</td>
</tr>
<tr>
<td>Short-term debt ratio</td>
<td>-0.906</td>
<td>-0.093</td>
<td>0.337</td>
<td>0.079</td>
</tr>
<tr>
<td>Constant</td>
<td><strong>1.474</strong></td>
<td></td>
<td></td>
<td>0.491</td>
</tr>
</tbody>
</table>

**SELECTION EQUATION (PROBABILITY THAT A FIRM APPLIES FOR A BANK LOAN)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient estimate</th>
<th>Marginal effect</th>
<th>Coefficient estimate</th>
<th>Marginal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvency ratio</td>
<td><strong>-0.693</strong></td>
<td><strong>-1.005</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit ratio</td>
<td>0.001</td>
<td><strong>-0.209</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implied interest</td>
<td><strong>1.863</strong></td>
<td>0.314</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquidity ratio (broad)</td>
<td><strong>-2.123</strong></td>
<td><strong>-1.302</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term debt ratio</td>
<td><strong>-0.497</strong></td>
<td><strong>-0.630</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN (number of employees)</td>
<td>-0.048</td>
<td>0.027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN (total assets)</td>
<td>0.070</td>
<td>0.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied for loan (other source)</td>
<td><strong>1.058</strong></td>
<td><strong>0.865</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td><strong>-1.072</strong></td>
<td>-0.671</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The selection equation expresses the probability that a firm applies for a bank loan, while the main equation expresses the probability that a loan application is accepted. The marginal effect indicates the change in the probability of a loan application being accepted due to an increase in the explanatory variable of one unit. For categorical variables (dummy variables), however, the marginal effect indicates the difference in the probability of acceptance of a loan application between two firms, the only difference being whether the dummy criterion is true or false. The marginal effects are calculated on the basis of the average of the explanatory variables. *** p<0.01, ** p<0.05, * p<0.1.

Source: Abildgren, Drejer and Kuchler (2012).
IMPACT OF BANK AND FIRM CHARACTERISTICS ON THE PROBABILITY OF ACCEPTANCE OF A LOAN APPLICATION

Table 7.3

<table>
<thead>
<tr>
<th></th>
<th>2007 Coefficient estimate</th>
<th>2007 Marginal effect</th>
<th>2009-10 Coefficient estimate</th>
<th>2009-10 Marginal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROBABILITY OF ACCEPTANCE OF A BANK LOAN APPLICATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvency ratio</td>
<td>1.393</td>
<td>0.056</td>
<td>***1.809</td>
<td>0.434</td>
</tr>
<tr>
<td>Profit ratio</td>
<td>-0.035</td>
<td>-0.001</td>
<td>***1.798</td>
<td>0.431</td>
</tr>
<tr>
<td>Implied interest</td>
<td>-5.038</td>
<td>-0.204</td>
<td>0.494</td>
<td>0.118</td>
</tr>
<tr>
<td>Liquidity ratio (broad)</td>
<td>6.440</td>
<td>0.261</td>
<td>*2.451</td>
<td>0.588</td>
</tr>
<tr>
<td>Short-term debt ratio</td>
<td>-0.815</td>
<td>-0.033</td>
<td>0.593</td>
<td>0.142</td>
</tr>
<tr>
<td>Bank: Danish Financial Supervisory Authority’s group 1</td>
<td>0.409</td>
<td>0.021</td>
<td>-0.017</td>
<td>-0.004</td>
</tr>
<tr>
<td>Bank: Loan impairment charge ratio</td>
<td>-0.155</td>
<td>-0.006</td>
<td>*-0.055</td>
<td>-0.013</td>
</tr>
<tr>
<td>Bank: Excess capital adequacy</td>
<td>-0.207</td>
<td>-0.008</td>
<td>-0.077</td>
<td>-0.019</td>
</tr>
<tr>
<td>Constant</td>
<td>1.549</td>
<td></td>
<td>0.145</td>
<td></td>
</tr>
</tbody>
</table>

SELECTION EQUATION (PROBABILITY THAT A FIRM APPLIES FOR A BANK LOAN)

<table>
<thead>
<tr>
<th></th>
<th>2007 Coefficient estimate</th>
<th>2007 Marginal effect</th>
<th>2009-10 Coefficient estimate</th>
<th>2009-10 Marginal effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvency ratio</td>
<td>**-0.836</td>
<td></td>
<td>***-1.066</td>
<td></td>
</tr>
<tr>
<td>Profit ratio</td>
<td>0.000</td>
<td></td>
<td>-0.356</td>
<td></td>
</tr>
<tr>
<td>Implied interest</td>
<td>1.901</td>
<td></td>
<td>-0.950</td>
<td></td>
</tr>
<tr>
<td>Liquidity ratio (broad)</td>
<td>***-2.444</td>
<td></td>
<td>***-2.146</td>
<td></td>
</tr>
<tr>
<td>Short-term debt ratio</td>
<td>-0.314</td>
<td></td>
<td>-0.461</td>
<td></td>
</tr>
<tr>
<td>Bank: Danish Financial Supervisory Authority’s group 1</td>
<td>-0.012</td>
<td></td>
<td>***-0.389</td>
<td></td>
</tr>
<tr>
<td>Bank: Loan impairment charge ratio</td>
<td>0.328</td>
<td></td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Bank: Excess capital adequacy</td>
<td>0.117</td>
<td></td>
<td>-0.098</td>
<td></td>
</tr>
<tr>
<td>LN (number of employees)</td>
<td>-0.013</td>
<td></td>
<td>-0.033</td>
<td></td>
</tr>
<tr>
<td>LN (total assets)</td>
<td>0.054</td>
<td></td>
<td>0.044</td>
<td></td>
</tr>
<tr>
<td>Applied for loan (other source)</td>
<td>***0.973</td>
<td></td>
<td>***0.916</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>*-1.162</td>
<td></td>
<td>0.080</td>
<td></td>
</tr>
</tbody>
</table>

Note: The selection equation expresses the probability that a firm applies for a bank loan, while the main equation expresses the probability that a loan application is accepted. The marginal effect indicates the effect on the probability of a loan application being accepted due to an increase in the explanatory variable of one unit. For categorical variables (dummy variables), however, the marginal effect indicates the difference in the probability of acceptance of a loan application between two firms, the only difference being whether the dummy criterion is true or false. The marginal effects are calculated on the basis of the average of the explanatory variables. *** p<0.01, ** p<0.05, * p<0.1.

Source: Abildgren, Drejer and Kuchler (2012).

8. ALTERNATIVE FUNDING SOURCES AND MACROECONOMIC EFFECTS OF CREDIT SHOCKS

In addition to bank loans, firms use many other funding sources, e.g. mortgage loans, equity funding, intra-group loans, issuance of bonds, trade credits, leasing or factoring.

Mortgage funding is the most widely used alternative to bank funding in Denmark. Chart 8.1 shows lending by banks and mortgage banks in
On the other hand, lending by mortgage banks increased during the same periods. This may indicate that households and firms were able to cover part of their credit requirements in the mortgage-credit sector during periods when banks needed to reduce their lending exposure.

Non-financial corporations have also increased their bond issuance in recent years, although the total outstanding volume remains limited, cf. Ministry of Business and Growth (2012).

Chart 8.1 also shows the credit mix, defined here as bank lending as a ratio of total bank and mortgage-bank lending. The credit mix has been characterised by a long-term downward trend as mortgage-bank lending has gained increased weight in the economy. This should be viewed in conjunction with the rise in real house prices over the period shown,

1922-1933, 1987-1993 and 2008-12, all periods characterised by defaults in the banking sector and a falling or stagnating trend in bank lending. On the other hand, lending by mortgage banks increased during the same periods. This may indicate that households and firms were able to cover part of their credit requirements in the mortgage-credit sector during periods when banks needed to reduce their lending exposure. Non-financial corporations have also increased their bond issuance in recent years, although the total outstanding volume remains limited, cf. Ministry of Business and Growth (2012).

Chart 8.1 also shows the credit mix, defined here as bank lending as a ratio of total bank and mortgage-bank lending. The credit mix has been characterised by a long-term downward trend as mortgage-bank lending has gained increased weight in the economy. This should be viewed in conjunction with the rise in real house prices over the period shown,

Note: Quarterly observations. Comprises lending to domestic non-MFIs. The credit mix is calculated as bank lending as a ratio of total bank and mortgage-bank lending.
Source: Abildgiren (2012a).

1 It should be noted, however, that part of the fall in bank lending since 2008 is attributable to the transfer of loans from banks under the Financial Stability Company to units without a banking licence. In addition, foreign banks in Denmark transferred loans to Danish firms to the parent bank in their home country. Moreover, the joint funding agreement between BRFkredit and several banks in 2012 contributed to a small decline in bank lending.
cf. Abildgren (2006). However, there is a clear tendency for the credit mix to fall in periods of crisis in the banking sector.

Chart 8.1 indicates that in periods of crisis in the banking sector, there has been relative substitution of lending by banks towards lending by mortgage banks, reflecting that the business models of banks and mortgage banks are fundamentally different.

The main activity of mortgage banks is to offer loans against real property as collateral, financed by issuance of negotiable bonds. The business model of mortgage banks follows the balance principle, ensuring that the terms of the issued mortgage bonds reflect the terms of the loans granted, cf. Gundersen et al. (2011). The balance principle thus sets the limits for the financial risks that mortgage banks can assume, including interest-rate, option, liquidity and exchange-rate risk. This means that Danish mortgage banks assume risks other than credit risk to a very limited extent, the latter risk being limited by requiring that property be pledged as collateral for all loans – even the "most secure" part of the property value (first mortgage). In contrast, banks grant both collateralised and uncollateralised loans.

The different business models are reflected in substantial differences in the level of loan impairment charges between banks and mortgage

---

**LOAN IMPAIRMENT CHARGES IN BANKS AND MORTGAGE BANKS**

<table>
<thead>
<tr>
<th>Year</th>
<th>Banks</th>
<th>Mortgage Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>1920</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>1925</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>1930</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>1935</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>1940</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>1945</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>1950</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>1955</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>1960</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>1965</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>1970</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>1975</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>1980</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>1985</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>1990</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>1995</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>2000</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>2005</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>2010</td>
<td>2.1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**Note:** In 1990, the principles for mortgage banks' loan impairment charges were changed so that provisions had to be made for probable losses and not just for certain losses. In principle, part of the provisions in 1990 therefore concern previous years.

**Source:** Statistics Denmark and Danish Financial Supervisory Authority.
banks, even during periods of financial crisis, cf. Chart 8.2. The very low level of mortgage banks' loan impairment charges during the recent financial crisis compared with the late 1980s and early 1990s should be viewed in the context of considerably lower rates of enforced sales and unemployment, cf. Abildgren and Thomsen (2011).

These conditions contribute to explaining how it is possible for mortgage banks' lending to improve in periods of crisis in the banking sector, while banks have to consolidate and reduce their lending exposure. Accordingly, households and firms were able to cover part of their credit requirements in the mortgage-credit sector during periods when banks needed to reduce their lending exposure. This contributed to the fact that, during the recent crisis, total lending by banks and mortgage banks did not decline substantially relative to GDP, cf. Chart 8.3.

The increase in the credit mix in the mid-1930s and in the second half of the 1990s does not imply that mortgage-bank lending declined in absolute levels in the years following periods of banking crisis. But bank lending increased more strongly than mortgage-bank lending during those periods. Since mortgage banks only grant loans based on real property as collateral, this may reflect that marginal borrowing during a cyclical upswing – when the outlook for the ability of firms and households to meet payments is good – takes place to a greater extent on an uncollateralised basis via banks.

