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The objectives of macroprudential mortgage measures: an exploration

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The objectives of macroprudential mortgage measures: an exploration

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Abstract: Macroprudential policies aimed at preventing excessive build-ups in household mortgage debt can mitigate costly debt deleveraging effects that otherwise amplify economic downturns. These benefits are likely to be especially important for small open economies operating under fixed exchange rates without independent monetary policy. Macroprudential debt limits can also improve the resilience of banks by reducing risk in mortgage portfolios, but these benefits will tend to be undone as capital requirements for banks using model-determined risk weights with fall. Such policies also come with costs as they potentially reduce aggregate consumption outside of crisis periods, and they constrain the borrowing capacity—and hence housing tenure choices—available to some borrowers. The report identifies several channels via which these costs might occur, although there is little empirical work quantifying their overall effects. The paper ends by outlining a potential approach for assessing the macroeconomic costs and benefits jointly, using the so-called "GDP-at-Risk" approach.

[†] This report was commissioned by the Central Bank of Ireland to inform its future deliberations on macroprudential housing debt limit policies. It has benefitted from conversations with, and helpful comments from, Robert Kelly, Vasileios Madouros, Fergal McCann, Martin O'Brien, Sofia Velasco and Fang Yao, as well as comments from seminar participants at the Central Bank of Ireland. All views are my own, however, and do not necessarily reflect the comments from these discussions or the views of the Central Bank of Ireland.
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1. Introduction

History provides us with numerous examples of how boom-bust cycles in housing markets and household debt can generate large economic and social costs. Recognising these costs, central banks and financial regulators in advanced economies began taking a more proactive policy approach to managing housing market risks after the 2008 global financial crisis, employing a range of macroprudential tools for this purpose. While experience with using such tools is growing, several fundamental policy design questions governing their use remain, including: Which tools are most effective? How should they be calibrated? Should this calibration be adjusted over the financial cycle, or are they better used as structural, i.e., fixed, measures? And what are the costs to society associated with these tools?

In January 2021, the Central Bank of Ireland embarked on a review of the policy framework underpinning its macroprudential policies directed at the mortgage market. These measures, first introduced in January 2015, comprise limits on the size of mortgages consumers can obtain via maximum loan-to-income (LTI) and loan-to-value (LTV) ratios on new loans. In particular, for first-time buyers, the maximum mortgage is 3.5 times borrowers' gross income or 90% of the value of the property (up to a threshold), whichever is smaller. Differential limits apply for second and subsequent buyers and buy-to-let investors. To smooth the impact of these limits, the framework includes certain allowances, which permit lenders to extend some proportion of their new lending outside the scope of these limits.[2] See the appendix for details.

This report provides one input into this broader review and focuses on the appropriate objectives of the central bank's macroprudential mortgage policies. Currently, the objectives of these policies as described by the Central Bank of Ireland are two-fold: first, "increasing the resilience of banks and borrowers to negative economic and financial shocks", and second, "dampening the pro-cyclicality of credit and house prices so a damaging credit-house price spiral does not emerge".

The remit for this paper is to examine whether these objectives are appropriate from an economics/financial stability perspective, and to explore potential frameworks for assessing the policies' costs and benefits jointly with a view to informing their calibration. The aim in doing so is to provide a framework to guide the central bank in its future deliberations on these policies. Issues relating to ease of communicating these objectives and their linguistic complexity are outside the scope of the paper; so too are political economy considerations as to whether such policies are best set by independent central banks or by governments.

The paper is organised as follows. **Section 2** presents a simple framework for assessing the costs and benefits of macroprudential mortgage policies. **Section 3** presents evidence from the economics literature on the benefits of such policies, focusing on their impact in reducing debt deleveraging spillovers and in enhancing banking system resilience. **Section 4**

[2] See Kinghan and McCann (2019) for details and an assessment of their impact.

considers the potential economic costs of such measures, including both their macroeconomic impact on aggregate consumption and output outside of crisis episodes, and their distributional impact on different cohorts of households. **Section 5** explores possible approaches for considering costs and benefits jointly. **Section 6** concludes.

2. Cost-benefit framework

We begin our analysis by setting out a proposed framework for assessing policy objectives. This framework is similar to that used in central banks' assessment of the optimal level of system-wide bank capital requirements (see Basel Committee on Banking Supervision (2009) for example).

2.1 Macroeconomic costs and benefits

Our approach takes as its starting point that economic policy measures should be assessed in terms of the overall monetary gains and losses they generate across the economy as a whole – as proxied in this instance by their impact on aggregate consumption over time.

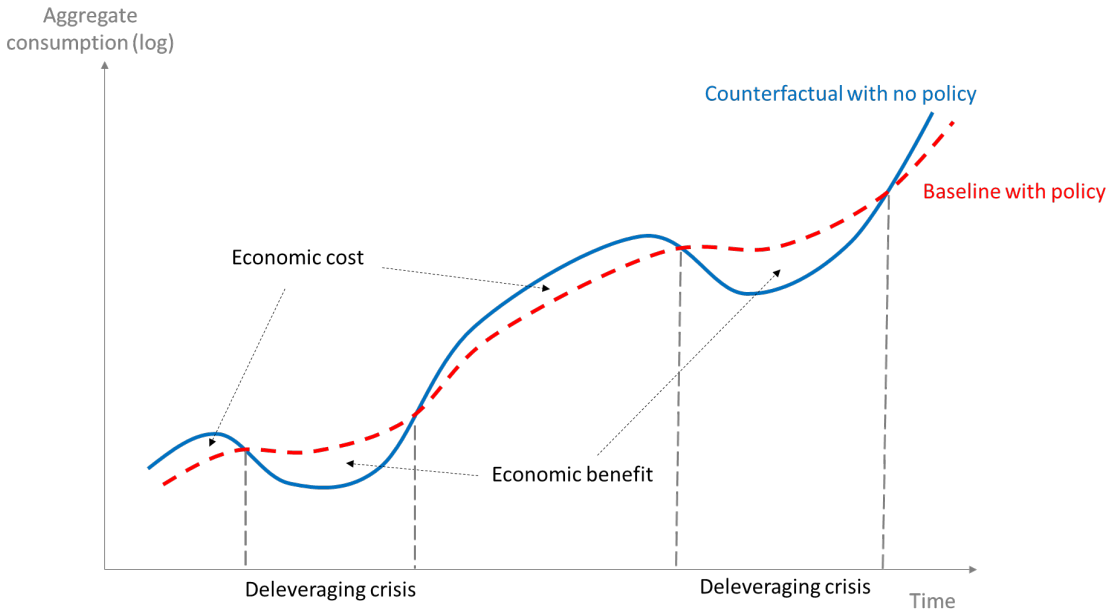
We advocate this macroeconomic perspective for several reasons. First, economy-wide consumption is a proxy for the overall living standards of all Irish households. Second, it aligns with the typical objectives of central banks, which are conventionally expressed in terms of inflation and output stabilisation. Third, it allows us to express the costs and benefits of these policies in the same units, which is necessary in developing a joint assessment framework. And fourth, the approach can be justified on the grounds that if willingness-to-pay among beneficiaries of a policy exceeds willingness-to-accept among those made worse off, there is the possibility of a Pareto improvement where all are better off – conditional on appropriate lump-sum wealth transfers taking place.

Figure 2.1 provides a stylised illustration of the approach. The blue solid line shows the path of aggregate consumption we might expect with no measures in place to limit household indebtedness. Consumption grows over time, but there are occasional deleveraging crises which cause sharp and persistent declines in its level. The red dashed line shows the path of consumption with macroprudential mortgage measures in place. The benefits of these policies manifest themselves in crisis times: these downturns are less severe. Their costs manifest themselves in non-crisis times: consumption is lower in these periods.

The net benefits of the policy are given by the expected present discounted value of aggregate consumption with the policy measures in place less the expected present discounted value of consumption in the counterfactual where they are removed. In terms of **Figure 2.1**, this is the integral of the gaps between red and blue lines appropriately discounted. The task of the policymaker here is to choose a policy setting that maximises

the present discounted value of social welfare provided by the resulting consumption stream, allowing for the possibility of risk averse preferences that penalise volatile paths.

Figure 2.1: Stylised depiction of macroeconomic costs and benefits of macroprudential mortgage policy



It is worth discussing the nature of the economic costs of these policies before proceeding. One benefit of taking a macroeconomic perspective is that it forces us to recognise that pure transfers, while a benefit to the recipient, are zero sum and so do not count as a social benefit. An example of a transfer in this context would be if macroprudential mortgage measures resulted in lower house prices. All else equal, lower house prices per se are not a social cost – the decline in housing wealth for older households is offset by benefits to younger households who will consequently spend less on lifetime housing consumption.[3] This is not to say that changes in house prices do not have knock-on consequences with genuine social costs – for instance, via the effects of lower housing collateral on consumption and investment. A related point is that impacts on particular industries (e.g., the construction sector) do not count as costs unless they depress overall national wealth.[4]

This is not meant to imply that the distributional effects of such policies should be ignored. Macroprudential policies that restrict the quantity of mortgage debt at the household level

[3] Indeed, in models of infinitely lived representative agents enjoying housing consumption, changes in house prices reflect equivalent changes in the net present value of future implicit rental costs, leaving net wealth unchanged. See Buiter (2008) for an articulation of this argument.

[4] Furthermore, a central tenet of welfare economics is the rationale for applying Pigouvian taxes or other regulations in the presence of externalities or other market failures. If such measures reduce an economy's output, this is not in itself a "cost" provided the policy has been calibrated accurately.

undoubtedly benefit some in the population while being costly to others, as we discuss in later sections.

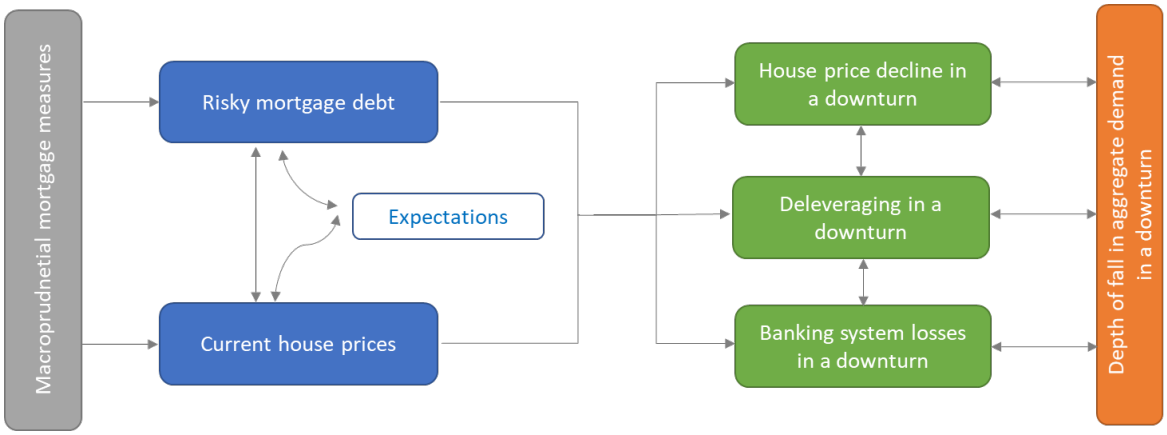
3. The benefits of macroprudential mortgage measures

In this section, we explore channels via which macroprudential mortgage policies can mitigate the damaging effects of boom-bust cycles in housing markets and household debt. As described in **section 2**, the focus in on how these measures can mitigate the severity of economic contractions. We first review conceptual arguments for the beneficial role of such policies, including their impacts on borrower and lender resilience. We then consider empirical evidence on whether such policies deliver such benefits in practice.

