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How Risky are Residential Mortgages in Switzerland?

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1. Background

The Swiss housing market has experienced significant developments over the past decade. Home ownership rates, still low by European standards, increased from 34.6 in 2000 to 36.8 percent in 2011.[1] During the same period, buying prices for single-family houses and condominiums experienced a cumulative increase of 51% and 74% respectively.[2] The increase in home ownership and the rise in house prices have arguably been fuelled by historically low interest rates. Rising incomes and immigration have put additional pressure on housing demand, especially in the urban agglomerations.[3] Mirroring these developments in the real estate market, the volume of mortgage lending by banks has increased from 462 billion CHF in 2000 (106% of GDP) to 860 billion CHF (145% of GDP) in 2012.[4]

In light of the above developments, policymakers have expressed deep concern that an increase in interest rates or a downward correction of house prices may compromise financial stability.[5] Exposure to credit risk from mortgage lending is of first-order importance for the Swiss banking sector as mortgage loans dominate the domestic asset-holdings of almost all banks. Since 2012 two macroprudential measures were introduced, aimed at mitigating credit risk in the mortgage market. In July 2012 the members of the Swiss Banking Association agreed to implement tighter equity requirements for mortgage borrowers requiring them to contribute at least 10% of own funds that are not part of their 2nd pillar retirement savings. In February 2013, the federal government, following a request by the Swiss National Bank, activated an anticyclical capital buffer which increased banks' capital requirements for new mortgage loans from September 2013.

The goal of this research note is to examine to what extent the concerns of Swiss regulators over developments in the housing and mortgage market are warranted. Using data on a sample of recent mortgage applications, we quantify the exposure of borrowers to potential interest-rate changes and house-price shocks.

[1] http://www.bfs.admin.ch/bfs/portal/de/index/themen/09/03/blank/key/bewohnertypen/nach_region.html
[2] http://www.wuestundpartner.com/en/publikationen/publikationen-schweiz/immobilienmarkt-schweiz.html
[3] See Degen & Fischer (2010) as well as Basten & Koch (2013) for an analysis of the impact of immigration and income growth on regional house prices.
[4] Including residential mortgages and mortgages for commercial and investment purposes http://www.snb.ch/en/iabout/stat/statpub/bchpub/stats/bankench.
[5] See for example the 2013 & 2010 Financial Stability Reports of the Swiss National Bank.

2. Drivers of mortgage default

The recent housing market crises in the U.S. and selected EU countries (e.g. Ireland or Spain) have spurred a strong interest in understanding the determinants of residential mortgage defaults (see e.g. Mayer et al., 2009). Several recent studies have explored the importance of interest rate shocks, income shocks and house-price shocks in explaining the surge of mortgage defaults in the U.S. from 2007 onwards. The picture emerging from these studies shows that the combination of all three types of shocks adversely affected the liquidity and solvency of mortgage borrowers (Demyanyk & van Hemert, 2011; Elul et al., 2010). In addition, the drop in house-prices seems to have triggered a large number of strategic defaults (Guiso et al., 2013), especially by wealthy borrowers in non-recourse states (Ghent & Kudlyak, 2011).

Given that mortgage lenders in Switzerland have full recourse to the assets and the income of defaulting borrowers, it is highly unlikely that a severe decline in house-prices, and corresponding negative home equity (i.e. a situation in which the outstanding balance on a mortgage loan exceeds the market value of the underlying property) would lead to strategic default of solvent households. Nevertheless, falling house-prices, rising interest rates or household-specific income shocks could trigger default as a result of illiquidity or insolvency (Elmer & Seelig, 1999).

Rising interest rates as well as negative income shocks (for example due to unemployment) may temporarily affect the ability of households to meet mortgage installments. Such liquidity shocks may trigger delinquencies on mortgage installments if households do not have access to alternative sources of formal credit (consumer credit, credit cards) or informal credit (families, friends). Hereby, liquidity constraints are most likely to be binding for households which are already highly leveraged (Elmer & Seelig, 1999). Severe shocks to interest rates or household income (or expenditures) may also trigger default on mortgage installments due to insolvency: households are not able to meet outstanding mortgage obligations with their expected future cash-flow.

A severe fall in house prices may trigger mortgage default due to household insolvency: households are no longer able to meet all future mortgage obligations with their expected future cash-flow. Households may still be able to meet current mortgage installments out of their net

income per month. However, house price shocks imply that a sale of the house or mortgage refinancing would not yield sufficient funds to repay the outstanding principal on the existing mortgage as the current loan contract expires.[6]

The above considerations suggest that a significant increase in interest rates lead to delinquencies on monthly mortgage installments. Interest rate risk is largest for households with a high payment-to-income (PTI) ratio, adjustable rate mortgages or fixed rate mortgages with short maturities. By contrast, severe house-price corrections may lead to defaults on final principal payments for maturing mortgage contracts. House price shocks pose a risk especially for households with high loan-to-value (LTV) ratios and no additional financial assets. Moreover, house-price shocks are most likely to lead to defaults on mortgages which are close to maturity, as these borrowers may have to refinance their mortgage before prices recover.