### LENDING BY BANKS AND MORTGAGE BANKS TO DANISH HOUSEHOLDS AND NON-FINANCIAL CORPORATIONS

<table>
<thead>
<tr>
<th>Chart 8.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per cent of GDP</td>
</tr>
<tr>
<td>250</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

The above analyses do not necessarily mean that individual households and firms or even whole industries may not have found it hard to obtain sufficient funding during the crisis, e.g. due to insufficient real estate equity. Nor is there any doubt that the recent financial crisis has given rise to considerable additional loss of output in the Danish economy, cf. Abildgren et al. (2011).

The financial crisis had negative social effects through several channels – in addition to the negative impact from the international economy, which was characterised by financial and debt crises. The financial crisis eroded the firms’ credit standing and ability to meet payments in particular, which caused banks to tighten their credit standards and to limit their lending exposure. In addition to the negative impact on the real economy caused by lending restraint in a crisis-stricken banking sector, the financial crisis also adversely affected the economy in more general terms. The growing perceived uncertainty about the future economy and the economic outlook for households and firms brought about by the financial crisis may have led to lower consumption and investment and thus to lower demand for credit. Furthermore, corporate confidence in the banking sector’s willingness and ability to always meet the demand for credit and liquidity in an economic downturn may have weakened. This may have amplified consolidation and debt reduction by non-financial corporations and dampened credit demand, investment activity and employment. Non-financial corporations show substantial savings surpluses, and the financial savings surpluses of Danish firms and households relative to GDP have reached the highest levels since the start of the statistical series in the early 1970s. The savings surpluses are thus higher than during the deep recessions in the early 1980s and 1990s.

All other things being equal, due to the consolidation and debt reduction of the corporate sector, there is no reason to expect strong growth in demand for bank loans when the economy improves. This is particularly true, considering that Danish firms traditionally use retained earnings to fund part of their fixed gross investments at the beginning of an upswing rather than loans from mortgage banks in Denmark and abroad, cf. Abildgren (2009). If a coming upswing is accompanied by moderate demand for credit, it is paramount to future financial stability that banks do not ease their credit standards to a level that is too low.
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Consumption, Income and Wealth

Jens Bang-Andersen, Tina Saaby Hvolbøl, Paul Lassenius Kramp and Casper Ristorp Thomsen, Economics

Private consumption accounts for a considerable share of domestic demand in most countries in the western world. In Denmark, private consumption accounts for around half of domestic demand and has a strong impact on the business cycle. Consequently, it is important to have good insight into the determinants of private consumption, e.g. in connection with business cycle analyses of the Danish economy.

Over the last 10-15 years, Danish households have increased their net wealth as a ratio of income. At the same time, they have also expanded their balance sheets, i.e. both assets and liabilities. As a result, their gross debt ratio is now among the highest in the world even though their net wealth ratio is on a par with comparable countries. The high gross debt has attracted considerable attention both nationally and internationally.

This article examines how net wealth and its composition have influenced growth and fluctuations in private consumption, first in a wider international perspective, followed by a separate analysis for Denmark. We also investigate the effects of financial flows from household wealth on household income and hence the scope for consumption.

Rising wealth entails more scope for consumption, and the consumption and wealth ratios are expected to show similar patterns under normal circumstances. However, a number of countries have seen an increase in the net wealth ratio without the consumption ratio following suit. Growth in net wealth covers in particular rising housing wealth and in some countries – including Denmark – rising pension wealth. There are a number of possible explanations of why the higher wealth ratio has not increased the consumption ratio, such as the widespread use of savings-based pension schemes.

As regards fluctuations in consumption, Denmark stands out from most other comparable countries. The fluctuations in consumption seem to be attributable especially to housing wealth and income.

The focus is on Denmark in the second half of the article. In order to throw light on the significance of wealth to consumption, we construct and estimate a consumption model with special focus on the short and medium run. The short-run and medium-run properties of the consumption function are to a high degree determined by the choice of defin-
ition of income (consumption-determining income), while the definition of wealth plays a smaller role.

The choice of income definition concerns, in particular, the treatment of investment income from pension wealth. We choose a description where investment income from pension wealth only affects household disposable income with a lag via future pension payouts. Consequently, interest-rate changes will be passed through to household interest expenses immediately, while interest income from pension wealth will only slowly affect income. In the short and medium run, interest-rate increases will thus lead to higher net interest expenses for households.

Alternatively, interest income from pension wealth can be included directly in consumption-determining income, e.g. by using the disposable income of the private sector. However, this approach will not necessarily change the pass-through of a change in interest rates to net interest expenses, since pension wealth to a high degree has a fixed return as a result of guarantees and interest-rate hedging. Hence, interest-rate changes will, also in this case, principally impact household interest expenses and only to a limited extent on their interest income.

The identification of consumption-determining wealth is difficult and associated with uncertainty, but as mentioned, the choice of definition of wealth has only a minor impact on the properties of the consumption function in the short and medium run. The wealth ratio of Danish households has risen considerably over the last 30 years without the consumption ratio following suit. An increasing wealth ratio in conjunction with a stable consumption ratio poses challenges in the construction of a stable consumption function. It is not possible to identify clearly, on the basis of macroeconomic data, which components of wealth have risen without influencing consumption. However, there are some empirical and theoretical clues.

The various types of household assets, such as pension schemes, equities, bank deposits and housing, are very different, implying varying influence on consumption.

Pension savings, for instance, are tied up until retirement, cannot be pledged and are typically paid out over a number of years. Moreover, payouts from household pension wealth in part reduce public pension payouts by decreasing the pension premium, among other channels. This indicates a small impact on the consumption ratio from pension wealth, especially in the short and medium run. For some households, e.g. those that are close to retirement, pension wealth no doubt plays a larger role. An in-depth analysis of the long-run effects of increased private pension wealth is beyond the scope of this analysis, however.
Equity wealth is typically also found to have a relatively small impact on consumption, *inter alia* because the distribution of this wealth is very uneven, as it is held by high-income families in particular. Moreover, in Denmark any capital gains are taxable.

Real house prices have risen over the last 20 years, e.g. due to falling interest rates and the introduction of new loan types. Housing wealth can only be translated into consumption by the households borrowing against home equity or selling the home. The Danish mortgage-credit system provides ample room for borrowing against home equity, thus translating house price increases into consumption, but there are limits to how much the households can and will increase the loan-to-value, LTV, ratio. This implies that the last 20 years' house price increases have only partially been translated into consumption.

The above discussion indicates that increasing pension and equity wealth has played a substantial role in the divergence of the consumption and wealth ratios over the last 30 years, but that higher housing wealth may also have been a factor. Specifically, this means that the weights of pension, equity and housing wealth are reduced accordingly, ensuring that the consumption-determining wealth ratio has, by and large, fluctuated around a historical average. The weights reflect an empirical choice, but formal estimations confirm that the weighting chosen strengthens the long-run relationship between consumption, income and wealth compared with the choice of total household net wealth.

As mentioned already, the information content of data is not sufficient to provide clear identification of the correct weights, but a robustness check shows that changes of the weights have only a small impact on the model properties in the short and medium run.

In the short run, a number of factors may cause consumption to deviate from the estimated long-run model. We construct an aggregate model in which the quarterly changes in consumption are explained by deviations from the long-run model and a number of variables that may influence consumption in the short run, such as unemployment and real interest rates.

The properties of the consumption function are then examined within the framework of Danmarks Nationalbank's macroeconomic model, MONA. This makes it possible to take into account dynamic effects of shocks to the consumption function, e.g. how increased consumption stimulates income, which in turn boosts consumption. In order to link the consumption function to MONA we construct a financial submodel to manage the relationship between household income, consumption and savings on the one hand and wealth on the other.
Fluctuations in housing wealth play a large role in the aggregate model. During the boom in 2004-07, house prices rose by approximately 60 per cent, whereas they fell by around 15 per cent from end-2007 to end-2009. According to the model, this was the most important factor behind the surge in consumption during the boom and the subsequent sharp falls. The key role of housing wealth in consumption fluctuations ties in well with the observations from the international comparison.

Moreover, the model demonstrates that the falling interest rates in recent years – in response to the marked international economic slowdown – have contributed substantially to cushioning private consumption. The decline in interest rates has both reduced net interest expenses and supported house prices.

The key role of interest rates can be attributed, among other factors, to the households’ accumulation of a high gross debt ratio over the last 15 years without correspondingly increasing interest-bearing assets. At the same time, a far larger share of the debt is now variable-rate debt. All in all, this implies higher interest-rate sensitivity for household disposable income and thus private consumption today, compared with previously.

As a result of the more pronounced interest-rate sensitivity, the transmission mechanism of monetary-policy has strengthened and, viewed in isolation, normalisation of monetary-policy interest rates will have a stronger dampening effect on consumption today than a corresponding interest-rate increase would have had 10 years ago. The higher interest-rate sensitivity emphasises how important it is that financial markets have confidence in the Danish economy.

**RELATIONSHIP BETWEEN CONSUMPTION, INCOME AND WEALTH**

A budget constraint is the point of departure for economic models of private consumption. A person’s consumption at a given time depends on the volume of available resources and on how large a share of the resources the person chooses to consume. Total available resources consist of the sum of existing wealth, $W_t$, and life-cycle income less taxes and other mandatory expenses, e.g. interest expenses, $l_t$. The assumption here is that it is possible to borrow against future income.

A normal assumption in economic theory is that individuals will seek to have relatively stable consumption over time, i.e. they currently wish to consume a virtually constant share of their total resources.¹ This share

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¹ This corresponds to the original "Life-Cycle Hypothesis", cf. Modigliani & Brumberg (1979).
may vary over time, e.g. if the price of consumption varies over time.\(^1\) Moreover, it is assumed that individuals spend all of their income over their life cycle.

Consumption at a given time, \(C_t\), can thus be determined as:

\[
C_t = m_t \times (I_t + W_t)
\]

where \(m_t\) is the share of total resources consumed at time \(t\).

A number of consequences can be drawn from this simple model:

- Predicted changes in income and wealth will not affect consumption. Consequently, changes in wealth as a result of planned savings will have no impact on consumption.
- Unpredicted capital gains and losses, e.g. as a result of unexpected house price increases or falls, have an impact on consumption, but only in so far as these changes in value are found to be permanent.
- Unpredicted temporary changes in income will only have a limited impact on consumption, since the temporary change in income will be distributed over the remaining lifetime (consumption smoothing).

The simple model can be expanded in several areas, e.g. by\(^2\):

- introducing uncertainty about income. Wealth will thus also act as a buffer to be used in connection with temporary loss of income, e.g. due to a short period of unemployment;
- introducing uncertainty about life expectancy. This means that wealth is often not consumed in full, resulting in inheritance. There could also be an explicit wish to leave an inheritance;
- introducing credit constraints, e.g. only limited access to borrow against future income.

The first two expansions do not change the model properties to any substantial extent. For example, predicted changes in income still have no impact on consumption. Changed uncertainty may, however, influence the preference of wealth size. For a certain period – while the buffer is accumulated – increased uncertainty can thus entail lower consumption.

Credit constraints, on the other hand, will have an impact on the properties of the consumption model. If households do not have access to credit, some will be forced to spend less than what they ideally would like to. Hence an increase in income, even if it was predicted, will lead to higher consumption. Thus, one consequence of introducing credit con-

\(^1\) The price of consumption is determined by real interest rates. See Box 1 for more details.

