Price Discrimination and Mortgage Choice

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What we find

❶ Most people face a daunting number of mortgages to choose from.

❷ On average, people don't pick particularly well, but cost implications small.

❸ Some customers (7%) leave a lot of money on the table.
- High LTV & LTI customers $\rightarrow$ Young, first-time-buyers.
- Bad menus $\rightarrow$ Expensive choices.

❹ Evidence consistent with price discrimination to profit from poor decisions or lack of alternatives. We rule out cost and risk.

Literature   Summary Stats

UK market structure

- Most mortgages: fixed rate period of 2, 3, or 5 years.

- Long period of floating rate.

- People roll over their mortgage multiple times.

- 5 components: initial period, initial rate, upfront fee, reset rate, maximum LTV.

- Customers face multi-product menus at multiple banks.

Choice Set   Data

Evaluating choices

❶ Find all mortgages on offer at given LTV for given loan amount and initial payment period.

- Both **within** the chosen bank, and **across** all 6 banks.

❷ Compute NPV of payment over first 7 years.

❸ Rank NPVs.

❹ Define baseline mortgage: 15th percentile of choice set.

NPV calculations   Example   Within vs. Across Banks

Alternative Ranking

Results hold for two other ranking methods:

1. **Immediate refinancing:** Assume refinancing at the end of the promotion period

   - Eliminates relevance of the reset rate

2. **Dominance:** Find mortgages that dominate in at least one dimension

   - Rules out private information

Ranking Pros and Cons

How well do people pick?

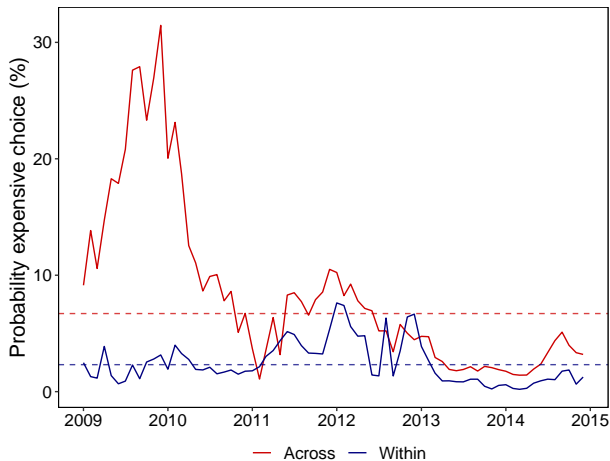|	Choice set size	Pctile chosen
25th pctile	46	27
Median	73	47
75th pctile	101	70
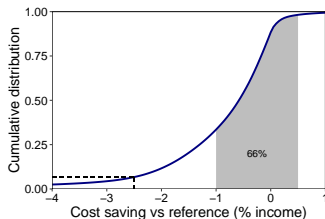
Expensive choice: costs $\geq 2.5\%$ of monthly net income.

Within bank Choice proliferation
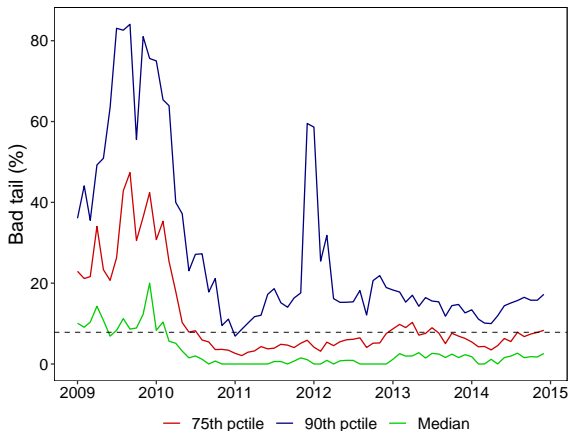
Time Series of Expensive choices

Where do expensive choices come from?

