STAFF MEMO

Banks' reports of demand and credit standards since 2008: results from Norges Bank's Survey of Bank Lending

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KJERSTI-GRO LINDQUIST, OLAV M.K. MUNDAL, MAGDALENA D. RIISER AND HAAKON SOLHEIM

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Banks' reports of demand and credit standards since 2008: results from Norges Bank's Survey of Bank Lending

Kjersti-Gro Lindquist, Olav M. K. Mundal,
Magdalena D. Riiser og Haakon Solheim*

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Abstract: The article presents the developments in reported demand for credit and credit standards from Norges Bank's Survey of Bank Lending from 2008 until 2016. Norwegian banks have reported substantial tightening of credit standards in this period. Norges Bank's Survey of Bank Lending provides insights into the reasons for this tightening and the manner in which banks have changed their loan conditions. There was a considerable tightening of credit standards for enterprises during the financial crisis, while the tightening of credit standards for households has been more gradual and largely as a response to new requirements and regulations from the authorities. We find that tighter loan conditions for households have affected credit growth in this sector.

1 Introduction

Since 2007 Q4, Norges Bank has conducted a quarterly survey of banks' credit standards and banks' assessments of credit demand. The survey is the only available source providing separate information about both the supply of and demand for bank loans.

Lending surveys have become an important source of information for central banks as an indication of developments in bank lending and are currently used by a number of central banks. The Federal Reserve has conducted its lending survey since 1967, the Bank of Canada since 1999, the Bank of Japan since 2000, the European Central Bank (ECB) since 2003, the Bank of England since 2007 and Danmarks Nationalbank since 2009. These surveys are typically conducted on a quarterly basis and cover lending to households and/or enterprises.

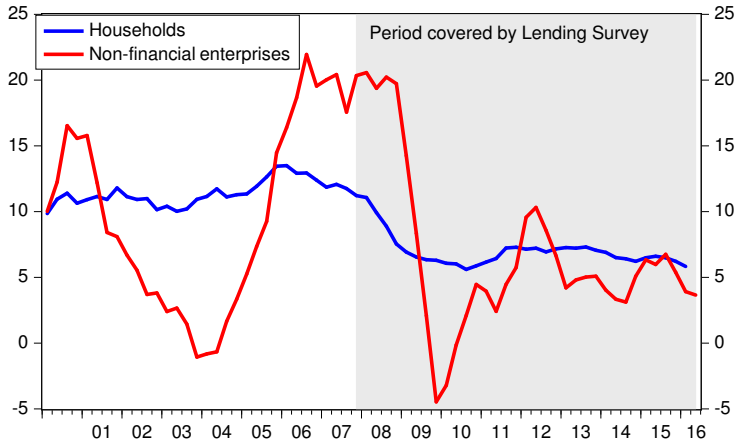
In the wake of the financial crisis, the authorities in Norway and in other countries tightened the rules for banks' capital adequacy and credit standards. Norway has introduced a systemic risk buffer and set minimum requirements for residential mortgage risk weights. Moreover, the authorities have tightened credit quality requirements, especially for mortgage loans. In March 2010, Finanstilsynet (Financial Supervisory Authority of Norway) issued guidelines for prudent residential mortgage lending, which they tightened in December 2011. In July 2015, the Government issued a separate regulation for household lending standards.

There have been considerable changes in credit growth over the period. For households, four-quarter credit growth fell by approximately half between 2007 and 2010; for enterprises the change was even more pronounced (Chart 1).

In line with the regulatory changes, banks have reported substantial changes in credit standards. Changes in the breakdown of credit standards across loan sectors and over time may help us to understand how regulatory changes affect the supply of credit.

In this paper we present the development in banks' demand for credit, changes in credit standards and lending spreads as they have been reported in Norges Bank's Survey of Bank Lending. In Section 2, we provide a brief description of the Survey of Bank Lending. Section 3 examines what banks report regarding changes in demand. In Section 4, we discuss developments in credit standards and their impact on credit growth. Section 5 looks more closely at banks' reported changes in lending spreads.

Chart 1: Four-quarter growth in C2 to non-financial enterprises and households, respectively.[1] Percent. 2000 Q1-2016 Q2



1) Total debt to domestic creditors.
Sources: Statistics Norway and Norges Bank

Section 6 provides a summary. In Appendix A document an empirical analysis of the relationship between credit standards and change in credit growth. Appendix B discusses the driving forces behind changes in credit standards.

2 Norges Bank's Survey of Bank Lending

Norges Bank's Survey of Bank Lending covers the nine largest banks in Norway (eight prior to 2015). The survey covers new lending and is qualitative. It separates between lending to households and non-financial enterprises.

The banks are asked to answer questions within four main categories: demand, credit standards, factors affecting credit standards and loan conditions, including developments in lending spreads.

Respondents are senior loan officers.[1] The banks report whether demand has increased or decreased and whether credit standards and loan conditions have tightened or eased. On each question the banks give a numerical value in whole numbers between -2 and 2. The numbers +/-2 indicate "substantial change", +/-1 "small change" and 0 means "unchanged".[2] Banks are asked about changes over the past three months and expectations for the coming three months.

The survey does not specify exact limits for when a change is large or small. The banks need to make an independent evaluation. However, the survey is followed up with questions and dialogue with the respondents. Nevertheless, it is not given that if banks report tightening at some point, they will also report a corresponding easing if standards return to what they were at the outset.

[1]The respondent should be a credit manager or person with similar responsibilities.

[2]The results published on Norges Bank's website are reported as a weighted index between +/-100. Banks' responses are weighted by the size of their total assets. In this Staff Memo, we have chosen to use the scale +/-2. In practice, this is the published results divided by 50.

The questions in the survey are intended to reflect banks' credit process:

$$Demand \rightarrow Credit\ evaluation \rightarrow Price\ quote \rightarrow Contract \rightarrow Disbursement \quad (1)$$

The process begins when the customer applies for a loan. For households, this will normally be on the customer's initiative. For corporate loans, demand is more complicated - new customers will seek out the bank, but the bank may also actively seek to attract customers. Developments in demand are observable only for the bank itself, which is why the lending survey is a unique source of insight into this process.

