# ESRI Research Note

## *An Empirical Assessment of the Macroprudential Measures in the Irish Housing and Credit Market*

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# An Empirical Assessment of Macroprudential Measures in the Irish Housing and Credit Market

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## 1. Introduction

This Research Note empirically assesses the impact of the macroprudential measures recently implemented by the Central Bank of Ireland on the credit and housing markets in Ireland. An existing model of the overall Irish housing and banking sectors (Gerlach-Kristen and Mc Inerney, 2014; Duffy et al., 2016) is simulated to examine how the macroprudential measures have impacted on key housing variables such as prices, supply and credit levels over the period the measures have been implemented.

The Note is structured as follows. We first construct a scenario whereby we look at the effects of the loan-to-value (LTV) and loan-to-income (LTI) restrictions relative to a baseline scenario on the housing and credit markets with respect to mortgage credit, house prices and housing supply. Under the baseline scenario, the measures are assumed not to have been implemented. Therefore, by comparing the outcomes for the different housing variables under the two scenarios, the relative impact of the measures can be gauged.

## 2. Results Overview

We begin by examining how two macroprudential policy restrictions, the LTV and LTI ratios, have affected the credit and housing markets since their introduction. To do this, we construct two different scenarios and compare them to the actual outcomes observed over the period. We first look at what would have happened to mortgage credit, house prices and housing supply with no change in loan-to-value and loan-to-income ratios and on the basis of this, how much of the actual change in mortgage credit etc. can be attributed to these mortgage restrictions.

The results from our scenarios suggest that the impact of the mortgage restrictions only began to take hold in the second half of 2015 and early 2016 as the weighted average of LTVs and LTIs started to fall. The results suggest that the

* This paper is part of a research project carried out on behalf of the Banking and Payments Federation of Ireland.

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LTV has become the more binding restriction of the two in the most recent period. By 2016 Q1 the combined effect of the LTV and LTI restrictions has been to reduce new mortgage lending by approximately 10 per cent relative to the baseline of no change in the ratios. The effect on the housing market is as yet quite muted with house prices being only approximately 0.05 per cent lower than in the baseline as at 2016 Q1. The results also show that the effect of the macroprudential rules on housing supply has been effectively zero at this point but this is not surprising given the lags involved in construction.

We next conduct an analysis on the potential longer-term impact on housing supply of the macroprudential policies and find that the full effects of the restrictions are not manifested until 3-4 years after the changes. Overall, the analysis suggests that over the longer term new mortgage lending is 15 per cent lower in each quarter relative to a baseline of no changes in the LTV or LTI leading to a mortgage stock that is 8 per cent lower. This decline in mortgage lending leads to a reduction in house prices; they are approximately 3.5 per cent lower relative to the baseline level. As this simulation holds all of the model's exogenous variables apart from the LTV and LTI ratios constant, the decline in house prices lowers the profitability of housing construction. The number of housing units completed in each quarter is approximately 5 per cent lower relative to the baseline by the end of the simulation period. Overall this results in a housing stock that is 0.5 per cent lower than the baseline case.

## 3. Model Description

The housing and credit model (Gerlach-Kristen and Mc Inerney, 2014; Duffy et al., 2016) can be considered in two blocks which consist of housing demand and supply equations, as well as equations for mortgage and housing stock accumulation.

Macroprudential policy enters the model as restrictions on mortgage demand through changes in the LTI and LTV ratios. Cyclical influences on these ratios are first removed so that they purely reflect exogenous (to the model) changes in credit conditions (similar to the case of Duca et al., 2011 and Duffy et al., 2016). These ratios, together with house prices, income levels and interest rates determine the volume of new mortgage lending in the model.

We assume that the Irish mortgage market is monopolistically competitive so that mortgage supply can be modelled as banks setting mortgage rates as a mark-up over deposit and money market funding costs.[1] This mark-up mainly reflects both

[1] Our identifying assumption is therefore that loan quantities do not enter the mortgage supply equation. The representative interest rate used in the model is the standard variable rate (SVR).

macroeconomic and household-specific risks, which are approximated by the unemployment rate and housing equity respectively.

