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The Causal Effect of House Prices on Mortgage Demand and Mortgage Supply

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We identify the causal effect of house prices on mortgage demand and supply in Switzerland by exploiting exogenous shocks to immigration and thereby to house prices. Detailed micro data allow us to observe multiple offers for each mortgage request. We find a 1% increase in house prices to raise the requested mortgage amount by 0.52%. Due to positive feedback effects, the entire partial correlation is 0.78%. While we find higher house prices to increase mortgage demand, they induce banks to make fewer offers and charge higher rates, especially later in the boom and especially for highly leveraged households.

Keywords: House Prices, Mortgage Demand, Mortgage Supply, Instrumental Variables;
JEL codes: D14, G21, J61, R21

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1. Introduction

Recurrent real estate and mortgage booms have shown that surging house prices and mortgage market expansions tend to coincide. This has been the case in the US subprime boom as well as in recent real estate booms in Spain, Ireland and other Eurozone economies. It also applies to more recent booms in Norway and Switzerland. Yet the direction and channels of causality between house prices and mortgage markets have largely remained unclear.[1]

This paper addresses the issue of causality by instrumenting house prices with the exogenous component of immigration. We obtain the latter by means of an "origin push" or "shift share" strategy invented by and previously used in the literature on immigration and employment, and that on immigration and house prices. It isolates variation in immigration resulting from "push factors" operating in immigrants' countries of origin rather than "pull factors" at their destinations. By use of canton, year and month fixed effects, we can furthermore focus on variation between different neighborhoods located within the same labor market and public policy environment. This removes many effects immigration may have on other outcomes. With micro data on individual mortgage requests and offers we control for detailed applicant and object characteristics, in contrast to previous shift share papers that typically had to rely on aggregate data. We also investigate how the causal effect of house prices varies with some of these characteristics. More importantly, observing for each request the supply responses of different lenders allows us to distinguish to what extent house prices affect equilibrium mortgage lending through mortgage demand and to what extent through supply.

[1] For more examples, see IMF (2011) and Igan and Loungani (2012).

We find that a 1% higher house price increases the requested mortgage amount by 0.52%. The non-causal partial correlation between house prices and mortgage demand however amounts to 0.78% due to reverse causality from mortgage amounts to house prices. This points at a mutually reinforcing mechanism between real estate and mortgage market booms and busts. By contrast, higher house prices are not found to induce lenders in our sample to expand mortgage supply: Instead, lenders make ceteris paribus fewer offers and charge higher risk premiums the higher the house price. This cautious lending behavior is particularly pronounced in the second half of our sample. During this period house prices have already gone through an extended period of growth and hence are more likely to be overvalued. The caution is also particularly pronounced for mortgage requests with high loan to value (LTV) ratios, but does not depend on the request's payment to income (PTI) ratio. It is also more pronounced for applicants requesting adjustable rather than fixed rate mortgages.

The remainder of the paper is structured as follows: Section 2 first covers different theories of how real estate prices, mortgage demand and mortgage supply could be causally related, and then provides a brief summary of the as yet limited evidence on the topic. Following this, Section 3 introduces our data and Section 4 our empirical strategy. Section 5 presents the results and Section 6 summarizes the detailed robustness checks presented in our Online Appendix. Section 7 concludes.

2. Theories and existing evidence on links between house prices and mortgage volumes

We investigate the causal relationships behind the correlation between house prices and mortgage volumes for the case of Switzerland. Figure 1 illustrates this

correlation by displaying the annual growth rates of respectively apartment prices, single-family home (SFH) prices, and mortgage volumes for the years 1971-2013. While there are also idiosyncratic factors at play, the growth rates clearly appear correlated. As for timing, it would if anything appear that mortgage volumes slightly lag house prices, although any such observation must at this stage remain tentative given the small number of observations. To shed light on the potential causal relationship between house prices and mortgage volumes the literature offers three major hypotheses, which we sketch in blue in Figure 2.

Firstly, there may be a positive causal effect running from house prices to the mortgage market via mortgage demand. This is because more expensive houses lead potential home buyers to *demand* larger mortgages, as they cannot finance the increased cost for a given size and quality of housing only out of their savings. Looking at housing as an investment rather than solely a consumption good, higher current house prices may furthermore trigger expectations of higher future prices. For given levels of income and financial wealth, higher loans also imply higher LTV and PTI ratios. High PTI ratios, i.e. high annual debt service payments relative to regular annual income, reflect an increased risk that borrowers cannot meet their interest and amortization obligations. By contrast, high LTV ratios reflect the risk that after a price drop the collateral will not be sufficiently valuable to compensate lenders when borrowers are struggling to repay. Conditional on their balance sheets and regulatory requirements, banks[2] may satisfy increased mortgage demand, but only in return for higher risk premiums and hence higher mortgage rates. Higher mortgage demand does then result in higher equilibrium mortgage amounts, also absent an outward shift in the mortgage supply curve.

[2] In our empirical setup, some mortgages are offered by insurance companies. For simplicity, we shall nonetheless use the terms "banks" and "lenders" interchangeably. Further, we shall often write "house" for both houses and apartments.

Secondly, house prices may also exert a positive causal effect on mortgage *supply*: If banks deem higher house prices sustainable and hence the collateral more valuable, they may be willing to lend more. Thus Igan and Loungani (2012) write: "Real estate plays an important collateral role and lenders tend to become more willing to extend loans when collateral values increase". This idea is formalized in the model by Bruckner et al (2011), where higher house price expectations ease mortgage lenders' default concerns.[3]

A third possible link between house prices and mortgage volumes runs in the opposite direction: from mortgage volumes to the housing market. Under that scenario, banks shift the mortgage supply curve by making a larger share of applicants an offer or by offering more attractive mortgage rates. The resulting easier access to mortgages allows more potential home buyers to enter the market for owner-occupied property, and allows each of them to afford a more expensive house, thereby bidding up house prices. Thus Geneakoplos (2010) presents a model in which some buyers are more eager to buy a house and so have a higher reservation price than others. If these buyers are extended enough credit, equilibrium house prices will be higher than if some of the most eager buyers are kept out of the market. In an extension of this work, Fostel and Geneakoplos (2012) show how leverage and tranching first raised US house prices, and the introduction of Credit Default Swaps then lowered them.

On top of these three possible causal relationships, both house prices and mortgage volumes are of course also exposed to other economic developments. A particularly important factor influencing house prices and mortgage volumes

[3] Alternatively, careful banks may instead respond to higher house prices by *restricting* the mortgage amounts and PTI ratios or by charging *higher* risk premiums. This alternative behavior would *reduce* rather than increase pro-cyclicality.

are interest rates. Low interest rates may increase mortgage demand, as they make larger mortgage amounts affordable. At the same time, low interest rates may diminish the risk-adjusted returns that lenders can earn on other assets and hence increase the willingness to supply mortgages. In our empirical setup we implicitly control for the effect of interest rates by way of year and month fixed effects.[4] Another possible source of noise in our setup is high income growth. Thus in some past booms there has been feedback from house prices to mortgage demand via income levels in the construction sector. In the Swiss setup investigated though this is not the case: In the period under consideration, the median wage in construction grew as slowly as that across all sectors (1.3% p.a.). Furthermore, despite the house price boom the share of workers employed in construction has remained constant at about 8%. In any case, any other macroeconomic developments, are being controlled for by canton, year and month fixed effects, as explained in more detail below.

Another possibly idiosyncratic shock to house prices however arises from population growth and in particular immigration. Figure 2 illustrates immigration as an idiosyncratic shock to house prices by means of a red arrow. We explain below which components of immigration may under which conditions indeed be considered as idiosyncratic or exogenous, i.e. as having a direct effect on house prices but not on mortgage volumes.

Understanding the relative importance of different causal links between house prices and mortgage volumes is not only of scientific interest. It is also crucial to design appropriate policy measures: If causality runs mainly from mortgage lending to house prices (hypothesis 3 above), then policy measures targeting the mortgage market should be able to effectively address both mortgage and house

[4] The effect of interest rates is analyzed explicitly in a forthcoming companion paper.

price growth. If by contrast observed growth rates ensue from a shock to house prices that is exogenous to the mortgage market, then mortgage market measures alone may be able to slow down the credit expansions, but are unlikely to suffice to also affect house prices. Of similar importance is an understanding of whether house prices have a more positive effect on mortgage demand or on mortgage supply. In the former case, demand-side measures should take center-stage. These may include changes to the tax deductibility of mortgage debt, or restrictions on the LTV or PTI ratios with which households can apply for a mortgage. In the latter case by contrast policy-makers may wish to increase banks' marginal costs of mortgage lending, e.g. by use of higher capital requirements.[5]

We are aware of three papers that have sought to tackle empirically the two-way causality between house prices and mortgage volumes. Firstly, Adelino et al (2012) instrument mortgage supply in the US with annual changes in the conforming loan limit, the maximum loan amount with which a mortgage can still be purchased and securitized by the US government-sponsored enterprises. They find that houses which become eligible for a conforming loan end up costing $1.1 or 0.5% more per square meter. They conclude that access to cheaper funding was a significant driver of the US subprime bubble, even if it cannot fully account for the price increases. Similarly Favara and Imbs (2011) exploit post-1994 US branching deregulation to compare mortgage origination of regulated and hence affected lenders to that of independent mortgage lenders. They find that the increase in mortgage supply attributable to branching deregulation raised annual house price growth by up to three percentage points. Mian and Sufi (2011) approach the same two-way causality issue from the real estate side,

[5] Crowe et al. (2011) provide a detailed discussion of the advantages and disadvantages of different policy instruments. Kuttner and Shim (2013), using a panel of 57 countries and more than 3 decades, find specifically that demand side measures and in particular PTI limits have a larger effect on mortgage expansions than supply side measures, and only tax policies can robustly affect house prices.

instrumenting house price *growth* with differences in land scarcity across different US Metropolitan Statistical Areas (MSAs). They show that for every dollar in house price appreciation home owners extract an extra 25 cents in home equity.

These three papers jointly draw a picture in which the US subprime bubble has mainly been triggered by an increase in the supply of mortgage lending. This in turn was caused by lenders' increased ability to rate and securitize their mortgages, as well as by a huge inflow of capital into the US. Once this increase in mortgage lending had caused house prices to increase, the ability to borrow against these higher values then further accelerated mortgage growth.[6] Whether the "second-round borrowing" effect of house prices on borrowing operated mainly by making borrowers more confident to borrow or by making lenders more confident to lend is something we do not know. However, the US subprime bubble emerged from the interplay of factors that to a significant extent seem specific to the recent US context, in particular the huge-scale securitization. It is therefore interesting to widen the focus from that specific boom and analyze another in which there is little securitization and little foreign bank refinancing.

