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The interplay between credit standards and credit demand: Microeconometric evidence from Denmark

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Abstract

This paper analyses the role of bank-specific and business cycle factors in explaining the development of credit standards and loan volumes of the larger Danish banks during the recent financial crisis. The analysis is based on a unique panel data set combining the individual answers from the Danish Bank Lending Survey with bank characteristics such as loan volumes and prices. We find that business cycle variables and the financial soundness of the individual bank are important factors in explaining its credit standards. We also find that credit standards and credit demand play complementary roles for loan developments at the individual bank level. Throughout most of the study period, shocks to credit demand are significantly related to growth in lending. Changes in credit standards have mainly played a role after the collapse of Lehmann Brothers in early 2009, and during the peak of the sovereign debt crisis in late 2011 and early 2012.

Key words: Credit standards, loan growth, bank lending survey.
JEL Classification: E30, E32, E51, G21.

Resumé (Danish summary)

Denne artikel analyserer betydningen af bankspecifikke og konjunkturelle faktorer for udviklingen i kreditstandarder og långivning i de største danske banker i løbet af den seneste finanskrise. Analysen er baseret på et unikt datasæt, som kombinerer bankernes individuelle besvarelser af Nationalbankens udlånsundersøgelse med bankkarakteristika såsom udlånsvolumen og priser. Vi finder, at konjunkturelle variable i kombination med den enkelte banks finansielle styrke har betydning for bankens kreditstandarder. Desuden finder vi, at den enkelte banks kreditstandarder og efterspørgslen hos den enkelte bank har betydning for dens udlånsvækst. I løbet af det meste af den betragtede periode er det primært kreditefterspørgslen, der har betydning for bankernes udlånsvækst, mens ændringer i kreditstandarder primært har haft betydning i begyndelsen af 2009, hvor finanskrisen var på sit højeste, samt under forværringen af den sydeuropæiske gældskrise i slutningen af 2011 og begyndelsen af 2012.

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1. Introduction

Bank lending in Denmark – in particular to enterprises – has decreased considerably since 2008. This is in line with the experience of other developed countries in the wake of the financial crisis. The extent to which this decline in lending can be explained by either reduced demand or tightening of credit standards (i.e. a lower supply of credit) is difficult to assess, since the observed loan volumes are influenced by these two factors simultaneously.

Using micro data from the Danish Bank Lending Survey (BLS), this paper addresses two related questions. First, we investigate which factors matter for banks' lending standards. This part of the paper uses information at bank level from the BLS, joined with data from other sources such as regular reporting for the balance sheet and interest rate statistics and for supervisory purposes. Second, the extent to which growth in lending at the level of individual banks can be explained by supply and demand factors is investigated by panel data techniques.

The simultaneous information on supply and demand conditions is quite a unique feature of bank lending surveys. The empirical approach taken in this paper is novel, in that it combines 'soft' micro data from the survey with 'hard' data, such as information on lending growth, at bank level. Del Giovane *et al.* (2011) takes a related approach to answering our second research question, using Italian data for loans to enterprises (non-financial corporations), while Blaes (2011) does the same using German data. This paper focuses on loans to enterprises as well as to households.

The impact of financial intermediation on the real economy has received substantial focus through the recent decades. The current study contributes to this literature by providing an estimate of the extent to which credit standards of individual banks are influenced by the performance or other characteristics of the bank. We find that weak banks tighten their credit standards disproportionately, and that especially the soundness of a bank in the view of other market participants significantly influences credit standards. For credit standards on loans to households, the impact of bank-specific variables vanishes when controlling for the macroeconomic development, while credit standards on loans to enterprises are influenced by the soundness of the bank as well as the macroeconomic development.

A related contribution of this paper is that we provide an estimate of the relative importance of demand and supply factors for actual growth in lending at the individual bank. The relative contributions from demand and supply factors are often difficult to disentangle because changes may happen simultaneously. We find that both demand and supply factors play a role for loan growth at bank level. Demand shocks experienced by individual banks have the most robust impact on loan growth across model specifications, while supply shocks in some

specifications have a higher impact on loan growth than demand shocks and in other specifications an insignificant impact. An analysis of the relative contribution of demand and supply factors reveals that reduced demand contribute to a reduction in lending to enterprises over most quarters, while supply factors mainly contribute in the beginning of 2009 and late 2011 / early 2012.

An important advantage of the use of micro data is that lending standards and demand can be related to outcomes for the same unit. Studies using a panel of countries such as those included in the BLS for the euro area (e.g. Del Giovane *et al.*, 2010; Maddaloni and Peydró, 2010) face the shortcoming that BLS responses based on answers from only the larger banks are related to aggregate figures such as loan growth for all banks in a country. In the case of Denmark, the population of reporters for the BLS includes mortgage banks as well as large and medium-sized commercial and savings banks. Small banks are not included, and the survey may not be exactly representative for the behaviour of the large number of small Danish banks, which of course influence the aggregate figures. This issue is overcome by the use of data on credit standards and development in loan volumes for the same unit. One additional issue specific to the case of Denmark is the high specialization of the mortgage banks, which only accept loans backed up by real estate as collateral. Because of the differences in funding structure and business model, this paper focuses only on commercial banks and savings banks, and, thus, not mortgage banks[3].

The Danish BLS is relatively new. The first round of the survey relates to the 4th quarter of 2008. This study uses the first 15 rounds of the survey and therefore we are able to assess bank behaviour during and after the 2008 financial crisis. It would clearly be worthwhile to repeat the study when more data from expansionary periods become available.

The remaining part of the paper is structured as follows. Section 2 provides a brief overview of related literature. Section 3 briefly presents the data sources, while section 4 provides a deeper description of data and a graphic analysis of determinants of credit standards. Section 5 presents the econometric methodology, while section 6 and 7 present results on determinants of credit standards and the relative contribution of demand and supply factors for loan growth, respectively. Section 8 provides concluding remarks and directions for future research.

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[3] Some of the large Danish banks have an associated mortgage bank within their group. To the extent possible, those banks may have had an incentive to transfer loans to the mortgage bank to reduce their total exposure following increased regulatory requirements. It is, however, not clear if and how such intra-group substitution will impact the responses to the BLS.

2. Brief review of related literature

Studies which identify factors that determine credit standards have been conducted in relatively few contexts. Calani *et al.* (2010) use micro data from the Chilean BLS to address this question. As part of their analysis of demand and supply elasticities, the authors use individual bank responses to the Chilean BLS joined with a number of bank characteristics to investigate determinants of credit standards. They find that bank characteristics in general are unrelated to credit standards, although the result is not investigated thoroughly, as the question is not the main interest of the paper. Another relevant study is Lown and Morgan (2006), who use macro results from the U.S. Senior Loan Officer Opinion Survey of Bank Lending Practices to show that lending standards are associated with innovations in credit.

A number of studies use other measures of supply side conditions than those from bank lending surveys. One recent example is Dell'Ariccia *et al.* (2012), who find that loan denial rates were lower in areas that experienced faster credit growth and that lenders in the high-growth areas attached less weight to the creditworthiness of the borrowers. Jimenez *et al.* (2006) find that collateral requirements decrease during credit booms.

The strand of literature most closely related to our second research question is concerned with identifying the relative importance of supply and demand conditions for loan growth. A few papers are, like the present, based on bank-level answers to bank lending surveys, joined with bank-level data from other sources. One example is Del Giovane *et al.* (2011), who use an approach to estimating the relative importance of demand and supply factors, which is largely similar to the one used in this paper. They find that both demand and supply played a role for credit developments in Italy between 2002 and 2009, also during the recent crisis. Similar results, albeit with a different lag structure, are found for the development in loans to non-financial corporations in Germany (Blaes, 2011). Calani *et al.* (2010) use bank level answers from the Chilean BLS coupled with additional bank-level and macroeconomic indicators to estimate demand and supply curves.

Using aggregate data from the Euro Area BLS, Ciccarelli *et al.* (2010), investigate the credit channel of monetary policy. For business loans, they find that the impact of monetary policy is larger through the supply channel than through demand, while the opposite is the case for households. De Bondt *et al.* (2010) find that results of the Euro Area BLS can be used as leading indicators for credit and output growth, while Lacroix and Montornès (2010) construct forecasts for lending developments using the aggregate figures from the BLS for France. Maddaloni and Peydró (2010) use the cross-country variation from the national aggregations of the Euro Area BLS to analyse risk-taking and credit standards. They find that low short-term interest rates soften lending standards and increases banks' risk taking.

Finally, this paper is also related to a large body of literature which examines the impact of financial intermediation on the real economy (see e.g. Levine, 2005; Krotzner *et al.*, 2007; Abildgren *et al.*, 2011) and the interactions between economic fluctuations and bank credit (Bernanke and Lown, 1991; Matsuyama, 2007).

