

# Price Discrimination and Mortgage Choice

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Views are solely those of the authors and so cannot be taken to represent those of the Bank of England or any of its committees.

# What we find

- ① Most people face a daunting number of mortgages to choose from.
- ② On average, people don't pick particularly well, but cost implications small.
- ③ A small percentage (7%) leave a lot of money on the table.
  - High LTV & LTI customers → Young, first-time-buyers.
  - Bad menus → Expensive choices.
- ④ Evidence consistent with price discrimination to profit from poor decisions or lack of alternatives. We rule out cost and risk.

## 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

- ① 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.
- ② Compute NPV of payment over first 7 years.
- ③ Rank NPVs.
- ④ Define baseline mortgage: 15<sup>th</sup> percentile of choice set.

NPV calculations

Example

Within vs. Across Banks

# Alternative Ranking

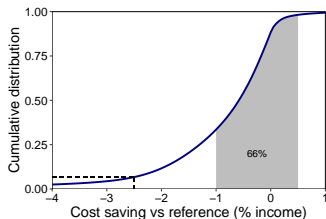
Results hold for two other ranking methods:

- 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
25 <sup>th</sup> pctile	46	27
Median	73	47
75 <sup>th</sup> pctile	101	70

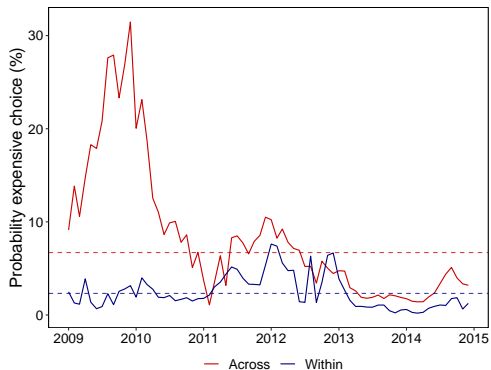


**Expensive choice:** costs  $\geq 2.5\%$  of monthly net income.

Within bank

Choice proliferation

# Time Series of Expensive choices



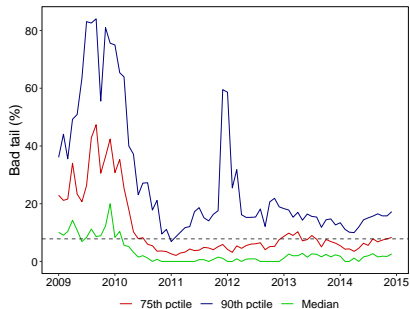
# Where do expensive choices come from?

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.

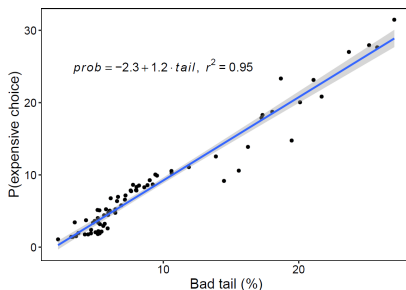


# Menu variation



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



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

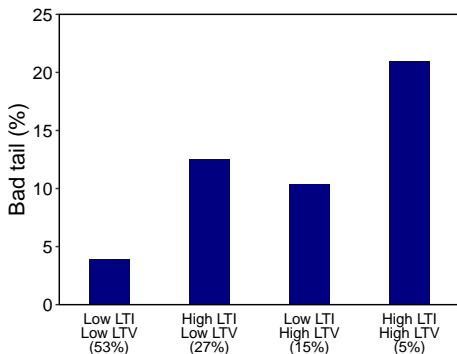
	<i>Dependent variable:</i>				
	MFX	Expensive choice across			MFX
	MFX	MFX	MFX	MFX	MFX
Cost difference within bank			0.016*** (0.0002)		0.023*** (0.0002)
Cost difference vs. best bank				0.023*** (0.0002)	0.029*** (0.0002)
Bad tail		0.304*** (0.001)	0.279*** (0.001)	0.224*** (0.001)	0.150*** (0.001)
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.

