

# Who is interested?

## ESTIMATION OF DEMAND ON THE HUNGARIAN MORTGAGE LOAN MARKET IN A DISCRETE CHOICE FRAMEWORK

5th EBA Policy Research Workshop

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27.11.2016



# Outline

1. Motivation
2. Related literature
3. Empirical Approach
4. Results and Policy implications





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# Who is interested in the price of mortgage loans?

## Clients

Taking a mortgage loan is among the biggest financial decision of people

## Policy makers

Understand how to improve competition

## Financial institutions

Strategic planning

**Interest rate matter for clients...**



# Who is interested in the price of mortgage loans?

## Clients

Taking a mortgage loan is among the biggest financial decision of people

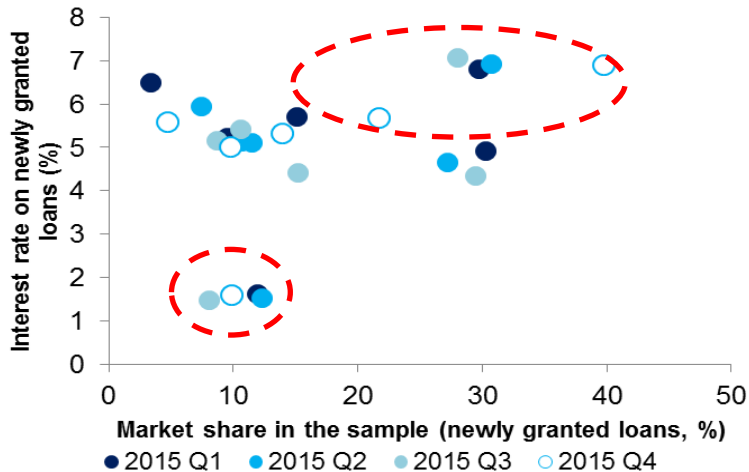
## Policy makers

Understand how to improve competition

## Financial institutions

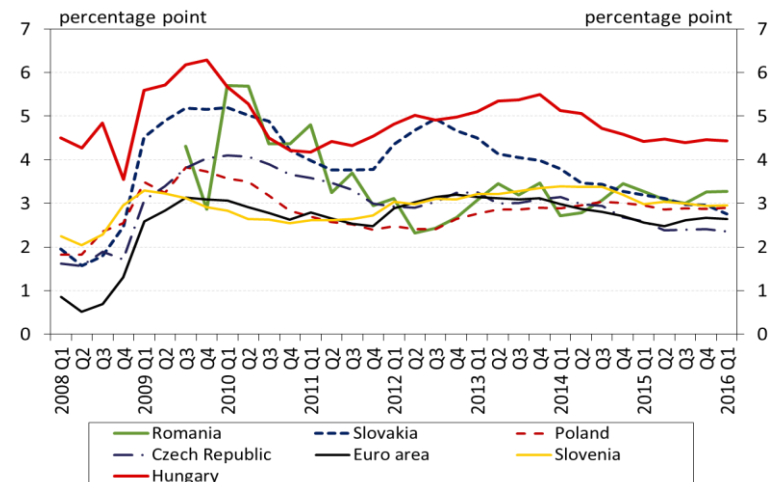
Strategic planning

Market shares and interest rates in sampled banks (2015)



Source: Credit Registry, own calculations

International comparison of spreads on housing loans extended in domestic currency



Source: National Bank of Hungary, Trends in Lending 2016 Q1

**Interest rate matter for clients but their choices are constrained**



# Why people choose expensive loans?

## Demand side problems

Temporary shocks?

Structural reasons?

Geographic constraints  
Financial constraints  
Special preferences

## Supply side problems

Temporary shocks?

Structural reasons?