3. Data sources

The Danish BLS was introduced in the 4th quarter of 2008. The purpose of the survey is to gain systematic knowledge on developments in credit standards and demand for loans. The survey uses a standardized questionnaire, which is directed to senior loan officials in the reporting banks. The Danish BLS is largely similar to other surveys of this kind, such as the Euro Area BLS and the U.S. Senior Loan Officer Opinion Survey of Bank Lending Practices.

The population of banks reporting to the Danish BLS covers all large and medium sized banks[4] as well as almost all mortgage banks. The total population is approximately 20 banks, with only little variation over time. In this study, attention is restricted to commercial banks and savings banks, due to the fact that the business model and funding structure of mortgage banks differs a lot from that of commercial and savings banks. The number of banks in the sample used in this analysis varies over time between 15 and 17. In the latest survey round, they hold 83 per cent of the Danish bank loans to enterprises and 76 per cent of loans to households (excluding loans from mortgage banks).

The BLS questionnaire covers five main categories of questions:

1. Changes in credit standards
2. Factors contributing to changes in credit standards (financing costs, competitive pressure, risk assessment and willingness to take risk)
3. Changes in terms and conditions (prices, collateral requirements and other terms and conditions)
4. Changes in demand for credit (new and existing customers)
5. Changes in losses and write-offs.

All questions are answered separately for loans to enterprises and loans to households. There are separate questions relating to the development during the past quarter and the expectation for the next quarter. Some of the questions for enterprises additionally distinguish between small- and medium-sized enterprises and larger enterprises.

All questions are answered using a five-point scale, e.g. tightened considerably, tightened somewhat, unchanged, eased somewhat, eased considerably. The individual answers to each question are assigned a score (-100, -50, 0, +50, +100, respectively) which is then aggregated

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[4] All banks included in groups 1 and 2 according to the ranking of banks by size from the Danish FSA are included in the BLS.

using each bank's share of total loans as a weight. Results are published separately for mortgage banks, large banks and medium-sized banks, as well as overall.

CHANGE IN CREDIT STANDARDS AND DEMAND, AND GROWTH IN LOANS TO ENTERPRISES
Figure 1

Note: Credit standards and demand are measured on a scale ranging from -100 (tightened/decreased considerably) to +100 (eased/increased considerably). The quarter-on-quarter loan growth is based on seasonally adjusted loans to enterprises.
Source: Danmarks Nationalbank

CHANGE IN CREDIT STANDARDS AND DEMAND, AND GROWTH IN LOANS TO HOUSEHOLDS
Figure 2

Note: Credit standards and demand are measured on a scale ranging from -100 (tightened/decreased considerably) to +100 (eased/increased considerably). The quarter-on-quarter loan growth is based on seasonally adjusted loans to households.
Source: Danmarks Nationalbank

Figures 1 and 2 show the main results of the BLS, i.e. change in credit standards and demand for loans from enterprises and households, along with the growth in seasonally

adjusted lending. In some periods, a link between loan growth and changes in credit standards and demand seems more plausible than in other. Total lending to households is less influenced by the crisis as growth rates are closer to 0 than those for enterprises throughout the studied period. A number of possible explanations for the observed deviation between loan growth and demand and credit standards as reported in the BLS could be mentioned. First, the restructuring of failed banks, which took place in some quarters in especially 2010 and the first half of 2011, implies that loans to enterprises have declined more than may be explained by factors related to demand and credit standards as reported by the largest banks in the BLS[5]. Second, a part of the decline in loan volumes as reported in the balance sheet statistics can be ascribed to technical reasons, e.g. a few foreign banks having closed their branches in Denmark and transferred the business to books in their home country. Finally, it could be mentioned that some of the larger commercial banks are directly associated with a mortgage bank. In times with pressure to reduce loan exposures, those banks may have an incentive to transfer loans to the associated mortgage bank, where possible. Such intra-group substitution may give rise to a reduction in bank lending which may not be captured by the BLS indicators[6].

This study takes advantage of the individual responses of the BLS. Data from the survey is joined with data from a range of other sources; most notably data that is regularly collected by the authorities for the purposes of banking supervision and compilation of banking statistics.

4. Data characteristics and descriptive evidence

Figure 3 shows the distribution of responses to the three BLS questions on credit standards, which we focus on here, namely changes in overall credit standards, changes in prices and changes in collateral requirements. All bank-quarter observations are pooled in the figure. Banks tightened their credit standards for enterprises in 22 per cent of the observations, while credit standards have been tightened less for loans to households, with only 18 per cent of the observations. It should also be noted that banks have tightened their prices considerably more than what is reflected in their responses to the general question on credit standards. Since prices can be interpreted as a subset of overall credit standards, one interpretation may be that the weight that banks put on prices in their overall assessment of credit standards is relatively low.

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[5] Three banks, which participated in the first rounds of the BLS, have failed in 2009 or 2010. However, a part of their lending is still included in the balance sheet statistics while being liquidated by the state owned entity responsible for resolving failed banks taken over by the state. Other parts of their lending have been moved to a company without banking license, and hence, is therefore no longer included in the statistical figures.
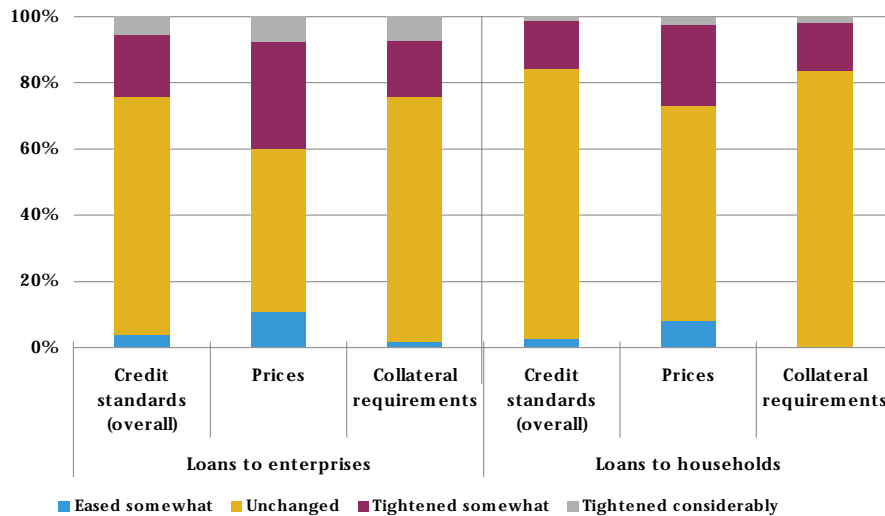
The first part of the analysis is concerned with identification of the determinants of credit standards. We are interested in whether bank-specific variables are correlated with the extent to which a bank tightens its credit standards. Hence, we use as explanatory variables a number of bank-level characteristics, some of which are static and related to the structure of the bank before the crisis, and others are dynamic and varies over time. These variables are initially used in a descriptive analysis. In addition, a number of macroeconomic variables are included in the subsequent econometric analysis to investigate the impact of the general economic situation on credit standards of individual banks. In an economic downturn, the earnings potential of households and enterprises is in general worsened. Hence, a weaker general economic outlook may lead banks to tighten their credit standards as a consequence of their customers' worsened repayment possibilities. The variables used are briefly discussed in the following, along with a number of figures showing their (bivariate) relation with lending standards of individual banks.

First, we use an indicator of loan impairment, namely the quarter-on-quarter change in the write-off ratio (percentage write-offs during the current quarter divided by outstanding loans at the end of the quarter). An increase in the write-off ratio is likely to induce a tightening of credit standards, in order for the bank to reduce the risk exposure. We also include the solvency ratio of the bank and a measure of non-performing loans, namely the quarter-on-quarter change in the loan stock for which interest rate accrual has been suspended. In the

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[6] All major mortgage banks are separately included in the BLS as well, but as noted in the introduction, it is unclear how substitution within large banking groups, if any, affects the BLS responses of the banks and the

models presented later, we use a measure of the capital buffer based on the solvency ratio and the individual solvency requirement.

Figures 4-6 compare the patterns of change in credit standards of individual banks in different groups based on the bank-specific variables described above[7]. All bank-quarter observations are pooled, and subsequently allocated to three groups of equal size based on the given characteristic, say the write-off ratio. This means that a bank need not be in the same group over time as the write-off ratio changes over time for the given bank[8]. From the figures we find that banks with a high growth in their write-off ratio and banks with low solvency have a higher tendency to tighten their credit standards.

CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY CHANGE IN WRITE-OFF RATIO (BY QUARTER)   **Figure 4**
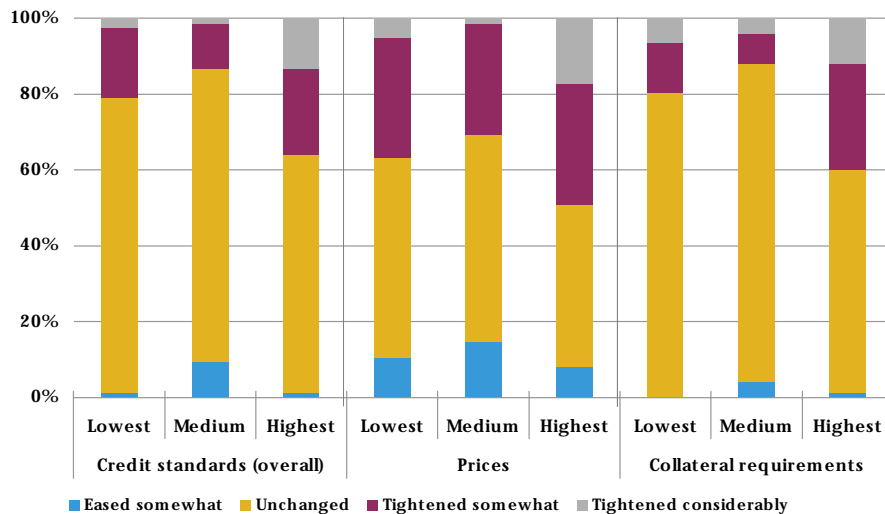
Eased somewhat   Unchanged   Tightened somewhat   Tightened considerably

Note.: All bank-quarter observations are included in the figure. Each observation is allocated to a group based on the change in the write-off ratio. The group allocation is done by splitting the sample into three groups of equal size, containing the bank-quarter observations with the lowest, medium and highest values of the change in write-off ratio, respectively. For example, "highest" in the figure means the group of observations in which banks have experienced the largest increase in write-off ratio.

Source: Own calculations based on the BLS and banks' reporting to the FSA.

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associated mortgage banks.

[7] In this section, only figures relating to loans to enterprises are included. Corresponding figures for loans to households can be found in the appendix.

[8] This approach to graphing the relation between bank specific variables and credit standards can only be used as a partial analysis. To illustrate this point, note that banks may be expected to have higher write-offs in periods with an unfavourable macroeconomic development. Hence, the higher likelihood of a bank tightening its credit standards in the group of bank observations with highest write-off ratios may be caused by more observations from periods with macroeconomic stress being represented in this group. The econometric analysis presented later will provide a more complete view as the effect of bank specific and macroeconomic variables can be estimated at the same time.

**CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY SHARE OF LOANS
WITH INTEREST ACCRUAL SUSPENDED**   **Figure 5**

CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY SOLVENCY RATIO   **Figure 6**

Funding costs are an important indicator of the well-being of individual banks, and therefore we include a measure of the funding costs. The measure is the change in the interest rate spread on intra-MFI deposits, i.e. the interest rate paid on deposits from other MFIs

(excluding central banks) minus the money market interest rate[9]. The variable reflects the creditworthiness of the bank in the view of other banks, and can thus be interpreted as a proxy for the soundness of the bank's operations[10]. It is evident from figure 7 that the creditworthiness of the individual bank is important for the development in its credit standards. The relation is even stronger for the question on prices; in the group of observations with highest funding cost growth, prices are tightened in almost three out of four cases.

CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY CHANGE IN INTER-MFI DEPOSIT RATE SPREAD   Figure 7

Note: All bank-quarter observations are included in the figure. Each observation is allocated to a group based on the change in the inter-MFI deposit rate spread. The group allocation is done by splitting the sample into three groups of equal size, containing the bank-quarter observations with the lowest, medium and highest values of the change in inter-MFI deposit rate spread, respectively. For example, "highest" in the figure means the group of observations in which banks have experienced the largest increase in inter-MFI deposit rate spread. The spread is calculated as the difference between the average interest rate on deposits from other MFIs minus the money market interest rate.

Source: Own calculations based on the BLS and banks' reporting to Danmarks Nationalbank.

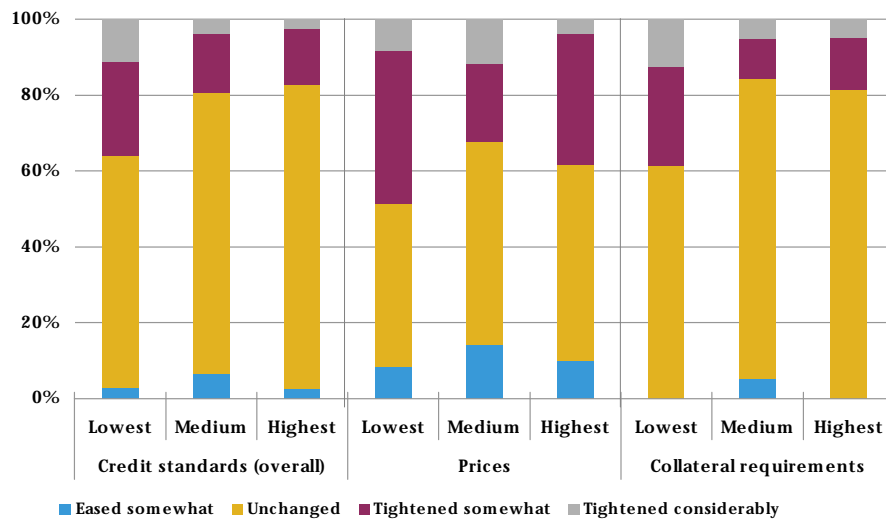In order to learn from the crisis and possibly gain a better understanding of the dynamics between bank behaviour and credit standards, we are interested in analysing the relationship between pre-crisis bank characteristics and subsequent credit standard tightening. Exposure to specific sectors, such as real estate and agriculture, is often mentioned as having an impact on the soundness of individual banks. We represent exposure to specific sectors of the economy

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[9] Inter-MFI rates include existing loans; while money market interest rates are based on new loan offers. In order to avoid that results are driven by large changes in the money market interest rate which are not followed immediately by changes in the inter-MFI rate (e.g. as observed in the first part of 2009), we restrict the change in the inter-MFI interest spread to be in the interval [-2/3;2/3] percentage points. This entails cutting of 5 per cent of the lowest and 9 per cent of the highest values. The results are not sensitive to the exact cut-off point.

[10] One limitation to this interpretation may be, that during the period October 2008 – September 2010, the Danish government guaranteed all deposits in Danish MFI's under the so-called 'Bankpakke 1'. To the extent that lenders perceived this guarantee to be credible, inter-MFI interest rate spreads may not fully reflect the creditworthiness of the bank.

by the fraction of total loans directed to those sectors. No systematic relation between credit standards and exposure to real estate or agriculture can be identified, cf. figure 8. One reason may be that a number of banks with relatively high exposure to, in particular, real estate have failed during the crisis, and hence, only participated in the first periods of the BLS.

CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY PRE-CRISIS SHARE
OF LOANS TO REAL ESTATE (LEFT) AND AGRICULTURE (RIGHT)   Figure 8

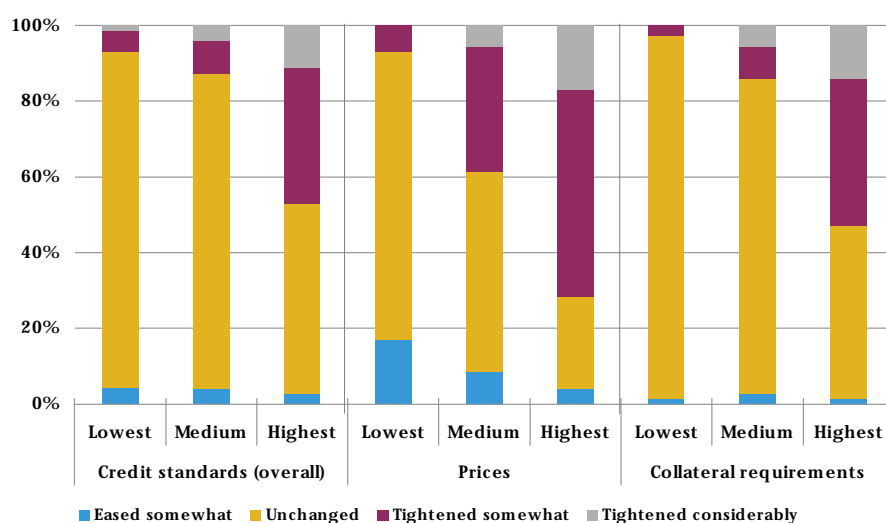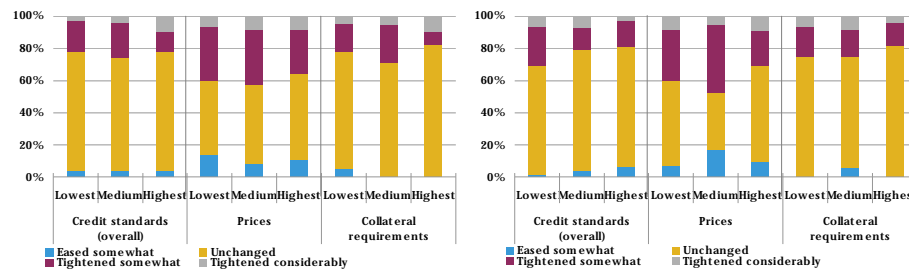

Note: All bank-quarter observations are included in the figure. Each observation is allocated to a group based on the pre-crisis
         share of loans to real estate (left) and agriculture (right). The group allocation is done by splitting the sample into three
         groups of equal size, containing the banks with the lowest, medium and highest values of the share of loans, respectively.
         For example, "highest" in the figure means the group of banks which had the largest pre-crisis share of loans to real
         estate or agriculture.
Source: Own calculations based on the BLS and banks' reporting to Danmarks Nationalbank.

