Credit availability, macroprudential regulations and the house price to rent ratio

David Cronin

Central Bank of Ireland

Kieran McQuinn

Economic and Social Research Institute‖

Abstract

Quantifying the real economy effects of macroprudential policy is important at a time when such measures are increasingly being promoted as central to the prevention of future credit and house price bubbles. Recently, like other regulatory authorities, the Irish central bank introduced regulatory limits on mortgage lending aimed at protecting greater financial stability. In this paper we seek to examine some of the wider implications of these measures for tenure choice in the Irish housing market. We find that a reduction in the loan-to-value ratio, such as may occur as a result of regulatory limits, will lead to a greater demand for rental accommodation, prompting higher rents for a given house price level. While this result is somewhat incidental to financial stability, it does have significant implications for housing policy, particularly, at a time when the Irish housing market is confronted by an acknowledged supply shortage.

1.   Introduction

Given the scale of disruption experienced after 2007 in many international property markets and the associated economies, an increasing number of regulatory authorities and central banks have advanced macroprudential policy as an appropriate tool to temper any future, asset price bubbles.[1] Limits on loan to value (LTV) and loan to income (LTI) ratios, have been used for some time in Hong Kong, China, Korea, Singapore, and other emerging market economies, while more recently, regulatory authorities in Hungary, Norway, Sweden, Finland and Ireland have all adopted these types of macroprudential measures.[2]

While the financial stability merits of macroprudential policy have received a considerable amount of attention, there has been a relative dearth of analysis examining the real economy implications of these measures. In this paper, therefore, we examine the potential implications of constraints on LTV ratios on relative prices (purchasing versus renting) in the housing market and, by implication, on housing tenure choices. In particular, we employ a framework presented conceptually by Kim (2007) and implemented empirically by Duca, Muellbauer and Murphy (2011) to assess the impact on the house price to rent ratio of macroprudential measures which restrict LTV ratios. Using data for Ireland, we find that reduced LTV ratios will, *ceteris paribus*, raise rents relative to house prices over the longer term. This finding has important implications, including when a need to stimulate the rate of housing supply is acknowledged.

The Irish mortgage market provides an interesting case study for assessing macroprudential policy. House prices in Ireland increased by more than in any other country in the OECD over the period 1995 to 2007, culminating in a sizeable credit-driven house price bubble. By 2007, prices were estimated to be approximately 30 to 35 per cent overvalued.[3] Consequently, when the international and domestic economic downturn occurred, Irish house prices were particularly affected, registering a 50 per cent decline in nominal terms between 2007 and 2012. Alongside these price developments, the

---

[1]By bubble, we mean a situation where house price movements become dislocated from movements in fundamental, underlying economic variables such as interest rates, household incomes and population levels.

[2]See Magyar Nemezeti Bank (2010), Norges Bank (2010), Swedish Financial Supervisory Authority (2010) and Central Bank of Ireland (2015) for more details.

[3]See Honohan (2010).

supply of houses declined substantially.

Since early 2013, the Irish housing market has shown strong signs of recovery with house prices and rental rates, particularly in the Dublin area, registering strong growth. In 2015, the Irish central Bank introduced regulations placing ceilings on the proportion of mortgage lending at high LTVs and LTIs by domestic financial institutions. The stated objective of these measures is to increase the resilience of the banking and household sectors to the property market and to try and reduce the risk of bank credit and housing price "spirals" from emerging in the future (Central Bank of Ireland (2015)).

While the demand side of the Irish housing market appears to have undergone some recovery of late, housing supply remains persistently below the level of structural demand estimated for the Irish economy.[4] Consequently, an increasing amount of domestic policy attention has been devoted towards addressing the shortfalls in housing supply.[5] In that context, it is important to consider the implications for the housing market of policy tools such as the adoption of macroprudential measures.

An analysis of the house price to rent ratio, in our view, provides a useful mechanism for assessing the effects of mortgage-specific macroprudential tools. Its components (house prices and rents) neatly capture the tenure choice of households; whether to buy or to rent. The house price to rent ratio is a finance-based measure popular in the literature for assessing the sustainability or otherwise of house price movements. Typically, in equilibrium, the house price to rent ratio is related to the real user cost of capital. Kim (2007), however, demonstrates, theoretically, that the relationship may have to be augmented to accommodate restricted credit conditions such as binding maximum LTV ratios. We find that, at least in the Irish situation, a greater availability of credit, expressed in a higher LTV ratio, exerts a positive long-run effect on the house price to rent ratio. Any regulations which reduce LTVs, therefore, are likely to cause rents to increase for a given house price level.

The rest of the paper is as follows: in the next section, we examine the house price to rent ratio and the manner in which its determination has been expanded to allow for credit market frictions. We then examine developments in the Irish property and

---

[4]Based on demographic trends and household formation rates, Byrne, Duffy and Fitzgerald (2014) estimate this structural demand to be 25,000 units per annum in the medium term, whereas actual housing supply in the Irish economy, over the period 2010-2015, averaged just under 11,000 units.

[5]See Barrett, Duffy and McQuinn (2015), for example, which examines the possible use of the taxation system in stimulating housing supply.

credit markets before reviewing trends in macroprudential policy. An empirical section presents the results of our analysis along with the estimates of a policy simulation exercise. We find that changes in LTV ratios, as may occur as a result of macroprudential policy, can cause changes to the house price to rent ratio. A concluding section offers some final comments.

2.   The house price to rent ratio

In reviewing different house price models, McQuinn and O'Reilly (2008) differentiate much of the existing literature between two broad approaches. They label the first the "econometric" approach whereby a reduced-form price equation is estimated based on some underlying notion of the fundamental determinants of supply and demand. Typically, house prices are regressed on a set of potential determinants. The fitted values from the regression are then interpreted as the price level justified by fundamentals within the economy and any misalignment in house prices is gauged by comparing this fundamental price with the actual price level. One feature of empirical studies using this approach is that variables which are believed, a priori, to be important in house price determination, such as interest rates, often appear in estimated models with the wrong sign or are found to be insignificant. For example, in models estimated for eight different US states, Case and Shiller (2003) acknowledge that the mortgage interest rate had an insignificant coefficient in all but one of the regression models. Mayer (2003) also notes that the results from such regression models suggest that, historically, house purchase behaviour and housing values may not have been very responsive to changes in interest rates.

An alternative, more finance-based, approach in the literature can be characterised by an underlying notion of arbitrage, with the returns to investing in housing relative to some other asset evaluated, or the costs and benefits of renting a house relative to buying compared. This price-to-rent approach, which builds on the Jorgensen (1963, 1967) theory of the user cost of capital, was first applied to housing markets by Poterba (1984). Its advantage is that a strict relationship is imposed between house prices and interest rates. This contrasts with the former, econometric approach where the interest rate variable enters in freely into the house price regression specification and can often

be "swamped" in the estimation, yielding a very small and often insignificant semi-elasticity effect.

One standard metric used in this context is the relationship between the real user cost and the ratio of house prices to rental income. The price to rent approach assumes that, absent substantial frictions and credit restrictions, arbitrage between owner-occupied and rental housing ensures that the house price to rent ratio depends on the real user cost of capital, i.e.

$$hp_t/rent_t = (r_t + \sigma_t + t_t - \triangle hp_t^e/hp_t). \tag{1}$$

where hp is house prices, $rent$ is actual rental rates, t relates to any property taxes to which the homeowner is liable, r is the real interest rate, σ is the natural rate of depreciation of the house and hp^e is *expected* house prices. We label the right hand side of (1) as $RUSER_t$, the real user cost of capital. In log format:

$$l(hp_t/rent_t) = lRUSER_t. \tag{2}$$

Variants of this framework applied to housing markets can be found in Blackey and Follain (1995), Himmelberg et al (2005), Murphy (2005), Campbell, Davis, Gallin and Martin (2006), Diaz and Luengo-Prado (2008), Gallin (2008), Diaz and Luengo-Prado (2012) and, in an Irish context, Browne, Conefrey and Kennedy (2013).