Two aspects to an expensive choice:

1. Quality of your choice: given your menu, did you pick well?
   - *choice* = percentile rank of choice you made.
2. **Quality of choice set:** how many bad choices were on offer?
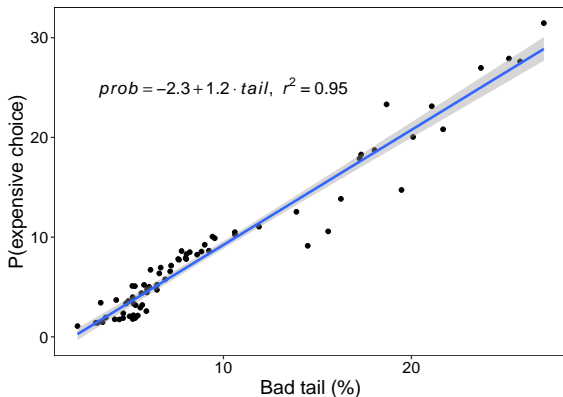   - *bad tail* = % of expensive mortgages on offer.

Menu variation

Menu prevents the median person from picking expensive option, but **sometimes the menu is filled with bad choices**. (Within bank)

Menu Quality and Expensive Choices

$prob = -2.3 + 1.2 \cdot tail, \quad r^2 = 0.95$

Menu quality is the key driver in making expensive choices.

Within bank

Is it more important to get the right bank or to pick well?

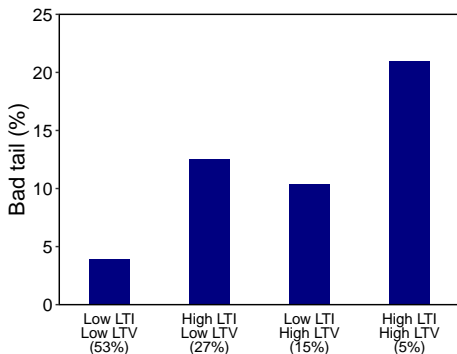|		Dependent variable:			
			Expensive choice across		
	MFX	MFX	MFX	MFX	MFX
Cost difference within bank			0.016***		0.023***
			(0.0002)		(0.0002)
Cost difference vs. best bank				0.023***	0.029***
				(0.0002)	(0.0002)
Bad tail		0.304***	0.279***	0.224***	0.150***
		(0.001)	(0.001)	(0.001)	(0.001)
Bank dummies	No	No	No	No	No
Product dummies	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.09	0.56	0.63	0.59	0.71
Mean dependent variable	0.067	0.067	0.067	0.067	0.067
Observations	883,459	883,459	883,459	883,459	883,459

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

- Role for where you shopped and what you picked, but menu quality biggest driver of expensive choices.
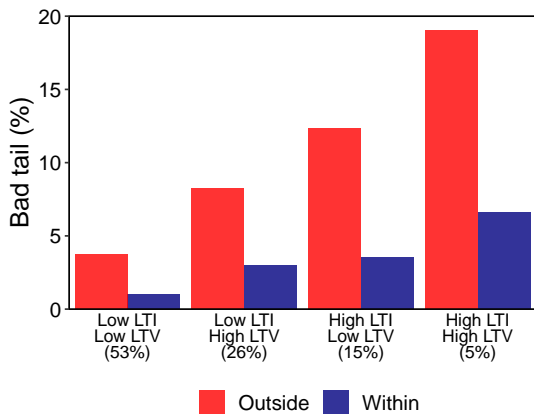
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Who gets a bad menu?

Note: High LTV=LTV> 85%. High LTI=LTI> 4

Banks offer worse menus to high LTV & LTI customers. `Within Banks`

Choice sets within and outside banks

Note: High LTV=LTV> 85%. High LTI=LTI> 4

What do LTV and LTI load on?

	Dependent variable:		
	High LTV MFX	High LTI MFX	High LTV & LTI MFX
Young	0.071***	0.023***	0.016***
	(0.001)	(0.001)	(0.001)
Old	−0.095***	−0.079***	−0.035***
	(0.002)	(0.001)	(0.001)
First-time buyer	0.234***	0.037***	0.042***
	(0.001)	(0.001)	(0.001)
Poor	−0.076***	0.065***	−0.003***
	(0.001)	(0.001)	(0.001)
Rich	0.032***	−0.067***	−0.014***
	(0.001)	(0.001)	(0.001)
Bank dummies	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes
Pseudo R-squared	0.12	0.05	0.05
Mean dependent variable	0.32	0.2	0.05
Observations	894,901	894,901	894,901

Note: *p<0.1; **p<0.05; ***p<0.01

Young people & first-time buyers choose high LTV and high LTI mortgages.