## Who gets a bad menu?

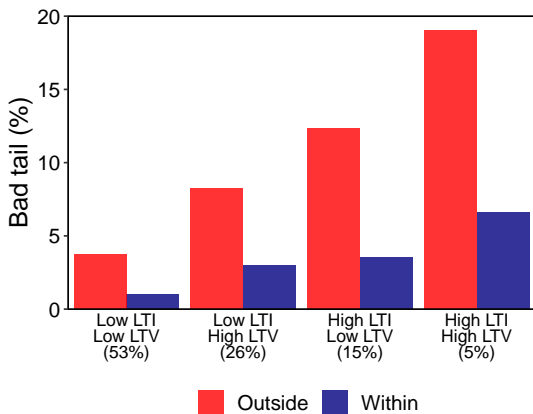


Note: High LTV=LTV > 85%. High LTI=LTI > 4

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 does LTV and LTI load on?

	<i>Dependent variable:</i>		
	High LTV MFX	High LTI MFX	High LTV & LTI MFX
Young	0.071*** (0.001)	0.023*** (0.001)	0.016*** (0.001)
Old	-0.095*** (0.002)	-0.079*** (0.001)	-0.035*** (0.001)
First-time buyer	0.234*** (0.001)	0.037*** (0.001)	0.042*** (0.001)
Poor	-0.076*** (0.001)	0.065*** (0.001)	-0.003*** (0.001)
Rich	0.032*** (0.001)	-0.067*** (0.001)	-0.014*** (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?

	<i>Dependent variable:</i>	
	Expensive choice across MFX	MFX
Young	0.018*** (0.001)	0.005*** (0.0004)
Old	-0.031*** (0.001)	-0.006*** (0.001)
First-time buyer	0.005*** (0.001)	-0.005*** (0.0004)
Poor	0.003*** (0.001)	0.001** (0.0004)
Rich	-0.006*** (0.001)	-0.006*** (0.0004)
Bad tail		0.303*** (0.001)
Bank dummies	No	No
Product dummies	Yes	Yes
Pseudo R-squared	0.09	0.56
Mean dependent variable	0.067	0.067
Observations	883,459	883,459

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

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

Within bank

Dominated

## Potential explanations

**Risk?**



# Potential explanations

## 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?

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

# Menu-based Price Discrimination

Suppose there are two types of customers:

- ① **Sophisticated** customers: go to all banks and pick the cheapest product available.
- ② **Randomizers**: walk into a random bank and pick a random option on the menu.

Menu design trade-off:

- ① Cheap options to entice sophisticated customers.
- ② 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 Competition: Disciplines the banks and protects customers.
- ④ Small group face menu with huge price dispersion - young, first-time-buyers.
- ⑤ 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.

## Summary Statistics

	Mean	Std. dev.	25 <sup>th</sup> pctile	Median	75 <sup>th</sup> pctile
<i>Demographics</i>					
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
<i>Loan characteristics</i>					
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
<i>Prices</i>					
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

	Rate	APRC	Max LTV	Product Fees	Initial Payment	Total Over 3 Years
	<b>2.15%</b> 2.15% Fixed to 01/03/2024 reverting to 4.34%	<b>3.8%</b>	<b>65%</b>	<b>£995.00</b>	<b>£767.53</b>	<b>£28,946.08</b>

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## Coventry BS Fixed

	Rate	APRC	Max LTV	Product Fees	Initial Payment	Total Over 3 Years
	<b>1.45%</b> 1.45% Fixed to 31/12/2023 reverting to 3.99%	<b>3.8%</b>	<b>65%</b>	<b>£999.00</b>	<b>£707.71</b>	<b>£26,796.56</b>

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

→ **Allows us to compare the chosen mortgage with alternatives.** [Back](#)

## Choice set example

- Customer borrows £150k; Deposit of £35k  $\rightarrow$  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.

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## 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

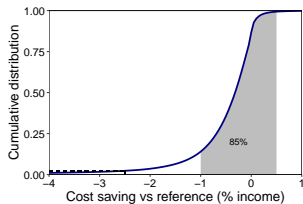
- **Baseline:** Supposes people care about the average total monthly payment, not the components – assumes intermediate (7year) horizon.
- **Immediate refinancing:** Assumes unrealistic aggressive refinancing but eliminate reset rate relevance.
- **Strong dominance:** Assumes people care about cost components and eliminates any private information, but can ignore very costly choices.