3. Data

The previous section suggests that a comprehensive assessment of credit risk in the Swiss mortgage market requires not only information on the distribution of mortgage affordability (PTI) and household leverage (LTV). In addition, we require information on the interest rate type and maturity of mortgages as well as on the income sources and financial assets of households. We obtain this detailed data for a sample of 295 mortgages applications processed through an independent mortgage broker in Switzerland in 2013.[7] The sample includes 206 applications for first-time mortgages and 89 applications for mortgage-refinancing.

Table 1 provides summary statistics of the households covered in our sample, and compares it to characteristics of a sample of mortgage borrowers from a representative survey as reported by Brown & Hoffmann (2013). The table shows that the households covered in our sample over-represent what are commonly viewed as the mortgage borrowers most exposed to default risk in Switzerland: young, unmarried and high-income households which are located in urban areas.

[6] Note that margin calls are not typical in Switzerland for ongoing mortgage contracts, i.e. banks do not ask existing mortgage borrowers for additional equity in case of house price depreciations.
[7] The data were analyzed under a confidentiality agreement with MoneyPark.

Table 1. Sample characteristics

This table compares the characteristics of our sample of households applying for mortgages at MoneyPark in 2013 with the characteristics of households that had a mortgage loan in a representative survey of households in German-speaking Switzerland commissioned by the University of St. Gallen in 2011. Definitions of the variables are provided in appendix 1.

	MoneyPark applications		**Representative survey**	
	Mean	**Obs.**	**Mean**	**Obs.**
Household characteristics				
Age	43.85	295	49.47	581
City residence	0.52	285	0.29	581
Married	0.65	294	0.83	581
Annual income (Total household income**)**				
> CHF 180'000	0.48	295	0.09	581
CHF 144'000 - CHF 180'000	0.19	295	0.11	581
CHF 108'000 - CHF 144'000	0.17	295	0.23	581
< CHF 108'000	0.16	295	0.56	581
Financial wealth *(Liquid assets)*				
> CHF 1'000'000	0.04	295	0.03	581
CHF 250'000 - CHF 1'000'000	0.42	295	0.11	581
CHF 100'000 - CHF 250'000	0.32	295	0.22	581
< CHF 100'000	0.22	295	0.65	581

Table 2 provides summary statistics of the mortgages applied for by the households in our sample. The median first-time mortgage has a value of 663’500 CHF compared to a median property value of 945’000 CHF and a median annual household income of 181’911 CHF. For refinancing mortgages we observe a median mortgage value of 500’000 CHF compared to a median property value of 870’000 CHF and a median annual household income of 155’200 CHF.

More than half the first-time borrowers apply for two mortgage tranches, while refinancing mortgages mostly consist of one single tranche. Mortgage applications are dominated by long-term, fixed interest rate tranches. Among first-time (refinance) mortgages 82% (74%) have a fixed interest rate and 72% (58%) have a maturity of more than five years.

Table 2. Mortgage application characteristics

This table compares the characteristics of first-time mortgage applications (Panel A) and refinancing mortgage applications (Panel B). Definitions of the variables are provided in appendix 1.

Panel A. First-time mortgages (N=206)

	Mean	**Min**	**0.25 percentile**	**0.50 percentile**	**0.75 percentile**	**Max**
Total loan amount	723'386	126'000	500'000	663'500	870'000	2’244’000
Share with fixed interest rate	0.82	0.00	0.65	1.00	1.00	1.00
Share with variable interest rate	0.18	0.00	0.00	0.00	0.35	1.00
Share with maturity >5 years	0.72	0.00	0.57	0.82	1.00	1.00
Number of tranches	1.77	1	1	2	2	4
Property reference value	1'024'673	176'000	748'000	945'000	1'250'000	2'845'000
Total household income	204'836	27'000	137'859	181'911	238'600	768'000

Panel B. Refinancing mortgages (N=89)

	Mean	**Min**	**0.25 percentile**	**0.50 percentile**	**0.75 percentile**	**Max**
Total loan amount	551'749	150'000	365'000	500'000	664'000	1'342'000
Share with fixed interest rate	0.74	0.00	0.50	1.00	1.00	1.00
Share with variable interest rate	0.26	0.00	0.00	0.00	0.50	1.00
Share with maturity >5 years	0.58	0.00	0.00	1.00	1.00	1.00
Number of tranches	1.30	1	1	1	2	3
Property reference value	989'723	258'000	700'000	870'000	1'100'000	3'200'000
Total household income	179'321	50'606	108'400	155'200	205'200	810'000

