The Anatomy of the Transmission of Macroprudential Policies: Evidence from Ireland

Viral Acharya, Katharina Bergant, Matteo Crosignani, Tim Eisert, Fergal McCann

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The Transmission of Macroprudential Regulation

- Macroprudential policies implemented throughout the world
- Goal is almost always to preserve financial stability
- Often aimed at limiting bank risk exposure to real estate
- Little work on transmission: recent episodes, data limitations

▶ **This paper:** Analysis of the effect of macroprudential policies aimed at limiting bank exposure to real estate on:
  1) Household access to credit
  2) Evolution of house prices
  3) Bank credit supply to firms
  4) Bank holdings of securities

This Paper

- ▶ Setting:
  - LTI and LTV limits on new residential mortgages
  - Adopted in Ireland in February 2015

- ▶ Data:
  - Mortgage-level data for residential mortgages
  - Loan-level data for credit to firms
  - Security-level holdings by banks
  - House price data by region

- ▶ Lending limits induce banks to reallocate their portfolio
  1) High-income households take larger mortgages, increase their LTV at *lower* interest rates
  2) House price evolution consistent with mortgage credit reallocation patterns
  3) Banks increase lending to risky firms (volumes and prices)
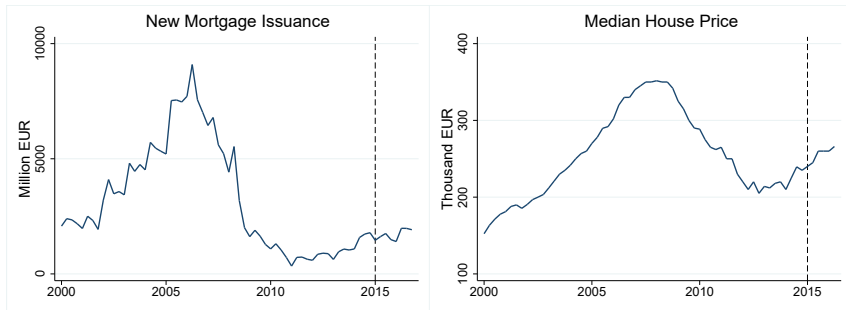 4) Banks increase their holdings of risky securities

Literature on Macropru and Bank Lending

- Cross-country evidence
  (Claessens et al., 2013; Ayyagari et al., 2017)
- Countercyclical capital buffers and bank lending
  (Jimenez et al., forthcoming; Basten and Koch, 2015)
- Capital requirement on residential mortgages
  (Auer and Ongena, 2016)
- The effect of liquidity requirements in emerging markets
  (Dassatti Camors et al., 2015)

  Contribution: comprehensive analysis of the transmission using
  microdata across asset classes (mortgages to households, loans
  to firms, and securities)

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Residential Mortgages
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Other Assets
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Setting and Data

Mortgage Issuance and House Prices in Ireland
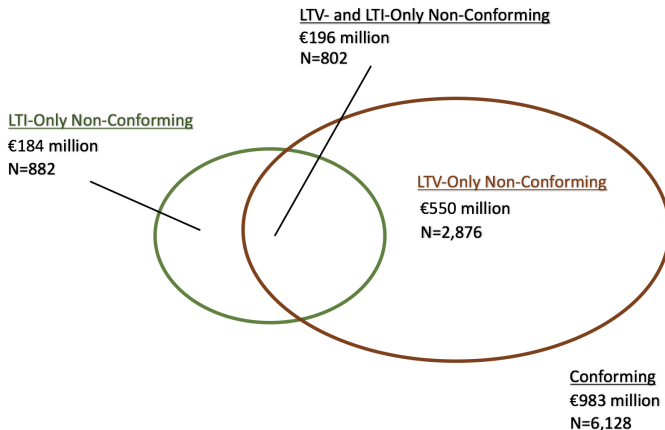
LTV/LTI Limits in Ireland

Patrick Honahan (at that time Governor) in January 2015:
"What we are trying to prevent is another psychological loop between credit and prices and credit. If we avoid that, we can keep banks safe, we can keep borrowers safe."

