Credit conditions, macroprudential policy and house prices

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Introduction

- The link between credit and house prices is one of the key relationships that drive financial cycles across the globe.
- Macroprudential policy (MPP) is currently of immense interest and importance amongst Central Bankers, academics and industry practitioners.
  1. We calculate a measure of "Credit Availability" for borrowers from 2003 to 2007, and whether this credit amount was determined by the LTV, LTI or monthly DSR limits set by banks.
  2. We then run a micro-level house price regression where prices are explicitly a function of CA and other factors.
  3. We show how combinations of LTV, LTI and DSR limits would have lowered the credit available to borrowers in Ireland between 2003 and 2007.
  4. We simulate the short-run impact of MPP restrictions on house prices in Ireland. A plausible but strict MPP regime leads to one-year house price falls of roughly 10 per cent from boom-time starting point.

Previous Literature ; Our innovation

- Large macroeconomic literature on credit and house prices, with recent innovations at sub-national level identifying a credit effect on HP using IV strategies (Favara and Imbs, 2015; Di Maggio and Kermani, 2014; Adelino et al., 2012; Labonne and Welter-Nicol, 2015).
- Literature on link between macroprudential policy and asset prices is more limited and recent:
- Cross-country or aggregate single-country data on effect of policy regime on asset prices Wong et al. (2011); Claessens et al. (2013); International Monetary Fund (2011); Igan and Kang (2011); Avouyi-Dovi et al. (2014); Kuttner and Shim (2013).
- DSGE modelling (Rubio and Carrasco-Gallego, 2012; Rubio, 2014; Clancy and Merola, 2014).
- At the micro level: Igan and Kang (2011); survey data; that households more likely to have dampened house price expectations and delayed house purchases in Korea after the introduction of macroprudential limits on LTV and LTI.
- Our identification of multiple channels through which credit availability can be determined, and the way in which macroprudential policy interacts with these channels, has not been seen before. Further, we have not seen a micro-data-based simulation on house prices and macropru.

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Loan Level Data

- Central Bank of Ireland Loan-Level Data (LLD)
- Population of mortgages in the Republic of Ireland at December 2013 from AIB, EBS, BOI, PTSB (2/3 of market).
- We consider owner-occupier ("Principal Dwelling House", PDH).
- Following Kelly, O'Malley, O'Toole, we restrict data to *primary loan* on a property (no equity releases/top-ups).
- Information on originating house price, balance, LTV, income, term, borrowers' age.
- Originating information varies for SVR and Tracker interest rates. Data collected on SVR rates quarterly per bank from 2003 q1. Tracker rates follow ECB rate with a fixed margin, which we take at the loan level from the data.
- We finish with 188,405 properties in the model.

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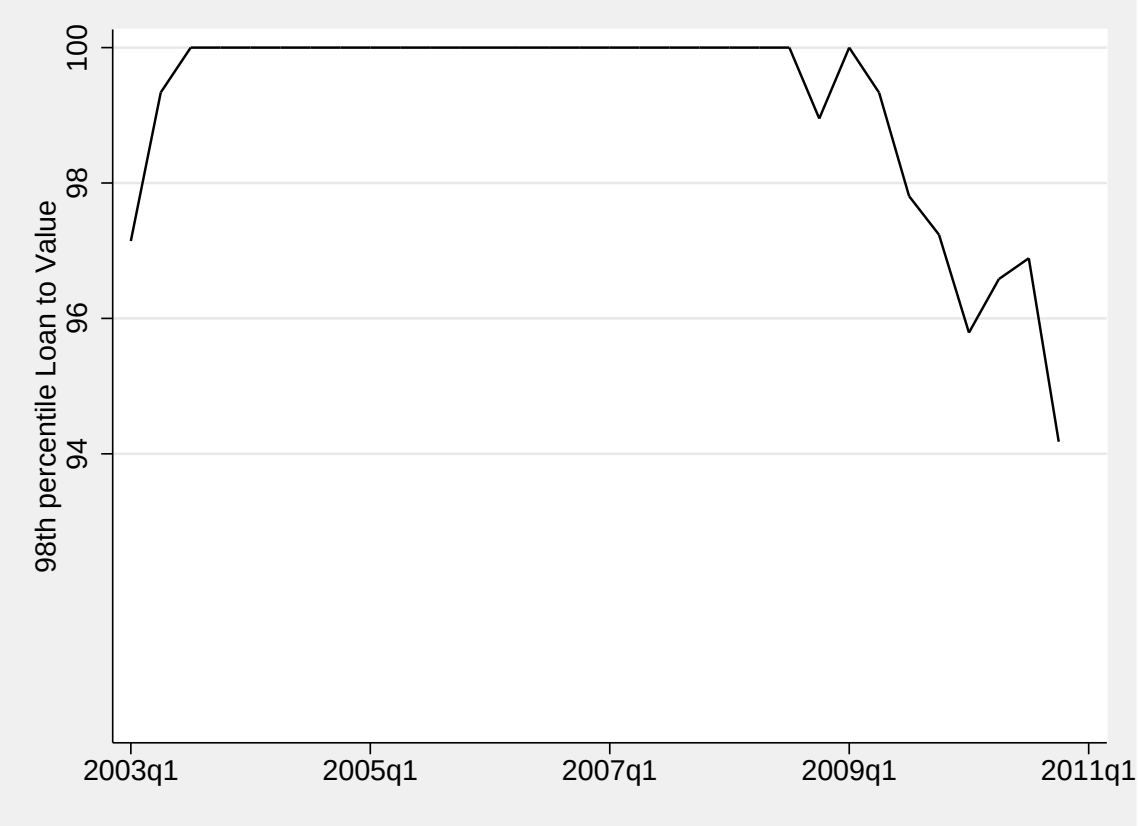
Market-wide credit conditions