4. Interest rate risk

We first assess the exposure of mortgages in our sample to interest rate risk. Figure 1 shows the distribution of payment to income (PTI) ratios for all mortgages in our sample.[8] We display three different PTI ratios which vary in their assumptions regarding financing costs and household income. The solid black line displays PTI ratios based on a calculatory interest rate of 5% p.a. on the total loan amount plus 1% p.a. upkeep on the property value. The corresponding annual payments are divided by total annual income of the household (including variable wage components and capital income). The dashed blue line displays PTI ratios in which mortgage costs additionally account for 1% p.a. amortization of the loan. Here, the PTI ratio is thus based

[8] The distributions of PTI for first-time mortgages and refinance mortgages are presented separately in Appendix 3.

on annual payments of 6% of the loan value (5% interest and 1% amortization) plus 1% on the property value for upkeep. The dotted red line displays PTI ratios again based on payments which account for interest, upkeep and amortization. Here, the total annual payments of 6% of the total loan amount plus 1% on the house value are now divided by a more conservative income measure: we exclude all capital income and variable wage components of the household and take into account only the fix wage income of the household.

Figure 1. Cumulative distribution of payment to income ratios – All mortgage applications

This figure shows cumulative distributions of payment to income ratios (PTI) for all mortgage applications. The solid black line displays the PTI distribution using an interest rate of 5% on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dashed blue line display the PTI distribution based on an installment rate of 6% (5% interest plus 1% amortization) on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dotted red line displays the PTI distribution based on an installment rate of 6% (5% interest and 1% amortization) and 1% upkeep as a share of fix wage income. Definitions of the variables are provided in appendix 1.