- Oct 7, 2014: Announcement of new macroprudential measures

- Feb 9, 2015: LTV/LTI limits for new loans implemented

- LTI limits:

    ▸ 3.5 for Primary Dwelling Homes (PDH)

- LTV limits:

    ▸ 90 for First-Time-Buyers (FTB)
    ▸ 80 for Second- and Subsequent-Buyers (SSB)
    ▸ 70 for Buy-To-Let (BTL)

- By 2017, 13 European countries have adopted similar measures

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Aggregate Facts

49% Mortgages Affected, Mostly by LTV

LTV- and LTI-Only Non-Conforming
€196 million
N=802

LTI-Only Non-Conforming
€184 million
N=882

LTV-Only Non-Conforming
€550 million
N=2,876

Conforming
€983 million
N=6,128

- 49% of typical issuance is non-conforming
- 80% of typical non-conforming issuance is LTV-non-conforming

Issuance Volume Unaffected

Total Mortgage Issuance

Conf./Non-Conf. Issuance
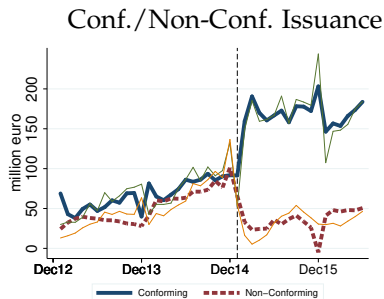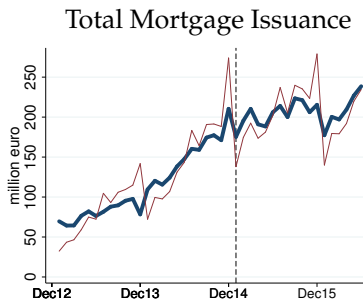
- No decrease in total mortgage issuance
- The market "moves" from non-conforming to conforming

Buildup of Risk Exposure Unaffected
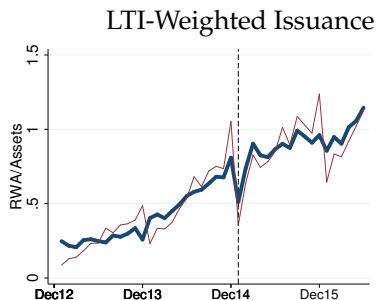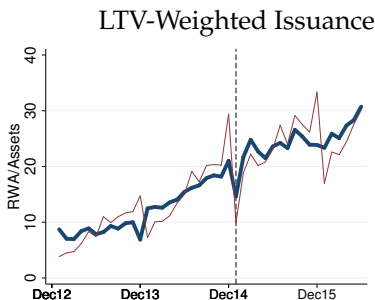
- LTV-weighted issuance as a fraction of assets keeps increasing
- LTI-weighted issuance as a fraction of assets keeps increasing

Pre-Period Borrower Characteristics

Income Quintiles	Bottom Q1	Q2	Q3	Q4	Top Q5
Borrower Characteristics					
Income	32,682	47,659	64,899	91,756	168,129
Age	34.2	35.3	36.2	37.7	40.0
First-Time Buyer	82.7	78.1	65.1	41.7	27.0
Buy-to-Let	1.7	2.3	3.2	4.3	8.4
Loan Characteristics					
Size	95,119	127,008	168,902	215,070	235,773
LTV	77.2	77.2	78.3	76.7	71.8
LTI	3.2	3.0	3.0	2.7	2.3
Rate	4.15	4.26	4.25	4.26	4.27
Distance from Lending Limits					
Distance from LTI Limit	0.54	0.75	0.73	1.00	1.28
Distance from LTV Limit	6.73	5.92	3.64	4.22	10.00

Subsample means, period from February 2014 to January 2015.

