Identifying (un)warranted tightening in credit supply

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Content

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Executive summary

Credit conditions tend to vary through the business cycle as banks adjust credit availability in response to a changing macroeconomic outlook. Such adjustments in credit provision are a typical feature of banks' response to developments in the risk environment and are central to prudent risk management. However, if the reduction in the supply of credit is greater than warranted by the changes in the macroeconomic outlook, it can make a downturn in the economy much worse and lead to further defaults – for example, if businesses cut spending and employment further, this could potentially lead to amplification of an economic downturn.

Several factors can motivate banks to adjust credit provision by more than warranted by macroeconomic conditions. Financial frictions, information asymmetries and other sources of market failures make it difficult for banks to price risk on new lending and are key causes of such unwarranted tightening. Banks might also cut back the provision of credit if they are concerned about their own financial health and capital positions over and above the financial health of the households and businesses they lend to.

As a result of such market failures, tightening in credit supply unwarranted by macroeconomic conditions could have implications for macroprudential policy, although it does not immediately imply an automatic macroprudential policy response. Rather, such unwarranted tightening of credit could provide a signal that the Financial Policy Committee (FPC) should consider: i) what has driven the tightening; and ii) whether macroprudential policy action is appropriate. This could possibly lead to a macroprudential response which might include (though may not be limited to) the setting of the countercyclical capital buffer (CCyB). Specifically, release of the CCyB rate in a period where tightening in credit supply unwarranted by macroeconomic conditions is likely or observed would enable banks to utilise the extra capital to support lending to households and businesses, thereby reducing the potential for the banking system to amplify an economic downturn.

However, identifying unwarranted tightening in lending data is challenging as many factors inform banks' lending decisions during shocks. A key challenge is isolating changes in bank credit that are driven by changes in credit demand or broader macroeconomic conditions and those that are driven by credit supply shocks. In this paper, we set out an empirical model that attempts to do this, closely following **Bassett et al (2014)**. The empirical model examines how a composite measure of banks' lending standards, constructed using the Bank

of England's Credit Conditions Survey (CCS) responds to changes in key macroeconomic variables, their own balance sheet variables and measures of financial risk. By explicitly controlling for credit demand and expected borrower defaults (as reported in the CCS) this allows us to identify credit supply shocks, and thereby assess whether banks are tightening above and beyond what is explained by the explanatory variables. For the purposes of this paper, we interpret the 'explained' variation in bank lending standards as being warranted by macroeconomic conditions. Any residual changes in banks' lending standards, which cannot be explained by the macroeconomic and related variables, can therefore be considered as a proxy measure for unwarranted tightening or credit supply shocks.

The model results show credit supply shocks and some evidence of credit tightening unwarranted by economic conditions during recent and historical shocks, specifically during the global financial crisis (GFC), the eurozone crisis, the Covid pandemic, and the liability-driven investment (LDI) stress.

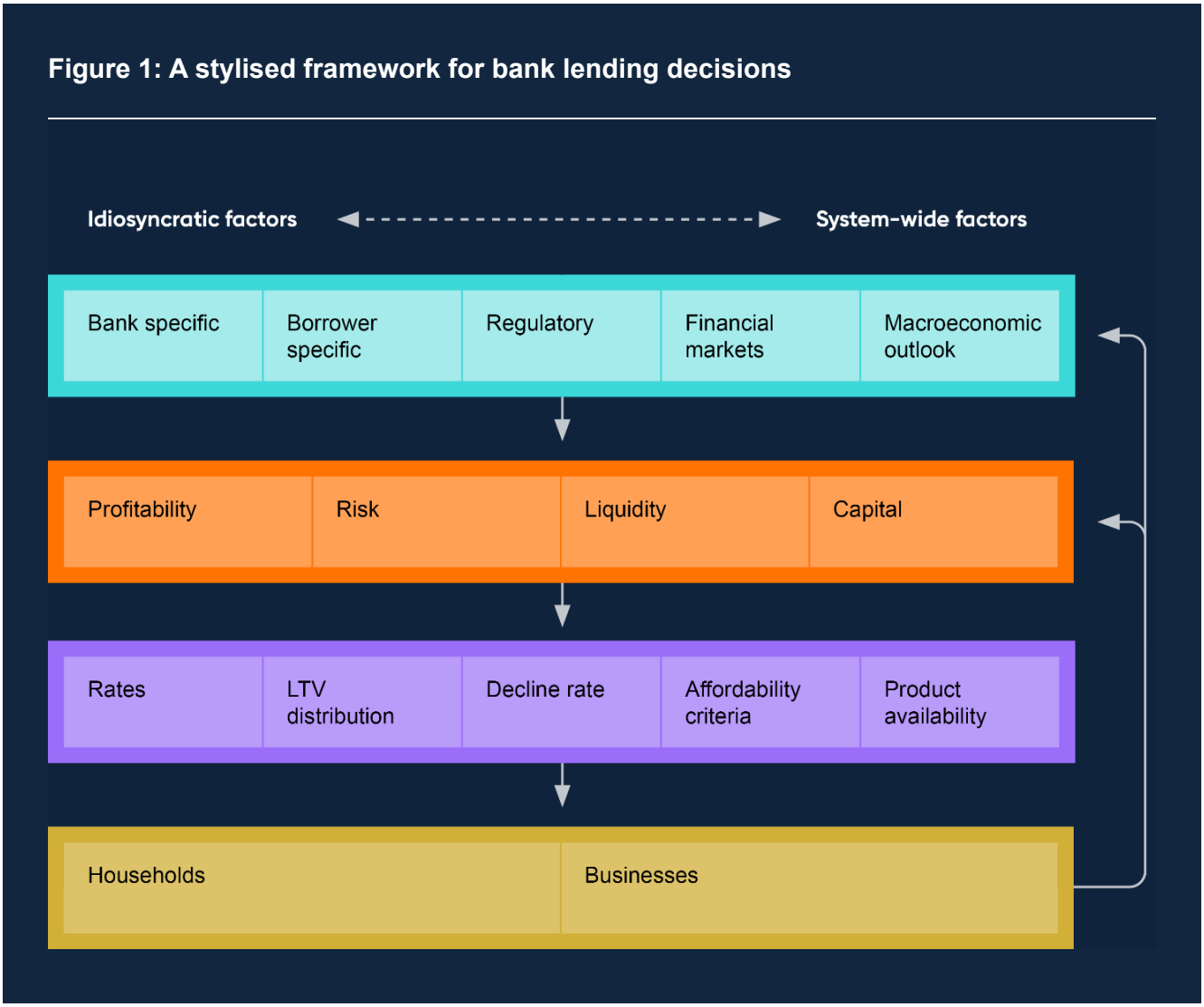
As our model provides a proxy measure for unwarranted tightening, it can be used as an indicative tool to decide when policy intervention could be considered to reduce the likelihood of the banking system amplifying a shock. This will support the FPC in future judgements on whether observed credit tightening is warranted by changes in the macroeconomic outlook, alongside their consideration of other indicators, including supervisory and Agents' market intelligence, indicators of banks' proximity to regulatory buffers, and results of stress tests assessing resilience of the banking system to severe macroeconomic conditions.