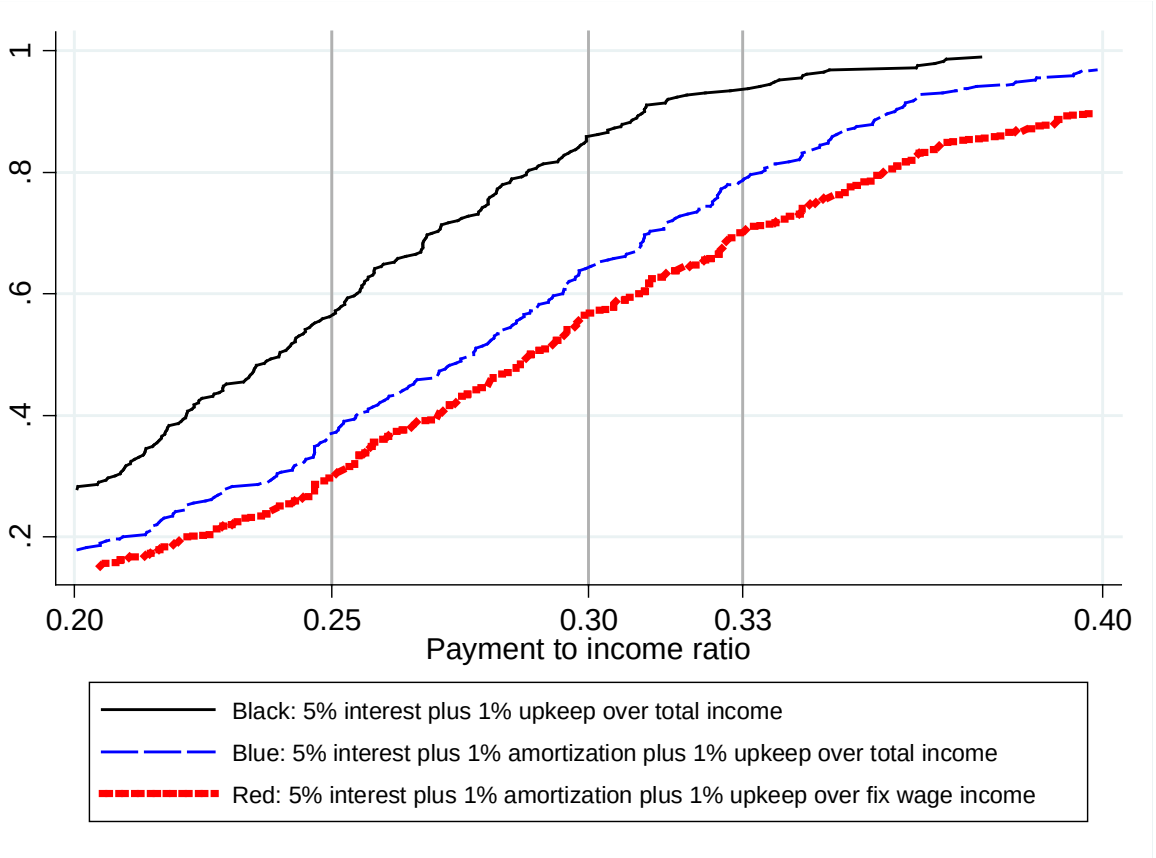


Figure 1 shows that the assessment of the interest rate risk exposure of mortgage applicants is strongly dependent on which mortgage costs and which income components are considered. At an interest rate of 5% p.a. plus 1% p.a. upkeep on the house value we find that only 8% of the mortgage applicants in our sample would face annual mortgage payments which exceed one-third of their total annual household income (solid black line). However, once we account additionally for the costs of mortgage amortization the share of households exposed to interest rate risk increases sharply. The dashed blue line shows that 23% of current applicants would have payments exceeding one-third of their income, once we additionally account for 1% p.a. amortization on their mortgage. Furthermore, when we exclude variable income components from total household income (dotted red line), and again account for costs of interest payments, upkeep of the house and amortization of the mortgage we find that 31% of all applicants would face annual payments exceeding one-third of their fix wage income.

Table 3. Characteristics of applications with high vs. low PTI ratios

This table shows the mean share of mortgage applicants asking for a variable interest mortgage (first row) and fixed interest mortgage (maturity not more than 5 years) (second row) depending on whether the payment to income ratio is above or below 33%. The last column tests the differences using univariate t-tests. The payment to income ratio is calculated using an installment rate of 6% (5% interest plus 1% amortization) on the total loan amount and 1% upkeep on the property reference value over fix wage income. Definitions of the variables are provided in appendix 1.

Variable	**PTI > 33% (N=90)**	**PTI <= 33% (N=203)**	**Difference (N=293)**
Share with variable interest rate	0.236	0.192	0.045 (0.042)
Share with fixed interest rate <= 5 years	0.101	0.130	-0.028 (0.035)

In Table 3 we consider mortgage applications as potentially exposed to interest rate shocks if total annual payments of 6% of the total loan amount plus 1% for upkeep would exceed their fix wage income by more than one-third. This is the case for 31% of the households in our sample (see dotted red line in Figure 1). In the table we examine the interest rate sensitivity of these applications and compare them to applications with low PTI ratios. Table 3 shows that mortgage applications with high PTI ratios are not more sensitive to short-term interest rate changes than applications with low PTI ratios. The share of adjustable rate mortgages is low and similar among

high PTI loans (24%) and low PTI applications (19%). Moreover, the share of medium-term fixed rate mortgages (maturity of not more than 5 years) is lower among high PTI loans (10%) than as it is among low PTI applications (13%). These findings suggests that the effective exposure to short-term or medium-term interest rate hikes is limited in our sample of mortgage applicants, and is not concentrated among households with high payment to income ratios.

5. House price risk

The exposure of mortgages to house price risk depends on the leverage of households as well as on additional asset holdings of households. Moreover, as house-price risk affects mortgages at contract expiry, the time-to-maturity of the mortgage contract also influences whether temporary or medium-term shocks to house prices may trigger default.

