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Abstract

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JEL Classification: E59, G20, G21, G28

Keywords: self-financed investors, zero lower bound, macro-prudential regulation

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The effect of self-financed property buyers on local house prices

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April 5, 2020

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This paper tests the hypothesis whether self-financed property buyers, such as insurance and pension funds, have a larger effect on local house prices than bank-financed property buyers, such as homeowners. Self-financed property buyers of new residential housing are not dependent on mortgage credit and operate independently of the macro-prudential environment. This is not so for bank-financed property buyers. We examine the response of Swiss house prices to new housing investments by self- and bank-financed property buyers at the municipality level between 2008 and 2015: a period when interest rates were at the zero lower bound and macro-prudential regulation became more restrictive. Despite being a small investor class for new residential housing, self-financed property buyers have a disproportionate effect on local house prices.

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1. Introduction

Insurance and pension firms are an important but often overlooked investor group in local housing markets.[1] Insurance and pension firms are primarily self-financed property buyers and differ from traditional bank-financed property buyers, such as homeowners, in that they are not dependent on mortgage credit and operate unconstrained in the macro-prudential environment. A diverging demand effect between self- and bank-financed property buyers may ensue when low interest rates push self-financed property buyers to search for yield, while tighter macro-prudential regulation, designed to curb risk, stymie credit growth for bank-financed property buyers. If an important (yield-seeking) investor group operates outside the realm of macro-prudential policies, then financial stability risks remain.

This paper identifies the effect of self-financed property buyers on local house prices in a policy environment of low interest rates with stricter macro-prudential measures. Under such a policy environment that is currently prevalent in many advanced economies, the empirical hypothesis is that investments in residential housing by self-financed property buyers have a greater effect on local house prices than investments in residential housing by bank-financed property buyers. The disproportionate effect may arise from greater risk-taking of self-financed property buyers because of low interest rates or constrained demand of bank-financed investors because of tighter

[1] Ivashina and Lerner (2018) document that in the ten years following the financial crisis, allocations to private equity and real estate nearly doubled, representing about 20% of assets under management in 2017 for pension firms in many of the largest economies. Similarly, OECD data for Australian, Portuguese, and Swiss pension funds hold more that 10% of their assets in residential housing. The source of the database of the OECD Pension Statistics is https://$stats.oecd.org/viewhtml.aspx?datasetcode = PNN_NEW lang = en$.

macro-prudential regulation.

The empirical study considers the recent Swiss experience from 2008 to 2015 of sustained short-term interest rates at the zero lower bound and the newly introduced macro-prudential measures defined by a sectoral-specific counter-cyclical capital buffer (CCyB). The analysis focuses on the property market for new residential housing. This segment of the property market is attractive for self-financed property buyers that seek to invest in real estate as non-occupant homeowners, because Swiss (national) rent control laws do not impose rent-setting restrictions for first-time tenants.

The analysis relies on spatial information from three separate data sets that identify property buyers, local house prices, and bank balance sheets from mortgage providers. Property buyers are identified by information from building permits at the project level. House prices are for single- and multi-family homes at the municipal level. Information on the CCyB to total risk-weighted assets (RWA) ratio is available for 106 MS (mobilité spatiale) regions.

The empirical framework regresses the change in log house prices at the municipality level on the volume of housing construction for new residential homes by self- or bank-financed property buyers over the total volume of new housing construction in the municipality. Two types of property buyers are considered: self-financed and bank-financed property buyers. The analysis controls for macro-prudential regulation through MS regional CCyB/RWA ratios based on information from regional banks. Our variable of interest is the interaction between the share of new housing construction by type of property buyer and the CCyB/RWA ratio. Under the assumption that

macro-prudential measures are binding, our hypothesis is that the coefficient for the interaction term is positive and greater for (unconstrained) self-financed property buyers than for (constrained) bank-financed property buyers.

The main empirical findings show that self-financed property buyers have a disproportionate effect on local house prices. The coefficient of the interaction between new housing construction by self-financed property buyers and regional CCyB/RWA ratios is positive and highly statistically significant, whereas the coefficient for the interaction between bank-financed property buyers and regional CCyB/RWA ratios is negative. This result suggests that local house prices increase faster in areas with a high share of new housing investment by self-financed property buyers. A further finding concerns the geographic concentration of new construction by self-financed property buyers in urban areas where the regional CCyB/RWA ratios are the highest. This evidence implies that self-financed property buyers bypass regulatory measures designed to curtail the demand for local housing and complicates the interpretation of imbalances linked to the credit cycle in the residential housing market.[2]