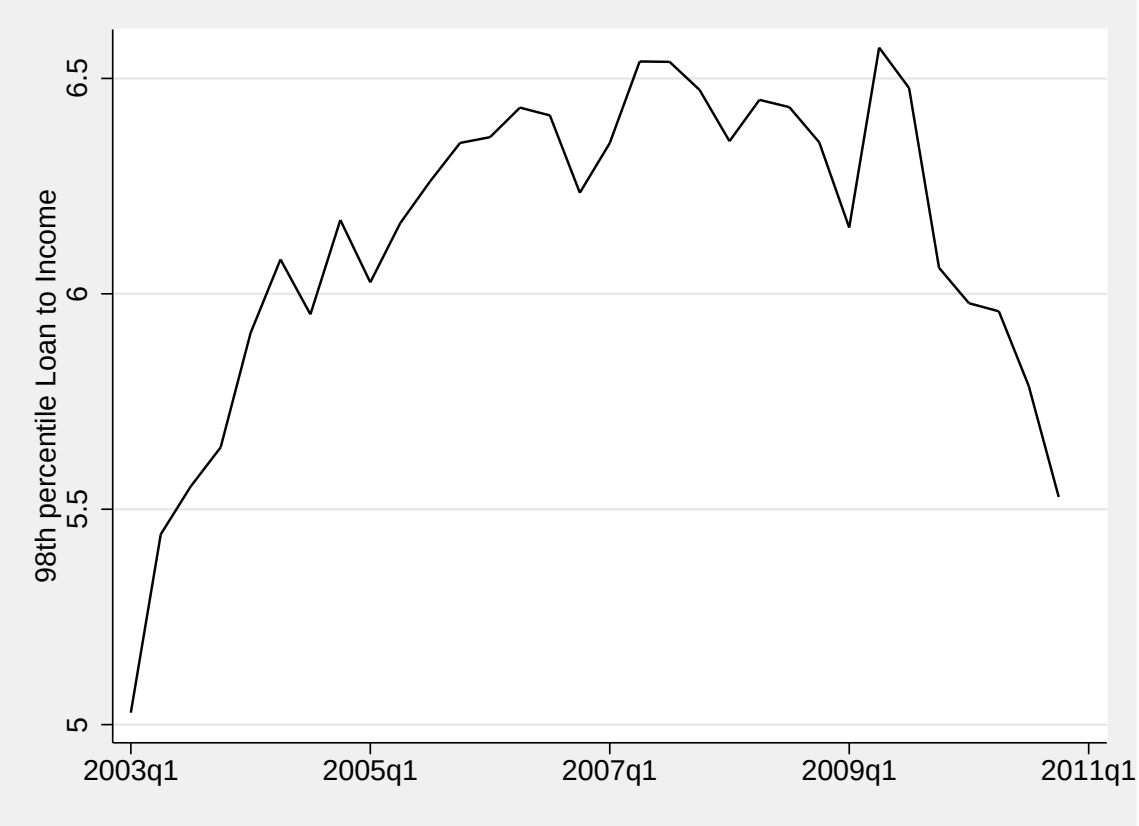
- The balance drawn down at mortgage origination is a reflection of the interaction of the borrower's demand for credit, his risk appetite, his income and wealth, as well as the credit supply conditions in the market at t.
- We want to identify the amount of credit that was **available** to a borrower at t, rather than the amount she decided to draw down.
- As long as there always exists a marginal borrower with a demand for a higher-leveraged position, the top-end of the observed distribution of originating credit conditions gives us a good proxy of the level to which banks were willing to lend in a given time period.
- For our measure of credit conditions (LTV, LTI and DSR) we take the 98th percentile among observed mortgages in a quarter to be the "available" value.
- We will then combine these market measures with borrower-level information to calculate borrower-specific credit **availability**, CA.
- Next three slides show the evolution of our proxy for market conditions.

Figure: 98th percentile LTVs, observed quarterly mortgage data 2003-2010



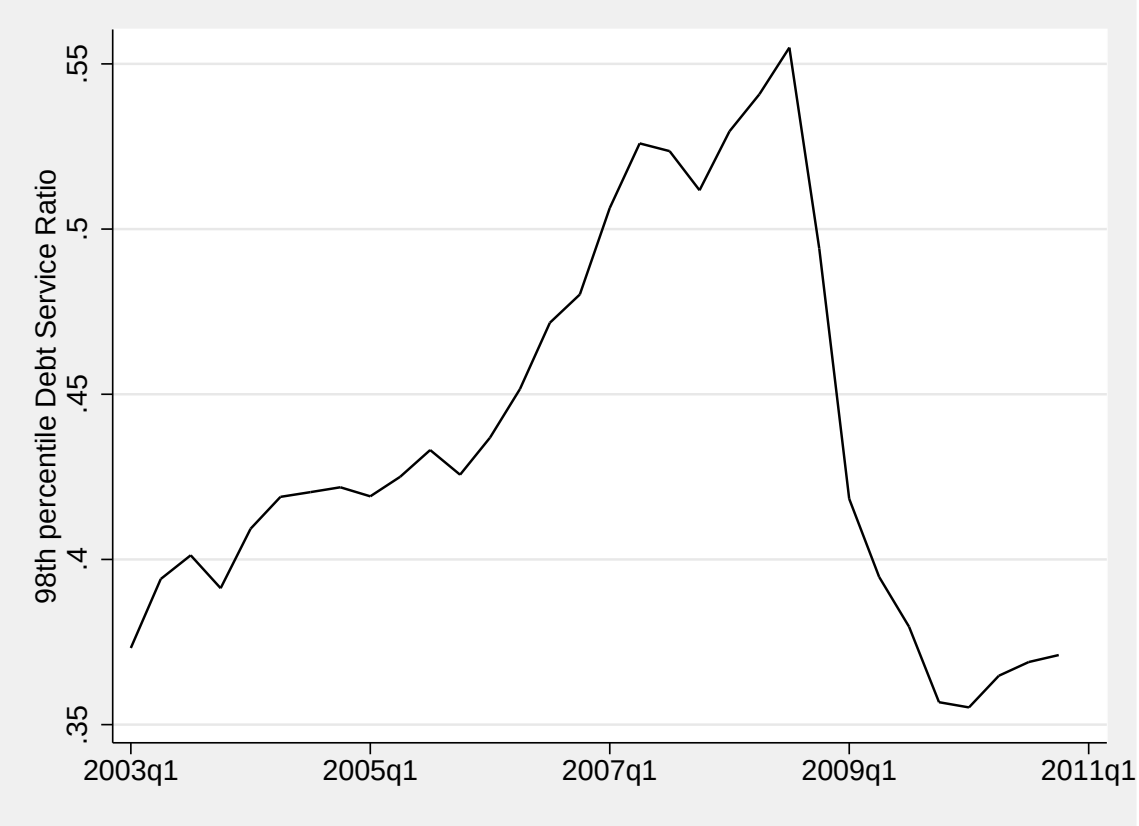
Source: Central Bank of Ireland Loan Level Data, authors' calculations