In terms of housing demand, we adopt the standard inverted demand for housing framework which relates house prices to income levels, demographics, the user cost of capital and a proxy for the demand for housing services. One of the innovations in Duffy et al. (2016) in terms of modelling Irish house prices was the inclusion, following international research such as Duca et al. (2011), of an additional demand shifter in the inverted demand function related to credit conditions. These studies are typically single equation reduced-form models which simply include an indicator of credit conditions, such as an LTV that is adjusted so that it purely reflects changes in credit supply. However, the key innovation in Duffy et al. (2016), as described above, is to build a structural model where exogenous changes in credit conditions affect mortgage volumes directly so that credit conditions are endogenous in the house price equation through the inclusion of the ratio of the mortgage stock to disposable income.

Housing supply is modelled in terms of the completion of new housing units which are mainly determined by the profitability of housing investment (the ratio of house prices to building costs), similar to a Tobin's Q approach to investment (Poterba, 1984). Housing supply is also influenced by the availability and cost of construction credit as well as other variables such as the corporate insolvency rate and output gap which can capture uncertainty about investing.[2]

Finally, the model contains two equations reflecting stock accumulation, similar to the perpetual inventory method. In particular, the housing stock evolves by accumulating the contemporaneous level of housing completions on to the depreciated stock from the previous period (assuming a quarterly depreciation rate of 0.5 per cent). Similarly, the mortgage stock accumulates new mortgage lending on to the previous period's mortgage stock at a rate that is estimated from the data.

We estimate the model over the period 1988 Q1-2014 Q4 so that our sample ends in the quarter prior to the mortgage restrictions being introduced. Tables 1A and 1B present the model's parameters.

In terms of mortgage demand, changes in income levels and interest rates (the affordability channel) and house prices (the collateral channel) have a significant impact on the quantity of new mortgage lending. In addition, credit conditions,

[2] For example, an increase in uncertainty creates a mean-preserving widening of the perceived distribution of future house prices and therefore raises the real option value of postponing housing investment.

which relax the affordability and leverage constraints facing households, are also important. The results suggest that a given percentage change in the LTV ratio has almost twice the impact on mortgage demand as a similar percentage change in the LTI ratio.

On the mortgage supply side, funding costs clearly have an important role in how Irish banks set their mortgage interest rates. Moreover, the pass-through relationship is quite strong in both the short- and long-run with almost 80 per cent of any change in the money market rate feeding into mortgage interest rates in the long run. The results also indicate that repayment and default risk, as proxied by the unemployment rate and household equity respectively, are important determinants of the mortgage interest rate spread. Importantly, from a macroprudential policy perspective, restrictions on the LTV ratios associated with new mortgage lending will affect the mortgage interest rate through the household equity channel, as the leverage of the marginal mortgage will be lower.

On the housing side, Table 1B shows that the traditional determinants of house prices such as income levels, demographics and the user cost of capital all play an important role in Irish house prices. For example, the long-run elasticity of house prices with respect to income is 0.87, which is consistent with both the Irish and international house price literature. We also find that our indicator of credit conditions in the housing market, given by the mortgage stock-to-income ratio, is also important, with a long run elasticity of 0.45. Short-run house price dynamics are primarily driven by shocks in house prices themselves and changes in the unemployment rate.

Table 1B also presents the estimates for the housing supply component of the model. The completion of new housing units is mainly determined by the profitability of housing construction, given by the ratio of house prices to building costs. In addition, there is evidence of credit channels working via both the price and quantity of construction credit. Finally, the model's indicators of uncertainty, as approximated by the output gap and the corporate insolvency rate, suggest that the macroeconomic variables play an important role in housing construction via channels other than house prices and building costs.

As mentioned, the model adopts a perpetual inventory method in modelling both housing and mortgage stocks. The rate of depreciation on the existing housing stock is assumed to be 2 per cent per annum which is consistent with the rate assumed by the CSO. The relationship between the mortgage stock in the current and previous period is estimated from the data and takes a value of 0.985 over the sample period.