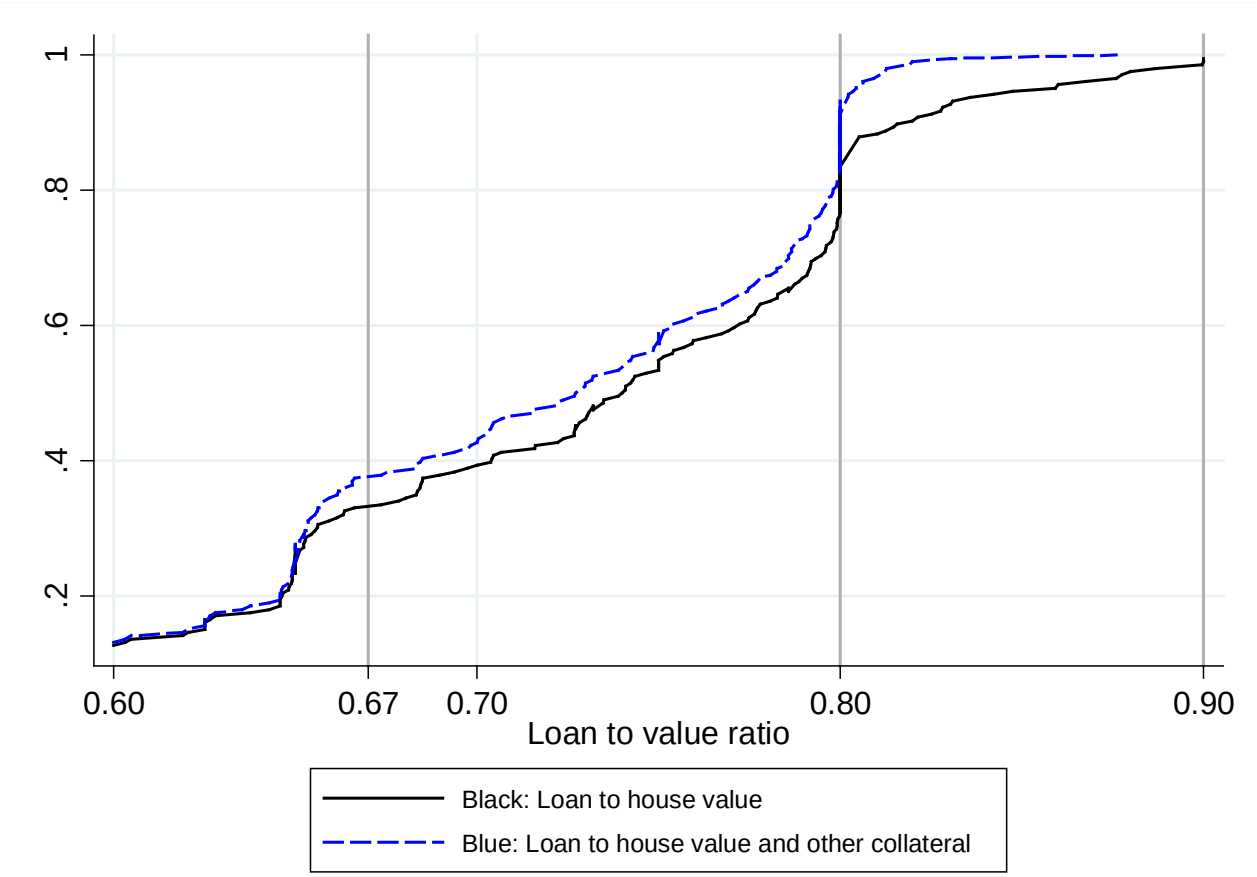
Figure 2 displays the distribution of leverage for first-time mortgages in our sample. We focus our analysis on first-time mortgages as for these applications we have a precise measure of the current market value (sales value) of the underlying property. The solid black line displays a raw loan to value (LTV) ratio, calculated as the ratio of the mortgage volume to the sales price of the property.[9] According to this measure 24% of the first-time mortgages in our sample could be considered at risk to sharp house-price corrections: they display LTV ratios of at least 80%.

The raw LTV ratio overstates the potential credit risk for lenders if mortgage borrowers pledge further collateral in addition to the mortgaged property, e.g. their pension fund, their security portfolios or life insurance. The dashed blue line in Figure 2 therefore displays the ratio of mortgage loan to the total collateral value, after adding further pledged collateral to the house value. Accounting for additional collateral we find that the share of mortgages with high leverage is reduced. Among first-time borrowers, 16% have a loan to total collateral value of 80% or more. For almost all of these households, the ratio lies between 80-85%.

[9] In appendix 4 we present the distribution of LTV ratios for refinancing mortgages.

Figure 2. Cumulative distribution of loan to value ratios - first-time mortgage applications

This figure shows cumulative distributions of the loan to value ratios (LTV) for first-time mortgage applications. The solid black line indicates the distribution of the total loan amount over the property reference value. The dashed blue line indicates the distribution of the loan to total collateral ratio, i.e. we add other collateral pledged by the borrower to the property reference value. Definitions of the variables are provided in appendix 1.



While a house price shock may impact on household net-worth, this does not imply that it will trigger a mortgage default. First, if households have long-term mortgage contracts (and do not need to sell the house for exogenous reasons) they may not need to refinance their mortgage until house prices have recovered. Second, even if households need to refinance their mortgage in the medium term, they may be able to do so if they have free (unencumbered) financial assets. Table 4 examines the loan maturity and volume of free assets for mortgage applications with high LTV ratios (exceeding 80%) and compares them to those for low LTV ratios (below 80%).

Table 4. Characteristics of applications with high vs. low LTV ratios

This table shows the share of loans with maturities of not more than 5 years (first row), the share of free liquid assets over total mortgage value of more than 10% (second row), the share of free liquid and illiquid assets over total mortgage value of more than 10% (third row) depending on whether the LTV ratio is above or below 80% (first-time mortgage applications only). The last column tests the differences using univariate t-tests. Definitions of the variables are provided in appendix 1.

Variable	**LTV > 80% (N=49)**	**LTV <= 80% (N=157)**	**Difference (N=206)**
Share with maturity <=5 years	0.200	0.306	-0.105* (0.055)
Free liquid assets / total loan amount >=10%	0.204	0.331	-0.127* (0.075)
Free liquid and illiquid assets / total loan amount >=10%	0.653	0.803	-0.149** (0.069)

Table 4 shows that most mortgage applicants do not have sufficient unencumbered liquid assets to cushion a price shock if they had to refinance their mortgage after a price shock: The share of applicants with a ratio of free liquid assets over total mortgage value of more than 10 percent is low among high-LTV applicants (20%) and much lower than among low LTV applicants (33%). When we additionally consider illiquid financial assets (pension funds, life insurance) the share of households with sufficient total financial wealth to cushion a significant shortfall at the time of mortgage refinancing increases substantially. However, the share of households with free assets is still much lower for high LTV applications than for low LTV applications.