1: Introduction

When weighing lending decisions during shocks, banks will consider a range of factors that affect their capacity to lend.

Figure 1 is a stylised characterisation of the types of factors the banking system may consider – including macroeconomic, financial, bank specific or borrower specific – and how they propagate to lending conditions. Banks typically assess the impact of these factors on borrower quality and risk-adjusted returns on lending, which can impact bank profitability and financial resilience. Financial constraints such as capital and liquidity positions are also important determinants of lending decisions. For instance, funding shocks might increase costs associated with raising capital and liquidity but may not directly increase the risk profile of existing credit balances. By contrast, a change in the macroeconomic outlook does not necessarily immediately impact banks' liquidity positions but might have implications for borrower quality. Notwithstanding this, there could be simultaneous effects on borrower quality and financial resilience in some instances.

Figure 1: A stylised framework for bank lending decisions



Changes in credit supply that are not warranted by changes in the macroeconomic environment can result in amplification of the business cycle.

Over a business cycle, credit supply typically adjusts in line with changes in the macroeconomic outlook and the risk environment as banks manage exposures to growing risks. In a worsening macroeconomic outlook, banks may reduce credit supply as the potential for them to incur higher credit losses on loan balances increases (**Rodano et al (2018)**). This may result in greater provisioning for impaired loans and reduced profitability and capital buffers. Considering this, it is prudent for a bank to adjust credit supply in line with a changed macroeconomic outlook to mitigate the impact of increased borrower risk on their balance sheets. Such changes in credit supply would be considered warranted by macroeconomic conditions.

However, there are instances when banks might adjust credit supply by more than is commensurate with the macroeconomic environment leading to amplification of the business cycle (**Kiyotaki and Moore (1997)** and **Bernanke et al (1999)**). Such instances might occur if financial frictions, information asymmetries and other sources of market failures make

it difficult for banks to price risk on new lending; for instance, banks might limit credit to specific sectors of the economy (such as small businesses or first-time buyers) if full information on borrowers' credit history is not available. The risk of unwarranted tightening in credit supply can also arise in periods when banks are faced with extremely high macroeconomic uncertainty leading to greater risk aversion if, for instance, borrower quality is made more difficult to assess as was evident during the onset of Covid.

Banks can also reduce lending in an unwarranted way in order to defend their own capital and liquidity positions, if they are concerned about their own financial resilience over and above the financial health of the households and businesses they lend to. Such a reduction in the supply of credit supply could lead to worse macrofinancial outcomes as credit losses on balance sheets are precipitated through a more severe contraction in credit. This is also an example of a collective action problem: what may appear rational for each bank in isolation could result in all banks being worse off. Restricting lending beyond what would be warranted by changes in the macroeconomic outlook would therefore be counterproductive, harming both the wider economy and ultimately banks themselves. Some of this was evident during the GFC when banks tightened lending standards not only in response to the worsening macroeconomic outlook, but also as a result of tighter funding conditions and liquidity pressures as well as a desire to improve their capital positions (**Gambacorta and Marques-Ibanez (2011)**). This had damaging effects on the real economy.

> **The risk of changes in credit supply that are not warranted by changes in the economic environment has important implications for policy setting, including macroprudential policy.**

Any – or a heightened risk of – unwarranted changes in credit supply can have implications for policy, including (but not limited to) the setting of the CCyB rate.[2] However, tightening in credit conditions not warranted by the macroeconomic outlook does not immediately imply an automatic macroprudential policy response. Instead, it is a signal that the FPC should consider: i) what has driven the tightening; and ii) whether macroprudential policy action is appropriate.

The FPC expects to cut the CCyB if it anticipates that the banking system faces the prospect of losses that could otherwise lead it to restrict lending to defend capital positions in the face of a shock, by more than was warranted by the macroeconomic outlook. However, if unwarranted tightening in credit supply is the result of underlying frictions, market failures or other factors, other policy actions may be more appropriate. Indeed, as evidenced during Covid, the increase in information asymmetry around credit quality, driven by the level of macroeconomic uncertainty, was addressed through other policy actions, in particular, government guarantees for bank loans.

However, identifying credit supply shocks and unwarranted tightening is challenging.