3. Data and Descriptive Statistics

Our main data stem from Comparis, a Swiss online company that intermediates mortgages. Households apply online for a mortgage and then simultaneously receive several offers from different participating lenders. Since households pay CHF 148 (about USD 160) to submit a mortgage request and banks adjust their offer or rejection according to the comprehensive set of submitted information, we can be confident that households will give accurate and verifiable information.

[6] By contrast Justiniano, Primiceri snd Tambalotti 2013, using a quantitative dynamic general equilibrium model, argue that the US boom is more likely to have been caused by factors that impacted house prices directly and then affected mortgage lending through the collateral channel.

For applicants, paying the fee means to save the time to personally inquire with each of the banks individually. Furthermore, lenders know that applicants simultaneously receive offers from many different lenders, so lenders have an incentive to make a competitive offer. For the purpose of our research, the Comparis data have a number of advantages. First, we observe for each mortgage request many details on both demand and supply. On the demand side these include the characteristics of the requested mortgage, details of the house to be financed, as well as of the financial situation of the applying household. On the supply side, we observe which banks respond with an offer and which rates they offer. Second, observing many offers for the same request allows us to distinguish between the causal effects of house prices on mortgage demand and those on mortgage supply. Third, we observe exactly the same set of details about both the applying household (including age, income, wealth, liquid wealth, debt, and existing real estate holdings) and the real estate object to be financed (including postcode, age, type and market price) as potential lenders do receive. Since customers apply anonymously online rather than by visiting lenders' local branches, banks have no further, private information.[7]

For the purpose of instrumenting house prices, we combine our micro level data with information on immigration into each of Switzerland's 106 statistical ("MS") areas defined by the Swiss Federal Office of Statistics (Bundesamt für Statistik, BfS). MS areas offer a finer grid than the 26 cantons (states) or the 16 labor market regions (also defined by the BfS). From the Statistics Office we have obtained information on the total population, as well as on immigration for each

[7] For an example on how soft information matters in branch based consumer lending, see Puri, Rocholl and Steffen (2012). More specifically on the role of the breadth of the banking relationship on mortgage lending in Switzerland, see Brown and Hoffmann (2013).

calendar year and each MS area.[8] As explained in the empirical strategy section, we need information not only on the total number of immigrants, but also on immigrants' countries of origin. A matching key between MS areas and zip codes allows us to merge that immigration information to our main dataset.

Table 2 presents a first overview of our sample composition in terms of the years covered (Panel A), the mortgage model requested (Panel B) and the type of object to be financed (Panel C). It shows that our sample stretches from January 2008 until October 2013. As Comparis was one of the first websites to offer the service of obtaining mortgage offers from multiple banks at the same time, the sample is particularly large in the first years of our sample period. Panel (B) shows that a bit over 80% of applicants ask for a fixed rate model, most of them with a duration of either 5 or 10 years. About 5% have their rate pegged to the Libor rate for a predetermined period, and another 5% choose a model in which the bank may change the rate at its discretion, but where in return the household may at any time move from the variable to a fixed-rate contract without punishment. With a view to the types of object to be financed, Panel (C) shows that the single largest groups are single-family homes (39%), apartments (28%), semi-detached houses (10%) and town houses (9%). Table 7 in the Online Appendix, shows that the sample covers all of Switzerland's 106 MS areas, although its density is of course a bit higher in the more populated areas. Beyond the distributions covered by those two tables, it is also worth mentioning that on the supply side the sample represents almost all types of mortgage lenders. These include cantonal, regional and savings banks, banks owned by retail chains, foreign banks and insurance companies. Merely Switzerland's two big banks are not included in the sample.

[8] For years 1995-2010 these stem from the "PETRA" database, afterwards from the "STATPOP" database.

Table 2 then provides the more detailed summary statistics, starting in Panel (A) with the key figures on the mortgage requests. We see that the mean mortgage amount requested was about CHF 587,000 and the mean house price to be financed about CHF 940,000. The *loan-to-value* (LTV) ratio amounted on average to 65% and the . Another common indicator of a mortgage's riskiness is the *payment to income* (PTI) ratio, the percentage of regular annual income that a household would have to spend on debt service for the suggested object, given a conservatively chosen interest rate. Comparis computes this for the participating lenders by assuming 5% of the mortgage amount for interest payments, 1% of the mortgage amount for amortization to be paid only by those borrowers with a starting LTV in excess of two-thirds, and 1% of the house price paid for maintenance. Setting these payments in relation to regular annual income yields a PTI ratio with a mean of about 26%. This mean lies somewhat below the 33% rule-of-thumb threshold above which the PTI would typically be deemed problematic, but about 23% of requests have PTI ratios at or above that threshold (not shown in the table).

About 52% of the requests concern a new mortgage. The rest are for refinancing a mortgage taken out in the past. This occurs because Swiss mortgage contracts typically envisage a period of several years during which neither side can leave the contract without incurring an additional fee. In fixed rate contracts this corresponds to the period for which the interest rate is fixed. At the end of that period however, households may shop around to see if another lender offers a better deal. The average amount requested for refinancing deals (not displayed separately) was about CHF 509,000. That new amount for refinancing requests was higher than the initial mortgage in 12% of cases, lower in another 12%, and identical in the remainder of cases. The differences between new and refinancing mortgages are investigated and discussed further in the results section.

Panel (B) features further information on the applying households. It shows that average *household income* is around CHF 167,000 p.a. and average *liquid wealth* lies slightly above one year's income, at CHF 169,000. Close to 20% of households hold some form of other debt and about 28% already own some other real estate. The mean value of households' total wealth including pension wealth is about CHF 512,000 and the average age is about 46. The average age of the houses is 2.5 decades, but half of the objects are 10 or fewer years old. Panel (C) covers immigration. It shows that both actual annual immigration and different variants of the instrument explained in more detail in the empirical strategy section amounted on average to between 1.33% and 1.36% of the previous year's resident population. In all cases we are forced to use gross rather than net migration, because data on the outflow of foreigners mix true outflows with naturalizations. Furthermore, note that the panel on immigration reflects the distribution across our 12'753 mortgage requests, as they enter our estimations, and not an equal or exactly population weighted average across all 106 MS areas. Panel (D) finally looks at the supply side. It tells us that the average applicant in our sample receives 5.4 different offers. The best interest rate offered across all models did on average amount to 2.31% and the median one to 2.54%.

4. Empirical Strategy

Estimations of the causal effect of house prices on mortgage demand and supply may suffer from reverse causality as increases in mortgage volumes are likely to in turn affect house prices. We exploit house price shocks exogenous to the mortgage market by using variation in the exogenous component of immigration, within cantons or labor market regions and within a given year and month. In the following, we explain in several steps what we mean by the exogenous

component of immigration and which crucial role our set of fixed effects and further controls at the applicant level play.

4.1 The Role of Total Immigration for House Prices and Mortgage Market

At first sight, immigration by area and period may seem to already constitute a decent instrument for house prices[9]: While there is likely to be *reverse causality* from mortgage volumes to house prices, mortgage lending would seem less likely to directly affect immigration and thus cause *reverse causality* problems of its own. This is particularly true for Switzerland, where various studies show that immigrants themselves typically do not buy real estate and especially not *in the year of arrival*. Rather, immigrants affect house prices only indirectly: They may push up rents in the short-run and thus motivate more residents to buy a house.

A study by the Swiss federal agency for housing, Bundesamt für Wohnungswesen (2007), underlines this: Using data from the Swiss Labor Force Survey SAKE, the authors find that as of 2006 on average 51% of Swiss citizens live in their own home, but only 10% of new immigrants do (Table 22, page 70), although the ownership share of immigrants does increase somewhat with the duration of their stay. A similar picture emerges specifically for the canton of Zurich in Rey (2011) and Rey (2012). Besides, the share of immigrants living in owner-occupied property is likely even lower in those agglomerations where immigration is highest because of shorter average residence times and higher house prices relative to incomes. Concerns about reverse causality from the mortgage market and more specifically the real estate market on immigration flows are diluted further by data on employment showing that despite the house

[9] As Accetturo et al. (2014) show, immigration can affect house prices not only through immigrants' extra housing demand, but also since a higher density of immigrants may affect the attractiveness of housing in an area for natives. For our purposes we may remain agnostic about the channels through which immigration affects house prices.

price boom the share of workers employed in construction has remained constant over the period under consideration, as has the share of foreigners amongst them. This refutes the possible concern that booming housing markets may have attracted many construction workers from abroad, as happened for instance during the Spanish house price in the early Eurozone years.

Yet, immigration per se as an instrument for house prices may still suffer from *omitted variable bias*: It is conceivable that in areas or periods with generally high economic growth we observe higher immigration (through increased demand for labor) and at the same time higher house price and mortgage growth (through higher income and wealth growth). Relatedly, areas with currently low house prices might simultaneously be more attractive to immigrants and have more potential for subsequent house price growth. The vast majority of such omitted variable bias is likely to be soaked up by our set of control variables, as we can control firstly for region fixed effects (at different levels of granularity as discussed in the robustness section), secondly for both year and month effects, thirdly for each applicant's income, wealth, pension wealth and liquid wealth, and fourthly for each real estate object's characteristics. Yet concerns about potential endogeneity of immigration may remain, since it is known that immigration flows are in general responsive to economic conditions at the destination.

4.2 The Origin-Push (Shift-Share) Method to isolate Exogenous Immigration

Potential remaining endogeneity of immigration to local economic conditions however is an issue that has been extensively addressed by the literature on the effects of immigration on respectively employment and house prices. In fact, papers in that literature have typically had available only aggregate data by region and period and have thus had reasons to be much more concerned about the issue

than we do. In response, Card (2001) developed the "shift share" or "origin push" methodology to identify the causal effect of immigration on local employment. For this purpose, it has also been applied to the Swiss context by Favre et al (2013) as well as by Basten and Siegenthaler (2013). The latter have adapted the strategy to the Swiss context, in which separate regions are much better connected by public transport than different regions of the US, by comparing occupation-age cells of the labor market rather than different geographic areas. Hunt and Gauthier-Loiselle (2010) use the same empirical strategy to investigate the causal effect of immigration on innovation. More importantly for the present paper, Saiz (2007), Degen and Fischer (2010), Fischer (2012), Gonzalez and Ortega (2013) and Accetturo et al. (2014) have adapted the shift-share strategy for investigating the effect of immigration on house prices in respectively the US, Switzerland, Spain and Italy. However, to the best of our knowledge this paper is the first to exploit a shift-share strategy not for focusing on the causal effect of immigration itself, but in turn as an instrument for house prices in investigating their effect on the mortgage market.