Who chooses poorly?

	Dependent variable:	
	Expensive choice across	
	MFX	MFX
Young	0.018***	0.005***
	(0.001)	(0.0004)
Old	−0.031***	−0.006***
	(0.001)	(0.001)
First-time buyer	0.005***	−0.005***
	(0.001)	(0.0004)
Poor	0.003***	0.001**
	(0.001)	(0.0004)
Rich	−0.006***	−0.006***
	(0.001)	(0.0004)
Bad tail		0.303***
		(0.001)
Bank dummies	No	No
Product dummies	Yes	Yes
Pseudo R-squared	0.09	0.56
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Note:	*p<0.1; **p<0.05; ***p<0.01	

- Young people and FTB are more likely to pick expensively.
  $\rightarrow$ These effects are driven by quality of the menu.

Within bank   Dominated

Potential explanations

Risk?

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Risk?

1. Default extremely rare.
2. Default patterns do not follow menu pattern.
3. Risk may cause average price to vary by leverage, but not **price dispersion**.

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Cannot rule this out for across-banks, but **within lenders** (and conditional on loan size and house values) approvals don't vary across products.

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Refinancing?

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Approval standards?
Cannot rule this out for across-banks, but **within lenders** (and conditional on loan size and house values) approvals don't vary across products.

Refinancing?
Results same if we assume customers refinance once initial period ends.

Menu-based Price Discrimination

Suppose there are two types of customers:

❶ **Sophisticated** customers: go to all banks and pick the cheapest product available.

❷ **Randomizers**: walk into a random bank and pick a random option on the menu.

Menu design trade-off:

❶ Cheap options to entice sophisticated customers.

❷ Expensive offers to profit from the randomizers.

Offer menu with **price dispersion that is increasing in the fraction of randomizers**.

Menzio and Trachter (2018) set out a model in this spirit.

Menu-based Price Discrimination

Young, and first-time-buyers:

- **Constrained** - can't afford a bigger mortgage; may not qualify at other lenders.
- **Less likely to pick well** (Lusardi & Mitchell, 2011; Agarwal et al, 2009).

As a consequence, these customers are prone to picking expensive mortgages.

Conclusions

1. People face a large number of choices.
2. Most don't pick well, but cost implications low.
3. Some customers face menu with large price dispersion - young, first-time-buyers.
4. Evidence consistent with banks using menu to price discriminate.

Literature

Product choice and shopping
Bhutta et al. (2021); Woodward & Hall (2012); Foà et al. (2019);
Célérier & Vallée (2017); Agarwal et al (2016); Andersen et al
(2020); Fisher et al. (2021); Keys et al. (2016); Allen et al.
(2019); Allen & Li (2021).

UK mortgage market
Liu (2019); Iscenko (2020); Benetton (2020); Benetton, Gavazza &
Surico (2022); Robles-Garcia (2020); Mysliwski & Rostom (2022).

Price dispersion
Huge literature, recently Menzio & Trachter (2018); Kaplan &
Menzio (2015); Kaplan et al (2017).

Our contribution
Novel mechanism: dial up price dispersion to price discriminate.
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Summary Statistics

	Mean	Std. dev.	25th pctile	Median	75th pctile
Demographics					
Young (%)	36	48	0	0	100
Old (%)	11	31	0	0	0
First-time buyer (%)	40	49	0	0	100
Net income (£000s)	42	26	28	37	50
Loan characteristics					
Loan value (£000s)	157	90	100	136	190
House price (£000s)	201	119	125	172	242
Loan-to-value (%)	79	8	74	80	85
Loan-to-income ratio	3.2	0.9	2.6	3.2	3.8
Prices					
Fee (£000s)	0.66	0.57	0.10	0.76	1.00
Initial rate (%)	4.0	1.0	3.2	3.9	4.7
Reset rate (%)	4.1	0.4	4.0	4.0	4.2

The choice set

	Virgin Money Fixed						
M●NEY	Rate **2.15%** 2.15% Fixed to 01/03/2024 reverting to 4.34%	APRC **3.8%**	Max LTV **65%**	Product Fees **£995.00**	Initial Payment **£767.53**	Total Over 3 Years **£28,946.08**	

