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How do banks and households manage interest rate risk?

Evidence from mortgage applications and banks' responses

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Disclaimer: The following empirical results are based on ongoing data analyses and are not to be considered final. The purpose of presenting them here as is is to stimulate discussion.

The usual disclaimer applies that none of the preliminary views expressed here are those of the Bank of England, or any other institution.

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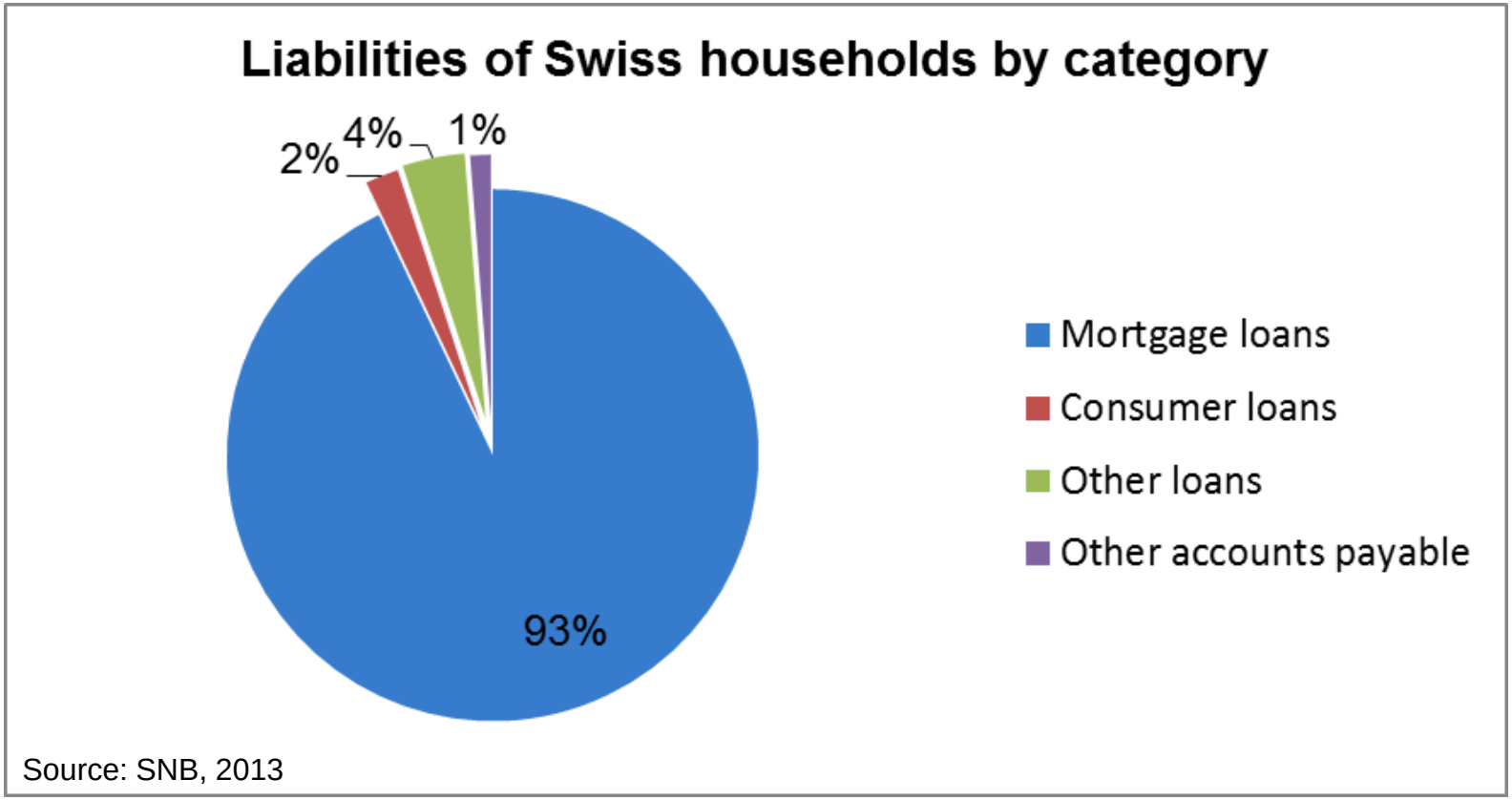
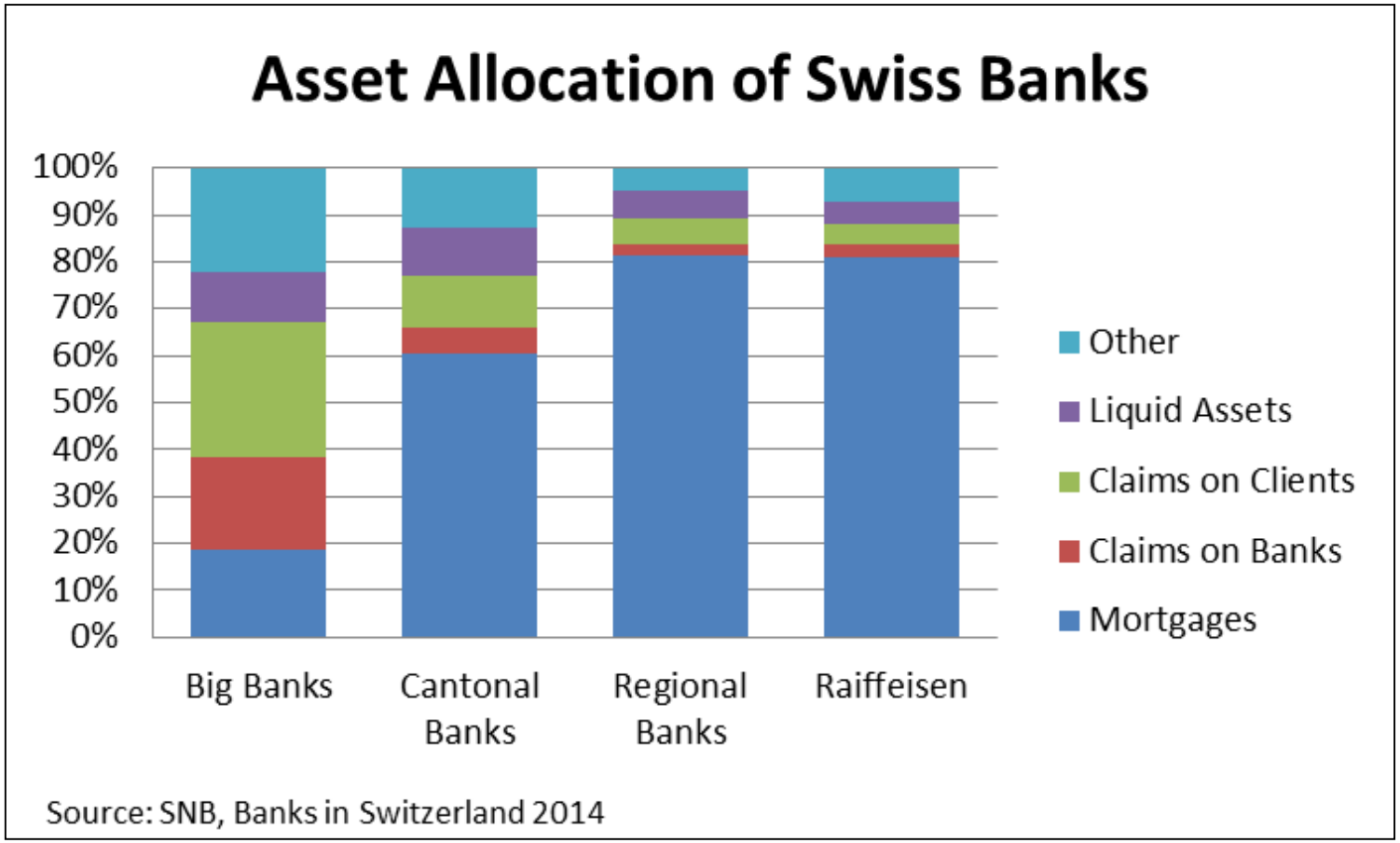
1. Motivation

