Mortgage Pricing and Monetary Policy

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Policy and Regulation after the Financial Crisis

- **"Macro" - unconventional monetary policies:**
  - Goal: Stimulate Credit Markets
  - Approach: Reduce Funding Costs of Lenders
  - Authorities: FED in US, Bank of England in UK, ECB in Europe
  - Examples: Targeted Longer-term Refinancing Operations in Europe; Funding for Lending Scheme in UK

- **"Micro" - consumer product regulations:**
  - Goal: Improve financial outcomes for consumers (confused, irrational, imperfectly informed)
  - Approach: Regulate markets for consumer financial product
  - Authorities: CFPB in US, Financial Conduct Authority in UK
  - Examples: Direct Regulation of Prices and/or Fees (Caps); Standardized Products + Price Comparison Websites.

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Policy and Regulation in the UK: Macro

UK house prices + Add to myFT

Funding for Lending Scheme viewed as a mixed success

Tanya Powley and Claire Jones AUGUST 12, 2013 1

A year on, the Bank of England's Funding for Lending Scheme can be viewed as a mixed success.

Launched last August, the scheme was supposed to increase credit supply by providing lenders with cheap funds in return for commitments to lend to businesses and households.

While it has helped cut mortgage rates to record lows for homeowners, spurring activity in the UK housing market, it has done little for UK small and medium-sized businesses.

Policy and Regulation in the UK: Micro

Mortgage lenders under FCA review for masking high fees

Study into market will also look at restrictions on choice of broker

© Bloomberg

James Pickford DECEMBER 12, 2016

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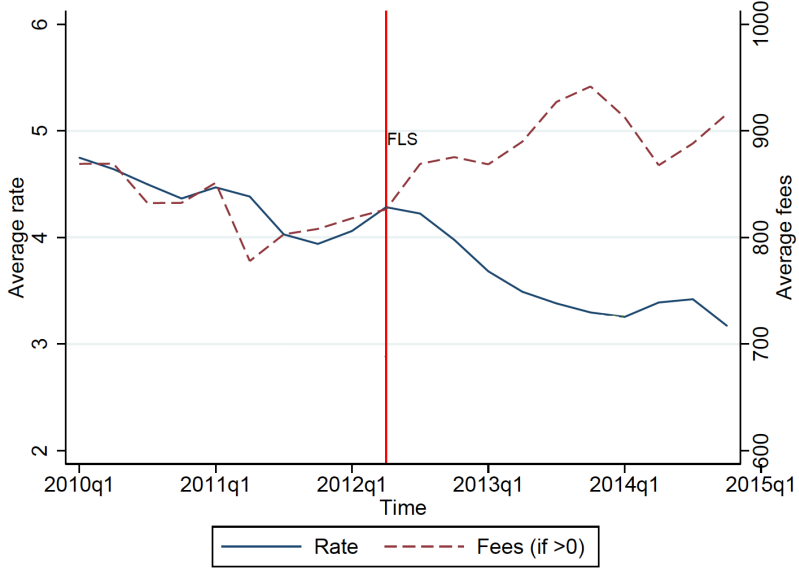
Low mortgage interest rates that mask inflated fees and estate agents who restrict a buyer's choice of mortgage broker are two of the practices that the City regulator will tackle in a sweeping study of the UK's home loan market.

Lenders Decrease Rates, but Increase Fees



Research Questions

- **Demand:** How borrowers choose among differentiated mortgages with multi-dimensional prices?
- **Supply:** How lenders price mortgages using different combinations of rates and fees?
- **Demand + Supply:** How macro policies and micro regulations affect the mortgage market:
  - equilibrium prices and quantities;
  - lenders' profits and consumer surplus.

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This Paper

1. **Loan-level Data**
   - Universe of mortgage originations in UK
   - Universe of offered mortgage products in UK

2. **Variation:**
   - Two-part tariffs with rate and fee within mortgage product
   - Lenders' borrowing from Bank of England Funding for Lending Scheme

3. **Structural Equilibrium Model:**
   - Demand: discrete-continuous choice of mortgage-loan size
   - Supply: pricing with interest rates and origination fees, borrowing from central bank

4. **Counterfactual Regulations:**
   - Macro/Funding: remove unconventional monetary policy
   - Micro/Pricing: ban origination fees

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Data and Patterns

Setting

- **The UK mortgage market**
  - Short-term fixed rate mortgages with prepayment penalties (e.g. 2-5 years) & Higher standard variable rates after fixed period
    - → Refinancing incentives (Cloyne et al., 2018); Remortgaging
    - → Contribution of origination fees to profits.
  - Pricing based on product characteristics: lender, rate type, maximum loan-to-value; no price heterogeneity across borrowers conditional on product-market. Products

- **The Funding for Lending Scheme (FLS)**
  - FLS started on 7/2012 amid Euro Sovereign Debt Crisis;
  - Collateralized loans with a 4 year maturity;
  - Each bank could borrow initial amount of up to 5% of stock of existing loans to real economy + additional funding = to net lending (one for one) at as low as 25bps