\(^2\) See Muellbauer and Lattimore (1995) for a thorough discussion of a large number of expansions of the simple model.
straights into the model is that current income will play a larger role as regards consumption.

**Empirical considerations**

The above model is based on how an individual makes consumption decisions. Adding up all individuals is necessary in order to determine an aggregate consumption function for private consumption as a whole. Aggregate consumption is thus a function of aggregate wealth and income (current and future).

The present value of future income is difficult to calculate in practice. A simple solution, which is often used in the empirical literature, is to use current income as a measure of future income, e.g. by assuming that future income is proportional to current income, $Y_t$, so $I_t = k*Y_t$.

Hence, aggregate consumption can be written as:

$$C_t = m_t * (k*Y_t + W_t) = \alpha_1 Y_t + \alpha_2 W_t,$$

where $\alpha_1$ expresses the consumption share of one extra krone of income (the marginal propensity to consume income), and $\alpha_2$ expresses the consumption share of one extra krone of wealth (the marginal propensity to consume wealth).

If equation (2) is rewritten, then:

$$\frac{C_t}{Y_t} = \alpha_1 + \frac{\alpha_2 W_t}{Y_t},$$

meaning that, according to the model, the consumption ratio ($C_t/Y_t$) and the wealth ratio ($W_t/Y_t$) show the same pattern over time. According to this relationship, consumption will fall – even though income remains unchanged – if the wealth ratio decreases e.g. as a result of a drop in house prices (capital loss). Lower consumption at unchanged income will entail higher savings and hence a higher wealth ratio. This process will continue until the households have restored their wealth ratio to the desired level. The opposite applies in the event of capital gains.

Given the assumption that future income is proportional to current income, household expectations of future income are not affected by

---

1 This corresponds to the existence of one representative consumer. If the sum of many individuals’ consumption is to be represented by one representative consumer, consumption must not be influenced by the distribution of income and wealth across individuals, cf. Mas-Colell, Whinston and Green (1995), Chapter 4.

2 The parameter $m_t$ is assumed to be constant over time, corresponding to constant real interest rates. Real interest rates are included in the estimations of the short-run dynamics of consumption below, corresponding to allowing $m_t$ to vary.
structural changes. Hence, it is difficult to use his model framework to describe how consumption is influenced by household expectations. A possible interpretation of this assumption is that households do not form explicit expectations about the future (myopic expectations) – or that households are subject to credit rationing, so it is difficult for them to respond to e.g. expectations about higher future income.

A widespread alternative to the model type discussed above is dynamic stochastic general equilibrium (DSGE) models. In a DSGE model, household expectations of the future play a key role in consumption, cf. Box 1, so this type of model is better suited to analysing the significance of e.g. structural changes that can be expected to influence household behaviour.

However, the DSGE model framework entails the challenge of explicit modelling of formation of expectations. It is typically assumed that households have rational expectations and can comprehend the conse-

<table>
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<th>THE CONSUMPTION FUNCTION IN DSGE MODELS</th>
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<td>Box 1</td>
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**In DSGE models consumers choose the consumption and savings levels which will maximise their wellbeing within their budget constraint, i.e. they maximise utility. Moreover, consumers are forward-looking, basing today’s consumption on expectations of future income and wealth.**

**Implications of the consumption function**

Given that consumption in a typical DSGE model is a forward-looking variable, formation of expectations may potentially play a key role. These expectations are typically assumed to be formed rationally. If consumers have fully rational expectations, they use all available information (i.e. all information on relationships in the model) to form expectations regarding future income. For example, this means that consumer expectations of future income and wealth will be based on information on how the other economic agents are expected to act in the future, including the central bank and the public sector.

Consumers are assumed to be able to identify all shocks, e.g. whether higher income can be attributed to higher wages as a result of stronger productivity growth, or whether higher income is attributable to higher tax-funded transfers. Given forward-looking and rational expectations, the first case will entail consumption growth, since it implies higher future income for the consumers. In the second case, the consumption effect will be zero, since life-cycle income is unchanged (tax-funded transfers are to be financed via higher taxes in the future).

Since consumers optimise their consumption taking future income into account, real interest rates will play a key role in consumption development, because today’s consumption depends on expectations regarding all future real interest rates. If monetary policy can influence real interest rates, e.g. because of price stickiness, monetary policy will not only be passed through via today’s real interest rates, but also via expectations regarding the future monetary-policy stance.
quences of all changes and shocks to the economy. This is a strict assumption that does not always hold true in practice. No matter which model framework is chosen, it is therefore necessary to include simplified assumptions that are not necessarily met in the real world.

CONSUMPTION, INCOME AND WEALTH IN AN INTERNATIONAL CONTEXT

This section first examines whether developments in consumption and wealth ratios across a number of countries are in accordance with the simple model described above. Differences in consumption fluctuations across countries are then examined.

Many countries have seen a general increase in the wealth ratio over the last 30 years, cf. Chart 1. In most countries, rising housing wealth has accounted for a considerable share of the increase, e.g. in Denmark and Sweden, where housing wealth rose by 150 and 110 per cent, respectively, relative to disposable income in the period 1990-2010.\(^1\)

Higher pension savings have also contributed substantially to rising net wealth in some countries, such as Denmark and the Netherlands. Since 1995, pension wealth in Denmark and the Netherlands has grown by approximately 140 and 170 per cent of disposable income, cf. Chart 2.

Development in consumption and wealth ratios

Given the increase in the wealth ratio over the last 30 years, the consumption ratio could also be expected to have risen. However, not many

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\(^1\) Properties owned by non-residents are included in housing wealth in the country where the property is located. This may have considerable influence on the calculation of e.g. housing wealth in Spain.
AVERAGE NET WEALTH RATIO FOR HOUSEHOLDS

Chart 1

Per cent of disposable income

Note: Including pension wealth before tax.
Source: Own calculations based on data from OECD, Statistics Denmark, Isaksen et al. (2011) and De Bonis, Fano and Sbano (2007).

CHANGE IN WEALTH RATIO IN THE PERIOD 1995-2010

Chart 2

Per cent of disposable income

Note: Including pension wealth before tax.
Source: OECD, Statistics Denmark and Isaksen et al. (2011).
countries have seen such an increase. Instead, average consumption ratios have been virtually stable over the last three decades, cf. Chart 3. Only Italy, Portugal and Japan have seen a considerable increase in the consumption ratio, which should be viewed in light of such factors as the initially very low consumption ratios in these countries relative to other OECD countries.

However, the ratio of consumption to disposable income varies substantially across countries. For example, the Danish consumption ratio has been around 10 percentage points higher, on average, than the German ratio over the last three decades. The variation in consumption ratios can be attributed to several factors, such as differences in the size of the public sector, demographics, financial development, corporate savings, interest-rate levels and tax structures, cf. Isaksen et al. (2011).

Chart 4 compares consumption patterns and wealth ratios for a number of countries since 1980. In the UK, the USA, Italy and the Netherlands, the consumption ratio follows the same pattern as the wealth ratio over time. For the remaining countries – including Denmark – the wealth ratio tends to have increased considerably more than the consumption ratio. In the years up to the financial crisis, Denmark and the USA, in particular, saw considerable growth in housing wealth, which
Note: The net wealth ratio includes net financial assets and housing wealth. Income has been calculated including net pension contributions, cf. Box 2.
Source: OECD, Statistics Denmark, Isaksen et al. (2011) and De Bonis, Fano and Sbano (2007) and Sveriges Riksbank.
contributed to the substantial rise in the consumption ratio. In the post-crisis years, both the wealth ratio and the consumption ratio have fallen back.

The literature has identified several factors that may have contributed to the rise in net wealth over time without the consumption ratio following suit. Demographics, for instance, may have affected the consumption ratio over time. More widespread use of savings-based pension schemes may also have played a role, e.g. if public pension payouts are partially replaced by private pension payouts. Financial constraints or lack of response to higher pension savings among households may also lead to pension savings increasing net wealth without the consumption ratio following suit. Moreover, falling interest rates have presumably increased wealth; a case in point is the strong growth in house prices in most countries. Over the last 20 years, house price gains have probably only partially been translated into consumption. Possible reasons are credit constraints – for instance, it is not possible to borrow against home equity in a number of countries – or households’ aversion to increasing their LTV ratios.

Consequently, the pattern in Denmark over the last three decades with an increasing wealth ratio and a stable consumption ratio is not unique; it is also found in other countries such as Sweden, France and to a lesser extent Germany. However, this development may not necessarily have the same determinants across countries. In Denmark, the LTV ratio for homes has increased over the last 20-30 years, presumably due to both the Danish mortgage-credit system and to the fact that high pension wealth reduces the need for having redeemed all debt by the time of retirement. This makes it possible that a larger share of house price increases in Denmark over the last 20 years has been translated into consumption compared with other countries. Moreover, a further distinguishing feature of private consumption in Denmark relative to comparable countries is the high degree of volatility, which is analysed in more detail in the following section.

Volatility in consumption
From the 1980s until the present crisis, many countries have seen a decrease in the volatility of growth in real private consumption, which is typically explained by enhanced economic policy and/or smaller shocks to the economy. This development has been called the great moderation.¹ Despite the decrease over time, volatility still varies considerably across countries. For example, fluctuations in private consumption are

¹ For more details, see Gali and Gambetti (2009).
more than twice as strong in Denmark as in Germany (measured in terms of standard deviations), cf. Chart 5. Consumption growth volatility is generally stronger in Denmark than in most other comparable countries.¹

The variation of consumption volatility across countries may be attributable to several factors. The differences may e.g. be attributable to the composition of consumption or differences in the volatility of the factors determining consumption, i.e. income and wealth.

**Composition of consumption**

In countries with a large public sector, such as Denmark, healthcare services and education, among other things, are paid by the government (individual public consumption). As a result, these consumer goods are not included in private consumption in Denmark. Since many of these services are necessities, they will tend to fluctuate less over a business cycle than the remainder of consumption. This indicates a higher degree of volatility in private consumption in countries with a large public sector. In the period from 1995 to 2007, there was a clear link between

¹ There is a positive relationship between GDP per capita and the volatility of consumption growth. In order to ensure a more comparable basis this section focuses on countries with almost the same level of welfare.
higher individual public consumption and more pronounced volatility in private consumption. In the period after the financial crisis this link has been less characteristic.

Changes in income and wealth
A key factor contributing to varying volatility in consumption growth is differences in volatility in income and wealth across countries, cf. Chart 6.

There may be several reasons why incomes fluctuate. For example, fluctuations in employment will entail stronger fluctuations in income and thus consumption, cf. Chart 7 (right). A generous unemployment benefit system, on the other hand, will dampen fluctuations in income.

In addition, the household debt ratio may influence disposable income via interest payments, cf. Chart 7 (left). Interest-rate fluctuations tend to
affect income more for households with a high debt ratio than for households with a low debt ratio. Moreover, households with high debt and a high LTV ratio will find it difficult to smooth out consumption by increasing borrowing in the event of a temporary decrease in income due to e.g. unemployment. The Danish and partially the Dutch households differ from households in other countries in that their incomes tend to fluctuate far less than could have been expected, viewed in isolation, on the basis of their gross debt ratios. One possible explanation is that the underlying structural factors that contribute to the high gross debt ratios in Denmark and the Netherlands, such as developed financial markets, large private pension wealth and sound public finances, tend to dampen fluctuations in income at the same time.