Figure: 98th percentile LTIs, observed quarterly mortgage data 2003-2010



Source: Central Bank of Ireland Loan Level Data, authors' calculations

Figure: 98th percentile DSRs, observed quarterly mortgage data 2003-2010

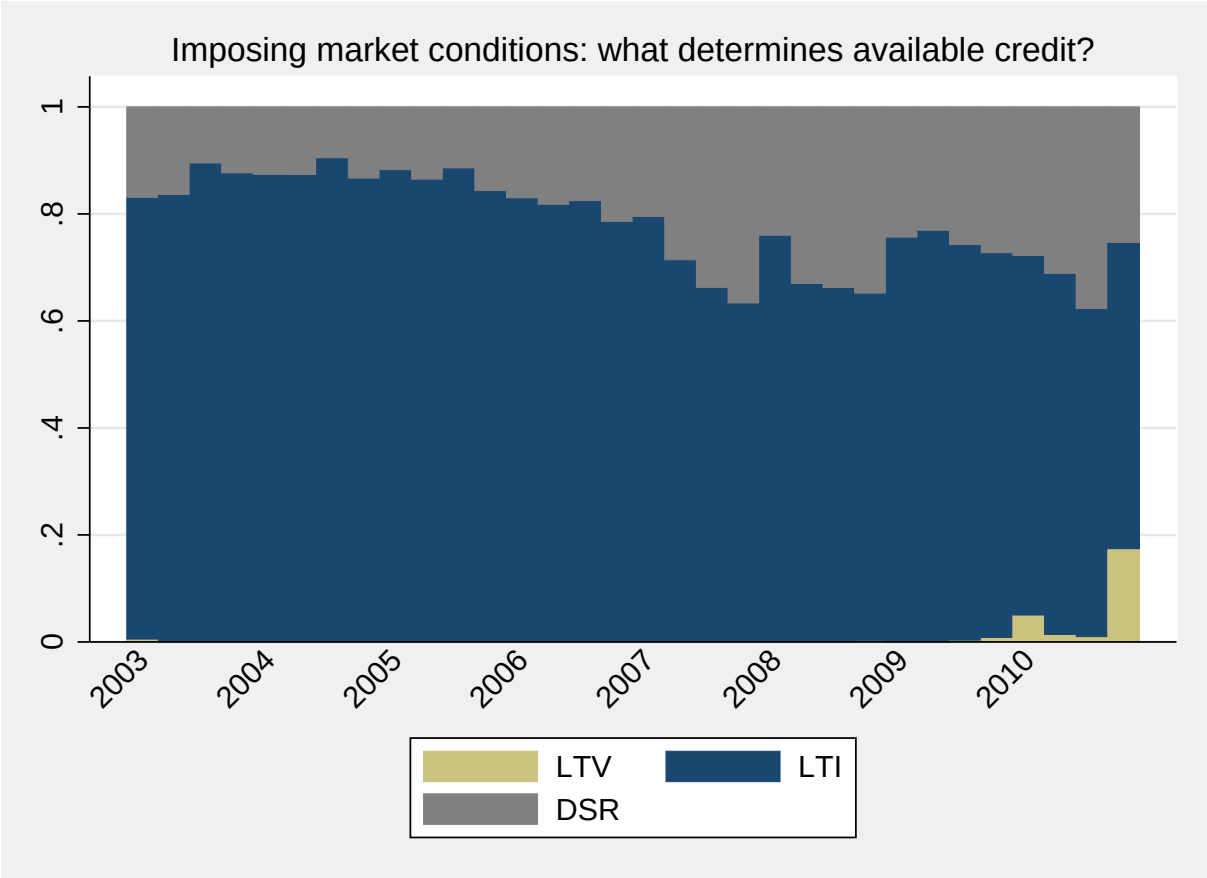


Source: Central Bank of Ireland Loan Level Data, authors' calculations

Variable construction

- At the loan level, for **observed borrower characteristics**, we can calculate the *maximum credit available* as the minimum of the following three mortgage annuities. An almost idential approach has been taken in agent-based modelling work at the Bank of England by Galbiati et al. (2015).
  - Loan to Value ratio: borrower's deposit, combined with the LTV available in the market at t.
  - Loan to Income ratio: borrower's gross income, combined with the LTI available in the market at t.
  - Debt Service Ratio: annuity available conditional on the borrower's monthly net income, the maximum term available given the older of the borrowers' age and bank-driven age limits at maturity, the interest rate in t, and the DSR available in the market at t.
- We assume that the credit available CA is the minimum of the three loans calculated for each household i given borrower characteristics and market conditions when the mortgage was originated.

Figure: Which prevailing market condition determines credit availability? Quarterly market shares 2003 to 2010.



Source: Central Bank of Ireland Loan Level Data, authors' calculations

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Regression model set up

- House price models which incorporate credit are typically run at the aggregate level, using Error Correction, VAR or other time series or panel methods.
- We run a reduced-form property-level model using data on mortgages originated between 2003 and 2010:

$$\text{HP}_i = CA, Income, Wealth, Bank, PropertyType, \lambda_{rt} \quad (1)$$

- $PropertyType$ is our best proxy for hedonic information on houses: Dublin versus Non-Dublin, crossed with 4-category house type.
- $Wealth$ is proxied by the deposit posted by the borrower. We make an adjustment for the fact that there may be more wealth available than the deposit posted by taking deposit to income ratios across geographic, vintage, income and FTB groups.
- λ_{rt} are dummies for each Quarter* NUTS2 region.

	Level	Level	Log
Credit Available	0.205***	0.218***	
	(0.00692)	(0.00732)	
Income	0.772***	0.575***	
	(0.0400)	(0.0423)	
Deposit	0.727***		
	(0.00197)		
Borrower Age	-882.5***	-1070.6***	-0.00357***
	(22.19)	(23.88)	(0.0000901)
Wealth for Down-Payment		0.761***	
		(0.00221)	
Log Credit Available			0.155***
			(0.00956)
Log Income			0.215***
			(0.00922)
Log Wealth for Down-Payment			0.246***
			(0.000851)
Reference category: Dublin Houses			
Non-Dublin Apartment	-107636.5***	-116527.6***	-0.511***
	(4793.4)	(5241.9)	(0.0229)
Non-Dublin House	-90242.7***	-91174.4***	-0.382***
	(4710.7)	(5151.1)	(0.0226)
Non-Dublin Other	-80508.9***	-82804.3***	-0.384***
	(5109.9)	(5563.8)	(0.0235)
Non-Dublin Terrace/Semi	-102326.7***	-109876.6***	-0.481***
	(4718.4)	(5159.6)	(0.0226)
Dublin Apartment	-48827.4***	-50206.0***	-0.138***
	(1966.5)	(2048.8)	(0.00505)
Dublin Other	-34237.3***	-32924.8***	-0.0780***
	(2726.5)	(2853.4)	(0.00783)
Dublin Terrace/Semi	-36789.2***	-38972.1***	-0.0964***
	(1885.8)	(1946.3)	(0.00460)
R^2	0.753	0.725	0.666
4 Bank dummies?	YES	YES	YES
256 Region* Time dummies?	YES	YES	YES

Table: Robustness: Credit Conditions varying by sub-group

Credit condition varies by:	(1) Bank	(2) Dublin	(3) FTB	(4) Property Type
Log CA	0.124***	0.157***	0.238***	0.175***
	(0.00741)	(0.00942)	(0.00926)	(0.00799)
Log Income	0.246***	0.214***	0.138***	0.197***
	(0.00714)	(0.00905)	(0.00882)	(0.00771)
Log Wealth for Down-Payment	0.246***	0.246***	0.247***	0.246***
	(0.000850)	(0.000851)	(0.000849)	(0.000851)
Borrower Age	-0.00376***	-0.00352***	-0.00308***	-0.00347***
	(0.0000841)	(0.0000907)	(0.0000894)	(0.0000853)
Observations	188405	188405	188405	188405
R^2	0.666	0.666	0.666	0.666

$Y =$ natural log of property purchase price.
256 Region* Time dummies, 8 hedonic property dummies and 4 bank dummies in all models.
Standard errors in parentheses
$^{*}\ p < .1,\ ^{**}\ p < .05,\ ^{***}\ p < .01$

▸ See FTB distribution

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Imposing macroprudential policy

- Our approach, by determining the CA available along three credit channels, is unique in allowing a macroprudential policy to impact all households heterogeneously through numerous channels.
- We impose two sample regimes (5 LTV ; 4 LTI ; 37% DSR), and (85 LTV ; 4.5 LTI ; 45% DSR).
- The credit available under the LTV, LTI and DSR channels will be recalculated as a function of borrowers' income, deposit, age and the new maximum values for the imposed credit conditions.
- This will lead to a new CA for each loan, with the binding condition changing depending on household characteristics.
- The following charts show what percentage of the market are bound by which credit channel under a range of macroprudential scenarios over 2003-2010.