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Quick Recap

1) Mortgage issuance keeps increasing (market "moves")
2) Buildup of risk exposure unaffected
3) High income borrowers are more distant from lending limits

Transmission Channel

Possible Transmission Channels

1) **Borrowers cannot borrow anymore and are shut out of the market**

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2) **"Borrower Adapting" Channel**
   - Banks do not change their credit supply
   - Households demand a different LTI/LTV loan to qualify

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$$\downarrow LTV = \frac{House - DownPayment}{House} = 1 - \frac{DownPayment \uparrow}{House \downarrow}$$

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3) **"Bank Credit Reallocation" Channel**

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3) **"Bank Credit Reallocation" Channel**
   - Banks change their credit supply and lend to *different* types of households to make-up for the lost business

Distance to LTV Limits

Distribution of Distance to LTV Limits – Top Income Quintile Q5
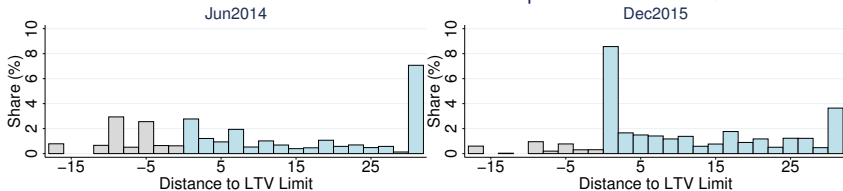
Distribution of Distance to LTV Limits – Income Quintile Q4
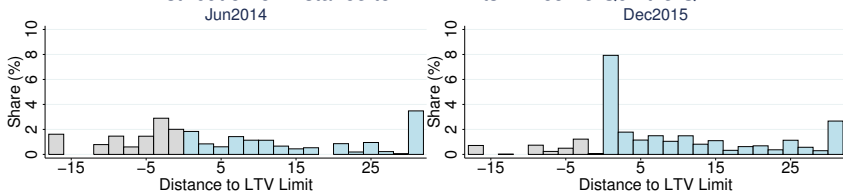
Distance to LTV Limits