Motivation (1): Mortgages are households' key liability

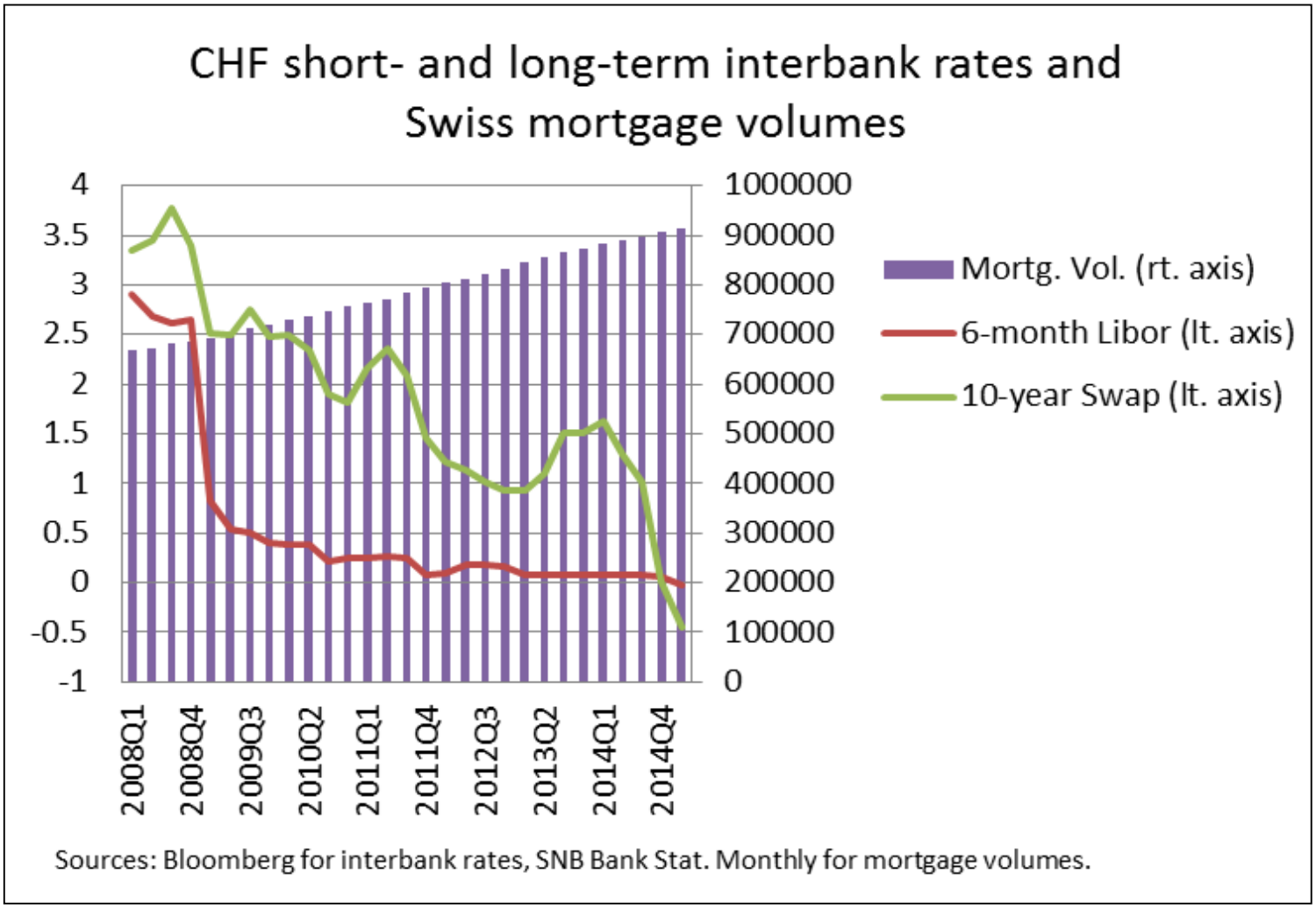


Source: SNB, 2013

Motivation (2): Mortgages are commercial banks' key asset



Motivation (3): Low rates and growing mortgage volumes



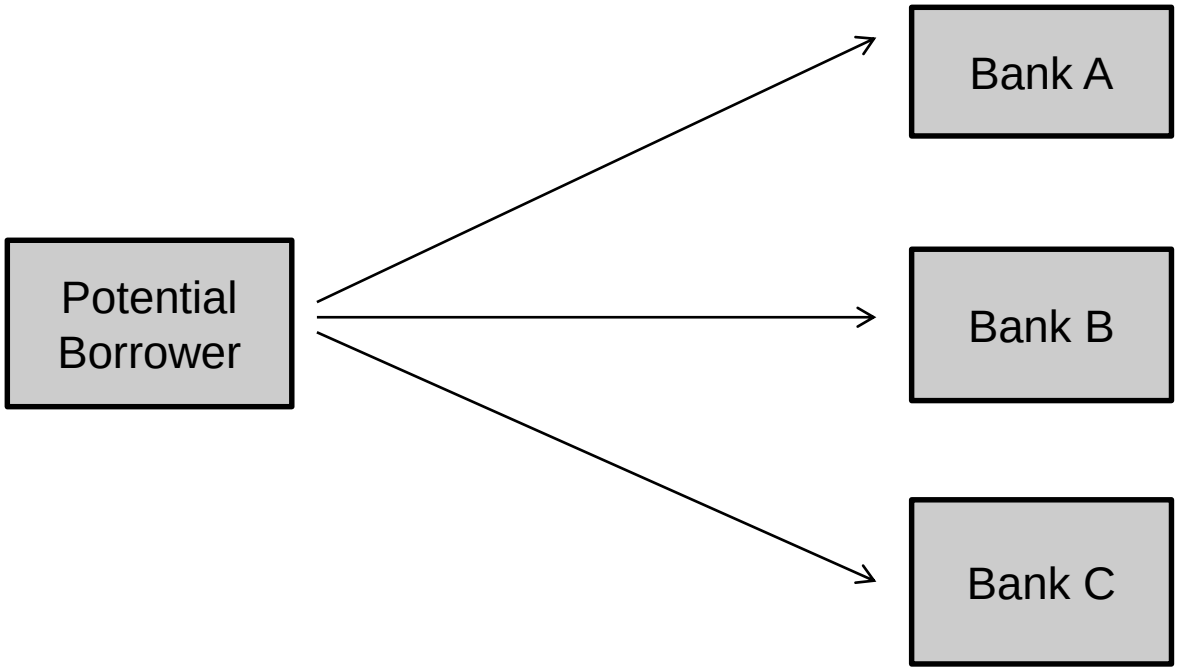
Who chooses fixation periods (FPs) and how?

- **"Mortgage Choice" Literature** (HH Finance) **assumes** it's entirely HHs' choice; Can't distinguish influence of lenders vs. borrowers, as at best contracts observed; Analyze:
  - Term premium, markup for longer FPs (Koijen &al, JFE, 2009; Badarinza &al, MS, 2017)
  - Vulnerability to rate hikes (Campbell & Cocco, QJE, 2003)
  - HH-specific ability/willingness to buy insurance (Rampini & Viswanathan, mimeo, 2018)

- **Banking Literature**:
  - Santomero (JF 1983): Shifting IRR to vulnerable households increases **Credit Risk**
  - Drechsler et al (2018): **IRR management** should see deposits as fixed-rate liability