When a bank receives a loan application, it will perform a credit evaluation. This evaluation is a function of the bank's credit standards. The bank's credit standards will generally depend on the bank's assessment of economic conditions and current regulations. The lending survey asks both about changes in the bank's overall credit standards, about factors behind changes and about changes in loan conditions. Especially in the event of regulatory changes, we would expect concurrent changes in credit standards and loan conditions across banks.

Once banks have performed a credit evaluation and the loan application meets the requirements, they will offer a price quote. In the lending survey, developments in lending spreads are reported. As we shall return to in Section 5, banks' responses to this question will reflect both developments in their funding costs and changes in the pricing of new loans.

If the customer accepts the bank's offer, a contract is drawn up. However, the delay between signing and disbursement may vary. For household credit the delay is short, normally as little as a week. For construction loans and large corporate loans, the delay may be long - perhaps as long as a year.

3 Developments in demand for credit

The lending survey asks banks to provide an account of developments in credit demand. The individual bank's response shows developments in demand faced by the bank. In the responses, banks look past seasonal variations and focus on changes in demand growth.

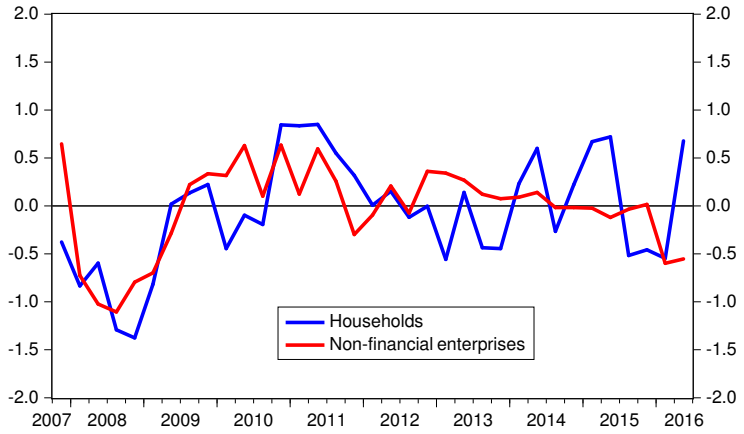
Banks' credit demand is influenced both by developments in general credit demand and how attractive the bank is compared with other banks. We therefore look at the sum of banks' responses to obtain a picture of overall developments in the demand for bank loans from households and non-financial enterprises, respectively.

In the lending survey, banks reported a marked fall in demand from both households and enterprises through 2008 and to the end of the first half of 2009 (Chart 2), after which reported demand has hovered around zero. Developments reflected the fall in observed credit growth between 2007 and 2010 (Chart 1).

3.1 Expected and realised demand

There is generally a high correlation between what banks report regarding expected demand over the next three months and what they report in the following quarter

Chart 2: Reported change in demand for loans from households and non-financial enterprises. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote lower demand.
Sources: Statistics Norway and Norges Bank

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regarding actual demand in the previous three months (Chart 3). The correlation between the responses is 0.64. For households, there appears to be a difference between what banks expect and what they report regarding actual developments in the following quarter, depending on whether demand growth is rising or falling. When demand growth is falling, banks' expectations are more in line with actual developments, while banks appear to underestimate growth expectations when growth is high.

For enterprises, expected growth appears to be a more unbiased estimator of what will be observed in the following quarter, with a correlation of 0.77.

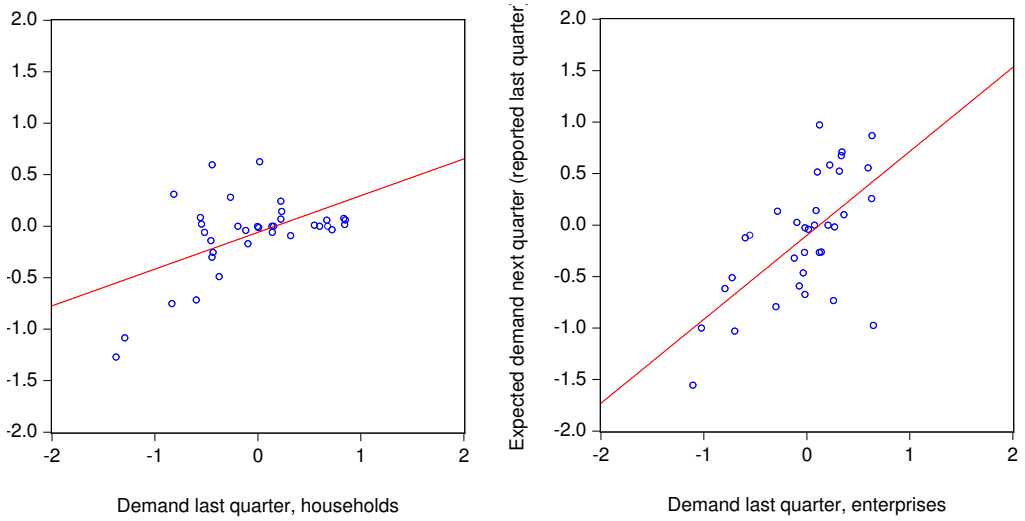
3.2 Demand for various types of loans

The survey divides demand for loans to households into loan types, such as residential mortgage, first-home loan, home equity line of credit and other secured loans. Overall demand and demand for various types of loan secured on real estate largely fluctuate in tandem (Chart 4). The correlation with overall demand is high for all series, between 0.79 and 0.97. The weakest correlation is with first home loans and home equity lines of credit. These loans account for a somewhat smaller share of the total lending portfolio.

For enterprises, the survey distinguishes between demand and the use of credit lines (Chart 5). Credit line utilisation is an alternative to taking out new loans, especially when credit standards are tightened. The use of credit lines picks up in periods of economic weakness and tighter credit standards, such as 2008, 2011-2012 and, to some degree, 2015.

The survey also has a question about the demand for fixed interest loans. Demand for fixed-rate loans appears to vary somewhat more among households than

Chart 3: Correlation between expected demand over the next quarter and observed demand in the following quarter. Simple regression line. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote lower demand.
Sources: Statistics Norway and Norges Bank

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among enterprises. Household demand for fixed interest loans are sensitive to periods when long term interest rates fall, like in 2015, see (Chart 6).