Distribution of Distance to LTV Limits – Income Quintile Q3
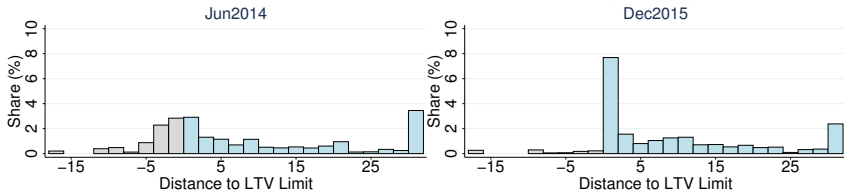
Distribution of Distance to LTV Limits – Income Quintile Q1Q2
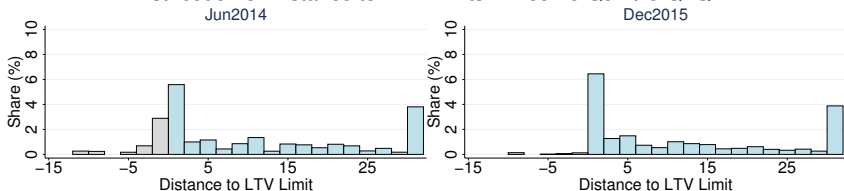
Evolution of LTV by Income
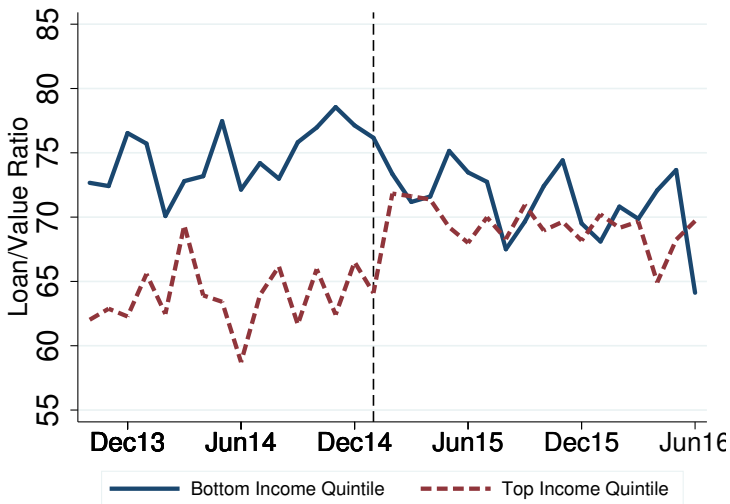
Evolution of LTI by Income
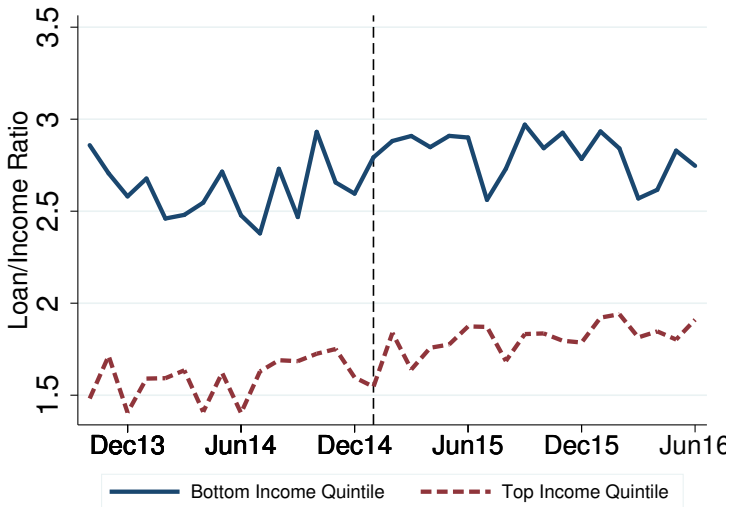
Bank-Level Heterogeneity

$$Exposure_b = \frac{\sum_{t=Feb14}^{Jan15} \text{Non-Conforming Mortgage Issuance}_{bt}}{\sum_{t=Feb14}^{Jan15} \text{Total Mortgage Issuance}_{bt}}$$

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Conforming Mortgage Issuance
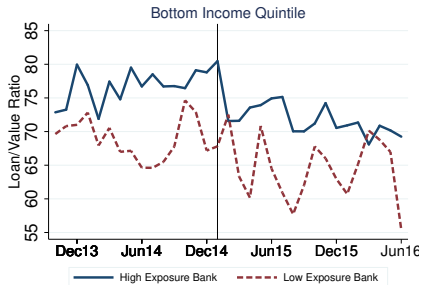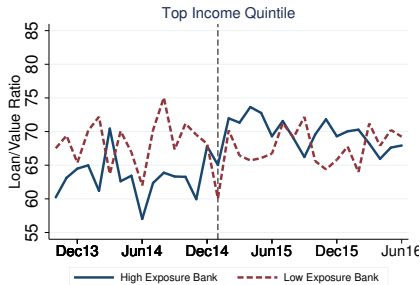
Legend: High Exposure, Low Exposure

DiD Graph

LTV

Household Income Subsamples

$$Y_{bcht} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{b,t-1} + \nu_b + \eta_{ct} + \epsilon_{bcht}$$

- Bank b, county c, income bucket h, time t
- County-time FE, bank FE, time-varying bank controls

LTV	Q1	Q2	Q3	Q4	Q5
Post X Exposure	-58.791***	-21.373**	1.137	4.674	57.831***
	(10.805)	(9.951)	(11.751)	(10.198)	(19.857)
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓
Observations	2,363	2,755	2,896	2,466	1,866
R-squared	0.361	0.235	0.223	0.245	0.339