Intuitively, the idea of the Shift Share strategy is to exploit only *that* part of the variation in immigration which can be explained by "push" factors in immigrants' countries of origin, as opposed to potential "pull factors" operating in the areas of destination — hence the name "Origin Push Immigration" (OPI). Therefore it focuses on the year-on-year *shifts* both in the total number of immigrants coming into any area of Switzerland and in their composition in terms of countries of origin. To obtain different treatment intensities for the 106 different MS areas, the total number of immigrants is then distributed to the 106 areas not according to their actual present-year flows (which may be partly endogenous) but, for each country of origin, according to the *shares* with which they were distributed in a historical year in the past. This exploits the finding that, on top of taking into

account local economic opportunities (variation which we thus do not exploit), immigrants do also have a tendency to move to areas where their compatriots in earlier waves of immigration have already settled, as found by Bartel (1989). Thus the methodology is also known as "shift share" or "Bartel" instrument. In the following we first give a concrete numerical example and then a more formal illustration of how exactly the instrument is computed.

4.3 A Numerical Example

To illustrate the functioning of the instrument, Table 3gives an example involving the two characteristic immigrant groups from respectively Germany and ex-Yugoslavia[10], the MS areas Zurich and Geneva, and the years 1995 (our earliest baseline year) and 2008 (the earliest year of our Comparis sample). Panel (A) shows the necessary raw data, Panel (B) the resulting values for the endogenous regressor actual immigration and the instrument origin-push immigration, both in capita terms. Panel (C) shows the resulting values scaled by an area's previous year's population levels. We show this in Column (1) for immigrants from Germany, in Column (2) for those from Ex-Yugoslavia, and in Column (3) we show the corresponding raw data values for all origins combined.

Looking at Panel (A), we see that in 1995 Switzerland experienced gross immigration of 8,215 from Germany and of 20,169 from ex-Yugoslavia, where the latter was largely driven by the Yugoslav Wars acting as push-factor. Total gross immigration into Switzerland in 1995 amounted to 83,456 individuals. By 2008 the legacy of the Yugoslav Wars had largely receded and so Switzerland saw far fewer immigrants from ex-Yugoslavian countries. By contrast, labor market slack at home now motivated many Germans to move to Switzerland.

[10] Since the country definitions have changed over the years and immigrant numbers for many individual countries are small, we have included all countries on the territory of former Yugoslavia in a single origin group.

Furthermore, immigration of Germans (and, for that matter, any EU citizen) had been facilitated relative to 1995 by the Free Movement of Persons (FMP) Treaty concluded between Switzerland and the EU and implemented in 2002, as discussed in Basten and Siegenthaler (2013). So between 1995 and 2008, the numbers of immigrants from these two origins changed in opposite directions, with now only 7,739 gross immigrants coming from Ex-Yugoslavia but 34,270 from Germany. At that time, total gross immigration into Switzerland amounted to 125,937 individuals. This example shows that not only did total immigration into Switzerland fluctuate widely over the years, but so did the composition of immigrants' countries of origin. The FMP Treaty is one of the major factors contributing to that change in origin nationalities. Given the different destination area preferences of different origin nationalities, this shift translated also into a change in destinations exogenous to our MS area comparisons. The FMP Treaty thus additionally strengthens our setup relative to a Shift Share setup without such structural breaks.

The destinations of a given nationality of immigrants did also change over the years: While in 1995 close to 6% of German immigrants into Switzerland opted for Geneva, in 2008 only slightly more than 2% did. By contrast, only 2.62% of immigrants from Ex-Yugoslavia went to Geneva in 1995, but 8.61% did in 2008. These changes in destinations could at least partly be due to a destination area's economic prospects: While immigrants from Ex-Yugoslavia in 1995 were mostly war refugees distributed across Switzerland by the Swiss government, in 2008 they were more likely to choose their destination according to where they expected the best economic prospects for them. In order to avoid this possible source of endogeneity, the shift-share instrument distributes them as if 1995 shares were still applicable, thus exploiting the fact that to the extent to which immigrants do *not* go by economic prospects, they may go to where they happen

to already know someone, are more likely to find shops and clubs corresponding to their preferences, etc.

Looking at Panel (B), our instrument thus says that in 2008, based on 2008 totals but 1995 shares, 0.1422*34,270 = 4,873 Germans and 0.0628*7,739=486 immigrants from Ex-Yugoslavia move to Zurich. Likewise, the instrument tells us that respectively 1,984 Germans and 203 immigrants from Ex-Yugoslavia move to Geneva in 2008. Actual immigrant numbers for Zurich (Geneva) in 2008 were respectively 4,496 (764) Germans and 413 (666) from Ex-Yugoslavia. As the table shows, the OP Immigration we use as instrument is sometimes higher, sometimes lower than the actual number of immigrants for that MS area and year. This can also be seen when we look at the scaled values in Panel (C). Given these predictions for each year, MS area and nationality, we then sum up within each year and MS area but across nationalities, so as to obtain a single instrument value for each year and area. While for our baseline we compute instrument values using the shares from 1995, the earliest year available, robustness checks use 2008 as first sample year and 2000 as an intermediate year.

4.4 Formal Computation of our Instrument

More formally, OP immigration from origin country *o* into destination area *d* in year *t* is computed as follows:

(1) $$z_{o,d,t} = (z_{o,Switzerland,t}) * (\alpha_{o,d,1995})$$

where $z_{o,Switzerland,t}$ is the total inflow of origin *o* immigrants into Switzerland in year t and α is the share of origin *o* immigrants from 1995 who went to destination area *d* in 1995.

We compute this for each origin *o*, then sum up over all countries of origin:

(2) $$Z_{d,t} = \sum_{o} z_{o,d,t}$$

4.5 Advantage: Variation within state or labor market and request level controls

An important advantage of our micro data setup is that, in contrast to previous work using the shift-share instrument, we have enough observations to include not only year (and month) fixed effects, but also fixed effects for the 26 Swiss cantons (states). As a result, we are able to focus on variation in immigrant flows and resulting house prices between the 106 different neighborhoods (MS areas), but always *within a given canton*. This is advantageous because the limited size of most cantons as well as Switzerland's excellent public transport make it possible to commute to a job from any MS area in the canton. So even if some cross-sectional differences in labor market prospects (or tax regimes or other factors) are firstly correlated with the number and composition of immigrant inflows and are secondly persistent from 1995 until our sample period, then our canton fixed effects can control for this. They allow us to focus on where within a given canton immigrants choose to live. Put differently: Labor market prospects make immigrants move to a different canton, economic factors like rents (not exploited) and the residence patterns of compatriots (exploited) tell them where within a canton or labor market area to reside. In the robustness section we discuss the consequences of this within-canton focus further and introduce also some variants, including one in which we replace our fixed effects for the 26 cantons with fixed effects for 16 labor market regions defined by the Statistics Office.

The same set of fixed effects also addresses the concern that immigrants from a given source country may have a tendency to enter particular labor market sectors

(e.g. Germans may be likely to enter engineering sectors) and hence be more likely to move to cantons that have a lot of jobs in that sector. Because we focus on variation between different neighborhoods within the same canton or labor market, differences in the sectoral compositions of different cantons or labor markets do not influence our estimates. In addition, note that the sectoral composition of each nationality group is by no means stable. Thus Credit Suisse Global Research (2013) shows that while in 2009 the group of immigrants from Portugal, Spain and Italy working in catering and repair services was more than 50% larger than that working in financial services, only 3 years later the largest group was working in financial services.[11]

Furthermore, the literature cited above shows that immigration affects not only house prices but also inter alia employment and incomes. With a view to the exclusion restriction for our instrument, it is important to note that these effects can be expected to operate at the canton or labor market level, whereas we find the effect of house prices to operate at the more granular MS area level. Therefore it is advantageous that, in contrast to most earlier papers using the instrumental-variable strategy, we can focus on variation across MS areas but within cantons (states) or contiguous labor markets.

Finally, it is also important that we can control for all the applicant and object level details that banks consider relevant when granting mortgages. In particular, several of the studies cited above have shown that immigration may not only affect house prices but may also affect the labor market and hence earnings prospects of natives. On the one hand our setup takes care of this by comparing only different areas within the same labor market region. On the other hand, our controls for several measures of applicants' income and wealth ensure that we are

[11] They also show large year-on-year changes in the national composition of immigration: Their Graph 5 shows that net immigration from Germany was below 10,000 in 2002, above 30,000 in 2007 and 2008, and again below 10,000 by 2012.

not capturing changes in mortgage demand and supply caused by changes in incomes that in turn have been triggered by immigration.

4.6 Estimating Equations

Overall, given our instrument and control variables explained above, we first estimate for mortgage requests *i* submitted in MS area *d* in year *t* the following first stage equation:

$$(3) \qquad lnHousePrice_{i,d,t} = \alpha + \beta Z_{d,t} + \gamma_c + \delta_t + \theta controls_i + \varepsilon_{i,d,t}$$

Beyond the instrument $Z_{d,t}$ explained above, this includes time (year and month) fixed effects δ_t, canton (or, in a variant labor market region) fixed effects γ_c, as well as a long list of control variables capturing the characteristics of the object to be financed and the household applying for a mortgage, $controls_i$. Given the instrumented values of the log house price obtained through these first stage estimations, we then estimate a set of second stage equations of the following form:

$$(4) \qquad Outcome_{i,d,t} = \vartheta + \mu \widehat{lnHousePrice}_{i,d,t} + \rho_c + \tau_t + \varphi controls_i + \omega_{i,d,t}$$

We use four different outcome variables: As a measure of mortgage demand we use the log of the requested mortgage amount, and as measures of mortgage supply we use respectively the number of offers a request attracts[12], the best interest rate offered in response to a request, and the median interest rate offered in response to that request.

[12] For that outcome measure it is also important to have the canton fixed effects, since the number of banks potentially making offers does differ across cantons (some cantonal banks offer only in specific cantons), but not within a canton.