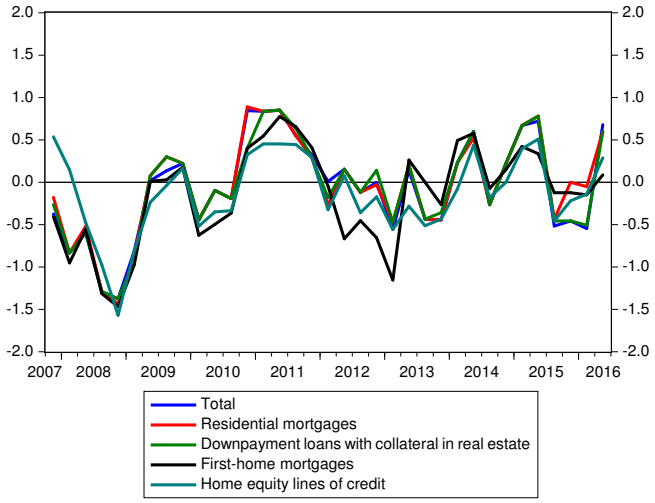
3.3 Reported demand as an indicator of future growth in C2

There is covariation between reported changes in demand from the lending survey and changes in actual lending, represented by C2. We find the highest correlations between C2 households and reported household demand in the same and previous quarter, approximately 0.5 (Table 1). This is in line with the generally short delay between loan application and disbursement for household loans. Somewhat surprising is the low correlation between the demand banks expect in the following quarter and the actual lending growth realised.[3]

Expected demand from non-financial enterprises is highly correlated with actual lending to this sector 2-4 quarters ahead. The time lag between the responses in the lending survey and developments in corporate credit reflects delays between loan approval and disbursement. Banks' expectations regarding future demand for corporate loans also provide a reliable indication of actual credit growth for non-financial enterprises. Highest correlation with C2 is 3-5 quarters ahead.

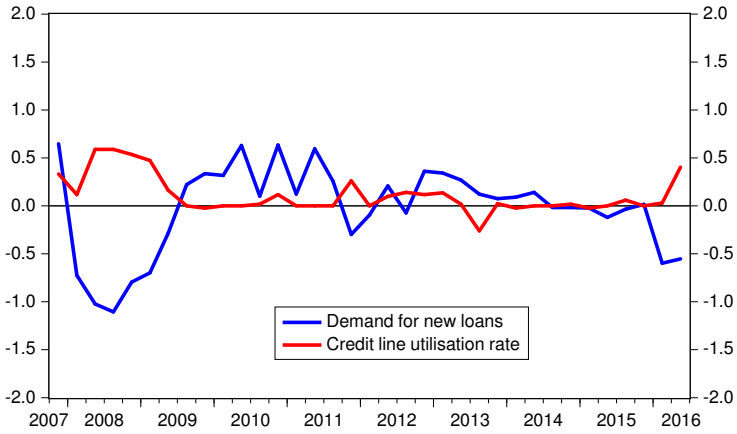
[3]The Survey of Bank Lending provides information on the growth in C2 prior to other data sources, however. Still, as shown in Appendix A, the information on demand from households in the survey does not provide information on household credit growth beyond what is being captures by a well specified model for C2.

Chart 4: Demand for housing-related loans, households. 2007 Q4-2016 Q2[1]



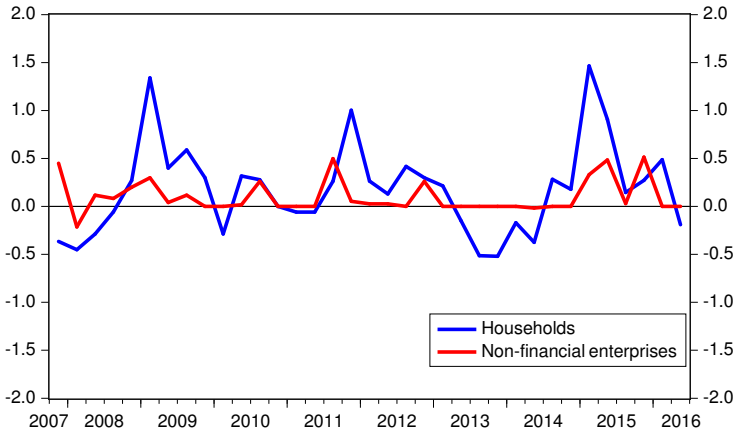
1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote lower demand.
Sources: Statistics Norway and Norges Bank

Chart 5: Demand for new loans and credit line utilisation, non-financial enterprises. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote lower demand.
Sources: Statistics Norway and Norges Bank

Chart 6: Demand for fixed-rate loans. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote lower demand.
Sources: Statistics Norway and Norges Bank

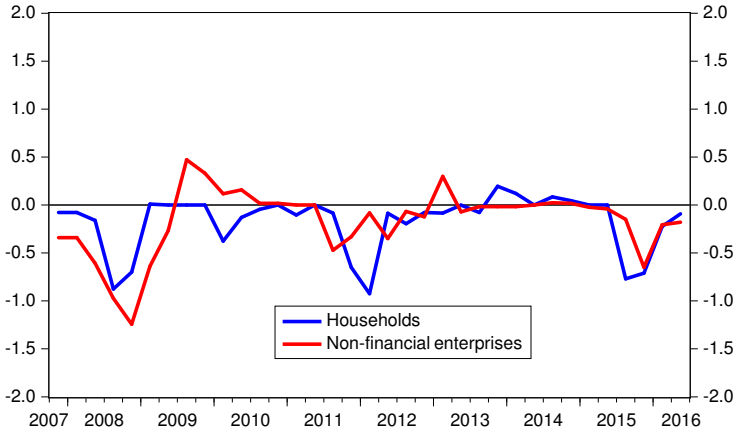
Table 1: Empirical correlation between C2 for households and non-financial enterprises and reported demand in the Survey of Bank Lending. Simultaneous correlation and with reported demand in previous periods. 2007 Q4-2016 Q2[1]

	Demand			
	Actual		Expected	
	House-holds	Enter-prises	House-holds	Enter-prises
t	0.53	0.08		
t-1	0.54	0.34	0.03	0.05
t-2	0.40	0.70	0.19	0.38
t-3	0.23	0.78	0.24	0.67
t-4	0.07	0.59	0.17	0.67
t-5	0.15	0.51	0.07	0.50
t-6	0.12	0.04	0.27	0.23

1) The significance limits at the 5 and 10 percent significance levels are 0.37 and 0.31, respectively.
Sources: Statistics Norway and Norges Bank

4 Developments in credit standards

Chart 7: Developments in overall credit standards. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote tighter credit standards.
Sources: Statistics Norway and Norges Bank

Banks' reported changes in credit standards are an indication of the way banks evaluate loan applications. The extent to which changes in credit standards affect debt growth is discussed further in Section 4.3.