Figure: 75 LTV ; 4 LTI ; 37% DSR

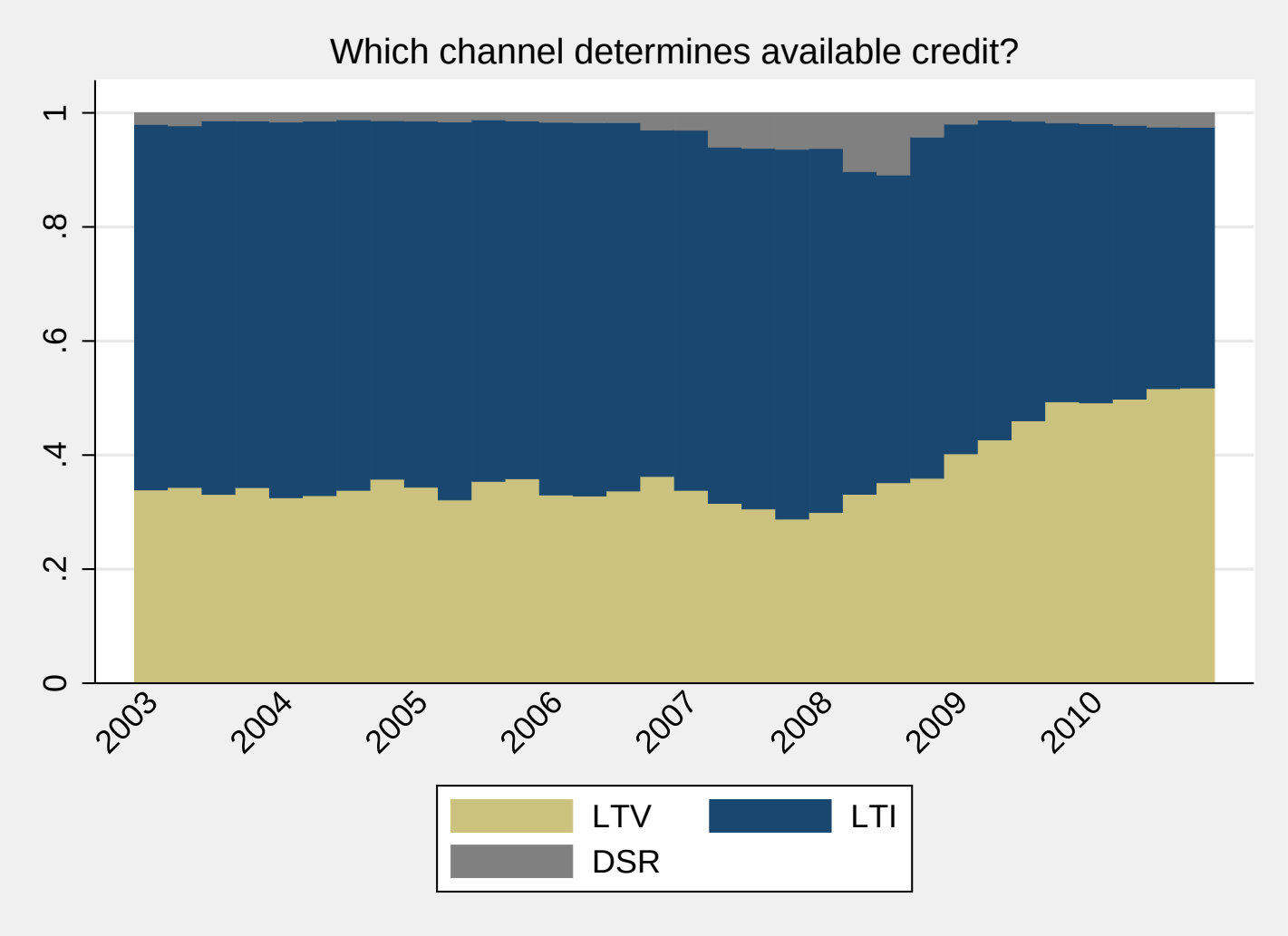
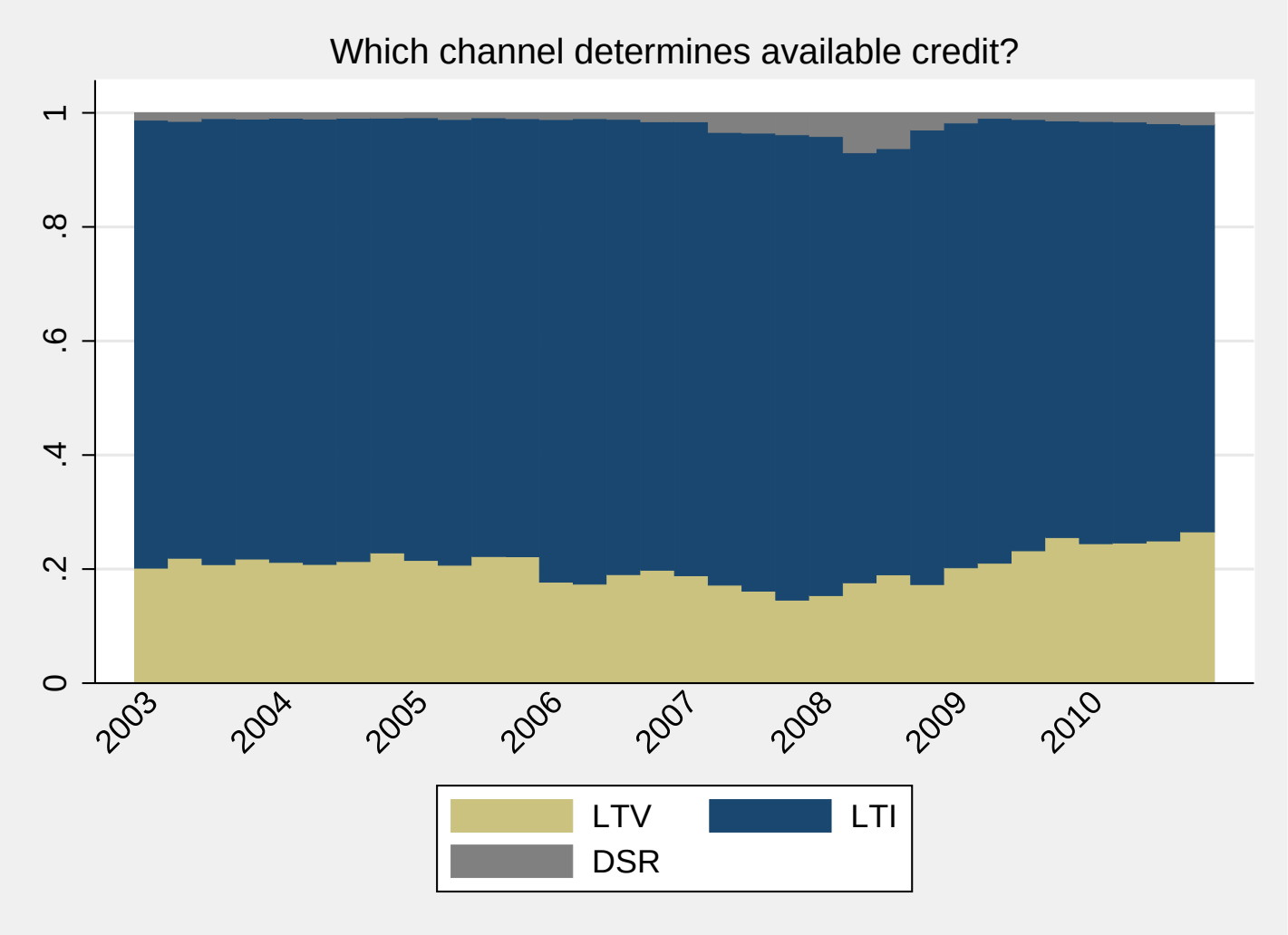


