Effects of borrower-based measures

A report written for the Swedish Financial Supervisory Authority

by

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Abstract

This report studies the effects of borrower-based measures (BBMs). BBMs are macroprudential policy instruments that aim to influence households' debt choices, typically in relation to their mortgages, such as limits on the maximum loan-to-value or debt-to-income ratios of borrowers, or amortisation requirements. The report discusses when borrower-based measures have the potential to improve economic welfare, namely when BBMs target an externality that would otherwise remain unaddressed. The main part of the report focuses on what we can learn from empirical studies on the effects of BBMs, in particular from studies analyzing detailed household data. An important conclusion is that improved household solvency (reduced household indebtedness) through BBMs does not necessarily improve households' welfare if it simultaneously reduces households' liquid positions.

Keywords: Borrower-based measures, macroprudential regulation, cross-country studies, household data, sensitivity of consumption to shocks.

JEL classification: E21, E58, E61, G21, G28, G51.

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1. Introduction

This report analyses the effects of borrower-based measures (BBMs). Borrower-based measures are restrictions on borrowers' housing financing options, such as restrictions on loan-to-income (LTI) ratios, loan-to-value (LTV) ratios or debt-service-to-income (DSTI) ratios of borrowers, amortisation or down-payment requirements. BBMs are used in macroprudential regulation, that is regulation aimed at stabilising the financial system. Macroprudential regulation complements traditional microprudential regulation, which regulates individual companies and financial markets.

Macroprudential regulation has become widespread after the global financial crisis of 2008-09, as the financial crisis challenged the resilience of financial systems around the world. In Europe, for example, the European Systemic Risk Board (ESRB) tabulates that all 23 countries analysed in ESRB (2021) have introduced some form of LTV regulation (Table A.2.1, ESRB 2021), while 18 out of 20 countries have introduced DSTI (debt-service-to-income), LTI (loan-to-income) or DTI (debt-to-income) restrictions. Alam et al. (2019) report that LTV restrictions are the most prominent macroprudential tool used in advanced economies. 25 out of 36 countries had applied LTV restrictions in December 2016, 15 out of 36 countries had DSTI restrictions and 18 out of 36 countries had other credit restrictions.

Borrower-based measures aim to improve the resilience of financial systems. When they work, they enable borrowers to better withstand economic shocks, leading to better macroeconomic and financial outcomes. At the same time, BBMs restrict the choices available to borrowers. So while BBMs are implemented to improve financial stability, they also impose costs on some borrowers. Against this background, Finansinspektionen (FI), i.e. the Swedish Financial Supervisory Authority, which is also the designated macroprudential authority in Sweden, has commissioned this report to assess the potential effects of borrower-based measures.

The main conclusion of the report is that while BBMs have the potential to improve economic welfare, particularly by addressing externalities that would otherwise remain unaddressed, recent literature shows that BBMs that improve one part of households' balance sheets, such as their solvency, may have negative consequences for other parts of households' balance sheets, such as their liquid assets. This highlights a trade-off regulators face: How to design BBMs that address externalities while not reducing other means available to households to insure against shocks?

The report is divided into eight sections. Sections 2-6 discuss findings from studies of BBMs in the literature. In Section 2, I provide a brief introduction to borrower-based measures, their history, why they have been introduced, etc. In Section 3, I describe theoretical arguments that justify the use of BBMs. The next three sections provide selected overviews of main lessons learnt from the use of BBMs. Section 4 discusses findings from cross-country panel studies, Section 5 discusses experiences with BBMs in individual countries, and Section 6 presents findings from comprehensive studies of BBMs using detailed household data. In Section 7, which is the most comprehensive section in the report, I draw on learnings presented in Sections 2-6 to specifically address five questions posed by the FI: (i) Under what conditions can the existence or introduction of BBMs reduce households' vulnerability to economic shocks? (ii) Under what conditions might they have the opposite effect, i.e. increase

households' vulnerability to shocks? (iii) How and when, if at all, should BBMs be used to stabilize the macroeconomy? (iv) What are possible methods to evaluate welfare costs of BBMs? (v) How is the regulatory experience with BBMs from your country/countries that you are familiar with from your research? A final section gives a short conclusion of the report.

2. Macroprudential regulation and borrower-based measures: Background and history

Macroprudential regulation and, in particular, borrower-based measures aim to promote financial stability. The promotion of financial stability has been achieved in the past through the main instruments of FSAs and central banks, i.e. the monetary policy interest rate at central banks and microprudential supervision, such as capital, liquidity and similar requirements, at FSAs. This section discusses why these traditional tools have been supplemented by macroprudential regulation.

2.1 Macroprudential policy as a supplement to monetary policy

The most important policy instrument of the central bank is the monetary policy interest rate. This can be a blunt instrument to use when it comes to financial stability, however, because it affects all interest rates in the economy and thus, in principle, all types of lending and saving decisions. Thus, a change in the monetary policy rate has far-reaching effects that can go beyond financial stability. Moreover, the main objective of central banks is a monetary policy objective, i.e. low and stable inflation, stable exchange rates or similar, while the promotion of financial stability is a different objective. This means that when the central bank changes the monetary policy rate to influence financial stability, central banks often also influence the inflation rate, and a potential conflict between the two objectives might arise. An example could be when a hot property market threatens financial stability, but inflation is low at the same time. In such a situation, the property market calls for higher interest rates, while inflation calls for lower interest rates. This is not dissimilar to the situation the Riksbanken faced in the late 2010s. Therefore, instruments other than the monetary policy interest rate are sometimes needed to promote financial stability, and macroprudential instruments come into play.

2.2 Macroprudential policy as a supplement to traditional microprudential regulation

The main task of financial supervisory authorities is to regulate individual financial institutions and markets. Financial supervisory authorities define requirements that individual financial companies must fulfil (based on the relevant legislation) and supervise that companies fulfil these restrictions. This is known as "microprudential regulation". However, sometimes the actions of individual financial firms or other actors using the financial system (including borrowers) have an impact on other firms and borrowers, i.e. the wider financial system. When this is the case, macroprudential measures that affect the stability of the broader financial system come into play.

As macroprudential regulation supplements actions of both central banks and FSAs, different countries chose different set-ups. In a survey of 14 countries, BIS (2023) reports that in most countries, the macroprudential regulator is the central bank, while in other countries, the regulator is either the Financial Supervisory Authority, an inter-agency authority (usually anchored in the Ministry of Finance), or macroprudention powers are split between authorities. In Sweden, (Finansinspektionen) is the macroprudential regulator.