Double Clustering at the bank-county and time level

Household Income Subsamples

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▶ One SD higher Bank Exposure leads to
  ▶ 4.26pp lower LTV for Q1 households
  ▶ 4.19pp higher LTV for Q5 households

Household Income Subsamples

$$Y_{bcht} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{b,t-1} + \nu_b + \eta_{ct} + \epsilon_{bcht}$$

- Bank b, county c, income bucket h, time t
- County-time FE, bank FE, time-varying bank controls

Loan Size	Q1	Q2	Q3	Q4	Q5
Post X Exposure	-0.258	-0.445**	-0.733**	-1.257***	3.483***
	(0.310)	(0.186)	(0.322)	(0.329)	(0.906)
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓
Observations	2,404	2,786	2,947	2,512	1,929
R-squared	0.418	0.338	0.339	0.357	0.437

Double Clustering at the bank-county and time level

Household Income Subsamples

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- ▶ Average Loan Size to Q5 in pre period: 222,822 EUR
- ▶ One SD higher Bank exposure leads to 42,717 EUR larger loans used to buy 26,684 larger houses

Household Income Subsamples

$$Y_{bcht} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{b,t-1} + \nu_b + \eta_{ct} + \epsilon_{bcht}$$

- Bank b, county c, income bucket h, time t
- County-time FE, bank FE, time-varying bank controls

Total Loan Vol	Q1	Q2	Q3	Q4	Q5
Post X Exposure	-0.804*	-0.284	-0.122	-0.377	1.591**
	(0.404)	(0.391)	(0.477)	(0.472)	(0.729)
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓
Observations	2,404	2,786	2,947	2,512	1,929
R-squared	0.496	0.491	0.568	0.578	0.639

Double Clustering at the bank-county and time level

Household Income Subsamples

$$Y_{bcht} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{b,t-1} + \nu_b + \eta_{ct} + \epsilon_{bcht}$$

- Bank b, county c, income bucket h, time t
- County-time FE, bank FE, time-varying bank controls

LTI	Q1	Q2	Q3	Q4	Q5
Post X Exposure	-5.474	1.958	2.129	3.021	2.913
	(4.630)	(2.897)	(3.469)	(3.858)	(3.011)
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓
Observations	1,396	1,775	1,929	1,743	1,267
R-squared	0.391	0.389	0.457	0.466	0.502

Double Clustering at the bank-county and time level

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Interest Rate

Why are high-income households taking larger loans?

Interest Rate

Why are high-income households taking larger loans?

PANEL A	Pre	Post	Difference
Q1	4.12	3.84	-0.28
Q2	4.24	3.85	-0.39
Q3	4.21	3.81	-0.40
Q4	4.21	3.80	-0.41
Q5	4.24	3.78	-0.46

Interest Rate

PANEL B	Rate	Rate	Rate	Rate	Rate
Post × Exposure	0.712**	0.250	0.348	-0.023	-0.753**
	(0.308)	(0.262)	(0.264)	(0.346)	(0.346)
Observations	376	382	383	379	367
R-squared	0.604	0.731	0.731	0.586	0.567
Bank FE	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
Sample	Q1	Q2	Q3	Q4	Q5

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Evolution of House Prices

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House Price Growth and Price to Rent Ratio
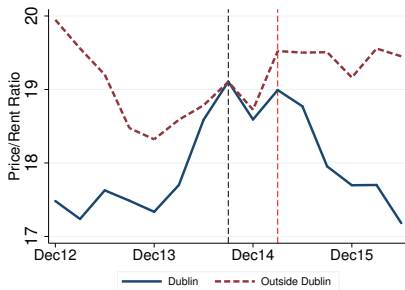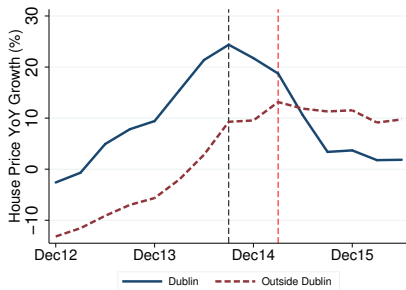
House Price Growth by Property Size