2. Data

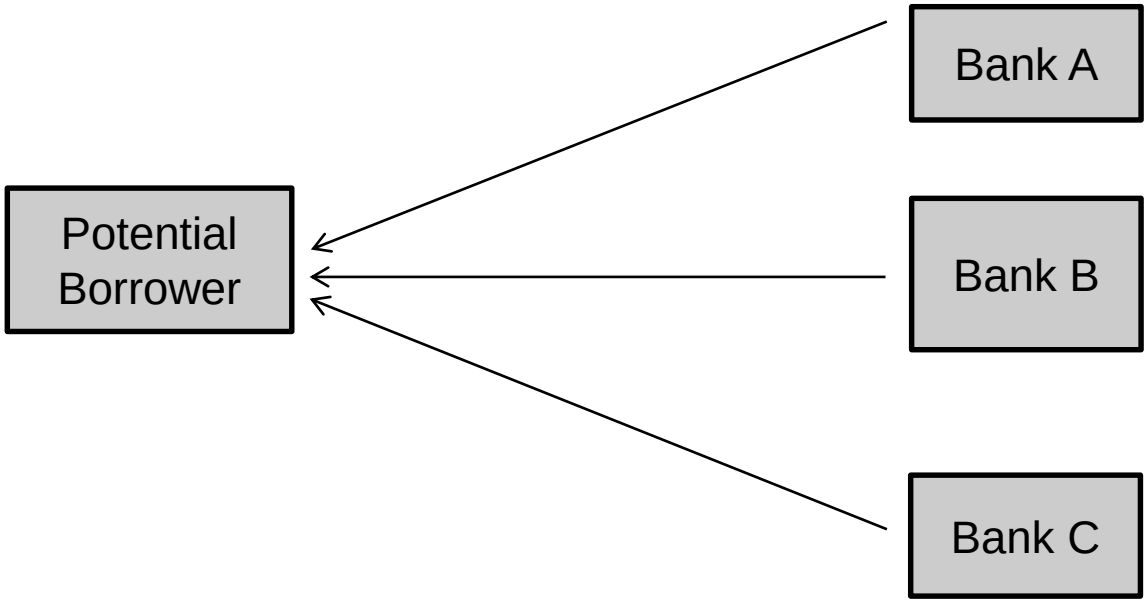
Mortgage data (1): Each application seen by multiple banks



11'961 mortgage applications from 2008-2013 that include:

- Property information (size, age, location)
- Borrower information (income, wealth, pension savings, debt)
- Loan amount requested
- **Requested Fixation period (RFP)**

Mortgage data (2): Multiple banks send responses



39’692 bank responses that include:

- Offer or Rejection
- Offered Fixation period (OFP)
- Offered Spread = Rate – (FP-congruent Swap Rate)

Mortgage data (3): Advantages

- By observing responses from multiple banks to each applicant,
  rule out endogenous matching between lenders & borrowers
- Since Khwaja & Mian (2008) standard in work on corporate loans, **new** for mortgages
- All banks get same information as us -> **Close down "soft information"**
- Can **isolate FP preferences** of both households and banks
- **Close down "advice channel"** through verbal dialogue in branches (Foa & al., 2017)

Add key bank characteristics

- Deposits / Total Assets
- Total Assets
- Equity / Total Assets

3. Household Behavior: Hypotheses, Strategy & Results

Household Behavior: Hypothesis

- Switzerland's last **mortgage crisis** in 1990s arguably triggered by **rate increases**
- Floden et al (2017) show for Sweden how much **households have to cut down on consumption after rate increases** if they hold Adjustable Rate Mortgages (ARM)
- Campbell & Cocco (2003) show how **FRMs can protect households against the need to default** after rate increases – all the more relevant in Europe, where banks have full recourse to mortgage borrowers' future wealth…

***Hypothesis 1:* Households tend to request mortgages with a longer fixation period (FP) if they report a higher Loan-to-Income (*LTI*) ratio.**

Household Behavior: Counter-Arguments

- Kuchler & Zafar (forthc. in JF) show that households can have **short memories** …
- Rampini & Viswanathan (2018) show that often those households most vulnerable to risks insure the least because they **prioritize moving consumption forward** over insuring against bad situations in the future…

Household Behavior: Empirical Strategy

$$RFP_{i,t}=\alpha+LTI_i'\beta_1 + LTV_i'\beta_2 + \beta_3 Rates_t + Z_i'\beta_3 + \varepsilon_{i,t} \qquad (1)$$

$RFP_{i,t}$: Requested fixation period of borrower i at point in time t.