## Geographic constraints

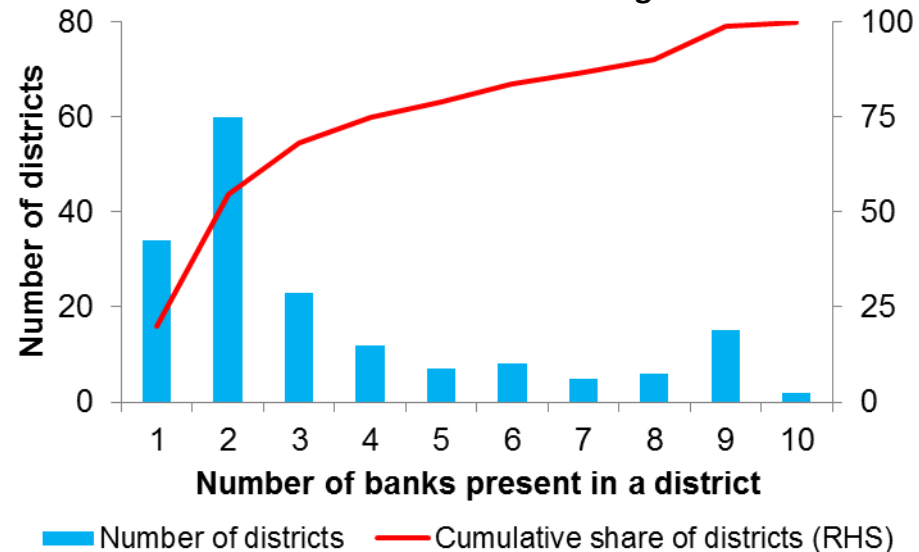
Bank presence is **strictly limited in half of the districts**

- no more than 2 banks are present out of the 11 big banks in Hungary

Bank presence is at least **weakly limited in 75 per cent of the districts**

- no more than 4 banks are present out of the 11 big banks in Hungary

Distribution of branches among districts





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# Related literature

## Discrete choice models

McFadden (1973, 1974, 1977, 1978, 1978b, 1987, 2001)  
Train (2002)  
Berry (1994)  
BLP (1995, 2004)  
Nevo (2001)

Follow the methodology  
described in McFadden (1973)

## Discrete choice models on bank choice with aggregate data

Dick (2002)  
Molnár et al. (2007)  
Holló (2010)

Depart from models with  
aggregate data to utilize the  
information in micro data that I  
access

## Discrete choice models on bank choice with micro data

Rachlis & Yezer (1993)  
Phillips & Yezer (1996)  
Follain (1990)

Do not concentrate on sample  
selection issues  
Results cannot be applied if the  
population of potential mortgage  
owners change considerably





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# Dataset

## Sample banks



## Data source



## Variable set

### Demography

Age  
Wage  
Location



### Terms of contract

Loan size  
Term  
Interest rate  
Value of collateral



### Bank related

Granting institution  
Branch network



11 big banks in the sample  
After data cleaning remained:  
7 banks  
19420 observations

Hungarian Credit Registry  
New dataset  
Big part of dataset cannot  
be used due to data issues

Data on individual level  
Year:2015

# Conditional logit model

**Utility maximizing consumer** choose the option which maximizes his utility:

$$U_{ij} > U_{ik} \quad \forall j \neq k$$

Utility can be written as a function of **alternative specific and individual specific characteristics** plus a taste shock:

$$U_{ij} = V_{ij}(x_{ij}, s_i) + \varepsilon_{ij},$$

The probability that a consumer chooses a given option depends on the differences between the observed characteristics (alt. spec. & indiv. spec.) and on the differences between taste shocks:

$$P_{ij} = P(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik} \quad \forall j \neq k) = P(\varepsilon_{ik} < V_{ij} - V_{ik} + \varepsilon_{ij} \quad \forall j \neq k)$$

The function of the observed characteristics can be estimated by a linear equation:

$$V_{ij} = x'_{ij}\beta + D_{ij}s'_i\gamma$$

Finally, the probability of consumer  $i$  chooses option  $j$  can be written as:

$$P_{ij} = \frac{e^{\hat{x}'_{ij}\beta + D_{ij}s'_i\gamma}}{\sum_k e^{\hat{x}'_{ik}\beta + D_{ik}s'_i\gamma}}$$