2.3 Externalities as a rationale for macroprudential regulation

Microprudential regulation regulates individual actors in financial markets, while macroprudential regulation addresses the risks to the financial system. But why is it not enough to regulate individual actors; why is macroprudential regulation sometimes necessary?

The key term here is "externalities".

The classic argument in favour of public intervention in markets are externalities (Helbling, 2010). Externalities refer to situations in which economic activities (consumption, investment, production) of some individuals (or firms) influence other individuals (or firms). If the market does not internalize the externality, there is an argument in favour of regulation to prevent/reduce/internalise the action that creates the externality in the first place. Similarly, if the price of the economic activity that creates the externality does not reflect the cost of the externality, differences between the private and social costs of the activity arise.[2] Here too, policy intervention may be needed to correct the price of the activity that causes the externality so that the price reflects the true costs.

Claessens (2015) argues emphatically that "only externalities can justify a macroprudential approach". This leads to the important policy implication that macroprudential policies should clearly identify the externalities they address, and it should be carefully explained how and why the policies address these externalities. This is because macroprudential measures are also associated with costs. A borrower-based measure that prevents some individuals from taking out a loan, e.g. individuals with a high loan-to-value ratio, naturally directly restricts the actions of these individuals. There must be well-reasoned arguments as to why the actions of these people should be restricted. If their action (their loan) "only" has the potential to harm themselves, it is not obvious that a good argument in favour of restricting that action/loan exists. However, if the action also harms other people (externalities), then the argument in favour of intervention is stronger. Furthermore, if the macroprudential policy does not clearly target an externality, situations may arise where a macroprudential intervention leads to a worse economic allocation, and possibly even increases financial instability, by restricting the actions of some economic agents. To justify a macroprudential policy, it must therefore be clear which externalities the policy is targeting. It is not enough to say that an intervention aims at "reducing household debt". It must be carefully explained what externality results from excessive debt and how the proposed restriction targets this externality.

Di Nicolò, Favara and Ratnovski (2012) classify financial externalities into three components: Those related to (i) strategic complementarities, (ii) distress sales and (iii) interconnectedness of financial institutions. Borrower-based measures aim to reduce externalities related to (i) strategic complementarities, as explained in Section 3.

2.4 The global financial crisis and increased focus on borrower-based measures

In his overview of the origins of macroprudential regulation, Clement (2010) judges that the term "macroprudential regulation" first appeared in 1979 at a meeting of the predecessor of

[2] The classical example is pollution. A firm that pollutes the environment imposes a burden – an externality – on society. If the price of the good the firm is producing does not reflect the cost of its pollution, but only the firm's direct costs of producing the good, a difference between the benefits of the good to the company and society arises. In the next section, I describe examples of externalities in the financial sector that justifies intervention via macroprudential regulation.

today's Basel Committee on Banking Supervision. Macroprudential regulation was discussed in policy circles in the 1980s, 1990s and 2000s, notes Clement (2010), but the global financial crisis of 2008 brought macroprudential regulation to the forefront of financial regulation.

The global financial crisis of 2008 had its origins not least in the property market. There were many channels through which the property markets impacted the financial system and the macroeconomy. For example, borrowers had difficulty paying their mortgages and therefore cut their consumption, banks cut back on lending to the public (businesses and households) because they were facing losses on their property investments, banks cut back on lending to other banks because they were unsure how much exposure these banks had to the property markets, and so on. As a result, part of macroprudential regulation has been concerned with the debt and credit characteristics of households that engage on the mortgage market. These are "borrower-related measures", i.e. regulations that restrict how much an individual (or household) can borrow, what type of loan they can take out or what repayment requirements apply. This is the subject of this report.[3]

3. Theoretical justifications for borrower-based measures

Korinek & Simsek (2016) examine how BBM measures have the potential to improve economic welfare by reducing the likelihood of a liquidity trap that would otherwise keep economic output inefficiently low. The reasoning is as follows. Booms in household debt, such as the accumulation of household debt in many countries before the global financial crisis of 2008, are often followed by sharp deleveraging, such as immediately after the financial crisis. During deleveraging, aggregate demand in the economy falls as households save to reduce their debt. To compensate for the fall in aggregate demand, the central bank should lower the monetary policy interest rate. However, sometimes it is not possible to pursue the "optimal" monetary policy response. This could be because, for example, interest rates are close to or at the zero-lower bound. The zero-lower bound refers to a situation in which the interest rate cannot fall (much) below zero because people have an alternative to saving in interest-bearing instruments; people can save in fiat money. A situation where the interest rate is at the zero lower bound but should be lowered even more to optimally stimulate aggregate demand is a "liquidity trap".

In the model by Korinek & Simsek (2016), households accumulate too much debt from a societal perspective in the accumulation phase, even if they behave rationally from an individual perspective. Therefore, macroprudential measures that limit the accumulation of household debt have the potential to improve welfare. The externality that a macroprudential intervention can address is that the reduction in household consumption during the decumulation phase negatively affects aggregate demand, i.e. households' own actions affect the income of others. By limiting the accumulation of debt from the outset through macroprudential intervention, the negative external effects in the decumulation phase are reduced and possibly even eliminated.

Note that there would be no need for macroprudential regulation in the Korinek & Simsek (2016) model if monetary policy rates could be lowered to compensate for the fall in aggregate

[3] There are many other types of macroprudential regulation that this report does not address, such as countercyclical capital requirements, different types of liquidity restrictions, levies on certain activities, etc., see e.g. Claessens (2015), Table 1.

demand as households reduce their debt. However, if monetary policy rates cannot be lowered sufficiently during the decumulation phase, for example due to a zero-lower bound or for other reasons, macroprudential policy becomes relevant.

Korinek & Simsek (2016) find that the greater the deleveraging, the greater the recession in the decumulation phase. This is not obvious, because deleveraging means that liquid wealth is transferred from borrowers to lenders; borrowers repay their loans and thereby transfer wealth to savers/lenders. Someone else (the lenders) now owns the wealth that the borrowers previously owned, but the amount of total wealth in the economy has not changed. So why would greater deleveraging lead to greater recessions? In the Korinek & Simsek (2016) model, aggregate demand falls during periods of deleveraging if the marginal propensity to consume is higher for borrowers than for lenders, which is a reasonable assumption. This has the interesting implication that the optimal macroprudential intervention depends on the difference between the MPCs of borrowers and lenders. The larger this difference is, the higher the tax/restriction on borrowing during the accumulation phase.