Banks have experienced large growth rates in lending during the pre-crisis years. It could be expected that banks which have experienced the largest growth rates are more in need of cutting back on lending after the crisis. This could be due both to a perhaps poorer average quality of the lending portfolio and to the fact that the worsening of the economic outlook may force those banks to reduce their risk exposure. To determine the importance of pre-crisis loan growth, we use the average growth rate during the years 2005-07. In the econometric analysis, we also include the log of total pre-crisis lending volume to investigate the importance of size for credit standards. Figure 9 shows that the relation between pre-crisis loan growth and credit standards during and after the crisis is not strong. One explanation may be that most banks saw a relatively large increase in their lending in the years before the crisis. And again, the banks which were included in the first rounds of the BLS, but subsequently failed, had relatively large pre-crisis loan growth, a fact which implies that the effect of pre-crisis loan growth on credit standards may be underestimated by the graphical representation in figure 9.
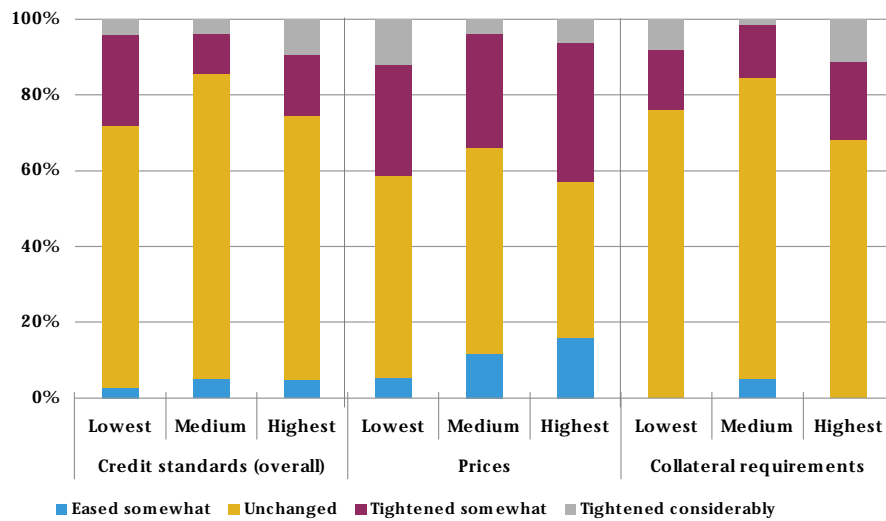
Note: All bank-quarter observations are included in the figure. Each observation is allocated to a group based on the pre-crisis growth rate in lending to enterprises. The group allocation is done by splitting the sample into three groups of equal size, containing the banks with the lowest, medium and highest pre-crisis growth rates in lending to enterprises, respectively. For example, "highest" in the figure means the banks which had the largest pre-crisis growth rate in lending to enterprises.

Source: Own calculations based on the Bank BLS and banks' reporting to Danmarks Nationalbank.

In the econometric analysis that follows, we are interested in the relative importance of macroeconomic and bank-specific factors. We therefore include a few business cycle indicators in the models as well. First, the quarter-on-quarter growth in seasonally adjusted real GDP is included, with the expectation that it is negatively correlated with subsequent credit standard tightening. Second, we include the number of bankruptcy proceedings initiated in the model of credit standards for business loans; and the number of foreclosures in the model for loans to households. Finally, we include the average money market interest rate. Descriptive statistics for the variables used in the econometric analysis are shown in table 1.

5. Econometric strategy

The first part of the analysis is concerned with the identification of factors associated with a tightening of credit standards. A logistic regression model is used for this purpose. As explanatory variables, we include a number of bank-level and macro variables as described above.

Variable	Source	No. of obs.	Mean	Std. Dev.	Min	Max
Quarter-on-quarter growth rates in seasonally adjusted lending						
To enterprises	BSI	213	0.16	7.26	-14.21	51.81
To households	BSI	198	-0.26	6.49	-35.25	54.88
Change in credit standards (enterprises)						
Tightened	BLS	216	0.23	0.42	0.00	1.00
Tightened somewhat	BLS	216	0.17	0.38	0.00	1.00
Tightened substantially	BLS	216	0.06	0.23	0.00	1.00
Eased somewhat	BLS	216	0.04	0.20	0.00	1.00
Tightened prices	BLS	216	0.39	0.49	0.00	1.00
Tightened collateral requirements	BLS	216	0.24	0.43	0.00	1.00
Change in credit standards (households)						
Tightened	BLS	216	0.12	0.32	0.00	1.00
Tightened somewhat	BLS	216	0.12	0.32	0.00	1.00
Tightened substantially	BLS	216	0.01	0.12	0.00	1.00
Eased somewhat	BLS	216	0.03	0.16	0.00	1.00
Tightened prices	BLS	216	0.25	0.43	0.00	1.00
Tightened collateral requirements	BLS	216	0.14	0.35	0.00	1.00
Change in credit demand						
Increased (private)	BLS	216	0.32	0.47	0.00	1.00
Decreased (private)	BLS	216	0.26	0.44	0.00	1.00
Increased (enterprises)	BLS	216	0.36	0.48	0.00	1.00
Decreased (enterprises)	BLS	216	0.35	0.48	0.00	1.00
Time-varying bank-specific variables						
Change in accounts with interest accrual suspended	MIR	211	0.00	0.01	-0.02	0.07
Change in capital buffer (solvency need - solvency ratio)	FSA	213	0.00	0.02	-0.20	0.13
Change in percentage write-offs (pct. points)	FSA	211	0.00	0.02	-0.06	0.16
Change in intra-MFI deposit rate spread (pct. points)	MIR	211	-0.01	0.38	-0.67	0.67
Pre-crisis bank characteristics						
Annual growth in lending 2005-2007 (enterprises) (%)	BSI	215	22.76	14.37	-0.02	50.25
Annual growth in lending 2005-2007 (households) (%)	BSI	215	22.57	8.77	13.22	49.00
Log of total lending, 2007	BSI	215	16.18	1.50	12.34	18.90
Sectoral distribution of loans, 2007 (loans to sector/total loans)						
- Construction	BSI	215	0.03	0.03	0.01	0.14
- Real estate	BSI	215	0.12	0.06	0.01	0.23
- Agriculture	BSI	215	0.06	0.05	0.00	0.16
- Households	BSI	215	0.39	0.16	0.00	0.62
Macroeconomic/business cycle variables						
Q-on-q growth in seasonally adjusted real GDP (%)	DST	216	-0.30	1.09	-2.42	1.26
Q-on-q change in money market interest rate (pct. points)	DN	216	-0.32	0.63	-2.38	0.28
Q-on-q growth in bankruptcy proceedings (%)	DST	216	1.40	8.38	-13.62	21.65
Q-on-q growth in foreclosures (%)	DST	216	1.16	13.50	-23.08	16.22

Sources: BLS: The Danish bank lending survey; BSI: Balance Sheet Statistics, Danmarks Nationalbank; MIR: Monetary Interest Rate Statistics, Danmarks Nationalbank, FSA: Reporting to the Financial Supervisory Authority; DST: Statistics Denmark; DN: Danmarks Nationalbank.

The model takes the following form:

$$P\left(\text{Tight}_{it} = 1 \middle| x_{it}, b_i, m_t\right) = f\left(\alpha + \beta x_{it} + \gamma b_i + \lambda m_t\right) \tag{1}$$

Where Tight_{it} is a dummy variable taking the value 1 if a bank has tightened its credit standards in the quarter and 0 otherwise, f is the logistic function[11], x_{it} is a vector of bank-specific time varying variables (capital buffer, accounts with suspended interest accrual, inter-MFI deposit rate spread), b_i is a vector of pre-crisis bank-specific variables (loan growth, size, sectoral distribution of loans) and m_t is a vector of macroeconomic/business cycle indicators.