# Different target segments in mortgage lending

## Targeting affluent vs. mass clientele

There are relevant differences among banks' clientele

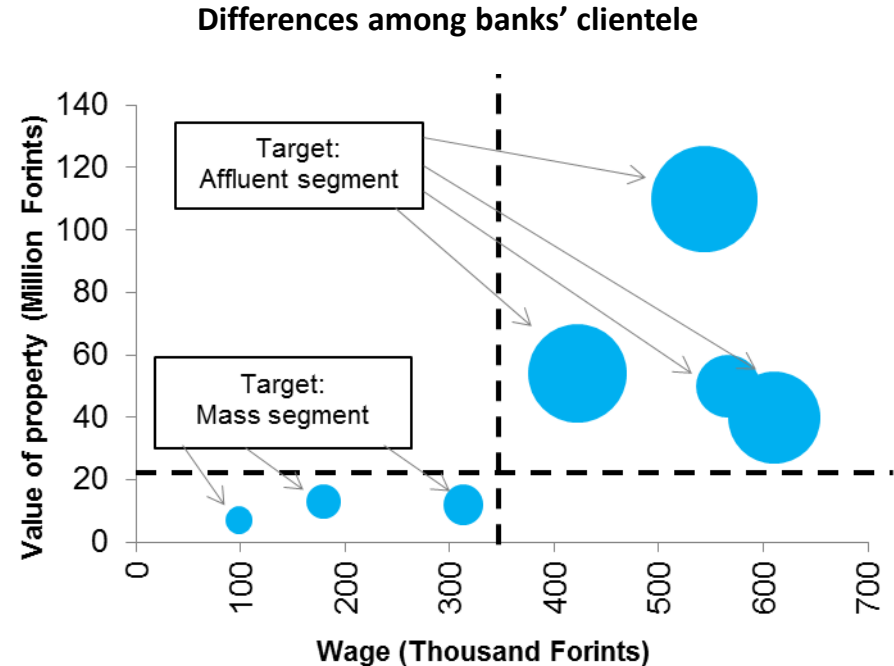
Part of Bank strategies can be pinned down by the **distributions of clients' wage, value of property and loans size:**

One group of banks targets **mass segment:**

- low wage
- cheap property
- small loans

Other group targets **affluent segment:**

- high wage
- expensive property
- large loans



Source: Credit Registry, own calculations

Note: size of circle reflects the size of average loans

Banks serve only a restricted group of clients

Clients face financial constraints

# Restrictions on choice sets

Restrictions are based on differences among banks' clientele (financial and geographic constraints)

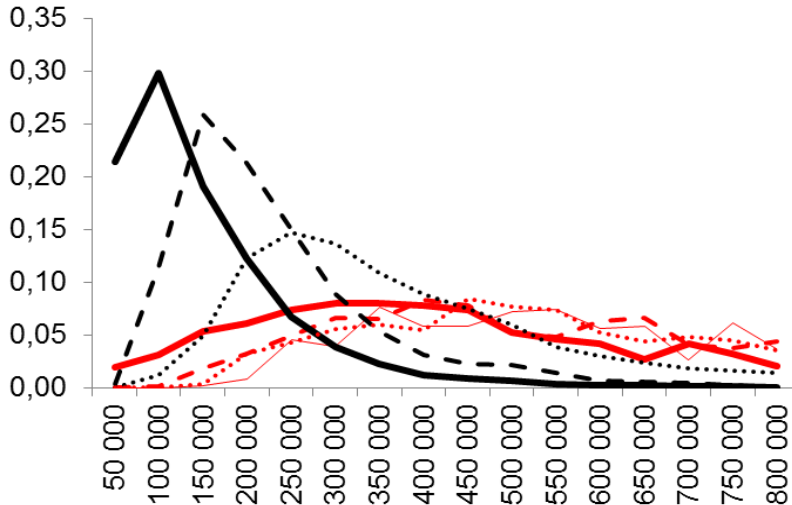
To estimate the minimum a **biased estimator is used: 5th percentile**

Reason: lack of data around minimum, difficult to find true minimum

To test the sensitivity of results to this estimator, results are also calculated with 1st percentile – No material difference