Finally, Korinek & Simsek (2016) analyse whether central banks could raise interest rates as an alternative to introducing BBMs in order to prevent the accumulation of debt in the first place. In their model, a higher interest rate – perhaps somewhat counterintuitively – increases debt. The reason is that a higher interest rate reduces current production, which increases the incentive for households to borrow in order to smooth consumption. In addition, a higher interest rate transfers more wealth from borrowers to lenders. This could encourage borrowers to borrow even more to maintain consumption. Although the latter implications may seem surprising, they lead to the interesting conclusion that an interest rate increase during the accumulation phase is less effective in reducing debt than a BBM measure and thus supports the introduction of BBMs.

Fahri & Werning (2016) also discuss the external effects of aggregate demand, which are not internalised by the individual households, as a reason for the introduction of macroprudential instruments. Fahri & Werner (2016) come to similar conclusions as Korinek & Simsek (2016), i.e. that macroprudential measures to limit borrowing during a credit boom can increase welfare by reducing the severity of a future macroeconomic crisis. In addition to liquidity traps that prevent monetary policy from responding optimally to the shock in the decumulation phase, Fahri & Werner (2016) analyse other examples where monetary policy is constrained. For example, monetary policy is usually constrained when a country pursues a fixed exchange rate policy. Macroprudential instruments become a second-best option to regain monetary policy autonomy in such situations.

Jean & Korinek (2019) model a situation in which the individual borrower does not internalise the effects of his actions on the opportunities of other borrowers, i.e. there is an externality. More specifically, a borrower who has more liquid assets during an economic downturn not only relaxes his own borrowing constraint, but also the borrowing constraint of other borrowers. This is because there is a positive relationship between asset prices and credit flows in the Jean & Korinek (2019) model. When a borrower reduces his/her debt, asset prices in the economy fall, reducing the liquid assets of other borrowers. If this spillover effect is not internalised, it can lead to borrowers taking on more debt in the accumulation phase than is socially optimal. A time-consistent policy can impose a cyclical tax on debt to prevent borrowers from taking on too much debt in the accumulation phase. The optimal intervention

(tax or macroprudential policy) is countercyclical, Jean & Korinek find: it is high during the boom but can be relaxed during the downturn. As crises are rare events, Jean & Korinek also emphasise that the tax should not be too high.

As a final example, Bianchi and Mendoza (2019) use a model that is in the spirit of the financial accelerator models originally developed by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997). In a financial accelerator model, borrowers are confronted with a collateral constraint. This may be, for example, a loan-to-value limit imposed by a bank. Households can pledge their house as collateral, but can only borrow up to a certain fraction of the value of the house. When the restriction kicks in, market participants sell assets, causing asset prices to fall, i.e. a negative feedback loop between asset sales and borrower capacity. The externality is that borrowers do not internalise how their lending decisions in good times negatively affect asset prices via distress sales in bad times when the borrowing constraint is binding. Bianchi and Mendoza (2019) show that a macroprudential debt tax can offset this externality. This is a time-varying intervention that is levied in good times, i.e. when the borrowing constraint is not binding but there is a positive probability that it will be binding in the following period. Bianchi and Mendoza (2019) concede that such a tax could be difficult to implement in practise, which is why they also analyse a simpler macroprudential Taylor rule. This levies a tax on debt if debt is high in relation to a target value. Bianchi and Mendoza (2019) find that such a policy reduces the likelihood of financial crises.

4. Cross-country macroeconomic studies of BBMs

Theoretically, then, borrower-based measures can in certain situations (if there is an otherwise unaddressed financial externality) improve economic welfare. But what are the experiences with BBMs? How have they worked? In recent years, a number of studies have been published on the impact of BBMs. In this and the following two sections, I provide a selective review of the literature. It is a selective rather than a comprehensive review, as I deliberately focus on studies that help me answer questions posed by the FI, which I return to in Section 7. In particular, I focus on studies that pay attention to the effects of borrower-based measures and pay less attention to studies that examine other macroprudential measures. In this section I review the results of cross-country studies, in the next section I look at single-country studies that do not rely on full-scale household-level data, and in Section 6 I review studies that use comprehensive household-level data.

Kuttner and Shim (2016) is a representative cross-country study. They examine how different types of macroprudential regulation, including LTV and DSTI restrictions, affect the growth rate of housing credit and house prices. House prices are either national price indices or indices from major cities. The authors analyse 57 countries, with data going back to the 1980s in some cases. They find that tighter LTV and DSTI restrictions significantly reduce housing credit growth after four quarters. DSTI restrictions have the largest impact, while LTV restrictions have a smaller effect. LTV and DSTI restrictions have no significant impact on house price growth, the authors conclude.

Cerutti, Claessens and Laeven (2017) is a related study. They analyse an even larger sample of countries, 119 in total, but over a shorter period of time, namely 2000-2013, and similarly examine the impact of different macroprudential policies on credit and house price growth. Of the 12 different macroprudential measures the authors analyse, borrower-based measures appear to be the most effective in reducing credit growth, both total credit growth and

household credit growth. On the other hand, borrower-based measures do not seem to affect house price growth. Finally, the authors find that restrictions are more effective in boom times, i.e. they reduce credit growth more effectively in boom times than in bust times.

Other studies that examine cross-country evidence include Crowe et al. (2013), who find that LTV ratios can curb property booms, Dell'Arreccia et al. (2012), who find that macroprudential measures can curb credit booms, and Alam et al. (2019), who find that LTV restrictions reduce lending to households but have no effect on house prices.

So BBMs reduce credit growth, but what are their macroeconomic costs? Richter, Schularick and Shim (2019) investigate whether changes in loan-to-value ratios affect monetary policy outcomes such as output growth and inflation in addition to their impact on credit growth. They analyse a panel of 56 countries. Like the studies mentioned in the previous paragraphs, they find that tighter LTVs have relatively large negative effects on credit growth. Their main new finding is that LTV restrictions appear to negatively affect output growth, but the effect is small, the authors argue. They find that a 10-percentage point reduction in the maximum loan-to-value ratio reduces output growth by about 1 per cent after four years, but the effect is imprecisely estimated. The authors mention that this effect is comparable to the effect of a small change in the monetary policy interest rate of 0.25 percentage points. In other words, Richter, Schularick and Shim (2019) conclude that policymakers can achieve a significant reduction in credit and house price growth through macroprudential measures that lower LTV ratios. The costs of such a policy are low, as it only leads to slightly lower economic activity, and this latter effect is even estimated imprecisely.