Figure: 85 LTV ; 4.5 LTI ; 45% DSR



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Approach

- For all observed mortgages, impose macroprudential rules in the mortgage market in each quarter from 2003 q1.
- Allow our model to fit values based on coefficients from the regression and changes to MPP values (LTI, LTV, DSR).
- We allow the model to loop forward for **four quarters** from each t, to calculate the short-run impact of MPP on the housing market.
- Our fitted values for a property i purchased at time $t = 1$ are calculated as follows:

$$\hat{HP}_1 = X_{i1}\beta_X + Wealth_{i1}\beta_{Wealth} + CA_{i1}\beta_{CA} \tag{2}$$

- Where $X_{i1}\beta_X$ includes all parameters that do not vary in the simulation; income, age, hedonic property type and λ_{rt}.

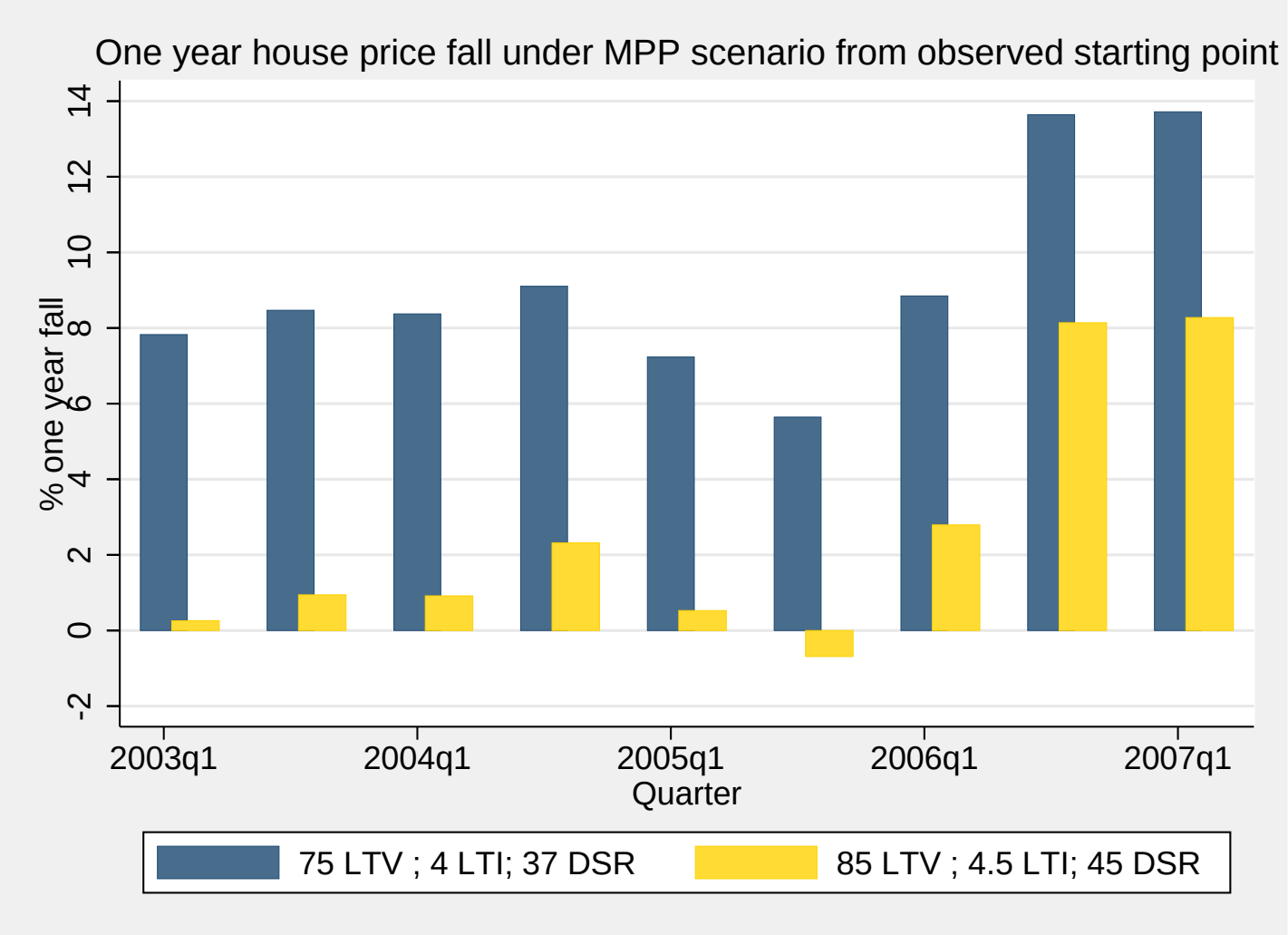
Approach (cont.)

- A change to the LTV and LTI limits in period 1 will have two effects on the $\hat{HP}$ in our simulation.
  1. CA at $t = 1$, (through mechanical changes in the calculation of $Loan_{LTV}$ and $Loan_{LTI}$)
  2. $Wealth$ at $t = 2$ for movers (we assume that if scenario house prices at t are lower than observed house prices, then $Wealth$ of movers should be reduced relative to that observed in the data due to housing equity reductions. This is a collateral channel effect in the spirit of Kiyotaki and Moore (1997).)
- CA at $t = 2$ is now altered (due to the change in $Wealth$, $Loan_{LTV}$ must be recalculated, and thus CA may change).
- $\hat{HP}$ at $t = 2$ now depends on a new value for CA_2 and $Wealth_2$.
- This loop continues through to $t = 5$ to calculate a one-year effect for an MPP introduced in 2003q1.
- Then the model moves to 2003q2, and repeats the procedure until $t = 6$.
- Values for income, property type, bank remain unchanged in the model.