In general, banks have reported more tightening than easing of credit standards (Chart 7). The most pronounced tightening for non-financial enterprises was in 2008, and in 2011-2012 and in 2015, banks reported the most pronounced tightening for households.

4.1 Drivers of changes in credit standards

When the lending survey was designed, it was thought that formulation of credit standards could be understood as a two-step process:

1. There are a number of external shocks–factors–that affect how banks evaluate the risk of loans.

2. These lead to changes in the conditions banks set on loans.

In the lending survey, a choice was therefore made to distinguish between factors affecting credit standards and loan conditions, if any, that have been changed. Banks have six response alternatives to the question concerning factors affecting credit standards (seven for enterprises):

1. Economic outlook (for enterprises also the sector-specific outlook)

2. Bank's appetite for risk

3. Market share objectives

4. Funding

5. Capital adequacy

6. Default

Some of these questions are related to banks' choice of business model, while funding and capital adequacy typically depend on the market or are affected by regulation. It has been shown in practice that banks seldom report that market share objectives have affected their credit standards. This may suggest that banks focus on profitability over market share when performing credit evaluations.

Banks have five response alternatives to the question concerning changes in loan conditions:

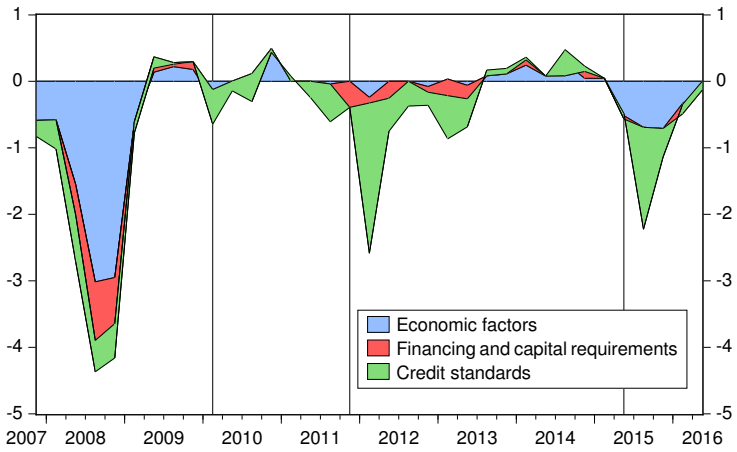
1. Two questions concerning collateral requirements:
   (a) For households: maximum loan-to-value (LTV) and loan-to-income (LTI) ratios
   (b) For enterprises: collateral and equity requirements
2. Two questions concerning repayment:
   (a) Maximum loan maturity
   (b) Use of interest-only periods
3. Commissions/fees

Many of these conditions are affected by recommendations and regulatory measures from the authorities. In the period we are examining, this has especially been the case for household loans.

Distinguishing in practice between factors and conditions in this manner has proved to be difficult. Changes in conditions are often a result of regulatory changes, like the new regulation on lending practices from the FSA. This becomes a separate contribution from the factors.We therefore found it most useful to look at factors and conditions together when assessing the change in credit standards (see Appendix B for more information). When presenting a decomposition of credit standards, we divide factors into three main categories:

1. Economic factors (including the economic outlook, default, bank's appetite for risk and market share objectives)
2. Funding and capital adequacy [4]
3. Loan conditions (including collateral requirements, repayment and fees).

Chart 8: Decomposition of changes in credit standards, loans to households. 2007 Q4-2016 Q2[1]



1) The banks respond to a number of questions on a scale of +/-2. The responses to each question are aggregated using the size of banks' balance sheets as weights. The chart shows the sum of the aggregated responses to each question. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

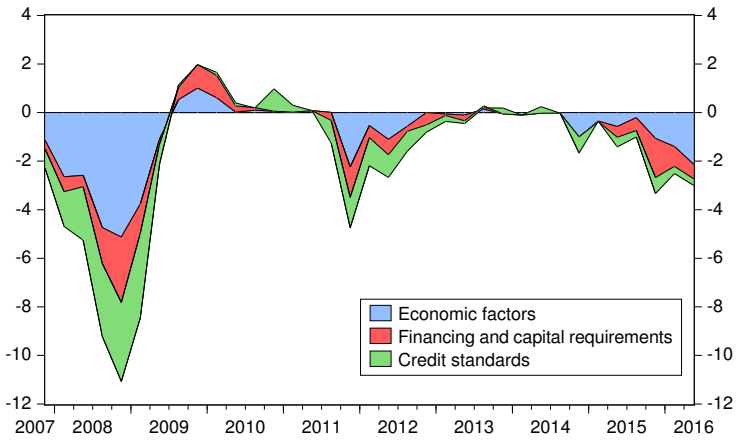
Economic factors were the most important drivers of tightening during the financial crisis in 2008-2009 and after the fall in oil prices towards the end of 2014. This applies both to households and to non-financial enterprises (Charts 8 and 9). Economic factors also explained tighter credit standards for non-financial enterprises in 2011-2012. In general, economic factors are important for non-financial enterprises than for households (Chart 10).

Capital adequacy and access to funding had a tightening effect on loans to households in 2008 and, to a somewhat lesser degree, in 2011-2012 (Chart 8). The years 2011-2012 was a period when new capital requirements and risk weights for loans to households were announced. Nevertheless, bank funding and banks' capital requirements are more important for evaluating loans to non- financial enterprises than for loans to households (Chart 11). In 2008, 2011-2012 and 2015, banks reported that capital requirements and funding had a tightening effect on corporate lending. This probably reflects the fact that residential mortgages tie up less capital for banks than corporate loans and are therefore not affected to the same degree by changes in capital adequacy regulations.