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[11] The logistic function is given by $f(z) = \exp(z) / (1 + \exp(z))$

In the second part of the analysis, we investigate the relative importance of supply and demand factors for loan growth, using data from the BLS and regularly reported data from the balance sheet statistics reported to Danmarks Nationalbank. The main model takes the following form:

$$y_{it} = \alpha_i + \delta y_{it-1} + \beta D_{it} + \gamma CS_{it} + \varepsilon_{it} \tag{2}$$

where y_{it} is quarter-on-quarter growth in seasonally adjusted lending, D_{it} is a vector of dummy variables representing changes in demand and CS_{it} is a dummy variable representing tightening of credit standards for bank i in quarter t[12]. In different specifications, we use the responses of the general question on credit standards and the specific questions on factors contributing to tightening of credit standards and changes in specific terms and conditions to represent credit standards. We also test different lags of the variables related to credit standards, to allow for the fact that implementation of decisions on credit standards may not be immediate.

The model is estimated using the fixed effects estimator, which takes advantage of the panel structure of the data by performing a so-called within transformation[13]. The transformation eliminates the bank-specific effect α_i. The model is estimated separately for loans to enterprises and loans to households, with the relevant indicators from the BLS included. We also estimate a version of the model using OLS, where the bank-specific effect α_i is not included. The specification does not include control variables such as macroeconomic indicators, as they may capture both demand and supply side conditions; a fact which would complicate the interpretation of the estimated model. Bank-specific variables are not included either, as the within transformation ensures that bank specific factors are differenced out (as long as their impact does not vary over time).

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[12] Due to the fact that easing of credit standards has only been observed a few times during the history of the Danish BLS, we do not include an indicator of easing.
[13] See e.g. Wooldridge (2002), chapter 10.

Table 2: RESULTS - LOGISTIC REGRESSION MODEL OF CREDIT STANDARDS TIGHTENING

	Loans to enterprises				Loans to households			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time-varying bank-specific variables								
Change in accounts with interest accrual suspended	3.686	3.669	1.595	1.554	1.456	1.989	0.532	0.837
	(3.123)	(2.876)	(2.201)	(1.864)	(1.645)	(2.015)	(1.495)	(1.511)
Change in capital buffer	-3.607*	-3.700	-3.392*	-3.322	-0.985*	-1.328*	-0.402	-0.731
	(1.938)	(2.372)	(2.057)	(2.826)	(0.512)	(0.673)	(0.393)	(0.561)
Change in intra-MFI deposit rate spread	0.425***	0.409***	0.246**	0.223**	0.190***	0.192***	0.0508	0.0515
	(0.0726)	(0.0671)	(0.102)	(0.0967)	(0.0543)	(0.0522)	(0.0540)	(0.0466)
Pre-crisis bank characteristics								
Annual growth in lending 2005-2007†		-0.00565		-0.00259		0.00214		0.00226
		(0.00386)		(0.00500)		(0.00463)		(0.00403)
Log of total lending, 2007		0.0188		-0.00633		0.0166		0.0111
		(0.0234)		(0.0298)		(0.0274)		(0.0237)
Sectoral distribution of loans, 2007 (loans to sector/total loans)								
- Construction		1.929		1.193				
		(1.319)		(1.784)				
- Real estate		0.344		-0.163				
		(0.502)		(0.592)				
- Agriculture		-0.569		-1.095				
		(0.579)		(0.803)				
- Households						0.00214		0.00226
						(0.00463)		(0.00403)
Macroeconomic/business cycle variables								
Q-on-q growth in GDP			-0.110***	-0.111***			-0.0622***	-0.0588***
			(0.0227)	(0.0227)			(0.0221)	(0.0251)
Q-on-q change in money market interest rate			0.0926**	0.0913**			0.0143	0.0130
			(0.0355)	(0.0374)			(0.0274)	(0.0252)
Q-on-q growth in bankruptcy proceedings			0.00896***	0.00907***				
			(0.00238)	(0.00257)				
Q-on-q growth in foreclosures							0.00169	0.00151
							(0.00168)	(0.00123)
Observations	209	209	209	209	194	194	194	194

Marginal effects from logistic regressions. Standard errors in parentheses are clustered at the bank level.

†The variable included in the model refers to the relevant sector only. For example 'Annual growth in lending' in the model for loans to enterprises is the annual growth in lending to enterprises, etc.

Significance of coefficient estimates: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

6. Determinants of credit standards

This section presents the results from the analysis of determinants of credit standards of individual banks. First, we present logistic regression results using the overall credit standards indicator as the dependent variable. We then proceed by using other outcome variables related to credit standards as dependent variables.

The results of the basic logistic regression analysis of determinants of credit standards are shown in table 2. The table is based on the responses to the BLS of individual banks. The figures shown are marginal effects on the probability of reporting a tightening in credit standards for loans to enterprises (left part of the table) and households (right part). All models include a basic set of bank-specific time varying variables. In the second and third column, we include a number of pre-crisis bank-specific characteristics, and a number of macroeconomic variables related to the business cycle, respectively. The fourth column presents results with all variables included in the regression.

Due to insufficient variation in the response variable in some time periods, time dummies can in general not be included in the models. Results for time-varying regressors using the fixed effects logit estimator is qualitatively similar, although the inability to include time-invariant variables makes us prefer the standard logistic regression model with clustered standard errors.

A number of observations can be made from an inspection of table 2. First, it can be noted that a change in the inter-MFI deposit rate spread is significantly related to credit standards. The spread is taken as a proxy for the creditworthiness of the bank, as it measures the price of borrowing from other MFIs. *Ceteris paribus*, the premium required by other banks on lending to a specific bank is increasing with the perceived riskiness of the operations of that bank. The cross-sectional and temporal variation in the inter-MFI deposit rate spread is quite substantial. At the same time, the spread is relatively uncorrelated with pre-crisis bank characteristics, suggesting that it captures an additional (perhaps more forward looking) element of the creditworthiness of a bank. All other things held constant, if the change in the inter-MFI deposit rate spread increases by an inter-quartile range, the probability of the bank tightening its credit standards increases by between 10 and 19 percentage points for lending to enterprises. This is evidence that the funding costs experienced by a bank, which is here interpreted to reflect the soundness of the bank's lending portfolio and operations, has an important impact on credit standards for loans to enterprises.

Another indicator of the financial soundness of a bank is its capital buffer. The variable measuring change in the capital buffer is marginally significant in the models which include only bank-specific explanatory variables, and the sign is as expected: Banks which have recently increased their capital buffers have a lower tendency to tighten credit standards. However, when macroeconomic variables are included, the capital buffer looses significance.

Overall, this points to a conclusion that, when controlling for macroeconomic conditions, and thereby the credit quality of the banks' customers, banks are not setting their credit standards based on their actual capital buffer or solvency ratio. Due to correlation between the capital buffer and the write-off ratio, we do not include both in the same model. Estimates which include the write-off ratio and the actual solvency ratio are not reported in this paper. In general, these results show that the write-off ratio is less related to credit standards than the capital buffer, while replacing the capital buffer with the actual solvency ratio produces largely similar results. Both the capital buffer, which depends on the individual solvency need, and the write-off ratio may be influenced by rules and principles issued by the supervisory authority[14]. The relatively weak impact of the size of the capital buffer on credit standards may in part be due to the comprehensive public support measures implemented in the wake of the financial crisis, most notably capital injections.

Virtually none of the pre-crisis variables that we include in our models are significant. As such, there is no impact of pre-crisis lending growth on the degree of tightening during the crisis. Sectoral lending exposures are not significant either. As previously noted, one explanation may be that a number of banks, which were included in the first rounds of the BLS, subsequently failed. Taken together, those banks were characterized by high pre-crisis loan growth and high exposure to real estate; a fact which may imply that the effect of those variables is underestimated in the models reported in tables 2 and 3.

As for the macroeconomic indicators, we find a significant negative relation between quarter-on-quarter growth in seasonally adjusted GDP and the probability of tightening credit standards. The relationship is economically significant as well. An increase of 1 percentage point in quarterly GDP growth means that the probability of a bank tightening its credit standards for loans to enterprises is reduced by 12 percentage points. For loans to households the impact in terms of marginal effects is approximately half, although it is even more important in relative terms as the baseline probability of tightening is lower for households than for enterprises[15]. A possible explanation could be that the crisis until now mainly has affected enterprises. Compared to the crisis in the early 1990s, households have been relatively less affected by the current crisis, as evidenced by comparatively lower rates of unemployment and foreclosures. It should also be noted that in the models for credit standards for loans to households, the significance of bank-specific variables vanish when macroeconomic conditions are taken into account, suggesting that credit standards for households are less dependent on bank-specific factors.

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[14] In practice, the Danish FSA has tightened rules and practices considerably since 2008. One example is a limitation of the value of agricultural land as collateral, which has forced some banks to increase their write-offs substantially.