LTI_i: Vector of dummies for Loan-to-Income (LTI) ratios > 4.5 and > 5.5

LTV_i: Vector of dummies for Loan-to-Value (LTV) ratios >67% and >80%

$Rates_t$: Rate on 3-month Libor, and term premium for 10-year mortg. rate

Z_i: Vector of other HH controls: Labor income, rental income, other income, age, household total wealth, household financial wealth, dummy for other real estate, dummy for debt, property age, property type, canton FE, year*month FE.

Household Behavior: Results

	(1)	(2)	(3)	(4)	(5)	(6)
I(LTI>4.5)	0.198**	0.268***	0.254***	0.354***	0.247**	0.007
I(LTI>5.5)	-0.286**	-0.269**	-0.399***	-0.639***	-0.416***	-0.268
I(LTV>67)	0.023	0.029	0.036	-0.028	-0.148	-0.086
I(LTV>80)	-0.362***	-0.315***	-0.297***	-0.306**	-0.291**	-0.209
Avg. Rate on 3m Libor Mortg.	-1.128***	-1.112***	-1.103***	1.649	-1.045***	-1.078***
10y-3m Mortg. Rates	-0.918***	-0.910***	-0.897***	-1.386***	-0.858***	-0.888***
	…	…	…	…	…	…
Constant	10.960***	10.911***	11.465***	10.101***	12.198***	10.505***
Observations	11'961	11'961	11'961	6'952	6'149	5'812
R2	0.112	0.085	0.083	0.051	0.062	0.073
Year*Month FE	Yes	No	No	No	No	No
House Type FE	Yes	No	No	No	No	No
Years	2008-13	2008-13	2008-13	2010-13	2008-13	2008-13
Sample	New & Refin	New & Refin	New & Refin	New & Refin	Only New	Only Refin
LTI4.5+LTI5.5	-0.09	0	-0.15	-0.29**	-0.17	-0.26*

Household Behavior: Summary

- Overall the 25% of households with LTI ratios >= 4.5 demand longer FPs
- **But the 9% of households with LTI ratios >= 5.5 demand shorter ones**
- Does the latter reflect households who (maybe justifiably) expect growing incomes? Then unclear why correlation between LTIs and FPs positive at 4.5 threshold
- More likely: **Those with tightest budgets prioritize drawing consumption forward**
- Might also just deem rate increases sufficiently unlikely, given “short memories”; But unclear why top-LTI HHs would deem them more unlikely than medium-LTI ones

4. Bank Behavior: Hypotheses, Strategy & Results

Bank Behavior: Hypotheses on Borrower Characteristics

- Already Santomero (JF, 1983) pointed out: Variable rate loans increase the bank's credit risk unless borrower income happens to increase when rates do
- We clarify that this is particularly pronounced with tighter budgets:

Hypothesis 2: Banks tend to prefer mortgages with longer fixation periods (FPs) if borrowers report a higher Loan-to-Income (LTI) ratio.

Bank Behavior: Hypotheses on Lender Characteristics

- *Fuster & Vickery (2015)* and *Foa et al (forthcoming)* showed that contracted fixation periods do instead vary systematically with bank characteristics

- Traditionally expect that more deposit funding shortens liability maturities, so limiting maturity mismatch and IRR calls call to also shorten asset maturities, so posit:

Hypothesis 3: Banks for whom a larger fraction of liabilities consists of deposits will ceteris paribus prefer to grant shorter mortgage rate fixation periods.

- *Drechsler et al (2018)* have more recently posited: Deposits have *contractually short*, but *effectively long* fixation periods -> More deposit-dependence calls for *shorter FPs*

- We let the data speak how Swiss banks decide in practice …

Bank Behavior: Empirical Strategy

$$\mathrm{OFP}_{b,i,t} = \alpha + \mathrm{LTI}_i\ '\beta_1 + \mathrm{LTV}_i\ '\beta_2 + \mathrm{RFP}_i\ '\beta_3 + \mathrm{Borr}_i'\gamma + \delta\left(\frac{\mathrm{Dep}}{\mathrm{TA}}\right)_{b,t-1} + \mathrm{Bank}'_{b,t-1}\xi + \varepsilon_{b,i,t} \quad (2)$$

$OFP_{b,i,t}$: Offered Fixation Period from bank b to household i on day t

LTI_i : Vector of dummies of i's PTI level.