4.7 Immigrants as House Buyers?

Above we have demonstrated how our setup allows us exploit only *that* part of the variation in immigration and thereby in house prices which has not been reversely caused by the demand for, or supply of mortgages. Another question however is whether (the exogenous component of) immigration could affect mortgage demand or supply through a channel other than house prices, namely with immigrants themselves showing up as mortgage applicants. In general this seems of limited concern since we know from the studies cited above that in Switzerland immigrants rarely buy real estate themselves, or at least not right in their year of arrival in which they induce variation in our instrument: Since many immigrants are not sure initially how long they will stay for, whether and when their family follows them, and how the new market works, they will typically first rent. This influx into the market for rental housing may however bid up rents and thereby motivate more long-time residents to consider switching to owner-occupied housing. As an additional factor to ensure that our results are not driven by increasing the numbers of immigrants applying for mortgages, it is helpful that we are able to observe and control for all the same household finance characteristics that lenders are able to observe. In particular, banks do not know whether a given applicant is himself an immigrant. They can therefore not price mortgages based on how they expect different immigrant groups to perform as borrowers. What banks do observe is applicants' income, total wealth, liquid wealth and pension wealth, all of which may have been influenced by characteristics correlated with the applicant's potential immigrant status and nationality. Exploiting the comprehensive information and multiple dimensions of our micro data, we are able to control for all of these characteristics.

5 Results

5.1 Main Results

Table 4 presents our main results. Column (1) shows our estimates of the first-stage relationship between origin push immigration and house prices, which is common to all instrumental-variable results displayed in the following columns. Column (2) shows the second-stage relationship for the effect of house prices on mortgage demand, and Columns (3)-(5) show the effect of house prices on different measures of mortgage supply. All columns use the same comprehensive set of covariates, which we describe in more detail below. As expected, the 1st stage relationship is positive. It is statistically significant far above the 1% threshold. The F statistic for the hypothesis of a jointly zero effect of all instruments, in this special case just origin-push immigration, on house prices amounts to 216.79. It does thus by far exceed all relevant Stock and Yogo (2005) critical values and we can confidently reject the null of weak instruments.

Thanks to our large sample size and good data quality, we obtain similarly high statistical precision when estimating our second stage relationships. The estimates obtained there tell us that a 1% higher house price causes the household to request a 0.52% higher mortgage amount. This reflects the fact that, largely for tax reasons, Swiss households do typically not fully exhaust their own savings before asking for a mortgage. Hence they still have reserves of their own and so do not need the bank to *fully* finance the price increase. If households had to finance the entire amount through mortgage funding, the marginal effect would have had to be closer to unity. Yet there is indeed a strong causal effect of house prices on mortgage demand.

We now turn to the results on mortgage supply. Interestingly the higher house prices are not found to increase banks' willingness to lend, so the collateral channel behind Hypothesis 2 above and described inter alia in IMF (2011) does not seem to operate here. By contrast, Column (3) shows that conditional on our set of object, household, location and time controls, each percent increase of the house price does *reduce* the number of offers by 0.009. Furthermore, conditional on making an offer, the lenders in our sample charge *higher* risk premiums for a higher house price: Thus Columns (3)-(5) show that each percent increase in the house price raises the best interest rate offered by 0.0015 percentage points (or 0.15 basis points), and raises the median interest rate offered by 0.0018 percentage points (0.175 basis points).

We now turn to the effect of control variables on house prices, mortgage supply and mortgage demand. Indeed, the risk-adjusted pricing is also reflected in the coefficients estimated on the control variables: While a higher income is ceteris paribus associated with a higher house price and a higher mortgage amount, lenders respond to higher incomes with on average more offers and more advantageous interest rates. The same positive supply responses can be observed for wealth and, for the number of offers, also for liquidity. By contrast, having other financial obligations (which increases the requested mortgage amount) or other real estate (which decreases it) both reduce the number of offers. So does, ceteris paribus, the age of the house: Requests with older houses receive, conditional on the house price and location, fewer offers and are charged higher interest rates. These relationships observed for our set of control variables confirm that banks do make use of this information, rather than just submitting uniform offers. As the coefficient estimates on the control variables feature reasonable signs and sizes, these results also support our regression specifications.

5.2 Evidence on the Reverse Causality from Mortgage Lending to House Prices

It is also interesting to compare the instrumental variable estimates to the results we would have obtained with Ordinary Least Squares estimations, i.e. without isolating the *causal* effect of house prices. Table 5 displays these OLS results and shows that the mortgage demand estimates biased by reverse causality are about 50% larger. With respect to mortgage supply, they are biased toward less careful mortgage lending, with a smaller negative effect on the number of offers and a negative rather than positive effect of the house price on interest rates. Both findings suggest that the reversely causal effect of mortgage volumes on house prices is indeed strongly positive. Overall then, we have evidence of a two-way causality between house prices and mortgage volumes in Switzerland.

5.3 Changes over Time

To gain a deeper understanding of the effects of house prices on mortgage demand and supply, we now look at how both have changed as the joint real estate and mortgage volume boom has progressed. To do so, we have interacted our main explanatory variable of interest, the log house price, with an indicator for the 2nd half of our sample, 2011-13. For this reason, we now have to deal with two endogenous regressors: the house price in the first half of our sample and the house price in the second half (i.e. the house price times the period 2 indicator), and they are instrumented by respectively origin-push immigration in the first half and origin-push immigration in the second half (i.e. origin-push immigration times the period 2 indicator). This procedure of interacting both the excluded instrument and the endogenous regressor with an exogenous sample split indicator to test for subsample differences is one we shall use several times below. For a more detailed explanation, see for instance Ozer-Balli and Sorensen (2010).

Table 6 provides the results on the sample split by period. Columns (1) and (2) show both first-stage regressions, which again feed into all second-stage estimations in the following columns. Column (3) shows the effect of the house price on mortgage demand and Columns (4)-(6) show that on mortgage supply. The interaction term in Line 4 shows how the marginal effect of house prices on these different outcomes in the second period differs from that in the first. Findings on this issue are two-fold. Firstly we find that the marginal effect of the house price on mortgage *demand* is much stronger in the second than in the first period. This might reflect the fact that in the course of the boom houses have already become more expensive, while wealth has not increased as much, so households must rely more heavily on external finance. It may also reflect the fact that potentially the fraction of "marginal households", whose savings are low in relation to the envisaged house price, may have increased. Lenders respond to these changes in house prices by making significantly *fewer* offers, whereas the inter-period difference in pricing behavior is not statistically significant.

5.4 The Effect of House Prices for Low- vs. High-LTV and PTI requests

Another way to deepen our understanding of how mortgage demand and supply respond to higher house prices is to analyze this separately for low and high LTV ratios, and for low and high PTI ratios. In contrast to the sample split by period, the indicator for high vs. low LTV is *endogenous to mortgage demand*: The higher the mortgage amount requested, the more likely the request is to be in the high-LTV and high-PTI subsamples. But the interaction procedure explained in the previous subsection is only valid if the interaction variable is exogenous, for otherwise interacting it with the instrument does not yield a valid second instrument. Therefore we cannot validly test for subsample differences in the effect of house prices on mortgage *demand* here.

By contrast we may validly test for differences in the effect on mortgage supply. This is based on the reasoning that in our setup LTV and PTI are not reversely caused by the *request-specific* mortgage supply (*average* mortgage supply is being controlled for by our year, month and canton fixed effects), because offers are made only *after* requests have been submitted. Our robustness checks based on a Simultaneous Equations Model (SEM) below confirm that this reasoning is indeed plausible.

Table 7 and Table 8 describe the results of the interactions with respectively LTV and PTI indicators. Like in the table on the first vs. the second half of the sample, we interact both our endogenous regressor and our instrument with an indicator, now for respectively LTV ratios above 67% and for PTI ratios above 33%. These are commonly deemed relevant thresholds in the Swiss market and are also mentioned as such to applicants on the Comparis website. Traditionally, Swiss banks have required households to amortize the portion with an LTV above 67% and since 2012 they are required by regulation to do so. For banks there are also changes in regulatory risk weights at the 67% threshold as well as at the 80% threshold. Given the second discontinuity at the 80% LTV as well as some outliers above that level, we focus in Table 7 on observations with LTVs below 80%. Table 7 shows that in the case of more leveraged households banks restrict the number of offers in response to high house prices more strongly than otherwise: The more "skin the bank is to put into the game", the more it wants to be compensated for additional risk. Point estimates also suggest that the interest rate response to house prices is higher for high-LTV than for low-LTV applications, however that difference is not statistically significant at conventional levels. Table 8 by contrast reveals no difference in the supply response of banks to house prices between more and less affordable requests. A possible explanation for these differences between Tables 7 and 8 is that while highly leveraged

households are particularly exposed to price risk, households with high PTI ratios are instead more exposed to interest rate and income risk, as explained in Brown and Guin (2013).

5.5 Multi-Family Homes as Proxy for Income-Producing Real Estate

Table 9 interacts our main regressors of interest with an indicator for multi-family homes (MFH), which can be seen as a proxy for Income-Producing Real Estate (IPRE). Given the evidence from other studies that migrants themselves tend to rent rather than buy, we would expect a larger 1st stage effect of OP immigration on house prices for MFHs. This is confirmed by Columns 1 and 2, which show a 1st stage effect of about 9% for non-MFHs but one of about 17% for MFHs. Column 3 shows tentative evidence that for MFHs house prices have a larger effect on the amount demanded, although that difference is not statistically significant. Columns 4-6 show that ceteris paribus high house prices make banks less nervous when the object is a MFH. Presumably this is so since for MFHs house prices must be assessed in relation to expected rents, which are not being observed and controlled for here.

5.6 New Mortgage vs. Refinancing Requests

Table 10 continues with a distinction between new mortgage and refinancing requests, each of which makes up about half of our sample. This is because when they first buy a house, Swiss households will typically get a fixed rate or Libor-pegged mortgage for a fixed period of mostly up to 10 years. After that time they will not have repaid their mortgage but must renegotiate a refinancing deal. In the period covered by our sample, mortgage interest rates were typically lower than 5 or 10 years before and so all such households had an incentive to renegotiate both

with their previous bank and with other banks via the Comparis website. Another specificity of our sample is that at the time at which households were asking for a refinancing mortgage the market value of their house had typically increased a good deal above that at which they had concluded their initial mortgage contract. In contrast to many other countries however[13], only about 12% of refinancing requests in our sample asked for a higher than the original mortgage amount.[14] In that environment of increasing house prices, these 12% are also more likely (66%) to provide an updated house value instead of the original purchase price[15] than those asking for the same as the original amount (48%) or those who have already repaid part of the mortgage (42%).