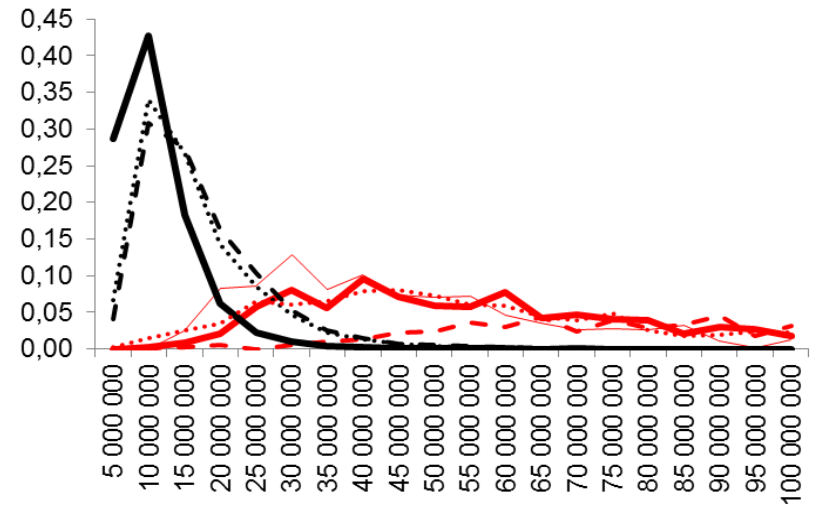


Distribution of customers' wage by banks



Source: Credit Registry, own calculations

Distribution of customers' value of property by banks



Source: Credit Registry, own calculations

# Estimating theoretical interest rates

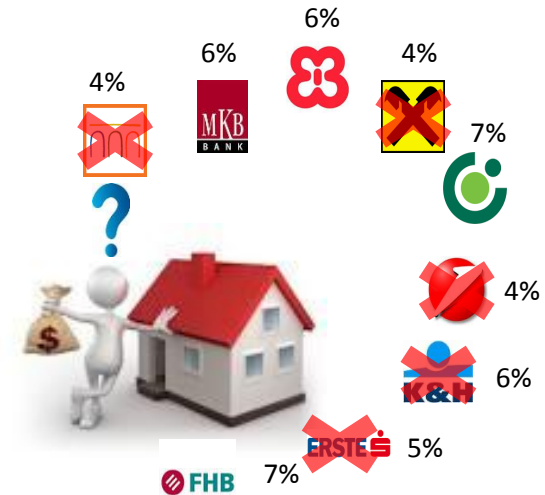
All the variables used in the model are observed except interest rates

Theoretical interest rates should be estimated:

$$interest_{ij} = x_i' \beta_j + \epsilon_{ij},$$

Separate models are estimated for all the banks to **mimic scoring models**

- Models are based on consumers' characteristics



**Self selection** can be an issue, however I argue that banks follow a similar approach:

## Banks' approach

1. Estimate **probability of default** based on individuals' characteristics
  - Assign a score based on the probability
  - Scale this score to get an interest rate
2. Use loans only from **own portfolio**
3. Use the same model to price an „unlikely consumer” also



## My approach

1. Estimate **interest rate directly** based on individuals' characteristics
2. Use loans only from **own portfolio** (2015)
3. Use the same model to price all consumers (including unlikely ones)
  - Rule out unlikely consumers by restricting choice sets

# Exogeneity and endogeneity issues

## Exogeneous variation comes from...

...Frictions in bank presence due to costs of establishing/closing branches

- compensation to layed off employees,
- penalties due to terminating contracts of renting

Frictions lead to exogeneous variation in bank presence among districts

Variation between interest rates of two identical consumers in different districts is due to **difference in bank presence** that is **exogeneously determined**

## Ruling out endogeneity

Introducing **bank fixed effects** rules out most of the concerns regarding endogeneity

E.g. No strong brand problem



# Limitations of the model

## Independence from Irrelevant Alternatives (IIA)

Material issue during simulations only

- Including demographic patterns to control for substitution patterns (tastes)
- Including choice restrictions to control for unlikely choices