LTV_i : Vector of dummies of i's LTV level.

RFP_i : Requested Fixation Period of application i.

Borr_i: Further borrower characteristics as specified in Equation (1)

Dep/TA : Fraction by which bank b is financed through deposits.

$Bank_{b,t}$: Further characteristics of bank b in period t: ln(TA), Equity/TA

Bank Behavior: OFPs

	(1)	(2)	(3)	(4)
Requested Fix Period	0.937***		0.937***	
I(LTI>=4.5)	0.036***	0.296***	0.036***	0.295***
I(LTI>=5.5)	0.002	-0.412***	0.002	-0.411***
I(LTV>=67)	0.023***	0.066**	0.022***	0.067**
I(LTV>=80)	0.019	-0.338***	0.022	-0.324***
Labor Income (ln)	0.009	-0.067*	0.012	-0.065*
Age	-0.001***	-0.040***	-0.001***	-0.040***
HH Total Wealth (ln)	0.011***	0.156***	0.011***	0.156***
Deposits/TA	0.001	0.007***		
Bank Total Assets (ln TA)	-0.004*	-0.002		
Equity/TA	-0.016***	-0.014		
Constant	0.755***	8.913***	0.641***	9.387***
Observations	39,692	39,692	39,692	39,692
R2	0.953	0.145	0.954	0.148
Year*Month FE	Yes	Yes	Yes	Yes
Canton & House Type FE	Yes	Yes	Yes	Yes
Bank FE	No	No	Yes	Yes

1. Banks choose even longer FPs than applied for when LTI>=4.5
2. But they fail to correct short-FP preferences of HHs with LTI>=5.5
3. Contrary to Hypothesis 3, more deposit-dependent banks offer ***longer FP!***

Bank Behavior: Empirical Strategy

$$Spread_{b,i,t} = \alpha + RFP_i * LTI_i\,'\beta_1 + LTI_i\,'\beta_2 + LTV_i\,'\beta_3 + RFP_i\,'\beta_4 + Borr_i'\gamma + \delta_1 RFP_i * (\frac{Dep}{TA})_{b,t-1} + \delta_2 (\frac{Dep}{TA})_{b,t-1} + Bank'_{b,t-1}\xi + \varepsilon_{b,i,t} \quad (3)$$

$Spread_{b,i,t}$: Offered rate – FP-congruent CHF interest swap rate on the same day

LTI_i : Vector of dummies of i's LTI level.

LTV_i : Vector of dummies of i's LTV level.

RFP_i : Requested Fixation Period of application i.

$Borr_i$: Further borrower characteristics as specified in Equation (1)

Dep/TA : Fraction by which bank b is financed through deposits.

$Bank_{b,t}$: Further characteristics of bank b in period t: ln(TA), Equity/TA

- As Corr(OFP,RFP)>0, positive coefficients on RFP proxy term premium
- **Interactions of RFP with LTI and Dep/TA proxy how term premium varies with them**

Bank Behavior: Spreads

	(1)	(2)	(3)	(4)
Requested Fix Period	-0.036***		-0.039***	
RFP*I(LTI>=4.5)	-0.003***		-0.003***	
RFP* I(LTI>=5.5)	0.002		0.002	
I(LTI>=4.5)	0.034***	0.013***	0.032***	0.011***
I(LTI>=5.5)	-0.013	0.001	-0.018	-0.002
I(LTV>=67)	0.016***	0.016***	0.015***	0.015***
I(LTV>=80)	0.018***	0.017***	0.016***	0.015***
Labor Income (ln)	-0.018***	-0.018***	-0.018***	-0.018***
Age	0.000***	0.000***	0.000***	0.000***
HH Total Wealth (ln)	-0.008***	-0.008***	-0.008***	-0.007***
RFP*(Deposits/TA)	0.001***		0.001***	
Deposits/TA	-0.008***	-0.004***		
Bank Total Assets (ln TA)	-0.020***	-0.020***		
Equity/TA	0.005***	0.005***		
Constant	1.949***	1.691***	1.389***	1.401***
Observations	39,692	39,692	39,692	39,692
R2	0.372	0.367	0.424	0.416
Year*Month FE	Yes	Yes	Yes	Yes
Canton & House Type FE	Yes	Yes	Yes	Yes
Bank FE	No	No	Yes	Yes