Table 4, however, also shows that that the share of loans with maturities of not more than 5 years is lower among applicants for high LTV mortgages (20%) compared to applicants for low LTV mortgages (31%). This suggests that only a limited share of the new mortgage borrowers which are exposed to price risk would have to refinance their mortgage in the medium term.

6. Discussion

Given the medium-term risk of higher interest rates and lower house prices in Switzerland, it is important for regulators and banks to have a comprehensive assessment of the exposure of mortgage borrowers to interest-rate and house-price risks. Our analysis, based on a sample of recent mortgage applications, suggests that the long-term exposure to interest rate risk and house price risk could be significant, while the short-term or medium-term exposure is limited.

If interest rates return to their long term average (5% p.a.) nearly one-quarter of the mortgage applicants in our sample would face total mortgage payments – including interest, amortization and costs of upkeep – that exceed a third of their total household income. Thus, a substantial share of current mortgage applicants is exposed to interest rate risk. However, the large share of mortgage applicants with high payment-to-income ratios choose long-term fixed rate contracts. Thus, an increase in interest rates would not have an immediate or medium-term impact on mortgage affordability.

A severe correction to house prices could make it difficult for one in six borrowers to refinance their mortgages once their current loan expires. This is particularly the case as only a minority of mortgage applicants has sufficient unencumbered and liquid financial assets to cushion a price shock. Again though, most of the high-LTV applications are for long-term mortgages, suggesting that they will not have to refinance their current mortgage in the next five years. Thus, these borrowers are exposed only to prolonged decline in house prices rather than temporary or medium-term price slumps.

All in all, our analysis suggests that a rise in interest rates to their long-term level (5%) and a downward correction of house prices (e.g. 20%) would not lead to a significant increase in mortgage defaults in the short or medium term. However, a prolonged correction of house prices or a long-term rise in interest rates to their historical average - both experienced by Switzerland in the early 1990’s - could drive a significant share of the most recent mortgages into default.

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Appendix 1. Variable definitions

Variable name	Definition
Household characteristics	
Age	Age of the main credit applicant in years
City residence	Dummy = 1 if the credit applicant lives in a major city (Zürich, Geneva, Basel, Lausanne, Bern, Winterthur), = 0 otherwise
Married	Dummy = 1 if the credit applicant is married, = 0 otherwise
Financial wealth	
Total assets	All liquid and illiquid financial assets
Liquid assets	Liquid financial assets (cash, deposits, securities etc.)
Illiquid assets	Illiquid financial assets (second pillar, third pillar, life insurance etc.)
Free liquid assets	Liquid financial assets not employed as equity for the property purchase
Free liquid & illiquid assets	Liquid & illiquid financial assets not employed as equity for the property purchase
Other collateral	Financial assets pledged as collateral (except property value)
Income	
Total household income	Household income in CHF per year
Fix wage income	Household wage income in CHF per year
Mortgage	
Total loan amount	Total mortgage loan (fixed and variable tranches) in CHF
Share with fixed interest rate	Fixed interest rate mortgage tranches over total loan amount
Share with variable interest rate	Variable interest rate mortgage tranches over total loan amount
Share with fixed interest rate <=5 years	Fixed interest rate mortgage with maturity <=5 years over total loan amount
Share with maturity >5 years	Mortgage tranches with maturity >5 years over total loan amount
Share with maturity <=5 years	Mortgage tranches with maturity <=5 years over total loan amount
Number of tranches	Number of mortgage tranches per application
Property	
Property reference value	Property value in CHF as published or demanded by the seller
Property hedonic value	Property value in CHF as assessed by an internal hedonic pricing method