Identifying unwarranted tightening in credit supply can be challenging particularly as it is difficult to directly observe changes in credit conditions while also isolating the impact of credit supply from credit demand. Indeed, as was observed during the onset of Covid, determining whether the decrease in mortgage financing was driven by supply or demand factors was difficult. On the demand side, households responded to income uncertainty by delaying mortgage applications. At the same time, on the supply side, banks tightened risk appetite and lending standards in line with increased borrower risk. Identifying credit supply shocks/unwarranted tightening is therefore complex.

To address this, we implement an empirical model, which attempts to disentangle credit supply and demand, closely following **Bassett et al (2014)**. The empirical model examines how a composite measure of banks' lending standards, constructed using the CCS responds to changes in key macroeconomic variables, their own balance sheet variables and measures of financial risk. By controlling explicitly for credit demand and expected borrower defaults as reported in the CCS, this allows us to identify credit supply shocks, and thereby assess whether any tightening has occurred beyond what is explained by the explanatory variables. We interpret this 'explained' variation in bank lending standards as being warranted by macroeconomic conditions. The residual changes in banks' lending standards, which cannot be explained by the macroeconomic conditions and related variables, can then be considered as a proxy measure for unwarranted tightening or credit supply shocks. We find that the key variables that significantly affect banks' lending standards include current and expected GDP, yield curve, credit default swap (CDS) spreads and expected default rate.

The rest of this paper is structured as follows. Section 2 outlines the contribution of our paper to literature identifying credit supply shocks. The data and empirical method we employ are outlined in Sections 3 and 4 respectively. Sections 5 and 6 discuss our regression results and evidence of tightening unwarranted by macroeconomic conditions during recent shocks. Section 7 summarises policy implications and conclusions.

2: Literature on bank credit conditions and the business cycle

The post-GFC slowdown and credit crunch underscored the importance of financial stability and a role for macroprudential policy as it demonstrated how disruptions in the financial system, especially bank credit, can increase the severity of downturns. **Bernanke et al (1999)** provide a framework to understand how credit market frictions can amplify and propagate shocks to the real economy (known as the 'financial accelerator'). **Schularick and Taylor (2012)** highlight the role of credit in driving financial cycles and that the output costs of financial crises could be large. **Claessens et al (2012)** find that recessions associated with financial disruptions tend to be longer and deeper, whereas recoveries associated with rapid credit growth tend to be stronger.

Since the GFC, there has been growing academic and policy interest on shocks emerging from the banking sector and their impact on banks' credit supply and the real economy. **Campello et al (2010)**, using a survey of Chief Financial Officers in the US, Europe and Asia, suggest that banks that faced greater financial constraints cut both lending and employment, sold more assets, and had to forgo attractive investment opportunities. **Iyer et al (2013)** study the effect of a shock to the interbank market on bank lending to businesses and find that the impact is higher for smaller businesses with weaker banking relationships. Further, **Buera and Karmakar (2022)** analyse the impact of the sovereign debt crisis on credit supply, finding that highly leveraged and short-term debt dependent firms experience sharper credit contractions following a shock.

Distinguishing between changes in the volume of bank credit that is driven by changes in credit demand or broader macroeconomic conditions and those that are driven by credit supply shocks can be complex and is not straightforward. We therefore turn our attention to the literature that attempts to identify credit supply shocks.

Barnett and Thomas (2013) attempt to identify separate credit supply and demand shocks using a structural vector autoregression (VAR) on macroeconomic data. They find that credit supply shocks explain a significant part of the variation in bank lending and GDP since the GFC.

Following **Khwaja and Mian (2008)**, several papers such as **Amiti and Weinstein (2013)**, **Jiménez et al (2020)** and **Alfaro et al (2021)**, attempt to identify credit supply shocks using data on firms borrowing from multiple banks and controlling for demand factors using firm-time fixed effects.

Degryse et al (2019) highlight that a majority of firms have single banking relationships and propose an alternative demand control (using industry–location–size–time fixed effects) to identify bank credit supply shocks using both single and multi-bank firms. They use credit data from Belgium to show that borrowers from banks with negative supply shocks experience lower growth in financial debt, assets, investments and operating margin, whereas positive credit supply shocks are associated with more risk-taking by banks.

An emerging literature uses loan officer surveys to identify credit supply shocks.

An emerging alternative strategy to disentangle the role of banks' credit supply from demand is to use data from bank loan officer surveys. **Bassett et al (2014)** use bank-level responses to the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS) to construct an indicator for banks' lending standards. Controlling for key macroeconomic, financial and bank-specific variables, they compute shocks to banks' lending standards. The advantage of using loan officer opinion survey data is that it contains information on banks' supply of credit and lending standards as well as information on credit demand, expected defaults etc. This allows controlling for demand-side variables in the regression model. They find that shocks to banks' lending standards lead to a decline in output, credit and widening of credit spreads.

Similarly, the Bank Lending Survey (BLS) conducted by the European Central Bank (ECB) has been used in several papers. For example, **de Bondt et al (2010)** provide evidence that responses of the lending survey are a leading indicator for euro-area credit growth and real GDP growth.

Del Giovane et al (2011) combine qualitative information from the BLS with microdata on Italian banks' loans to examine the role of supply and demand factors on bank lending in Italy. They find that both demand and supply played a significant role in their sample period including the GFC.

Ciccarelli et al (2015) use data from the ECB's Lending Survey in a VAR framework to disentangle demand and supply factors. They find the bank lending channel of monetary policy to be significant and that credit supply restrictions to firms in the euro area and tighter standards for mortgage loans in the US contributed significantly to the reduction in GDP.