By these controls estimations remain plausible

## Lack of outside option

Everyone is forced in the sample to choose one mortgage

Plausible until out of sample predictions are made

**Results are valid unless the group of potential mortgage owners changes considerably**





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# Results

Model is estimated with **bootstrapping to adjust error term** due to the uncertainty when estimating interest rates (100 replications)

Results show that interest rate, number of branches in the district and history with the given institution are important in individuals choices

Results – alternative specific variables

| BANKS | VARIABLES            | Full choice set         |                        |                         |                         | Restricted choice set  |                          |                         |                         |
|-------|----------------------|-------------------------|------------------------|-------------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------------|
|       |                      | No Taste                | Taste                  | No Taste                | Taste                   | No Taste               | Taste                    | No Taste                | Taste                   |
|       | <b>interest</b>      | 0.171***<br>(0.0222)    | -1.262***<br>(0.124)   | -0.0176<br>(0.0325)     | -1.182***<br>(0.135)    | -0.862***<br>(0.0749)  | -1.640***<br>(0.166)     | -1.042***<br>(0.0987)   | -1.539***<br>(0.185)    |
|       | <b>branch number</b> | 0.0221***<br>(0.000617) | 0.000881<br>(0.000707) | 0.0136***<br>(0.000854) | 0.00213**<br>(0.000959) | 0.0181***<br>(0.00133) | 0.00762***<br>(0.000707) | 0.00843***<br>(0.00156) | 0.00971***<br>(0.00114) |
|       | <b>history</b>       |                         |                        | 3.037***<br>(0.0237)    | 2.750***<br>(0.0240)    |                        |                          | 2.502***<br>(0.0422)    | 2.750***<br>(0.0357)    |

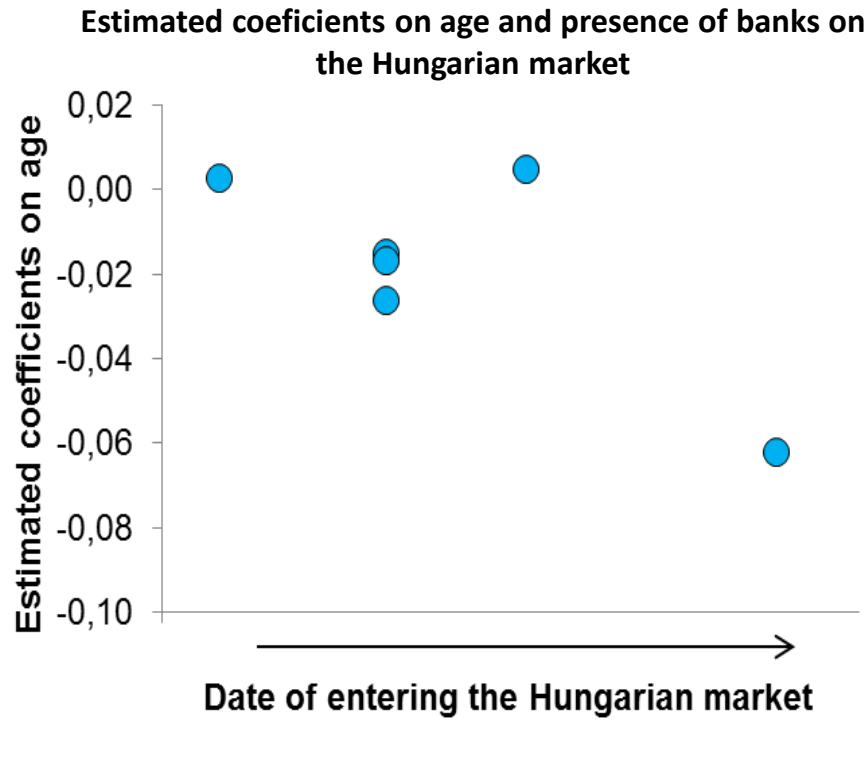
Results become plausible if restrictions on choice sets and/or demographic variables are introduced  
 → these factors matter in true decisions