The presence of mortgage market imperfections such as credit rationing, however, lead Meen (1990) and Kim (2007) to identify a wedge in the user cost / price-rent arbitrage relationship. Kim (2007), in particular, demonstrates that the equilibrium log price to rent ratio can be affected by binding, maximum LTV ratios (i.e. a credit constraint) as well as the real user cost of capital. Thus, to reflect such frictions, (2), is augmented in the following manner:

$$l(hp_t/rent_t) = f[(lRUSER_t), maxLTV]. \tag{3}$$

The relationship postulated in equation (3) is particularly useful in evaluating a macroprudential policy of imposing a limit on LTV ratios. It relates the policy variable, the LTV ratio, to a critical variable in the housing market, the house price-to-rent ratio in a parsimonious but rigorous manner. Following Duca, Muellbauer and Murphy

(2011), we then use equation (3) as the basis for our estimations, which will be provided in section 5. A significant sign on the estimated LTV variable would indicate it not to be neutral in its effect on the house price to rent relationship. This would then indicate that a macroprudential policy that impacts the effective LTV ratio will change that relationship, with the sign of the coefficient indicating the qualitative effect: whether it raises or lowers the house price to rent ratio. Impulse response analysis will indicate how long it takes for any permanent change in the ratio to take full effect.

3.   The availability of credit and the Irish mortgage market

To illustrate further the importance of including credit availability in the manner of (3) in analysing the Irish mortgage and property market, it is worth considering developments in both markets over the past quarter of a century or so. Figure 1 plots the log of the Irish house price to rent ratio. In general, it may be observed that the ratio was fairly stable between 1980 and 1995. Thereafter, as house prices started to increase, the ratio also increased in a significant manner, reaching a peak in 2008. Subsequently, as house price declines exceeded those of rents, the ratio fell.

Figure 2 illustrates the extent of the boom in the Irish housing market after 1990 with both house prices and housing supply registering substantial increases up to 2007. While some of the initial increases in housing market activity were prompted by the strong underlying performance of the Irish economy over the period, much of the later increases were due to a significant credit bubble which had emerged from 2003 onwards.[6]

The Irish credit market had since the mid-1980s been experiencing considerable financial deregulation and liberalisation, involving the removal of credit and interest-rate controls.[7] Notwithstanding the cumulative effects of these gradual changes, the most significant development in the provision of credit in the Irish market was the increased ability of Irish banks to attract deposits from non-residents following the introduction of the euro in 1999. Across the euro area, the more widespread use of deriva-

---

[6]See McCarthy and McQuinn (2013) for more on this.

[7]The changing regulatory environment for the Irish credit market is discussed in detail in Kelly and Everett (2004) and McCarthy and McQuinn (2013). See, in particular, Box 1 pgs 96-97 in Kelly and Everett (2004).

tives and repurchase (repo) agreements enabled greater cross-border lending between credit institutions allowing those with a surplus of funds to lend to those requiring such funds. The volume of repo transactions (which reduce risk by collateralising loans) more than doubled in the EU between 2002 and 2003. Given the build-up of demand side pressures in the Irish economy throughout the late 1990s, Irish financial institutions availed substantially of the increased funding available.

As noted in McCarthy and McQuinn (2013) and Duffy, McInerney and McQuinn (2015), the elasticity of the supply of credit to the household sector increased as a result of this new funding source. A flatter supply curve allowed financial institutions to increase the amount of lending to the household sector with little upward pressure on the interest rate. Perhaps, inevitably, this flatter supply curve led to a substantial increase in household debt levels within the Irish economy.

Figure 3 shows the extent of external funding for Irish resident credit institutions from 2001 until 2010 along with the difference between credit extended and the deposit base (the loan-to-deposit ratio) in the Irish banking system. The rapid increase in the external debt of domestic Irish credit institutions after 2003 and its relation to the ratio of total domestic lending to deposits (funding gap) is apparent. This gap was at the core of the difficulties experienced by the Irish banking sector in the wake of the financial crisis of 2007/08 as its access to external financing became severely constrained.[8]

The overall implications of these developments for mortgage credit in Ireland can be seen in Table 1. The total value of mortgages outstanding increased almost tenfold between 1995 and 2005. The total number of new mortgages issued went from just under 50,000 in 1995, to 80,000 in 2000 and to over 120,000 mortgages by 2005. The average size of a mortgage also increased considerably over the period. In 1995, the average mortgage extended by an Irish credit institution was €54,094; by 2005, this had climbed to €231,206. Inevitably with such a large expansion in credit, house prices increased substantially over the period. Between 2000 and 2007, prices rose by almost 90 per cent. The peak in house prices occurred in mid-2007 and between then and 2012 prices fell by 50 per cent in nominal terms before starting to recover. The residential

---

[8]Catte, Cova, Pagano and Visco (2011) note the role of domestic and external imbalances in contributing to the build up of financial excess in the global economy during the mid 2000s. They argue that a globally coordinated demand rebalancing should have occurred to counteract those imbalances developing.

market also witnessed a substantial decline in activity with new supply in 2014 down to 11,000 units, compared with nearly 81,000 units being built in 2005.[9]

The Irish experience of the relationship between the housing market and credit availability over recent decades then has been one of extremes; a sharp rise in house prices and housing supply accompanied by strong credit growth, and then a collapse of the housing market followed by a high household debt burden and a large number of non-performing mortgages for the domestic economy to contend with. Since 2013, there has been a pickup in house prices but the supply of new and second-hand houses remains low by historical standards. Against this background, the Irish central bank introduced regulatory limits on the proportion of mortgage lending at high LTV and high LTI ratios by regulated financial services providers in the Irish market (Central Bank of Ireland (2015)). Banks must restrict lending for primary dwelling purchase above LTV limits to no more than 15 per cent of the aggregate flow of all housing loans for principal dwelling purposes. A limit of 80 per cent LTV applies on new mortgage lending for non-first-time buyers, while a limit of 90 per cent LTV applies to the first €220,000 of the value of a residential property and a limit of 80 per cent applies to any value of the property thereafter. No more than 20 per cent of the total aggregate amount of new loans for the purchase of primary dwelling homes can have LTI ratios exceeding 3.5. The stated purpose of these measures is to increase the resilience of the banking and household sectors to the property market and to reduce the risk of bank credit-house price spirals emerging in the future. The first review of the mortgage rules by the Central Bank will be published in November 2016.

4.   The impact of macroprudential policies on the housing market - a brief review

The increase in the use of macroprudential policies over the past decade has seen a significant increase in the associated literature.[10] Many of these contributions focus

---

[9]Gustafsson, Stockhammar and Österholm (2016) note similiar developments occurring in Sweden over the past fifteen years, with a doubling of real house prices coinciding with a rise in household debt and raising the issue of whether financial imbalances exist in the Swedish economy and leave it vulnerable to a fall in house prices.