Table 3: RESULTS - LOGISTIC REGRESSION MODEL OF CHANGES IN TERMS AND CONDITIONS

	Loans to enterprises		Loans to households	
	(1)	(2)	(3)	(4)
Dependent variable: Tightened	Price	Collateral	Price	Collateral
Time-varying bank-specific variables				
Growth in accounts with interest accrual suspended	2.041	-0.522	3.948	0.0497
	(6.069)	(2.060)	(4.428)	(1.019)
Change in capital buffer	1.349	-1.867*	0.499	-0.0941
	(1.984)	(1.140)	(1.730)	(0.344)
Change in intra-MFI deposit rate spread	0.507***	0.269***	0.349***	0.0966
	(0.161)	(0.0749)	(0.131)	(0.0676)
Pre-crisis bank characteristics				
Annual growth in lending 2005-2007†	0.00943	0.00857***	-0.00717	-0.00578*
	(0.00830)	(0.00327)	(0.00530)	(0.00362)
Log of total lending, 2007	-0.103*	-0.0591**	-0.00501	-0.0148
	(0.0543)	(0.0231)	(0.0234)	(0.0182)
Sectoral distribution of loans, 2007 (loans to sector/total loans)				
- Construction	-1.498	-0.418		
	(4.324)	(1.086)		
- Real estate	-1.780	-1.868***		
	(1.391)	(0.510)		
- Agriculture	-1.625	-1.335***		
	(1.537)	(0.701)		
- Households			0.974***	0.00256
			(0.362)	(0.156)
Macroeconomic/business cycle variables				
Q-on-q growth in GDP	-0.252***	-0.0795***	-0.143***	-0.0582***
	(0.0675)	(0.0359)	(0.0382)	(0.0212)
Q-on-q change in money market interest rate	0.112	0.0185	0.0803	0.0188
	(0.112)	(0.0486)	(0.0591)	(0.0184)
Q-on-q growth in bankruptcy proceedings	0.0164*	0.0115***		
	(0.00954)	(0.00430)		
Q-on-q growth in foreclosures			0.00097	0.00037
			(0.00277)	(0.000927)
Observations	209	209	194	194

Marginal effects from logistic regressions. Standard errors in parentheses are clustered at the bank level. The dependent variable in models (1) and (3) is a dummy for a tightening of prices and in model (2) and (4) for tightening of collateral requirements.
†The variable included in the model refers to the relevant sector only. For example 'Annual growth in lending' in the model for loans to enterprises is the annual growth in lending to enterprises, etc.
Significance of coefficient estimates: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Another business cycle indicator, the quarter-on-quarter growth rate in number of bankruptcy proceedings, turns out significant in the model for loans to enterprises. If the number of bankruptcy proceedings increase by 1 per cent, the probability of a bank tightening its credit standards for loans to businesses increase by approximately 0.7 percentage points. For loans to enterprises the change in the money market interest rate has an impact on credit standards over and above the effect of the inter-MFI interest rate spread.

Banks may change their credit standards in various ways. A tightening could, for example, be implemented by increasing requirements such as those for collateral or credit score of the borrowers, or by increasing prices. While increasing prices could be a strategy to reduce demand for new loans or increase revenue, there is also a higher risk of adverse selection

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[15] As a robustness check, we have also estimated the model for credit standards on loans to households using a house price index instead of GDP growth. Results are qualitatively similar to those using GDP growth.

implied by the use of this strategy[16]. Table 3 presents results of logistic regressions using the BLS indicators of changes in terms and conditions. Specifically, we model the probability of a bank reporting that (1) it has tightened credit standards by increasing its prices, and (2) it has tightened credit standards by increasing collateral requirements[17]. As before, we perform the analysis separately for loans to enterprises and to households, and we use the full set of explanatory variables that were also included in table 2.

As in the case of overall credit standards, it can be noted that the intra-MFI interest rate is significantly related to a tightening of prices. The capital buffer is not related to changes in prices when controlling for the macroeconomic conditions.

Banks with low exposure towards real estate and agriculture have tightened their collateral requirements more than other banks. A possible explanation may be that collateral requirements are relatively well defined for real estate and agriculture whereas such requirements are often more open to negotiation in other sectors.

7. Relations between loan growth and factors related to demand and supply

In this section, we investigate the relative importance of factors related to credit supply and demand for growth in lending at the bank level. In addition, we analyze the relative importance of demand and supply factors for loan growth in Denmark in the period 2009-2012 by comparing the actual loan growth with the estimated loan growth in a counterfactual scenario, in which credit standards and demand are assumed unchanged.

The relatively short time period under study limits the number of observations, and thereby the statistical significance of our results. However, we can gain some insights by considering also the insignificant and marginally significant coefficient estimates.

The main results on determinants of growth in lending to enterprises are presented in table 4. As noted above, we include only measures of supply and demand from the BLS as explanatory variables. The fixed effects estimator eliminates any effect from time-invariant bank-specific factors. All banks in the sample reported a tightening of their credit standards for loans to enterprises in the first period of the BLS, 4th quarter of 2008, a fact which implies that there is no cross-sectional variation in this period. In our preferred model, we therefore exclude this time period from the analysis to ensure that our results are not entirely driven by

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[16] Adverse selection refers to the idea that, as prices are increased, only high-return projects apply for financing. They are often also high-risk, meaning that the overall pool of borrowers may become riskier when prices are increased – and hence, the banks' risk exposure may be increased. See Stiglitz and Weiss (1981) for an early contribution to the literature of adverse selection.

[17] Note that it is not a requirement for a bank to respond that its overall credit standards have changed in order for it to respond that it has tightened its prices or collateral requirements. In the sample the number of observations in which a bank reports having tightened its prices is substantially higher than the number of observations in which a bank reports having tightened its overall credit standards.

TABLE 4: ESTIMATES FROM MODEL OF GROWTH IN LENDING TO ENTERPRISES

	(1)	(2)	(3)	(4)	(5)	(6)
Loan growth (t-1)	0.0800*	0.0783*	0.0799*	0.0138	0.00800	0.00852
	(0.0403)	(0.0438)	(0.0451)	(0.0718)	(0.0726)	(0.0733)
Demand						
Decreased	-2.492**	-2.338**	-2.318**	-2.607**	-2.351*	-2.143
	(0.950)	(1.017)	(0.946)	(1.274)	(1.324)	(1.327)
Increased	-1.030	-0.896	-1.020	-0.973	-0.954	-0.960
	(0.966)	(1.030)	(0.950)	(1.164)	(1.201)	(1.181)
Credit standards tightened						
Overall credit standards	-3.661***			-3.261**		
	(1.007)			(1.420)		
Prices		-0.891			-1.141	
		(0.701)			(1.257)	
Collateral requirements		-1.276			-1.143	
		(0.988)			(1.531)	
Factors contributing to tightening of credit standards						
Cost of capital			-2.177			-2.148
			(1.252)			(1.584)
Competitive pressure			-0.418			-0.403
			(1.369)			(2.545)
Risk assessment			-1.303			-1.531
			(1.128)			(1.734)
Willingness to take risk			0.114			-0.0118
			(1.208)			(2.009)
Constant	1.492*	1.345	1.574*	1.464*	1.449	1.585*
	(0.840)	(0.838)	(0.854)	(0.840)	(0.895)	(0.877)
Estimation method	OLS	OLS	OLS	FE	FE	FE
Observations	196	196	196	196	196	196
Number of banks	17	17	17	17	17	17

Note: Dependent variable: Quarter-on-quarter growth in seasonally adjusted lending to enterprises. Observations from 4th quarter 2008 are excluded. OLS: Ordinary Least Squares. FE: Fixed Effects panel data estimation. Standard errors in parentheses. For OLS estimates, standard errors are clustered at bank level.
*** p<0.01, ** p<0.05, * p<0.1

the extraordinary development experienced by both banks and their clients in this period. Results based on all observations are qualitatively similar, although less strong, cf. table 6.

Growth in lending to enterprises at the bank level is the result of a combination of supply and demand factors. We find in table 4 that banks reporting a reduction in demand experience a loan growth which is around 2.5 percentage points lower than banks which have not experienced a reduction. This result is based on the point estimate of the coefficient representing reduced demand, although the point estimate is not significant in all models.