3.1 The conceptual case for macroprudential mortgage measures

The channels via which macroprudential policies can generate economic benefits for society are illustrated in **Figure 3.1**.

Figure 3.1: Transmission map of benefits of macroprudential mortgage measures



The primary impact of macroprudential policy is in reducing build-ups of risky mortgage debt. Macroprudential debt limits do this directly, but there is also an indirect effect in dampening feedback loops that operate via rising house prices, easing borrowing capacity and further increasing house price expectations.

The ultimate aim is to reduce the depth of economic contractions. There are three channels via which macroprudential policy can achieve this (show in the green boxes). First, by reducing the likelihood and severity of deleveraging by borrowers with high marginal

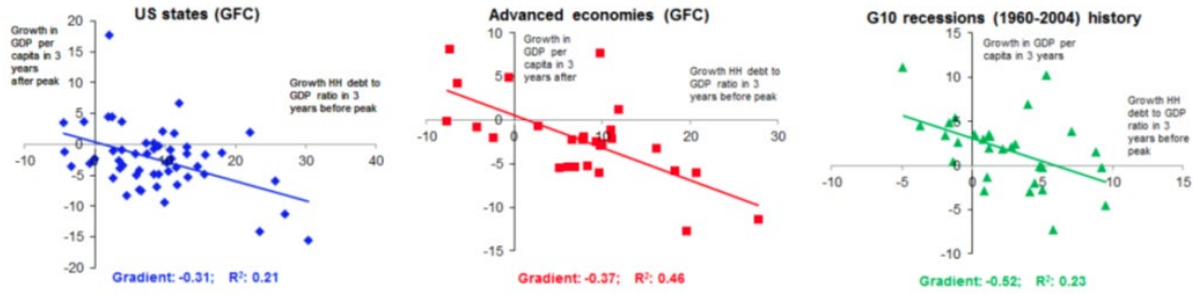
propensities to consume. Second, by reducing the likelihood of sharp house price declines, and their resulting impact of tightening borrowing constraints and triggering further deleveraging. And third, by reducing the likelihood of large banking system losses that risk triggering a bank loan supply crunch. We discuss each in turn.

3.1.1 Debt deleveraging

The first channel we consider via which housing booms can create macroeconomic instability is via the impact of debt on consumer spending. The idea is that highly indebted households may need to cut back sharply on spending during an economic stress, which can amplify an economic downturn.[5]

Consistent with this notion, **Figure 3.2** illustrates the relationship between household debt growth in the years preceding economic downturns and the severity of the subsequent downturn. The larger the increase in the ratio of household debt to GDP in the 3 years preceding a downturn, the weaker the cumulative growth rate of GDP in the 3 years that follow. This reduced form relationship is remarkably strong: it holds across US states (left-hand plot) and across advanced economies (middle plot) during the global financial crisis; it also holds for advanced economies over a longer sample period (right-hand plot).

Figure 3.2: Household debt growth and economic downturns



Source: Aikman et al. (2018)

What mechanisms might explain this relationship? One hypothesis is that it reflects debt overhang dynamics, whereby borrowing constraints tighten in a downturn, forcing highly indebted households to cut spending to pay down debt – an effect that could be exacerbated by voluntary deleveraging by households for precautionary reasons. A related hypothesis is that highly indebted households are more sensitive to tightening credit conditions in a downturn, reducing their cash flow and hence consumption.[6] As we will

[5] This idea goes back (at least) to Mishkin (1977), who argued that household balance sheet effects increased the severity of the 1973-75 US recession.

[6] As pointed out by Svensson (2021), for an economy with independent monetary policy and significant headroom above the effective lower bound, this cash flow effect is a double-edged sword as it also implies a

come on to discuss, these arguments provide a rationale for macroprudential policies that limit household debt booms.

Before expanding on these ideas, we note that other interpretations of **Figure 3.2** are possible. One explanation, which goes back to King (1990) and Pagano (1990), is that the reduced-form relationship reflects excessively optimistic expectations of future income growth in a boom, which then adjust downwards sharply once the downturn begins. Another possibility recently advanced by Svensson (2021) is that the relationship may instead reflect the effects of rising house prices relaxing borrowing constraints in a boom, permitting households to temporarily increase their consumption financed by housing equity withdrawal. When house prices stop increasing, the period of 'over-consumption' ends, and consumption falls sharply. While there may well be an element of truth in both these alternative interpretations, it is unclear whether shifts in expectations or a normalisation of spending alone can account for the depth and persistence of recessions illustrated in **Figure 3.2**.

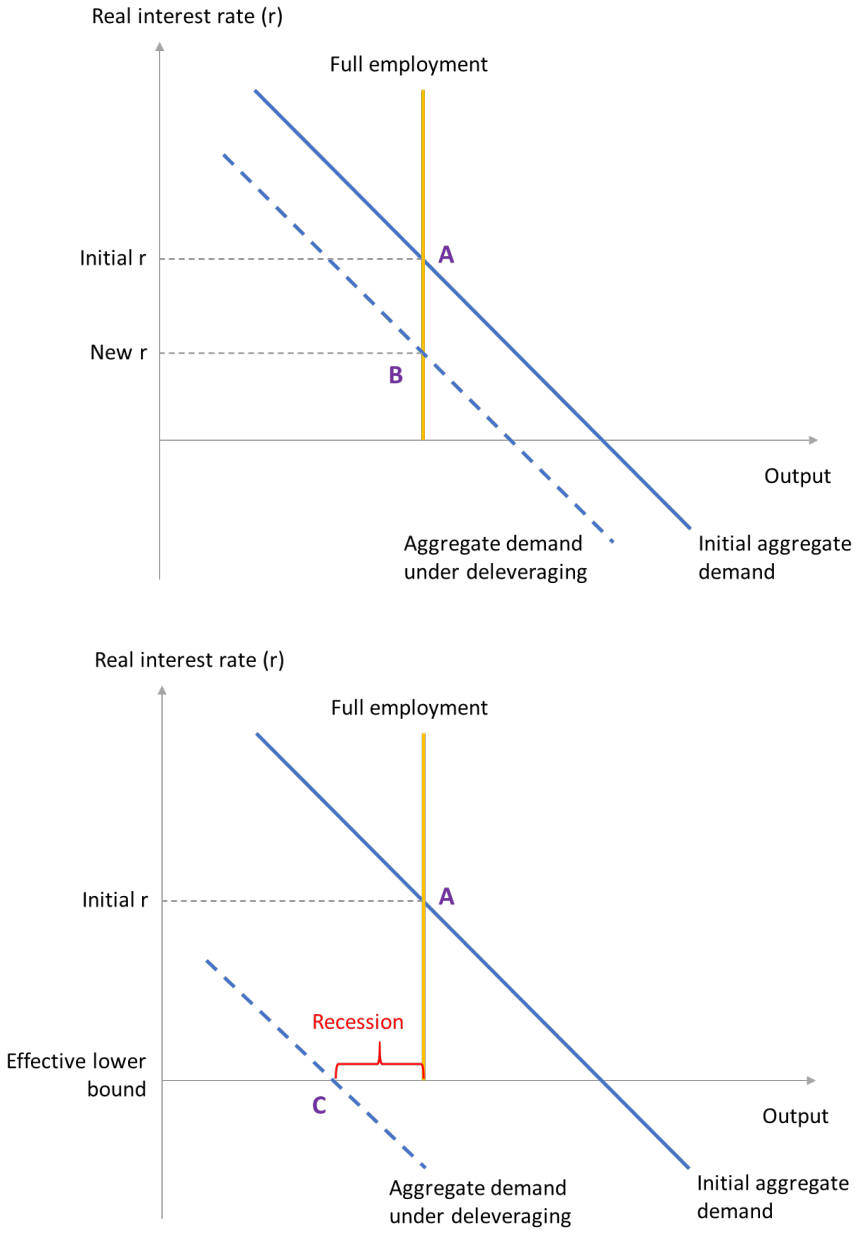
This debt deleveraging channel has been given rigorous conceptual foundations in recent years. In an early contribution, Eggertsson and Krugman (2012) presented a simple model where agents differ in the rate at which they discount the future. Relatively impatient individuals end up as borrowers, whereas the relatively patient become lenders. Borrowers spend aggressively and pile up debt until a realisation that the process has gone too far and an adjustment is required (sometimes referred to as a 'Minsky moment').[7] The economy then moves into a deleveraging phase, where households who have overextended need to pay down their debt. This puts downward pressure on the equilibrium interest rate as savers, who have a lower marginal propensity to consume out of liquid wealth than borrowers, need to be induced to spend enough to sustain full employment. **Figure 3.3** (upper panel) illustrates this process, with the economy moving from point A to B.

If this deleveraging process is sufficiently powerful, the equilibrium real rate can become negative. In this situation, and if prices and wages are sticky, even a central bank operating under a flexible exchange and hence independent monetary policy may find itself unable to cut the interest rate enough to induce sufficient spending by those that are not too deep into debt because of the zero bound. The result is a liquidity trap and recession. This case is illustrated in **Figure 3.3** (lower panel), with the economy moving from point A to C and the recession given by the gap between aggregate demand and full employment output at the effective lower bound.

stronger transmission from cuts in interest rates. But for a small open economy with a fixed exchange, these monetary transmission benefits are not available unless policy rates are being cut in the anchor country.

[7] While Eggertsson and Krugman (2012) model the shock as an exogenous tightening in borrowing constraints forcing borrowers to pay down debt, we might expect a similar effect if "wealthy hand-to-mouth" households – that is, households with substantial illiquid assets but little or no liquid wealth (Kaplan et al. (2014)) – suffer shocks that reduce their disposable income post-mortgage payments.

Figure 3.3: Debt deleveraging process with moderate and high debt



Greater leverage leads to a greater *ex post* reduction in aggregate demand and a deeper recession. This increases the risk of losses to lenders on all forms of lending, including consumer loans and corporate lending. The dynamics illustrated by this model would be more virulent in the case of an economy operating under a fixed exchange rate regime, such as Ireland. Highly indebted households living in a monetary union would need to reduce their outstanding debt by more than in a flexible exchange rate regime because there is less capacity for the central bank to use its monetary policy to ease financial conditions and borrowing constraints. And the impact on aggregate demand will be greater because that the central bank cannot use its monetary policy to stimulate consumption of savers.[8] Added

[8] See Fornaro (2018) for a model of debt deleveraging in a currency union.

to this, the process of "internal devaluation", whereby an economy in a monetary union attempts to restore competitiveness by cutting production costs, can amplify economic costs significantly.

These predictions are consistent with empirical findings on the relationship between household debt and economic performance. For instance, Mian et al. (2017) find that an increase in the household debt to GDP ratio predicts lower GDP growth and higher unemployment in the medium run – an effect which is stronger for countries with less flexible exchange rate regimes.