[10]For a general overview of macroprudential policy, see Galati and Moessner (2012) and Lim et al. (2011).

on the efficacy of LTV and LTI limits. In a relatively early review, Borio, Furfine and Lowe (2001) outline the role LTV limits could play in curbing pro-cyclical bank lending. They argue that procyclical bank lending is likely to be greater, the higher the average LTV is, as the larger the ratio, the greater is the marginal amount of new lending that can be granted for a given change in the value of the collateral. A 2010 IMF survey (Lim, Columba, Costa, Kongsamut, Otani, Saiyud, Wezel and Wu (2011)), reports that nearly 70 per cent of 49 countries surveyed use either LTV ratios or LTI ratios, with most of these countries using judgement in both designing and calibrating the instruments in question. Caruana (2010) and Crowe, Dell'Ariccia, Igan and Rabanal (2011) conclude that limits on both loan-to-value and debt-to-income ratios temper movements in property markets. Wong, Fung, Fong and Sze (2004) cite LTV and LTI limits as mitigating the house price boom in Hong Kong in 1994 and buffeting the financial system against the fallout from the crash in 1997.

Much of the empirical work on the use of LTV and LTI limits finds that such limits have a contractionary impact on both house price inflation and activity levels in housing markets. Almeida, Campello and Liu (2006), using cross-country variation in LTVs, provide evidence to support the "financial accelerator" hypothesis. In particular, they find that both house prices and new mortgage borrowings are more sensitive to aggregate shocks in countries with higher LTVs. They also find that the empirical relationship between LTVs and income sensitivities is stronger where the income constraint is less likely to be a binding factor. Therefore, households, who are constrained by the availability of collateral, have more procyclical debt capacity in the presence of higher LTVs.

Igan and Kang (2011) examine the introduction of LTV and LTI limits in Korea. Combining a regional dataset and survey data, they find evidence that transactions levels fall after the introduction of such limits. They show that the implementation of a LTV limit had a negative statistically-significant impact on Korean house price growth. Although the coefficients for a LTI limit were also negative, they were not statistically-significant. Crowe, Dell'Ariccia, Igan, Rabanal (2011), using a cross-country panel data model, estimate that a 10 percentage point increase in maximum LTV results in a 13 percent increase in nominal house prices.

5. Empirical Application

The purpose of our empirical analysis is to analyse the relationship between rents and house prices in the Irish market due to changes in LTVs brought about by macroprudential policy. To do so, we undertake an empirical application of the credit-augmented house price to rent ratio model discussed in section 2. The Kim (2007) model argues that the typical relationship between the house price to rent ratio and the real user cost must be augmented to allow for credit frictions such as changes in LTVs. McCarthy and McQuinn (2013) provide a detailed overview of changing credit conditions in the Irish financial sector over the period 2001 to 2010. Using granular, loan level data collected from the balance sheet of the main Irish banks, they illustrate the significant changes in both the LTI and LTVs associated with the substantial increase in credit over this period. Thus, the specification presented in (3) would appear to be particularly warranted in an Irish context.

The actual average LTV in the Irish mortgage market over the period 1980 to 2014 is plotted in Figure 4. To capture the impact of supply-side changes in credit conditions on the LTV, the actual series is adjusted to allow for demand-side factors. The actual LTV is modelled as a function of demand side factors such as changes in unemployment (dlU), interest rates (r), population levels (POP) and household income levels (Y). The LTV is filtered ($flLTV$) to allow for long-run changes. The following specification is also estimated for the Irish market in Kelly and McQuinn (2014):

$$lLTV_t = \alpha_0 + \alpha_1 lLTV_{t-1} +$$

$$\alpha_2 flLTV_t + \alpha_3 dlU_t + \alpha_4 Y_t + \alpha_5 POP_t + \alpha_6 r_t + \epsilon_t. \tag{4}$$

In estimating (4) we adopt the Hendry (1993) general-to-specific approach and only leave in the variables, which are significant. The results of the estimation are in Table 2. The actual LTV and the fitted values from (4) are presented in Figure 5. The fitted series is similar to the indicator of credit conditions estimated by Fernandez-Corugedo and Muellbauer (2006) for the UK market and the mortgage market conditions index estimated for the Irish market by McCarthy and McQuinn (2013). The resulting *adjusted* LTV ($ALTV_t$) is calculated in the same manner as in Duca, Muellbauer and Murphy

(2011).

To estimate an expression for the real user cost ($RUSER_t$), we compile an expected house price appreciation term. Following Kelly and McQuinn (2014), we use a four period moving average of this term here.[11]

With these series, we can then estimate the relationship given by (3). Each of the data series representing the three variables in (3) are treated as I(1), consistent with the outcome of unit root tests. It is appropriate then to estimate (3) within a cointegration framework. We do so using two cointegration methodologies: the Johansen (1988) maximum likelihood procedure and the autoregressive distributed lag (ARDL) approach (Pesaran and Shin (1999)).

The chosen lag length for the Johansen estimation is five, based on the Akaike information criterion (AIC). We estimate with restricted intercepts and no trends in the VAR. The Johansen (1988) trace statistic supports the number of cointegrating vectors among the three variables being one at the 90 per cent critical value. We proceed then on the basis that there is one cointegrating vector, the estimate of which is shown in the first column of Table 3.

Two estimates of (3) using the ARDL method are shown in the second and third columns of Table 3, with the AIC and Schwartz-Bayesian (SBC) information criterion being used to select the respective ARDL specifications. The equation estimates across all three columns are broadly similar, with coefficient values having the expected sign. Furthermore, the magnitude of the coefficients is broadly in line with the comparable results in Duca, Muellbauer and Murphy (2011).

We also use the Johansen procedure to provide a model of the short-run behaviour of $l(hp_t/rent_t)$. This involves regressing its first difference ($\Delta l(hp_t/rent_t)$) on the first-quarter lag of the error correction term (i.e., the difference between the actual value of $l(hp_t/rent_t)$ and its fitted value based on the coefficient values in the first column of Table 3, denoted as ecm) and the first four lags of the changes in the three variables included in the cointegrating VAR system. The results are shown in Table 4. The sign on the lagged ecm term is negative and statistically significant, indicating error correction

---

[11]Kelly and McQuinn (2014) examine alternative possible price expectations mechanisms such as a naïve expectations approach and following Himmelberg, Mayer, and Sinai (2005) and Duca, Muellbauer, and Murphy (2011) lagged house price appreciation over the prior four years. However, the overall results were not sensitive to the alternative specifications.

occurring over time.[12]

5.1.   Simulated effects of macroprudential policy

The Johansen procedure allows us to identify the orthogonalised response of $l(hp_t/rent_t)$ to a shock in $ALTV_t$. With the variables in the VAR ordered as $l(hp_t/rent_t)$, $lRUSER_t$, $ALTV_t$, an orthogonalised impulse response option implies that a shock to $ALTV_t$ will not have an effect on the other variables in the impact period (0) but can have an effect in subsequent quarters.

The response of $l(hp_t/rent_t)$ to the shock is shown in Figure 6. It indicates that a positive shock to $ALTV_t$ will have a positive impact on $l(hp_t/rent_t)$ over time, but with most of the adjustment to a new long-run value for the house price-to-rent variable occurring within 10 quarters. The implication is that a rise in $ALTV_t$ will cause house prices to rise relative to rents; similarly a decline in ALTV, such as may occur as a consequence of macroprudential policy, will cause rents to increase relative to prices. Significant changes in credit provision due to the introduction of macroprudential policy, therefore, lead to a shift in tenure choice causing a change in the relative value of house prices to rents.