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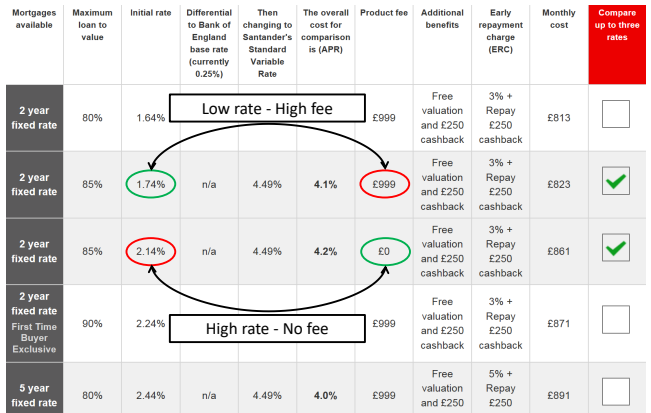
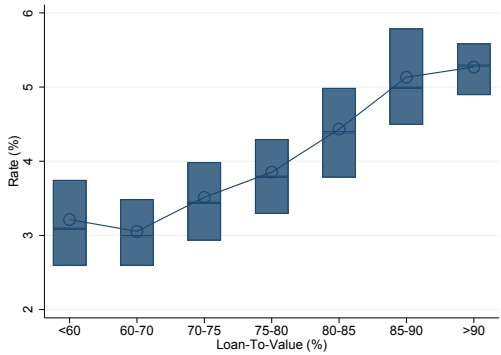
Fact #1 - Supply: Negative Relation Rate - Fee



Mortgages available	Maximum loan to value	Initial rate	Differential to Bank of England base rate (currently 0.25%)	Then changing to Santander's Standard Variable Rate	The overall cost for comparison is (APR)	Product fee	Additional benefits	Early repayment charge (ERC)	Monthly cost	Compare up to three rates
2 year fixed rate	80%	1.64%				£999	Free valuation and £250 cashback	3% + Repay £250 cashback	£813	☐
2 year fixed rate	85%	1.74%	n/a	4.49%	**4.1%**	£999	Free valuation and £250 cashback	3% + Repay £250 cashback	£823	☑
2 year fixed rate	85%	2.14%	n/a	4.49%	**4.2%**	£0	Free valuation and £250 cashback	3% + Repay £250 cashback	£861	☑
2 year fixed rate First Time Buyer Exclusive	90%	2.24%				£999	Free valuation and £250 cashback	3% + Repay £250 cashback	£871	☐
5 year fixed rate	80%	2.44%	n/a	4.49%	**4.0%**	£999	Free valuation and £250 cashback	5% + Repay £250 cashback	£891	☐

- Full sample: £1,000 origination fee $\approx$ 27 basis points. Regression Quotes

Fact #2: Rates Price Risk, Fees Extract Surplus



- Interest rates adjust with risk (proxied by LTV), fees do not
- Origination fees likely to segment market and extract surplus

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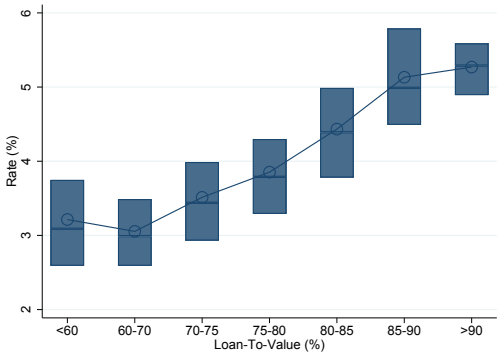