**TABLE 1A** Demand and Supply in the Irish Mortgage Market

| Mortgage Demand | | Mortgage Supply | |
|---|---|---|---|
| | $NewMortgages_t$ | | $\Delta MorRate_t$ |
| $NewMortgages_{t-1}$ | 0.746 | $MorRate_{t-1}$ | -0.359 |
| | (13.1) | | (-7.1) |
| $RMorRate_t$ | -0.026 | $HHEquity_{t-1}$ | -0.326 |
| | (-2.9) | | (-3.2) |
| $\Delta Income_t$ | 0.891 | $URate_{t-1}$ | 0.306 |
| | (2.1) | | (5.9) |
| $\Delta HPrices_{t-1}$ | 0.678 | $DepRate_{t-1}$ | 0.079 |
| | (3.1) | | (3.9) |
| $LTV_t$ | 0.728 | $MMRate_{t-1}$ | 0.279 |
| | (2.5) | | (15.9) |
| $LTI_t$ | 0.392 | $LTD_{t-1}$ | -0.526 |
| | (2.8) | | (-5.9) |
| *Constant* | 5.511 | $\Delta MMRate_t$ | 0.519 |
| | (4.5) | | (13.1) |
| | | $\Delta DepRate_{t-1}$ | 0.111 |
| | | | (2.8) |
| | | *Constant* | -0.034 |
| | | | (-1.6) |
| Adj. $R^2$ | 0.949 | Adj. $R^2$ | 0.884 |
| Sample | 1988q1-2014q4 | Sample | 1988q1-2014q4 |

*Source:* Authors' own calculations.

**TABLE 1B** Demand and Supply in the Irish Housing Market

| Housing Demand | | Housing Supply | |
|---|---|---|---|
| | $\Delta HPrices$ | | $HCompl_t$ |
| $HPrices_{t-1}$ | -0.102 | $Hcompl_{t-1}$ | 0.851 |
| | (-2.9) | | (15.3) |
| $(HStock_{t-1}/Pop2534_{t-1})$ | -0.075 | $HPrices_t/BCosts_t$ | 0.224 |
| | (-7.2) | | (2.1) |
| $User_{t-1}$ | -0.002 | $\Delta RNFC_t$ | -0.014 |
| | (-9.8) | | (-2.5) |
| $Income_{t-1}$ | 0.087 | $Insolr_t$ | -0.014 |
| | (5.6) | | (-2.9) |
| $(MorStock_{t-1}/Income_{t-1})$ | 0.045 | $\Delta CLoans_{t-1}$ | 0.915 |
| | (6.5) | | (4.4) |
| $\Delta HPrices_{\tau-1}$ | 0.415 | $Gap_{t-1}$ | -1.237 |
| | (4.4) | | (-2.4) |
| $\Delta Prices_{-2}$ | 0.213 | *Constant* | -0.188 |
| | (3.0) | | (-0.6) |
| $\Delta URate_{\tau-1}$ | -0.015 | | |
| | (-4.2) | | |
| *Constant* | 0.002 | | |
| | (1.6) | | |
| Adj. $R^2$ | 0.713 | Adj. $R^2$ | 0.979 |
| Sample | 1988q1-2014q4 | Sample | 1988q1-2014q4 |

*Source:* Authors' own calculations.

We first calculate the change in the weighted-average LTV and LTI using data from the Banking and Payments Federation of Ireland (BPFI). Data on the distribution of lending by loan-to-value ratios are not available so we use the loan-to-price (LTP) ratio instead. Table 2 shows the distribution of lending for certain ranges of LTI and LTP ratios and the calculated weighted average for each ratio.