Korinek and Simsek (2016) extend the Eggertsson and Krugman (2012) analysis by considering the implications for policies that limit borrowing growth *ex ante*.[9] Their key result is that, without public intervention, borrowers will take on excessive leverage, resulting in a deeper contraction in aggregate output in the deleveraging phase than is optimal from a social point of view. The mechanism behind this inefficiency is a so-called "aggregate demand externality". The idea is that households' spending decisions that affect aggregate demand also affect the economy's overall level of output produced and therefore other households' income. Borrowers, even if they behave individually rationally, are unlikely to take these general equilibrium effects into account, leading them to take on excessive debt relative to what a social planner would choose.

This provides a rationale for policies that slow the accumulation of leverage in the boom phase, such as macroprudential policies in the form of mortgage LTI or LTV limits. As argued above, these policies are likely to be particularly valuable in countries with fixed exchange rates as there will be no scope to loosen monetary policy to mitigate the macroeconomic fall-out from deleveraging. Korinek and Simsek (2016) show that such policies can make both mortgage borrowers and lenders better off. While macroprudential policies distort mortgage borrowers' consumption decisions away from levels that would be chosen privately, they also generate first-order welfare benefits because they reduce the decline in output in a deleveraging episode. These benefits are likely to be especially important for households that are more likely to suffer unemployment in a recession.

The concept of borrower resilience in models of this sort relates to the capacity of the household sector to continue spending in the face of a negative shock. This, in turn, is likely to be related to factors such as the burden of servicing existing debt (i.e., interest payments relative to disposable income), and the correlation between debt, borrowing capacity and liquid asset holdings across households.

One factor missing from this model is the role of house prices in amplifying the magnitude of the credit boom. The mechanism here operates via housing collateral: rising house prices increase the value of a household's collateral, expanding their capacity to accumulate debt. If new debt leads to increased effective housing demand, house prices rise, increasing collateral and debt capacity further. This procyclicality can be amplified if expectations are formed in an extrapolative fashion, so that conditional expectations of future values are

[9] See also Farhi and Werning (2013), who distil broader lessons from this literature in a general framework.

based on recent past realisations – a factor that appears to be an important driver of house price dynamics in many countries (Duca et al. (2011)).

This strengthens further the rationale for macroprudential policies that limit build-ups in risky mortgage debt ex ante. Such policies tighten borrowing limits directly and have the indirect benefit of mitigating the procyclical feedback loop between house prices and debt capacity described above. LTI limits are particularly effective in this regard given that borrowing capacity is tied to borrowers' income, which tends to be relatively stable over the cycle; LTV limits are less effective in constraining borrowing among those already with housing equity in an environment of rising house prices unless the calibrated limit is tightened in such periods.

3.1.2 Banking system resilience

One relevant consideration in predicting the magnitude of debt-deleveraging effects on consumption in downturns is the propensity of households to default on their mortgages during periods of economic stress. In economies where legal or institutional forces mean that default is very rare, the effect of a downturn is more likely to be felt through consumption reductions. However, when shocks are large or where the propensity to default is higher, we may see adverse shocks manifest themselves more quickly in terms of mortgage defaults. This alleviates the debt deleveraging channel by transferring more of the risk directly to mortgage lenders. Recent history suggests that Ireland is among the economies where the propensity for mortgage default could be higher.

Given the large direct exposure of the banking system to the housing market, the impact of a wave of mortgage defaults on banks' equity capital and hence loan supply can be significant. Moreover, banking sector resilience issues can spill over into fiscal crises, which themselves can amplify recessions. Despite progress globally in the resolution of banks and attempts to mitigate "Too Big to Fail" issues, the potential for bank capital adequacy concerns to trigger the need for bailouts and associated fiscal retrenchment is a potentially large cost of a household debt-driven boom-bust cycle. Such effects are especially relevant in the Irish case where the government remains an equity shareholder in retail banks as a legacy of the 2008 crisis.

Macroprudential debt limits influence this process via three channels. First, it is well known that the default probability (PD) for a mortgage is influenced by a range of borrower and loan characteristics, including current LTV, LTI, and debt service burden, and these values at the origination of the loan.[10] These are factors that are directly influenced by macroprudential debt limits. Second, macroprudential policy can influence the loss given default (LGD) by ensuring that mortgages are better collateralised, i.e., have lower LTV at

[10] Campbell and Cocco (2015) present a model of households' mortgage default decision which emphases the role of LTV in determining the likelihood of negative equity and LTI and debt service ratios as determining loan affordability.

origination. And third, there is an indirect macroeconomic channel: if these policies mitigate debt deleveraging, economic downturns should be less severe, the volatility in house prices should be lower, improving stressed PDs and LGDs further.

There is substantial empirical evidence on these links, including for the Irish experience. Kelly and O'Malley (2016) find that, in addition to macroeconomic factors, the current LTV and debt service ratio are significant drivers of the transition to default for Irish mortgages. Kelly et al. (2015) present evidence that higher levels of LTV and LTI at origination are associated with subsequently higher default probabilities for Irish households. McCann and Ryan (2016) find that, for a given distribution of house price shocks, the reduction in LTV at origination generated by these policies has reduced the severity of losses on Irish mortgages in the event of default. In addition, they find that the correlation between LTV and loan size has fallen, implying that loans more likely to default are now likely to have smaller balances.

Some of these resilience benefits are likely to be offset by the response of the bank capital framework, however. For banks whose mortgage risk weights are model-based (i.e., those operating under the Internal Ratings-Based approach), the capital they are required to maintain against mortgage exposures is endogenous to the modelled level of PD and LGD. To the extent banks' models factor in the relationships described above, there will be a direct correspondence between tighter macroprudential debt limits and lower capital requirements on mortgages. Indeed, if these models correctly reflect these microprudential relationships, the overall net impact on bank resilience from the direct effect of these policies on PD and LGD will eventually be neutral. Mortgage risk will be lower, but so too will be banks' ability to absorb that risk, leaving resilience unchanged.[11]

One channel that is not automatically "undone" by the Basel capital framework is the beneficial macroeconomic impact macroprudential debt limits have on bank resilience via reducing the severity of economic downturns. But even this could be offset if the macroprudential regulator were to factor this channel into its stress test scenarios, i.e., by making them less severe given the presence of LTI/LTV limits.

The high-level point here is that the impact of macroprudential debt limits on bank resilience rests on the response of the bank capital framework to the reduction in mortgage risk these policies generate.

3.2 Empirical evidence on the benefits of macroprudential mortgage measures

What evidence is there that the application of macroprudential mortgage policies generates the purported benefits identified in the conceptual literature surveyed above? The empirical literature on this question comes in two varieties. First, there is a growing literature assessing the impacts of various macroprudential policies – including those

[11] Of course, this endogenous risk weight effect is not relevant for any banks constrained by the leverage ratio.

targeting the mortgage market – on credit and housing markets. The logic here is that we know from previous research that recessions that follow credit and housing booms tend to be more severe (e.g., Jorda et al. (2015)). If it can be shown that macroprudential actions are effective at stemming such booms, we can infer that there are likely to be resulting benefits in terms of macroeconomic stability. Second, there is a nascent literature that attempts to measure the benefits of macroprudential policy actions directly by analysing whether downside risks to the economy tend to be lower following the implementation of such policies. We discuss each in turn.

3.2.1 Impact of macroprudential policy measures on credit and housing markets

There is now considerable evidence on the effectiveness of LTV and LTI limits in containing mortgage credit growth, and to a lesser extent house price growth.

One of the first such studies was Lim et al. (2011), who study cross-country panel regressions of macroprudential actions taken by 49 countries over the period 2000-2010. They found preliminary evidence suggesting that the presence of policies such as LTV and DTI limits (as well as ceilings on credit growth, reserve requirements, and dynamic provisioning rules) are associated with reductions in the credit growth.

Akinci and Olmstead-Rumsey (2018) provide a more formal analysis on a dataset comprising 57 advanced and emerging economies over the period 2000 to 2013. They construct indices of several macroprudential tools and assess their impact on bank credit growth, real housing credit growth, and real house prices. They find that macroprudential policy variables exert a statistically significant negative effect on bank credit growth and house price appreciation. And that targeted policies intended to limit house price appreciation seem to be more effective, especially in economies where bank finance is dominant. A panel study on a similar dataset by Kuttner and Shim (2016) finds that debt service to income limits are more effective than LTV caps for slowing real house price growth, but both are effective in curbing real housing credit growth.

Cerutti et al. (2017) widen this type of analysis to a dataset comprising 119 countries over the period 2000-2013. Similar to the above studies, their main finding is that the activation of macroprudential policies is generally associated with lower growth in credit – albeit this relationship is weaker in financially more developed and open economies. They also find that the effectiveness of macroprudential policies depends on the state of the financial cycle, and that they work less well in busts.

The most recent and comprehensive such paper is by Alam et al. (2019), who examine 134 countries over the period 1990 to 2016. In addition to broadening the sample, these authors also address potential endogeneity concerns with previous analyses – in particular, if policy tightening occurs amid high credit growth, this could bias downwards the estimated effect of tighter macroprudential policies on credit growth. The authors find strong effects

of LTV actions on household credit; they also find evidence of nonlinearity in the form of declining impacts for larger LTV changes and when the starting LTV level is already tight.

3.2.2 Impact of macroprudential policy measures on tail risk

If macroprudential policy is effective in reducing systemic risk, we might expect these benefits to lead to reduced downside risk of GDP growth. Two recent papers explore this idea by studying the impact of borrower-based macroprudential policy measures for the concept of GDP-at-risk – introduced by the Adrian et al. (2018) and based on the left-hand tail of the probability distribution of future GDP growth.

Franta and Gambacorta (2020) study the impact of changes in LTV limits and other macroprudential policies on GDP-at-Risk. The use the Kuttner and Shim (2016) policy actions dataset, which includes 75 LTV policy changes, with actions classified as 'moderate' or 'intense'. They find that a tightening in the LTV limit influences both left-hand and right-hand tails of the GDP distribution over the medium term, shifting probability mass to the centre and reducing the probability of extreme outcomes. The left-hand tail begins to shrink – implying a smaller probability of severe recessions – 12 quarters after the policy change occurs; the right tail begins to shrink from the 10th quarter.

Using a related approach, Galan (2020) finds that borrower-based policies improve the tail of GDP growth. In contrast, however, he finds that these benefits manifest themselves very quickly after implementation and persist for around 8 quarters before dying away. Importantly, these effects occur only for policy tightenings; the effects of loosenings are more limited.

3.3 Summary

The recent academic literature provides a rigorous rationale for the use of macroprudential policy aiming to prevent excessive household mortgage debt. A key channel highlighted is the tendency for households to take on too much debt in housing booms, leaving them needing to reduce their leverage by cutting consumption in the event of an adverse shock. Borrowers are unlikely to take such macroeconomic effects into account when deciding how large a mortgage to obtain, leading them to take on too much debt. This channel is likely to be especially important for small open economies operating under fixed exchange rates without an independent monetary policy. Limits on mortgage debt via LTI or LTV restrictions are well suited to reducing this externality and improving social welfare.