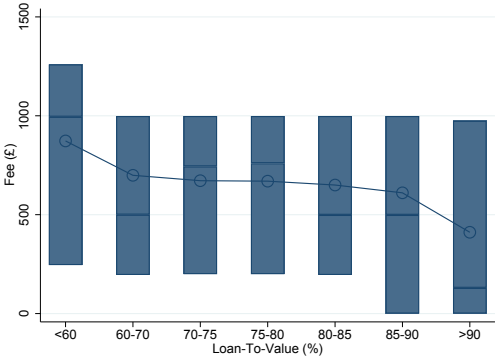

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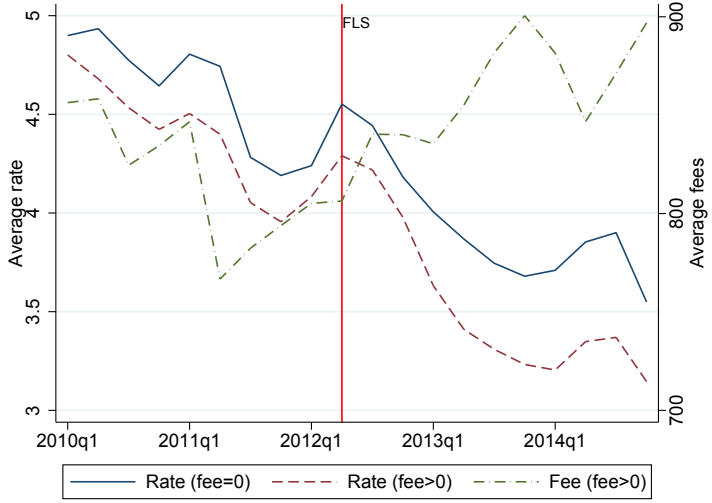
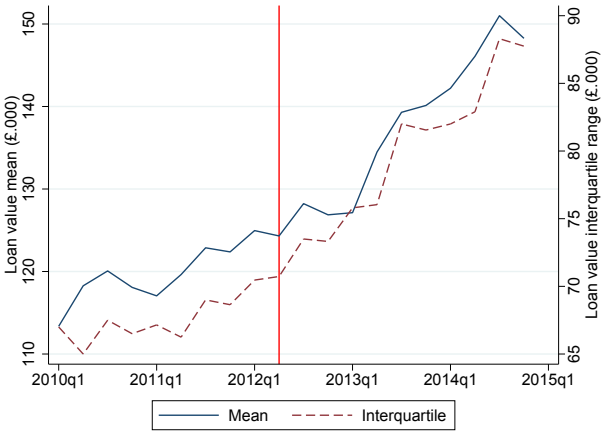
Fact #3 - Supply: Larger Rates Gap after FLS



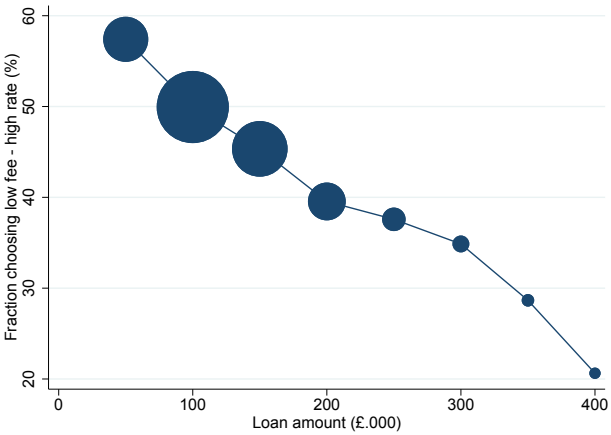
- Increasing gap in rates between zero-fee and non-zero-fee products

Fact #4 - Demand: Heterogeneity



- Loan size has been increasing due to house price increase.
- Heterogeneous house price increase $\longrightarrow$ heterogeneous loan size $\rightarrow$ Model: higher gain from segmentation and price discrimination

Fact #5 - Demand: Quantity and Rate - Fee Choice



- Consistent with cost minimization, fraction of borrowers choosing no-fee products declines with loan amounts → Model: correlation quantity and product choice

NPV

Fact #5 - Demand: Quantity and Rate - Fee Choice

	Fraction (%)
Cost-minimizing choice	51
Not cost-minimizing choice	49
High fee - low rate	43
Low fee - high rate	6

- Some borrowers do not seem to minimize NPV (given same non-price characteristics) → Model: random shocks to choice
- Increase borrowing costs by ≈ £1000 over fixation period
- Asymmetry in non-cost-minimizing choice toward low rate-high fee mortgages

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Model and Estimation

Roadmap

- Static equilibrium model. First-time buyers in each market (m) and quarter (t):
- **Demand:** I_{mt} heterogeneous borrowers choosing:
  - Renting vs. buying a house;
  - If buying, which mortgage to take from their choice set (discrete choice), and
  - How much to borrow (continuous choice).

  $\rightarrow$ Borrowers' demand elasticities to rates and fees.
- **Supply:** L_{mt} lenders:
  - Offering differentiated mortgage products;
  - Competing on rates and fees to maximize expected profits;
  - Deciding whether to borrow from FLS facilities.

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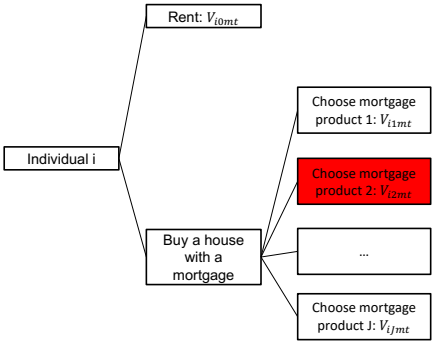
Demand: Product Choice and Loan Size



- Borrower chooses **mortgage product** j if $V_{ijmt} > V_{ikmt} \; \forall \; k \in J_i$

- At the chosen product, optimal **loan size** (q_{ijmt}) from Roy's identity:

$$\log(q_{ijmt}) = \log\left(\frac{\alpha_m}{\gamma_m}\right) - \log(r_{jmt}) + \psi_m \log\left(Y_i - f_{jmt}\right) + \delta_{jmt} + \zeta_i$$

δ_{jmt} is the same product fixed-effect as in the discrete choice.