**TABLE 2** Distribution of lending by LTI and LTP

| Customer Type | LTP Range | 2014 Q4 | 2015 Q1 | 2015 Q2 | 2015 Q3 | 2015 Q4 | 2016 Q1 |
|---|---|---|---|---|---|---|---|
| FTB | <=70% | 15.04% | 15.46% | 13.76% | 15.94% | 17.12% | 18.67% |
| | >70<=80% | 15.79% | 14.52% | 16.79% | 20.12% | 20.97% | 22.08% |
| | >80<=85% | 7.45% | 7.64% | 7.02% | 8.49% | 9.74% | 9.83% |
| | >85% <= 90% | 34.72% | 31.71% | 35.49% | 37.73% | 38.88% | 37.84% |
| | >90% | 27.01% | 30.67% | 26.94% | 17.71% | 13.28% | 11.59% |
| | W. Avg. LTP | 86.39 | 86.61 | 86.56 | 85.26 | 84.66 | 84.15 |
| **Customer Type** | **LTI Range** | **2014 Q4** | **2015 Q1** | **2015 Q2** | **2015 Q3** | **2015 Q4** | **2016 Q1** |
| FTB | <=2.5 | 29.51% | 28.11% | 28.08% | 27.69% | 29.82% | 28.52% |
| | >2.5 <= 3.0 | 22.10% | 20.47% | 22.81% | 22.85% | 23.08% | 22.60% |
| | >3.0 <= 3.5 | 21.26% | 21.98% | 21.33% | 24.96% | 28.26% | 34.36% |
| | >3.5 <= 4.0 | 16.39% | 18.39% | 17.32% | 16.18% | 11.49% | 9.29% |
| | >4.0 | 10.74% | 11.06% | 10.45% | 8.32% | 7.35% | 5.23% |
| | W. Avg. LTI | 3.28 | 3.32 | 3.3 | 3.27 | 3.22 | 3.2 |

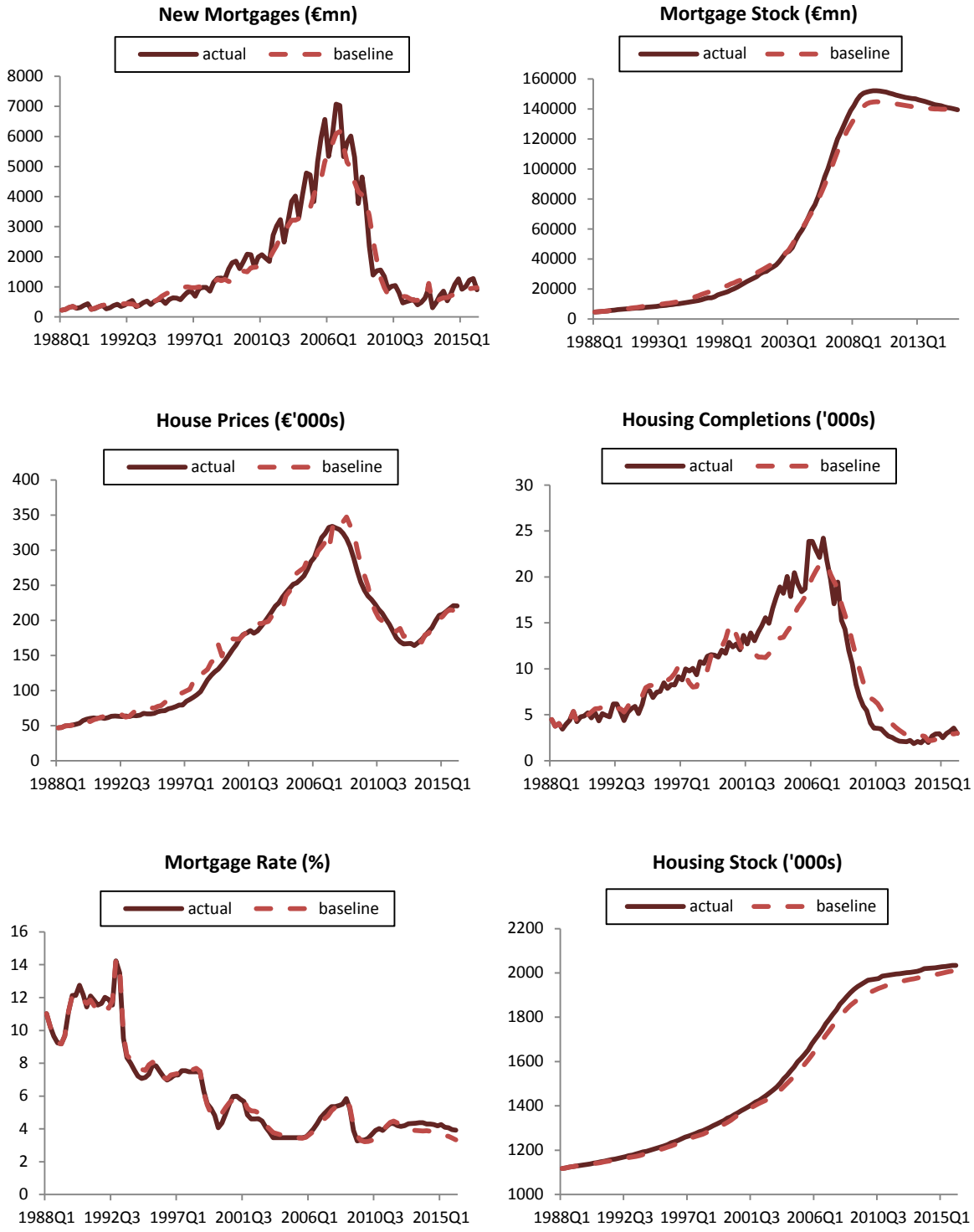
*Source:* BPFI.