However, there could be other negative effects of BBMs. Using the same dataset as Cerutti, Claessens and Laeven (2017), Frost and van Stralen (2018) find a weak positive cross-country correlation between LTVs and income inequality, measured as a lower income share for lower income deciles and a higher income share for higher income deciles. Frost and van Stralen (2018) therefore conclude that stricter LTVs and higher inequality are correlated, but emphasise that their results are merely correlations and not necessarily causal.

Overall, thus, cross-country studies suggest that borrower-based measures can limit credit growth in the household sector, while some, but not all, find that they are effective in influencing house price growth. The measures appear to be associated with low macroeconomic costs.

5. Single-country studies without full-scale comprehensive household data

The advantage of cross-country studies such as those mentioned in the previous section is that they provide the average effect of BBMs in many countries, i.e. results are not country specific. On the other hand, cross-country studies are subject to a number of caveats, not least with regard to identification and endogeneity. In this section, I discuss studies that address identification and endogeneity by examining individual countries and try to carefully identify the effect of a particular BBM intervention. This allows researchers to make before-and-after estimates and control for confounding effects more accurately than in cross-country panel regressions. The studies mentioned in this section typically do not have access to full-scale detailed information on many household characteristics but focus on the effects of BBMs on

house prices and housing/mortgage-related variables. In the next section, I look at studies that analyse detailed household data.

Tzur-Ilan (2023) is a careful study of the effects of introductions of LTV limits in Israel in 2010 and 2012.[4] The 2010 intervention increased the risk weights that banks apply to mortgage loans depending on the borrower's loan-to-value ratio, while the 2012 reform imposed strict LTV limits on borrowers. Tzur-Ilan (2023) finds that the imposition of LTV limits lowered borrowers' LTV ratios, i.e. reduced household indebtedness, as the regulation intended to do. At the same time, however, borrowers had to pay a higher interest rate, meaning that the financial resilience of households did not improve. Tzur-Ilan argues that this happened because borrowers resorted to other, unregulated forms of credit to make up for the lack of access to enough regulated mortgage loans. Tzur-Ilan (2023) also notes that the LTV limit prompted borrowers to buy smaller houses and houses further away from Israeli centres and in lower ranked neighbourhoods. Ultimately, Tzur-Ilan (2023) concludes that it is unclear whether or not the financial resilience of Israeli borrowers has increased. Without taking a clear position, as the paper did not explicitly test this, Tzur-Ilan (2023) suggests that welfare may not have increased.

Peydró et al. (2023) is another interesting study. They study introduction of LTV limits on lenders in the UK in 2014. The particularly neat feature of the study is that it examines the effects of BBMs both during a boom and a bust; Remember from Section 3 that BBMs should optimally be implemented during booms to lessen negative feedback loops during busts. Peydró et al. (2023) find that the LTV restriction lowered credit to low-income households. It also affected house prices. Area affected by the intervention experienced lower house price growth during booms, and – importantly – a lower cooling of house prices in affected areas following the negative economic shock of the UK Brexit decision in 2016. Also, low-income households in affected areas experience lower default rates after the negative Brexit shock. Hence, the authors conclude, the intervention dampened the housing cycle, as it was supposed to do.

Wong et al. (2011) provide a detailed overview of the LTV measures introduced in Hong Kong. Hong Kong was one of the first countries to start using LTV restrictions to dampen housing markets. Nielsen (2019) also analyses Hong Kong. He uses variations in LTV limits resulting from the anchoring of LTVs to house values. He finds that stricter LTVs reduce property price growth: lowering the LTV by one percentage point reduces house price growth by 0.8 percentage points. In a related study, Igan & Kang (2011) analyse the regional differences in LTVs in South Korea. Chi, LaPoint and Lin (2023) also analyse the effects of regional LTV limits, studying data from Taiwan where authorities have introduced LTV limits in neighbourhoods with high house-price growth. They find that the restrictions had a dampening effect on house prices. They also find that stricter LTVs reduce property price growth. Gatt (2023) describes the cases of LTV introductions in Ireland and New Zealand, but without statistically assessing their impact. Kiarelly et al. (2020) examine the introduction of LTVs in Brazil in 2013, finding that borrowers purchased more affordable homes, made larger down payments and were less likely to default 12 months after purchasing the home. Finally, BIS (2023) gathers lessons learnt from the experience of borrower-related measures in 14 countries,

[4] In an accompanying paper, Laufer and Tzur-Ilan (2021) find that the 2010 LTV reform in Israel lowered house prices by about 2.5%.

as assessed by the relevant authorities themselves. Of the 14 countries, 12 countries have LTVs in July 2023, 8 countries have DSTIs, 3 have DTIs and 7 countries have amortisation requirements. The report concludes that clear and transparent communication of the benefits and costs of BBMs helps to promote understanding of their implementation. Another conclusion is that LTV restrictions are less effective in promoting borrower resilience but effective in promoting lender resilience, while DSTI restrictions are more effective in promoting borrower resilience. Finally, the report contains 14 sub-reports, one for each country, which contain conclusions from the authorities of the participating countries on their own experiences with BBM.[5]

6. Studies analysing comprehensive microlevel household data

While the papers discussed in the previous section on individual countries' experiences with borrower-based measures often allow for a clean identification of BBMs' impact on household borrowing and house-price growth, they do not address issues such as how BBMs affect different socio-economic groups (people of different genders, high vs. low-income groups, young vs. elder individuals, etc.). Also, the studies do not address the impact of BBMs on household wealth and debt components, and household consumption, all of which are important when discussing the impact of BBMs on welfare.

Analysing the impact of BBMs on the asset and debt composition of different types of households requires very comprehensive data at the household level. In recent years, studies have begun taken on this task. Two recent comprehensive studies are Bekkum et al. (2023) and Aastveit et al. (2022), the first study analysing Dutch data, the second Norwegian.