In line with this picture in which few households exploit the rising house prices to increase their mortgage, Table 10 reveals that for refinancing requests house prices have a significantly smaller effect on mortgage demand than for new mortgages, as indicated by the negative coefficient on the interaction between the house price and the refinancing indicator in Column (3), Line 4. By contrast, the role of house prices for the degree of caution banks exert in their mortgage supply is if anything smaller for refinancing requests than for new mortgages. This can be seen from the fact that the interactions in Columns (5)-(7) carry the opposite sign of the main effects, with that for the number of offers also being statistically significant. The finding may firstly reflect that with few mortgage amount increases most refinancing requests now have a lower leverage relative to current house prices than the new mortgage requests. Secondly, refinancing requests have already been checked once by the bank financing the new mortgage, so that new

[13] E.g. Mian and Sufi (2011) show that in the US subprime boom leverage was increased by households taking equity out of their homes.

[14] At the same time, only about 12% had reduced the amount, with 76% asking for the same as the original amount, a consequence of tax incentives to save into other assets but retain mortgage debt as high as allowed by regulators and banks.

[15] The website allows for either, but asks households to specify the source of their house value.

banks may find fewer remaining shortcomings here than for new mortgage requests.

5.7 The Effects for Risk-Seeking vs. Risk-Averse Mortgage Applicants

It is also interesting to compare the effects of house prices on mortgage demand and supply for more with those for less risk-averse applicants. To do so, Table 11 shows the results for different types of mortgage model: Risk-averse applicants can be deemed more likely to choose a model in which the interest rate is fixed. As our summary statistics revealed, this applies to 81% of requests. Less risk-averse applicants may choose models in which the rate is tied to LIBOR interest rates or can be adjusted freely by banks in response to changing market environments[16]. Another interesting subsample are households applying for special mortgages with rate discounts for energy-efficient buildings, discounts for children, or initial discounts ("step mortgages"). Since we compare more than two categories here, we are not presenting an interaction of the main effect with an indicator, as before. Instead we have estimated results separately for different subsamples. Panel (A) presents, for reference, the results for our full sample. Panel (B) presents results only for fixed-rate mortgages, which with 10,381 of 12,753 requests presents the large majority of observations. Out of these 10,381 requests, again the largest groups (not displayed separately) are mortgages with rates fixed for either 5 or 10 years, whereas the groups with rates fixed for 1, 2, 3, 4, 6, 7, 8 or 9 years are smaller. The outcome variables presented in the 5 columns are the same as before. In the discussion of these results we focus on the IV results. A comparison of the effects of house prices on mortgage demand in

[16] In contrast to LIBOR mortgages, these can typically be terminated without punishment by either side at any time. These 5% of contracts are typically chosen by households who bet that interest rates will fall further and who hope to switch to a fixed-rate model later.

Column (2) between on the one hand fixed rate mortgages (Panel B) and on the other hand adjustable rate mortgages (Panel C) shows that for adjustable rate mortgages house price increases result in larger mortgage amount increases, reflecting a higher leverage and starting PTI of this type of applicant. Column (5) also provides some evidence that for that riskier group house prices have a larger marginal effect on the median interest rate (although the general interest rate level, not displayed, is of course lower for those contracts), suggesting that banks do also perceive these clients as on average riskier and take this into account in their pricing. An above-average effect of on mortgage demand is also found for special rate mortgages.

6 Robustness

Our Online Appendix explores in detail the robustness of our results. Here we provide a brief summary of these robustness checks, while encouraging the reader to take a view at the more detailed discussions and tables in the Online Appendix.

The first section there augments our baseline instrumental variable model, in which we use an excluded instrument only for house prices, with a more general simultaneous equations model that has an "excluded instrument" also for mortgage demand. This allows us to control for direct effects of mortgage demand on mortgage supply. Doing so does not significantly change the estimated effects of house prices on respectively mortgage demand and mortgage supply.

We also explore the role of different sets of fixed effects. We find that time fixed effects do not matter much for the mortgage demand equations, but do matter for mortgage supply, because they control for changes over time in the general level of interest rates. Omitting canton fixed effects does, expectedly, lead to larger estimates. This likely reflects that these canton fixed effects do

successfully absorb remaining cross-sectional differences in price levels. By contrast, whether we do this by means of canton or labor market fixed effects does not matter. Mortgage model fixed effects leave our point estimates largely unchanged, but increase statistical precision in our interest rate regressions.

In further robustness checks, we show that results do not change in a significant way when we use different historical shares to construct our instrument or when exclude the 5 MS areas with the largest inflows of German immigrants. We also show that the effects are not driven by the cantons of Zurich and Geneva, but are in fact weaker there. In particular, banks respond less cautiously to high house prices in Zurich and Geneva than elsewhere, presumably because despite the higher levels they consider prices more justified in these centers than in other regions. Finally, the Appendix shows that the statistical significance of our results does not hinge on how we cluster our standard errors.

7 Conclusion

This paper is one of the very few that disentangle the direction of causality between housing and mortgage markets, as well as to the best of our knowledge the first to do so for a setting other than the recent US subprime bubble. We address this two-way causality in a new way: By use of an origin-push or shift-share strategy, we isolate the exogenous component of immigration into an area. Thereby we exploit variation in house prices that has not been reversely caused by mortgage lending. To the best of our knowledge, we are the first to apply such a strategy to the analysis of mortgage markets. Furthermore, the use of micro instead of regional level data, as well as our focus on within-canton, within-year, within-month variation, renders this approach even more robust than it has been in many existing shift-share papers which had to work with aggregate data only. We find that a 1% higher house price causes a 0.52% higher requested mortgage

amount. The total, non-causal partial correlation between house prices and mortgage volumes is a good deal larger. Causality therefore is not restricted to one direction, but does flow in both ways.

At the same time, we are able to trace out separate causal effects of house prices on respectively mortgage demand and mortgage supply. We find strong evidence that the higher house prices have specifically led to an expansion of mortgage *demand*. Interestingly, our results do not support the hypothesis that higher house prices and therefore more valuable collateral cause banks to lend more or at lower rates. To the contrary, we find that higher house prices attract ceteris paribus *fewer* mortgage offers and *higher* mortgage interest rates. This result emphasizes the importance of the demand channel even more. However, it has been obtained by comparing requests with more and less expensive houses submitted in the same low-interest rate environment. So while we find lenders to be careful about high house prices, that does not rule out that in the market as a whole the low interest rates of recent years have also caused an expansion of mortgage supply.

We also demonstrate how the mutually reinforcing real estate and mortgage market booms have evolved and how the marginal effect of house prices on respectively mortgage demand (positive) and mortgage supply (negative) has become stronger over time. We show that the positive effect of house prices on mortgage pricing is particularly strong for high LTV applications, but does not vary with PTI ratios. Both demand and supply effects are smaller for rollovers than for new mortgage requests. Finally, the cautious response of lenders to high house prices is less pronounced in the "prime locations" Zurich and Geneva than elsewhere.

Our findings have important policy implications. First, we have shown that part of the house price boom has occurred for reasons exogenous to the mortgage market, although there is indeed also positive feedback from mortgage volumes to house prices. This implies that from the policy side, *house prices* can be influenced through mortgage market measures, but the influence is limited. If policy makers wish to exert a strong impact also on house prices, they may need to intervene also directly in the real estate market. Measures to be considered here may include changes to building permit restrictions, to the supply of public transport as an influence on which areas are well connected to jobs, subsidies for social housing, or affecting competition in the construction sector. Second, our finding that house prices have exerted a greater positive effect on mortgage demand than on mortgage supply supports the usefulness of measures targeting mortgage demand in order to affect the quantity and quality of mortgage growth. Kuttner and Shim (2013) have shown that changes to tax incentives have a particularly high probability of success here, but restrictions on LTV or PTI ratios, which can limit the maximum mortgage amount a household can request for a given level of savings or income, may also help.

Bibliography

Accetturo, Antonio, Francesco Manaresi, Sauro Mocetti, and Elisabetta Olivieri. "Don't stand so close to me: the urban impact of immigration." *Regional Science and Urban Economics*, 2014.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino. "Credit supply and house prices: evidence from mortgage market segmentation." *NBER Working Paper*, 2012.

Adrian, Tobias, and Hyun Song Shin. "Procyclical Leverage and Value-at-Risk." *Federal Reserve Bank of New York Staff Reports*, 2013.

Bartel, Anne. "Where do the new US immigrants live?" *Journal of Labor Economics*, 1989.

Basten, Christoph, and Michael Siegenthaler. "Do immigrants destroy or create natives' jobs? Quasi-experimental evidence from Switzerland." *KOF Working Paper 335*, 2013.

Brown, Martin, and Benjamin Guin. "How Risky are Residential Mortgages in Switzerland?" *Hochschule St. Gallen mimeo*, 2013.

Brown, Martin, and Matthias Hoffmann. "Mortgage Relationships." *Hochschule St. Gallen mimeo*, 2013.

Bruckner, Jan, Paul Calem, and Leonard Nakamura. "Subprime mortgages and the housing bubble." *Federal Reserve Bank of Philadelphia Working Paper*, 2011.

Bundesamt für Wohnungswesen. *Personenfreizügigkeit und Wohnungsmarkt (Modul 1).* 2007.

Campbell, John. "Mortgage market design." *Review of Finance*, 2013.

Card, David. "Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration." *Journal of Labor Economics*, 2001.

Coleman, Major, Michael LaCour-Little, and Kerry Vandell. "Subprime lending and the housing bubble: Tail wags dog?" *Journal of Housing Economics*, 2008.

Credit Suisse Global Research. "Immobilienmonitor 3. Quartal 2013." 2013.

Crowe, Christopher, Giovanni Dell'Ariccia, Pau Rabanal, and Deniz Igan. "Policies for Macrofinancial Stability: Options to Deal with Real Estate Booms." *IMF Staff Discussion Note*, 2011.

Degen, Kathrin, and Andreas M. Fischer. "Immigration and Swiss House Prices." *SNB Working Paper*, 2010.

Favara, Giovanni, and Jean Imbs. "Credit supply and the price of housing." *CEPR Discussion Paper*, 2011.