All else equal, macroprudential debt limits can also improve the resilience of banks by reducing risk in mortgage portfolios. But some of the microprudential resilience benefits will be undone by the bank capital framework, which will endogenously generate lower required capital for banks using model-determined risk weights. The macroprudential

benefits of lower recession severity and house price volatility will not be automatically undone in this way. But if regulators adjust stress test scenarios to reflect these benefits, there is the potential for these gains to be offset as well.

In economies where default propensity is higher or when shocks are larger, the debt deleveraging channel will be alleviated by transferring more of the risk directly to mortgage lenders. Recent history suggests that Ireland is among the economies where the propensity for mortgage default could be higher.

4. The costs of macroprudential mortgage measures

In this section, we explore channels via which the introduction of macroprudential mortgage limits can be costly for society. As described in **section 2**, these costs are likely to manifest themselves as lower consumption in non-crisis periods.

The section is organised as follows. We first discuss potential channels via which these policies might influence aggregate demand and the productive capacity of the economy. We then review the empirical evidence. Finally, we discuss the potential distributional consequences of these policy measures.

4.1 Channels via which macroprudential measures can affect the macroeconomy

The main channels via which macroprudential debt limits can impact aggregate consumption and overall economic activity are illustrated in **Figure 4.1**.

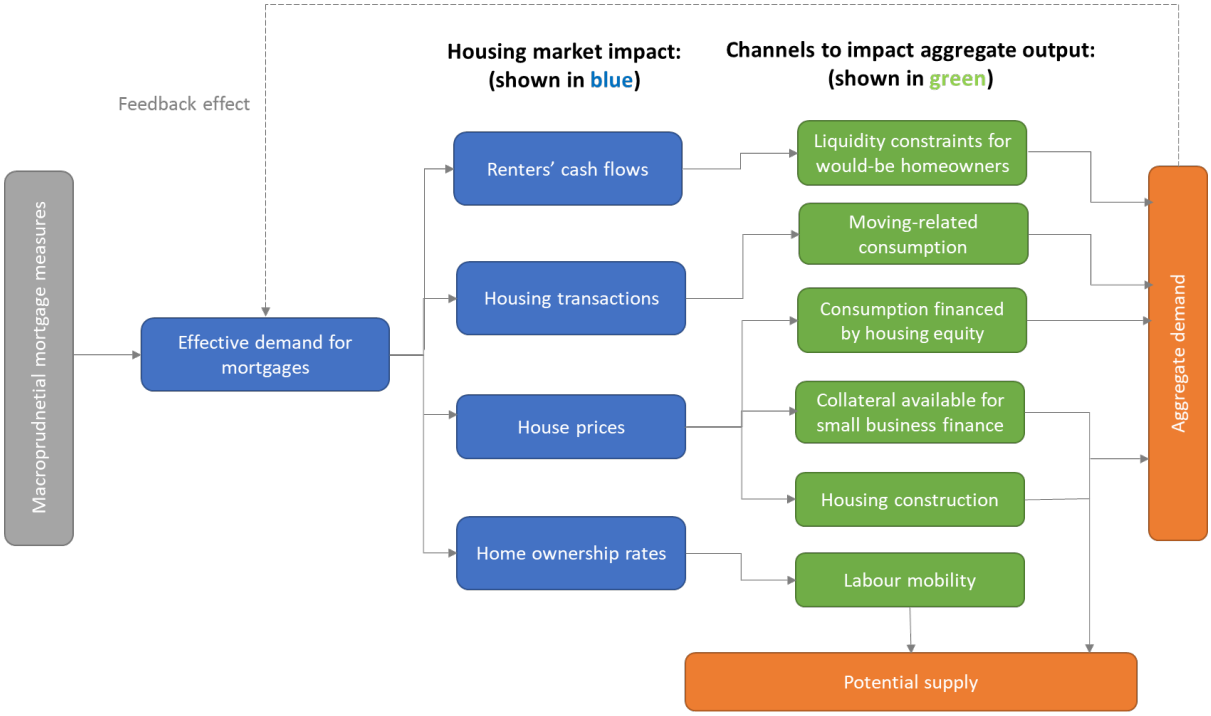
Macroprudential mortgage measures will, if they bind, reduce the effective demand for mortgages and with it, the effective demand for house purchases by current and prospective owner-occupiers. The partial equilibrium effect on the housing market is to reduce housing transactions and house prices, and to increase rental market prices. Home ownership levels will also be lower than otherwise. Aggregate demand and potential output will be affected via a variety of channels (shown in the green boxes and discussed individually below), which in turn will feed back to housing demand. Over time, housing construction and the supply of rental versus owner-occupier housing will also be affected.

4.1.1 Economics of the impact of macroprudential policy on the housing market

We first review the impact that macroprudential measures will have on the housing market. **Figure 4.2** presents a stylised supply-demand depiction of the housing market, with the house price to rent ratio on the vertical axis and home ownership rate on the horizontal.

For simplicity, the figure assumes a fixed stock of housing, so this is a short-run analysis of the impact of macroprudential policy on the housing market.

Figure 4.1: Transmission channels of macroprudential policy to aggregate demand and potential output

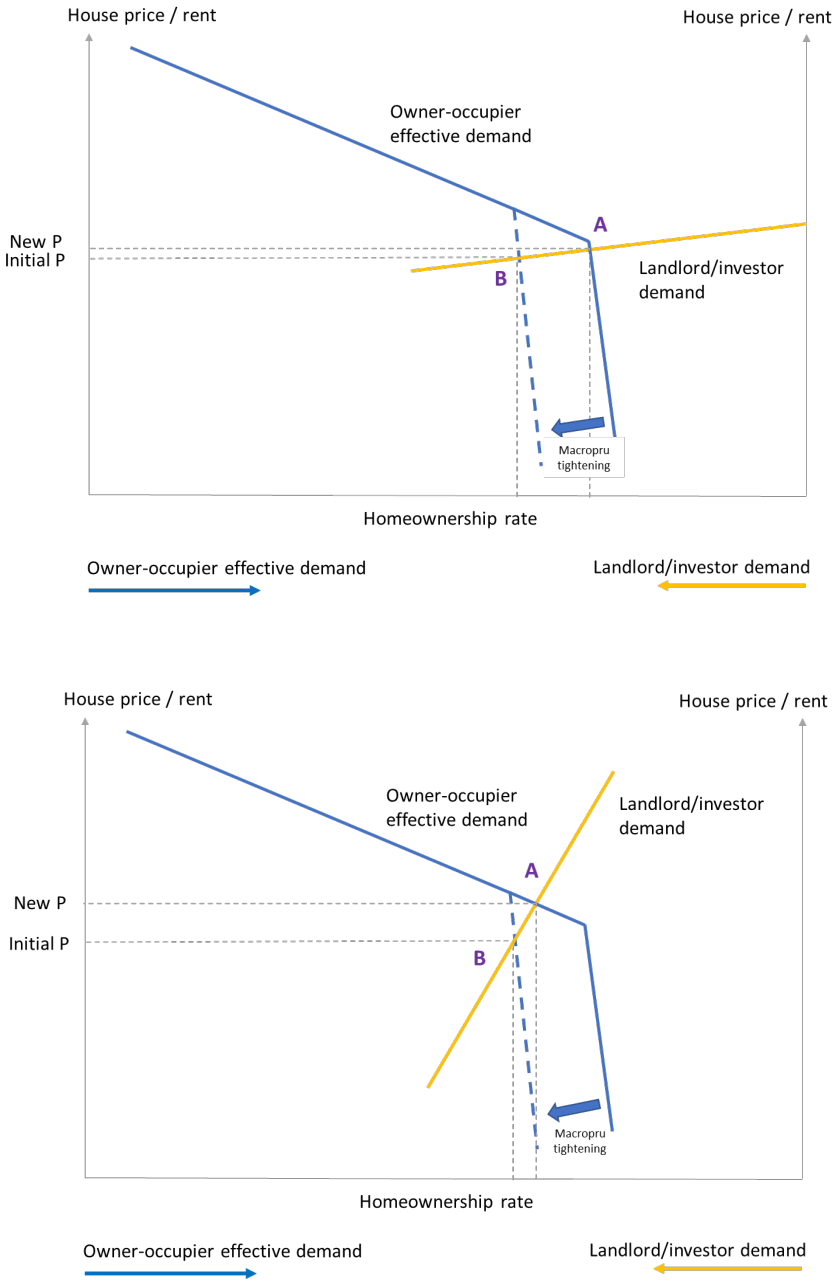


Demand by current or prospective owner-occupiers is measured from left to right; the demand curve of these households (shown in blue) slopes downwards reflecting the idea that, at the margin, more households will prefer to rent when the house price-to-rent ratio increases. The curve is drawn with a kink, capturing the point at which macroprudential mortgage measures bind, limiting credit availability and hence some households' capability to purchase their own homes. When macroprudential policy is tightened, credit constraints are more binding and effective demand shifts inwards, as illustrated by the dashed blue line.

The other source of demand is from landlords or investors (shown in orange), measured from right to left in the figure. These agents decide how much of the housing stock to purchase, and whether to let properties out or sell them outright. For simplicity, they are assumed to be deep-pocketed and unconstrained by the macroprudential debt limits. Their demand reflects the fundamental value of the stream of rental payments from housing – a fall in risk-free rates or in the risk premium would shift this demand curve up.[12]

[12] The most basic asset pricing model – the dividend discount model – assumes that the price of an asset corresponds to the present discounted value of all its future dividends. In a housing context, this translates into a relation between the current purchase price of a property and its future rents, which in turn implies a link between the current price-to-rent ratio and future rent expectations. A higher price-to-rent ratio should

Figure 4.2: Investor demand elasticity and housing market impact of tightening macroprudential policy



In the upper panel, investors' demand is highly elastic, reflecting a high degree of substitutability between owner-occupier properties and those that can converted into rental units.[13] In this case, a tightening in macroprudential policy results in only a small fall in the price to rent ratio, but a relatively large decline in the home ownership rate.

correspond to higher expected rent growth and/or a lower discount rate (risk free rate plus risk premium) attached to future rents.

[13] Greenwald and Guren (2020) emphasise the importance of the limited degree of substitutability between rental and owner-occupier housing in explaining house price and credit outcomes in the US housing boom.

Investors in this case only require a small decline in prices to induce them to purchase properties that would otherwise have been bought by would-be owner-occupiers.

In the lower panel, we show the converse case where investors' demand is highly inelastic, reflecting a high degree of segmentation between rental and owner-occupied housing. A tightening of macroprudential policy in this case translates in the main to a decline in the price-to-rent ratio, with little impact on home ownership rates.

This leaves the question of whether changes in the price-to-rent ratio are brought about by changes in prices or in rents. Empirically, house prices are significantly more volatile than rents (Braacke (2014)). Potential explanations for this include: house prices are likely to have a forward-looking component whereas rental prices do not; and rental prices are sticky, typically fixed over the period of the tenancy, whereas house prices are not. These arguments suggest that changes in the equilibrium price-to-rent ratio are likely to manifest themselves predominantly via house price changes, at least in the short run.

To summarise, the key factors determining the impact of macroprudential policy on the housing market in the short run are (a) the extent to which these policies bind to restrict credit availability, and (b) the elasticity of unconstrained investors' housing demand curves. We next consider channels via with these impacts might influence overall spending in the economy and aggregate demand. We begin with channels to household consumption, the most significant component of aggregate demand.