The new empirical findings for self-financing property buyers contribute to several strands of the literature on financial stability. First, our findings support empirical studies that emphasize the "investor narrative" in housing booms, i.e., small but highly concentrated property buyers generate large house price effects at the local level. Badarinza and Ramadori (2018) argue

[2]House prices play a fundamental role in the Swiss National Bank (SNB) quarterly assessment of imbalances in the real estate market. These views and other examples are documented in Appendix A1.

that foreign property buyers transmit a safe haven effect through increases in foreign risk on house prices in London with a high share of foreign residents. Similarly, Sá (2016) finds that foreign investment has a positive and significant effect on local house prices in England and Wales. Further, studies by Bhutta (2015), Chinco and Meyer (2015), Defusco et al. (2017), and Mian and Sufi (2018) present evidence that suggests a speculative investor class, "flippers", are a key factor behind U.S. house prices during the boom. Our findings are equally profound in that a larger than average house price effect is established for a particular property buyer that is not dependent on bank credit.

The empirical findings also contribute to the debate on the trade-offs and the appropriate balancing of goals between monetary policy and financial stability. Although exceptionally prolonged periods of low interest rates and other forms of monetary stimulus are sometimes needed to support growth and achieve predefined mandates for inflation, such policy measures may lead to excessive risk-taking activities and therefore contribute to the buildup of financial imbalances, see Williams (2014) and Kryvtsov et al. (2015). We argue the pronounced effect of self-financed property buyers on Swiss house prices is special and arises from the low interest rate environment.

The paper is organized as follows. Section 2 documents the main investor groups active in Swiss residential housing and discusses how they are affected by recently introduced measures to strengthen financial stability. Section 3 presents statistical information and data sources. Section 4 discusses the main hypotheses and the empirical setup. Section 5 presents the empirical results. Section 6 concludes with several policy recommendations.

2. Property buyers and the housing environment

The analysis of property buyers and house prices rests on the assumption that financing needs between self-financed property buyers and bank-financed property buyers differ.[3] The mechanism that we seek to explore rests on a specific policy environment. Abstracting from supply effects resulting from new housing projects, consider a policy environment of low sustained interest rates with restrictive macro-prudential measures. Bank-financed property buyers are financially constrained in that they are dependent on bank mortgages when investing in new real estate projects. Under the assumed policy environment, the demand for housing investment declines for highly leveraged property buyers. This arises because the higher costs of the macro-prudential measures for banks are passed on to the bank-financed property buyers. Ideally from the perspective of the financial regulator, this decline in demand should reduce credit growth of mortgages and dampen local house prices. At the same time, self-financed property buyers are financially unconstrained in that they possess enough capital to finance real estate projects independent of mortgage credit and of the macro-prudential environment. In a low interest rate environment, self-financed property buyers, such as pension funds and insurance companies, seek alternative higher yielding assets including residential housing. Hence, under the same interest rate and macro-prudential environment, housing demand by self-financed property buyers should increase. Even if their presence is small in the aggregate, concen-

[3]We consider only two extreme types of property buyers. In doing so, we do not capture the full number of buyers for new residential housing. Our decision for examining strictly self- and bank-financing is that they represent the extreme cases for which we have information regarding their financing needs. The concern of omitted variables is addressed in the empirical section.

trated investments in select areas however could generate an increase in local house prices.

The analysis considers two classes of property buyers in residential housing. The first type of investors are pension funds, insurance companies, real estate funds, foundations, and occupational pension groups. They tend to use their own capital to invest in residential housing for investment purposes. This means they own the building and receive income from rents. We call this group *self-financed investors*. Self-financed investors refers to owners that are non-occupants of new residential homes.

The second group of property buyers are households that are dependent on mortgage credit. We call this group *bank-financed homeowners*. Self-financed investors differ from bank-financed homeowners not only in their financing needs but also in their consumption requirements. Bank-financed homeowners tend to be occupants and consume housing services from their investment, while self-financed investors do not. This feature of consumption of housing services means that the location choice is not strictly based on maximizing investment returns. Housing projects by bank-financed homeowners therefore need not be concentrated in areas with the highest returns.

Figure 1 substantiates our assumption that not all property buyers in residential housing are equally dependent on bank credit. The solid and dashed lines plot the share of total mortgages to total liabilities for two self-financed groups: pension funds and insurance companies. Their share of total mortgages to total liabilities ranges between 0.2% and 5.7% for the years from 1999 to 2015. Next, the dash-dot line shows the same ratio of mortgages to total liabilities for bank-financed homeowners. The share of household

mortgages to total household liabilities is substantially higher compared to self-financed investors. It rises steadily from 89.2% in 1999 to 93.8% in 2015.