\textit{Change in wealth}

There is also a clear relationship between fluctuations in wealth and consumption, cf. Chart 6 (right). Wealth consists of several components. Volatility in housing wealth is the component that has shown the strongest correlation with volatility in private consumption since 1996, cf. Chart 8 (top left). Denmark is one of the countries that have seen the

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\begin{tabular}{|c|c|}
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Correlation between the annual real growth in private consumption and various wealth components: & \textbf{Chart 8} \\
\hline
\hline
\textbf{Standard deviation in annual real growth in private consumption} & \textbf{Standard deviation in annual real growth in private consumption} \\
\hline
3.0 & 3.0 \\
\hline
2.5 & 2.5 \\
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2.0 & 2.0 \\
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1.5 & 1.5 \\
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Correlation between the annual real growth in housing wealth and various wealth components: & \textbf{Chart 8} \\
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\hline
\textbf{Standard deviation in annual real growth in housing wealth} & \textbf{Standard deviation in annual real growth in financial wealth (excluding pension)} \\
\hline
3.0 & 3.0 \\
\hline
2.5 & 2.5 \\
\hline
2.0 & 2.0 \\
\hline
1.5 & 1.5 \\
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Correlation between the annual real growth in pension wealth and various wealth components: & \textbf{Chart 8} \\
\hline
\hline
\textbf{Standard deviation in annual real growth in pension wealth} & \textbf{Gross debt as a percentage of disposable income} \\
\hline
3.0 & 3.0 \\
\hline
2.5 & 2.5 \\
\hline
2.0 & 2.0 \\
\hline
1.5 & 1.5 \\
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Note: 1996-2011.
strongest volatility in housing wealth and private consumption in recent years. However, the reasons for the correlation cannot be determined on the basis of these simple graphs. One possibility is that falling interest rates or a fiscal easing increases both consumption and house prices. Another possible explanation is that fluctuations in housing wealth affect credit constraints and thus volatility in consumption.

In the period from 1996, fluctuations in pension wealth have been only weakly correlated with private consumption, cf. Chart 8 (bottom left), especially if the focus is on countries where households hold substantial pension wealth (Denmark, the Netherlands, Sweden, the UK and the USA). This is probably related to the fact that capital gains on pension wealth cannot be realised immediately, but are instead paid out over a number of years with a considerable lag. On the other hand, fluctuations in non-pension financial wealth have been more strongly correlated with consumption, cf. Chart 8 (top right).

Initially, the size of household gross debt also plays a role with regard to fluctuations in private consumption. As mentioned previously, this may be attributable to both the direct effect on income from interest-rate fluctuations and to the fact that it is more difficult for households with high debt and high LTV ratios to smooth out consumption in the event of a temporary fall in income.

**CONSUMPTION IN DENMARK**

Average annual growth in consumption in Denmark has been almost 2 per cent over the last 30 years. But this masks substantial fluctuations. For example, private consumption increased strongly in the period up to the financial crisis and then dropped by almost 6 per cent from the 2nd quarter of 2008 to the 1st quarter of 2009. In order to analyse the reasons for this development, we construct and estimate a model that explains consumption by income, wealth and several other factors.

While there is extensive empirical literature on aggregate consumption functions, especially on US data, there are also a number of studies based on Danish data.¹

The short-run and medium-run properties of the consumption function are to a high degree determined by the choice of consumption-determining income, while the choice of definition of wealth plays a smaller role. In order to explain the empirical choices in this article in the best possible way, we begin by discussing a number of definitions of income

and wealth. We then proceed to test formally whether our choices of income and wealth definitions provide a robust long-run relationship between consumption, income and wealth.

**Income definition**

Only households account for private consumption. Consequently, it is most natural in the first instance to focus on household income, which is indeed the approach in this article. While the major part of household income is wage income, households also have other income, such as investment income and public transfers in the form of old age pension, unemployment benefits, social benefits, leave allowances, etc. Moreover, income is taxable. Total household income after tax is called household disposable income in the national accounts.

The calculation of household disposable income is not entirely unambiguous. In the national accounts, mandatory pension savings, i.e. labour-market pensions, are included as a mandatory expense that reduces disposable income. Investment income from labour-market pensions does not impact the disposable income in the national accounts either, as investment income is assumed to accumulate in the pension accounts. Pension payouts, on the other hand, are regarded as income contributing to disposable income. It is also possible to calculate an adjusted disposable income where pension savings are treated as all other wealth, cf. Box 2.

It can be argued that a more broad-based income concept covering income in the private sector overall, i.e. including pension funds, can be an alternative to household disposable income.\(^1\) Corporate income will normally be paid out to the owners sooner or later via dividend and thus be included in household disposable income.

However, parts of corporate income may end up in the households without being included in household income. This is because corporate income can be transferred to households via firms buying back their own shares from the households. This will be posted in the national accounts as if the households have realised a capital gain (retained profits lead to higher equity prices). Hence, a household's income will not capture the development in earnings in the firms owned by the household. This supports the argument that income in the private sector overall may be a better measure of consumption opportunities in the long run.

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\(^1\) Most estimations on Danish data are based on income and wealth for the private sector overall, cf. Olesen (2008).
However, parts of corporate income are paid to foreign owners and to the central government, which supports using household income as a measure. It is, however, possible to adjust private-sector income accordingly. For the consumption function in Danmarks Nationalbank’s macro-economic model, MONA, private-sector income is adjusted for energy-sector income, among other factors.

But other factors go against the use of a broad-based income concept, *inter alia* in connection with analyses of e.g. interest-rate shocks. Rising interest rates will increase private-sector disposable income, since the private sector, including the pension funds, has interest-bearing net wealth. If the household sector is viewed in isolation, rising interest rates will, on the other hand, reduce income in the short and medium run, because the household sector has interest-bearing net debt, disregarding pension wealth.

In the slightly longer term, changed investment income in the pension funds will, however, affect household disposable income. The reason is that the accumulation of investment income from pension wealth affects household disposable income with a lag via future pension payouts.\(^1\) Thus, changes in interest rates will immediately be passed through

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1. The treatment of investment income from pension wealth corresponds to the disposable income concept in the national accounts. Other macro models, such as ADAM, have the same approach in the short run.
to household interest expenses, while the interest income from pension wealth will only slowly affect income.

Even including the return on pension wealth in consumption-determining income, there is reason to believe that interest-rate increases entail higher net interest payments for the households. This is because return on pensions is to a great extent fixed-rate return, either due to a guaranteed minimum return or to the widespread hedging of interest-rate risk among the pension funds. Pension wealth can thus be regarded as fixed-rate wealth.

On the basis of the above discussions, we opt for the household disposable income concept from the national accounts, i.e. an income concept where investment income from pension funds only slowly increases consumption-determining wealth. The model properties – especially interest-rate sensitivity – are strongly influenced by this income definition in the short and medium run.

In the period from 1973 until the end of the 1990s, the different income concepts showed almost identical patterns, cf. Chart 9, but since then the overlap between the income concepts has been slightly less clear.

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**Chart 9**

**DEVELOPMENT IN DISPOSABLE INCOME**

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- Private sector, disposable income
- Private sector, adjusted disposable income
- Households, disposable income
- Households, adjusted disposable income

**Note:** All indices are based on nominal, seasonally adjusted quarterly developments deflated by the development in consumer prices. Private sector, adjusted: disposable income adjusted for income in the energy sector and depreciation. The different developments in private-sector income and household income in 1999 are especially attributable to strong growth in income in the energy sector.

**Source:** Own calculations based on data from Statistics Denmark, Danmarks Nationalbank and MONA.
**Wealth definition**

Household wealth consists of various assets less debt. Housing accounts for the largest share of wealth, but the households also hold a number of financial assets, such as equities, bank deposits and pension savings. Fluctuations in wealth are attributable to fluctuations in housing and equity wealth in particular, cf. Chart 10.

The value of parts of the assets is associated with some uncertainty. This is because the market value of rarely traded assets is not known. In the national accounts, the market value of these assets is instead based on the market value of comparable traded assets.

While, as regards income, there are both pros and cons of using household or private-sector income, respectively, to explain private consumption, it is difficult, as regards wealth, to identify advantages of using private-sector wealth.

The most important difference between private-sector and household wealth is how the value of firms is calculated. For households, it is calculated as the market value of their equity wealth, while for the private sector overall it is calculated as the value of firms' capital stock at replacement cost. However, the value of a firm is influenced by factors other than just the value of the capital stock, e.g. the value of patents and goodwill.

In theory, equity prices should capture the market value of all these factors. Moreover, equities are far more liquid than the capital stock of firms. Equity wealth should thus be assumed to be more relevant to households' consumption and savings decisions than the value of firms' capital stock.

Household wealth and private-sector wealth have differed considerably since 1970. Both growth and volatility have been stronger for household net wealth than for private-sector wealth, cf. Chart 11.

Although it seems obvious to use household net wealth rather than private-sector net wealth, the final choice of consumption-determining wealth is a challenge and associated with uncertainty. The reason is that the wealth ratio for households has risen substantially without the consumption ratio following suit. An increasing wealth ratio in conjunction with a stable consumption ratio poses challenges when constructing a stable consumption function, as this requires identical development patterns for the two ratios. It is not possible to identify clearly, on the basis of macroeconomic data, which components of wealth have risen

---

1 Replacement cost is used in the absence of market value of the capital stock. For the private sector overall, equity wealth is practically negligible, because it constitutes an asset for households, but a liability for firms. Hence, net equity wealth for the private sector overall is by and large zero.
HOUSEHOLD BALANCE SHEET BY COMPONENTS

Chart 10

Per cent of disposable income

Source: Danmarks Nationalbank.

WEALTH DEVELOPMENTS

Chart 11

Index, 1974 = 100

Note: All indices are based on nominal, seasonally adjusted quarterly developments deflated by the development in consumer prices. Private-sector wealth consists of commercial plant and equipment, building and construction capital, housing wealth and net financial wealth (based on quarterly financial accounts) for the private sector overall, including financial corporations. The calculation of private-sector wealth in MONA is slightly different as regards calculation of financial wealth, but the pattern is almost the same.

Source: Own calculations based on data from Statistics Denmark, Danmarks Nationalbank and MONA.
without consumption following suit. However, there are some empirical and theoretical clues.

The various household assets differ markedly, and it is possible to identify a number of reasons why their respective impacts on consumption may also vary.

*Pension wealth*

The use of savings-based pension schemes, which are part of the collective agreements, has increased considerably over the last 30 years. At the same time, the contribution margins for these pension schemes have also risen. From 1980 to 2011, household pension wealth before tax has grown from approximately 50 per cent to more than 300 per cent of disposable income.¹ The large pension wealth is estimated to entail higher income for future pensioners, but pension payouts are regarded as income, which will reduce a number of income-related allowances, such as the pension premium. The widespread use of labour-market pensions for civil servants and corresponding phasing-out of civil servant pensions may also have increased pension wealth without increasing these people’s income as pensioners. For some households, higher pension savings will thus only to a minor degree increase their income as pensioners.

According to the simple consumption model presented above, the households decide their level of saving on the basis of their preference for even consumption. If a household is forced to save up more in a pension scheme than it wishes, it will just reduce other savings accordingly. Consumption and savings will thus remain unchanged, while disposable income will fall (the pension contributions erode disposable income). Overall, this entails a slight increase in the consumption and wealth ratios as a result of lower disposable income.