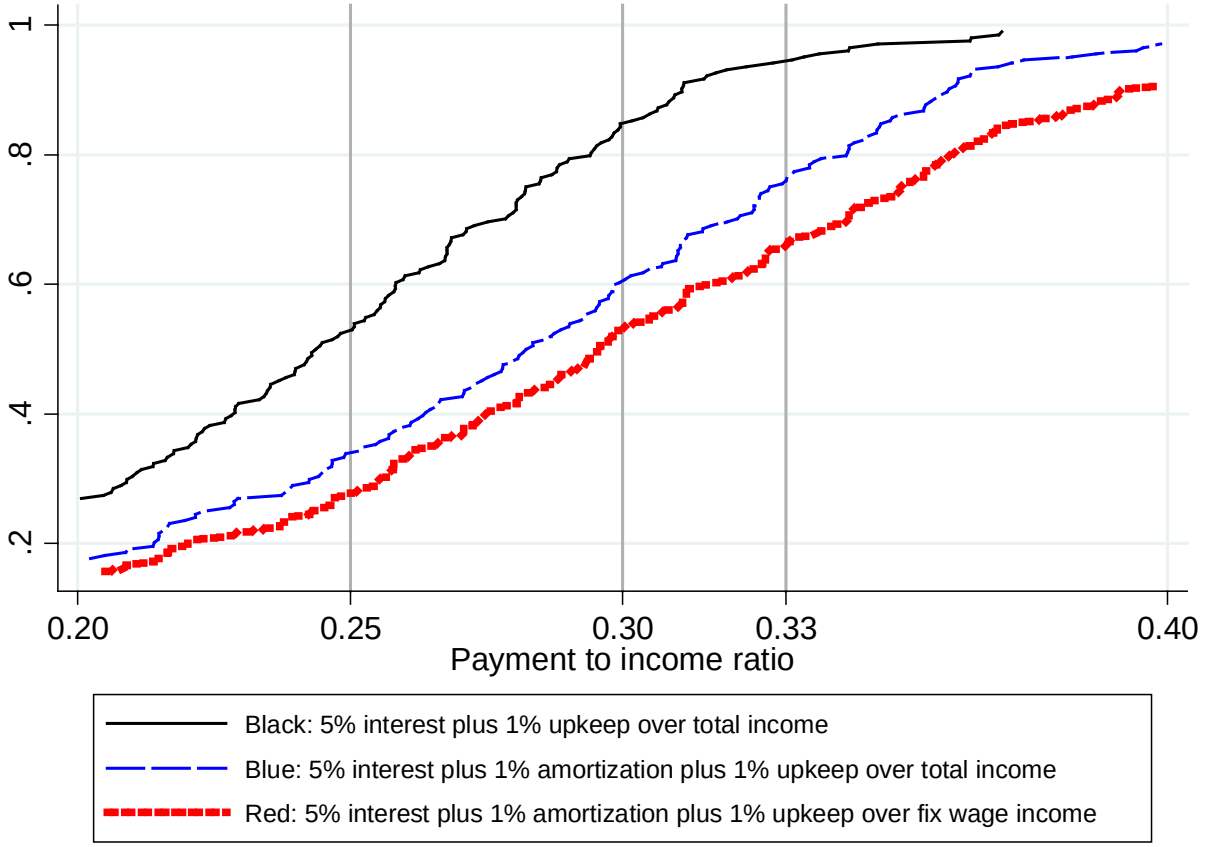
Appendix 2. Descriptive statistics

Definitions of the variables are provided in appendix 1.

	Mean	Min	0.25 percentile	0.50 percentile	0.75 percentile	Max	Obs
Household characteristics							
Age	43.85	24	36	42	51	78	295
City residence	0.52	0	0	1	1	1	285
Married	0.65	0	0	1	1	1	294
Financial wealth							
Total assets	551'764	0	236'000	408'482	680'000	3'705'402	295
Liquid assets	319'336	0	104'000	230'000	400'000	3'400'000	295
Illiquid assets	232'428	0	38'000	149'445	310'686	2'356'396	295
Free liquid assets	82'441	0	0	0	69'238	3'000'000	295
Free liquid & illiquid assets	260'169	0	12'567	136'125	330'307	3'000'000	295
Other collateral	11'673	0	0	0	0	593'918	295
Income							
Total household income	197'138	27'000	126'460	177'200	228'380	810'000	295
Fix wage income	180'639	0	120'000	164'700	214'750	768'000	295
Mortgage							
Total loan amount	671'604	126'000	450'000	620'000	815'000	2'244'000	295
Share with fixed interest rate	0.80	0.00	0.65	1	1	1	295
Share with variable interest rate	0.20	0.00	0.00	0.00	0.35	1	295
Share with fixed interest rate <=5 years	0.12	0.00	0.00	0.00	0.00	1	295
Share with maturity >5 years	0.68	0.00	0.50	0.82	1	1	295
Share with maturity <=5 years	0.32	0.00	0.00	0.18	0.50	1	295
Number of tranches	1.63	1	1	1	2	4	295
Property							
Property reference value	1'014'129	176'000	720'000	920'000	1'240'000	3'200'000	295
Property hedonic value	1'107'205	0	767'000	989'500	1'294'000	3'999'000	258