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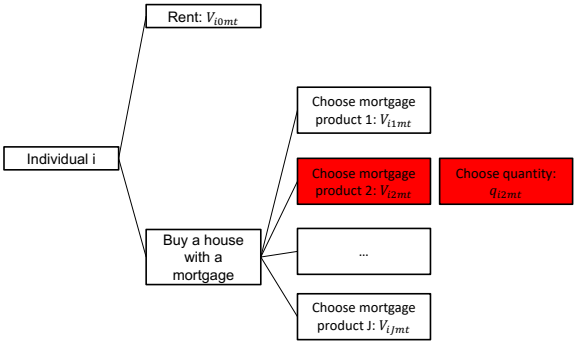

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Demand: Elasticities

	Mean	Sd	p10	Median	p90
Elasticity Rate	-8.64	1.48	-10.37	-8.60	-6.74
Elasticity Fee	-0.39	1.17	-0.68	-0.15	-0.00
Rate decrease per £1,000 Fee	-0.18	0.32	-0.38	-0.08	-0.04

- A £1,000 increase in fee $\sim$ a 18bps decrease in rate;
  - Pay £1 in fee to reduce interest payments by £0.64 (at average loan amount).
  - Low elasticity to fees consistent with evidence from Lu (2020).
  - In line with growing literature estimating empirical models of consumer financial products with suboptimal consumer decision-making (Hortacsu et al. 2017; Grunewald et al., 2024).
- Large heterogeneity: p10 $\sim$ 38bps; p90 $\sim$ 4bps.
- Model does a good job at fitting product market share and quantity distribution

▸ Elasticities formula ▸ Elasticities decomposition ▸ Model fit

Supply: Optimal Pricing

- Rates and fees maximize expected **flow profits**:

$$\max_{\mathbf{r}_{lt},\mathbf{f}_{lt}} \Pi_{lt}(\mathbf{r}_t, \mathbf{f}_t) = R_{lt}(\mathbf{r}_t, \mathbf{f}_t) - C_{lt}\left(\mathbf{s}_{lt}(\mathbf{r}_t, \mathbf{f}_t), \mathbf{q}_{lt}(\mathbf{r}_t, \mathbf{f}_t)\right),$$

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Discrete choice + Continuous choice + Optimal Fees

$$r_j^* = \overbrace{mc_j}^{\text{Marginal cost}} - \overbrace{\frac{\sum_i s_{ij} q_{ij}}{\sum_i q_{ij} \frac{\partial s_{ij}}{\partial r_j} + \sum_i s_{ij} \frac{\partial q_{ij}}{\partial r_j}}}^{\text{Mark-up}} - \overbrace{\frac{\sum_i \frac{\partial s_{ij}}{\partial r_j}}{\sum_i q_{ij} \frac{\partial s_{ij}}{\partial r_j} + \sum_i s_{ij} \frac{\partial q_{ij}}{\partial r_j}} \frac{f_j^* - a_j}{\tau_j}}^{\text{Net fee income}}.$$

Negative relationship between net interest margin and net fee income.

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Supply: Estimation and Identification

- Combining operating and funding costs, we estimate:

$$mc_{jt} = \omega_l^c + \omega_t^c + \omega^f \mathbb{1}\{Q_{lt}^F > 0\} + \omega_X^o X_j + \omega_X^f X_{lt} + \kappa_{jt}.$$

  - ω_l^c and ω_t^c are lender and quarter fixed effects;
  - X_j are product characteristics; X_{lt} are lender characteristics;
  - $\mathbb{1}\{Q_{lt}^F > 0\}$ is an indicator variable $= 1$ when lender l uses FLS funds in quarter t;
  - κ_{jt} are unobservable determinants of costs.

- Endogenous use of FLS:
  - Lenders with higher unobservable costs should be more likely to use FLS facilities.

- **Instruments:**
  - FLS allowance—intention-to-treat literature (Imbens and Angrist,1994).

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Supply: Marginal Cost Estimates

	Dep. Var.: Marginal costs (mc_{jt})				
	(1)	(2)	(3)	(4)	(5)
	OLS	FS	IV	FS	IV
FLS Flow > 0	-0.055		-0.466**		-0.319*
	(0.025)		(0.186)		(0.171)
Instruments:					
FLS Allowance (£)		0.026***		0.027***	
		(0.004)		(0.004)	
Controls	Yes	Yes	Yes	Yes	Yes
Time f.e.	Yes	Yes	Yes	Yes	Yes
Lender f.e.	Yes	Yes	Yes	No	No
Product f.e.	No	No	No	Yes	Yes
Marginal Cost (mean)	3.17		3.17		3.17
F statistic			52.29		53.01
Observations	2,796	2,796	2,796	2,796	2,796