4.1.2 Impact channels to household consumption and aggregate demand

Liquidity constraints for would-be homeowners

The first channel we consider derives from the impact of macroprudential policies on would-be homeowners, i.e., the marginal prospective buyers who are unable to access mortgage credit and are forced to remain in the rental sector.

In a completely frictionless housing market, we would expect the equilibrium user cost of housing (the all-in cost of owning a property with a mortgage for one period, including interest payments, taxes, operating costs, capital gains etc) to be either equal to or slightly higher than the rental cost, reflecting the non-monetary benefits of home ownership. Intuitively, owner-occupiers are willing to pay a premium for the benefits of living in their own home and the user cost and rental prices should reflect this. In this case, the cash flow impact of macroprudential debt limits that force some would-be homeowners to remain in the rental market would be limited.

However, if because of various frictions (e.g., borrowing limits) the user cost is below the rental price, then the cash flow impact of macroprudential debt limits could be material. For a given house price-rent ratio, would-be homeowners excluded from the owner-occupier market will take a direct cash flow hit, which may be compounded if, in addition,

they choose to increase saving rates to fund a deposit. This effect is larger the greater the existing wedge between user costs and rental prices.

In addition, house prices and rental prices are likely to respond – with reference to **Figure 4.2**, the strength of this response will depend on the elasticity of landlords and investors' property demand. To the extent the impact manifests as higher rental prices, liquidity constraints across the rental market will be tightened further. But if house prices instead decline, the pressure to save for a deposit will be eased. In the limiting case where investors' demand is perfectly inelastic, prices adjust fully to allow would-be homeowners to become owner-occupiers and this channel does not operate. Outside this special case, those living in rental property will find themselves spending a greater fraction of their disposal income on housing and are likely to reduce their non-housing consumption in response.

The impact of this cash flow tightening in the rental sector will partly be offset by higher rental income for landlords and investors. But there are two reasons why the overall impact on aggregate demand is likely to be negative. First, households living in rental accommodation are likely to have higher marginal propensities to consume out of income than landlords and investors. Second, to the extent that some of the higher rental income flows to foreign investors investing via Real Estate Investment Trusts and overseas landlords purchasing property outright, there is a pure leakage from domestic demand.

Overall, the strength of this channel is determined by (a) the existing wedge between the user cost of housing and rental prices, (b) the response of rental prices and house prices to macroprudential policy, (c) the gap between marginal propensities to consumer by those living in rental accommodation and landlords and investors, and (d) the proportion of foreign investors/landlords in the market.

Moving-related consumption

The second channel we consider derives from the fact that some portion of consumer spending is likely to be complementary to housing market activity. This includes expenditures tied to transactions such as moving expenses and spending often associated with house purchases such as furniture, appliances, and other durables. The presence of such complementarity is one factor that might explain lumpy adjustment in the stock of durables at the microeconomic level. This suggests macroprudential policy might exert a contractionary effect on consumption to the extent these measures reduce overall transactions in the housing market.[14] The effect would likely be temporary, reallocating spending on durables to future periods.[15]

[14] If instead the fall in transactions by owner-occupiers is offset by an increase in transactions – and hence consumer durables expenditure – by buy-to-let investors, then this channel would be blunted.

[15] This is likely to be the case even if macroprudential mortgage debt limits exert a persistent effect on housing transactions. Given individual households' lifetime budget constraints, lifetime expenditure on consumer durables is likely to be unaffected. This channel instead operates via the timing of such expenditure.

Clancy et al. (2014) analyse this channel for Irish households and find that durables expenditure is 27% higher for new homeowners compared to existing homeowners. Benito and Wood (2005) analyse this channel and its importance for UK consumption dynamics. They argue that this effect is likely to be small: while the act of moving does have a substantial effect on individual households' expenditure on durables, only a small number of households relative to the overall population are changing their behaviour as a result of fluctuations in the number of transactions.

Consumption financed by housing equity withdrawal

A third channel linking macroprudential mortgage measures to overall household consumption and aggregate demand operates via Housing Equity Withdrawal (HEW).[16] This measures the equity released by households through mortgages to provide a source of funds available for consumption spending or investing in other assets. It is the difference between mortgage transactions and investment in new housing assets.

The channel operates via the impact of macroprudential policy on house prices and hence existing homeowners' housing equity. It rests on there being credit-constrained homeowners who wish to borrow more today to smooth their consumption. To the extent that these households can borrow more cheaply out of their housing equity than from other sources, then their consumption may be depressed by macroprudential policies. Similar reasoning suggests housing improvements/investment may also be affected by these policies. This effect is likely to be larger for households with lower credit scores and higher levels of existing unsecured debt. Theory suggests the effect should be temporary, with reduced HEW leading to tighter credit conditions, tilting the optimal consumption path towards lower present consumption but higher future consumption.

The strength of this channel will depend on (a) the response of house prices to macroprudential policy – as governed by the elasticity of investor/landlord demand, (b) the existing stock of housing equity and its distribution among owner occupiers, (c) the interest rate differential between unsecured debt and mortgage debt, and (d) the use of the proceeds of HEW, and particular whether the funds are used for financing spending (consumption or housing investment) versus paying down existing unsecured debt or purchasing financial assets.

Mian and Sufi (2011), Mian et al. (2013) and Mian and Sufi (2014) emphasise the importance of this channel for explaining the significant rise in household leverage in the United States in the pre-Global Financial Crisis period. They find evidence that home equity-based borrowing was not used for purchasing additional real estate or financial assets, nor

[16] The role of housing equity withdrawal in financing consumption is emphasised in credit channel models of the household sector (e.g., Iacoviello (2005) and Aoki et al. (2004)). These models have highlighted the potential for swings in housing collateral values to amplify the effects of fundamental shocks.

was it used for paying down credit card debt, suggesting that the proceeds were used to fund consumption or home-improvement.

Clancy et al. (2014) study the importance of this channel, amongst others, for explaining Irish households' consumption and find mixed results. They estimate a marginal propensity to consume out of housing equity of 0.075 for homeowners with no dependent children (and even higher for durables only), but a value that is insignificantly different from zero for those with dependent children.

4.1.3 Impact channels to investment and potential output

We next review channels via which macroprudential policies might affect the economy's productive capacity and hence long-run output.

Collateral available for small business finance

One such channel operates via house prices and housing collateral, which in addition to affecting consumer demand, also influences the borrowing capacity of small firms. It is well known that small firms often face difficulties accessing external finance because of informational asymmetries that limit their borrowing capacity (see e.g., Beck et al. (2006)). Through this channel, changes in house prices brought about by macroprudential mortgage debt limits can influence investment spending and employment decisions of small firms, with company directors of such firms using their residential property as security for business loans.

This channel would be expected to be larger (a) the greater the impact of macroprudential policy on house prices, (b) the larger the financing frictions suffered by small businesses, and (c) the greater the proportion of investment and employment accounted for by such businesses.

A recent empirical literature has studied this channel, finding generally modest effects. Adelino et al. (2015) examine the US housing price boom prior to the Global Financial Crisis and find that areas with rising house prices experienced an increase in small business start-ups and a rise in the number of people employed in establishments with fewer than ten employees compared to areas where house prices did not increase. They find that a 1% increase in house prices translates into a 0.19% increase in employment at these firms. These effects are not present for larger existing companies. Bahaj et al. (2016) estimate that a 1% increase in house prices leads to a 0.13% increase in UK business investment. Banerjee and Blickle (2016) find a similarly limited impact for small French, Spanish, Italian and UK firms.

Housing construction

The second channel we consider operates via housing construction. To the extent that macroprudential policy reduces house prices, this reduces the profitability of housing construction, reducing the supply of new houses. The reduction in housing construction directly reduces aggregate output, with a "Keynesian cross" multiplier effect for consumer spending and business investment. Over time, this response of the supply of housing would be expected to dampen any impact of macroprudential policy on house prices.

The relationship between housing construction and the economy's potential output is not clear. If housing is scarce and there is a sustainable demand for the new houses that would have been constructed absent the borrowing limits, then the productive capacity of the economy might be harmed by macroprudential policy. But if macroprudential policies limit unsustainable construction booms – booms that result in an overhang of houses for which there is little demand, as was the case in Ireland, the US and Spain following the Global Financial Crisis – then the economy's supply potential will be enhanced, by helping to avoid a misallocation of resources (see Turner (2014) for an articulation of this argument).

So the strength of the channel depends on (a) the impact of macroprudential policy on house prices, which in turn depends on unconstrained demand by landlords/investors, (b) the price elasticity of housing construction, and (c) whether there was sustainable demand for the new houses that would have been constructed absent the policy.

Finally, it is important to recognise that there are many other policy levers that governments can use to influence housing construction and meet supply targets, including via planning restrictions and the tax system.

Home ownership and labour market mobility

The final channel we briefly discuss relates to the impact of home ownership on labour mobility. Housing is an illiquid asset that takes time to transfer from one homeowner to another. In theory, greater home ownership therefore reduces the geographical mobility of the labour force. This might be particularly so if house prices fall, making some owners unwilling to capitalise a loss even if better job opportunities arise elsewhere. We might expect greater home ownership therefore to result in higher equilibrium unemployment and lower productivity. This channel therefore operates in the opposite direction to those previously examined: tighter macroprudential mortgage measures reduce labour market frictions and improve productivity via their impact on labour mobility.

Head and Lloyd-Ellis (2012) study the link between home ownership and labour market performance in a model with search frictions in labour and housing markets. They find that, calibrated for the United States, the impact of this channel is small – a 10% reduction in the home-ownership rate reduces equilibrium unemployment by only one-third of a percentage point.

4.1.4 Summary

Table 4.1 summarises the channels via which mortgage limits can affect aggregate demand and potential output. Most affect aggregate demand only. The macroeconomic costs in this case are likely to be temporary, with lower aggregate consumption when the policies are introduced, but eventually a return to the long-run trend consumption path. The productive capacity of the economy and hence long-term growth is determined by capital, labour and technological progress. One channel via which macroprudential mortgage limits could negatively affect potential supply operates through the relationship between house prices, housing equity and small business investment, though the evidence suggests the impact is likely to be modest.

The strength of these effects will in part depend on the impact of these policies on housing market outcomes, which will in turn depend on the price elasticity of housing demand by landlords and property investors. If demand is very elastic, house prices will be little affected by these policies, but home ownership rates may respond significantly. Conversely, if investor demand is highly inelastic, meaning the owner and rental markets are segmented, macroprudential debt limits will have little impact on first-time buyers' access to the housing market, with prices instead adjusting.

Table 4.1: Summary of the impact of a tightening of macroprudential mortgage debt limits on aggregate demand and potential output

Channel	Impact on aggregate demand	Impact on potential supply	Increasing in:
Consumption by would-be homeowners forced to remain in expensive rental sector	**Negative**	None	Impact on homeownership rates
"Moving-related" consumption	**Negative** (Likely to be small)	None	Impact on housing transactions
Consumption financed by Housing Equity Withdrawal	**Negative**	None	Impact on house prices
Small business investment financed by Housing Equity Withdrawal	**Negative**	**Negative** (Likely to be small)	Impact on house prices
Housing construction	**Negative**	**Negative** or **Positive**	Impact on house prices
Labour mobility	None	**Positive** (Likely to be small)	Impact on homeownership rates

4.2 Macroeconomic evidence: Impact on output and inflation

There is very little empirical work on the macroeconomic costs of macroprudential mortgage debt limits. This reflects the limited historical experience with applying these measures, particularly in advanced economies. In this section, we review two recent papers that study the impact of changes in LTV limits on macroeconomic indicators.