Favre, Sandro, Rafael Lalive, and Josef Zweimüller. *Verdrängungseffekte des Freizügigkeitsabkommens Schweiz-EU auf dem Schweizer Arbeitsmarkt.* 2013.

Fischer, Andreas. "Immigrant language barriers and house prices." *Regional Science and Urban Economics*, 2012.

Fostel, Ana, and John Geneakoplos. "Tranching, CDS, and Asset Prices: How financial innovation can cause bubbles and crashes." *American Economic Journal: Macroeconomics*, 2012.

Geneakoplos. "The leverage cycle." *Cowles Foundation Working Paper*, 2010.

Gonzalez, Libertad, and Francesc Ortega. "Immigration and Housing Booms: Evidence from Spain." *Journal of Regional Science*, 2013.

Haughwout, Andrew, Donghoon Lee, Joseph Tracy, and Wilbert van der Klaauw. "Real Estate Investors, the Leverage Cycle, and the Housing Market Crisis." *Federal Reserve Bank of New York Staff Reports*, 2011.

Hunt, Jennifer, and Marjolaine Gauthier-Loiselle. "How much does immigration boost innovation?" *American Economic Journal: Macroeconomics*, 2010.

Igan, Deniz, and Prakash Loungani. "Global housing cycles." *IMF Working Paper*, 2012, 217 ed.

IMF. "Housing Finance and Financial Stability - Back to Basics?" In *Global Financial Stability Report*, by IMF. Washington, DC, 2011.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti. "Household Leveraging and Deleveraging." *NBER Working Paper 18941*, April 2013.

Kuttner, Kenneth N., and Ilhyock Shim. "Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies." *BIS Working Paper 433*, 2013.

Mian, Atif, and Mian Sufi. "House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis." *American Economic Review*, August 2011.

—. "The consequences of mortgage credit expansion: Evidence from the US mortgage default crisis." *Quarterly Journal of Economics*, 2009.

Ozer-Balli, Hatice, and Bent E. Sorensen. *Interaction Effects in Econometrics.* 2010.

Puri, Manju, Jörg Rocholl, and Sascha Steffen. "Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects." *Journal of Financial Economics*, 2011: 556-578.

Puri, Manju, Jorg Rocholl, and Sascha Steffen. "The impact of bank relationships on default risk in consumer lending." *Mimeo*, 2012.

Rey, Urs. *Immer mehr Altbauten stehen zum Verkauf.* Statistisches Amt des Kantons Zürich, 2012.

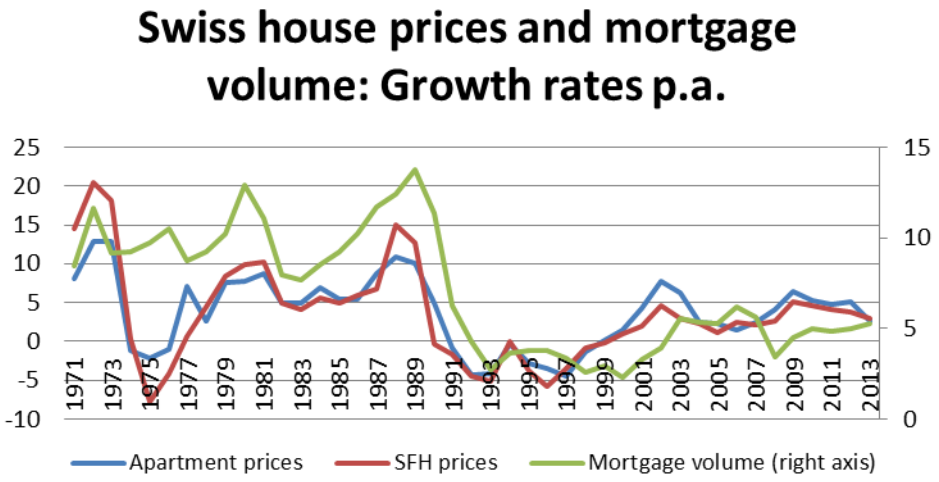
Rey, Urs. *Zuwanderung und Wohnungsmarkt.* Statistisches Amt des Kantons Zürich, 2011.

Saiz, Albert. "Immigration and housing rents in American cities." *Journal of Urban Economics*, 2007.

Schweizerische Nationalbank. *Statistisches Monatsheft Juni 2013.* Zurich, 201

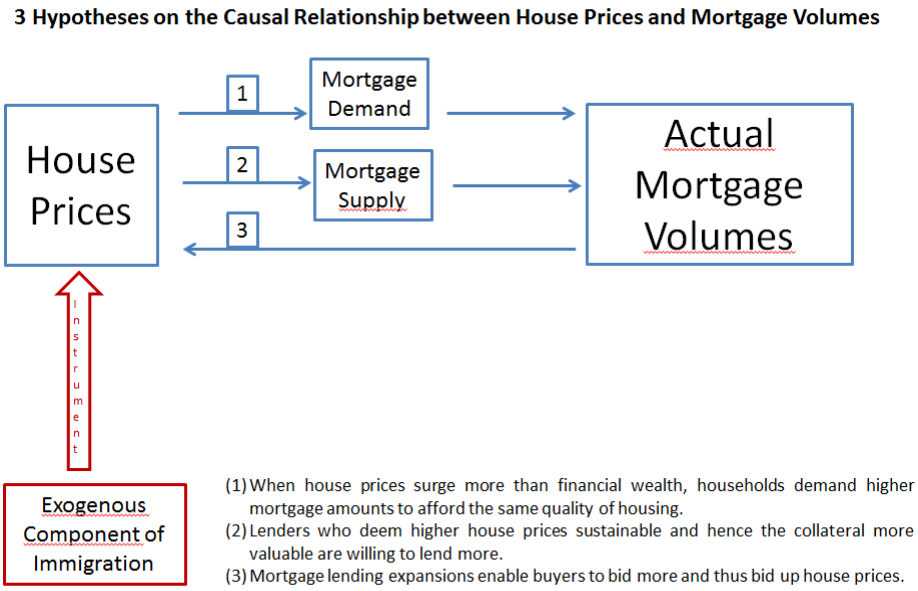
I. Figures

Figure 1: Swiss house prices and mortgage volume: Nominal growth rates per annum



Sources: SNB Stat. Monthly, T. Q4.3 (prices) and D1.1 (mortg. vol. 1988 ff.), SNB Hist. Data (MV pre-1988)

Figure 2: Three different causal relationships between house prices and mortgage volumes



II. Tables

Table 1: Sample Composition

		Observations	Percentage of the Sample
(A)	**By Year**		
	2008	2'599	20.38%
	2009	2'808	22.02%
	2010	2'587	20.29%
	2011	1'627	12.76%
	2012	1'746	13.69%
	2013 (Jan-Oct)	1'386	10.87%
(B)	**By Model**		
	Rate Fixed for 1 Year	36	0.28%
	Rate Fixed for 2 Years	194	1.52%
	Rate Fixed for 3 Years	582	4.56%
	Rate Fixed for 4 Years	179	1.40%
	Rate Fixed for 5 Years	3'332	26.13%
	Rate Fixed for 6 Years	282	2.21%
	Rate Fixed for 7 Years	494	3.87%
	Rate Fixed for 8 Years	663	5.20%
	Rate Fixed for 9 Years	59	0.46%
	Rate Fixed for 10 Years	4'562	35.77%
	Variable Rate	641	5.03%
	Rate Libor-pegged for 3 Years	553	4.34%
	Rate Libor-pegged for 5 Years	186	1.46%
	Combined mortgage for <5 Years	145	1.14%
	Combined mortgage for >=5 Years	79	0.62%
	Special mortgage	766	6.01%
(C)	**By Object type**		
	Penthouse	356	2.79%
	Semi-Detached House	1'232	9.66%
	Apartment	3'565	27.95%
	Single Family Home	4'957	38.87%
	Multi Family Home	977	7.66%
	Town/Row/Terraced House	1'141	8.95%
	Terrace House	206	1.62%
	Mansion/Bungalow	319	2.50%

Special models include those with interest rate discounts for respectively energy-efficient buildings and large families, as well as "step" mortgages with lower initial rates.

Table 2: Summary Statistics

		Observations	Mean	Std. Dev.	P10	P50	P90
(A)	**Key request figures**						
	Requested Mortgage Amount (CHF)	12'753	586'933	348'282	250'000	500'000	1'000'000
	House Price (CHF)	12'753	939'855	571'636	455'000	795'000	1'600'000
	Loan-to-Value ratio (LTV ratio)	12'753	64.79	16.83	39	69	80
	Price-to-Income (PTI ratio)	12'753	26.33	10.39	14	26	37
	Request for a new Mortgage in % (Indicator)	12'753	52.31%				
	Amount of the Previous Mortgage (for roll-overs)	6'082	527'104	450'614	227'000	449'540	830'700
(B)	**Key applicant and object figures**						
	Household Income (CHF p.a.)	12'753	167'256	91'417	85'000	146'000	270'000
	Household Liquidity (CHF)	12'753	168'997	216'317	16'500	100'000	400'000
	Household Debt in % (Indicator)	12'753	19.96	39.97	0	0	1
	Household owns real estate in % (Indicator)	12'753	27.57	44.69	0	0	1
	HH wealth incl retirement savings	12'753	511'768	924'411	95'000	315'000	1'022'000
	Applicant age	12'753	46.05	10.23	34	45	61
	House age in decades	12'753	2.49	3.57	0	1	7
(C)	**Immigration into MS Areas**						
	Origin Push Immigration / Population (1995 shares)	12'753	1.33%	0.82%	0.67%	1.07%	2.72%
	Origin Push Immigration / Population (2000 shares)	12'753	1.34%	0.83%	0.60%	1.07%	2.61%
	Origin Push Immigration / Population (2008 shares)	12'753	1.36%	0.87%	0.58%	1.08%	2.62%
	Actual Immigration / Population	12'753	1.36%	0.85%	0.59%	1.07%	2.71%
(D)	**Offers**						
	Offers per Request	12'753	5.41	2.55	2	5	9
	Best Interest Rate Offered	12'753	2.31	0.76	1.25	2.25	3.35
	Median Interest Rate Offered	12'753	2.54	0.76	1.56	2.49	3.57

Notes: Best and median interest rate: Amount-weighted average across tranches.