6.   Concluding Comments

Macroprudential policy is a relatively new mechanism that central banks and other regulatory authorities are adopting in the expectation of, or pre-empting, imbalances in the financial environment. The efficacy of the instruments by which it is implemented, and any side-effects they may have, is likely to be the subject of much empirical research in the years ahead. Likewise, analysts, including those in central banks, will want to develop econometric tools that allow them to assess the effects of macroprudential policy both from financial stability and real economy perspectives. Among the latter are the implications for housing market variables.

In this paper, we apply a model that links an instrument of macroprudential pol-

---

[12]We also estimated this equation where the first differences of $lRUSER_t$ and $ALTV_t$ are the dependent variables. The results (not shown here) indicate the sign of the error correction term being insignificant in both cases. This points to $l(hp_t/rent_t)$ being the only variable among the three that adjusts to correct any disturbance to equilibrium that occurs among the variables.

icy, the maximum LTV ratio, to an important variable in the housing market, the house price to rent ratio, in a rigorous, but parsimonious and estimable relationship. Our results indicate that a policy which lowers the effective LTV ratio will lead to a permanent decline in the house price to rent ratio. In other words, lower, binding LTVs result in permanent increases in rents for a given house price level.

This raises a number of important issues for central banks and others to consider. First, the imposition of a LTV rule, which changes rents relative to house purchase prices, ultimately reflects a change in the tenure preferences of households. An increase in the proportion of people renting in the economy has implications for the nature of the housing stock to be constructed. This warrants attention at a time in the Irish market when a number of policy considerations are being considered to stimulate housing supply. For example, Lyons (2015) suggeststhat building regulations should be amended to facilitate greater housing supply. However, this may reduce the appropriateness of the new housing stock to meet the changing tenure requirements.

Secondly, the supply side of the market will likely be affected by LTV rules. Duffy, McInerney and McQuinn (2015) use a structural model of the Irish property and credit market to examine the implications of the new macroprudential measures for house prices and key activity variables in the mortgage market. Their results indicate that, compared to a "baseline", or no policy change, scenario, the measures will more than likely result in house prices being lower than what they otherwise would be, may result in fewer houses being supplied to the market, and could see a smaller number of mortgage loans being issued. Cussen, O'Brien, Onorante and O'Reilly (2015) also note that housing supply will be lower due to the same macroprudential regulations.

Finally, it is worth noting that the supply of credit to a particular mortgage and housing market may be changed in a number of different ways. Both McCarthy and McQuinn (2013) and Campbell and Coco (2011) note the importance of the loan to income ratio in affecting credit supply levels alongside the LTV ratio. Further research could address the role that different means of regulating credit availability have on the house price to rent ratio.

References

[1] Almeida H., Campello M. and C. Liu (2006). "The financial accelerator: Evidence from international housing markets", *Review of Finance*, Vol 10, pp.1-32.

[2] Barrett A., Duffy D. and K. McQuinn (2015). Tax Breaks and the Residential Property Market, with Alan Barrett and David Duffy. Report for the Department of Finance. Published online at:
http://www.budget.gov.ie/Budgets/2016/Documents/ESRI_Report_on_tax_breaks_and%20_residential_property_market_pub.pdf

[3] Blackey D.M. J.R. and Follain (1995). In search of empirical evidence that links rents and user costs, NBER working paper No. 5177.

[4] Borio C., Furfine C. and P. Lowe (2001). Procyclicality of the financial system and financial stability: Issues and policy options. In *Marrying the macro and micro-prudential dimensions of financial stability*, Bank of International Settlements (BIS) working papers No. 1, pp. 1-57.

[5] Browne F., Conefrey T. and G. Kennedy (2013). Understanding Irish house price movements - a user cost of capital approach, *Central Bank of Ireland Research Technical Paper* 4/RT/13.

[6] Campbell S. D., Davis M.A., Gallin J. and R. F. Martin (2006). A trend and variance decomposition of the rent-price ratio in housing markets, Finance and Economics Discussion Series 2006-29, Board of Governors of the Federal Reserve System (U.S.).

[7] Caruana J. (2010). Macroprudential policy: Working towards a new conscensus. Remarks at the high-level meeting on the "The emerging framework for financial regulation and monetary policy" jointly organised by the Bank of International Settlement (BIS) Financial Stability Institute and the International Monetary Fund (IMF) Institute, Washington, DC. 23rd April.

[8] Case, K.E. and R.J. Shiller (2003). "Is there a bubble in the housing market?" *Brookings Papers on Economic Activity* 2:2003, 299-342.

[9] Catte, P., Cova, P., Pagano P. and I. Visco (2011). "The role of macroeconomic policies in the global crisis", *Journal of Policy Modeling* Vol. 33, Issue 6, pp. 787-803.

[10] Central Bank of Ireland. (2015). Information Note: Restrictions on residential mortgage lending. Central Bank of Ireland.

[11] Crowe C., Dell'Ariccia G., Igan D. and P. Rabanal (2011). How to deal with real estate booms: Lessons from country experiences, International Monetary Fund (IMF) working paper No. 11/91.

[12] Cussen M., O'Brien M., Onorante L. and G. O'Reilly (2015). Assessing the impact of macroprudential measures. Central Bank of Ireland Economic Letter Series, No. 3.

[13] Diaz, A. and M.J. Luengo Prado (2008). "On the user cost and homeownership," *Review of Economic Dynamics*, Elsevier for the Society for Economic Dynamics, vol. 11(3), pages 584- 613, July.

[14] Diaz, A. and M.J. Luengo Prado (2012). Homeownership: Economic benefits in: Susan J. Smith, Marja Elsinga, Lorna Fox O'Mahony, Ong Seow Eng, Susan Wachter, Richard K. Green, editors. International Encyclopedia of Housing and Home, Vol 2. Oxford: Elsevier; 2012. pp. 439445.

[15] Duca J., Muellbauer, J. and Murphy, A. (2011). "House prices and credit constraints: Making sense of the U.S. experience", *Economic Journal*, Royal Economic Society, vol. 121(552), pgs. 533-551, 05.

[16] Duffy D., McInerney N. and K. McQuinn (2015). Macroprudential measures in a recovering property market: Too much too soon?, Economic and Social Research Institute Working Paper No. 499 April.

[17] Fernandez-Corugedo, E. and J. Muellbauer (2006). "Consumer credit conditions in the UK", Bank of England working paper 314.

[18] Galati G. and R. Moessner (2012). "Macroprudential policy - A literature review," *Journal of Economic Surveys*, published online May 11.

[19] Gallin J. (2008). "The long-run relationship between house prices and rents," *Real Estate Economics*, vol. 36, no. 4, pp. 635-658.

[20] Gustafsson, P., Stockhammar P. and P. Österholm (2016). "Macroeconomic effects of a decline in housing prices in Sweden", *Journal of Policy Modeling*, available online March.

[21] Hendry, D. F. (1993). *Econometrics: Alchemy or Science?* Oxford: Blackwell Publishers.

[22] Honohan P. (2010), The Irish banking crisis regulatory and financial stability policy 2003-2008: A report to the Minister for Finance by the Governor of the Central Bank.

[23] Himmelberg. C., C Mayer and T. Sinai (2005). Assessing high house prices: Bubbles, fundamentals, and misperceptions, Federal Reserve Bank of New York Staff Report No. 218, September.

[24] Igan D. and H. Kang (2011). Do loan-to-value and debt-to-income limits work? Evidence from Korea, International Monetary Fund (IMF) working paper March.

[25] Johansen, S. (1988). "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control*, 12, pp. 231-254.