- FLS decrease lenders' funding costs by $\approx$ 32–47bps (approx 10–15%)

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Model Implications

Baseline

	Costs		Prices		Quantities	
	mc (bps)	a (£)	Rate (bps)	Fee (£)	Loan Amount (£)	Originations
Baseline (2011Q3)	327	2,149	399	1,051	121,308	16,617
FLS	292	2,149	355	1,288	146,394	17,017
FLS–No Fee	292	2,149	435	0	146,244	16,584

- Decrease in cost by 35bps, decrease in rate by 44bps and increase in fee by £237.
- Increase in mortgage lending. Increase in consumer surplus and in bank profits. Banks capture large share of surplus increase.
- Heterogeneous effects: "winner" households in richer areas (because of larger mortgage sizes) and with lower-income (because of greater interest-rate sensitivity)

The Effects of FLS

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- Heterogeneous effects: "winner" households in richer areas (because of larger mortgage sizes) and with lower-income (because of greater interest-rate sensitivity)

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The Effects of FEES

	Costs		Prices		Quantities	
	mc (bps)	a (£)	Rate (bps)	Fee (£)	Loan Amount (£)	Originations
Baseline (2011Q3)	327	2,149	399	1,051	121,308	16,617
FLS	292	2,149	355	1,288	146,394	17,017
FLS–No Fee	292	2,149	435	0	146,244	16,584

- Partial offset: Increase in rate by 80bps $\rightarrow$ decrease in loans originated.
- Decrease in lending $\rightarrow$ decrease in consumer surplus. Price discrimination increases consumer surplus and aggregate welfare.
- Heterogeneous effects: "losers" households in richer areas (because of larger loans they like the high-fee - low-rate products that are not available anymore).

Conclusions

Conclusions

- Borrowers seem less elastic to fees than to interest rates;
- FLS effective in reducing lenders' marginal costs, but fees (product complexity) allow lenders' to appropriate large share of surplus;
- We focus on FLS, but our pricing results apply more broadly in a low-interest-rate enviornment:
  - IO: How structure of pricing and price discrimation change when marginal costs
  - Banking (the $+$): Substitution from interest income to fee income. decline.

Thank you!

Conclusions

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Thank you!

APPENDIX

Calculations

- Average loan amount £135K
- **Reduced form:**
  - Exchange-rate: £1000 - 27bp
  - Willing to pay £500 in fee to save £365 in rates
  - Pay £1 in fee to reduce rate by £0.72
- **Structural estimation:**
  - Exchange-rate: £1000 - 24bp (total elasticity)
  - Willing to pay £500 in fee to save £324 in rates
  - Pay £1 in fee to reduce rate by £0.64

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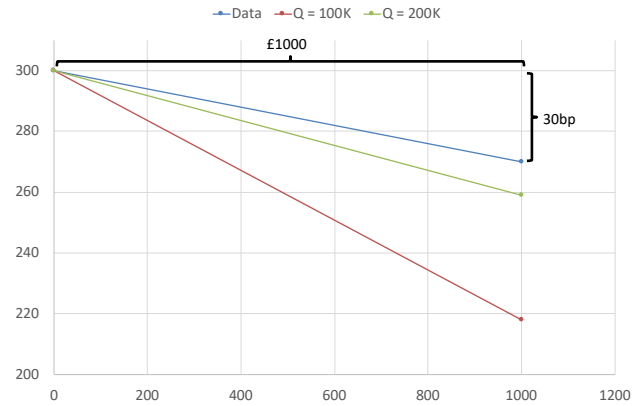
Calculations (2)



- Data: £1,000 origination fee $\approx$ 30 basis points.
- NPV minimization:
  - Quantity £100K: 1,000 origination fee $\approx$ 80 basis points.
  - Quantity £200K: 1,000 origination fee $\approx$ 40 basis points.

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Mortgage Product Type

- Rate type: fixed rate for 2 and 5 years ($> 70\%$ of originations)
- Lender: "big six", challengers, building societies, outside option
- Maximum Loan-To-Value: 60,70,75,80,85,90,95

Provider	Initial monthly cost	Initial rate	Type of mortgage	Max LTV
HSBC	£ 635.05	1.99% then 3.94%	Fixed for 25 months	90%
The Loughborough Building Society	£ 639.44	2.05% then 4.99%	Discounted Variable for 24 months	90%
YORKSHIRE BUILDING SOCIETY	£ 641.64	2.08% then 4.99%	Fixed for 25 months	90%