There are a number of studies – both at individual and macro level – of how mandatory pension savings affect other savings. Their general conclusion is that higher mandatory savings only leads to a reduction of other savings by 15-40 per cent for households, where studies based on individual data are generally at the low end of the interval.² A reduction of other savings by e.g. 20 per cent entails, viewed in isolation, a higher wealth ratio, but a limited effect on the consumption ratio (calculated as consumption over disposable income in the national accounts) since both consumption and disposable income are reduced as a result of higher mandatory savings. However, it is not possible to transfer these

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¹ Pension payouts are liable for income tax.
² See e.g. Isaksen et al. (2011), Economic Council (2008) and Arnberg and Barslund (2012).
estimates for household savings behaviour directly to a specific weight of pension wealth in the macro analysis.

The relatively small estimated reduction of other savings may be attributable to, inter alia, the households factoring in the reduction of parts of public pensions due to pension payouts. An additional possible explanation is that the households are not fully able or willing to reduce other savings, e.g. by increasing borrowing or that they are not fully able to perceive the consequences of the higher mandatory pension savings.

When labour-market pensions are fully phased in, payouts will exceed contributions, resulting in higher disposable income (the consumption ratio will remain largely unaffected). However, the large payouts will put a stop to growth in the pension wealth ratio.

The discussion above indicates a small impact on the consumption ratio from pension wealth, especially in the short and medium run. For some households, e.g. those that are close to retirement, pension wealth no doubt plays a larger role. An in-depth analysis of the long-run effects of increased private pension wealth is beyond the scope of this analysis, however.

Housing and equity wealth

From a theoretical perspective, it is by no means obvious that housing wealth should have an impact on consumption. The reason is that housing wealth – as opposed to other wealth – does not constitute a claim on another sector. Rising house prices will thus result especially in a shift of wealth from new to existing homeowners. Nevertheless, empirical analyses typically find that the consumption effect of housing wealth is more pronounced than the consumption effect of financial wealth (which tends to fluctuate as a result of variations in equity prices), cf. Altissimo et al. (2005). The following factors, among others, can be mentioned:

- Rising house prices reduce credit constraints and improve the access to raise loans against the home as collateral.
- Households regard house price fluctuations as more permanent than equity price fluctuations. Hence, households will be more inclined to adjust their consumption as a result of changes in house prices than as a result of changes in equity prices. This applies particularly in countries where it is easy to borrow against home equity.
- Purchase of a home is typically financed partially with borrowed funds, i.e. residential investment is leveraged. This means that increasing

---

1 Payouts exceed contributions as pension wealth accrues interest.
house prices result in a higher net return on equity, compared with non-leveraged investment. Accordingly, rising house prices have a stronger impact on consumption compared with other assets.

- Housing wealth is more evenly distributed across households than financial wealth. Only 9 per cent of Danish families hold equity for more than kr. 100,000, cf. Table 1, while approximately half of all families own a home. Moreover, families with substantial equity wealth tend to have considerably higher income than the average income (2.6 times higher for families with equity wealth exceeding kr. 1 million). If the propensity to consume is lower among the families in the highest income brackets, changes in equity prices will have a smaller effect on consumption, compared to house price increases.

- Capital gains on equities are regarded, for tax purposes, as capital income at the time of realisation of the capital gain. The payment of tax reduces the gain from equity price increases. Conversely, capital gains from housing are not taxable.

- A large part of the equity wealth consists of unlisted shares typically issued by small firms, e.g. a doctor's practice or a small firm of builders. Unlisted equity securities should be expected to be illiquid, i.e. they are difficult to sell quickly without a considerable loss. At the same time, it will often not be possible to sell only parts of the portfolio. Moreover, it may also be difficult to borrow against them. Consequently, any capital gains will be very difficult to realise. All of these factors indicate a low propensity to consume out of unlisted equity securities. In addition, the calculation of the value of household portfolios of unlisted equity securities is associated with far greater uncertainty than other wealth components, due to a combination of no available market prices and inadequate source data.  

However, there may be factors indicating a dampening of the effect of changed house prices on consumption. House prices have risen strongly over the last 20 years, due to, *inter alia*, falling interest rates and introduction of new loan types. Higher housing wealth can only be realised by the households – either by borrowing against home equity or by selling the home. The Danish mortgage-credit system provides ample room for borrowing against home equity and thus translating house price increases into consumption, but there are limits to how much the households can and will increase the LTV ratio. This means that the last 20 years' house price increases have only partially been translated into

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1 Source data for portfolios of unlisted equities stems from accounts statistics databases, but the coverage ratio of these databases is uncertain and may have changed considerably over time.
consumption. This is in line with analyses of inheritance at individual level. According to these analyses, the Danes, especially homeowners, have left increasing amounts of inheritance, cf. Juul (2012).\footnote{The calculations of inheritance are associated with considerable uncertainty. Juul (2012) finds that inheritance averaged around kr. 500,000 in 1997, while Economic Council (2004) finds that inheritance averaged around kr. 300,000 in 2000 (both in 2010-prices).}

The above discussion indicates that increasing pension and equity wealth has played a substantial role in the different patterns of the consumption and wealth ratios, but that higher housing wealth may also have been a factor. This is confirmed by a simple estimation explaining the consumption ratio by the pension, equity and housing wealth ratios and the remainder of the net wealth ratio. The estimated weights of the pension and wealth ratios become small and not statistically significant, while the weight of the housing wealth becomes slightly smaller than the weight of the remaining net wealth ratio. Hence, it seems obvious to reduce the weights of these wealth components in a model context.

### Long-run models: Estimation results

In order to obtain the best possible illustration of the consequences of various income and wealth definitions, we estimate four different consumption relations based on different income and wealth definitions:

- \textbf{M1:} Private-sector wealth and private-sector disposable income adjusted for income in the energy sector and depreciation.\footnote{M1 roughly corresponds to the present model in MONA, but with a slightly different wealth concept. However, the two wealth concepts show almost identical development patterns.}
- \textbf{M2:} Total household wealth, including pension wealth and adjusted household disposable income.\footnote{In M2, pension wealth is treated like all other wealth as regards both wealth and income. Pension contributions should therefore not reduce disposable income, so adjusted disposable income is used, cf. Box 2.}
- \textbf{M3:} Total household wealth excluding pension and unlisted equities and household disposable income.

<table>
<thead>
<tr>
<th>Share of average income/per cent</th>
<th>Income</th>
<th>Share of families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity wealth 0-10,000</td>
<td>0.9</td>
<td>76 per cent</td>
</tr>
<tr>
<td>Equity wealth 10,000-50,000</td>
<td>1.2</td>
<td>9 per cent</td>
</tr>
<tr>
<td>Equity wealth 50,000-100,000</td>
<td>1.3</td>
<td>4 per cent</td>
</tr>
<tr>
<td>Equity wealth 100,000-250,000</td>
<td>1.4</td>
<td>5 per cent</td>
</tr>
<tr>
<td>Equity wealth 250,000-500,000</td>
<td>1.5</td>
<td>2 per cent</td>
</tr>
<tr>
<td>Equity wealth 500,000-1,000,000</td>
<td>1.6</td>
<td>1 per cent</td>
</tr>
<tr>
<td>Equity wealth over 1,000,000</td>
<td>2.6</td>
<td>1 per cent</td>
</tr>
</tbody>
</table>

\footnote{Note: Data is based on custody bank statistics, which are not exhaustive. The data does not include e.g. equity securities in safety deposit boxes or similar. Source: Statistics Denmark and own calculations.}
• M4: Net household wealth, including housing wealth at a weight of 0.8, pension wealth at 0.2 and equity wealth at approximately 0.4, and household disposable income.

Model 3 excludes unlisted equities, corresponding to setting the weight at approximately 0.5, while also reducing the fluctuations in total equity wealth, since the calculated value of unlisted equities in the national accounts has tended to fluctuate more than the value of listed equities. In model 4, the weight is adjusted further downwards to around 0.4.

The choice of functional form is described in Box 3. Given the chosen functional form, the logarithms of the consumption and wealth ratios should move in parallel. Looking at the consumption and wealth ratios together thus provides an indication of the stability and properties of the four models, cf. Chart 12.

<table>
<thead>
<tr>
<th>CHOICE OF FUNCTIONAL FORM OF THE CONSUMPTION FUNCTION</th>
<th>Box 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>The basis for the consumption function is the simple model described above, where consumption is described as a linear function of income and wealth, cf. equation (2).</td>
<td></td>
</tr>
</tbody>
</table>

\[
C_t = m_t \times (k \times Y_t + W_t) = \alpha_1 Y_t + \alpha_2 W_t
\]  

In the empirical literature, estimation is only rarely made directly on an equation like (2), because growth in consumption, income and wealth is typically regarded as relatively steady in the long run (i.e. exponential growth). It is difficult to estimate the relationship between time series with exponential growth. Instead, the time series are transformed in a way that ensures a stable long-run relationship (i.e. cointegration).

We choose to transform all variables by compiling them as logarithms, resulting in linear development. In equation (2) above, the estimated parameters \(\alpha_1\) and \(\alpha_2\) can be interpreted as propensities to consume, i.e. by how many kroner consumption increases when income or wealth, respectively, increases by one krone. When the variables are compiled as logarithms, the estimated parameters become elasticities, i.e. they denote the percentage increase in consumption on a 1 per cent rise in income or wealth, respectively.

Comparison of elasticities is difficult, since they depend on the relative sizes of the estimated components. A 1 per cent rise in house prices e.g. tends to increase total household wealth more than would have been the case with a 1 per cent rise in bond prices, because housing wealth is larger than bond wealth. Hence, a 1 per cent increase in house prices should be expected to have a stronger impact on consumption, compared with a 1 per cent increase in bond prices, i.e. the elasticity of housing wealth becomes more pronounced than the elasticity of bond wealth.

In addition, the elasticities are only relevant in the short term, since wealth is, in the long run, endogenous and determined by income. In the very long run, the elasticity of income will be 1, and an increase by 1 per cent in income will boost wealth by 1 per cent.
Despite the different elasticities for the individual wealth components, the propensities to consume may be the same. The transition between consumption elasticities and propensities to consume are given as $MPC_Y = (C/Y) \times e_Y$ and $MPC_W = (C/W) \times e_W$, where $MPC$ is the marginal propensity to consume and $e$ the marginal consumption elasticity from income ($Y$) and wealth ($W$).

In connection with modelling of consumption in macroeconomic models such as MONA, a homogeneity constraint is imposed on the consumption function. The constraint implies that in the event of a 1 per cent increase in both income and wealth, consumption also grows by 1 per cent. The constraint corresponds to the requirement that the sum of $\alpha_1$ and $\alpha_2$ must be 1. This gives:

\[
\log(C_t) = \alpha_1 \log(Y_t) + \alpha_2 \log(W_t), \text{ where } \alpha_1 + \alpha_2 = 1
\]

\[
\log(C_t/Y_t) = (1 - \alpha_2) \log(W_t/Y_t)
\]

so that the constraint forces the consumption ratio, $\log(C_t/Y_t)$, and the net wealth ratio, $\log(W_t/Y_t)$, to show the same pattern in the longer run. A strong increase in the wealth ratio will increase the consumption ratio, resulting in declining savings. The wealth ratio will thus decline until equilibrium is restored. This is an attractive property ensuring balanced growth in consumption, income and net wealth in the longer run.

The consumption and wealth ratios based on private-sector income and wealth, M1, follow each other closely until the late 1990s, after which time the wealth ratio begins to show an upward trend. Consequently, in the model estimation, the parameter estimate of wealth will decline after 1995, and estimated consumption will tend to be too low in the beginning of the period and too high at the end.