Table 3: Numerical Example to illustrate the Functioning of the Instrument

		(1) From Germany	(2) From Ex Yugoslavia	(3) From Anywhere
(A)	Imm. into Switzerland 1995	8'215	20'169	83'456
	Share in Zurich 1995	14.22%	6.28%	7.90%
	Share in Geneva 1995	5.79%	2.62%	14.34%
	Imm. into Switzerland 2008	34'270	7'739	125'937
	Share in Zurich 2008	13.12%	5.34%	8.56%
	Share in Geneva 2008	2.23%	8.61%	14.18%
(B)	Actual Immigrants ZH 2008	4'496	413	
	Origin-Push Imm. ZH 2008	4'873	486	
	Actual Immigrants GE 2008	764	666	
	Origin-Push Imm. GE 2008	1'984	203	
(C)	Actual Imm. /Pop. ZH 2008	1.25%	0.12%	
	Origin-Push Imm. / Pop. ZH 2008	1.36%	0.14%	
	Actual Imm. / Pop. GE 2008	0.17%	0.15%	
	Origin-Push Imm. / Pop. GE 2008	0.45%	0.05%	

This table shows in Panel (A) the raw data, in Panel (B) actual and instrument values for 2008 for respectively MS areas Zurich and Geneva. The instrument values, denoted as Origin-Push or Shift-Share, Immigration are computed according to Equations (1) and (2), see Section 4.5. Panel C) shows the corresponding values as percentage of previous year's (2007) population levels, which were respectively 358'540 and 438'177.

Table 4: Main Instrumental Variable Results

	First Stage	Mortgage Demand	Mortgage Supply		
	(1)	(2)	(3)	(4)	(5)
	Ln House Price	Ln Mortg. Amount	Number of Offers	Best Int. Rate	Median Int. Rate
Origin Push Immigration	0.093***				
	(0.007)				
Ln House Price (instrumented)		0.523***	-0.972**	0.148**	0.175***
		(0.071)	(0.414)	(0.062)	(0.055)
Ln Income	0.311***	0.249***	0.853***	-0.087***	-0.068***
	(0.026)	(0.034)	(0.165)	(0.022)	(0.020)
Ln Wealth	0.067***	-0.021***	0.230***	-0.036***	-0.036***
	(0.006)	(0.007)	(0.039)	(0.006)	(0.005)
Ln Liquidity	0.046***	0.020***	0.117***	-0.001	0.001
	(0.003)	(0.005)	(0.027)	(0.004)	(0.004)
Other Fin. Obligations (y/n)	0.010	0.020**	-0.357***	0.006	0.000
	(0.010)	(0.009)	(0.053)	(0.008)	(0.007)
Other Real Estate (y/n)	0.038***	-0.031***	-0.456***	0.005	-0.016**
	(0.009)	(0.008)	(0.050)	(0.008)	(0.007)
House Age (Decades)	-0.021***	-0.010***	-0.019*	0.005***	0.005***
	(0.001)	(0.002)	(0.010)	(0.002)	(0.001)
Constant	8.697***	3.145***	6.820*	3.340***	2.988***
	(0.266)	(0.616)	(3.614)	(0.543)	(0.481)
Canton Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	12'753	12'753	12'753	12'753	12'753
R-sq	0.522	0.610	0.282	0.809	0.840

This table shows in Column (1) the common 1st stage effect of origin push immigration on the house price. Columns (2)-(3) show the 2nd stage estimates of the causal effect of the house price on mortgage demand, measured by respectively the amount requested and the payment-to-income ratio requested. Columns (4)-(6) show the 2nd stage estimates of the effect on mortgage supply, as measured by respectively the number of offers a household receives, the best interest rate offered, and the median interest rate offered. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 5: Ordinary Least Square (OLS) Results

	Mortgage Demand	Mortgage Supply		
	(1)	(2)	(3)	(4)
	Ln Mortg. Amount	Number of Offers	Best Int. Rate	Median Int. Rate
Ln House Price	0.777***	-0.367***	-0.014	-0.019**
	(0.013)	(0.063)	(0.008)	(0.008)
Ln Income	0.168***	0.660***	-0.036***	-0.006
	(0.018)	(0.084)	(0.007)	(0.006)
Ln Wealth	-0.038***	0.189***	-0.025***	-0.023***
	(0.005)	(0.026)	(0.004)	(0.004)
Ln Liquidity	0.008***	0.089***	0.007**	0.010***
	(0.003)	(0.020)	(0.003)	(0.003)
Other Fin. Obligations (y/n)	0.018**	-0.364***	0.007	0.002
	(0.008)	(0.052)	(0.008)	(0.007)
Other Real Estate (y/n)	-0.041***	-0.481***	0.012*	-0.008
	(0.007)	(0.046)	(0.007)	(0.006)
House Age (Decades)	-0.005***	-0.007	0.002**	0.001
	(0.001)	(0.006)	(0.001)	(0.001)
Constant	0.949***	1.585**	4.740***	4.660***
	(0.139)	(0.766)	(0.107)	(0.094)
Year month canton FEs	Yes	Yes	Yes	Yes
Object Type FEs	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
Mortg. Model FEs	Yes	Yes	Yes	Yes
N	12'753	12'753	12'753	12'753
R2	0.637	0.289	0.814	0.849

This table shows in Column (1) the Ordinary Least Squares estimates of the association between house prices and mortgage demand, measured by the amount requested. Columns (2)-(4) show the assocations between house prices and mortgage supply, as measured by respectively the number of offers a household receives, the best interest rate offered, and the median interest rate offered. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 6: Years 2008-10 vs. years 2011-13

	First Stage		Mortgage Demand	Mortgage Supply		
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln House Price	Ln HP* I(yr>=2011)	Ln Mortg. Amount	Number of Offers	Best Int. Rate	Median Int. Rate
Origin Push Immigration (OPI)	0.084***	-0.019***				
	(0.007)	(0.004)				
OPI*Indicator(year>=2011)	0.024***	0.134***				
	(0.009)	(0.008)				
Ln House Price			0.462***	-0.537	0.161**	0.201***
			(0.081)	(0.465)	(0.072)	(0.063)
Ln HP*Indicator(year>=2011)			0.159**	-1.130***	-0.035	-0.070
			(0.069)	(0.353)	(0.062)	(0.054)
Ln Income	0.311***	0.122***	0.249***	0.856***	-0.087***	-0.068***
	(0.026)	(0.012)	(0.034)	(0.166)	(0.022)	(0.020)
Ln Wealth	0.067***	0.029***	-0.022***	0.234***	-0.036***	-0.036***
	(0.006)	(0.004)	(0.007)	(0.039)	(0.006)	(0.005)
Ln Liquidity	0.045***	0.021***	0.020***	0.121***	-0.001	0.001
	(0.003)	(0.002)	(0.005)	(0.028)	(0.004)	(0.004)
Other Fin. Obligations (y/n)	0.010	0.013*	0.019**	-0.346***	0.006	0.001
	(0.010)	(0.007)	(0.009)	(0.053)	(0.008)	(0.007)
Other Real Estate (y/n)	0.038***	0.003	-0.029***	-0.468***	0.005	-0.017**
	(0.009)	(0.007)	(0.008)	(0.050)	(0.008)	(0.007)
House Age (Decades)	-0.021***	-0.007***	-0.010***	-0.019*	0.005***	0.005***
	(0.001)	(0.001)	(0.002)	(0.010)	(0.002)	(0.001)
Constant	8.709***	-1.949***	4.001***	0.756	3.152***	2.615***
	(0.266)	(0.131)	(0.782)	(4.427)	(0.699)	(0.612)
Canton Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	12753	12753	12753	12753	12753	12753
R-sq	0.522	0.998	0.605	0.273	0.808	0.840

This table tests whether the effects of interest differ between the 1st and the 2nd half of our sample. It shows in Columns (1) and (2) the 1st stage regressions for respectively the house price in 2008-10 and that in 2011-13. Column (3) shows the 2nd stage estimate of the effect of the house price on mortgage demand, measured by the amount requested. The effect for 2008-10 is given by the coefficient in Line 3 alone, that for 2011-13 by adding to that the coefficient from Line 4 (Log HP*Indicator). Hence that coefficient tells us how the effect in 2011-13 differed from that before. Columns (4)-(6) show analogously the effects of the two house price variables on mortgage supply, measured by respectively the number of offers received, the best and the median interest rate offered. Robust SEs in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 7: High- vs. low-LTV applications

	First Stage		Mortgage Supply		
	(1) Ln House Price	(2) Ln HP* I(LTV>=67)	(3) Number of Offers	(4) Best Int. Rate	(5) Median Int. Rate
Origin Push Immigration (OPI)	0.103***	-0.011**			
	(0.009)	(0.005)			
OPI*I(LTV>=67)	-0.016*	0.107***			
	(0.009)	(0.008)			
Ln House Price			-1.177***	0.172**	0.207***
			(0.434)	(0.069)	(0.062)
Ln HP*I(LTV>=67)			-0.989**	0.094	0.040
			(0.417)	(0.074)	(0.066)
I (LTV>=67)	-0.086***	13.436***	12.877**	-1.224	-0.485
	(0.014)	(0.012)	(5.665)	(1.008)	(0.896)
Ln Income	0.307***	0.146***	1.229***	-0.118***	-0.089***
	(0.030)	(0.015)	(0.210)	(0.027)	(0.023)
Ln Wealth	0.049***	0.015***	0.163***	-0.028***	-0.029***
	(0.007)	(0.004)	(0.038)	(0.006)	(0.005)
Ln Liquidity	0.042***	0.026***	0.113***	-0.005	-0.002
	(0.004)	(0.003)	(0.029)	(0.005)	(0.004)
Other Fin. Obligations (y/n)	0.025**	-0.004	-0.291***	0.005	-0.004
	(0.011)	(0.008)	(0.062)	(0.009)	(0.008)
Other Real Estate (y/n)	0.039***	0.018**	-0.511***	0.005	-0.013*
	(0.009)	(0.007)	(0.054)	(0.009)	(0.008)
House Age (Decades)	-0.020***	-0.010***	-0.028***	0.006***	0.005***
	(0.001)	(0.001)	(0.011)	(0.002)	(0.002)
Constant	9.044***	-2.117***	6.549	3.275***	2.711***
	(0.303)	(0.152)	(4.226)	(0.682)	(0.613)
Canton Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	9994	9994	9994	9994	9994
R-sq	0.519	0.998	0.320	0.810	0.840