## 4. Model Solution

We solve the model up to the most recent period for which all data are available which is 2016 Q1, using the coefficients that are estimated up to 2014 Q4. The 2016 Q1 data for the consumer expenditure deflator, real and nominal GDP and personal disposable income are forecasts taken from the ESRI's *Quarterly Economic Commentary.*

Figure 1 graphs the dynamic solution of the model for each variable against the actual values of those variables. The results suggest that the model closely replicates the actual outturn of the variables over the entire sample period, although there are short periods of deviations, particularly for housing supply. Overall, however, the solution suggests that the model's parameters have been stable over the period. The solution of the model gives us a baseline against which we can analyse the contribution of the changes in the LTV and LTI to the changes in the model's endogenous variables: the volume of new mortgage lending, the total stock of mortgage lending, the standard variable mortgage rate, average house prices, housing completions and the housing stock.

**FIGURE 1** Actual and Predicted Values for Mortgage and Housing Market Variables




*Source:* Authors' own calculations.

We now conduct our scenario analysis. We investigate three possible scenarios. We simulate the model over the 2014 Q4 to 2016 Q1 period holding the LTI constant at its 2014 Q4 value. A comparison of the results of this scenario against our baseline allows us to determine how much of the change in the mortgage and housing variables can be attributed to changes in the LTI alone. We then conduct

a similar scenario analysis for the LTV ratio by holding it constant at its 2014 Q4 value. Our final scenario keeps both the LTI and LTV ratio constant at their 2014 Q4 values and allows us to estimate how much of the change in mortgage volumes and interest rates, house prices and housing supply can be attributed to the total change in credit conditions given by the change in both the LTI and LTV. As the model is essentially linear, we would expect the combined effect of the LTV and LTI to be a simple addition of their individual impacts.