M2, which is based on total household wealth, including pension wealth and adjusted household disposable income, has the same problem as M1, in view of the upward trend of the wealth ratio throughout the period.

In M3, which excludes both pension wealth and unlisted equities, the result is an almost stable wealth ratio. However, the increase in the consumption ratio during the boom in 2004-07 was initially somewhat smaller than what the consumption ratio would have warranted, viewed in isolation.

If pension wealth is included at a small weight and the weight of housing wealth correspondingly reduced as in M4, the result is again an almost stable wealth ratio. The comparison of M4 and M3 illustrates that it is difficult to determine the correct weights on the basis of data alone.

The models are estimated formally below. In the first step, a long-run relation is estimated between consumption, income and wealth corres-
Corresponding to the curves in Chart 12. The four models are estimated using an Engle-Granger 2-step procedure, cf. Box 4.

According to the estimations, all four models can be used as empirical long-run equilibrium models, cf. Table 2. The tests of a model as an empirical long-run equilibrium model are, however, weak, so they should not stand alone. Recursive parameter estimates and compliance with the imposed homogeneity constraint can give a better view of the properties and stability.

The homogeneity constraint can clearly be rejected for M1 and M2 (based on a Wald test). This is indicated by the parameter estimates not being stable. In M3, on the other hand, the homogeneity constraint is not rejected, resulting in far more stable parameter estimates. In model M4 it is only just rejected, but the result is sensitive to small changes, e.g. in the estimation period.

On the basis of the above considerations, we opt for model M4. This is an empirical choice. As discussed previously, the information content of

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**CONSUMPTION AND WEALTH RATIOS IN LOGARITHMS**

**Chart 12**

Note: Top left: curves based on disposable income for the private sector adjusted for income in the energy sector and depreciation of the total capital stock. Wealth is based on the calculation of net private-sector wealth, cf. the note to Chart 11. Top right: curves based on adjusted household disposable income (i.e. including D8, cf. Box 2). Wealth is total net household wealth including pension wealth after tax. Bottom left: curves based on household disposable income (i.e. excluding D8). Wealth is total net household wealth excluding pension wealth and unlisted equities. Bottom right: curves based on household disposable income (i.e. excluding D8). Wealth is net household wealth based on adjusted weights.

Source: Own calculations based on data from Statistics Denmark, Danmarks Nationalbank and MONA.
ESTIMATION METHOD

The consumption function is estimated by means of an Engle-Granger 2-step procedure.

The first step is a test of whether a stable long-run relation exists between consumption, income and wealth (i.e. whether cointegration exists). This is achieved by testing whether the residuals from an estimated long-run relation are stationary (critical values from MacKinnon (2010)).

The long-run relation is estimated by means of dynamic OLS, cf. Stock and Watson (1993). The advantage of using dynamic rather than ordinary OLS is that it provides for calculation of asymptotically valid standard deviations, e.g. using HAC Newey-West. Dynamic OLS includes a number, $p$, of leads and lags. We determine $p$ by first setting $p$ at 5 and subsequently eliminating insignificant variables, cf. e.g. Gagnon et al. (2011).

In the second step, the short-run dynamics are estimated using an error correction model (estimated by means of simple OLS), where the quarterly change in consumption is explained by the error correction term (excluding the $p$ leads and lags), which captures the adjustment to the long-run equilibrium 1st lag of the deviation from the long-run model) and a number of short-run variables.

### Long-Run Model for Private Consumption

<table>
<thead>
<tr>
<th>Left-hand side variable: consumption</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>0.83***</td>
<td>0.98***</td>
<td>0.90***</td>
<td>0.92***</td>
</tr>
<tr>
<td>Net wealth, beginning of period</td>
<td>0.17***</td>
<td>0.02***</td>
<td>0.10***</td>
<td>0.08***</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.33***</td>
<td>-0.10***</td>
<td>-0.05***</td>
<td>-0.01***</td>
</tr>
<tr>
<td>$R^2$ adj.</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>AIC</td>
<td>-4.21</td>
<td>-4.28</td>
<td>-4.58</td>
<td>-4.44</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>0.93</td>
<td>0.44</td>
<td>0.51</td>
<td>0.44</td>
</tr>
</tbody>
</table>

**Test for cointegration:**

<table>
<thead>
<tr>
<th>DF test value</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6.78***</td>
<td>-4.78***</td>
<td>-6.06***</td>
<td>-6.16***</td>
<td></td>
</tr>
<tr>
<td>ADF(1) test value</td>
<td>-4.54***</td>
<td>-3.87**</td>
<td>-4.43***</td>
<td>-4.56***</td>
</tr>
<tr>
<td>ADF(2) test value</td>
<td>-3.97**</td>
<td>-3.71**</td>
<td>-3.73**</td>
<td>-3.90**</td>
</tr>
</tbody>
</table>

**Critical test values:**

<table>
<thead>
<tr>
<th>10 per cent</th>
<th>5 per cent</th>
<th>1 per cent</th>
<th>Wald test for homogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.07</td>
<td>-3.07</td>
<td>-3.07</td>
<td>0.00</td>
</tr>
<tr>
<td>-3.38</td>
<td>-3.38</td>
<td>-3.38</td>
<td>0.00</td>
</tr>
<tr>
<td>-3.97</td>
<td>-3.97</td>
<td>-3.97</td>
<td>0.48</td>
</tr>
</tbody>
</table>

**Note:** All variables are in logarithms and are deflated by consumer prices. Estimation period: M1: 1974q1-2011q1, M2: 1974q1-2011q1, M3: and M4: 1973q2-2011q1. Estimated using dynamic OLS, cf. Box 3. Newey-West-calculated standard deviations. * 10 per cent significance level, ** 5 per cent significance level and *** 1 per cent significance level.

**Source:** Own calculations based on data from Statistics Denmark, Danmarks Nationalbank and MONA.
data is not sufficient for clear identification of the correct weights of wealth. For example, the weight of pension wealth could be reduced, while the weight of equity and/or housing wealth is increased equivalently, corresponding to M3.¹

As a robustness check we have tried to apply M3 as a long-run relation. According to the analysis, such changes of the weights have only limited effect on the model properties in the short and medium run.

**From a long-run to a short-run perspective**

In the above model, a long-run relation has been estimated between consumption, income and wealth. In the short run, however, consumption could deviate from the long-run relation, as indicated by a number of factors. We specifically examine the significance of changes in the following variables: unemployment, expected loss of income due to unemployment, inflation, corporate income and real interest rates. In addition, we include five financial variables, which attempt to capture fluctuations in the credit supply, among other things, and three dummy variables, which capture changes in VAT and indirect taxes in the 1970s.

A rise in the unemployment rate increases the risk of being hit by unemployment, which may induce the households to reduce their consumption – applying a precautionary approach – and increase their savings. In order to capture fluctuations in consumer savings resulting from the precautionary approach, the expected loss of income due to unemployment is also included. *A priori*, both variables are expected to have a negative sign.

Inflation may also influence consumption in the short term, e.g. if rising energy prices result in lower fuel consumption beyond the potential effect of falling real income. The sign is expected to be negative *a priori*.

Corporate income is ultimately a gain for households (and foreign owners). The households may thus react to changes in corporate income, meaning that higher corporate income leads to higher consumption.

In the short term, real interest rates may affect consumption via several channels, i.e. the substitution, income and wealth channels. According to the substitution channel, consumption should rise when real interest rates fall, since lower real interest rates make it less attractive to save. The income channel influences consumption via changes in household interest

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¹ Although pension wealth is included with a small weight in consumption-determining wealth in the long-run relation, investment income from pension wealth is not included in income in the short and medium run. The reason is that it is presumably very difficult in the short run to borrow against investment income from pension wealth. Even if it was possible to borrow against it, it is still to a high degree subject to a fixed interest rate and hence not influenced by interest-rate developments. Consequently, the effect on consumption is expected to be very small.
income and expenses and pension payouts when real interest rates change. Finally, via the wealth channel, changes in real interest rates affect the value of wealth (e.g. via changes in house or equity prices).

The estimations capture the income and wealth channels by including income and wealth in the short-run dynamics. Consequently, only the substitution channel is not captured via other variables in the short-run dynamics. The sign of real interest rates in the short-run dynamics should thus be expected to be negative.

Finally, a number of financial variables are examined, which are to capture fluctuations in credit supply, financial innovation and financial liberalisation. According to the life-cycle hypothesis, households will seek to smooth out their consumption over time, but in reality, the households’ scope for smoothing consumption is limited. For a household under a liquidity constraint, i.e. without access to borrow as much as it wants to, current income tends to play a larger role in consumption.

Credit constraints arise as a natural result of asymmetrical information between borrower and lender, among other factors. For instance, the borrower knows his or her own abilities better than the lender. Consequently, the borrower may wish to borrow more than the lender is willing to lend, given the limited information available to the lender. The extent of credit constraints depends on both financial regulation and innovation and the willingness and/or ability of the financial institutions to lend. With a view to identification of the short-run effects of these factors on private consumption we have constructed five financial variables: interest margin, credit mix, loan impairment charges and nominal and real costs of home financing, cf. Box 5.

### Short-run model: estimation results

In the short-run model, the quarterly change in consumption is explained by the error correction term from the long-run model and by the variables described above. In addition, changes in household income and housing wealth are included, bringing the total number of variables to 15, besides the error correction term. The error correction term is included as the deviation from the long-run model lagged one period, thus capturing the adjustment to the long-run equilibrium, while the short-run variables are included with a lag of up to four periods. ¹

In the short term, the following model is estimated:

\[ \Delta \log(\text{consumption}) = \alpha_0 \text{ECM}_{t-1} + \sum_j \alpha_j \text{SR}_i,t + \varepsilon_t \]

¹ A potential simultaneity bias may exist between changes in consumption and income. However, this bias is assessed to be small, so no adjustment has been made accordingly.
CONSTRUCTION OF FOUR CREDIT VARIABLES

Box 5

Interest margin (measure of credit supply)
The first variable is the banks’ interest margin, i.e. the difference between their lending and deposit rates. The interest margin reflects, inter alia, the banks’ earnings, their credit ratings of customers and statutory capital requirements, which makes it an indicator of the banks’ lending capacity. However, the interest margin is also affected by structural factors. For example, as a result of the banks’ restructuring of their interest and fee policies, fees account for a larger share of earnings. This indicates a generally narrowing interest margin. Structural changes are removed by means of an HP filter. The coefficient on the interest margin in the estimated consumption function is expected to have a negative sign.

Credit mix (measure of credit supply)
The second variable is a credit mix, defined as the banks’ share of total lending to households by banks and mortgage banks. The idea is that changes in the credit supply will typically increase the banks’ share of total lending. The reason is that lending by banks is affected by the supply side to a higher degree than lending by mortgage banks. Over time, the credit mix has been influenced by structural changes. A case in point is that it became possible in the late 1980s to borrow against home equity, which has presumably increased lending by mortgage banks relative to lending by banks, while the introduction of mortgage loans in 2004 had the opposite effect. The estimated coefficient on the credit mix is expected to be positive.

Loan impairment charges (measure of credit supply)
The third financial variable is the banks’ impairment charges on outstanding loans and guarantees. The banks’ loan impairment charge ratios affect their ability to meet statutory capital requirements, which has an impact on the banks’ wish to lend and their lending opportunities. The coefficient on the loan impairment charge ratio is expected to have a negative sign.