Beck et al (2018) use interviews with Bank chief executive officers, and spatial data on branch locations to assess the impact of credit constraints at different points in the business cycle. They find that lending based on an established bank-borrower relationship alleviates credit constraints during downturns, particularly for small firms in regions with severe downturns.

We contribute to this literature as follows. This paper is the first to use the Bank's CCS to identify UK banks' credit supply shocks. It also introduces two new features: i) use of a composite index of credit conditions survey responses to measure changes in bank lending standards; and ii) use of survey respondent's economic expectations (expected default and loss given default) as control variables.

3: Data

We combine data on banks' responses to the UK CCS with macro data and banks' regulatory reports.

Our main source of data is the CCS, equivalent to the US SLOOS used by **Bassett et al (2014)**. The CCS is a quarterly survey run by the Bank of England since 2007 Q2, in which bank loan officers give qualitative responses to questions on current and expected changes in the availability and supply of credit, demand, loan defaults and other factors. It covers secured and unsecured lending to households as well as corporate lending. The questions we use include:

- Credit supply, such as 'How has the availability of secured credit provided to households changed in the past three months?'.
- Key price and non-price aspects of credit supply such as 'How have credit scoring criteria/loan acceptance rates/credit spreads on new loan applications changed in the past three months?'.
- Credit demand, such as 'How has demand for secured lending for house purchase/remortgage from households changed in the past three months?'.
- Credit quality, such as 'Has there been any change in the default rate/loss given default on lending in the past three months?'.

Banks' responses – which are subjective and could be exposed to bias – are assigned a score, which are then combined to produce time-series data. For example, in answering the question 'How has the availability of secured credit provided to households changed (in the previous three months)?', respondents may select that it has not changed, or decreased/increased 'a little' or 'a lot', assigned a score of -100 to +100 (explained in detail in the following section). The published aggregate results are produced by producing an average of respondents' answers to each question, weighted by market share. However, our empirical strategy uses banks' individual unweighted responses of five major UK banks, which are not available publicly.

We combine banks' CCS responses with regulatory data on their financial positions. Due to changes in regulatory reporting since 2007, we take data from three sets of reports: the Historical Banking Regulatory Database, Financial Services Authority and Financial Reporting Standards returns.[3] From this data, we calculate measures of banks' loan to asset ratio, deposits to assets ratio, profitability (as proxied by net interest margin (NIM)) and asset quality (loan loss provisions).

We limit our sample to five of the major UK banks, which jointly provide around 65% of total UK real economy lending as of 2022. Bank financial data for these banks are used at the group level – despite the CCS covering UK lending only – as this is the basis that banks typically make portfolio allocation and risk management decisions.[4]

To control for the macro environment, we include various ONS and Bank of England data on the macro environment including GDP, the unemployment rate, Bank Rate, and yield curve steepness. We also control for measures of financial risk, such as the S&P implied volatility index (VIX), used as a proxy for global equity market volatility, Bank of England estimates of the UK excess bond premium (a proxy for the risk-bearing capacity of UK financial markets using data on credit spreads and expected defaults),[5] bank CDS spreads and the expected one-year gilt rate.[6]

4: Empirical methodology

We compute a ‘lending standards’ index for each bank that captures key price and non-price aspects of UK banks’ credit supply.

Our empirical strategy to identify credit tightening unwarranted by the macroeconomic outlook is based on **Bassett et al (2014)**, which used the SLOOS data to identify credit supply shocks for the US. We use the Bank of England CCS to perform a similar exercise for the UK. Credit supply shocks are a proxy for unwarranted credit changes as they are, by construction, unrelated to macroeconomic and other key factors influencing credit supply. As mentioned above, the advantage of CCS data is that it contains information on supply of bank credit and lending standards over time, across different products as well changes in demand for credit, which is otherwise difficult to disentangle in usual time-series data. This allows us to identify changes in credit supply, which can then be used to measure unwarranted tightening.

Banks’ credit supply decisions are complex and encompass both price and non-price measures. The CCS data, through its various questions, allows us to capture different aspects of banks’ credit supply such as availability of credit, credit scoring criteria, loan acceptance rates and credit spreads (for example, ‘How has the availability of credit changed in the last three months?’). Banks respond by choosing one of the following options (which is assigned a particular score): not changed (which has a score of 0); decreased ‘a little’ (score of -50); decreased ‘a lot’ (score of -100); increased ‘a little’ (score of 50); and increased ‘a lot’ (score of 100). For each of the four questions mentioned in Section 3, we construct a diffusion index[7] for the period from 2007 Q2 to 2023 Q1 by computing the weighted average across product categories (mortgages, corporate loans and unsecured loans) using the respective bank’s product shares.

More formally:

$$I^{j}_{i,k,t} = +100, +50, 0, -50, -100$$

is the bank i’s reply to question j for the product category k at time t.

The diffusion index for every question ($\Delta L^{j}_{i,t}$) is then computed combining these replies with respective bank’s product shares ($\omega_{i,k,t}$) as follows:

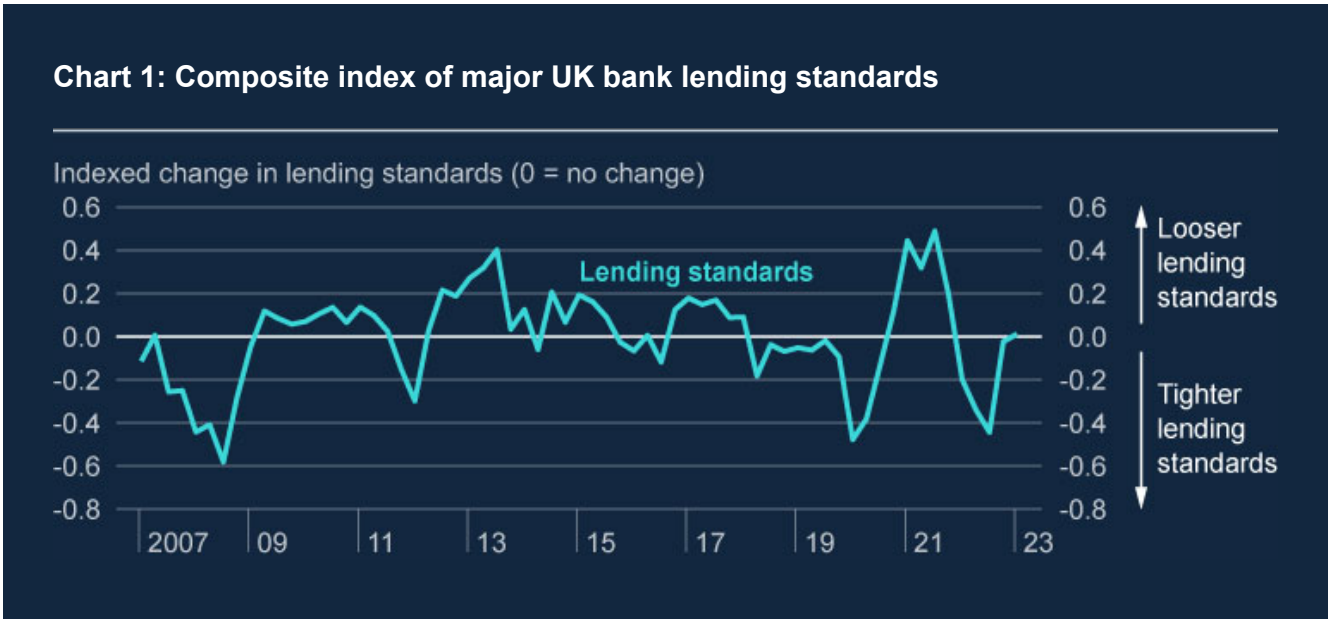
$$\Delta L^{j}_{i,t} = \sum_{k} I^{j}_{i,k,t} \omega_{i,k,t}$$

On similar lines, we also compute a diffusion index for the responses to the question on loan demand $\Delta D_{i,t}$.

Finally, the bank lending standards index $\Delta L_{i,t}$ is constructed as the principal component of the four diffusion indexes $\Delta L^{j}_{i,t}$, capturing different dimensions of lending standards. As mentioned above, these are: availability of credit; credit scoring criteria; loan acceptance rates; and credit spreads.

Bassett et al (2014) use one question in the SLOOS to construct their lending standard index. In comparison, we attempt to improve upon their methodology by including four different but inter-related questions from the CCS to construct respective diffusion indices. We use principal component analysis to summarise this information, as it enables us to capture the underlying forces driving banks' credit supply decisions from information contained across the different metrics of banks' credit supply responses (henceforth 'bank lending standards') in the CCS (credit availability, credit scoring criteria, loan acceptance rates and credit spreads). This enables us to improve our understanding of supply decisions given the aim of the empirical methodology is to isolate credit supply shocks. The aggregate bank lending standards index for the five major UK banks included in our sample is given in Chart 1. This is used as the dependent variable in the panel regression discussed below.

Chart 1: Composite index of major UK bank lending standards



Source: Bank of England CCS.

We then use an empirical model to explain the changes in UK banks' lending standards using macroeconomic variables, banks' balance sheet ratios and financial factors.

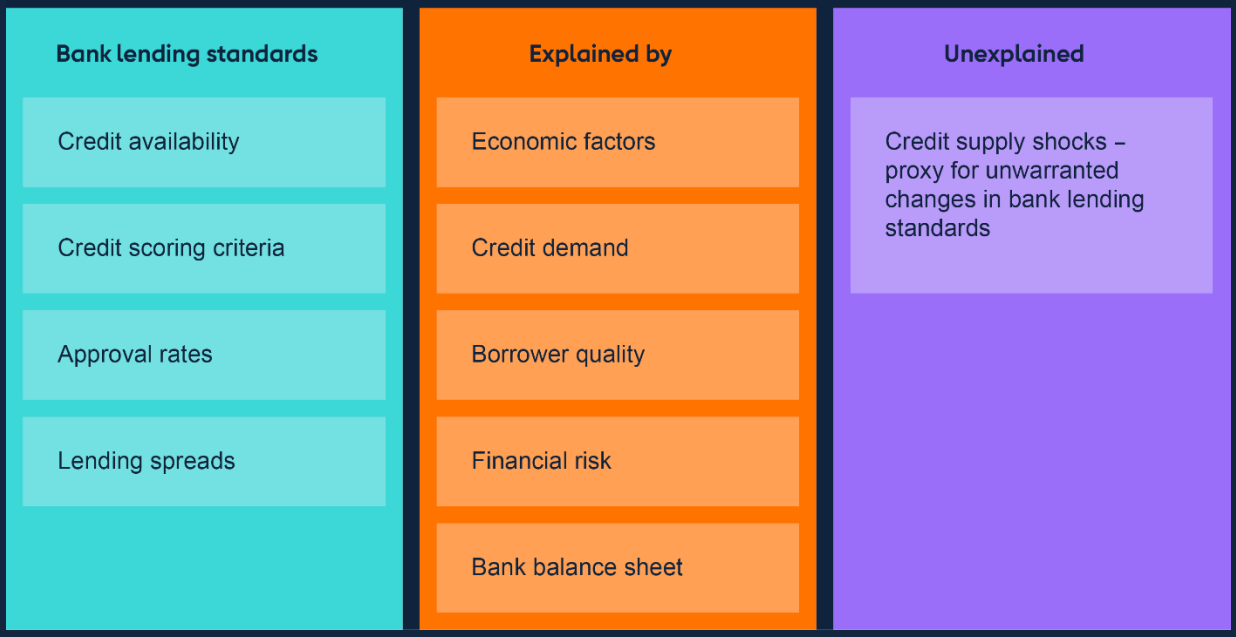
We estimate the following regression equation:

$$\Delta L_{i,t} = \beta_1 \Delta D_{i,t} + \beta_2 \Delta L_{i,t-1} + \beta_3 Economicoutlook_{t-1} + \beta_4 Borrowerquality_{i,t} + \beta_5 Financialrisk_{t-1} + \beta_6 Bankcontrols_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