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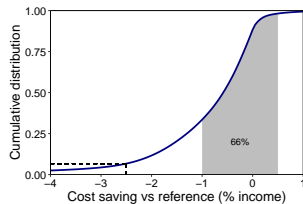


# How well do people pick?

	Within		Across	
	Choice set size	Pctile chosen	Choice set size	Pctile chosen
25 <sup>th</sup> pctile	11	33	46	27
Median	16	53	73	47
75 <sup>th</sup> pctile	23	75	101	70



Cost savings within bank



Cost savings across banks

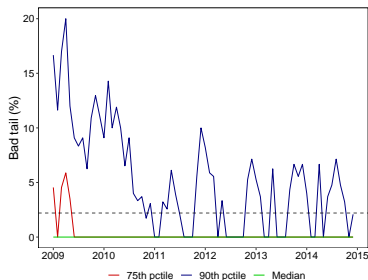
# Choice Proliferation

## **Banks usually offer:**

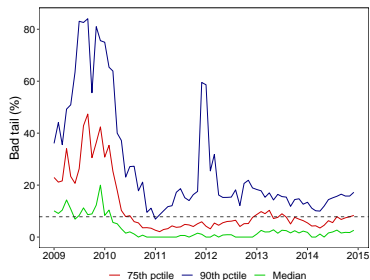
- Multiple max loan amounts (e.g. £250,000; £500,000; £1,000,000)
- Several initial fees (e.g. None; £99; £199; £499; £999; £1499)
- Several initial rates (lower rates for lower fees)
- Typically one reset rate

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# Menu variation



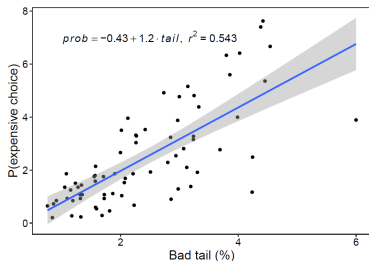
Bad tail within



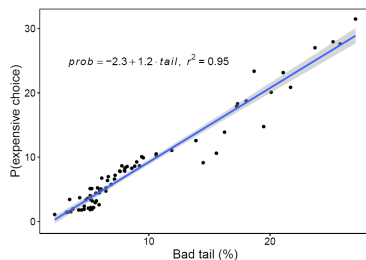
Bad tail across

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

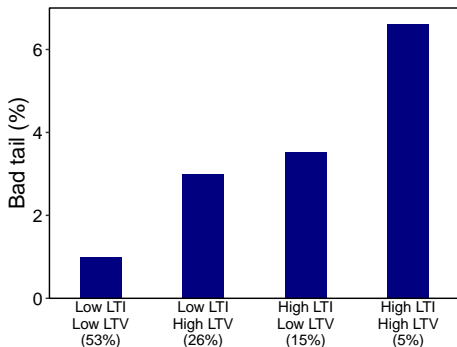


Across banks

- 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

## Who chooses poorly?

	<i>Dependent variable:</i>			
	Expensive choice within MFX	MFX	Expensive choice across MFX	MFX
Young	0.005*** (0.0004)	0.001*** (0.0002)	0.018*** (0.001)	0.005*** (0.0004)
Old	-0.008*** (0.0004)	-0.0003 (0.0003)	-0.031*** (0.001)	-0.006*** (0.001)
First-time buyer	0.006*** (0.0004)	-0.0003 (0.0002)	0.005*** (0.001)	-0.005*** (0.0004)
Poor	0.0005 (0.0004)	0.001*** (0.0002)	0.003*** (0.001)	0.001** (0.0004)
Rich	-0.0001 (0.0003)	-0.001*** (0.0002)	-0.006*** (0.001)	-0.006*** (0.0004)
Bad tail		0.117*** (0.001)		0.303*** (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  $\geq 1$  dimension
- If savings  $\geq 2.5\%$   $\rightarrow$  **Strongly dominated**

	<i>Dependent variable:</i>	
	Strongly dominated across MFX	MFX
Young	0.043*** (0.001)	0.015*** (0.0001)
Old	-0.075*** (0.001)	-0.036*** (0.001)
First-time buyer	0.003*** (0.001)	-0.030*** (0.001)
Poor	0.034*** (0.001)	0.010** (0.001)
Rich	-0.043*** (0.001)	-0.029*** (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:

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$