Much of the tightening of credit standards for households is due to tighter loan conditions (Chart 8). In periods when Finanstilsynet published new requirements for residential mortgages, banks reported tighter loan conditions. Conditions for loans to non-financial enterprises were substantially tightened during the financial crisis and to some extent eased after the crisis. There was a new round of tightening in connection with the market turbulence in 2011-2012 (Chart 12).

[4]Note that the question concerning capital adequacy was first included in the survey in 2009.

Chart 9: Decomposition of changes in credit standards, loans to non-financial enterprises. 2007 Q4-2016 Q2[1]



1) The banks respond to a number of questions on a scale of +/-2. The responses to each question are aggregated using the size of banks' balance sheets as weights. The chart shows the sum of the aggregated responses to each question. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

Growth in corporate lending has historically fluctuated more than growth in household lending (Chart 1). Much of this may reflect fluctuations in corporate credit demand, but there are also more pronounced impacts on banks' credit standards for enterprises than for households. The results indicate that the supply of credit to enterprises shifts more over the economic cycle than the supply of credit to households.

4.2 Loan conditions

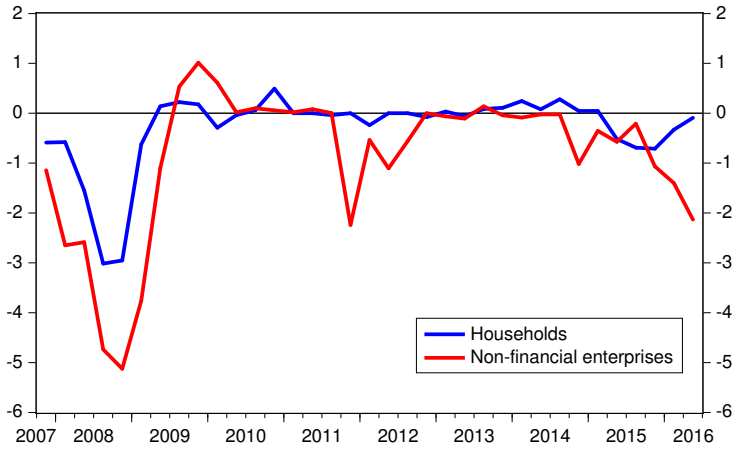
To compare the relative importance of changes in different loan conditions, we look at how they have accumulated over time by summing effects from quarter to quarter.

We notice that when we look at the responses over time, the lending survey indicates a more pronounced tightening for non-financial enterprises than for households (Chart 13). This primarily reflects the responses during the financial crisis in 2008-09. At that time, there was a considerable tightening of loan conditions for non-financial enterprises, while banks reported little tightening of conditions on loans to households in this period.

After 2009, there has been a gradual tightening for both sectors. For households, LTV requirements and use of interest-only periods dominate, while adjustments in maximum loan maturity is of little importance for loans to households.

For non-financial enterprises, the use of fees is the most important single condition that banks change. Equity and collateral requirements have also been tightened. Use of interest-only periods means little for corporate loans, while changes in loan maturity mean more.

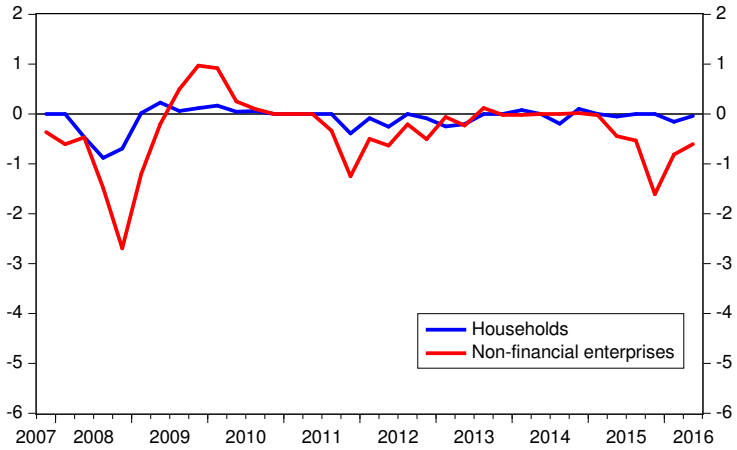
Chart 10: Economic factors. 2007 Q4-2016 Q2[1]



1) The banks respond to a number of questions on a scale of +/-2. The responses to each question are aggregated using the size of banks' balance sheets as weights. The chart shows the sum of the aggregated responses to each question. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

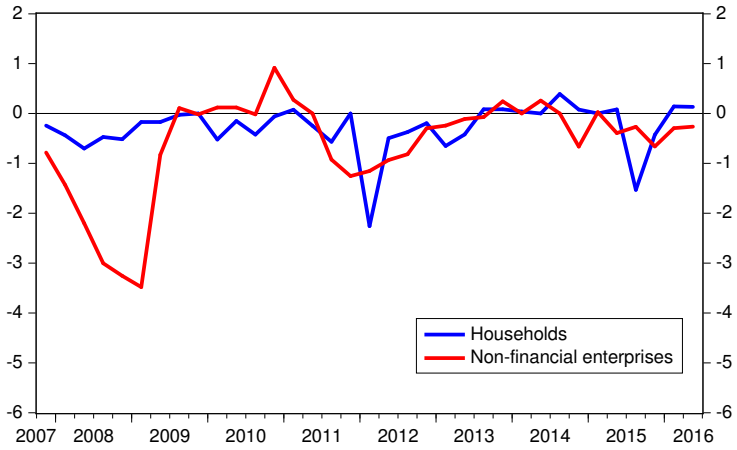
Chart 11: Capital requirements and funding. 2007 Q4-2016 Q2[1]



1) The banks respond to a number of questions on a scale of +/-2. The responses to each question are aggregated using the size of banks' balance sheets as weights. The chart shows the sum of the aggregated responses to each question. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