Bekkum et al. (2023) analyse the introduction of a loan-to-value limit of 106% in the Netherlands in 2011 and how it affected first-time buyers. The study conducts differences-in-difference regressions, i.e. it compares the post-intervention behaviour of people affected by the reform to the behaviour of people who are not affected by the intervention. Bekkum et al. (2023) find that the introduction of LTV limits reduced the rate at which renters become first-time homebuyers, i.e. some renters had to postpone buying their first home due to the restriction. They also find that mortgage debt is concentrated right at the maximum loan-to-value ratio, which implies that some households borrow less than they would have done without the restriction. The authors also find that the LTV ratios of affected first-time homebuyers fall by about 5 per cent because they buy cheaper houses and take on less mortgage debt after the restriction. Most importantly, Bekkum et al. (2023) find that affected homebuyers engage in a trade-off between solvency and liquidity. Affected households become more solvent (have less debt) as a result of the LTV restriction, but also use more of their liquid assets to buy a house. The lower liquidity is a negative consequence of the LTV reform, as it means that the affected households have fewer liquid assets to cover unforeseen expenses. Despite lower liquidity, Bekkum et al. (2023) find that the affected households are more

[5] In addition to papers mentioned in the text, a number of studies from central banks and related bodies exist, examining individual countries' experiences with BBMS and typically finding that BBMs reduce credit growth, such as Epure et al. (2017) for Romania, Dirma and Karmelavičius (2023) for Lithuania, Caloia (2022) for the Netherlands, Cesnak Klacso, and Vasil (2021) for Slovakia, Neugebauer, Oliveira, and Ramos (2021) for Portugal, and IMF (2023) for Germany. Galán and Lamas (2023) show that LTV limits in Spain were not effective because banks used inflated house values when calculating LTVs. Han et al. (2021) find that increased downpayments for homes selling for more than $1m in Canada increased bidding for such homes.

financially resilient after the reform. Finally, the authors note that affected households do not accumulate less wealth in the longer term. This means that affected households, even if they enter the housing market later, are not financially worse off in the longer term. Overall, Bekkum et al. (2023) find that the Dutch LTV restriction improves the financial resilience of households at low economic cost.

Aastveit et al. (2022) analyse the introduction of a loan-to-value ratio of 90% in Norway in 2010 and a further reduction to 85% in 2011, focusing on the last intervention (2011).[6] Aastveit et al. (2022) also use dif-in-dif regressions to compare how the intervention affected some households compared to unaffected households. They find that, as a result of the reform, affected households enter the housing market later, have lower loan-to-value ratios, and house prices and household interest expenditures fall. In other words, households are more solvent after the reform. On the other hand, affected households use more of their liquid assets to make larger down payments when buying a home, which means that households have smaller financial buffers (less liquid assets). Like Bekkum et al. (2023), Aastveit et al. (2022) thus find that affected households engage in a trade-off between solvency and liquidity: The introduction of LTV requirements has a positive effect on household indebtedness but a negative effect on household liquidity. To quantify the net effect on household resilience, the authors calculate marginal propensities to consume (MPC) out of income and wealth shocks. They find that household consumption reacts more strongly to shocks after the reform, something I return to in Section 7.2. Aastveit et al. (2022) end up with a negative assessment of BBMs: "Our results suggest that LTV caps are unlikely to improve financial stability if the main objective of regulators is to increase the resilience of household demand."

Kabas and Roszbach (2023) examine the impact of the 2011 reduction in the loan-to-value ratio (from 90% to 85%) in Norway on the labour market performance of households. Kabas and Roszbach (2023) find that the reduction of the LTV has reduced the indebtedness of affected borrowers. When new homeowners have a lower debt-to-income ratio and lower debt servicing costs, they can afford to spend more time looking for the right job when changing jobs. Kabas and Roszbach (2023) find that households affected by the LTV limit do indeed earn higher wages. LTV restrictions and the resulting lower household debt thus enable people seeking jobs to achieve better labour market outcomes (higher wages).

Eerola, Lyytikäinen, and Ramboer (2023) study LTV restrictions in Finland and find that the restriction caused a 17% reduction in transitions into first-time ownership of apartments, in particular affecting low-income households. Also, affected households substitute mortgage debt with other forms of debt.

Finally, Acharya et al. (2022) analyse the loan-to-value and LTI limits introduced in Ireland in 2015. They find that lending shifts from low-income to high-income borrowers and from 'hot' (regions where house prices are rising sharply, typically urban areas) to 'cool' housing markets following the introduction of LTV limits.

7. Addressing specific questions from the FI

Finansinspektionen (FI) has commissioned this report to discuss a specific set of issues. Based on the analyses in the previous sections, this section addresses these questions.

[6] Subsequent changes to the maximum LTV ratios have been implemented in Norway. The authors analyse the consequences of the first two.

7.1. Under what conditions can the existence or introduction of BBMs reduce households' vulnerability to economic shocks?

The theoretical literature presented in Section 3 finds that BBMs have the potential to improve economic welfare if they address an externality that would otherwise remain untouched. The externality that is analysed in most papers is that households reduce their debt in a negative phase of the housing cycle, i.e. they reduce their consumption relative to income in order to pay off debt. This reduction in consumption reduces overall demand in the economy and thereby affects the incomes of other people. The important point is that households in the decumulation phase reduce consumption because they accumulated too much debt in preceding accumulation phase; they accumulated too much debt from a societal perspective, even though they behaved rationally from an individual perspective. A BBM intervention can improve welfare if it leads to households accumulating less debt in the first phase. With less debt, households can go through a bad phase of the housing cycle without reducing consumption.

Another insight from theoretical work is that BBMs are particularly useful when monetary policy is constrained. Such constraints can arise from a liquidity trap (due to interest rates being close to zero) or for other reasons. In general, the less monetary policy can be used to address financial stability problems, the more suitable BBMs are. A final insight from the theoretical papers that is worth repeating here is that the optimal intervention might be time-varying, i.e. that the constraint on lending that the intervention represents is harsher in good times in housing markets and weaker in bad times.