Limitations - why the focus on the short run?

- The great advantage of micro-data simulation is that we capture heterogeneity across borrowers, and we capture the three channels through which CA can be determined by MPP regime changes.
- However it would be disingenuous not to outline the things that such and approach **can not** capture:
  1. Borrower house purchase delay / removal from market. Our effects operate through lower house price purchases for those who purchased homes between 2003 and 2010.
  2. A housing supply response to $\hat{HP}_t$.
  3. The impact of changing house prices on national and household incomes (employment effects, wealth/consumption effects).
  4. Changes in the rental market. Lower prices may lead to higher rents in the short run due to owner-occupier exclusion. However, investors should eventually respond to these higher yields and increase prices in some market segments.
- Given that these numerous general equilibrium effects cannot be captured in our framework, we only allow MPP to impact house prices for four quarters after introduction.

Figure: One-year fall from observed average house price



Source: Central Bank of Ireland Loan Level Data, authors' calculations

Alternative exposition

- Rather than focus on two combinations of LTV/LTI/DSR, we can run multiple versions of the simulation under varying parameter combinations.
- Due to limitations in our ability to graph in 3 (or 4) dimensions, we restrict DSR to be set at the market limit, and run combinations of LTV and LTI limits through the model.
- LTV takes all multiples of 5 from 70 to 95.
- LTI takes all multiples of .3 from 2.8 to 4.3.
- The results are presented as a heatmap, conditional on the one-year house price fall from 2006q3 and 2003q1 under each LTV-LTI combination.

Figure: Average one-year house price falls from 2006q3 under combinations of LTV and LTI limits

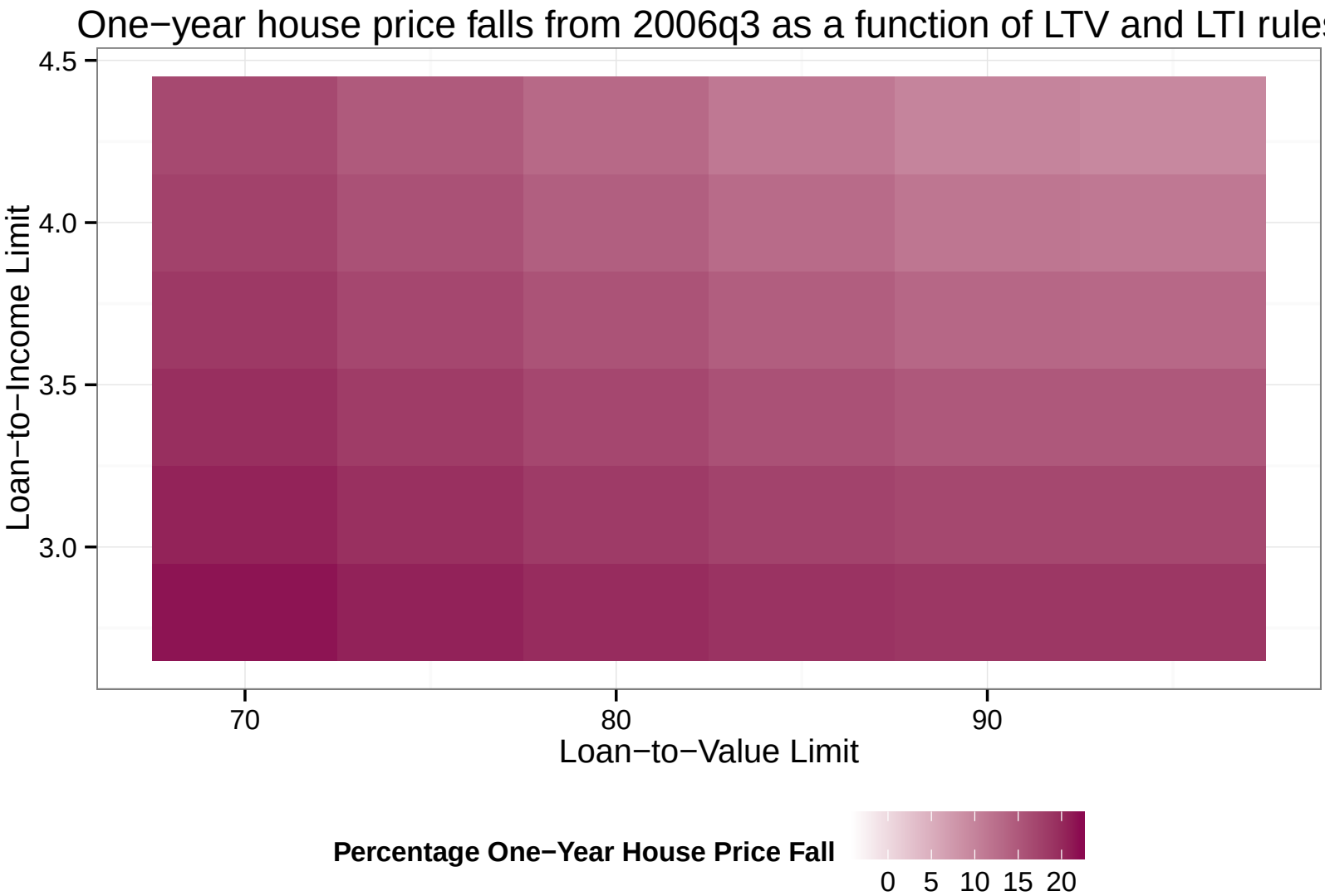
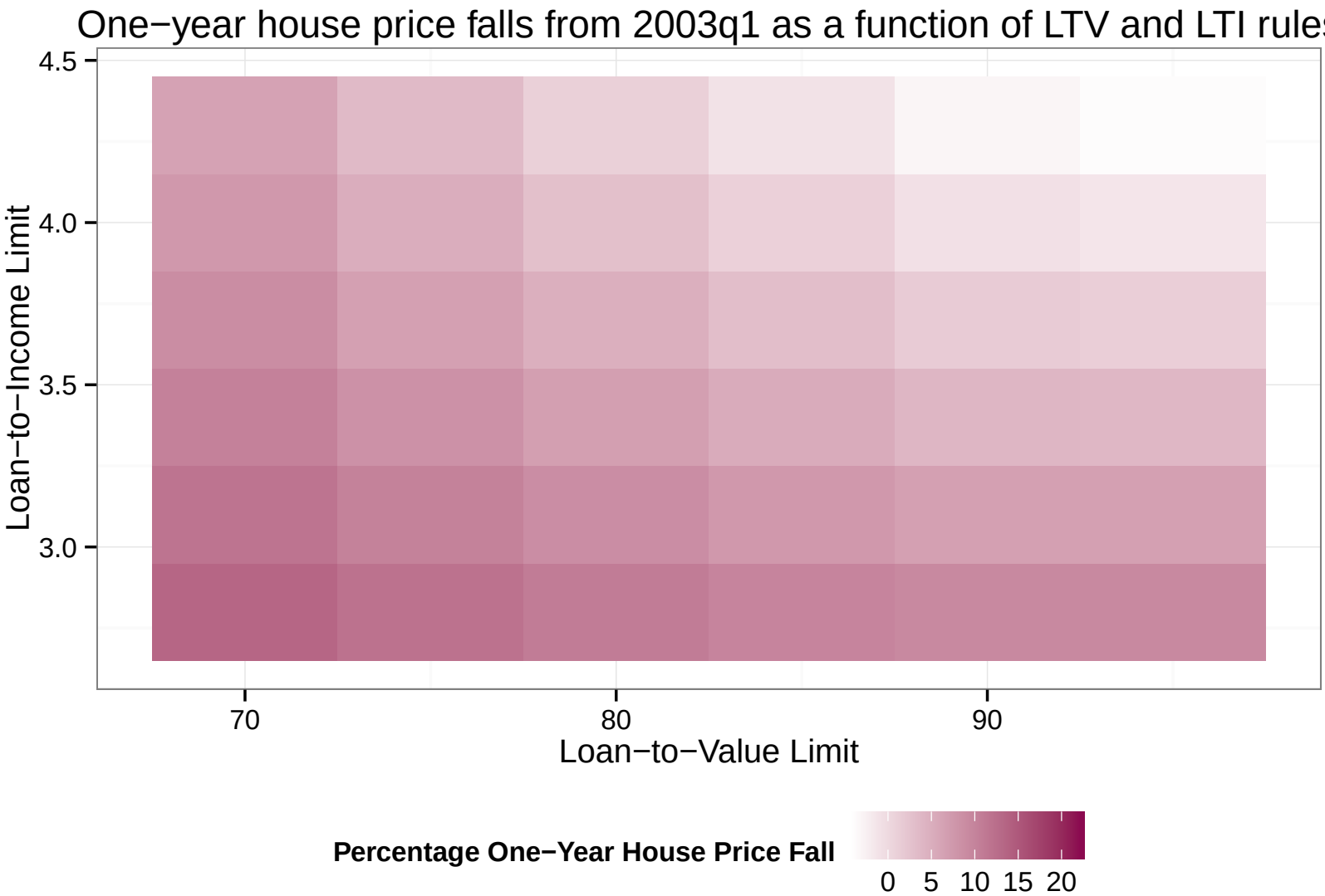