[26] Jorgenson, D. W. (1963). "Capital theory and investment behaviour", *American Economic Review* Papers and Proceedings, 53(2), May, 247 59.

[27] Jorgenson, D. W. (1967). The theory of investment behaviour, in Determinants of Investment Behavior, ed., R Ferber, New York, Columbia University Press.

[28] Kelly, J. and M. Everett (2004). Financial liberalisation and economic growth in Ireland, Central Bank of Ireland, Quarterly Bulletin Article, Autumn pp. 91 - 112.

[29] Kelly R. and K. McQuinn (2014). "On the hook for impaired bank lending: Do sovereign-bank inter-linkages affect the net cost of a fiscal stimulus?" *International Journal of Central Banking*, Volume 10, Number 2, pp. 95 - 128.

[30] Kim Y. (2007). Rent-price ratios and the earnings yield on housing, Unpublished manuscript, University of Southern California.

[31] Lim C., Columba F., Costa A., Kongsamut P., Otani A., Saiyid M., Wezel T. and X. Wu (2011). Macroprudential policy: What instruments and how to use them? International Monetary Fund (IMF) working paper WP/11/238.

[32] Lyons R. (2015) Daft.ie house price report, October, available online at https://www.daft.ie/report/ronan-lyons-2015q3-sale.

[33] Magyar Nemezeti Bank (2010). Report on Financial Stability, April.

[34] Mayer, C. (2003). "Is there a bubble in the housing market? - Comments and Discussion" *Brookings Papers on Economic Activity* 2:2003, 343-354.

[35] McCarthy Y. and K. McQuinn (2013). Credit conditions in a boom and bust property market. *Central Bank of Ireland Research Technical Paper* 8/RT/13.

[36] McQuinn K. and G.O'Reilly (2008). "Assessing the role of income and interest rates in determining house prices", *Economic Modelling*, Vol. 25 pp.377-390.

[37] Meen, G. (1990). "The removal of mortgage credit constraints and the implications for econometric modelling of UK house prices", *Oxford Bulletin of Economics and Statistics*, Vol 52(1), pp 1-23

[38] Murphy, A, (2005). Modelling Irish house prices: A review and some results, mimeo, December. http://www.nuff.ox.ac.uk/Users/MurphyA/Irish$%$20House$%$20Prices.zip 29

[39] Norges Bank (2010). "Finanstilsynet's new guidelines for prudent lending - effects on household debt", Financial Stability Report no. 2/2010.

[40] Pesaran, M.H. and Y. Shin (1999). An autoregressive distributed lag modelling approach to cointegration analysis, in S. Strom (ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Chapter 11, pp. 371-413. Cambridge: Cambridge University Press.

[41] Poterba, J. M. (1984). "Tax subsidies to owner-occupied housing: An asset-market approach" *The Quarterly Journal of Economics*, MIT Press, vol. 99(4), pages 729-52, November.

[42] Swedish Financial Supervisory Authority (2010). "Mortgages capped at 85 per cent as of 1 October", www.fi.se/Folder-EN/Startpage/Press/Press-release/Listan/Mortgages -capped-at85-percent-as-of-1-October, 9 July.

[43] Wong J., Fung L., Fong T. and A. Sze (2004). Residential mortgage default risk in Hong Kong, Hong Kong Monetary Authority Working Paper.

Table 1: Summary of Irish Residential Mortgage Market Statistics: 1995 - 2014

Variable	Unit	1995	2000	2005	2007	2014
Total Value of Mortgages Issued	€ million	2,666	9,004	27,753	24,064	6,187
Average Mortgage Issued	€	54,094	111,355	231,206	271,154	193,974
Total Number of Mortgages Issued		49,288	80,856	120,037	88,747	31,897
House Prices	€	77,994	169,191	276,221	322,634	246,378
Housing Supply		30,575	49,812	80,957	78,027	11,016

Table 2: Loan to Value (LTV) model

Variable	Coefficient	T-Stat
Constant	0.018	0.207
lLTV(-1)	0.384	4.945
flLTV	0.612	7.46
dlU	0.155	2.86
R^2	0.96	

Note: Estimation is with quarterly data covering the period 1980Q1 to 2014Q1.

Table 3: House price to rent model

	Dependent Variable : $l(hp_t/rent_t)$		
		Estimator	
Variable	Johansen	ARDL(AIC)	ARDL(SBC)
Constant	-2.95	-2.29	-2.26
	(-1.94)	(-2.43)	(-2.41)
$LRUSER_t$	-0.55	-0.55	-0.54
	(-2.61)	(-3.93)	(-4.00)
$ALTV_t$	0.73	0.60	0.59
	(3.32)	(3.74)	(3.72)

Note: Estimation is with quarterly data covering the period 1982Q3 to 2014Q1 and T-Stats are in parentheses.

Table 4: Short-run dynamic equation for the change in the house price to rent ratio

Variable	Coefficient	T-Stat
$Dependent\ Variable:\ \Delta l(hp_t/rent_t)$		
$(\Delta l(hp_{t-1}/rent_{t-1}))$	0.24	2.79
$(\Delta lRUSER_{t-1})$	0.01	1.03
$(\Delta ALTV_{t-1})$	-0.01	-0.47
$(\Delta l(hp_{t-2}/rent_{t-2}))$	-0.21	-2.51
$(\Delta lRUSER_{t-2})$	-0.001	-0.12
$(\Delta ALTV_{t-2})$	-3.85E-05	-0.003
$(\Delta l(hp_{t-3}/rent_{t-3}))$	0.16	1.94
$(\Delta lRUSER_{t-3})$	0.002	0.24
$(\Delta ALTV_{t-3})$	0.01	0.57
$(\Delta l(hp_{t-4}/rent_{t-4}))$	0.24	2.99
$(\Delta lRUSER_{t-4})$	0.02	2.35
$(\Delta ALTV_{t-4})$	0.01	0.51
ecm_{t-1}	-0.04	-2.92
ecm_t	$1.00 \times l(hp_t/rent_t) + 0.55 \times lRUSER_t - 0.73 \times ALTV_t + 2.95$	
R^2		0.40

Note: Estimation is with quarterly data covering the period 1982Q3 to 2014Q1.