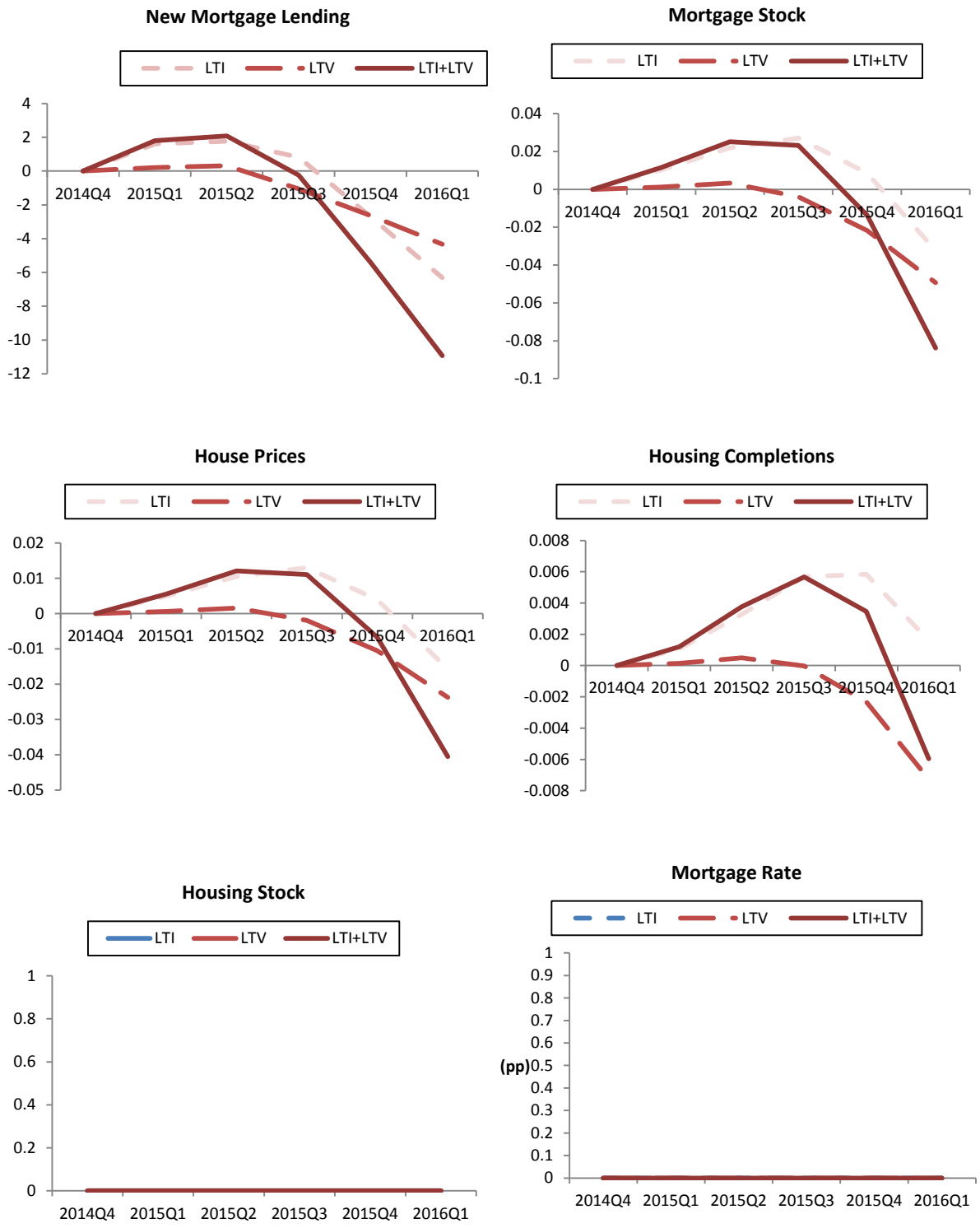
Figure 2 presents the results of these scenarios. The weighted-average LTV and LTI actually increased in the first two quarters of 2015 relative to 2014 Q4, and therefore mortgage volumes and house prices actually rose relative to the baseline of no change in the LTV and LTI ratios. One explanation for this is that mortgages succeeded in getting approval for high LTV and LTI loans during the consultation process prior to the macroprudential restrictions being introduced. These restrictions only affected new lending and not that which had already been approved and therefore we see a 'bunching' of lending at the beginning of 2015.

The main driver of the higher mortgage lending (and resultant house prices) relative to the baseline was the changes in the loan-to-income ratio. The overall effect, however, was quite weak with the combined effect of the changes in the LTI and LTV only raising new mortgage lending by 2 per cent and house prices by 0.01 per cent relative to the baseline.