As explained above, our left-hand side variable 'lending standards index' is computed using a combination of responses to four key questions in the CCS related to banks' credit availability, lending standards and spreads across different product categories (secured household, corporate loans and unsecured loans).

Economic outlook is a vector of controls that define the macroeconomic environment including expected and current GDP, unemployment, the expected one-year and 10-year gilt rate, and Bank Rate. **Borrower quality** includes the expected default rate and expected loss given default based on CCS data. **Financial risk** is a vector of financial risk variables, comprised of CDS premia, the excess bond premium (a measure of investor sentiment or risk appetite in the corporate bond market), and the S&P implied VIX. **Bank controls** is a vector of bank-level variables from regulatory reports, including NIM, loan loss provisions, the loan to deposit ratio for bank i in time $t-1$. η_i is a bank fixed effect capturing time invariant unobserved heterogeneity across banks. The demand variable comes from CCS data and controls for the changes in demand for credit.

Figure 2: A stylised diagram of our empirical strategy



The residuals from the regression serve as a proxy for changes in lending standards unwarranted by the macroeconomic outlook.

The error term $\varepsilon_{i,t}$ is the residual of our equation. In **Bassett et al (2014)** this residual is interpreted as the 'credit supply shock', as it is the portion of banks' changes in lending standards not related to the macroeconomic environment, borrower quality, financial uncertainty or bank-specific financials. They show that this measure performs well in a standard macro-VAR setup as an indicator of credit supply. As mentioned above, we interpret the residual as a proxy for unwarranted expansions/contractions in credit. This could be driven by factors not included in our model, such as banks' cutting lending to defend capital ratios or the financial accelerator effect (**Bernanke et al (1996)**), however as it is a residual we are not able to identify the specific driver of unwarranted tightening.

5: Results

Our model shows banks tighten lending standards in response to changes in the macro-outlook, as well as balance sheet constraints and financial risk.

This section sets out the results of our baseline regression specification, which is set up in line with **Bassett et al (2014)**. Our model produces broadly intuitive coefficients on variables capturing the macro-outlook, borrower and bank balance sheets and measures of financial risk. This provides reassurance that our coefficients provide insights into the extent of tightening, historically associated with a change in macro, balance sheet and financial risk variables.

Table A sets out our baseline results. We first regress our index of bank lending standards on its one-quarter lag, as well as demand. We then control for macro variables, and thereafter include bank financials, and measures of financial risk in the third specification. Lower values of the dependent variable ‘bank lending standards’ imply a tightening in credit while higher values imply credit loosening.

Table A: Baseline regression results explaining changes in the dependent variable 'bank lending standards'

Explanatory variables	Specification 1	Specification 2	Specification 3
Bank lending standards (lag)	0.526 (a)	0.419 (a)	0.397 (a)
Demand for credit	0.098 (b)	0.045	0.038
Economic factors			
GDP growth		1.809 (a)	1.698 (a)
GDP growth (lag)		0.213	0.233
Expected GDP growth		0.031 (b)	0.027 (a)
Unemployment (lag)		0.046	0.033
Bank Rate		0.022	-0.006
Expected one-year gilt rate		-0.008	-0.011
Yield curve		0.042 (a)	0.061 (a)
Borrower quality			
Expected defaults		-0.105	-0.104 (b)
Realised defaults		0.086	0.079
Loss given default		0.054	0.058
Expected loss given default		-0.112	-0.087
Financial risk			
VIX			0.002
Excess bond premium			-0.001 (b)
CDS (lag)			-0.039 (a)
Bank financial metrics			
Loan loss provisioning (lag)			0.015
NIM (lag)			0.002
Loan to assets (lag)			-0.091
Deposits to assets (lag)			0.072

Explanatory variables	Specification 1	Specification 2	Specification 3
Observations	320	320	320
R^2	0.301	0.394	0.408

Note: Negative values of our dependent variable reflect a tightening in bank lending standards. Explanatory variables are standardised and stationarised and standard errors have been clustered at the group level.

(a) p<1%.
(b) p<5%. No results had a p value between 5% and 10%.

The coefficient on lagged bank lending standards has a positive and significant coefficient. Intuitively, this suggests a bank which tightens credit supply in one quarter is more likely to continue to tighten credit in the next.

We also control for bank-reported changes in demand. In our simplest specification, demand and supply are positively and significantly correlated. That is, a decrease in demand is associated with a simultaneous decrease in credit supply. This is intuitive as often business cycle downturns lead to decreases in investment and aggregate demand as well as an increase in credit risk, necessitating tighter lending standards. However, as we additively control for other factors, the coefficient loses significance. We interpret this as evidence that our macro variables sufficiently capture macroeconomic drivers of demand. Likewise, expected defaults and loss given default (computed using CCS data) have negative coefficients suggesting that banks contract credit supply in response to deterioration of borrowers' credit quality, as hypothesised in Section 1.