	Virgin Money Fixed						
M●NEY	Rate **2.39%** 2.39% Fixed to 01/03/2024 reverting to 4.34%	APRC **3.8%**	Max LTV **65%**	Product Fees **£0.00**	Initial Payment **£788.71**	Total Over 3 Years **£28,713.56**	

	Coventry BS Fixed						
COVENTRY Building Society	Rate **1.45%** 1.45% Fixed to 31/12/2023 reverting to 3.99%	APRC **3.8%**	Max LTV **65%**	Product Fees **£999.00**	Initial Payment **£707.71**	Total Over 3 Years **£26,796.56**	

Mortgages on offer via Moneyfacts for a given LTV

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Data

Product Sales Database

- Data on universe of mortgages for 6 top UK banks
- 2009 - 2014
- Limited borrower characteristics; loan contract details

Moneyfacts

- Mortgage comparison site/booklet
- Shows all mortgages on offer each month
- Compare what they picked with what they could have picked

$\rightarrow$ **Allows us to compare the chosen mortgage with alternatives.** Back

Choice set example

- Customer borrows £150k; Deposit of £35$k \rightarrow$ LTV = 77%.
- Choice set is all mortgage products where:
  1. Max loan-to-value is 80%.
  2. Max loan size is greater than £150k.

  $+$ the customer's chosen mortgage if not in this set.

- In principle, customers qualify for all mortgages with higher max LTV, but these would represent expensive choices and relatively few customers (8%) do this.

- We restrict the choice set to focus on the menus banks target at particular customer groups, and run a number of robustness checks.

NPV calculation details

$$\text{NPV} = \text{fee} + \sum_{t=1}^{T_F} \frac{IP}{(1+i)^t} + \sum_{t=T_F+1}^{84} \frac{RP}{(1+i)^t}$$

where

- T_F is the fixation period;

- IP is the monthly payment in the initial period;

- RP is the monthly payment after the initial period; and

- the monthly discount rate i is computed using the 7yr LIBOR.

where T_F is the fixation period, IP is the monthly payment in the initial period, RP is the monthly payment after the initial period, and the monthly discount rate i is computed using the 7yr LIBOR. Back

Which comparison set: within or across?

They address different questions, and have different pros and cons.

Within

- Pros: Covers choices that were definitely available, and is informative about how banks price discriminate.
- Cons: Many people use brokers and/or comparison shop, so actual choice set is likely bigger.

Across

- Pros: Likely closer to the options people had and past work suggests even modest shopping leads to savings.
- Cons: Not sure if any particular person shopped or, if they did, what they saw. Indirectly related to price discrimination.

Ranking Pros and Cons

- **Baseline:** Supposes people care about the average total monthly payment, not the components – assumes intermediate (7year) horizon.

- **Immediate refinancing:** Assumes unrealistic aggressive refinancing but eliminate reset rate relevance.

- **Strong dominance:** Assumes people care about cost components and eliminates any private information, but can ignore very costly choices.

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How well do people pick?

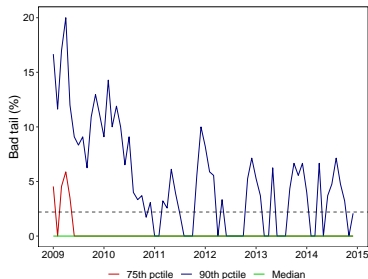|	Within		Across	
	Choice set size	Pctile chosen	Choice set size	Pctile chosen
25th pctile	11	33	46	27
Median	16	53	73	47
75th pctile	23	75	101	70
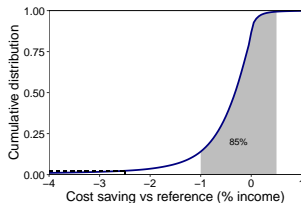
Cost savings within bank
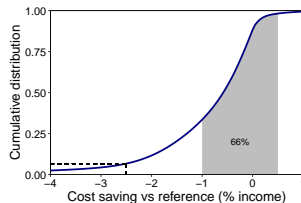
Cost savings across banks
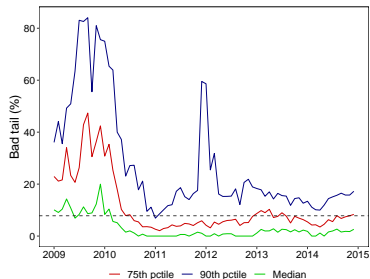
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Choice Proliferation