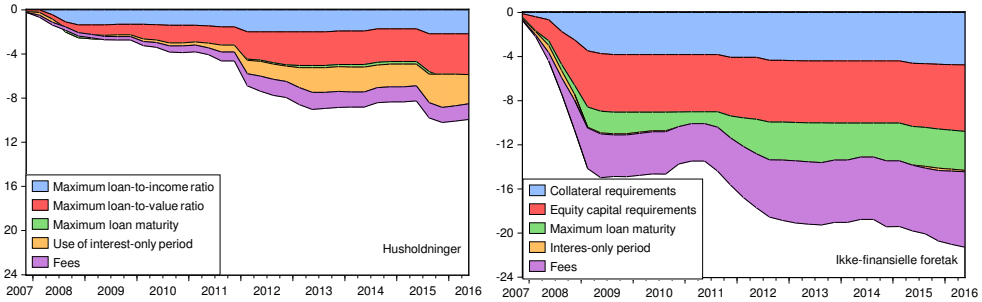
Chart 12: Conditions on loans to households. 2007 Q4-2016 Q2[1]



1) The banks respond to a number of questions on a scale of +/-2. The responses to each question are aggregated using the size of banks' balance sheets as weights. The chart shows the sum of the aggregated responses to each question. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

Chart 13: Loan conditions. Cumulative responses. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote tighter credit standards.

Sources: Statistics Norway and Norges Bank

4.3 Do changes in credit standards affect household credit growth?

The information about credit standards give important information about banks supply of capital. It gives insight in the internal processes in the banking system, and as we saw in Section 3.3 early information about the development of credit. It is of particular interest to know whether the lending survey provides information beyond that reflected in other sources - whether the lending survey provides a unique range of information.

To elucidate this, we begin with an estimated model of household credit.[5] Then we assess whether variables from the lending survey can help to explain what our model cannot explain, ie the error terms. The credit equation is based on standard theory and earlier studies of Norwegian data[6] where household credit is explained by developments in household income, interest rates and house prices or housing wealth.

The model is estimated on quarterly data over the period 1996 Q2 - 2016 Q1. The estimated relation is given in Appendix A. The error terms from the estimated model pass the standard test of their properties and non-stationarity is rejected. A test of whether the error term process can be explained with the aid of a variable from the lending survey is therefore a strict test of the extent to which the survey has explanatory power beyond the variables already included.

We have regressed the error terms from the estimated credit equation on "Change in demand", "Change in credit standards" and loan conditions included in banks' credit standards separately and simultaneously. The variables are included with up to six time lags.[7]

We find that banks' reported change in demand generally has no added value compared with the credit equation. The greatest value associated with asking about demand therefore appears to be that this information is available before all the variables included in the credit equation, as well as credit growth itself, are observable.

On the other hand, change in credit standards has explanatory power for developments in household credit growth beyond the other variables. There is a particularly strong correlation between the error term and changes in the loan condition maximum loan-to-value ratio and loan maturity.[8] The significance of the maximum loan-to-value condition probably reflects the relatively substantial weight given to this condition in new residential mortgage regulation. We obtain the most additional information if we use the variable without a time lag.

These findings support the assumption that changes in credit standards affect credit growth both immediately and with some time lag. This also provides support for using the lending survey as an indicator of household credit and as a cross-check

[5] We are only able to make this analysis for the household sector. For non-financial enterprises we can not identify a stable credit relationship necessary to do similar analysis.

[6] See Jacobsen, D.H. og B.E. Naug (2004), Akram, Q.F. (2014) og Anundsen, A.K. and E. Jansen (2013).

[7] See Section 3.3.

[8] There is also a strong correlation with changes in maximum loan maturity (Table 2). But, since this is an alternative little used by banks, we are more uncertain about how strongly this result would persist as we obtain more observations over which to estimate.

of other available information on credit developments.

5 Lending spreads

The lending survey includes a question concerning developments in margins on loans.

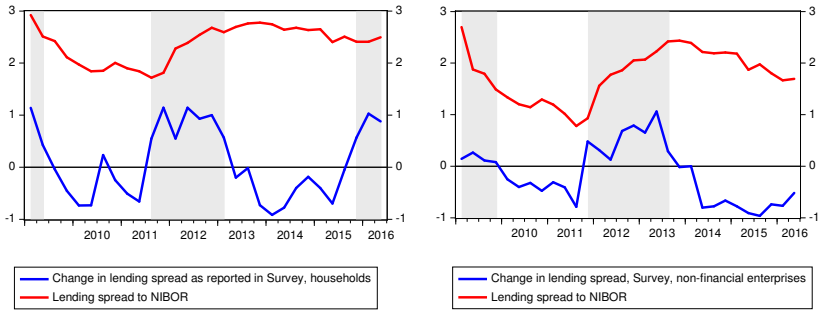
Statistics Norway defines the lending spread as the difference between the average lending rate and the three-month Nibor reference rate. However, for banks, Nibor does not provide a representative picture of their funding cost. On the other hand, it is common for many corporate loans to be priced in the form of a margin over Nibor.[9]

The Lending Survey reported increasing interest margins for both households and non-financial enterprises in 2009 and in 2011-2013. In 2009 the actual interest margins were decreasing, but from a high level, see Chart 14. However, in 2011-2013 the margins are increasing in line with banks' reports. This was a period with a sharp increase in banks' funding margins over NIBOR. Banks needed to increase interest rates to cover funding costs. This is reflected in the increasing margins to NIBOR.

In 2016 banks have reported about a reprising of loans to non-financial enterprises. So far this has not been reflected in observed lending spreads over NIBOR[10]

The lending survey indicates that interest margins have increased less for households than for non-financial enterprises. This change is in line with reported spreads. The results may reflect more competition in the market for loans to households.

Chart 14: Reported changes in lending spreads in the Survey of Bank Lending[1] and lending spreads to NIBOR[2]. 2007 Q4-2016 Q2



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote tighter higher lending spreads.

2) In percentages.

Sources: Statistics Norway and Norges Bank

[9]Banks will look at both the spread towards NIBOR and towards funding cost. Over time the spreads will depend on the definition chosen, but changes in reported lending spreads and changes in spreads to NIBOR or funding costs will often come together in time.

[10]However lending spreads to funding costs seems to have increased more than the spreads to NIBOR.