Next, the policy setting for interest rates and macro-prudential regulation influences the behavior of self-financed investors and bank-financed homeowners. Figure 2A shows the profile for the 3-month Libor, an important index for flexible mortgages, together with fixed rate mortgages of different maturities. From the perspective of bank-financed investors, the period 2013 to 2015 is characterized by negative interest rates for the 3-month Libor, which averaged -0.15% in the years after the CCyB was introduced (as opposed to an average of 0.65% in the years between 2008 to 2012). Figure 2B shows a similar low interest rate environment for Swiss government bond yields with durations between 1 year and 30 years. Pension funds, occupational pension funds, and insurance companies are holders of government paper. The persistent low interest rate environment pushes these companies to take on greater risk and seek alternative investment strategies that potentially offer higher yields. Residential investment is one such alternative investment.

Against this policy environment and the desire to limit economic risks posed by banks in the context of the global financial crisis, macro-prudential policy was first discussed in a report by a Swiss commission of experts in 2010. The commission prepared a policy mix containing specific measures in four key areas: capital, liquidity, risk diversification, and organization. In July 2012, the Federal Council announced a set of macro-prudential measures that included a permanent increase in risk weights for high loan-to-value mortgage loans, a revision of the banking industry's self-regulation guidelines

for mortgage lending, and the legal basis for the activation of the CCyB.[4]

The CCyB is the main macro-prudential instrument that counteracts the negative consequences for the real estate market arising from a sustained low interest rate environment.[5] The Swiss CCyB is a sector application in that it applies to both owner-occupied and rental-occupied properties but not for other forms of bank credit. The rationale for its implementation is to increase the resilience of the Swiss banking system against a correction of the imbalances in residential housing. The CCyB acts to counter a further buildup of real estate imbalances, by making it less attractive for banks to grant mortgage loans compared to other forms of lending.[6]

The CCyB was first activated in February 2013 with effect in September 2013. It requires banks to hold additional capital amounting to 1% of risk-weighted residential mortgage loan positions. The counter-cyclical capital buffer was further increased to 2% in January 2014 with effect in June 2014.[7]

[4]See *https : //www.snb.ch/n/mmr/reference/CCB_communication_*2016/*source/ CCB_communication_*2016.*n.pdf* for more details.

[5]In Switzerland, there is no single macro-prudential authority or financial stability board. Responsibilities are divided. For instance, the Swiss National Bank (SNB) has the mandate to ensure financial stability via monetary policy, whereas the Swiss Financial Market Supervisory Authority's (FINMA) responsibility is to ensure the functioning of financial markets. The Federal Government has the role of setting and implementing financial stability policies.

[6]See SNB press statement from 13.2.2013. Auer and Ongena (2016), Basten and Koch (2015a), and Basten and Koch (2015b) examine the effectiveness of the CCyB on Swiss credit and loan pricing conditions. Jimenz et al. (2017) present empirical evidence of the Spanish case.

[7]A further measure by the Banking Association's adjustment of the self-regulation guidelines affected borrowers. The measure introduced in July 2012 consisted of a tightening in the amortisation rules of the self-regulatory directives and a strengthening of the down payment requirement for residential mortgages (at least 10% in cash, i.e., no more than 10% contributed from the retirement fund of the borrower).

3. Data and statistical properties

We combine three separate data sets to construct an annual sample from 2008 to 2015 at the municipality level with 18,312 observations. The first data set uses information, evaluated for the first time, from project-level building permits to identify the property buyer at the municipality level. The second data set is house prices for single- and multi-family homes at the municipality level. The third data set uses information from the SNB's Quarterly Capital Adequacy Reporting Form to define a capital buffer variable, capturing the most recent macro-prudential measures affecting housing finance in Switzerland. The variable is the ratio of a bank's capital set aside according to the counter-cyclical sectorial capital buffer, CCyB, to its total risk-weighted assets, RWA.

The next subsections discuss the three data sets in greater detail.