# Results – taste patterns

Demographic variables interacted with bank dummies are also important in understanding choices

There are **taste patterns** observable based on the estimated coefficients

One particular pattern is that **older customers prefer banks that are present on the market for longer time**, while **younger customers prefer younger banks**





# Policy implications

## Interest rate channel

Change of branch network may affect interest rates  
Transmission mechanism may be affected through **interest rate channel**

## Demand and Supply effects

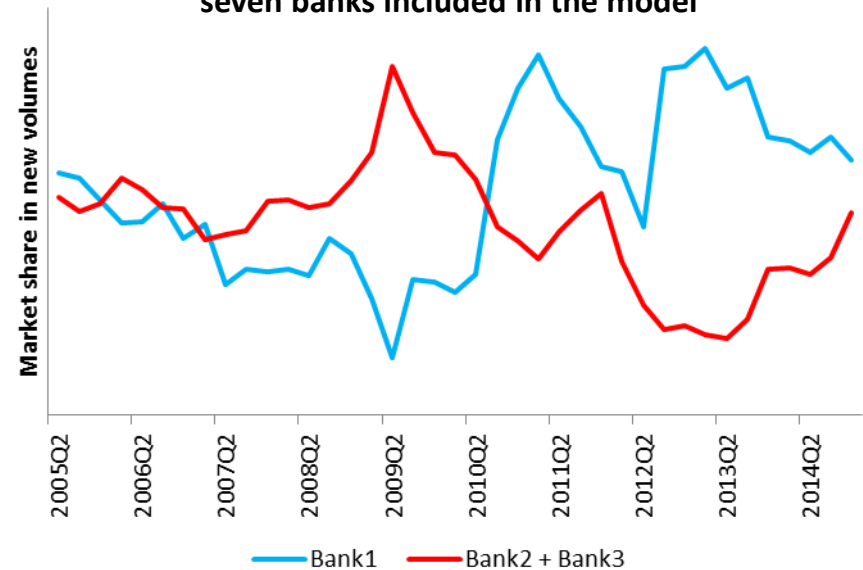
Changing supply of different banks have **different effect on separate groups of consumers**  
Changing demand of different consumer groups may **affect banks differently**

## Detect groups of competitors

**Own and cross price elasticities** can be estimated  
**Groups of main competitors** can be detected

A **nested logit** model would also allow market simulations – it is a potential development of this model

Market share of three competing banks among the seven banks included in the model



# Conclusion

**Consumers do care about interest rates** (negative and significant coefficient on interest rates)

However consumers **focus on some particular banks** only according to their tastes, hence banks have room for monopolistic competition

Results become plausible when restrictions on choice sets and/or demographic variables are introduced

This change in the coefficients highlight that **restrictions matter in the true decisions**

These results can partially explain the micro structure and high spreads on the market

Deeper analysis of the **transmission mechanism**, analyzing the effects of **consumers' demand** and **banks' supply**, and **detection of main competitors** are some potential policy implications



# Thank you for your attention!



# Appendices



# Robustness checks

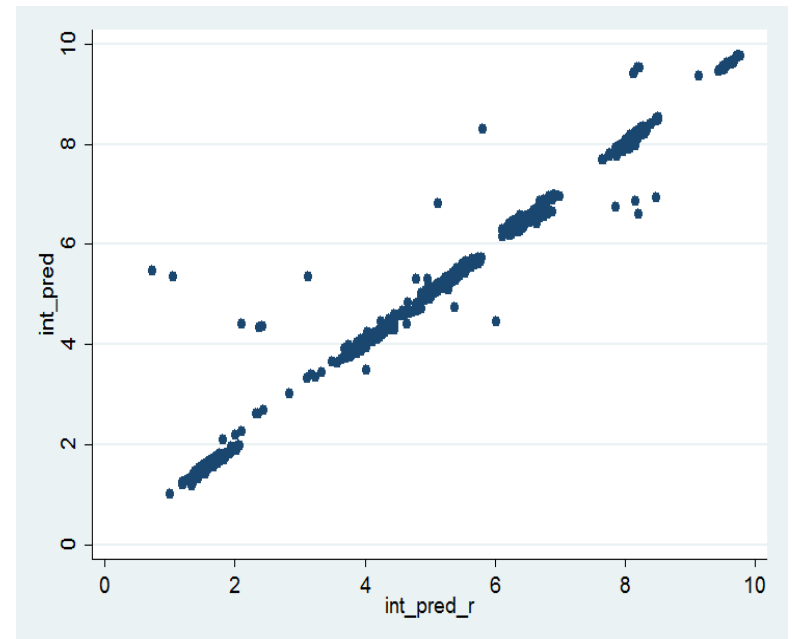
## Test interest rate models out of sample