However, the impact of the mortgage restrictions appears to have taken hold in the second half of 2015 and early 2016 as the weighted-average LTIs and LTVs have started to fall. In particular, the results suggest that the LTV has become the slightly more binding restriction in the more recent period. By 2016 Q1 the combined effect of the LTV and LTI restrictions has been to reduce new mortgage lending by approximately 10 per cent relative to the baseline of no change in the ratios. The effect on the housing market is as yet quite muted with house prices being only approximately 0.05 per cent lower than in the baseline as at 2016 Q1.

Figure 2 also shows that the effect of the macroprudential rules on housing supply is approximately zero. This is unsurprising given the lags involved in construction. We explore this issue further in the next section and also discuss the likely longer term impact of the rules if we extrapolate from the current values of the LTI and LTV ratios.

**FIGURE 2** Assessing the Impact of Actual Changes in LTI and LTV on Housing and Mortgage Market




*Source:* Authors' own calculations.

## 5. Assessing the Future Impact on Housing Supply

The simulation results above clearly illustrate that the short-run response of housing supply to changes in house prices is quite weak. This is partly because our model measures the response of housing completions to house prices and therefore, given the lags involved in site purchase and construction, the impact

on housing supply is likely to be distributed over several years. Indeed, Duffy et al. (2016) find the impact of changes in LTV and LTI ratios on housing completions only peaks after 3-4 years.

To illustrate this point we now consider the longer impact on housing supply by assuming that the values of the LTV and LTI ratios at 2016 Q1 are the steady-state or equilibrium ratios under the new macroprudential rules and, therefore, that the short-run volatility in these ratios caused by banks granting new mortgages before the rules took full effect has now subsided. As a result, we simulate a scenario (using historical data) in which the first five periods reflect the recent actual changes in the LTV and LTI (those that prevailed in the 2015 Q1-2016 Q1 period) and that in subsequent periods these ratios remain constant at their values in the fifth (2016 Q1) period.