Figure: Average one-year house price falls from 2003q1 under combinations of LTV and LTI limits



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Conclusion

- Link between macroprudential policy, credit conditions and house prices has not been studied previously using micro data.
- Our approach allows us to exhibit the way macroprudential policies impact borrowers in detail.
- A micro-level house price model allows us to construct a simulated house price series for Ireland under a range of macroprudential scenarios.
- The elasticity of house prices to credit is 0.15.
- The equivalent effects for income and wealth are in the 0.22 and 0.24.
- Our model allows us to simulate a house price path under no-policy and macroprudential policy scenarios. Policy changes feed through to house prices through credit, but also through expectations for future prices and changing housing equity.
- The results suggest that plausible scenario limits on LTI and LTV in 2003 would have led to one-year house price falls of 5-14 per cent. A less restrictive regime would have reduced prices by 0-8 per cent.
- The impact of MPP limits varies hugely with the point of the housing cycle at which they are introduced!

Adelino, Manuel, Antoinette Schoar, and Felipe Severino, "Credit Supply and House Prices: Evidence from Mortgage Market Segmentation," NBER Working Papers 17832, National Bureau of Economic Research, Inc February 2012.

Avouyi-Dovi, S., C. Labonne, and R. Lecat, "The housing market: the impact of macroprudential measures in France," *Financial Stability Review*, April 2014, (18), 195–206.

Claessens, Stijn, Swati R. Ghosh, and Roxana Mihet, "Macro-prudential policies to mitigate financial system vulnerabilities," *Journal of International Money and Finance*, 2013, *39* (C), 153–185.

Clancy, Daragh and Rossana Merola, "The effect of macroprudential policy on endogenous credit cycles," Research Technical Papers 15/RT/14, Central Bank of Ireland November 2014.

Favara, Giovanni and Jean Imbs, "Credit Supply and the Price of Housing," *American Economic Review*, March 2015, *105* (3), 958–92.

Galbiati, Marco, Marc Hinterschweiger, Katie Low, Daniel Tang, and Arzu Uluc, "Macroprudential Policy in an Agent-Based Model of the UK Housing Market," Mimeo 8, Bank of England August 2015.

Igan, Deniz and Heedon Kang, "Do Loan-To-Value and Debt-To-Income Limits Work? Evidence From Korea," IMF Working Papers 11/297, International Monetary Fund December 2011.

International Monetary Fund, "Macroprudential Policy; What Instruments and How to Use them? Lessons From Country Experiences," IMF Working Papers 11/238, International Monetary Fund October 2011.

Kiyotaki, Nobuhiro and John Moore, "Credit Cycles," *Journal of Political Economy*, 1997, *105* (2), pp. 211–248.

Kuttner, Kenneth N and Ilhyock Shim, "Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies," BIS Working Papers 433, Bank for International Settlements November 2013.

Labonne, Claire and Cécile Welter-Nicol, "Cheap Credit, Expensive Houses?," Mimeo, ACPR Banque de France 2015.

Maggio, Marco Di and Amir Kermani, "Credit-Induced Boom and Bust," Research Paper 14-23, Columbia Business School December 2014.

Rubio, Margarita, "Macroprudential Policy Implementation in a Heterogeneous Monetary Union," Discussion Papers 2014/03, University of Nottingham, Centre for Finance, Credit and Macroeconomics (CFCM) 2014.

___ **and Jos. Carrasco-Gallego**, "Macroprudential Measures, Housing Markets, and Monetary Policy," Dynare Working Papers 23, CEPREMAP December 2012.

Wong, Eric, Tom Fong, Ka Fai Li, and Henry Choi, "Loan-to-Value Ratio as a Macro-Prudential Tool - Hong Kong's Experience and Cross-Country Evidence," Working Papers 1101, Hong Kong Monetary Authority 2011.

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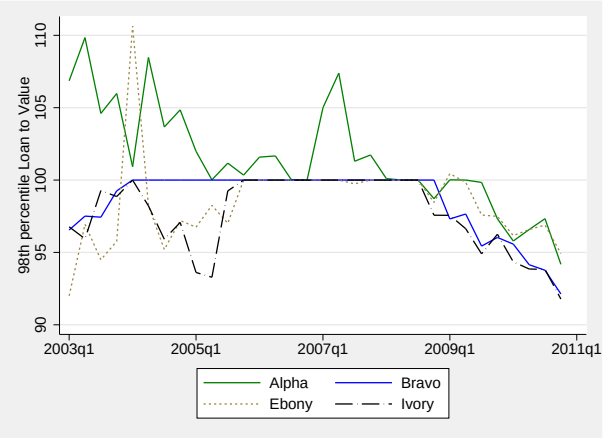
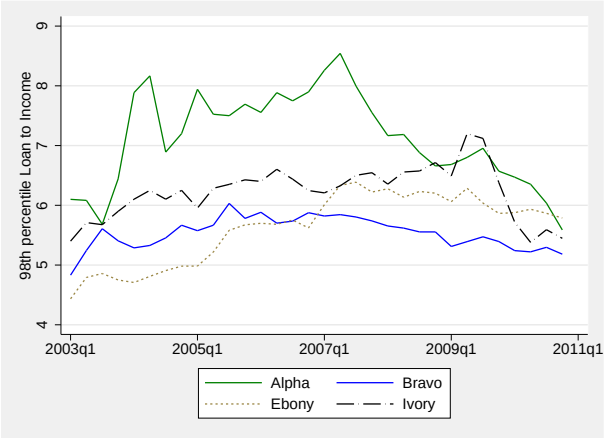
Figure: Varying LTV, LTI and DSR availability by Bank