Cost of home financing (measure of financial liberalisation and innovation)
The fourth and last variable denotes the minimum first-year instalment for financing kr. 100 with an owner-occupied home as collateral. The instalment is very much influenced by financial liberalisation and innovation. Cases in point are statutory requirements regarding mixed loans in the mid-1980s or the introduction of variable-rate loans in 1996. We calculate two variants, i.e. a nominal and a real variant, i.e. adjusted for inflation. The sign of the home financing variables is expected to be negative.

where $ECM$ is the error correction term from the long-run model, and $SR_i$ denotes the 15 short-run variables.

In the model shown (M4 baseline model), the most insignificant lags have been removed, whereby each variable is only included once, cf. Table 3. The model without insignificant variables is shown as model M4. In general, all variables have the expected sign, although there are a few problems with some of the financial variables. The model is well-specified overall, assessed on the basis of common misspecification tests.
The coefficient on the error correction term is highly significant, and around half of a deviation from the equilibrium is eliminated within 3 quarters.

Changes in private-sector income are insignificant, whereas household income is significant. The estimate of the income effect in the short run is, however, relatively small (a short-run propensity to consume of around 0.13, against 0.92 in the long run).

The housing wealth estimate, on the other hand, is relatively large. Hence, a 1 per cent increase in house prices will immediately cause consumption to rise by 0.10-0.14 per cent, i.e. one additional krone of housing wealth will increase consumption in the short run by around kr. 0.04. Part of this short-run effect is due to the fact that rising house prices normally coincide with growing activity in the housing market, cf. Chart 13. A house trade is typically associated with considerable private con-

### Table 3: Short-Run Model for Private Consumption

<table>
<thead>
<tr>
<th>Left-hand side variable: Δlog(consumption)</th>
<th>M4 Baseline model</th>
<th>M4</th>
<th>Propensity to consume</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM_{t-1}</td>
<td>-0.25***</td>
<td>-0.19***</td>
<td>0.92/0.07^1</td>
</tr>
<tr>
<td>Δlog(income_{t, households})</td>
<td>0.15***</td>
<td>0.13**</td>
<td>0.13</td>
</tr>
<tr>
<td>Δlog(income_{t, private sector})</td>
<td>0.01</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Δlog(housing wealth_{t, beginning of period})</td>
<td>0.14***</td>
<td>0.09**</td>
<td>0.04</td>
</tr>
<tr>
<td>Inflation term_{t}</td>
<td>-0.70***</td>
<td>-0.71***</td>
<td></td>
</tr>
<tr>
<td>Δunemployment rate_{t-2}</td>
<td>-0.01***</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Expected loss of income_{t}</td>
<td>-3.11***</td>
<td>-2.25**</td>
<td></td>
</tr>
<tr>
<td>Δreal interest rate_{t-2}</td>
<td>-0.42**</td>
<td>-0.55***</td>
<td></td>
</tr>
<tr>
<td>Interest margin_{t-2}</td>
<td>-0.01***</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Credit mix_{t-2}</td>
<td>0.00</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Loan impairment charges_{t-2}</td>
<td>0.01</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Home financing, real_{t-2}</td>
<td>-0.04</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Home financing, nominal_{t-2}</td>
<td>0.14***</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Dummy (75, Q4 and '76, Q1)</td>
<td>0.03***</td>
<td>0.03***</td>
<td></td>
</tr>
<tr>
<td>Dummy (77, Q3 and Q4)</td>
<td>0.05***</td>
<td>0.05***</td>
<td></td>
</tr>
<tr>
<td>Dummy (78, Q4)</td>
<td>-0.06***</td>
<td>-0.05***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.00*</td>
<td>0.00***</td>
<td></td>
</tr>
<tr>
<td>R^2 adj.</td>
<td>0.57</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td>-5.97</td>
<td>-5.97</td>
<td></td>
</tr>
<tr>
<td>Normality^1</td>
<td>0.21</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Heteroskedasticity^2</td>
<td>0.43</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Autocorrelation^2</td>
<td>0.20</td>
<td>0.50</td>
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</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.27</td>
<td>2.18</td>
<td></td>
</tr>
</tbody>
</table>

Note: Estimation period: 1973q4-2011q2. Estimated using simple OLS. Newey-West standard deviations. * 10 per cent significance level, ** 5 per cent significance level and *** 1 per cent significance level. Normality test: (Jarque-Bera). Heteroskedasticity test: Breusch-Pagan-Godfrey, autocorrelation test: LM-test with 4 lags.

Source: Own calculations.

1. Long-run propensity to consume is 0.92 for income and 0.07 for consumption-determining wealth.
2. P values for misspecification tests.
sumption, e.g. in the form of removal costs, purchase of furniture and refurbishing. Higher turnover in the housing market may thus lead to higher private consumption.

Moreover, changed house prices may influence credit constraints, since higher house prices increase the value of the collateral.

The inflation term is highly significant, but this is due, among other factors, to the inclusion of inflation – measured as the implied deflator for private consumption in the national accounts – on both the left and the right sides of the regression. However, inflation may actually have an impact on real consumption beyond the effect that may be attributable to the fall in real income, so we have chosen to include the inflation term in the consumption function.

Changes in unemployment are not significant, but the expected loss of income is significant. In the short term, households thus increase their savings for precautionary purposes in connection with higher unemployment.

In general, the financial variables have only a negligible impact on consumption, although the interest margin is significant and has the expected sign. Nominal home financing is also significant, but has the wrong sign. However, the weak explanatory power does not mean that financial conditions have no impact on consumption. Instead, it means

\[ \Delta \log(fcp) = \Delta \log(cp) - \Delta \log(pcp). \]

---

1 Consumption in volumes, \( fcp \), is compiled as consumption at current prices, \( cp \), divided by the consumption deflator, \( pcp \), which gives: \( \Delta \log(fcp) = \Delta \log(cp) - \Delta \log(pcp) \).
that the financial conditions influence consumption particularly through income, wealth and interest rates, e.g. via higher house prices or lower interest rates. For example, the introduction of variable-rate loans led to a lower average interest rate payable by the households, while the introduction of deferred amortisation reduced the average housing burden, which may have contributed to rising house prices, cf. Dam et al. (2011).

Changes in real interest rates are strongly significant. A drop in real interest rates by 1 percentage point entails an immediate increase in consumption by around 0.5 per cent in addition to the effect of wealth and income. The household debt ratio has risen strongly over the last 20 years, while the average remaining maturity of outstanding mortgage debt has decreased, cf. Chart 14. As a result, the households have become more sensitive to changes in interest-rates. Nevertheless, recursive coefficient estimates show that the elasticity of interest rates has been very stable over time, meaning that the increased interest-rate sensitivity stems from interest payments in particular, and thus via disposable income and wealth, since house prices have probably become more sensitive to interest rates, cf. Dam et al. (2011).

1 Changes in financial conditions – including the credit supply – may also affect firms, e.g. small and medium-sized enterprises, whereby the financial conditions may influence household income.
The model has generally performed well in predicting consumption both before and after the financial crisis. Overall, the estimated model captures the fluctuations in consumption since 1974, cf. Chart 15 (right). Estimated consumption closely followed actual consumption throughout the boom years before the financial crisis. As a result of stickiness in the adjustment to the estimated long-run relation, the estimated consumption function is not fully able to capture the sharp fall in late 2008, so estimated consumption was higher than actual consumption during most of 2009, cf. Chart 15 (left). Rising house and equity prices in 2009 and 2010 meant that estimated consumption in 2011 and the beginning of 2012 was also higher than actual consumption. The weak development in consumption over the period may reflect that the considerable uncertainty, which characterised the period, caused households to increase their savings for precautionary purposes.

However, as a result of the subsequent house price falls, estimated consumption based on current income, wealth and interest-rate levels is close to actual consumption at end-2012.

MODEL PROPERTIES

In this section, the properties of the consumption function are presented by means of two experiments. In one experiment, all interest rates are raised permanently by 1 percentage point, while the second experiment operates with a temporary increase in house prices by 10 per cent. The experiments are carried out within the framework of a macroeconomic model, i.e. Danmarks Nationalbank’s existing macroeconomic model, MONA. Dynamic effects of shocks to the consumption function can thus be captured, e.g. how higher consumption stimulates income, which in turn increases consumption.
Linking the consumption function to MONA requires construction of a financial submodel for the relations between household income, consumption and savings on the one hand and household wealth on the other hand. The financial submodel is described in Appendix A.

**Interest-rate shocks**

In the interest-rate experiment, all interest rates are assumed to rise by 1 percentage point permanently, compared with the baseline scenario. The assumption that all interest rates rise immediately implies over-estimation of the effect of changes in market interest rates, since the assumption entails immediately higher interest rates also for households with fixed-rate loans. Conversely, over the estimation period, changes in market interest rates are passed through to average interest rates only with a certain lag.

The interest-rate increase reduces private consumption by around 1 per cent relative to the baseline scenario after a few quarters, cf. Chart 16 (top left). Consumption then continues to fall relative to the baseline scenario and is approximately 3.5 per cent lower after five years, compared with the baseline scenario. The decrease in private consumption stems from three channels. Firstly, the substitution channel means that households reduce consumption and increase savings, because the interest-rate increase makes it more attractive to save.

Secondly, private consumption declines as a result of lower consumption-determining wealth for the households (the wealth channel), cf. Chart 16 (bottom left). The drop in wealth is primarily attributable to lower housing wealth, particularly due to lower house prices and to a lesser extent a lower level of gross fixed investment. The interest-rate increase also reduces household borrowing as a result of falling house prices. However, debt is reduced less than housing wealth, resulting in an overall decline in consumption-determining wealth. In the long run wealth will approach the level in the baseline scenario due to lower consumption and higher savings.

Thirdly, household net interest expenses will rise (the income channel), reducing disposable income in the first years after the drop in interest rates, cf. Chart 16 (top right).²

After 10 years, GDP declines by approximately 1.4 per cent relative to the baseline scenario, cf. Chart 16 (bottom right). GDP is affected less than consumption, due to the strong increase in net exports, particularly as a result of falling imports and to a lesser extent rising exports.

² Net interest expenses rise, because the return on pension wealth is not included. The higher interest rates will entail a higher return on pension wealth. This increases pension wealth, which in the long run will lead to higher disposable income, cf. the discussions above.
As mentioned above, an alternative consumption function based on a slightly different weighting of the wealth components will give almost identical empirical properties. Moreover, the model properties also remain virtually unchanged, meaning that the interest-rate experiment will have a near-identical effect on the economy. But the use of private-sector income instead of household income will give markedly different results, unless pension wealth is assumed to be subject to a fixed interest rate. The reason is that higher interest income in the pension funds leads to higher consumption-determining income. However, it seems most natural to let investment income for pension funds impact on households via higher pension payouts, i.e. with a considerable lag and over a longer period, or alternatively to assume that pension wealth is subject to a fixed interest rate.

**Shocks to house prices**

In the housing experiment, house prices rise unexpectedly and temporarily by 10 per cent relative to the baseline scenario. After the initial shock, the development in house prices is determined by the model, whereby prices fall back to their long-run equilibrium.
Immediately after the increase in house prices, household consumption-determining wealth has risen by around 15 per cent, cf. Chart 17 (bottom left), i.e. consumption-determining wealth tends to grow more than the initial increase in housing wealth. This is because housing wealth is larger than consumption-determining wealth, which is calculated net of household financial liabilities.