We then turn to variables outside the CCS which might impact bank credit supply. The first set of variables we include in our model relate to the macroeconomic environment and all take an intuitive sign. A 1% increase in real GDP is associated with a substantial loosening in our bank lending standards index of over 1.7 percentage points and vice versa, and the result is highly significant. Similarly, higher GDP expectations are associated with looser lending standards. In line with previous papers (**Estrella and Mishkin (1998)** and **Bassett et al (2014)**), a steepening of the yield curve is associated with higher credit supply which may reflect an indication of higher future growth and profitability. On the other hand, increases in the expected short-term rate have a negative coefficient indicating that an expected increase in cost of funds leads to tightening of banks' lending standards.

Our controls for financial risk mostly take intuitive signs. Increases in bank CDS premia, a measure of perceived institution-specific credit risk, and the excess bond premium, are both associated with tightening in our index of lending standards. Coefficient for the excess bond premium is significant whereas the coefficient for VIX is not.

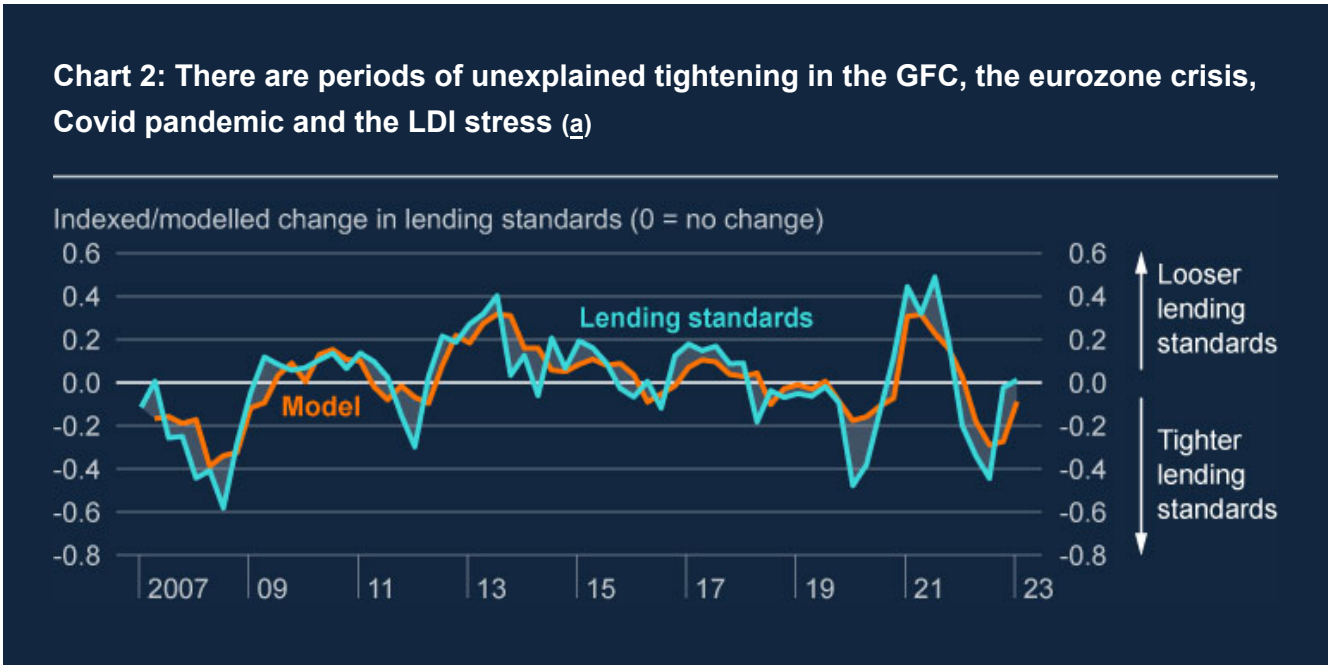
Bank financial variables also mostly take the intuitive sign, though are generally not significant. Increases in loans to assets – which is equivalent to a decrease in banks' liquidity ratios as loans tend to be less liquid than other assets – are associated with tightening in lending standards, possibly reflecting that liquidity-constrained banks are more likely to cut lending. Higher NIM and deposit to asset ratios are associated with a loosening of lending standards.

Overall, our model produces intuitive and significant results. The model explains around 40% of variance in bank lending standards during our sample period. When summing across banks, the predictions of our model fit well with realised tightening in lending standards as explained below.

6: Evidence of tightening unwarranted by macroeconomic conditions during recent shocks

The results of the empirical model enables us to identify instances of unexplained tightening in the UK over the recent past. Chart 2 shows realised bank lending standards (aqua line – also shown in Chart 1) which decreased during the GFC, eurozone crisis, Covid pandemic and the LDI stress. Chart 2 also shows our model's prediction for banking lending standards (orange line) based on the economic outlook, financial risk and bank-specific financials.

Chart 2: There are periods of unexplained tightening in the GFC, the eurozone crisis, Covid pandemic and the LDI stress (a)



Sources: Bank of England CCS, Bloomberg, Refinitiv and S&P Capital IQ Pro.

(a) Aqua line is a composite index of bank lending standards observed in the CCS. The orange line is our modelled tightening in bank lending standards. The grey shaded area shows the residual between our model and observed data. Negative (positive) values indicate credit tightening (loosening).

The model does not explain all variation in bank lending standards, and there are often substantial residuals (the grey shaded area). These residuals ie changes in bank lending standards, which cannot be explained by the macroeconomic and related variables, provide a proxy measure for unwarranted tightening or credit supply shocks.

These residuals are negative (implying credit tightening) during the following periods: 2007 Q4–2008 Q4 (the GFC); 2012 Q1–2012 Q2 (the eurozone crisis); 2020 Q2–2020 Q3 (the Covid pandemic) and 2022 Q4 (the LDI stress).