The first is Richter et al. (2019), where the authors use a 'narrative approach' to identify exogenous changes in LTV limits across a panel of advanced and emerging economies over the period 1990-2012. The authors analyse policymakers' stated rationales for adjusting LTV limits and discard cases where the motive for these changes reflects concern about developments in the real economy. They then construct a continuous measure of quarterly LTV changes, which applies a scaling factor to such actions when they only apply to a segment of the market (e.g., to first-time buyers).

The response of real GDP and the price level to a 1%-point tightening in the LTV series is found to be different in advanced and emerging economies. According to the authors' central estimates, while emerging market GDP falls persistently following a tightening in LTV limits, the same is not true for advanced economies. The point estimates suggest GDP actually increases, although the estimates are extremely noisy. The estimated impact on the price level is more precise – the price level falls for around 2 years, albeit the impact is very small.

A second example is a paper by Alam et al. (2020), which uses the IMF's iMaPP database that provides quantitative information on regulatory LTV limits and other macroprudential policies for a large number of countries including advanced economies and emerging market economies. The authors estimate a panel regression to study the effect of changes in LTV limits on consumption and GDP growth. They use a statistical method to take into account the potential endogeneity of these policy changes (i.e., that policy is typically tightened in a boom), which we might expect to exert a downward bias to the estimates.

They find evidence of a negative impact on consumer spending following an LTV tightening, particularly so for larger changes in LTV limits (tightenings of 10-25 basis points) where the effect is highly statistically significant. The authors do not report separate regression results for advanced and emerging market economies, so it is unclear to what extent these results are driven by the latter. The estimated impact on consumption growth is smaller than that for household credit growth.

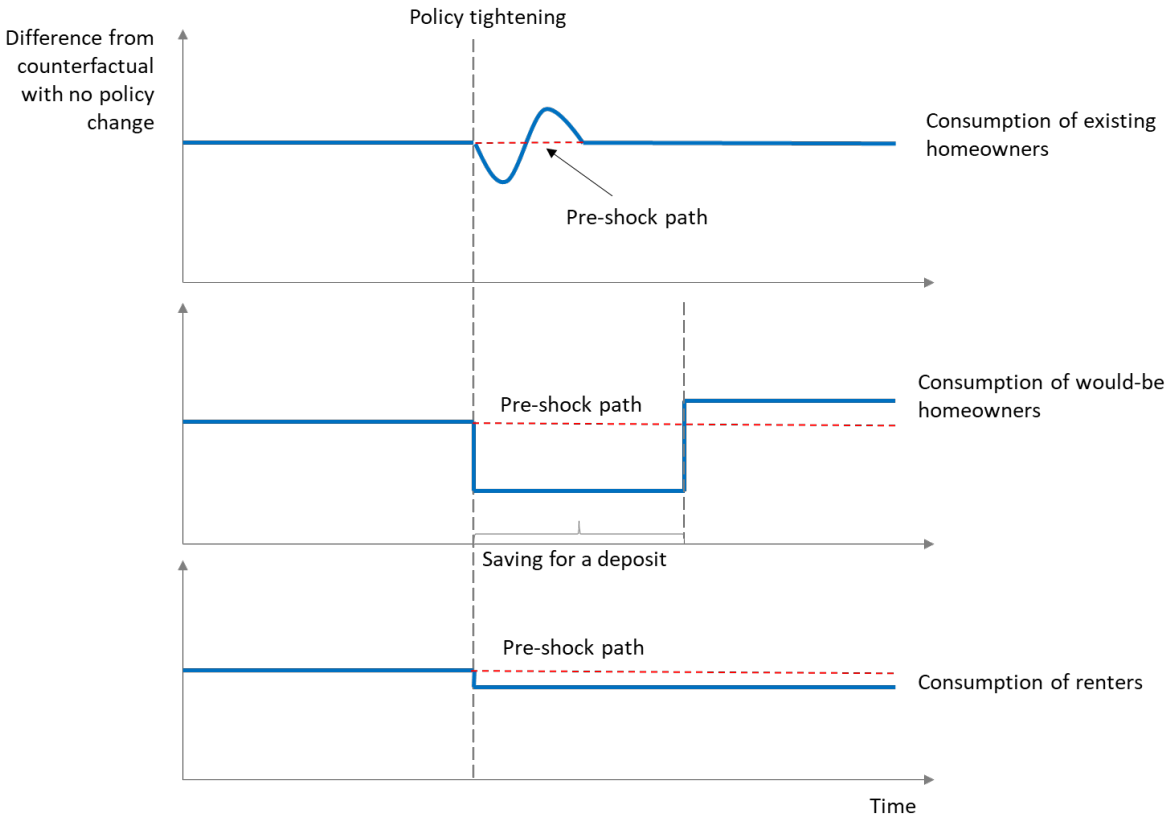
4.3 Distributional consequences

Up to this point, we have focused on the impacts of macroprudential mortgage measures on aggregate consumption and output. In this final subsection, we focus on what is known about the distributional consequences of these policies. As with the rest of this section, we

focus on gross costs – that is, impacts on welfare of different cohorts of the population outside of recessions or crises.[17]

We might expect macroprudential policies to have differential effects across borrower-types and over time. **Figure 4.3** presents a stylised illustration of these effects. The chart shows consumption levels of existing homeowners, would-be homeowners and renters before and after a tightening of macroprudential debt limits. Each line shows the difference relative to a counterfactual without the policy change. The figure plots the direct partial equilibrium effects; beyond this, there will be general equilibrium impacts on interest rates, inflation, wages and overall output which will affect all households' consumption – assessing these wider impacts would require a model and is beyond the scope of this study.

Figure 4.3: Consumption impact on different cohorts



As discussed earlier in this section, a tightening in macroprudential policies would be expected to reduce house prices (relative to the counterfactual), diminishing the housing equity of existing homeowners. Credit conditions for this cohort of households will therefore tighten, to the extent that some households use housing equity withdrawal to finance consumption spending. Theory suggests the effect on their consumption should be

[17] While these policies are also likely to have distributional *benefits* in periods of recession, it is possible that the benefits of less severe recessions are more evenly dispersed across society whereas costs are felt more acutely by some households. This hypothesis deserves further analysis.

purely temporary (shown in the top panel). With reduced housing equity, these households will face higher financing costs, the effect of which is to steepen the optimal consumption path, with lower present consumption and higher future consumption, leaving the long-run level unchanged.

The middle panel illustrates the impact on would-be homeowners – the marginal borrowers for whom macroprudential policies bind preventing them from obtaining a mortgage of sufficient size to become owner-occupiers. These households will reduce their consumption by a larger amount. This reflects the cash-flow impact of the higher rental payments they are forced to pay until they access mortgage finance to become owner-occupiers; it also reflects the likely increase in their savings rate to fund a larger down-payment. Once these households access the housing market, their consumption will be higher than in the counterfactual, reflecting their lower indebtedness, as well as potentially the reduction in house prices that results from the policy.

Finally, the bottom panel illustrates the impact on those who are forced to remain as renters. Rental prices are likely to rise persistently as a result of the policy tightening, reflecting the reduction in home ownership rates and consequently greater demand for rental accommodation. This generates a persistent fall in the consumption of this cohort relative to the counterfactual. In the long run (not shown in the figure), we might expect the supply of rental properties to increase, reducing rental prices and allowing consumption of this cohort to return to its initial trend path.

There is very little published empirical work on the distributional consequences of macroprudential mortgage measures.[18] One exception is a recent paper by Peydro et al. (2020), which examines the effects of the Bank of England's LTI limits, introduced in 2014. The authors find that mortgage borrowing by low-income households and first-time buyers declined following the introduction of these policies – this is despite the policy being calibrated to be binding only in the event of a strong boom in house prices. Acharya et al. (2020) report a similar finding for the case of the Irish macroprudential mortgage measures: mortgage credit was reallocated from low- to high-income borrowers. They also document a reallocation of credit from urban areas where borrowers tend to be close to the lending limits, and towards rural areas, where these limits are less binding. By contrast, Kinghan et al. (2019) find that the Irish LTV limits have affected higher income borrowers to a greater extent. This, they argue, reflects the design of the policy, which implies a stricter limit for higher-value properties. These findings highlight the potential for policies to be designed in a manner than mitigates unintended distributional consequences.

[18] There is recent theoretical work considering the distributional impacts of macroprudential policies. One such paper is by Fazio et al. (2019), which considers households' optimal housing demand including tenure choice in the presence of borrowing constraints and demand externalities. The authors find there can be trade-offs between addressing demand externalities and ensuring an efficient allocation in the housing market. Another recent paper by Gatt (2021) analyses the long-run consequences of introducing LTV limits on housing wealth inequality in an environment where wealth is dispersed unevenly. The model predicts stronger effects when the initial wealth distribution is more even.

It is ultimately the job of fiscal policy to ensure an appropriately equitable distribution of income and wealth across households in the population – fiscal policy alone has the power to make transfers that redistribute income and wealth. So how should the distributional consequences of mortgage debt limits be taken into account in a macroprudential policy framework conducted by an independent central bank or regulator?

To the extent that the distributional impacts of these policies negatively affects long-run consumption[19], it is uncontroversial that these impacts should be considered by the central bank in its policy calibration. Beyond this, subject to achieving their macro-financial stability goals, it is also uncontroversial that central banks should design their policies in a way that avoids unduly disadvantaging certain households. For example, where two policy settings are deemed to achieve an equivalent level of resilience, the central bank would choose to implement the one with a more favourable distributional impact. The current Irish framework has examples of policy design that may mitigate distributional impacts: the differential LTV requirements for first-time buyers and the allowances for individual banks to extend a certain fraction of their new lending above the limits. To the extent that the central bank's analysis is that these concessions do not cut across the primary stability goal of the policy, then such design features are desirable.

Finally, central banks may wish to consider regularly publishing their analysis of the side-effects and distributional costs that result from macroprudential policies. Such analysis can aid wider policy making by governmental and other agencies, who may wish to design policies to mitigate certain effects of these measures.[20] This analysis should consider distributional benefits as well as costs – e.g., policies that reduce the severity of recessions will benefit poorer households, whose living standards take the largest hit in such episodes.

4.4 Summary

Research on the costs of macroprudential policy – either in terms of macroeconomic impacts on aggregate output and inflation, or in terms of distributional impacts – is relatively scarce. Of course, this should not be taken to imply that the costs are negligible and can be ignored.

There are several channels via which LTI and LTV restrictions can affect aggregate demand – and to a lesser extent potential output. Most of the channels impact aggregate demand only; the costs in this case are likely to be temporary, implying lower aggregate consumption today but a return to the trend path for aggregate consumption in future. The productive capacity of the economy and hence long-term growth is determined by capital,

[19] For a model describing a mechanism whereby higher leverage and crises are the endogenous result of a growing income share of high-income households, see Kumhof et al. (2015).
[20] This information is, after all, a necessary condition if fiscal authorities are to make the required compensating transfers that in turn allow the central bank to focus on the policies' macroeconomic impacts.

labour and technological progress. We have identified one potential channel affecting these factors via the relationship between housing equity and small business investment.