Figure 1

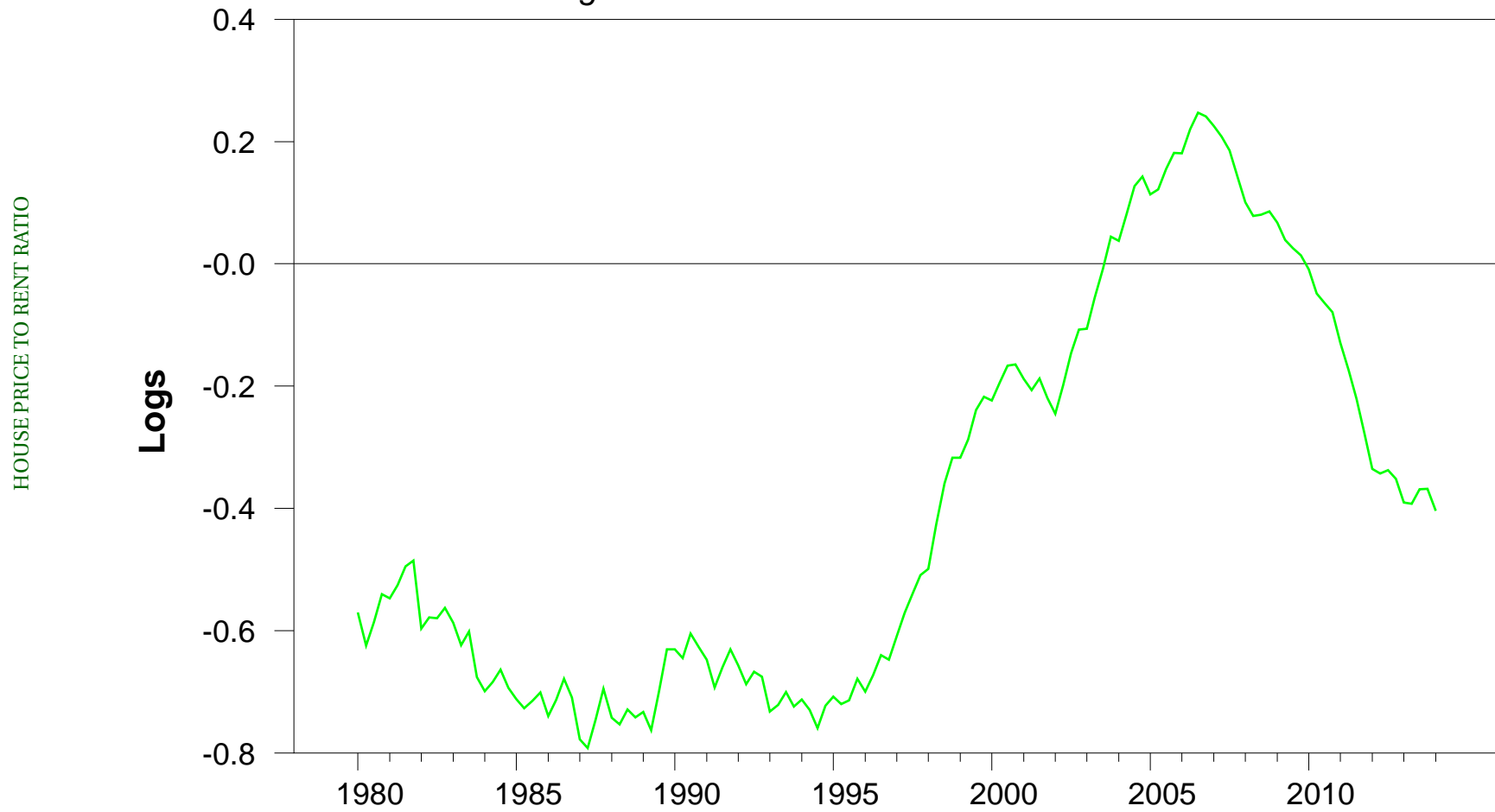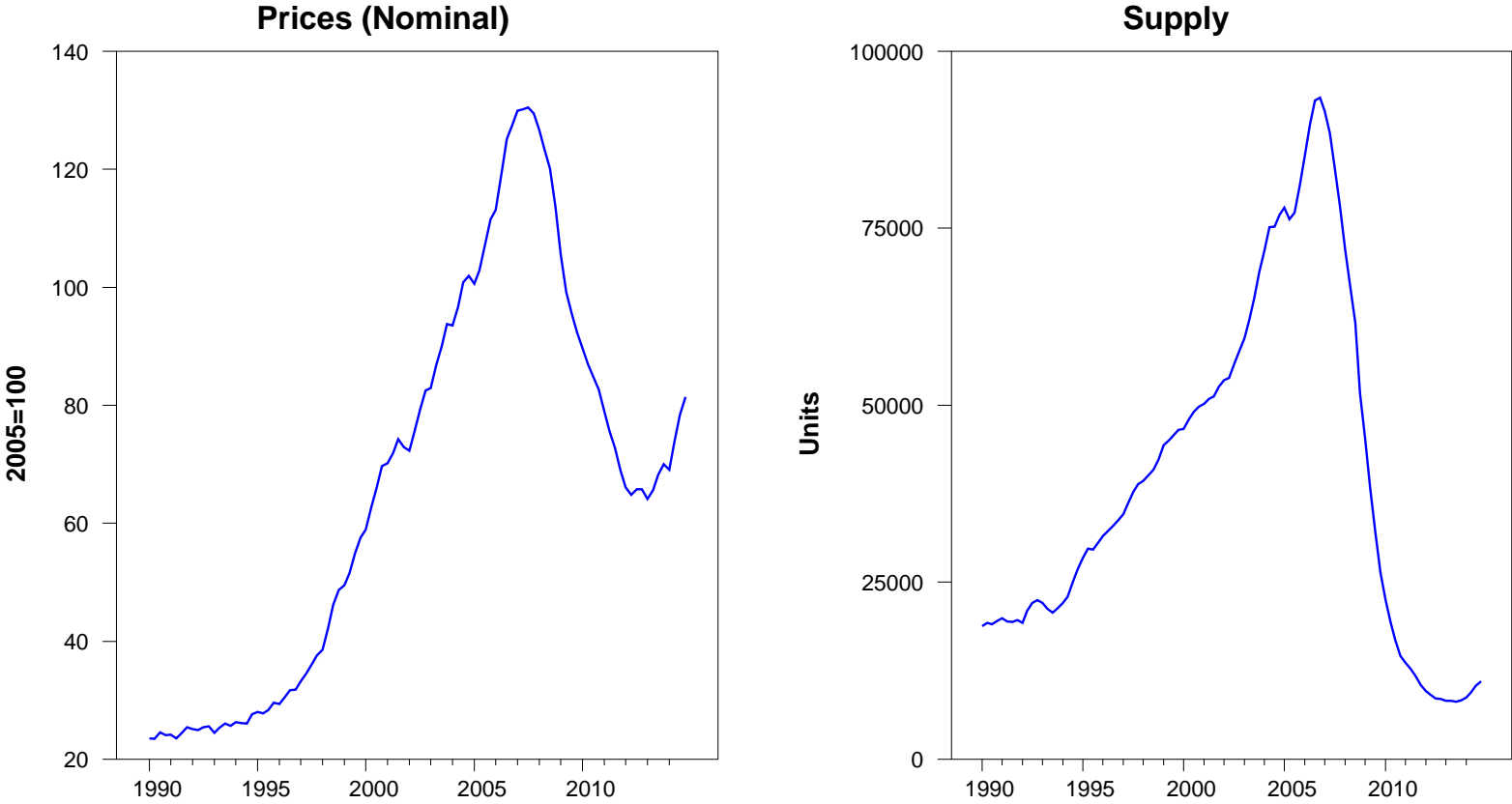*Log of the Irish House Price to Rent Ratio*