House prices continue to rise in the first year after the shock, when consumption-determining wealth becomes more than 20 per cent higher than the level in the baseline scenario. As a result of the increase in wealth, 2 years after the house-price rise households will expand consumption by approximately 1.5 per cent relative to the baseline scenario, cf. Chart 17 (top left). The growth in household consumption reduces savings, while borrowing increases as a result of higher house prices. This causes wealth to fall back over time, even to a lower level than in the baseline scenario.

Disposable income will grow a little in the first years after the increase in house prices, cf. Chart 17 (top right), due to stronger economic activity, cf. Chart 17 (bottom right). However, the increase in income is somewhat lower than the increases in both private consumption and GDP,
which can be attributed to higher interest payments due to stronger borrowing.

Around 5 years after the shock to house prices, disposable income starts to fall. Falling to a level below the baseline scenario, it contributes, together with the decrease in wealth, to reducing consumption to a lower level than in the baseline scenario.

In the very long run, household disposable income as well as consumption-determining wealth and private consumption fall back to the level in the baseline scenario, bringing the real economic effect in the very long run of a temporary increase in house prices to zero.

The presented effects on consumption of both the rise in interest rates and the hike in house prices are stronger than in the existing consumption function in MONA, cf. Appendix B.

DEVELOPMENT IN CONSUMPTION BEFORE AND AFTER THE FINANCIAL CRISIS

Consumption before the financial crisis – the role of housing wealth
In the period from end-2003 until end-2007, private consumption rose by almost 4 per cent annually, which is far more than the historical average of around 1.8 per cent in the period 1975-2010. In the same period, house prices rose by approximately 60 per cent, which contributed to the consumption boom. In order to assess the role of house price developments in consumption we have calculated the counterfactual development in consumption, given steady growth in housing wealth from the beginning of 2004 until the beginning of 2010.\(^1\)

The consumption effect of the strong increases in house prices was quite pronounced. Steady growth in housing wealth in 2004-09 would have entailed approximately kr. 25 billion lower private consumption by end-2007, cf. Chart 18 (right), corresponding to almost 1.5 per cent of GDP, while residential investment would have been around kr. 11 billion lower, equivalent to 0.75 per cent of GDP.

Private consumption after the financial crisis – the role of lower interest rates
In the wake of the burst house-price bubble, consumption contracted by almost 6 per cent from the 2nd quarter of 2008 to the 1st quarter of 2009. Since then, private consumption has shown weak development des-

\(^1\) A fixed growth rate has been calculated for the period from the 1st quarter of 2004 to the 4th quarter of 2009, so that actual house prices are hit in the 1st quarter of 2010. This removes the strong house-price increases and subsequent falls.
despite the easing of both fiscal and monetary policies and the strong drop in market interest rates.

In addition to the effects of the strong house price fluctuations, it is interesting to examine the effects on consumption of the interest-rate falls in recent years. From the 2nd quarter of 2009 to end-2012, the 1-year mortgage yield decreased by approximately 2.4 percentage points, cf. Chart 19 (top left). During the same period, household net interest expenses, calculated as the difference between interest paid and interest received, fell from 10.7 per cent to 5.9 per cent of disposable income.¹ From mid-2011, however, net interest expenses did not fall at the same pace as interest rates. One reason is that the higher credit risk premia were not reflected in mortgage yields, which are based on mortgages with homes as collateral.

In order to assess the significance of the drop in interest rates to consumption, the counterfactual development in consumption according to our model is calculated, assuming that all interest rates were constant at the level from the 1st quarter of 2009 to end-2012, cf. Chart 19 (top left), but if the international economic situation remained unchanged.² Thus, the counterfactual experiment shows the development in consumption given a combination of high interest rates and a very weak international economic position.

¹ Interest payments in the national accounts have been calculated according to FISIM, which is an estimate of the share of the interest margin that can be regarded as payment for a service. Consequently, the net expenses shown are slightly lower than the actual net interest expenses. But the development is presumably largely unaffected by FISIM.

² The level of e.g. the 1-year mortgage yield in the 1st quarter of 2009 roughly corresponds to its average level since 2000.
A higher level of interest rates would have led to lower disposable income (higher net interest expenditure) and lower house prices. The calculations show that as a result of the lower interest rates, household disposable income at end-2012 was 7.7 per cent higher than it would otherwise have been, cf. Chart 19 (bottom left), while consumption-determining wealth was almost kr. 350 billion higher than it would otherwise have been.

Hence, via lower interest-rate expenses and higher wealth, the drop in interest rates since 2009 has contributed to cushioning private consumption. Without the drop in interest rates, private consumption at end-2012 would have been approximately kr. 60 billion lower, corresponding to 8.3 per cent, cf. Chart 19 (top right).

**The role of household debt**
The household debt ratio has risen strongly over the last 15 years. Gross household debt has grown from around 200 per cent of disposable income in 2000 to more than 300 per cent at end-2012. Household inter-
est-bearing assets, on the other hand, have not increased, but have remained relatively stable around 90 per cent of disposable income. As a result, interest-bearing net household debt is currently more than 200 per cent of disposable income. At the same time, a far larger share is variable-rate debt today. Overall, this implies that household disposable income is more sensitive to interest rates now than 10-15 years ago. Alternatively, pension wealth can be regarded as fixed-rate wealth, so interest-rate changes will, also in this case, affect household interest expenses in particular and only to a limited extent their interest income.

In order to examine the increase in the interest-rate sensitivity of consumption, we compare the significance of a 1-percentage-point increase in interest rates in 2000 and 2011, respectively. In addition to a rise in gross household debt by around 100 per cent of disposable income, the share of variable-rate mortgages soared from around 0 in 2000 to more than 60 per cent in 2011. The shorter fixed-interest period has increased the pass-through from market rates to the average interest rate on household debt.

The comparison shows that the pass-through to consumption surged from 2000 to 2011, particularly due to the higher interest-bearing net household debt. An interest-rate shock entailing an immediate increase in all interest rates by 1 percentage point in 2011, would have reduced consumption by approximately 3.75 per cent after five years, while a corresponding interest-rate shock in 2000 would have dampened consumption by around 2.20 per cent, cf. Chart 20.

Taking into account that some loans are fixed-rate loans, whereby interest expenses are partly unaffected in the short run, the consumption effect is dampened somewhat.¹ This applies especially to the interest-rate shock in 2000, when consumption after five years would have been reduced by a little more than 1.5 per cent. In 2011, the share of fixed-rate loans was smaller, entailing a contraction of consumption by approximately 3.25 per cent after five years.

The calculated interest-rate sensitivity shows the effect of an isolated change in interest rates. Under normal circumstances, interest rates would be countercyclical, i.e. they rise during an economic upturn and fall during a slowdown. Hence, rising interest rates would typically coincide with strengthened domestic and foreign demand, including stronger growth in consumption.

¹ Specifically, it is assumed that full pass-through from market interest rates to average interest rates on fixed-rate loans takes 10 years, whereas the effect is instantaneous for variable-rate loans. This reflects that a considerable share of homeowners with fixed-interest loans will redeem their loans prematurely when buying and selling a home or remortgaging.
However, the experiment clearly shows that the interest-rate sensitivity of the Danish economy has grown substantially. This has resulted in stronger pass-through from monetary policy and entails that, viewed in isolation, normalisation of the monetary-policy interest rates will have a stronger dampening effect on consumption today than a corresponding increase in interest rates would have had 10 years ago. The higher interest-rate sensitivity emphasises how important it is that financial markets have confidence in the Danish economy.
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APPENDIX A

The financial submodel comprises the household sector only. Consequently, financial flows between the private sector and the other sectors (public sector and rest of the world) are still determined by the existing equations in MONA, and the financial submodel impacts the rest of MONA via private consumption and house prices only. Hence, private-sector investment income will still be determined by private-sector wealth as calculated in MONA. This corresponds to the assumption that households have financial accounts only with the rest of the private sector. However, this is likely to play only a limited role, because in reality the household sector’s financial accounts are especially with the rest of the private sector (particularly banks and pension funds).

The principle of the financial submodel is simple; savings influence wealth and wealth influences income via investment income:

\[ \text{Disp. inc.} - \text{consumption} = \text{savings surplus} + \text{inv.} \]
\[ \Delta \text{net wealth} = \text{savings surplus} + \text{revaluations} + \text{net inv.} \]

The change in net wealth is thus the savings surplus plus revaluations (capital gains/losses) plus net investment (investment less depreciation).

But the financial submodel is complicated by the variety of components in net financial wealth (equities, other financial assets, pension wealth and debt). Hence, the development in each component cannot be determined on the basis of the savings surplus alone.

The changes in debt are therefore determined on the basis of housing wealth via an error correction model, which ensures that the LTV ratio is constant in the long run. The savings surplus and the changes in debt result in an overall investment need, which determines transactions in financial assets.

A positive investment need entails that households increase their holdings of other financial assets, consisting of bank deposits and bonds, and that they increase pension savings (capital pensions). On the other hand, it is assumed that the households do not invest any of the savings surplus in equities, which is approximately in accordance with data from the financial accounts.

Pension wealth (labour-market pensions) is also affected by wage income, since a fixed share of it is contributed to a pension scheme. Moreover, all investment income from pension wealth (after PAL tax) is expected to be reinvested in pension wealth, whereby investment income from pension wealth is not included directly in disposable income. However, pension wealth influences disposable income via pension payouts.
Consumption-determining wealth consists of the sum of equity wealth, other financial assets, pension wealth and housing wealth less debt. Equity wealth is included with a weight of 0.4, pension wealth with 0.2 and housing wealth with 0.8. Consumption-determining wealth influences consumption via two channels, a direct and an indirect channel. The direct channel is via the wealth effect on consumption, while the indirect channel is via investment income, which increases household disposable income. Investment income is determined by wealth size, the level of interest rates and dividend payments (estimated relationships).

Finally, wealth is affected by revaluations. Revaluations have been estimated for pension wealth (determined by equity prices and interest-rate hedging via derivatives), housing wealth (house prices) and equity wealth (equity prices). On the other hand, other financial assets, particularly bank deposits, and debt are assumed to be affected only by transactions, meaning that bond prices, among others, are assumed to be unaffected by interest rates.

The overall financial submodel is outlined in Chart A1.
APPENDIX B

In connection with the interest-rate experiment, there are primarily three reasons why our model results in a more pronounced effect on consumption compared with MONA. Firstly, real interest rates are included directly in our consumption function. It thus captures the substitution effect of the fall in interest rates, which MONA does not.

Secondly, the increase in housing wealth due to the lower interest rates has a stronger impact on consumption-determining wealth in our relation. The reason is that the private-sector wealth ratio in MONA shows an upward trend after 1995 after having been almost stable for a prolonged period. This reduces the estimated coefficient on consumption-determining wealth, resulting in a more marked overall effect on consumption in our relation.

Thirdly, the income effect of the increase in interest rates is negative in our consumption function, whereas it is positive in MONA. This is a consequence of the higher interest expenses for the households as a result of their interest-bearing net debt. In MONA, the income effect of an interest-rate increase is positive, because the private sector has interest-bearing net wealth.

EFFECTS OF INTEREST-RATE INCREASE OF 1 PERCENTAGE POINT

Source: Own calculations.
In connection with the shock to house prices, the stronger consumption effect in our relation can be primarily attributed to the more pronounced wealth effect from housing wealth, compared with MONA.

**EFFECTS OF A 10 PER CENT INCREASE IN HOUSE PRICES**

**Chart B2**

Source: Own calculations.