A small nascent literature has studied the impact of LTV changes on consumption and output growth. The empirical evidence is mixed. There is some evidence of a small contractionary impact of these policies, but this is driven by emerging markets' experience.

While it is unclear how large and persistent the macroeconomic costs of these policies may be, these policies will inevitably constrain the borrowing capacity and hence housing tenure choices available to some borrowers.

5. Considerations for developing a joint assessment framework

In this section, we discuss a potential approach for assessing the benefits and costs of macroprudential mortgage measures jointly with the purpose of informing their calibration. This issue is at the cutting edge frontier of macroprudential analysis; the literature has not yet advanced to provide a comprehensive assessment of the costs and benefits of macroprudential policies and no off-the-shelf approach is available.

A useful starting point to fix ideas is to recall the approach taken for assessing the appropriate calibration of bank capital requirements developed by central banks participating in the Basel Committee's Long-Term Economic Impact exercise (BCBS (2009)). The broad idea to assume away transitional considerations and focus instead on the impact of capital requirements on expected economic output in the long run.[21] Higher capital requirements, it was thought, would push up banks' weighted average cost of capital leading to an increase in the cost of bank funding to households and companies, depressing output outside of crisis states of the world. But higher capital also meant greater loss absorbency in the banking system, making crises less likely. The key factors shaping the optimal capital calculation were the pass through from capital requirements to real economy funding costs, the frequency and severity of banking crises, and the impact of higher capital requirements on such crises. A range of models were then employed to quantify these factors.

The value of this approach is less its ability to generate precise optimal policies and more the framework it provides to understand the factors that matter most and to isolate the key areas of debate in a consistent way. This should be the same ambition for an assessment framework for assessing the quantification of macroprudential mortgage measures.

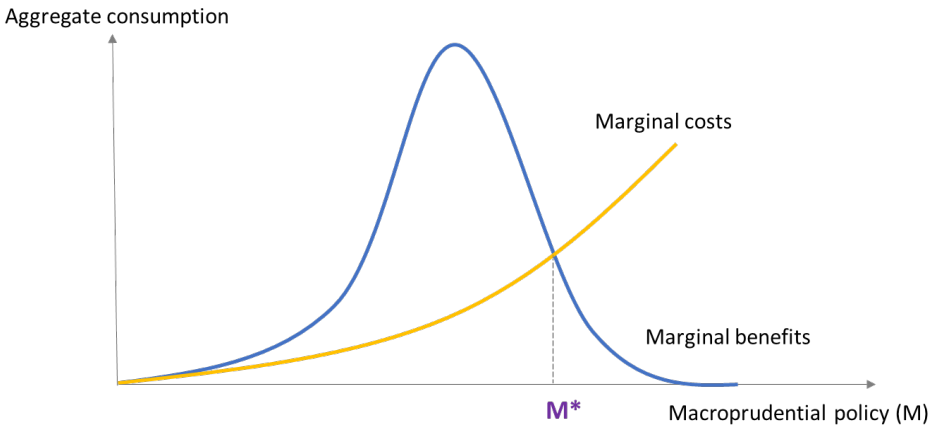
[21] One notable difference with the Basel Committee's exercise is that whereas higher bank capital requirements are likely to have a permanent impact on the economy's trend growth path, the long-run impact of macroprudential debt limits is less clear. A neoclassical perspective would suggest that at some future date the expected level of consumption with or without these policies will be the same. So, if these policies reduce consumption volatility, there would only be benefits from this date onwards. By contrast, if shifts in aggregate demand have persistent effects on output via hysteresis or liquidity trap/secular stagnation channels, then there may be costs and benefits from these policies even in the long run.

One notable difference with the Basel Committee's exercise is that whereas higher bank capital requirements are likely to have a permanent impact on the economy's trend growth path, the long-run impact of macroprudential debt limits is less clear. As discussed in **section 4**, given their limited impact on potential supply, a neoclassical perspective would suggest that at some future date the expected level of consumption with or without these policies will be the same.[22] So, if these policies reduce consumption volatility, there would only be benefits from this date onwards. Given this, in contrast to the Basel Committee's study, a cost-benefit assessment of macroprudential mortgage debt limits would need to weigh their transitional impacts and not just their long-run effect.

5.1 A high-level description of the approach

The basic approach we propose is illustrated in **Figure 5.1**. The horizontal axis shows the stringency of macroprudential policies, M. Think of this as capturing the overall setting of LTI and LTV requirements set by the central bank. As we move from left to right, the calibration of these policies tightens. The vertical axis measures the expected present discounted value of aggregate consumption. The curves plot the marginal benefits and marginal costs of macroprudential policies in terms of their impact on aggregate consumption.

Figure 5.1: Illustrating the optimal setting of macroprudential mortgage measures



The marginal benefits curve (blue) is drawn as hump-shaped, reflecting the idea that when LTV or LTI ratios are set at a very loose level (close to the origin), they bind on few households and so the benefits they provide in terms of avoiding costly deleveraging episodes is small. As the policies are tightened though, they bind on a greater proportion of

[22] An alternative perspective would be that shifts in aggregate demand might have highly persistent or event permanent effects on output via hysteresis or liquidity trap/secular stagnation channels.

households and marginal benefits rise sharply. Beyond a certain point though, marginal benefits must begin to tail off as the policies bind for households who are unlikely to be strongly deleveraging in a downturn. And eventually, these marginal benefits fall close to zero if debt limits are set at levels that imply little mortgage lending activity can take place.

Marginal costs (yellow), on the other hand, arguably increase throughout the range of M, as each tightening in macroprudential policies reduces house prices and housing transactions a little further, reducing the consumption of a greater number of households.

The optimum is the policy setting that equates costs and benefits at the margin, indicated by the point M*. The curves are drawn conditional on the state of the financial cycle. In a housing boom, we might expect both to shift upwards as macroprudential debt limits will prevent excessive borrowing by a larger number of households, while also generating a larger cost in terms of aggregate consumption out of crisis periods. M* can rise, fall or remain the same, depending on the shape of the curves and their respective shifts.

5.2 Implementing this approach

To operationalise this approach, we require an estimate of the relationship between different settings of macroprudential mortgage measures and (a) crisis risk/severity, and (b) aggregate consumption in non-crisis periods.

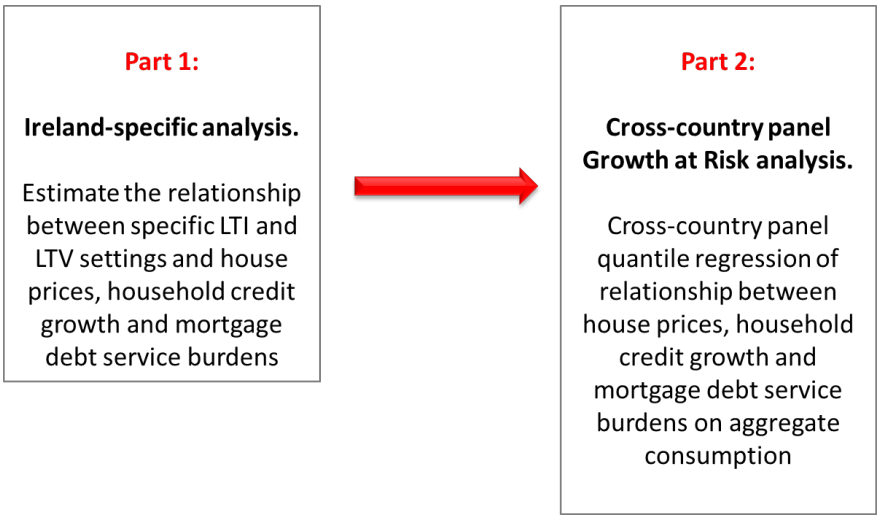
The recent "Growth at Risk" literature offers a promising avenue for informing the estimation of these relationships (see Adrian et al. (2019) and Adrian et al. (2018)).[23] The approach uses quantile regressions to estimate the various quantiles of the distribution of consumption or output at horizons t + h (where h = 1, 2, 3…), conditional on the state of the financial cycle and other variables in period t. One benefit is that it captures the intertemporal nature of the trade-off that lies at the heart of many macroprudential questions – namely, what is the cost in terms of depressing the economy now for the benefit of a less volatile economy in future? It also avoids us having to partition periods in "crisis" versus "non-crisis" states. Macroprudential policies may be beneficial in mitigating the probability and severity of a continuum of outcomes, including standard recessions, financial recessions and full-blown crises.

A challenge to obtaining reliable estimates of these relationships is the limited historical experience we have with applying macroprudential mortgage measures. There are few cases where an individual country has varied the calibration of these tools across a range of

[23] An alternative approach would be to attempt to develop a macroeconomic model with a rich description of housing market tenure choice, which would allow for an assessment of the impact over time of macroprudential mortgage measures on different cohorts' utility. Given such a model, the central bank could consider alternative descriptions of social welfare (weighting cohorts' utility) and choose an optimal policy that maximises this. Such a model would need to feature mortgage debt, endogenous house prices, households that differ in their housing and financial wealth, a rental and owner-occupier market, financial accelerator effects linking house prices to consumption, and deleveraging crises. A model with these components does not currently exist.

values, allowing us to estimate the full marginal benefit and cost curves from **Figure 5.1**. Indeed, the analysis available at present typically examines the impact of only binary policy settings, or those described with limited discrete values. For instance, Brandao-Marques et al. (2020) analyse a categorical policy indicator, which take integers between -2 and 2 depending on the number of tightenings or loosenings of policy in the quarter in question. This is better suited to analysing cyclical policies where the question is whether policy should be tightened/loosened this quarter given developments in financial system risk, rather than informing the structural level of LTI or LTV limits.

Recognising this challenge, an ad hoc approach for proceeding is to split the problem into two parts, as illustrated below. Part one would use Irish-specific analysis to estimate the impact of various settings of LTI and LTV limits on housing market indicators such as approvals, credit, house prices and debt service burdens. Part two would estimate cross-country quantile regressions as in the Growth at Risk literature to uncover the relationship between such indicators and quantiles of the distribution of consumption or GDP. The central bank could then produce forecasts of the distribution of consumption at different future periods conditioning on the housing market outcomes associated with LTI and LTV settings predicted in part one.



The value of this approach is that it allows us to condition on Ireland-specific information about the mapping from policy tools to housing market outcomes. And to combine this with rich cross-country information on the relationship between such indicators and the shape of the aggregate consumption distribution at different horizons – this is useful because the length of relevant time series information available for a single country will typically be insufficient to estimate quantiles in the tail of the distribution convincingly. The approach rests on the idea that the transmission of macroprudential mortgage measures can be summarised via a small number of housing market variables.