Figure 2

Irish Housing Market Activity 1990 - 2014

22

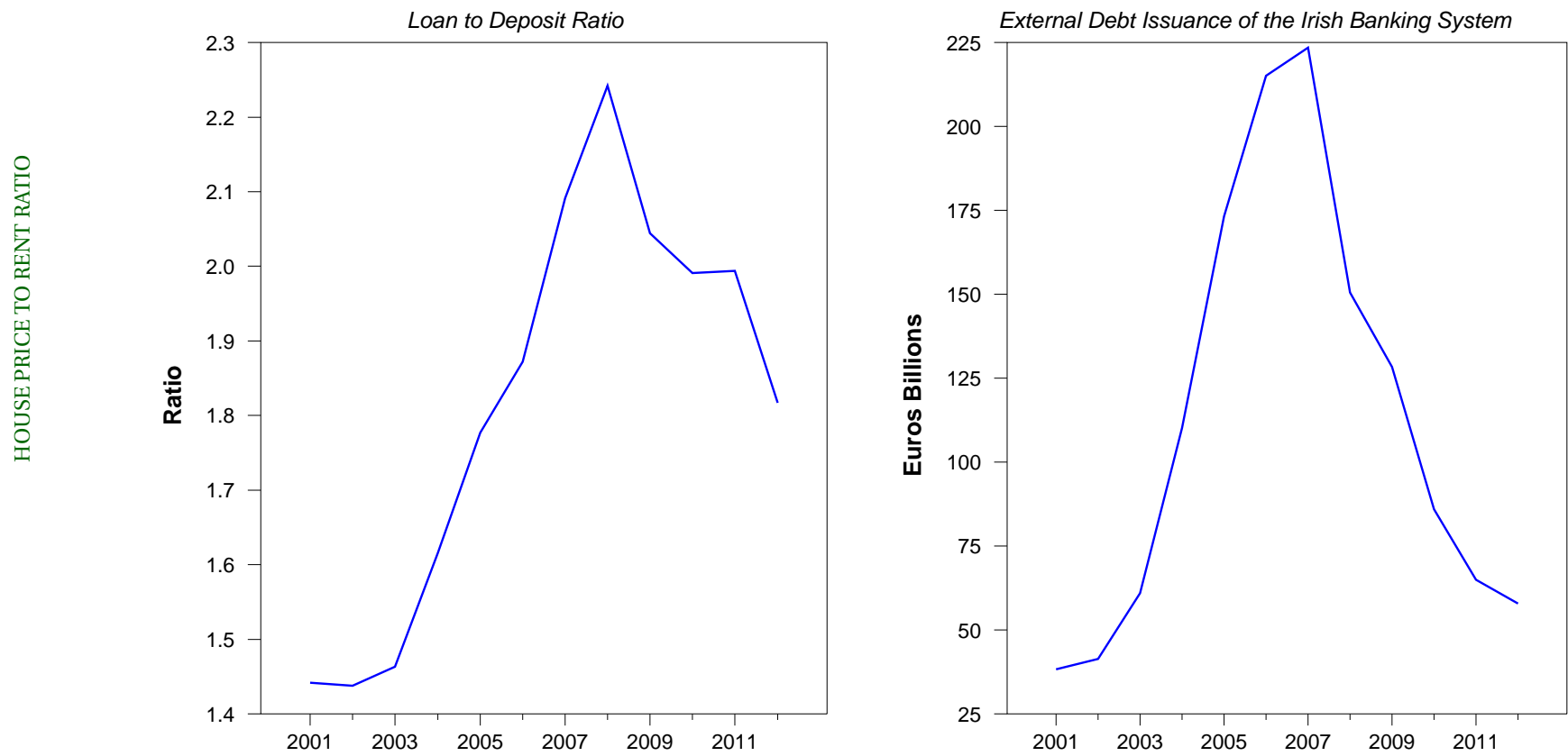# Figure 3

Irish Banking Sector Lending and Funding: 2001-2012

HOUSE PRICE TO RENT RATIO

Loan to Deposit Ratio

External Debt Issuance of the Irish Banking System

Figure 4

Irish Loan to Value (LTV) Ratio:1980-2014