Turning to empirical evidence, the BIS (2023) report mentioned in Section 5 highlights that one finding from the use of BBMs in 14 different countries is that LTV limits are good at improving lender resilience, while DSTI limits are good at improving borrower resilience. The reason is that while a LTV limit restricts household debt, it may not improve household financial resilience. DSTI limits, unlike LTV limits, are aimed at households' debt servicing capabilities, as DSTIs stipulate that households cannot use more than a certain proportion of their income to service debt. According to BIS (2023), this is a more precise way to improve household resilience. On the other hand, a LTV limit is preferable if the regulator aims to strengthen the resilience of lenders. This is because a LTV ensures a certain level of collateral that protects the lender if the borrower is unable to pay. Overall, therefore, different types of BBMs have different effects on different actors in financial markets, which the regulator must take into account when choosing the specific BBM.

Tzur-Ilan (2023) finds that household interest expenditure increased after the introduction of a loan-to-value ratio in Israel, as mentioned in Section 6. This suggests that LTVs are only effective if they are not circumvented by people taking on other types of debt. This is related to the finding in Hull (2015) that households could circumvent LTV restrictions by refinancing their mortgage more frequently.

Another important finding from the literature is that households respond to increasing loan-to-value requirements by reducing their holdings of liquid assets, as both Bekkum et al. (2023) and Aastveit et al. (2022) find. This is because households make larger down payments when they cannot borrow as much money as before the introduction of a loan-to-value limit. Bekkum et al. (2023) and Aastveit et al. (2022) differ in their assessment of this trade-off between liquidity and solvency, but the trade-off at least introduces the possibility that

households' resilience is reduced by a LTV restriction. Regulators need to take this into account when introducing LTV limits. If a BBM can improve households' solvency without reducing their liquidity, or the other way around, the likelihood that the BBM reduces households' sensitivity to shocks improves.

7.2. Under what conditions might they (BBMs) have the opposite effect, i.e. increase households' vulnerability to shocks?

If a BBM provides households with fewer resources to cope with shocks, this can lead to lower welfare. This is probably best explained by referring to the results of Aastveit et al. (2022). Aastveit et al. (2022) recognise that there are at least two types of shocks that we want to assess: How do households respond to income shocks and how do they respond to wealth shocks?

As Mian, Rao and Sufi (2013) show, households with higher debt/higher leverage adjust their consumption more in response to shocks to house prices. They find that for a given change in housing wealth, household access to credit is more constrained for households with higher leverage, i.e. the credit constraint channel works more strongly for households with higher leverage.

LTV ratios reduce household leverage. Therefore, LTV constraints could reduce households' response to housing wealth shocks, i.e. could make households more resilient.

On the other hand, as Aastveit et al. (2022) note, households might reduce their liquid assets if loan-to-value limits apply. And lower liquidity means that households react more strongly to income shocks, as Fagereng, Holm and Natvik (2021) find. Consequently, the MPC of households in relation to income shocks is higher for households with lower liquidity. The reason for this is that households who have only few liquid assets must adjust their consumption relatively more when faced with income shocks.

Thus, there are two (interrelated) conditions under which BBMs could reduce household resilience to shocks. If (i) the increase in MPC due to income shocks (which is caused by the LTV) outweighs the reduction in MPC due to housing wealth shocks (which is also caused by the LTV), then a BBM makes households less resilient. If (ii) income shocks are more prevalent in the economy than housing wealth shocks, then the end result of a BBM could be that welfare decreases because consumption volatility increases. In their evaluation of the Norwegian experience with LTVs, Aastveit et al. (2022) find that the increase in affected households' income MPC is greater than the decrease in affected households' wealth MPC, making households overall less resilient.

This discussion also refers to the choice of a particular BBM. All other things being equal, a LTV constraint reduces household indebtedness and should therefore improve households' resilience to property wealth shocks. A DSTI constraint, on the other hand, aims to ensure that households do not spend too much of their current income on debt servicing, i.e. households are left with a larger portion of income that they can use to cover sudden expenses or income shocks. In other words, a DSTI restriction would be expected to increase households' resilience to income shocks. Finally, an amortisation requirement, like in Sweden, means that people must spend a certain amount of their income on debt repayment. All else equal, this leaves households with fewer liquid funds to cover unforeseen expenses. In other words, an amortisation requirement could be expected to reduce households' resilience to income shocks (increase the MPC to income shocks). Whether this increases or decreases the

overall resilience of households depends on what happens to the amount of borrowing. If an amortisation requirement causes people to borrow less, then their resilience to property wealth shocks increases, offsetting their lower resilience to income shocks.

7.3. How and when, if at all, should BBMs be used to stabilize the macroeconomy?

As mentioned above, the main message of the theoretical literature is that BBMs can be useful when they address an externality that would otherwise not be addressed, and especially so when monetary policy is constrained. In addition, some papers argue that macroprudential interventions should be time-varying, i.e. strict in periods when risks accumulate and less strict in downturns.

So, the recipe is something like this. First, the regulator must consider who the intervention should primarily affect: lenders or borrowers? Next, the regulator should think about what types of shocks are most important to them – income shocks or housing wealth shocks? These considerations will influence what type of intervention is appropriate, i.e. whether a LTV limit, a DSTI restriction or a repayment restriction is best suited to tackle the externalities. Once the regulator has decided on a suitable macroprudential intervention, it should consider whether the intervention can be made time-varying, i.e. more stringent in boom times and less stringent in recession times. This requires the regulator to take a position on what policy rules should be used to determine when the economy/housing market is booming and when it is busting. Such a rule needs to be as clear and transparent as possible so that it can be communicated and understood by the general public.

7.4. What are possible methods to evaluate welfare costs of BBMs?

Welfare costs can be measured in theoretically calibrated models and empirically. I will focus on empirical measurements.

This question from the FI asks specifically about the "welfare costs" of BBMs. In economic models, we assume that people strive for a high and stable path of consumption. We do not expect BBMs to influence long-term consumption levels, as long-term consumption is determined by factors that influence long-term economic growth, such as productivity and its determinants, and BBMs are not considered such a factor here. BBMs that improve welfare should therefore be interventions that reduce the volatility of consumption over the business or housing cycle.

Cross-country studies on the effects of BBMs were mentioned in Section 4. Most of these studies address the question of whether BBMs reduce credit and house price growth and generally conclude that they do. It is perhaps somewhat surprising that there does not appear to be a cross-country study examining how BBMs affect consumption volatility.