This table tests whether the effect of house prices differs between high and low LTV requests. It shows in Col. 1 and 2 the 1st stage regressions for respectively the house price in applications with LTV<67% and in applications with LTV>=67%. Observations with LTV>80% are dropped. C. 3-5 show the effect of the house price on respectively the number of offers received, the best interest rate, and the median interest rate. In each case the effect for LTV<67% applications is given by the Line 3 coefficient alone,

Table 8: High- vs. low-PTI applications

	First Stage		Mortgage Supply		
	(1) Ln House Price	(2) Ln HP* I(PTI>=33)	(3) Number of Offers	(4) Best Int. Rate	(5) Median Int. Rate
Origin Push Immigration (OPI)	0.078***	-0.020***			
	(0.007)	(0.003)			
OPI*I(PTI>=33)	0.025***	0.151***			
	(0.009)	(0.010)			
Ln House Price			-0.373	0.140*	0.195***
			(0.446)	(0.072)	(0.064)
Ln HP*I(PTI>=33)			0.517	-0.021	-0.042
			(0.335)	(0.061)	(0.055)
Indicator (PTI>=33)	0.269***	13.648***	-9.038**	0.317	0.544
	(0.013)	(0.015)	(4.598)	(0.841)	(0.750)
Ln Income	0.365***	0.113***	0.268	-0.077***	-0.077***
	(0.030)	(0.009)	(0.170)	(0.027)	(0.025)
Ln Wealth	0.072***	0.015***	0.148***	-0.034***	-0.037***
	(0.006)	(0.003)	(0.039)	(0.006)	(0.006)
Ln Liquidity	0.036***	0.006***	0.144***	-0.001	0.002
	(0.003)	(0.002)	(0.024)	(0.004)	(0.004)
Other Fin. Obligations (y/n)	-0.010	-0.007	-0.232***	0.003	0.003
	(0.010)	(0.006)	(0.048)	(0.008)	(0.007)
Other Real Estate (y/n)	0.043***	0.043***	-0.530***	0.007	-0.015**
	(0.008)	(0.005)	(0.049)	(0.008)	(0.007)
House Age (Decades)	-0.018***	-0.003***	-0.024***	0.005***	0.005***
	(0.001)	(0.001)	(0.009)	(0.001)	(0.001)
Constant	7.994***	-1.563***	6.882*	3.305***	2.836***
	(0.306)	(0.096)	(3.777)	(0.612)	(0.549)
Canton Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	12753	12753	12753	12753	12753
R-sq	0.578	0.999	0.374	0.810	0.840

This table tests whether the effect of house prices differs between high and low PTI ratio requests. It shows in Col. 1 and 2 the 1st stage regressions for respectively the house price in applications with PTI<33% and in those with PTI>=33%. C. 3-5 show the effect of the house price on respectively the number of offers received, the best and the median interest rate. In each case the effect for PTI<33% is given by the Line 3 coefficient alone, that for PTI>=33% cases by the sum of the coefficients from ll. 3 and 4. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 9: Multi-Family Homes vs. other (typically owner-occupied) objects

	First Stage		Mortgage Demand	Mortgage Supply		
	(1) Ln House Price	(2) Ln HP* I(MFH)	(3) Ln Mortg. Amount	(4) Number of Offers	(5) Best Int. Rate	(6) Median Int. Rate
Origin Push Immigration (OPI)	0.094***	-0.002				
	(0.007)	(0.002)				
OPI*Indicator(MFH)	-0.008	0.167***				
	(0.022)	(0.024)				
Ln House Price			0.515***	-1.147***	0.155**	0.182***
			(0.071)	(0.424)	(0.063)	(0.056)
Ln HP*Indicator(MFH)			0.056	1.278**	-0.048	-0.053
			(0.128)	(0.532)	(0.099)	(0.086)
Ln Income	0.425***	13.854***	-0.635	-18.918**	0.687	0.701
	(0.035)	(0.037)	(1.799)	(7.454)	(1.388)	(1.212)
Ln Wealth	0.311***	0.032***	0.250***	0.867***	-0.088***	-0.068***
	(0.026)	(0.005)	(0.034)	(0.169)	(0.022)	(0.020)
Ln Liquidity	0.067***	0.007***	-0.021***	0.231***	-0.036***	-0.036***
	(0.006)	(0.002)	(0.007)	(0.039)	(0.006)	(0.005)
Other Fin. Obligations (y/n)	0.046***	0.007***	0.020***	0.117***	-0.001	0.001
	(0.003)	(0.002)	(0.005)	(0.028)	(0.004)	(0.004)
Other Real Estate (y/n)	0.010	-0.000	0.020**	-0.357***	0.006	0.000
	(0.010)	(0.004)	(0.009)	(0.053)	(0.008)	(0.007)
House Age (Decades)	0.038***	0.032***	-0.032***	-0.491***	0.006	-0.014*
	(0.009)	(0.004)	(0.009)	(0.052)	(0.008)	(0.007)
Constant	-0.021***	-0.005***	-0.010***	-0.016	0.005***	0.004***
	(0.001)	(0.001)	(0.002)	(0.010)	(0.002)	(0.001)
Canton Fixed Effects	8.696***	-0.531***	3.243***	9.041**	3.257***	2.897***
	(0.266)	(0.055)	(0.611)	(3.728)	(0.558)	(0.495)
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	12753	12753	12753	12753	12753	12753
R-sq	0.522	0.998	0.610	0.274	0.809	0.840

This table tests whether the effects of interest differ between multi-family homes (MFH) and other objects. It shows in Columns (1) and (2) the 1st stage regressions for respectively the house price of non-MFH and MFH objects. (3) shows the 2nd stage estimate of the effect of the house price on the mortgage amount demanded. The effect for non-MFHs is given by the coefficient in Line 3 alone, that for 2MFHs by adding to that the coefficient from Li.4 (Log HP*MFH). Hence that coefficient tells us how the effect i or MFHs differs from that for non-MFHs. C. (4)-(6) show analogously the effects of the 2 house price variables on mortgage supply, measured by the number of offers received, the best and the median rate offered. Robust SEs in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 10: New Mortgages vs. Refinancing requests

	First Stages		Mortgage Demand	Mortgage Supply		
	(1) Ln House Price	(2) Ln HP* I(Rollover)	(3) Ln Mortg. Amount	(5) Number of Offers	(6) Best Int. Rate	(7) Median Int. Rate
Origin Push Immigration (OPI)	0.096***	-0.011**				
	(0.008)	(0.005)				
OPI*Indicator(Rollover)	-0.004	0.118***				
	(0.008)	(0.008)				
Ln House Price			0.645***	-1.531***	0.197***	0.172***
			(0.069)	(0.446)	(0.067)	(0.060)
Ln HP*Indicator(Rollover)			-0.163**	1.028***	-0.088	0.024
			(0.066)	(0.351)	(0.060)	(0.054)
Indicator(Rollover)	0.002	13.438***	1.979**	-13.569***	1.156	-0.361
	(0.013)	(0.011)	(0.900)	(4.773)	(0.811)	(0.730)
Ln Income	0.311***	0.119***	0.225***	0.915***	-0.093***	-0.071***
	(0.026)	(0.012)	(0.031)	(0.169)	(0.022)	(0.020)
Ln Wealth	0.067***	0.017***	-0.008	0.218***	-0.035***	-0.033***
	(0.006)	(0.004)	(0.007)	(0.039)	(0.006)	(0.005)
Ln Liquidity	0.045***	0.013***	-0.020***	0.195***	-0.008*	-0.006
	(0.004)	(0.003)	(0.005)	(0.029)	(0.004)	(0.004)
Other Fin. Obligations (y/n)	0.010	0.022***	0.010	-0.352***	0.005	-0.002
	(0.010)	(0.008)	(0.008)	(0.053)	(0.008)	(0.007)
Other Real Estate (y/n)	0.038***	0.033***	-0.015*	-0.496***	0.009	-0.014**
	(0.009)	(0.007)	(0.008)	(0.050)	(0.008)	(0.007)
House Age (Decades)	-0.021***	-0.009***	-0.009***	-0.021**	0.006***	0.005***
	(0.001)	(0.001)	(0.002)	(0.010)	(0.002)	(0.001)
Constant	8.702***	-1.636***	2.194***	12.746***	2.833***	3.120***
	(0.269)	(0.132)	(0.643)	(4.160)	(0.635)	(0.562)
Canton Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year and month Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes
Object Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Mortg. Model Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	12753	12753	12753	12753	12753	12753
R-sq	0.522	0.998	0.657	0.282	0.809	0.840

This table tests whether the effect of the house price differs between new mortgages and refinancing requests. It shows in Columns (1) and (2) the 1st stage regressions for respectively the house price for new mortgages and for the house price in refinancingapplications. Column (3) shows the effect of both house price variables on mortgage demand, measured by the amount requested. C. (4)-(6) finally show the effects of the two house price variables on mortgage supply, measured by respectively the number of offers received,the best interest rate offered, and the median interest rate offered.Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 11: Results by mortgage model

			First Stage	Mortgage Demand	Mortgage Supply		
			(1) Ln House Price	(2) Ln Mortg. Amount	(3) Number of Offers	(4) Best Int. Rate	(5) Median Int. Rate
(A)	All	FS/IV	0.093***	0.523***	-0.972**	0.148**	0.175***
	(N=12'753)		(0.007)	(0.071)	(0.414)	(0.062)	(0.055)
(B)	Fixed Rate	FS/IV	0.088***	0.492***	-1.197**	0.150**	0.123**
	(N=10'381)		(0.007)	(0.084)	(0.487)	(0.068)	(0.058)
(C)	LIBOR & Variable Rate	FS/IV	0.119***	0.617***	0.126	0.023	0.361**
	(N=1'381)		(0.023)	(0.198)	(0.944)	(0.181)	(0.170)
(D)	Special	FS/IV	0.095***	0.607***	-1.960	0.143	0.312
	(N=991)		(0.019)	(0.190)	(1.527)	(0.236)	(0.239)

This table shows in Column (1) the first-stage effects of origin push immigration on house prices, in Column (2) the effects of house prices on mortgage demand, and in Columns (3)-(5) the effect of house prices on mortgage supply. It shows these in panel (A) for our full sample, in panel (B) only for mortgages whose rates are fixed for between 1 and 10 years. In panel (C) it shows the effects only for Libor and variable rate mortgages, in panel (D) for "Special" mortgages with discounts for energy-efficient buildings, discounts for children, or initial discounts ("step mortgages"). Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01