	2013Q4-2014Q4					2014Q4-2015Q4				
	1BR	2BR	3BR	4BR	5BR	1BR	2BR	3BR	4BR	5BR
Dublin	24.0	27.6	24.4	15.6	15.0	-9.9	1.3	2.2	7.8	12.5
Other Cities:	17.2	4.4	6.5	1.9	3.1	-0.8	16.4	20.6	23.0	23.9
-Cork	23.6	10.1	12.3	7.4	8.8	-0.4	16.8	21.0	23.4	24.3
-Galway	25.6	11.9	14.2	9.2	10.5	-1.2	15.9	20.0	22.4	23.31
-Limerick	7.1	-4.5	-2.6	-6.9	-5.7	0.8	18.2	22.5	24.9	25.8
-Waterford	12.4	0.2	2.2	-2.3	-1.1	-2.2	14.8	18.9	21.2	22.1

Household Income Subsamples

LTV	Q1	Q2	Q3	Q4	Q5
Dublin					
Post × Exposure	-108.471***	-24.770	-0.383	-28.649*	1.468
	(25.369)	(19.910)	(16.648)	(14.479)	(17.217)
Observations	314	400	446	444	439
R-squared	0.350	0.205	0.147	0.181	0.225
Outside Dublin					
Post × Exposure	-49.615***	-12.545	-4.700	18.559*	72.805***
	(11.803)	(10.204)	(10.306)	(11.193)	(18.607)
Observations	2,049	2,355	2,450	2,022	1,427
R-squared	0.360	0.237	0.228	0.253	0.355
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓

Double Clustering at the bank-county and time level

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- One SD higher Bank Exposure leads to 7.85pp lower LTV for Q1 households in Dublin

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County-Time FE	✓	✓	✓	✓	✓

- One SD higher Bank Exposure leads to
    - 3.59pp lower LTV for Q1 households outside Dublin
    - 5.27pp higher LTV for Q5 households outside Dublin

Household Income Subsamples

Loan Size	Q1	Q2	Q3	Q4	Q5
Dublin					
Post × Exposure	-1.250**	-0.690*	-0.282	-1.230**	0.840
	(0.515)	(0.387)	(0.316)	(0.473)	(0.527)
Observations	316	400	446	446	439
R-squared	0.275	0.201	0.186	0.226	0.162
Outside Dublin					
Post × Exposure	0.184	-0.221	-0.897***	-1.317***	4.956***
	(0.285)	(0.196)	(0.278)	(0.326)	(0.664)
Observations	2,088	2,386	2,501	2,066	1,490
R-squared	0.407	0.308	0.289	0.312	0.402
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓

Double Clustering at the bank-county and time level

Household Income Subsamples

Total Loan Vol	Q1	Q2	Q3	Q4	Q5
Dublin					
Post $\times$ Exposure	-1.863*	-0.551	1.128	0.477	0.727
	(1.033)	(1.030)	(0.865)	(0.875)	(0.927)
Observations	316	400	446	446	439
R-squared	0.367	0.486	0.519	0.548	0.563
Outside Dublin					
Post $\times$ Exposure	-0.099	0.083	-0.277	-0.177	1.607**
	(0.391)	(0.308)	(0.370)	(0.402)	(0.749)
Observations	2,088	2,386	2,501	2,066	1,490
R-squared	0.388	0.341	0.375	0.359	0.358
Bank Controls	✓	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓	✓
County-Time FE	✓	✓	✓	✓	✓

Double Clustering at the bank-county and time level

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Other Assets

Do banks increase their risk-taking in other asset classes?