As mentioned above, there are problems in cross-country studies when it comes to determining the impact of BBMs on economic welfare. For instance, lower credit growth (that cross-country studies find BBMs are associated with) cannot be a goal in itself, at least when it comes to effects on economic welfare. As the theoretical work mentioned in Section 3 shows, optimal policy is time-varying, i.e. it should reduce credit growth when this is too high, but not restrict credit growth when it is too low. After all, in bad times you want credit markets to help people smooth consumption. If a BBM slows credit growth when credit growth is already (too) low, the policy is not working properly. So, overall lower credit growth cannot be a goal in itself.

For BBMs to be welfare improving they must reduce credit growth when it is "too high", i.e. address the externality directly, not reduce credit growth at all points in time.

Impact identification is thus best achieved in carefully designed analyses that use household-level data. Such data make it possible to identify the people affected and see how their behaviour changes after the intervention compared to a group of people who are not affected by the intervention.

The "perfect" study would be one in which there was a crisis immediately before the introduction of a BBM and a crisis immediately afterwards. One could then examine whether the consumption of those who would have been affected by the BBM if it had been in place reacted more strongly (fell more sharply) during the first crisis than their consumption did during the next crisis, i.e. after the BBM was introduced. This would be a neat test of how BBMs prevent homeowners from reducing their consumption when faced with negative shocks.[7]

Unfortunately, such a test seems hardly feasible, as it requires crises before and after the introduction of BBMs and high-quality microdata.[8] As an alternative, the researcher can estimate how affected people would adjust their consumption in response to shocks in general, i.e. not to crises but to general shocks, before and after the introduction of BBMs. This is what Aastveit et al. (2022) do. They, as mentioned earlier, estimate income and wealth MPCs, i.e. how much households adjust their consumption when either income or wealth changes. Aastveit et al. (2022) compare the MPCs of households that would have been affected by BBMs before their introduction with the MPCs of households affected by BBMs after their introduction and find that income MPCs of affected households increase while wealth MPCs decrease. As mentioned, Aastveit et al. (2022) find that income MPC increases more than wealth MPC decreases, so that households overall are more affected by shocks after the introduction of the BBM. This is a neat way to test the welfare effects of BBMs.

If the data allow, the researcher could then test for distributional differences in these MPC changes. For example, whether the MPCs (income and wealth) change more for young people, old people, rich people, poor people, etc. This would give an indication of which population groups benefit from the BBMs. However, again, the data requirements for such a detailed analysis are immense.

In this section I have discussed 'economic welfare' in terms of consumption volatility, as this corresponds to what theoretical models that analyse BBMs do and how economists usually think about 'welfare'. However, one could extend the concept of 'welfare' to other aspects that regulators consider important for peoples' well-being. This means that the researcher could

[7] Using Danish household data, Andersen et al. (2016) show that households that were highly leveraged before the financial crisis in 2008-09 cut consumption more after the crisis than less leveraged households. If one could repeat that analysis during a crisis occurring after BBMs have been introduced, and then compare the changes in consumption for affected households, then this would seem to be an almost perfect way to investigate if BBMs improve welfare.

[8] Data requirements are extensive, as the researcher needs access to both financial data and other household level data. Minimum requirements are data on debt characteristics, such that affected and non-affected households can be identified, and consumption data. Typically, researchers back out consumption from income and balance sheet data, see Andersen et al. (2016), Fagereng, Holm and Natvik (2021), Aastveit et al. (2022), and Larsen et al. (2023), meaning such data are also needed.

use household data and the identification of treatment and control groups before and after a BBM intervention to examine how BBMs affect things other than consumption. The list is long. Relevant questions could include how BBMs affect first-time home purchases, effects on various items on the household balance sheet (assets and liabilities), arrears on loans, etc. Bekkum et al. (2023) have made considerable progress on these issues. One can also broaden the scope to include, for example, labour market outcomes, as Kabas and Roszbach (2023) do. Extensive research has also shown that homeownership affects the health of people and the economic success of children whose families live in their own homes (Dietz and Haurin, 2003; Haurin, Parcel, and Haurin, 2002). By delaying and possibly even limiting the decision of some families to purchase a home, BBMs could impact broader social outcomes in families. One could imagine that buying a house and the decision to raise a child are related. So do BBMs, because they postpone the purchase of the first home, also postpone the point at which first-time borrowers have their first child? BBMs could also affect where people buy a home, as reported by Acharya et al. (2022) and Tzur-Ilan (2023). If this is the case, it could have an impact on the geographical areas that experience greater, respectively lower, demand for their homes following the introduction of BBMs, i.e. one could imagine more economic activity taking place in these areas. Basically, if you go beyond consumption volatility as a measure of 'economic welfare', the list of effects to analyse becomes long.

7.5. How is the regulatory experience with BBMs from your country/countries that you are familiar with from your research?

To answer this question, I will discuss learnings from Denmark, Norway and Sweden, in addition to the discussion in Section 6 on Norwegian household data.

7.5.1 Denmark

The Danish Economic Councils' 2022 Spring Report contains a comprehensive discussion of borrower-based measures, including a review of the international literature, and a discussion of possible effects of Danish regulations. However, the report does not include empirical analyses of the impact of BBMs in Denmark.

Danmarks Nationalbank (2018) contains the results of a small analysis of the effects of stricter BBMs in 2016 in Denmark. The restriction targeted access to high-risk mortgages for borrowers in so-called "growth areas" in Denmark (mainly areas in and around Copenhagen and Aarhus), which had a high DTI. The analysis compares new mortgages in 2016-17, i.e. after the reform, for households in growth areas with those of households outside the growth areas in dif-in-dif regressions. It finds that affected borrowers took out smaller mortgages than comparable non-affected households. The reform also had a modest effect on the DTI ratios of affected households, but it had no effect on who received a loan, nor did it affect house prices. A follow-up analysis, Danmarks Nationalbank (2020), concludes that BBMs have made borrowers more resilient, as first-time borrowers have fewer of the riskiest mortgages and their DTIs are lower. Danmarks Nationalbank (2022) evaluates how different BBMs affect different people. They find that LTV restrictions mainly affect young and less wealthy households, while DTI and DSTI restrictions mainly affect real estate buyers in larger cities. These results thus inform regulators about the appropriateness of different policy tools depending on the goals regulators want to achieve. Cokayne (2019) examines the theoretical impact of tighter LTI and TLV ratios and finds that they can significantly dampen house price volatility. Cokayne et al. (2023) combine simple regressions with simulations of agent-based and general equilibrium

models. Examining Danish micro data, Cokayne et al. (2023) find that stricter LTV restrictions delay the time it takes first-time buyers to enter the housing market. LTV restrictions also reduce the take-up of the riskiest loans. In model simulations, these restrictions lead to lower systematic risk and higher economic welfare as the representative household's consumption is both higher and less volatile, the study finds.