With these estimates in hand, the final step in implementing this approach would be posit a dynamic loss function that would define the central bank's preferences over alternative

consumption distributions over time. We might distinguish three broad approaches. First, a "risk-neutral" approach that amounts to choosing the policy that maximises the expected presented discounted value of consumption. This was the approach taken by the Basel Committee's Long-Term Economic Impact study on optimal bank capital requirements, for instance. While simple, it could be argued that this attaches insufficient weight to low probability, high impact events that are the focus of macroprudential policy. Second, a quadratic approach, which penalises deviations from trend. While typical in macroeconomic analysis, a potential drawback for some is that upside and downside risks are treated symmetrically. Third, a nonlinear loss function, which allows the policymaker to attach larger weight to downside risk – for example, the "Linex" function (Varian (1975)). Regardless of which approach is favoured, the optimal policy would be the one that achieves the lowest present discounted value of estimated losses.

6. Conclusion

This report had assessed the macroeconomic benefits and costs of macroprudential mortgage debt limits. It is argued that the principal benefits relate to the mitigation of costly debt deleveraging effects that can otherwise amplify economic downturns. These benefits are likely to be especially important for small open economies operating under fixed exchange rates without independent monetary policy. These policies also carry potential benefits for bank resilience, by reducing risk in mortgage portfolios. But these benefits will tend to be undone by the bank capital framework, as required capital will fall for banks using model-determined risk weights.

Mortgage debt limits also come with costs as they potentially reduce aggregate consumption outside of crisis periods via a variety of channels considered in the report. There remains little empirical evidence quantifying these macroeconomic costs. These policies also have distributional consequences as they constrain the borrowing capacity, and hence housing tenure choices, available to some borrowers. It is principally the role of fiscal policy to address undesirable distributional effects. However, subject to achieving macro-financial stability goals, there is scope for central banks to design macroprudential policies in such a way that avoids unduly disadvantaging certain households. Central banks should also consider regularly publishing their analysis of these distributional impacts, including both benefits and costs.

The paper ends by outlining a potential approach for assessing the macroeconomic costs and benefits of these policies jointly – an issue that is at the cutting-edge frontier of macroprudential analysis. A promising approach would first estimate the impact of debt limits on credit, house prices and debt service burdens using Irish-specific information. And second, use cross-country information to estimate the relationship between these affected variables and future macroeconomic outcomes. To implement the approach, the central

bank would need to decide how it is willing to trade off impacts on the central outlook versus the tail.

Appendix

The table below summarises the macroprudential mortgage measures implemented by the Central Bank of Ireland.

Table: Summary of macroprudential mortgage measures

Policy	Target group	Limit	Allowances
Loan-to-value limit	For primary dwelling homes:	First-time buyers: Sliding LTV limit from 90% Subsequent buyers: 80%	15% of each bank's new lending can exceed the limit
	For buy-to-let:	70%	10% of each bank's new lending can exceed the limit
Loan-to-income limit	For primary dwelling homes:	3.5x	20% of each bank's new lending can exceed the limit

Notes: For first-time buyers, a 90% limit applies to the first €220,000 of the value of the property, and a limit of 80% applies thereafter. The following exemptions apply: switcher mortgages and those restructuring mortgages in arrears are exempt from both limits; borrowers in negative equity are exempt from the loan-to-value limit; borrowers for investment properties are exempt from the loan-to-income limit.

Source: Acharya et al. (2020)

References

Acharya, V, Bergant, K, Crosignani, M, Eisert, T, and McCann, F (2020), 'The anatomy of the transmission of macroprudential policies', IMF Working Paper 20/58.

Adelino, M, Schoar, A, and Severino, F (2015), 'House prices, collateral, and self-employment', *Journal of Financial Economics*, Volume 117, Issue 2, pages 288-306.

Adrian, T, Boyarchenko, N, and Giannone, D (2019), 'Vulnerable growth'. *American Economic Review*, 109 (4): 1263-89.

Adrian, T, Grinberg, F, Liang, N and Malik, S (2018), 'The term structure of Growth-at-Risk', IMF Working Paper No. 18/180, International Monetary Fund.

Aikman, D, Bridges, J, Kashyap, A and Siegert, C (2018), 'Would macroprudential regulation have prevented the last crisis?' *Bank of England Staff Working Paper* No. 747.

Akinci, O and Olmstead-Rumsey, J (2018), 'How effective are macroprudential policies? An empirical investigation', *Journal of Financial Intermediation*, Volume 33, pages 33-57.

Aoki, K, Proudman, J and Vlieghe, G (2004), 'House prices, consumption, and monetary policy: a financial accelerator approach', *Journal of Financial Intermediation*, Volume 13, Issue 4, pages 414-435.

Alam, Z, Alter, A, Elseman, J, Gelos, G, Kang, H, Narita, M, Nier, E and Wang, N (2019), 'Digging Deeper–Evidence on the Effects of Macroprudential Policies from a New Database', IMF Working Paper 19/66, International Monetary Fund.

Bahaj, S, Foulis, A, and Pinter, G (2016), 'The residential collateral channel', Centre for Macroeconomics Discussion Papers 1607.

Banerjee, R and Blickle, K (2016), 'Housing collateral and small firm activity in Europe', BIS Working Papers No 575.

Basel Committee on Banking Supervision (2009), *An assessment of the long-term economic impact of stronger capital and liquidity requirements*, August.

Benito, A and Wood, R (2005), 'How important is housing market activity for durables spending?', Bank of England Quarterly Bulletin, Summer.

Bracke, P (2015), 'House Prices and Rents: Microevidence from a Matched Data Set in Central London', *Real Estate Economics*, 43: 403-431.

Brandao-Marques, L, Gelos, G, Narita, M and Nier, E (2020), 'Leaning against the wind: a cost-benefit analysis for an integrated policy framework', IMF Working Paper 20/123.

Buiter, W (2008), 'Housing Wealth Isn't Wealth', NBER Working Paper no 14204.

Campbell, J and Cocco, J (2015), 'A model of mortgage default', *The Journal of Finance*, 70: 1495-1554.

Cerutti, E, Claessens, S, Laeven, L (2017), 'The use and effectiveness of macroprudential policies: New evidence', *Journal of Financial Stability*, Volume 28, pages 203-224.

Clancy, D, Cussen, M, and Lydon, R (2014), 'Housing market activity and consumption: macro and micro evidence', Central Bank of Ireland Research Technical Paper 13/RT/14.

Duca, J, Muellbauer, J and Murphy, A (2011), 'House prices and credit constraints: making sense of the US experience', *Economic Journal* 121 (552): 533–551.

Eggertsson, G and Krugman, P (2012), 'Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach', The Quarterly Journal of Economics, Volume 127, Issue 3, pages 1469-1513.

Farhi, E and Werning, I (2016), 'A theory of macroprudential policies in the presence of nominal rigidities', *Econometrica*, Vol 84, pages 1645-1704, September.

Fazio, M, Gimber, A and Miles, D (2019), 'Limiting mortgage debt: Aggregate demand externalities and housing market distortions', Mimeo.

Fornaro, L (2018), 'International debt deleveraging', *Journal of the European Economic Association*, Volume 16, Issue 5, pages 1394–1432.

Franta, M and Gambarcota, L (2020), 'On the effects of macroprudential policies on Growth-at-Risk', *Economics Letters*, Volume 196.

Galan, J (2020), 'The benefits are at the tail: Uncovering the impact of macroprudential policy on growth-at-risk', *Journal of Financial Stability*.

Greenwald, D and Guren, A (2020), 'Do credit conditions move house prices?', Mimeo.

Head, A and Lloyd-Ellis, H (2012), 'Housing liquidity, mobility and the labour market', *The Review of Economic Studies*, Vol 79, No 4, pages 1559-1589.

Iacoviello, M (2005), 'House prices, borrowing constraints, and monetary policy in the business cycle', *American Economic Review*, 95 (3): 739-764.

Jorda, O, Schularick, M and Taylor, A (2015), 'Leveraged bubbles', *Journal of Monetary Economics*, Vol 76, pages 1-20.

Kaplan, G, Violante, G and Weidner, J (2014), 'The wealthy hand-to-mouth', *Brookings Papers on Economic Activity*, Spring, pages 77-138.

Kelly, R and O'Malley, T (2016), 'The good, the bad and the impaired: A credit risk model of the Irish mortgage market', Journal of Financial Stability, Vol 22, pages 1-9.

Kelly, R, O'Malley, T and O'Toole, C (2015), 'Designing macro-prudential policy in mortgage lending: do first time buyers default less?', Research Technical Papers 02/RT/15, Central Bank of Ireland.

Kinghan, C and McCann, F (2019), 'Lending above macroprudential mortgage limits: The Irish experience since 2015', Financial Stability Notes No 8, Central Bank of Ireland.

Kinghan, C, McCarthy, Y and O'Toole, C (2019), 'How do macroprudential loan-to-value restrictions impact first time home buyers? A quasi-experimental approach', *Journal of Banking & Finance*.

Korinek, A and Simsek, A (2016), 'Liquidity trap and excessive leverage', *American Economic Review*, 106 (3): 699-738.

Kumhof, M, Ranciere, R and Winant, P (2015), 'Inequality, leverage and crises', *American Economic Review*, Vol. 105, No. 3, March.

Kuttner, K and Shim, I (2016), 'Can non-interest rate policies stabilize housing markets? Evidence from a panel of 57 economies', *Journal of Financial Stability*, Volume 26, pages 31-44.

Lim, C, Columba, F, Costa, A, Kongsamut, P, Otani, A, Saiyid, M, Wezel, T, Wu, X (2011), 'Macroprudential policy: what instruments and how to use them? Lessons from country experiences', Working Paper 11/238', International Monetary Fund (2011).

McCann, F and Ryan, E (2016), 'Originating loan to value ratios and the resilience of mortgage portfolios', Economic Letter Series Vol 2016, No 10, Central Bank of Ireland.

Mian, A and Sufi, A (2011), 'House prices, home equity-based borrowing, and the US household leverage crisis', *American Economic Review*, 101 (5): 2132-56.

Mian, A, Rao, K and Sufi, A (2013), 'Household balance sheets, consumption, and the economic slump', *The Quarterly Journal of Economics*, Volume 128, Issue 4, pages 1687–1726.

Mian, A and Sufi, A (2014), 'What Explains the 2007–2009 Drop in Employment?', *Econometrica*, 82: 2197-2223.

Mian, A, Sufi, A and Verner, E (2017), 'Household debt and business cycles worldwide', *The Quarterly Journal of Economics*, Volume 132, Issue 4, pages 1755–1817.

Mishkin, F (1977), 'What depressed the consumer? The household balance sheet and the 1973-75 recession', *Brookings Papers on Economic Activity*, 1.

Peydro, J-L, Rodriguez-Tous, F, Tripathy, K and Uluc, A (2020), 'Macroprudential policy, mortgage cycles and distributional effects: Evidence from the UK', Bank of England Staff Working Paper No 866.

Richter, B, Schularick, M, and Shim, I (2019), 'The costs of macroprudential policy', *Journal of International Economics*, 118, pp263-282

Turner, A (2014), 'Escaping the debt addiction: monetary and macroprudential policy in the post crisis world', Centre for Financial Studies, Frankfurt.

Varian, H (1975), 'A Bayesian approach to real estate assessment', in Fienberg, S and Zellner, A (eds.), *Studies in Bayesian Econometrics and Statistics in Honor of Leonard J Savage*, Amsterdam, North-Holland.