Original sample is cut to two parts: Estimating sample and testing sample  
Out of sample predictions are made for interest rates  
Results lie on 45 degree line → estimations are precise

## Restrict choice sets based on 1st percentile

Results are not materially different from the original results

Out of sample predictions of interest rate



Source: Credit Registry, own calculations



# Results

| BANKS         | VARIABLES     | Full choice set |            |           |            | Restricted choice set |            |            |            |
|---------------|---------------|-----------------|------------|-----------|------------|-----------------------|------------|------------|------------|
|               |               | No Taste        | Taste      | No Taste  | Taste      | No Taste              | Taste      | No Taste   | Taste      |
|               | interest      | 0.171***        | -1.262***  | -0.0176   | -1.182***  | -0.862***             | -1.640***  | -1.042***  | -1.539***  |
|               | branch number | 0.0221***       | 0.000881   | 0.0136*** | 0.00213**  | 0.0181***             | 0.00762*** | 0.00843*** | 0.00971*** |
|               | history       |                 |            | 3.037***  | 2.750***   |                       |            | 2.502***   | 2.750***   |
| <b>Bank A</b> | age           |                 | 0.00311    |           | 0.00563    |                       | 0.00956    |            | 0.0167**   |
|               | wage          |                 | 1.142***   |           | 1.213***   |                       | 0.401***   |            | 0.430***   |
|               | constant      |                 | -6.447***  |           | -6.015***  |                       | -2.614***  |            | -1.945***  |
| <b>Bank B</b> | age           |                 | -0.0266*** |           | -0.0115**  |                       | -0.0153    |            | -0.00750   |
|               | wage          |                 | 1.326***   |           | 1.332***   |                       | 0.428***   |            | 0.425***   |
|               | constant      |                 | -10.22***  |           | -9.233***  |                       | -3.936***  |            | -2.947***  |
| <b>Bank C</b> | age           |                 | -0.0155*** |           | -0.00626** |                       | -0.0149*** |            | 0.00206    |
|               | wage          |                 | 0.979***   |           | 1.032***   |                       | 0.439***   |            | 0.441***   |
|               | constant      |                 | -3.337***  |           | -2.895***  |                       | -1.705***  |            | -1.195***  |
| <b>Bank D</b> | age           |                 | -0.0623*** |           | -0.0511*** |                       | -0.0747*** |            | -0.0632*** |
|               | wage          |                 | 1.270***   |           | 1.289***   |                       | 0.523***   |            | 0.515***   |
|               | constant      |                 | -5.198***  |           | -4.584***  |                       | -0.590*    |            | 0.283      |
| <b>Bank E</b> | age           |                 | -0.0165*** |           | -0.00558*  |                       | -0.0180*** |            | -0.00227   |
|               | wage          |                 | 0.480***   |           | 0.540***   |                       | 0.0768**   |            | 0.146***   |
|               | constant      |                 | -2.626***  |           | -2.676***  |                       | -1.362***  |            | -1.509***  |
| <b>Bank G</b> | age           |                 | 0.00544    |           | 0.0136***  |                       | 0.00448    |            | 0.0129*    |
|               | wage          |                 | 1.245***   |           | 1.275***   |                       | 0.504***   |            | 0.502***   |
|               | constant      |                 | -7.052***  |           | -6.388***  |                       | -2.897***  |            | -1.948***  |