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Remortgaging

FIGURE A.1: REMORTGAGES HAPPEN WHEN THE RESET RATE KICKS IN

Source: Best, Cloyne, Ilzetzki and Kleven, 2015

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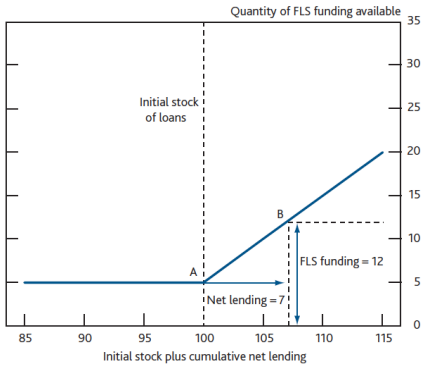
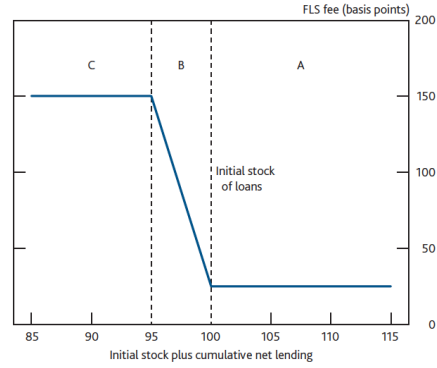
Funding for Lending Scheme Details





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Fact #2 - Supply: Negative Relation Rate - Fee

- Empirical "Exchange-rate" between rate and fee:

$$rate_{jkt} = \eta fee_{jkt} + \chi_{kt} + \upsilon_{jkt},$$

  - χ_{kt}: interacted product type-time fixed effects

- Full sample: £1,000 origination fee $\approx$ 27 basis points.

	Baseline	Heterogeneity					
		(Fix)	(Var)	(<75)	(>75)	(Big 6)	(Other)
Fee (.000)	-0.274***	-0.292***	-0.210***	-0.273***	-0.278***	-0.263***	-0.283***
	(0.019)	(0.018)	(0.043)	(0.022)	(0.026)	(0.027)	(0.022)
Product-Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.95	0.95	0.90	0.92	0.94	0.95	0.94
Observations	55611	41179	14432	46320	9291	24623	30988

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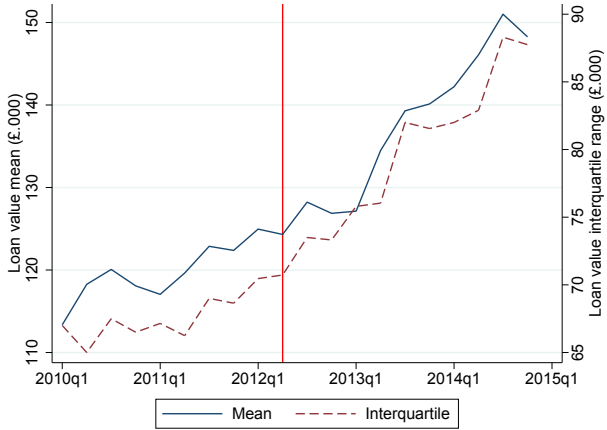
Borrowers #2: Increasing Heterogeneity



- Loan size has been increasing due to house price increase
- Heterogeneous house price increase $\longrightarrow$ heterogeneous loan size

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Demand Parameters

	α_r	$\beta_{highLTV}$	β_{Fix5}	λ	ψ	γ	μ	σ
Mean coefficient	0.058	0.033	0.014	0.039	0.617	0.822	11.685	0.256
Mean standard error	(0.008)	(0.011)	(0.007)	(0.353)	(0.002)	(0.340)	(0.029)	(0.014)

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Elasticities Formula

- **Rate**

$$\begin{aligned}
\epsilon^{r,q}_{ijmt} &= \frac{\partial q_{ijmt}}{\partial r_{jt}}\frac{r_{jt}}{q_{ijmt}} = \frac{\partial \ln(q_{ijmt})}{\partial r_{jt}} r_{jt} = -\alpha_m r_{jt}, \\
\epsilon^{r,s}_{ijmt} &= \frac{\partial s_{ijmt}}{\partial r_{jt}}\frac{r_{jt}}{s_{ijmt}} = -\alpha_m \mu_m \exp(-\alpha_m r_{jt} + \beta_m X_j + \xi_{jmt} + \zeta_i)(1 - s_{ijmt}) r_{jt}.
\end{aligned}$$

- **Fee**

$$\begin{aligned}
\epsilon^{f,q}_{ijmt} &= \frac{\partial q_{ijmt}}{\partial f_{jt}}\frac{f_{jt}}{q_{ijmt}} = -\frac{\psi_m}{\left(Y_i - \frac{f_{jt}}{\tau_{jt}}\right)\tau_{jt}}\frac{f_{jt}}{\tau_{jt}}, \\
\epsilon^{f,s}_{ijmt} &= \frac{\partial s_{ijmt}}{\partial f_{jt}}\frac{f_{jt}}{s_{ijmt}} = -\frac{\gamma_m(1 - s_{ijmt})}{\left(Y_i - \frac{f_{jt}}{\tau_{jt}}\right)^{\psi_m}}\frac{f_{jt}}{\tau_{jt}}.
\end{aligned}$$

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Demand: Elasticities Decomposition