1) **Credit to Firms**
2) Holdings of Securities

Credit to Firms (Loan Volume)

$$Y_{bclqt} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{bt-1} + \delta_{bc} + \eta_{clqt} + \epsilon_{bclqt}$$

- Bank b, industry l, county c, quality q, time t
- Semi-annual data from 2013H1 to 2016H1, $Post = 1$ from 2015H1
- Risky, bank rating 5-6. NonRisky, bank rating 1-4

Credit to Firms (Loan Volume)

$$Y_{bclqt} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{bt-1} + \delta_{bc} + \eta_{clqt} + \epsilon_{bclqt}$$

- Bank b, industry l, county c, quality q, time t
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- Risky, bank rating 5-6. NonRisky, bank rating 1-4

LHS: $\Delta VOLUME$	Total	Risky	NonRisky
Exposure×Post	0.842***	1.816***	0.299*
	(0.17)	(0.41)	(0.17)
Time-Varying Bank Controls	✓	✓	✓
Industry-County-Quality-Time FE	✓	✓	✓
Bank-County FE	✓	✓	✓
Observations	10522	3567	6955
R-squared	0.473	0.412	0.504

Credit to Firms (Loan Rate)

$$Y_{bclqt} = \alpha + \beta Post_t \times Exposure_b + \gamma X_{bt-1} + \delta_{bc} + \eta_{clqt} + \epsilon_{bclqt}$$

- Bank b, industry l, county c, quality q, time t
- Semi-annual data from 2013H1 to 2016H1, $Post = 1$ from 2015H1
- Risky, bank rating 5-6. NonRisky, bank rating 1-4

LHS: $\Delta RATE$	Total	Risky	NonRisky
Exposure×Post	-0.392**	-0.783**	-0.191
	(0.17)	(0.38)	(0.22)
Time-Varying Bank Controls	✓	✓	✓
Industry-County-Quality-Time FE	✓	✓	✓
Bank-County FE	✓	✓	✓
Observations	10522	3567	6955
R-squared	0.452	0.449	0.458

Do banks increase their risk-taking in other asset classes?

1) Lending to Firms
2) **Holdings of Securities**

Effect on Holdings of Securities

$$NetBuys_{sbt} = \alpha + \beta Exposure_b \times Post_t \times Yield_s + \gamma_{bt} + \eta_{st} + \epsilon_{sit}$$

$$NetBuys_{sbt} = \frac{Holdings_{sbt} - Holdings_{sbt-1}}{0.5 * (Holdings_{sbt} + Holdings_{sbt-1})}$$

- Net Buys $\in [-2, 2]$ of security s by bank b between t and $t-1$
- Quarterly data: 2013Q1 to 2016Q2, $Post = 1$ from 2015Q2

Effect on Holdings of Securities

$$NetBuys_{sbt} = \alpha + \beta Exposure_b \times Post_t \times Yield_s + \gamma_{bt} + \eta_{st} + \epsilon_{sit}$$

$$NetBuys_{sbt} = \frac{Holdings_{sbt} - Holdings_{sbt-1}}{0.5 * (Holdings_{sbt} + Holdings_{sbt-1})}$$

- Net Buys $\in [-2, 2]$ of security s by bank b between t and $t-1$
- Quarterly data: 2013Q1 to 2016Q2, $Post = 1$ from 2015Q2

	Net Buys	Buys	Sells
Exposure×Post×Yield	0.051***	0.225***	-0.176**
	(3.00)	(3.10)	(-2.16)
Bank-Time FE	✓	✓	✓
Security-Time FE	✓	✓	✓
Observations	8034	8034	8034
R-squared	0.950	0.918	0.914

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Concluding Remarks

Conclusion

1) Introduction of lending limits leads to reallocation of mortgages by banks affected by the regulation

2) Richer households take out larger loans than before and pay lower interest rates

3) Low income households in Dublin are less able to borrow, high income households outside Dublin see largest increase in bank credit, consistent with evolution of house prices

4) Banks increase their risk-taking in both corporate lending and security holdings