7.5.2 Norway

The two most comprehensive studies on BBMs in Norway are the studies by Aastveit et al. (2022) and Kabas and Roszbach (2023) discussed in Section 6. In addition to these papers, Wold et al. (2023) examine how parental wealth influences individuals' housing market decisions, i.e. whether households with wealthier parents are more likely to become early homeowners and buy more expensive houses. Wold et al. (2023) examine how BBMs affect the importance of parental wealth for housing market decisions. They find that stricter BBMs increase the importance of parental wealth. In other words: When BBMs are strict, having wealthy parents is even more important when it comes to the ability to enter the housing market and the size of the house that can be bought. This suggests that BBMs tend to increase inequality in access to the housing market.

7.5.3 Sweden

Finansinspektionen has published several studies on the impact of different rounds of BBM measures in Sweden using Finansinspektionen's mortgage survey data.

Finansinspektionen (2018) analyses the impact of the introduction of a loan-to-value (LTV) ceiling of 85% in Sweden in 2010 using household data from before and after the reform, i.e. from 2009 and 2011. The authors point out that the data from 2009 is of lower quality than the data from today's mortgage survey, so the results should be treated with caution. Using dif-in-dif estimates comparing affected (treatment) and unaffected (control) borrowers, Finansinspektionen (2018) find that affected borrowers borrow less than they would have borrowed if the restriction had not been implemented. Perhaps somewhat surprisingly, the impact was greatest for households residing outside major cities. What is less surprising is that young and old borrowers are particularly affected. Affected households are buying less expensive homes.

Finansinspektionen (2017) assesses the impact of the amortisation rules introduced on 1 June 2016, according to which "households with a mortgage of more than 50 per cent of the value of their home must repay at least one per cent of the loan each year. If the loan exceeds 70 per cent of the value, the household must repay at least 2 per cent per year" (FI, 2017, page 2). Using dif-in-dif analyses, FI (2017) concludes that affected borrowers took out smaller loans than they would have done without the reform, and that the effect is greatest for households with loan-to-values above 70 per cent. There are no significant geographical differences in this study. The restriction has had the greatest impact on one-person households and young and older households, i.e. middle-aged households are less affected. The restriction has also had some impact on house prices, although this depends on the type of house.

Finansinspektionen (2019a) examines the effects of the tightening of the amortisation requirement, which came into force on 1 March 2017. Compared to the 2016 rule, the new rule means that new mortgage borrowers with a DTI ratio of over 450% will have to amortise one percentage point more of their loan per year than before. Finansinspektionen (2019a) conducts a dif-in-dif estimate of the impact of the new restriction and finds that the average

mortgages of affected borrowers are 8.5% smaller than they would have been without the restriction. People in large cities and single-person households are most affected. Finally, affected households are buying less expensive homes. Finansinspektionen (2019b) uses the same structure as Finansinspektionen (2019a) and analyses how the amortisation requirements have affected home equity withdrawals. They find that the introduction of the amortisation requirement has reduced home equity withdrawals, with homeowners in large cities most affected. The decline in home equity withdrawals therefore also led to lower household mortgage debt.

Svensson (2020, 2021) evaluates and criticises the amortisation rules in Sweden. Svensson criticises two points in particular: (i) that empirical tests do not support the hypothesis that excessive debt accumulation leads to a subsequent decline in consumption, which is the main justification of many BBMs, and (ii) that higher amortisation requirements reduce people's liquid assets, which could make people's consumption more vulnerable to shocks, as Aastveit et al. (2022) have subsequently found.

There is some theoretical work with applications to Sweden. Chen et al. (2021) investigate in a stylised model how BBMs can be implemented to improve outcomes when monetary policy is constrained by the zero-lower bound. When monetary policy is constrained, high homeowner indebtedness can increase economic volatility. The authors find that welfare is improved when BBMs are introduced to reduce household debt in situations with constrained monetary policy. The long-term costs of different BBMs are moderate, while the short-term costs are different for different BBMs. LTI restrictions, for example, are associated with lower short-term costs than LTV restrictions. Hull (2015) analyses how amortisation requirements such as those in Sweden affect household debt. He concludes that such restrictions have only a minor impact on debt, mainly because households in Hull's model can refinance and thus avoid the reduction in debt that the repayment requirements are intended to achieve.

8. Conclusions

Borrower-based measures (BBMs) have the potential to improve economic welfare if they address an externality that would otherwise remain untouched. The theoretical literature on BBMs typically analyses the case where borrowers borrow too much from a societal perspective during a property boom (even if they act rationally from an individual perspective), forcing households to cut their consumption during a property slump. The reduction in consumption affects aggregate demand and thereby other people. If BBMs internalise the externality by reducing household debt in the first place, BBMs could improve welfare. This is especially the case when monetary policy is constrained, for instance, by a zero-lower bound, a fixed exchange rate policy or for other reasons.

The first wave of papers on the impact of BBMs looked at cross-country data and generally concluded that BBMs reduce credit growth. While this is a useful finding, these studies cannot clarify how BBMs affect different population groups, nor whether BBMs increase or decrease the sensitivity of households to shocks - a crucial aspect when it comes to assessing the impact of BBMs on economic welfare. In particular, the finding that BBMs lead to lower credit growth, which is reported in many studies, says nothing about whether this is good or bad. It is good if it reduces "bad" (excessive) credit growth, but if BBMs restrict credit growth even when it is needed to smooth consumption, BBMs could end up reducing economic welfare.

To better understand the impact of BBMs, detailed data at the household level is needed. Studies using such data also conclude that BBMs reduce household debt, i.e. households become more solvent. At the same time, however, the studies have raised awareness of the fact that lower household debt is not the only condition that must be met for welfare to improve. If the sensitivity of households to shocks increases while their indebtedness decreases, it is not clear whether the net effect on welfare is positive or negative. This means that regulators must consider the impact of BBMs on many parts of households' balance sheets, both the liquid and the non-liquid parts, when assessing the effects of BBMs.

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