	Mean	Sd	p10	Median	p90
Panel A: Total demand					
Elasticity Rate	-9.04	0.92	-10.14	-9.10	-7.87
Elasticity Fee	-0.49	0.74	-1.13	-0.17	-0.00
Rate decrease per 1000 Fee	-0.24	0.21	-0.51	-0.16	-0.05
Panel B: Continuous demand					
Elasticity Rate	-1.26	0.04	-1.32	-1.26	-1.21
Elasticity Fee	-0.48	0.73	-1.11	-0.16	-0.00
Rate decrease per 1000 Fee	-1.51	1.39	-3.27	-0.97	-0.26
Panel C: Discrete demand					
Elasticity Rate	-7.78	0.90	-8.82	-7.83	-6.65
Elasticity Fee	-0.01	0.01	-0.02	-0.01	-0.00
Rate decrease per 1000 Fee	-0.01	0.00	-0.01	-0.01	-0.01

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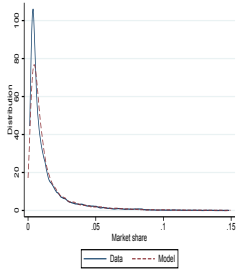
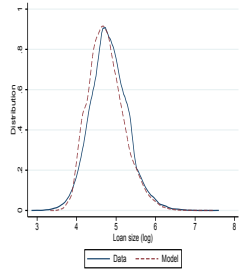
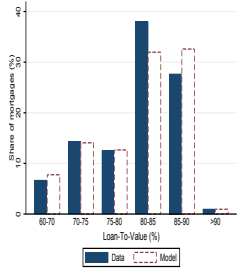
Model Fit







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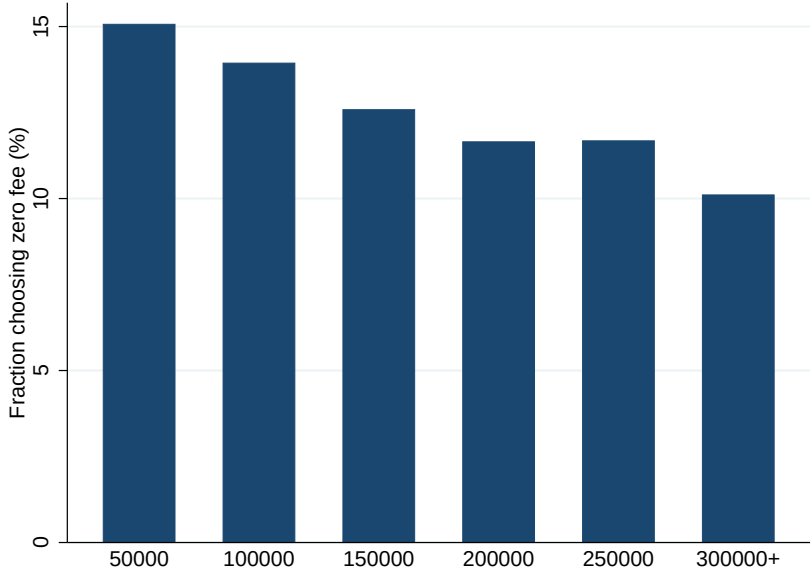
Quantity and Fee Choice



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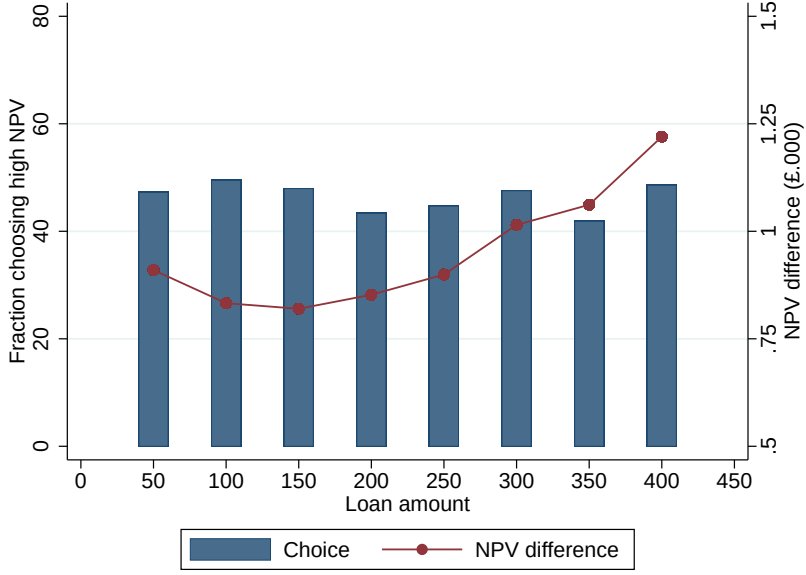
Quantity and NPV Choice



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Supply: Marginal Cost Estimates - IV Asset Abroad