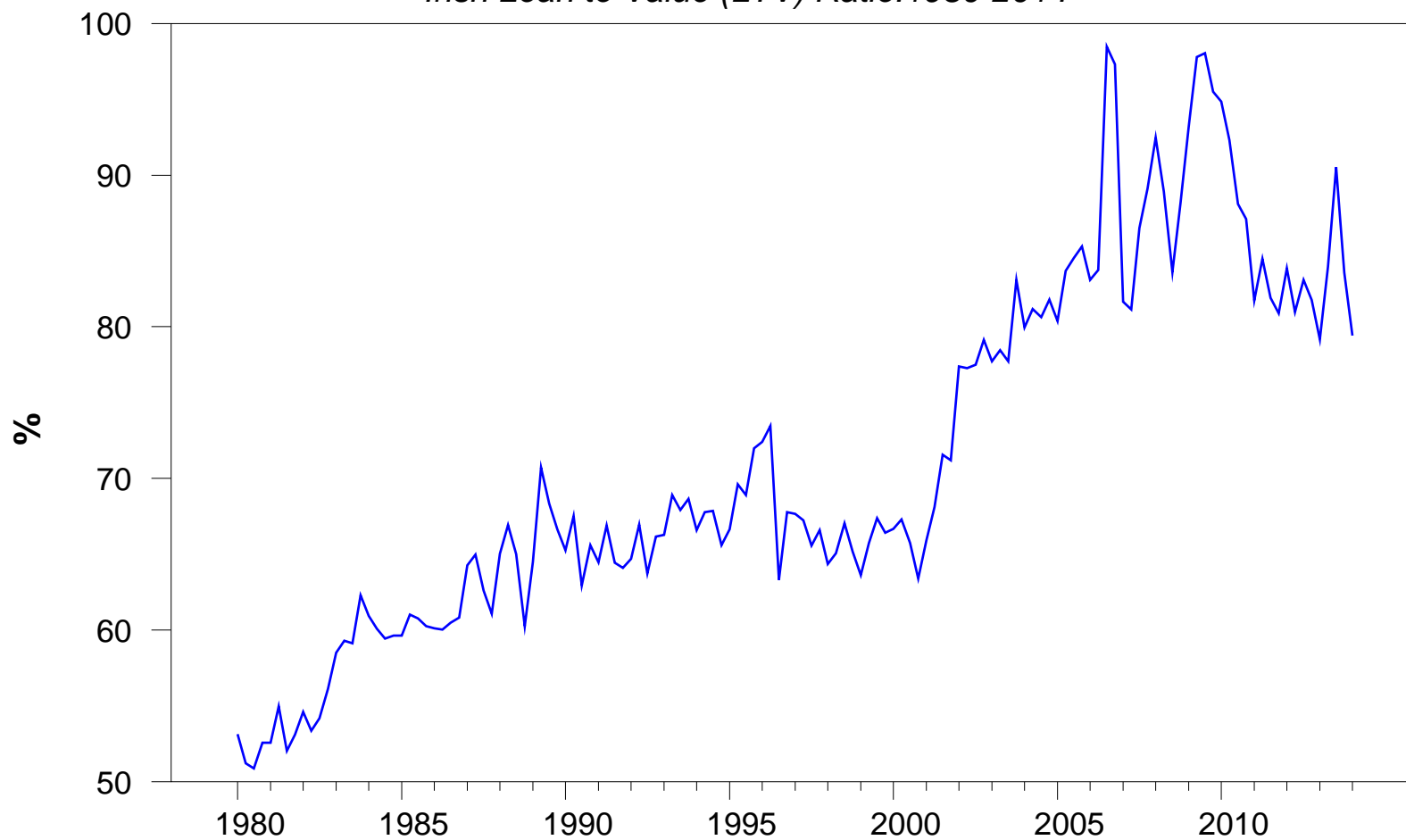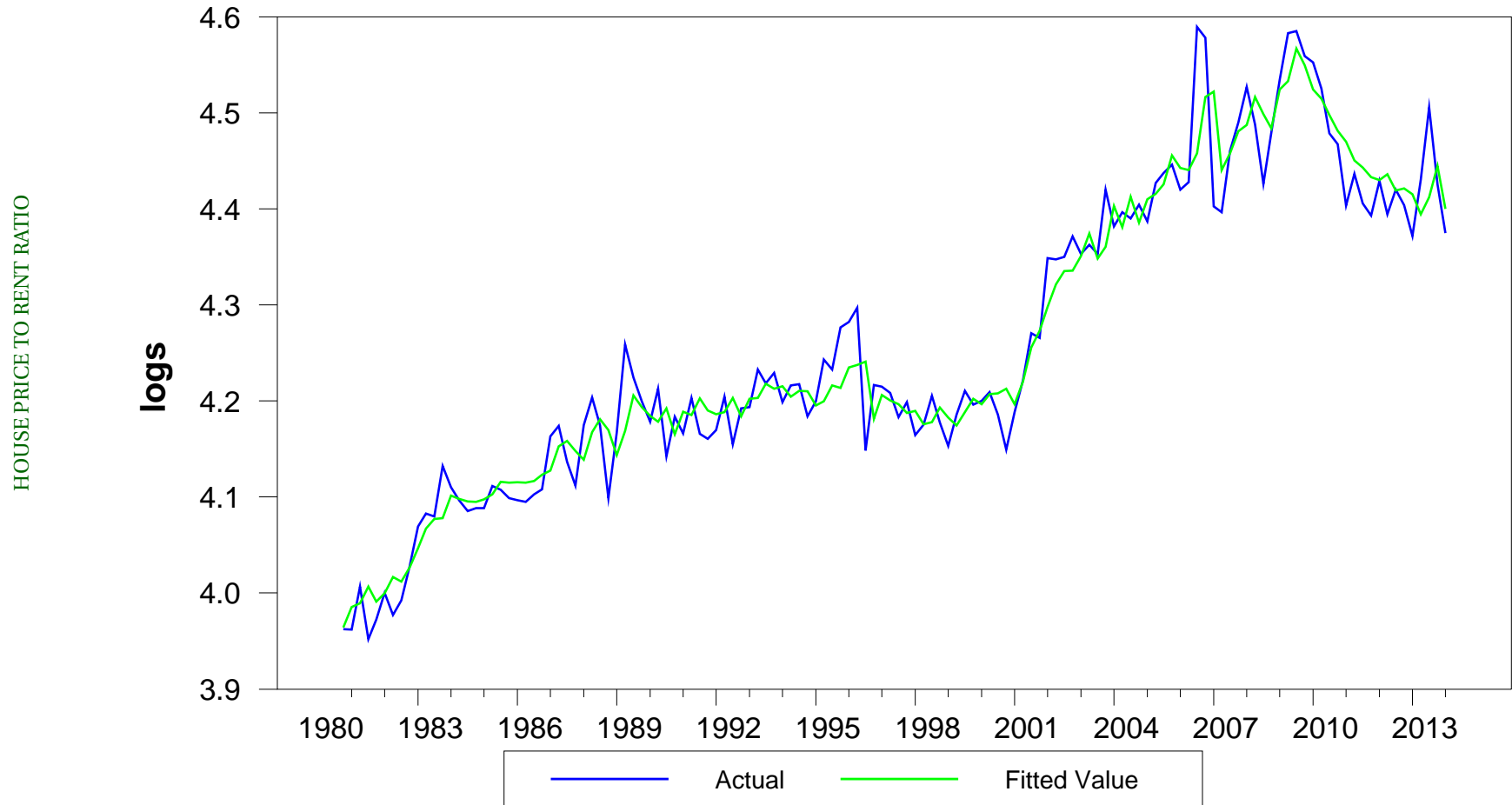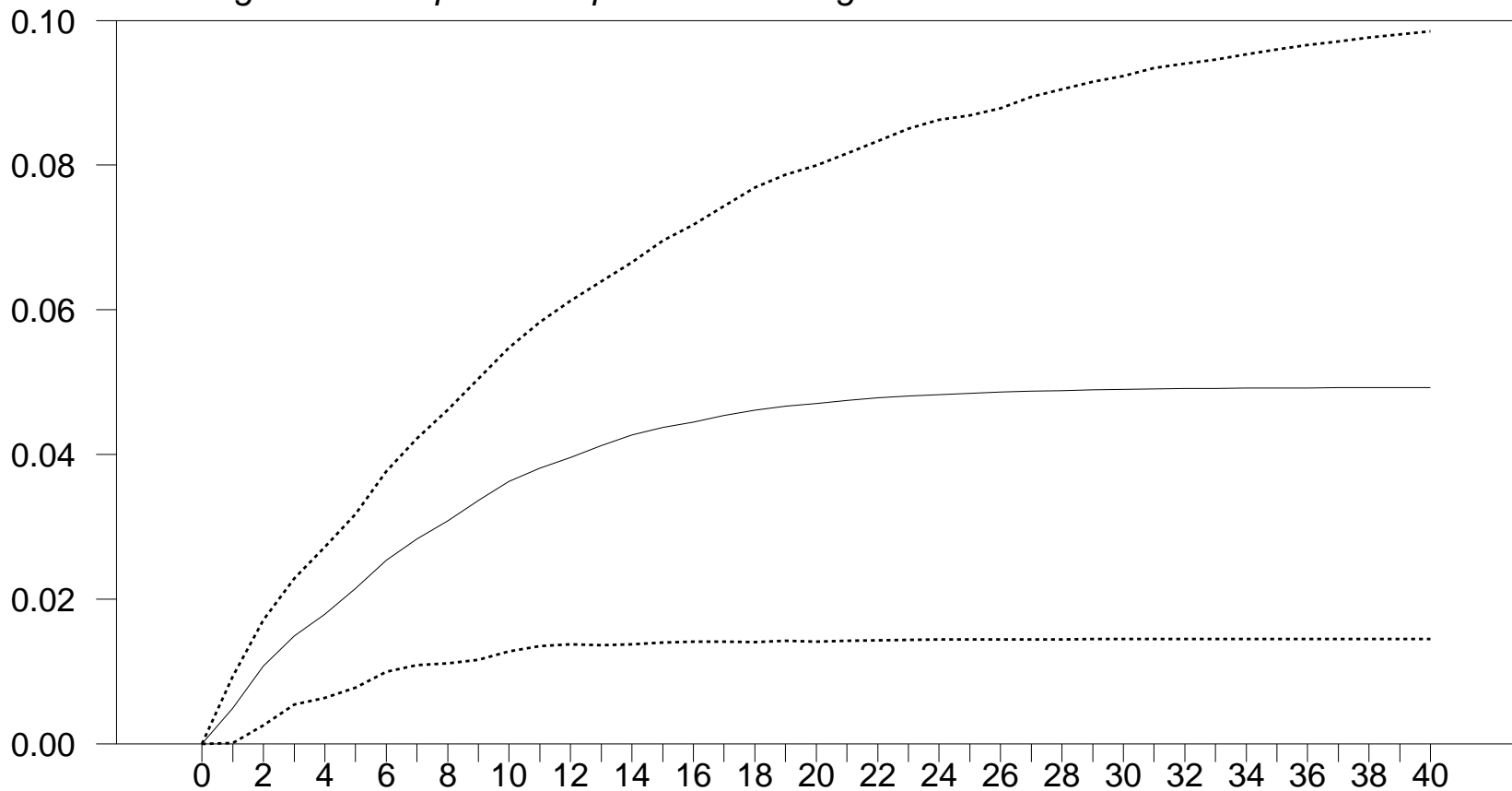
Figure 5

Actual and Fitted LTV: 1981-2014

Figure 6

Orthogonalised Impulse Response of the Log of the House Price to Rent Ratio

CRONIN, MCQUINN

Note: The solid line represents the impulse response while the dashed lines are the 95 per cent confidence intervals