Also according to table 4, banks which *ceteris paribus* tighten their credit standards in a given quarter experience a reduction in loan growth of slightly more than 3 percentage points, a result which is significant at the 5 per cent level. The coefficient estimates of the other supply side variables in general have the expected signs. The most important finding from the

TABLE 5: ESTIMATES FROM MODEL OF GROWTH IN LENDING TO HOUSEHOLDS

	(1)	(2)	(3)	(4)	(5)	(6)
Loan growth (t-1)	0.0367	0.0286	-0.00685	-0.0579	-0.0577	-0.0579
	(0.0647)	(0.0614)	(0.0559)	(0.0775)	(0.0775)	(0.0764)
Demand						
Decreased	-1.583	-1.263	-1.593*	-1.312	-1.074	-1.153
	(1.028)	(1.092)	(0.816)	(1.221)	(1.217)	(1.231)
Increased	-0.372	-0.430	-0.551	-0.820	-0.867	-0.808
	(0.944)	(0.890)	(0.867)	(1.092)	(1.094)	(1.075)
Credit standards tightened						
Overall credit standards	0.165			0.721		
	(1.057)			(1.893)		
Prizes		-1.399			-1.397	
		(0.853)			(1.344)	
Collateral requirements		-0.476			0.446	
		(2.075)			(1.877)	
Factors contributing to tightening of credit standards						
Cost of capital			-3.008			-2.514
			(1.937)			(2.080)
Competitive pressure			7.198***			6.988**
			(1.728)			(2.899)
Risk assessment			-0.255			-0.499
			(1.584)			(1.761)
Willingness to take risk			-3.660*			-3.701
			(1.820)			(2.299)
Constant	0.624	0.908	1.018	0.655	0.914	1.001
	(0.992)	(0.934)	(0.948)	(0.706)	(0.741)	(0.709)
Estimation method	OLS	OLS	OLS	FE	FE	FE
Observations	182	182	182	182	182	182
Number of banks	16	16	16	16	16	16

Note: Dependent variable: Quarter-on-quarter growth in seasonally adjusted lending to households. Observations from 4th quarter of 2008 are excluded. OLS: Ordinary Least Squares. FE: Fixed Effects panel data estimation. Standard errors in parentheses. For OLS estimates, standard errors are clustered at bank level.
*** p<0.01, ** p<0.05, * p<0.1

inclusion of these variables is that when the cost of capital contributes to a tightening of credit standards, loan growth is reduced by 2 percentage points, although the reduction is not statistically significant. In addition, though also not statistically significant, a tightening of prices is associated with a reduction in loan growth of around 1 percentage point.

Results for growth in lending to households are presented in table 5. They are difficult to interpret, and no clear relations between loan growth and demand and supply factors can be established. One possible explanation is that lending to households is less volatile than lending to enterprises. However, we do find an economically relevant but statistically insignificant relation between credit standards tightening caused by cost of capital, and lower growth in lending. In addition, we find that when banks tighten credit standards because of the actions of competitors, they actually experience a large growth in lending. This result is

TABLE 6: ESTIMATES FROM MODEL OF GROWTH IN LENDING (FULL MODELS)

	Loans to households			Loans to enterprises		
	(1)	(2)	(3)	(4)	(5)	(6)
Loan growth (t-1)	-0.0755	-0.0752	-0.0786	-0.0487	-0.0521	-0.0494
	(0.0742)	(0.0739)	(0.0728)	(0.0751)	(0.0754)	(0.0754)
Demand						
Decreased	-1.319	-1.163	-0.952	-1.866	-1.997	-1.869
	(1.128)	(1.129)	(1.143)	(1.311)	(1.361)	(1.353)
Increased	-1.082	-1.184	-1.138	0.485	0.367	0.211
	(1.051)	(1.053)	(1.036)	(1.181)	(1.205)	(1.188)
Credit standards tightened						
Overall credit standards	-1.159			-0.556		
	(1.486)			(1.296)		
Prices		-0.928			-0.400	
		(1.270)			(1.291)	
Collateral requirements		-0.918			0.540	
		(1.608)			(1.500)	
Factors contributing to tightening of credit standards						
Cost of capital			-2.654			-2.267
			(1.721)			(1.551)
Competitive pressure			4.424**			1.218
			(2.171)			(2.184)
Risk assessment			-0.821			-1.216
			(1.597)			(1.708)
Willingness to take risk			-2.937			2.567
			(1.888)			(1.892)
Constant	0.806	1.025	1.115	0.657	0.655	0.876
	(0.682)	(0.714)	(0.681)	(0.875)	(0.922)	(0.901)
Estimation method	FE	FE	FE	FE	FE	FE
Observations	195	195	195	210	210	210
Number of banks	16	16	16	17	17	17

Note: Dependent variable: Quarter-on-quarter growth in seasonally adjusted lending to households (model 1-3)/enterprises (model 4-6). Fixed Effects panel data estimation. Standard errors in parenthesis.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

statistically significant. One reason may be that, when a tightening is caused by the competitors tightening their credit standards perhaps even more, banks may actually increase their market share in spite of the tightening.

When the observations from the 4th quarter of 2008 are included (table 6), the significant relation between credit standards and loan growth for enterprises vanishes. This is likely to be a result of the fact that all banks tightened their credit standards in 2008, while this does not necessarily have a direct, immediate impact on outstanding loan volumes for all banks. For lending to households, inclusion of the extra observations from 2008 results in the expected negative sign on the coefficient estimate of credit standards, though the relation is still statistically insignificant. Other than that the results are very similar to those reported in table 5.

TABLE 7: ROBUSTNESS CHECK: MODELS OF GROWTH IN LENDING

	Loans to households			Loans to enterprises		
	(1)	(2)	(3)	(4)	(5)	(6)
Loan growth (t-1)	-0.0611	-0.0715	-0.0994	-0.0156	-0.0192	-0.0145
	(0.0824)	(0.0835)	(0.0838)	(0.0750)	(0.0751)	(0.0763)
Demand						
Decreased	-1.198	-0.840	-1.100	-2.931**	-2.720*	-2.572*
	(1.353)	(1.379)	(1.398)	(1.399)	(1.452)	(1.480)
Increased	-0.659	-0.553	-0.573	-1.329	-1.445	-1.421
	(1.164)	(1.172)	(1.158)	(1.254)	(1.260)	(1.267)
Credit standards tightened in this or preceding two periods						
Overall credit standards	0.450			-0.349		
	(1.391)			(1.213)		
Prices		-1.111			-1.217	
		(1.260)			(1.392)	
Collateral requirements		0.262			0.399	
		(1.435)			(1.434)	
Factors contributing to tightening of credit standards in this or preceding two periods						
Cost of capital			-1.306			0.00378
			(1.640)			(1.390)
Competitive pressure			3.485			0.383
			(2.107)			(1.983)
Risk assessment			-0.0424			-1.053
			(1.499)			(1.615)
Willingness to take risk			-2.806			-0.380
			(1.757)			(1.814)
Constant	0.646	0.975	1.268	1.407	1.810*	1.728*
	(0.770)	(0.816)	(0.807)	(0.949)	(1.054)	(1.034)
Estimation method	FE	FE	FE	FE	FE	FE
Observations	170	170	170	183	183	183
Number of banks	16	16	16	17	17	17

Note: Dependent variable: Quarter-on-quarter growth in seasonally adjusted lending to households (model 1-3)/enterprises (model 4-6). Observations from 4th quarter of 2008 are excluded. Fixed Effects panel data estimation. Standard errors in parenthesis.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The fact that there may be a lag between the decision to tighten credit standards and the actual implementation has led to a further analysis of the possible lag structure of impacts of credit standard tightening. Different lag structures have been tested, with the main conclusion being that lagged values of credit standards variables do not significantly contribute to explaining loan growth in the given quarter[18]. The relatively short time period of data is a limitation here, in that the number of observations rapidly decreases when additional lags are introduced[19]. This also has the implication that when lags are included, the significant tightening of credit standards observed for all banks in the first period of the BLS (4th quarter of 2008) is related to the outcomes in different subsequent periods.

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[18] Results are not included in this paper.

In addition, as a robustness check, we test a specification with other definitions of the independent variables, namely dummies for tightening of credit standards and changes in demand within the current or any of the two preceding quarters. Results are presented in table 7. Results are broadly consistent to this robustness check; signs on coefficient estimates are in general the same as those reported in tables 5 and 6, although fewer coefficient estimates are significant.

As a first step towards an assessment of the economic relevance of our results, we estimate the contribution of the changes in demand and credit standards to the loan growth among the banks in the sample. We use the basic specification for loans to enterprises, i.e. model 4 from table 4. As results for households are not statistically significant, this part of the analysis has only been conducted for loans to enterprises.

In practice, we first construct a counterfactual scenario in which credit standards are unchanged during the whole period, but demand is allowed to vary in line with the BLS responses. The predicted loan growth using the estimated coefficients from the basic model is then compared to the fitted values from the regression using the actual responses on credit standards and demand. The exercise is then repeated with demand unchanged during the whole period and credit standards are allowed to vary in line with the BLS responses. Since the estimated coefficient on the indicator of increased demand in the model used for prediction is not statistically significant, we exclude the positive demand shocks from this analysis and consider only negative shocks to demand and supply (credit standards). The results provide an indication of the relative contribution of the changes in demand and credit standards in explaining the decline in loan volumes during the financial crisis.