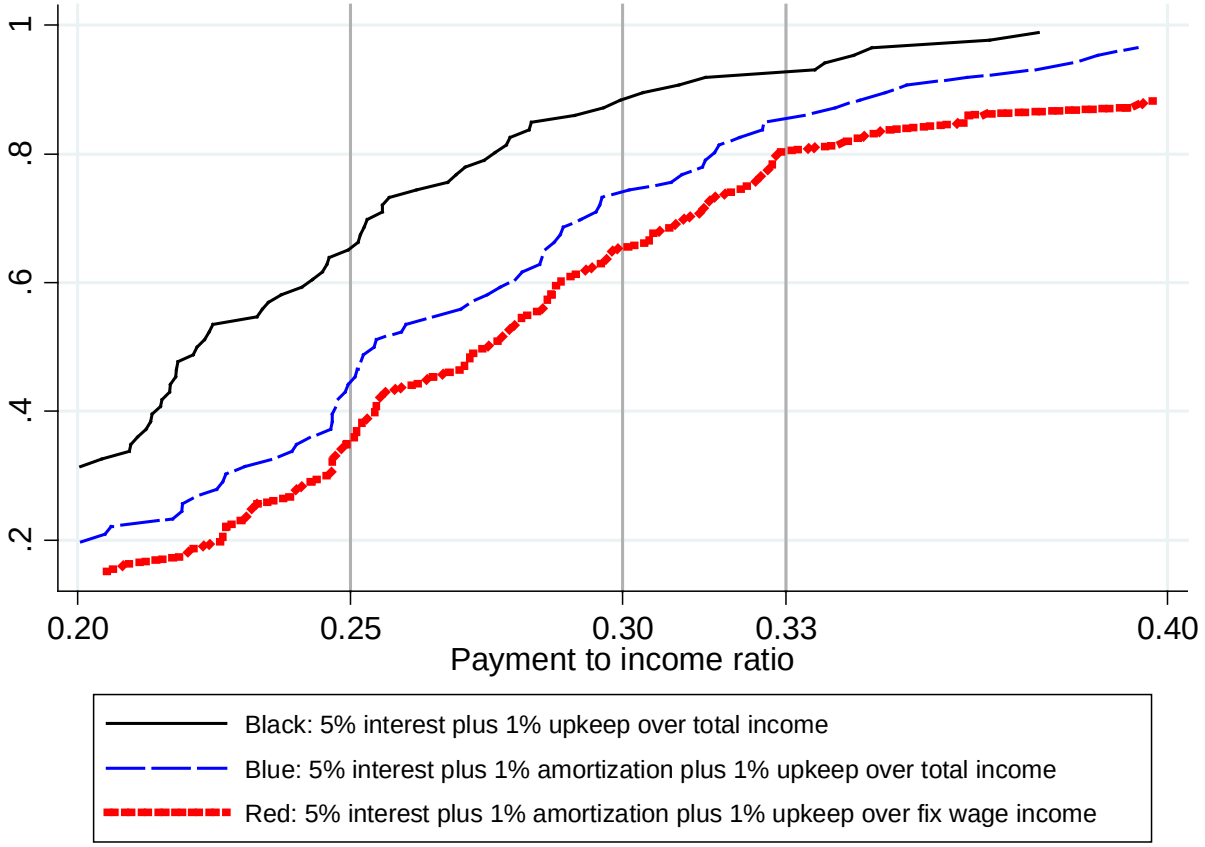
Appendix 3a. Cumulative distribution of payment to income ratios – first-time mortgages

This figure shows cumulative distributions of payment to income ratios (PTI) for first-time mortgage applications. The solid black line indicates the distribution of the PTI using a calculatory interest rate of 5% on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dashed blue line indicates the distribution of the PTI using a calculatory installment rate of 6% (5% interest plus 1% amortization) on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dotted red line indicates the PTI using a calculatory installment rate of 6% on the loan amount (5% interest and 1% amortization) and 1% upkeep on the property reference value as a share of fix wage income. Definitions of the variables are provided in appendix 1.



Appendix 3b. Cumulative distribution of payment to income ratios – refinancing mortgages

This figure shows cumulative distributions of payment to income ratios (PTI) for refinancing mortgage applications. The solid black line indicates the distribution of the PTI using a calculatory interest rate of 5% on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dashed blue line indicates the distribution of the PTI using a calculatory installment rate of 6% (5% interest plus 1% amortization) on the loan amount and 1% upkeep on the property reference value as a share of total household income. The dotted red line indicates the PTI using a calculatory installment rate of 6% on the loan amount (5% interest and 1% amortization) and 1% upkeep on the property reference value as a share of fix wage income. Definitions of the variables are provided in appendix 1.



Appendix 4. Cumulative distribution of loan to value ratios - refinancing mortgages

This figure shows cumulative distributions of the loan to value ratios (LTV) for refinancing mortgage applications. The solid black line indicates the distribution of the total mortgage amount over the property reference value. The dashed blue line indicates the distribution of the loan to total collateral ratio, that is adding other collateral pledged by the borrower to the property reference value. In case of refinancing mortgages, this is either the sales price of the property (if the purchase took place less than 15 years before the mortgage request) or the property hedonic value (otherwise). Definitions of the variables are provided in appendix 1.