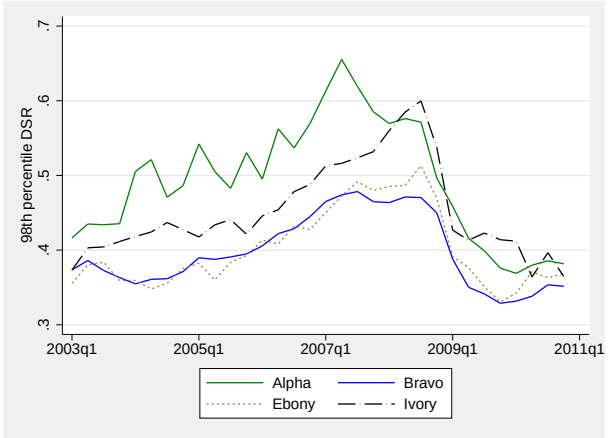
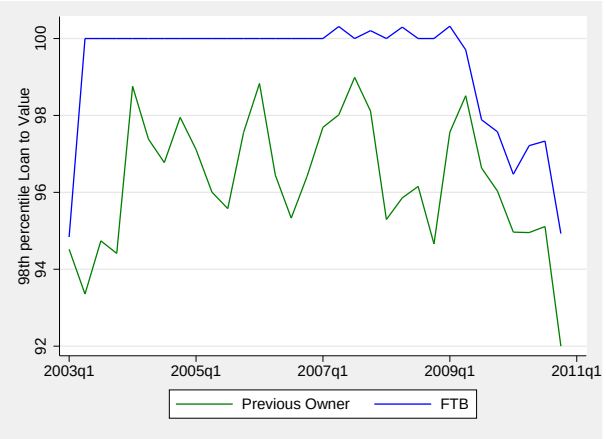
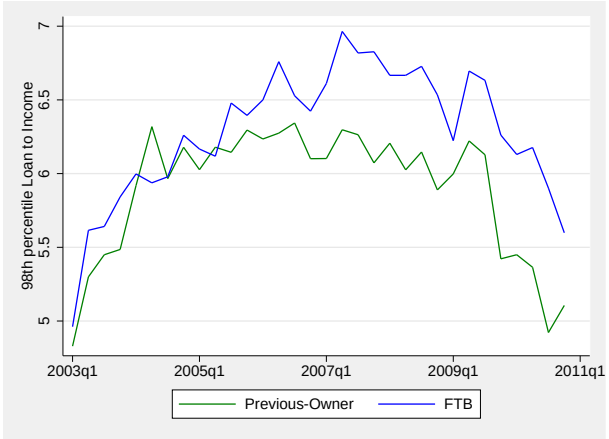


Figure: Varying LTV, LTI and DSR availability by First Time Buyer status





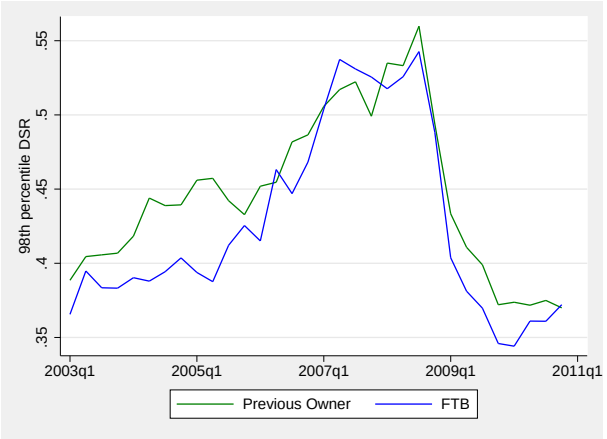


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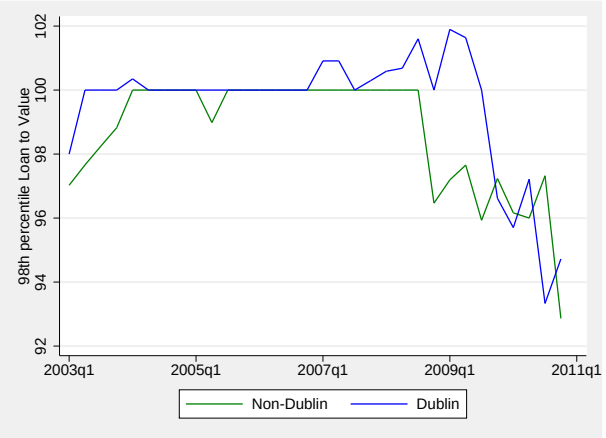
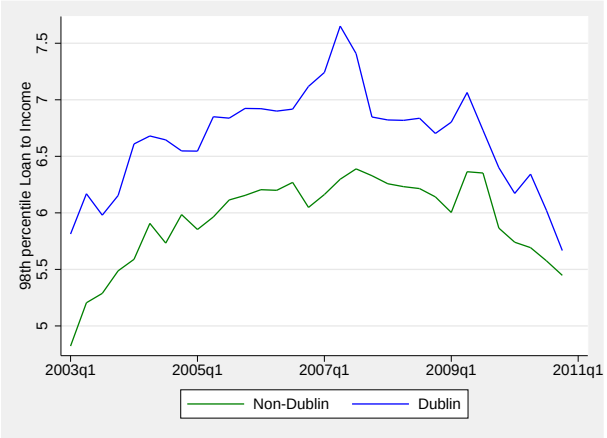
Figure: Varying LTV, LTI and DSR availability by Dublin status





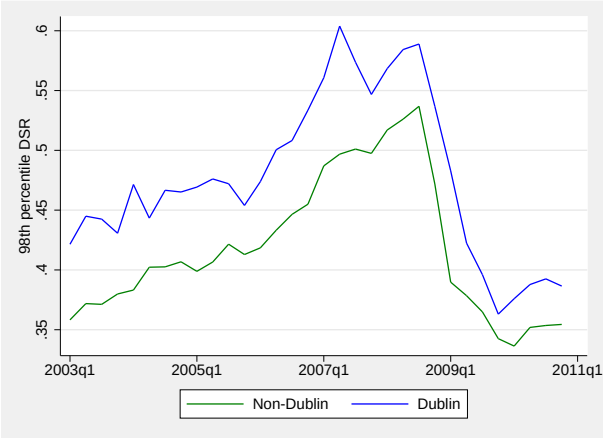


Figure: Varying LTV, LTI and DSR availability by property type