3.1 Property buyer

Data on the property buyer type are from Wüest Partner and are accessed on a local computer. This data set captures all new and conversion projects that require a building permit from local authorities for 2,289 municipalities. Our analysis considers only new residential building projects between 2008 and 2015. An important motive why investors prefer new housing projects over established buildings is that new buildings bypass Swiss rent control laws.[8]

[8]See Borowiecki (2012), Degen and Fischer (2017), and Sager (2018) for a discussion of Swiss rent control. Apart from rent control, it should be recognized that housing investment restrictive in that non residents cannot freely purchase Swiss real estate under the Lex Koller law and that capital gains taxes seek to hinder short-term speculation. These latter restrictions exclude the possible effect of foreign investment on Swiss house prices analyzed by Sá (2016) and the effect of flippers analyzed by Mian and Sufi (2018).

This means that investors receive market prices from first-time renters.

We observe for every new housing project the following information: (i) the building project applicant, (ii) the postal-code, (iii) the housing type (single-family or multi-family), (iv) usage type (consume, sell, or rent), (v) estimated project costs (in millions CHF excluding land purchases), (vi) the volume (in m^3), (vii) the amount of flats, floors, and buildings per project, (viii) the date of the building permit submission, and (ix) the date of the building permit issuance. Information from the application of building permits identifies the property buyer according to the classification discussed in the previous section. Our preference is to work with estimated building costs as a measure of building volume, because this information is available for each building permit.

Table 1 provides statistical information on the property buyer, project location, and other characteristics. The information on project count and location suggests that these characteristics differ considerably between the self-financed investors and bank-financed homeowners. Bank-financed homeowners tend to build single-family homes for own consumption located throughout Switzerland, whereas self-financed investors build multi-family homes for rent primarily in urban areas.

Figure 3 shows the cumulated projected building costs per type of property buyer for rural and urban areas. Urban areas are 487 municipalities with urban characteristics as classified by the topology index from Bundesamt für Statistik (Swiss Statistical Office, BfS). Rural municipalities are the remaining 1,802 municipalities with rural characteristics according to the

same topology index.[9]

The figure shows that self-financed investors make up a small share of new housing construction and that they are primarily concentrated in urban areas. The share of bank-financed homeowners instead is larger in rural areas. For self-financed investments, the figure shows that the level of persistence is high before and after the introduction of the CCyB measures in 2012.

3.2 House prices

House price data for single- and multi-family homes at the municipality level are from Wüest Partner.[10] Prices for single-family homes are a hedonic index for new residential housing, while prices for multi-family homes are discounted hedonic rents of a representative multi-family home at the municipality level.[11]

Figure 4 shows the evolution of house prices for the Wüest Partner house price index for single-family homes and other self-constructed house prices. The Wüest Partner house price index (green line) is an aggregate representative index for Swiss house prices. It shows a smooth increase of 30% over the eight-year sample. Our self-constructed "sample" index weighs the single-family and multi-family indexes according to their stock in a municipality.[12] Figure 4 shows that the "sample" index (i.e., black line) matches

[9] See Appendix A2 for urban-rural classification.

[10] See the appendix for details on how the house price indexes are constructed at the municipality level.

[11] Basten and Koch (2015a), Drechsel (2015), Degen and Fischer (2017), Fischer (2012), Hilber and Schöni (2016), and Steiner (2010) examine the interaction of Swiss house prices and causal variables for different spatial regions.

[12] The house price index for municipality i is a share of single or multi-family homes to the total number of homes multiplied by the respective index, i.e., $HP_i = \#SFH_i/TOT_i \times$

well the profile of the Wüest Partner house price index. Slight differences arise between the two indexes for the years 2011 and 2013.

Next, to understand how house prices evolve according to property buyer, Figure 4 also shows the profile of real estate prices of self-financed investors and bank-financed homeowners. The weighting of municipal house prices is based on the share of new investment by investor group to total investment for a particular municipality. The plots show that the evolution of house prices according to property buyer are not heavily dependent on the weighting scheme (either project costs or number of flats). The evolution of the house price index of self-financed investors is more volatile than the index of bank-financed homeowners. Important to note is that after the introduction of the new macro-prudential measures in 2012, the house price indexes for self-financed investors and bank-financed homeowners diverge. The house price index for self-financed investors increases well above the sample average, while the house price index for bank-financed homeowners lies below the sample average. This price divergence is significant, because the share of self-financed investment to total investment (i.e., measured by building costs) averaged 9% in the period between 2013 to 2015 (see Figure 3). During this period, the index for self-financed investment increased by 11%, while the index for bank-financed investment increased by 7.1% (see Figure 4). The empirical analysis in section 5 attributes the divergence in the two house price series to the introduction of the CCyB in 2013. The regulatory CCyB measure is discussed in the next subsection.

$SFHP_i + \#MFH_i/TOT_i \times MFHP_i$.