1. Pricing confirms OFP results on responses to LTI: Lower term premiums for LTI>=4.5, but **don't lower term premium more for LTI>=5.5**

2. While more deposit-dependent banks offered longer FPs, they charge higher term premiums **-> To evaluate Hypothesis 3, we must dig deeper….**

Bank Behavior: Controlling for Selectiveness of Offers

- Observe OFP and Spread only when bank makes an offer -> Selective?

- Heckman (1979) procedure:
  1. Estimate propensity of offers as function of all regressors above plus “instrument”
  2. Then repeat the above regressions while controlling for selection

- “Instrument”: A variable that influences offering but not our outcomes of interest
- We use indicator for **“Home Territory” = canton of bank HQ or direct neighbor:**
  - Most banks use online channel specifically to lend to new regions (Basten and Ongena mimeo 2019); Could also lower prices for distant clients
  - But no reason to prefer distant FPs for more distant customers as IRR management independent of location

Bank Behavior: Heckman Estimation

	(1) OFP	(2) OFP	(3) Spread	(4) Spread
Requested Fix Period	0.932***		-0.026***	
RFP*I(LTI>=4.5)			-0.003**	
RFP*I(LTI>=5.5)			0.005***	
I(LTI>=4.5)	0.078***	0.403***	0.060***	0.042***
I(LTI>=5.5)	0.140***	-0.040	0.055***	0.103***
I(LTV>=67)	0.033***	0.090***	0.022***	0.023***
I(LTV>=80)	0.182***	0.098	0.124***	0.136***
Income (main) (ln)	0.026***	-0.018	-0.006*	-0.005
Age	-0.001**	-0.038***	0.001***	0.001***
Ln(Total Wealth)	-0.008	0.104***	-0.020***	-0.022***
RFP*(Deposits/TA)			0.000***	
Deposits/TA	0.003***	0.013***	-0.005***	-0.003***
Ln(Total Assets)	-0.005	-0.003	-0.020***	-0.020***
Equity/TA	-0.009***	0.006	0.010***	0.011***
Constant	0.306***	6.695***	1.870***	1.662***
Observations	48'812	48'812	48'812	48'812
Lambda	-0.430***	-1.143***	-0.281***	-0.311***

1. Here banks propose longer **OFPs** also for LTI>=5.5 now
2. But «blind eye» to insurance needs of those with LTI>=5.5 strengthened in pricing: **Term premiums** not only not lower, but higher
3. Positive effect of deposit dependence on **OFPs** strengthened
4. Neg. effect on term premium discounts weakened

Bank Behavior: Summary

- Results for I(LTI>=4.5) support ***Hypothesis 2***, but those for I(LTI>=5.5) reject it: Banks fail to nudge top-LTI households into longer fixation periods, presumably because they fear their offers are not accepted then

- Results for (Deposits/TA) overall reject ***Hypothesis 3*** and support instead recent arguments by Drechsler et al (2018) and Carletti et al (2019): Banks seem to consider deposits a long-term liability, so more deposit-financing associated with a strife for ***longer*** mortgage rate fixation periods

5. Conclusion

Conclusion

- Our paper rejects implicit assumption of existing «Mortgage Choice» literature: Find that both household and bank characteristics matter for banks' OFPs and offered term premiums also after accounting for RFPs!

- Households who need more IRR insurance get more, but those who arguably need the most get less -> Emphasis on current consumption.

- Banks do push for longer fixation periods when LTI>=4.5 also beyond households' own choices, but are not willing to push also LTI>=5.5 households.

- Banks with more deposit-financing tend to offer longer, rather than shorter, fixation periods, in line with the arguments in Drechsler et al (2018) that deposits are effectively fixed-rate.