6 Summary

The Norges Bank Survey of Bank Lending provides insights into banks' credit process that cannot be derived from other sources. It is thus a useful tool for understanding the driving forces that affect banks and how banks respond. At the same time, it has limitations. For example, it captures to a limited extent information about competition conditions and banks' pricing of credit.

Since 2008, banks have reported changes in both demand and credit standards. Demand for credit fell sharply in 2008-2009, but has since picked up. Credit standards were also tightened considerably in 2008-2009, but this tightening does not appear to have been reversed appreciably in the following years. For households, loan conditions have been gradually tightened also after 2009.

Tighter credit standards coincide with periods of lower credit growth. The survey provides information about credit growth beyond what we find in a standard macroeconomic analysis of credit growth, but so far, we have not found permanent effects of tighter credit standards on credit growth.

The lending survey has proved to be a useful information source. After eight years of conducting the survey, we have a better understanding of what information the survey provides - and does not provide. This experience will be useful when interpreting the survey in the period ahead. The lending survey's most important contribution is that it provides qualitative supplementary information about banks and borrower behaviour that other sources do not provide. It helps to elucidate developments in credit. In a downturn, it will be particularly important to understand whether a decline in credit growth is due to lower household and corporate demand or to a tighter supply of credit on the part of banks.

A Model for household credit growth

In our general model, we use variables in real terms. We estimate the following general model[11,12]:

$$\begin{aligned}\Delta log\left(\frac{C2H}{CPI}\right)_t = \alpha_0 &+ \sum_{i=1}^{2}\beta_i \Delta log\left(\frac{C2H}{CPI}\right)_{t-i} + \sum_{j=0}^{1}\beta_{wj}\Delta log\left(\frac{WI}{CPI}\right)_{t-j} \\ &+ \sum_{j=0}^{1}\beta_{pj}\Delta log\left(\frac{PHN}{CPI}\right)_{t-j} + \sum_{j=0}^{1}\beta_{rj}\Delta(IH-\Delta_4 CPI)_{t-j} \\ &+ \left[\alpha_1 log\left(\frac{C2H}{CPI}\right)_{t-1} + \alpha_2 log\left(\frac{WI}{CPI}\right)_{t-1}\right. \\ &\left. + \alpha_3 log\left(\frac{PHN}{CPI}\right)_{t-1} + \alpha_4(1-0,28)(IH-\Delta_4 CPI)_{t-1}\right] + \epsilon_t\end{aligned} \tag{2}$$

where *log* indicates the logarithm, Δ indicates the difference, Δ_4 indicates four-quarter growth and ϵ is the error term in the regression.

- $C2H$ = C2 households (credit outstanding)
- CPI = Consumer price index, 1998=1
- WI = Total wages paid
- PHN = House price index
- IH = Lending rate from banks and mortgage companies, loans to households
- (1-0.28) compensates for the tax deduction for interest on debt

According to the estimated model (Table 3), the level of real household credit is determined by households' real wage income, real house prices and the after-tax real interest rate in the long run.[13] The long-run part of the model is given within the brackets. We have imposed a restriction between credit and house prices so that a 1 percent increase in house prices results in a 1 percent increase in credit in

[11]The ADF test with a constant term rejects H0 of non-stationarity for the first difference of real credit (***), real wages (**), real house-prices (*), the nominal interest rate (*) and the real interest rate (*). Where *, ** and *** stand for the 1, 5 and 10 percent significance level, respectively, over the analysis period 1996 Q4 - 2016 Q1.

[12]The model includes seasonal dummies for Q2 and Q3. DUM2003Q12 is -1 in 2003 Q1 and 1 in 2003 Q2. Without this correction, the equation has problems with autocorrelation. Owing to the persistence of some large error terms, we have used a robust least squares method. A Granger causality test of unlagged real wage levels shows that contemporary causality from the left-side variable is not a problem.

[13]We choose to use wages as an income variable since the interest rate is included in disposable income at the same time as it is included as a separate variable in the model. Housing wealth varies considerably with house prices, and we have chosen to include house prices as an explanatory variable.

the long run.[14] The short-run part of the model shows that credit growth depends on the previous period's credit growth, real wage growth, changes in the nominal interest rate and the departure from the long-run solution in the previous period.

Table 2 shows results from regressions of the error terms from the estimated model in Table 3 against variables in the lending survey.[15] The lending survey begins in 2007 Q4, ie at the beginning of the financial crisis, and banks tightened credit standards in 2008. We have chosen to start the second part of the regression analysis both in 2008 Q1, with allows one time lag, and in 2009 Q1. In connection with the latter period, we avoid having particular aspects of the financial crisis dominate the analysis of the lending survey's explanatory power, but at the same time, these results may be weaker than the real outcome.

Table 2: Lending survey's explanatory power for the error terms from the model for household credit[1]

	2008 Q1 - 2016 Q2				2009 Q1 - 2016 Q1			
	t	t-1	t and t-1		t	t-1	t and t-1	
			t	t-1			t	t-1
Change in demand	0.12	0.99	0.05*	0.28	0.20	0.91	0.14	0.43
Change in credit standards	0.01*	0.54	0.00*	0.08*	0.04*	0.81	0.04*	0.31
Max. LTI	0.07*	0.31	0.15	0.60	0.35	0.47	0.37	0.45*
Max. LTV	0.01*	0.63	0.00*	0.27*	0.02*	0.91	0.04*	0.93
Max. loan maturity	0.26	0.03*	0.26*	0.03*	0.86	0.01*	0.81*	0.01*
Interest-only periods	0.83	0.94	0.73	0.88	0.35	0.51	0.43	0.56

1) The error terms are regressed on variables from the lending survey. Three alternative regressions have been tested where the variables from the lending survey are included without a lag (t), with one lag ($t-1$) and where both unlagged and lagged values are included (t and $t-1$). Robust LSM has been used.
Two estimation periods have been chosen to avoid having particular aspects of the financial crisis dominate the assessment of the lending survey's explanatory power. Banks tightened their credit standards in 2008. The results of the estimations for 2009 may be weaker than the real outcome.
* shows that the variable has statistically significant explanatory power at the 10 percent level.