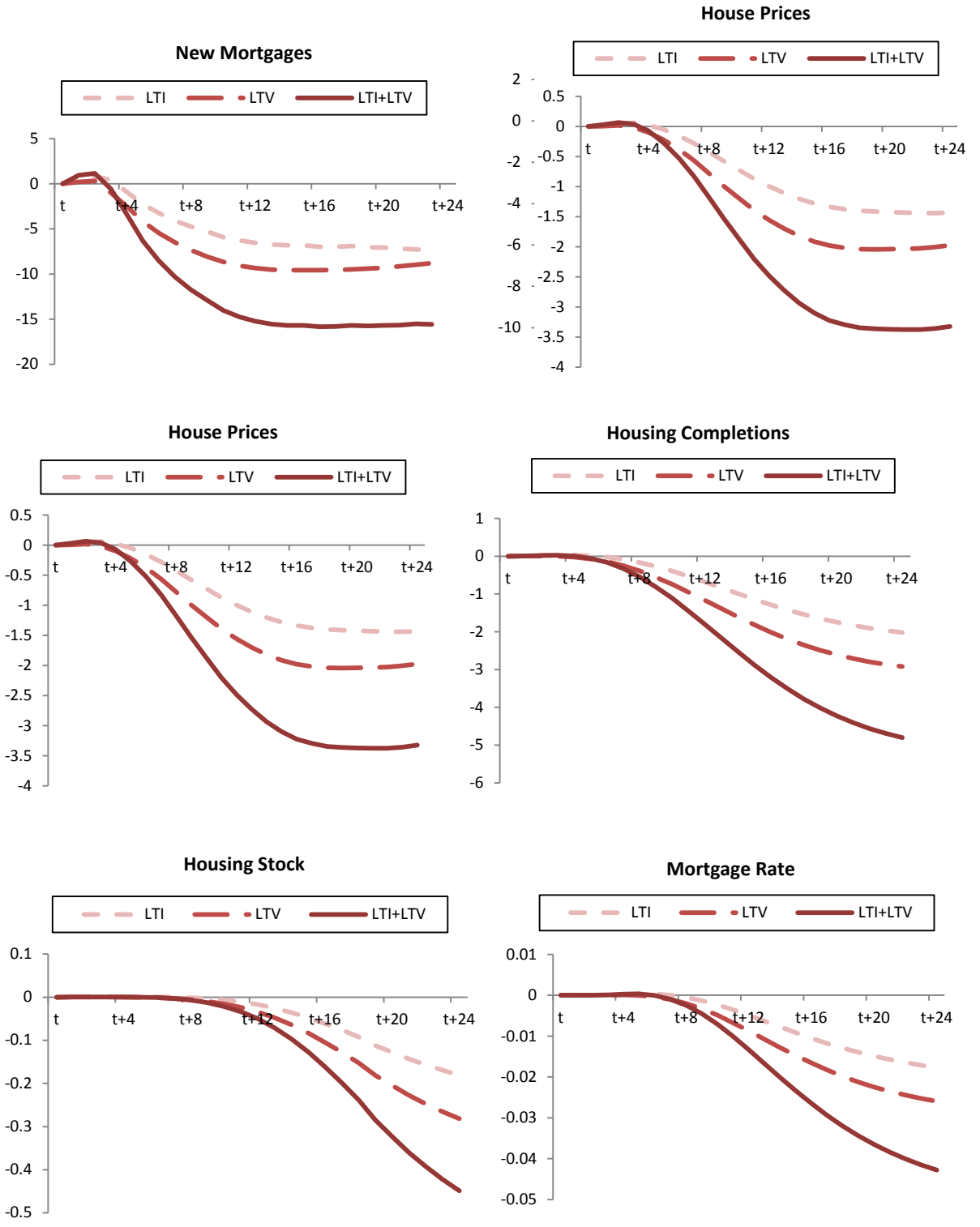
Figure 3 illustrates the longer term impact of the mortgage rules if we assume that the LTV and LTI remain at their 2016 Q1 values for periods (quarters) t+5 to t+24. It is clear that the full effects of the changes in the LTV and LTI ratios are not manifested until 3-4 years after the changes. In this respect, our results suggest that over the longer-term new mortgage lending is 15 per cent lower in each quarter relative to the baseline level. Consequently, the mortgage stock is 8 per cent lower than the baseline case. This decline in mortgage lending generates a decline in house prices that are approximately 3.5 per cent lower in the long term relative to the baseline.

As this simulation holds all of the model's exogenous variables apart from the LTV and LTI ratios constant, the decline in house prices lowers the profitability of housing construction. The number of housing units completed in each quarter is approximately 5 per cent lower relative to the baseline by the end of the simulation period resulting in a housing stock that is 0.5 per cent lower.

Figure 3 also illustrates the impact on the mortgage rate. The decline in house leverage as a consequence of the lower LTV ratio (and corresponding relative increase in housing equity) leads banks to lower the mortgage rate as the riskiness associated with mortgage lending is now less than under the baseline. However, it is clear that this effect is quite weak.

This scenario analysis also allows us to assess the relative importance of the changes in the LTV and LTI on the future evolution of the mortgage and housing markets. If we assume that the most recent values for the LTI and LTV ratios reflect their steady-state values under the new macroprudential regime, then approximately two-thirds of the long-term decline in mortgage lending, house prices and housing supply would be due to the behaviour of the LTV ratio.

**FIGURE 3** Longer-term Impact of Mortgage Rules




*Source:* Authors' own calculations.

## 6. Concluding Comments

In this note we have analysed the implications for the Irish housing and credit sector of the recent macroprudential measures introduced by the Central Bank of Ireland. While the macro level assessment of the measures implications is limited

somewhat by the relatively short period of time for which they have been in place, it is clear that the measures, as noted in Duffy et al. (2016), have in the period to date had a contractionary impact on lending in the Irish market; there has been very little impact of the measures on housing supply. However, the analysis also suggests that, over a longer period of time, housing supply levels will be less than they otherwise would have been in the absence of the macroprudential measures.

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