	OLS	First Stage	IV	Placebo
	(1)	(2)	(3)	(4)
$1(FLS_t = 1 \text{ and } Q_{FLS,l} > 0)$	-0.283***		-0.415***	
	(0.057)		(0.126)	
Assets Abroad × Post		-0.015***		0.003
		(0.003)		(0.002)
Time, Region, Lender f.e.	Yes	Yes	Yes	Yes
Cost shifters, Product chars	Yes	Yes	Yes	Yes
Marginal cost (mean)	2.33		2.33	2.45
F statistic		22.40	22.40	
Adjusted R^2	0.81	0.51	0.71	0.83
Observations	12,489	12,489	12,489	3,701

back

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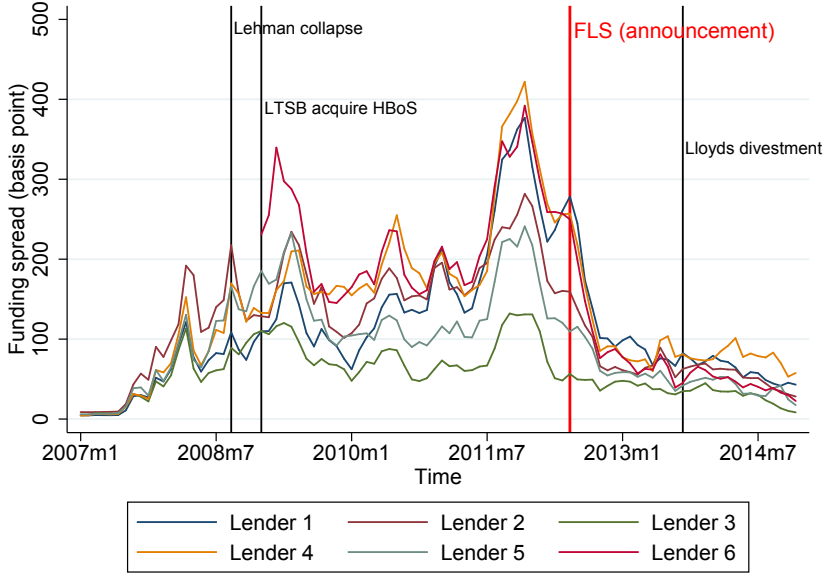
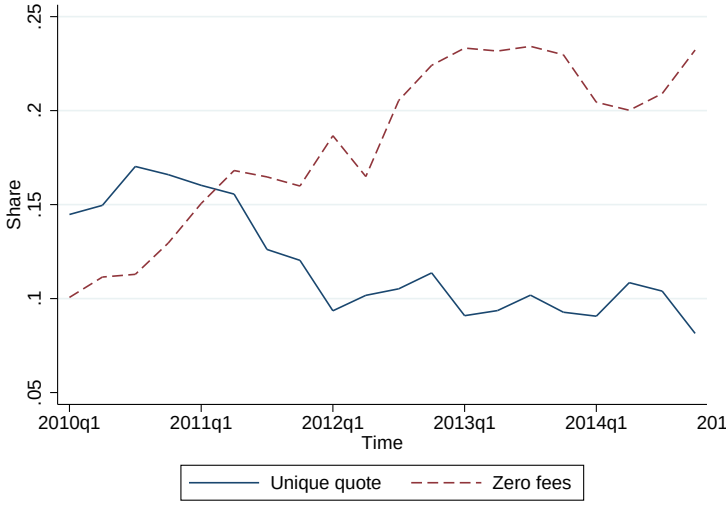
Policy #1: Lower Funding Costs and Less Dispersion



Increasing Product Complexity



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Net Present Value (Cost)

	High rate- low fee	Low rate-high fee		
		Paid upfront	2-years rollover	30-years rollover
Rate	2.14%	1.74%	1.74%	1.74%
Fee	0	999	999	999
Q = 200K				
NPV payments + fees	18299	18474	18376	17563
Q=250K				
NPV payments + fees	22874	22843	22744	21931

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Supply: Application Cost Estimates

	Dep. Var.: Application costs (a_{jt})				
	(1)	(2)	(3)	(4)	(5)
	OLS	FS	IV	FS	IV
FLS flow > 0	0.064		0.168		0.017
	(0.150)		(0.673)		(0.672)
Instruments:					
Past Mortgages (£)		1.434***		1.529***	
		(0.356)		(0.362)	
Property value (change log)		6.343**			
		(2.570)			
House Price-to-Income (change log)				8.383***	
				(3.086)	
Controls	Yes	Yes	Yes	Yes	Yes
Time f.e.	Yes	Yes	Yes	Yes	Yes
Lender f.e.	Yes	Yes	Yes	Yes	Yes
Marginal cost (mean)	1.02	0.21	1.02	0.21	1.02
F statistic			7.23		7.28
Adjusted R^2	0.25	0.56	0.25	0.56	0.25
Observations	511	511	511	511	511

- FLS no effect on application costs back