The first period of unexplained tightening we identify is during the GFC. Our model predicts a tightening between 2007 Q4 and 2008 Q4 would have been warranted by successive downside revisions to GDP and unemployment expectations following the failure of large financial institutions. However, some degree of lending standard tightening went beyond what was warranted by the variables we control for. This is in line with previous papers such as **Ivashina and Scharfstein (2010)**, **Aisen and Franken (2010)** and **Gambacorta and Marques-Ibanez (2011)** that highlight the widespread fall in bank credit post GFC.

Second, we identify unwarranted tightening during the eurozone crisis. Our model suggests that the extent of the contraction in UK credit during this period was not warranted by UK fundamentals. This may be consistent with the source of the shock being outside the UK and so having a less direct effect on the UK macroeconomic outlook, but credit supply nevertheless being affected through financial market and banking system interlinkages with the eurozone.

We also identify unwarranted tightening during the initial phase of the Covid shock. There are a number of potential explanations for this. First, it may be that the level of uncertainty in the period around the start of the pandemic triggered some market failures in banks' ability to identify creditworthy businesses and households. Second, banks may have been acting in a way that prioritised defending their capital positions over and above continuing to lend to creditworthy households and businesses. Or third, and as covered in model limitations below, our model may not be well suited to capturing the impact of such a substantial increase in uncertainty and how much of a reduction in the supply of credit that may warrant.

Subsequently, lending standards eased substantially after the announcement of extraordinary policy measures to encourage the continued provision of finance to UK businesses and households. This included monetary (such as lowering Bank Rate and quantitative easing), financial (such as lowering the CCyB and the introduction of the Term Funding scheme with additional incentives for Small and Medium-sized Enterprises) and fiscal (eg government-guaranteed loan schemes, furlough, mortgage forbearance and stamp duty relief) policy interventions. To note, our model combines bank lending standards across asset classes, hence it does not capture the bifurcation between corporate and mortgage lending standards. In reality, banks reported a rapid loosening of corporate lending standards driven by government guarantees, but a rapid tightening of household lending standards where there was no such intervention.

Finally, we capture some unwarranted tightening during 2022 Q4, which we attribute to the LDI stress. Following a fiscal event in 2022 Q3, the UK yield curve increased and became more volatile reflecting both increases in Bank Rate expectations, and disruption in gilt markets driven by the LDI stress. This increase led to a substantial but temporary withdrawal

of mortgage products from the markets as banks repriced and managed the operational impacts of high demand for best-buy products. Following a temporary, targeted financial stability intervention by the Bank of England, market functioning was restored.

Our model is subject to two limitations. First, we do not control directly for the level of macro uncertainty (ie the second moment of GDP expectations), nor do we explicitly control for monetary, fiscal or financial policy interventions such as those seen during Covid.

Second, some control variables may not be driven entirely by the macro-outlook but could be influenced by bank-specific factors. For example, we control for banks' profitability and liquidity positions which could otherwise also influence credit supply shocks. However, it is essential to control for these factors to avoid omitted variable bias in our estimates.

7: Conclusion and policy implications

This paper makes the following contribution to policy discussion on credit conditions and their relevance for macroprudential policy.

First, this paper is the first to use the UK CCS to identify UK banks' credit supply shocks, and introduces two new features: i) use of a composite index of CCS responses to measure changes in bank lending standards; and ii) use of survey respondent's economic expectations (expected default and loss given default) as control variables.

Second, as our model provides a proxy measure for unwarranted tightening, it can be used as an indicative tool to suggest when policy intervention might be considered to support banks in absorbing rather than amplifying a shock.

However, a policy intervention would not always be appropriate in response to tightening identified as unwarranted by the model. For example, the tightening may be considered justified by developments not well captured by the model. As such, the model will support the FPC in future judgements on whether observed tightening in bank lending is warranted by changes in the macro-outlook, but will be used alongside market data on credit conditions, supervisory and market intelligence, indicators of banks proximity to regulatory buffers and stress testing of the banking sector resilience to severe macroeconomic conditions.

Moreover, if a policy response is required, we do not prescribe a single tool. In times where tightening that is not warranted by changes in the macroeconomic outlook is driven by constraints on banks' balance sheets, it might be appropriate to lower the CCyB, increasing banks' headroom to regulatory buffers and requirements, and facilitating continued lending to the UK real economy. In other situations, different types of policy intervention might be appropriate, for example, the Funding for Lending Scheme which was introduced in 2012 to encourage banks and building societies to expand their lending by providing funds at lower rates than prevailing market rates, or the government-guaranteed loan schemes which were introduced to provide financial support to affected businesses during Covid.

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2. The UK CCyB rate is set each quarter by the FPC and enables the capital requirements of the UK banking system to be adjusted to the changing scale of risk of losses on UK exposures over the course of the financial cycle. For more information see: **The Financial Policy Committee's approach to setting the countercyclical capital buffer - Policy Statement**.

3. To address missing data due to incomplete or different regulatory reporting standards, we interpolate missing values using the ARIMA-13 seats model developed by the **US Census Bureau**. The Historical Banking Regulatory Database is a database built from banks' regulatory reports as described in **de-Ramon et al (2017)**.
4. Since the introduction of ring-fencing, banks might make capital allocation decisions at either the group or business-unit level (**Neamtu and Vo (2021)**).
5. The excess bond premium is produced by Bank staff in line with the methodology set out in **Gilchrist and Zakrajšek (2012)**.
6. Macro and financial data is from Bloomberg, Refinitiv Eikon and S&P Capital IQ Pro.
7. A diffusion index takes a value between -1 and +1 and can be interpreted as the net share of lending which has been subject to an increase (decrease) in credit conditions.