[14]This is in line with a credit equation in Norges Bank's system for stress testing financial stability.

[15]The error terms were regressed on the variables from the lending survey without a time lag and with a time lag of up to six periods. The results were most significant for the variables without a time lag and also for some with one time lag. Including several lags simultaneously was also tested, and the combination of without a time lag and one time lag often produced significant results. We also regressed the error terms on combinations of variables from the lending survey. The variable maximum loan-to-value (LTV) ratio dominated and was generally found to be significant.

Table 3: Estimated model for household credit. Dependent variable: $\Delta log\left(\frac{C2H}{CPI}\right)_t$

Variabel	Koeff.	St.avvik	z-Stat.	Prob.
α_0	0,49	0,09	5,73	0,0000
$\Delta log\left(\frac{K2H}{CPI}\right)_{t-1}$	0,35	0,07	4,54	0,0000
$\Delta log\left(\frac{WI}{CPI}\right)_t$	0,15	0,04	3,36	0,0008
ΔRH_t	-0,01	0,00	-4,59	0,0000
$log\left(\frac{K2H}{CPI}\right)_{t-1} - log\left(\frac{PHN}{CPI}\right)_{t-1}$	-0,06	0,01	-5,46	0,0000
$log\left(\frac{WI}{CPI}\right)_t$	0,01	0,00	2,55	0,0108
$(1-0,28)(RH_{t-1} - \Delta_4 CPI_{t-1})^1$	-0,24	0,07	-3,42	0,0006
DUM 2. kv[1,2]	0,39	0,17	2,35	0,0188
DUM 3. kv[1,2]	0,64	0,16	4,03	0,0001
DUM2003 1. & 2. kv[2]	0,02	0,00	4,10	0,0000
R^2	0.64	Adj. R^2		0.59
Rw^2	0.78	Adj. Rw^2		0.78
Akaike info crit.	93.94	Schwarz crit.		120.45
Deviance	0.0015	Scale		0.0044
Rn^2 stat.	184.64	Prob(Rn^2 stat.)		0.0000
Avg. dep. var.	0.0156	Std. dev dep. var		0.0093
Std. dev. regression	0.0050	Sum sqr. err. ter.		0.0018

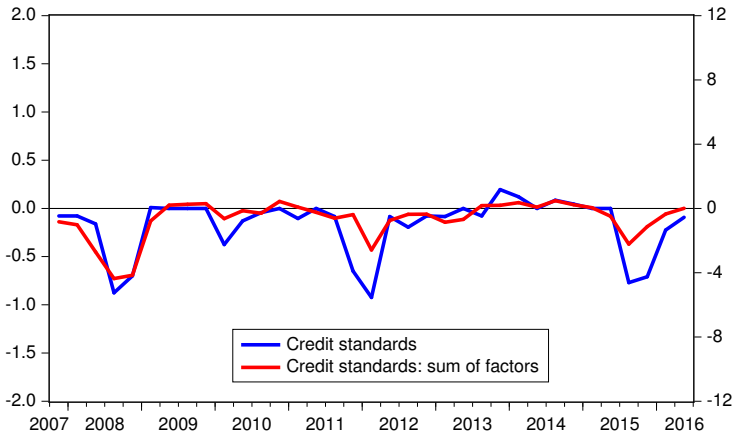
1) Multiplied by 100.
2) DUM Q2 and DUM Q3 represent systematic seasonal effects. DUM 2003 Q1 & Q2 have the value -1 and 1 in 2003 Q1 and 2003 Q2, respectively. Without this correction, the equation has problems with autocorrelation.
Method: Robust LSM; Observation period: 1996 Q2 - 2016 Q1; No. of obs.: 80

Sources: Statistics Norway and Norges Bank

B Drivers of changes in credit standards

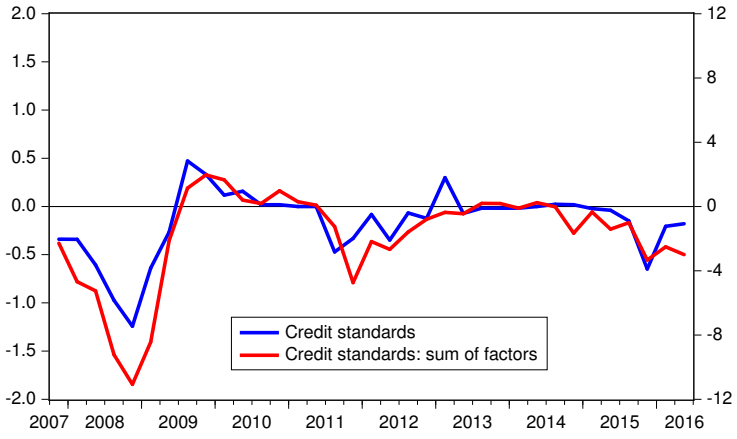
To investigate the consistency between banks' responses concerning "overall credit standards" and their responses concerning "factors" and "conditions" we compare banks' responses concerning developments in overall credit standards with the sum of developments in factors affecting credit standards and developments in loan conditions. However, the fact that banks explain changes in credit standards by reporting several factors, or a combination of factors and conditions, may indicate more extensive tightening. In general, when more conditions are changed, a larger number of borrowers are affected. We do not know if the quantitative effect of reported changes will be the comparable. In practice, we find a close match between the results, see Chart 15 and 16.

Chart 15: Credit standards for households. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote tighter credit standards.
Sources: Statistics Norway and Norges Bank

Chart 16: Developments in credit standards for non-financial enterprises. 2007 Q4-2016 Q2[1]



1) The banks respond on a scale of +/-2. In the aggregated figures, banks are weighted by the size of their balance sheets. Negative values denote tighter credit standards.
Sources: Statistics Norway and Norges Bank

References

Akram, Q.F. (2014). Macro effects of capital requirements and macroprudential policy,. *Economic Modelling 42, pp. 77-93.*

Anundsen, A.K. and E. Jansen (2013). Self reinforcing effects between housing prices and credit. *Journal of Housing Economics 22, pp. 192-212.*

Jacobsen, D.H. og B.E. Naug (2004). Hva p̌irker gjeldsveksten i husholdningene? *Penger og Kreditt 2/04, pp. 91-98.*