Figure 10 shows the contribution of demand and supply factors to loan growth for the banks included in the BLS. Both demand and credit standards play a role in explaining loan developments. During the two quarters in which loan volumes declined the most, demand and credit standards are almost equally important, while the decline in loans during most other quarters is primarily driven by demand factors. However, since credit standards were tightened substantially during the beginning of the financial crisis, some enterprises may have found it more difficult to obtain bank financing in the subsequent years as well, and may, partly as a consequence of this, have reduced their demand for credit. A significant part of loan growth cannot be ascribed to changes in demand and supply factors as reflected in the responses to the BLS.

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[19] Blaes (2011), using a rather mechanical approach to determining the 'optimal lag structure', finds that various lags of variables related to credit standards and demand have explanatory power for loan growth at the bank level.

CONTRIBUTION OF NEGATIVE DEMAND SHOCKS AND TIGHTENING OF CREDIT STANDARDS TO QUARTER-ON-QUARTER GROWTH IN LOANS TO ENTERPRISES   Figure 10
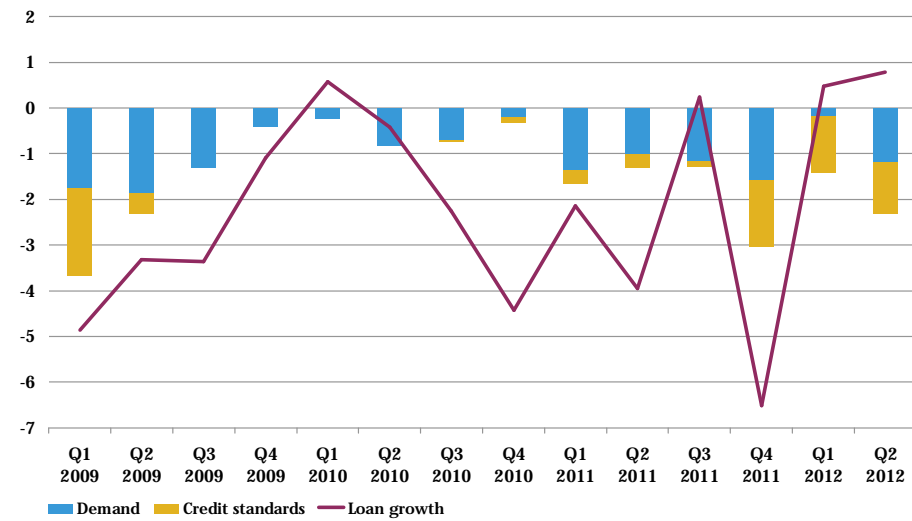
Note: The contributions are calculated as the difference between the fitted values from the estimated regression (Table 4, model 4) and the fitted values obtained by setting the variables measuring reduced demand and tightening of credit standards, respectively, to 0. Results are weighted using the individual banks' outstanding volume of loans to enterprises.
Source: Own calculations based on the BLS and data from Danmarks Nationalbank.

The counterfactual scenario underlines the result that the decline in total lending to enterprises in the studied period is the result of a combination of demand and supply factors. Supply factors mainly played a role in the wake of the collapse of Lehmann Brothers and during the sovereign debt crisis in late 2011 and early 2012, while reduced demand contributed during other periods as well. One interpretation could be that enterprises regularly update their expectations, and derived hereof, their credit demand, while banks change their credit standards at less frequent intervals. A likely implication is that the impact of changes in credit standards has to be seen in a longer time perspective than the impact of changes in demand. A deeper analysis of this hypothesis is left for future research.

8. Concluding remarks and scope for further research

This paper presents micro-based evidence that lending standards are determined in interplay between macro and bank-specific developments. In line with previous macro-based studies, we find that business cycle variables are important for credit standards. In addition, using the individual responses to the Danish BLS, we find that the financial soundness of the individual bank also matters for lending standards, in particular on loans to enterprises. In other words, banks under pressure are more likely to tighten their credit standards over and above the effect of the macroeconomic conditions. Banks have tightened credit standards for enterprises more than for households during the four years studied in this analysis.

In the second part of the analysis, we find that growth in individual bank lending to enterprises and households is in general determined in interplay between demand and supply factors. Based on the estimated model we find that, in the aggregate, demand factors are significantly related to loan growth during the whole sample period, while credit standards are more important for loan growth in the wake of the collapse of Lehmann Brothers and during the sovereign debt crisis in late 2011 and early 2012.

One potential drawback of this study is that time span of data is relatively short. In particular, this means that only one part of the business cycle is covered; we have yet no opportunity to assess bank behaviour in times of higher growth using the Danish BLS. Hence, a replication of the study when more data has become available would be worthwhile. It should also be noted that the sample of banks which participate in the BLS consists of the largest banks in Denmark. As the smaller banks are often more community-based and depend less on market funding, the results of this analysis may slightly overestimate the effect of bank-related factors for growth in lending in the banking sector as a whole. Finally, directions for future research include the extent to which credit standards influence credit demand at the individual enterprise, as well as the dynamics of the impact of credit standards over the business cycle.

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Appendix: Figures on credit standards and related factors for households

This appendix contains figures for loans to households, corresponding to figures 4-9 in section 4.

CHANGE IN BANKS' CREDIT STANDARDS: BANKS GROUPED BY DIFFERENT CHARACTERISTICS

Figure A1
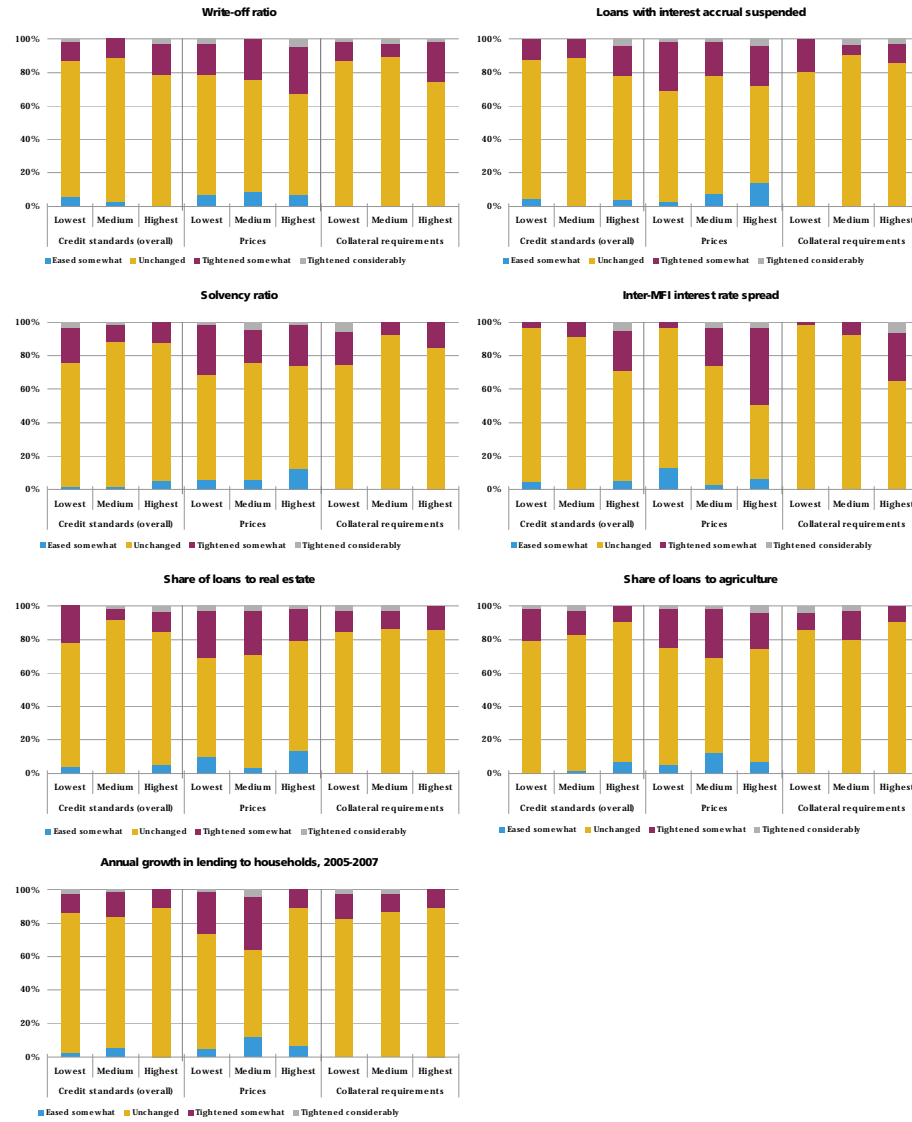
Note: See note to figure 4 in section 4.