Banks usually offer:

- Multiple max loan amounts (e.g. £250,000; £500,000; £1,000,000)
- Several initial fees (e.g. None; £99; £199; £499; £999; £1499)
- Several initial rates (lower rates for lower fees)
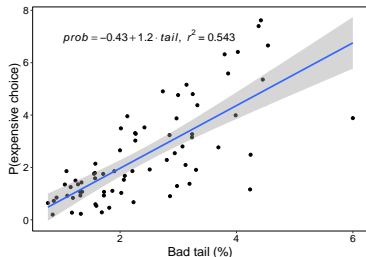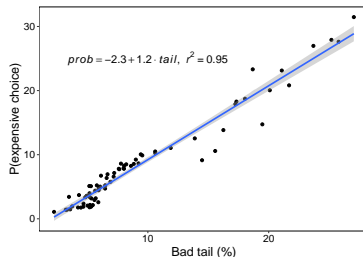- Typically one reset rate

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Menu variation

Bad tail within

Bad tail across

Menu prevents the median person from picking expensive option,
but **sometimes the menu is filled with bad choices**. Back
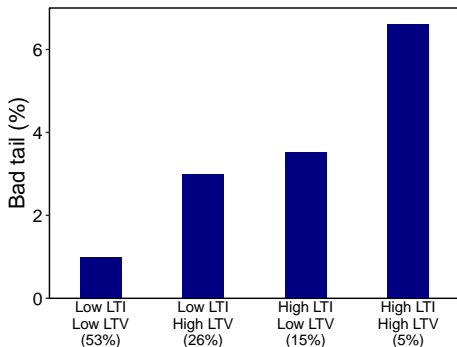
Menu Quality and Expensive Choices

Within bank   Across banks

- Plot probability of making expensive choice in a given month against mean size of bad tails in menu offerings.

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Who gets bad menus?

Within banks
Note: High LTV=LTV> 85%. High LTI=LTI> 4

- Banks offer worse menus to high LTVs & LTI customers.
- Young & FTBs (highly leveraged mortgages) face worse menus

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Who chooses poorly?

	Dependent variable:			
	Expensive choice within		Expensive choice across	
	MFX	MFX	MFX	MFX
Young	0.005***	0.001***	0.018***	0.005***
	(0.0004)	(0.0002)	(0.001)	(0.0004)
Old	−0.008***	−0.0003	−0.031***	−0.006***
	(0.0004)	(0.0003)	(0.001)	(0.001)
First-time buyer	0.006***	−0.0003	0.005***	−0.005***
	(0.0004)	(0.0002)	(0.001)	(0.0004)
Poor	0.0005	0.001***	0.003***	0.001**
	(0.0004)	(0.0002)	(0.001)	(0.0004)
Rich	−0.0001	−0.001***	−0.006***	−0.006***
	(0.0003)	(0.0002)	(0.001)	(0.0004)
Bad tail		0.117***		0.303***
		(0.001)		(0.001)
Bank dummies	Yes	Yes	No	No
Product dummies	Yes	Yes	Yes	Yes
Pseudo R-squared	0.3	0.69	0.09	0.56
Mean dependent variable	0.023	0.023	0.067	0.067
Observations	894,901	894,901	883,459	883,459

Dominated choices

- Compare mortgage to one that dominates in ≥ 1 dimension
- If savings $\geq 2.5\% \rightarrow$ **Strongly dominated**

	Dependent variable:	
	Strongly dominated across	
	MFX	MFX
Young	0.043***	0.015***
	(0.001)	(0.0001)
Old	−0.075***	−0.036***
	(0.001)	(0.001)
First-time buyer	0.003***	−0.030***
	(0.001)	(0.001)
Poor	0.034***	0.010**
	(0.001)	(0.001)
Rich	−0.043***	−0.029***
	(0.001)	(0.001)
Strongly dominated tail		0.870***
		(0.001)
Bank dummies	No	No
Product dummies	Yes	Yes
Pseudo R-squared	0.04	0.16
Mean dependent variable	0.277	0.277
Observations	883,459	883,459
Note:	*p<0.1; **p<0.05; ***p<0.01	

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