3.3 The CCyB/RWA ratio

We define the macro-prudential variable as the ratio of a bank's capital set aside according to the (sectorial) counter-cyclical capital buffer, CCyB, to its total risk-weighted assets, RWA. Ideally, we would like to have matched house buyers borrowings from banks to determine whether house buyers are borrowing from constrained banks. Instead, we assume that the RWA for a defined geographical region captures whether home buyers are borrowing from constrained banks. The variable, $CCyB_{r,t}/RWA_{r,t}$, varies over 106 MS regions, r, and time, t. It measures the importance of residential mortgage lending relative to other interest-bearing assets. Information to construct $CCyB_{r,t}/RWA_{r,t}$ is from the SNB's Quarterly Capital Adequacy Reporting Form.

Banks were not equally affected by the activation of the CCyB. Auer and Ongena (2016) and Bickesel et al. (2019) document that the level of capitalization of Swiss banks is heterogeneous. This development is compounded by the fact that most mortgage-lending banks (i.e., cantonal banks and regional and savings banks) operate in distinct regional areas. To construct the variable, $CCyB_{r,t}/RWA_{r,t}$, 149 mortgage-lending banks are classified into three groups.[13] CCyB ratios from cantonal banks are allocated to the respective MS regions within a canton with full weight. CCyB ratios from regional banks are allocated to the MS region in which the regional banks have branch offices. CCyB ratios from the other mortgage lending banks are

[13]This sample represents all banks that had to set aside capital according to the CCyB regulation except for the two big banks (UBS and Credit Suisse). Auer and Ongena (2016) show that their CCyB/RWA ratios were exceptionally small compared to other banks in 2014.

apportioned according to MS regions with respect to their yearly residential investment volume in new housing (Source: BFS). Based on this allocation, an unweighted average is created for each MS region.

Figures 5 and 6 show how $CCyB_{r,t}/RWA_{r,t}$ varies over the MS regions and over time in the aggregate. Figure 5 shows that the $CCyB_{r,t}/RWA_{r,t}$ ratios vary by a factor 11 between the smallest and the largest ratio. Similarly, Figure 6 shows that the aggregate adjustment to the new macro-prudential environment began in 2013. This adjustment profile is crucial for the interpretation of the econometric model discussed in the next subsection.

4. Empirical framework

We run *separate* regressions for self-financed investors and bank-financed homeowners. The following model is used to estimate the demand effect of investments by property buyers on local house prices:

$$\Delta ln(HP_{i,t}) = \gamma \frac{CCyB_{r,t}}{RWA_{r,t}} + \delta \left(\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}} \right) + x'_{i,t}\theta + \alpha_i + \lambda_t + \epsilon_{i,t}, \tag{1}$$

where $\Delta ln(HP_{i,t})$ is the log change in local house prices for municipality i and year t. As defined in the previous section, $HP_{i,t}$ is a weighted average of single-family and multi-family house prices at the municipality level. Next, the predetermined variable, $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, is the average share of new residential construction by property buyer, $g = \{$self-financed investors or bank-financed homeowners$\}$ to the total volume of new residential construction for

$k = \{$building costs or number of flats$\}$ for municipality i for the years prior to introducing the CCyB from 2008 to 2012. The predetermined variable, $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, implies the absence of serial correlation in the residual, $\epsilon_{i,t}$.[14]

The macro-prudential variable, $\frac{CCyB_{r,t}}{RWA_{r,t}}$, is the sectoral counter-cyclical capital buffer on risk-weighted mortgage portfolio over the total risk-weighted assets of banks in MS region, r, and year, t. The coefficient, γ, is interpreted as the percentage change in house prices associated with an annual increase of one-percentage point in $\frac{CCyB_{r,t}}{RWA_{r,t}}$ in the absence of housing investment in a municipality. The coefficient is expected to be negative in sign.

Our variable of interest is the interaction term, $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}} \times \frac{CCyB_{r,t}}{RWA_{r,t}}$, between the share of new residential construction by a property buyer in a municipality and the capital set aside on additional mortgage credit for banks operating in the regional area. The coefficient, δ, is expected to take on different signed values, depending on the type of property buyer for $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$ after the introduction of macro-prudential measures in 2012. For self-financed investors, the *reaching for yield* hypothesis says that δ should be positive. This hypothesis says self-financed investors increase their housing investment in areas where the perceived investment returns are highest and are unaffected by the macro-prudential measures captured by $\frac{CCyB_{r,t}}{RWA_{r,t}}$. Instead for the bank-financed homeowners, the *credit-stymieing* hypothesis says that δ should be negative. In other words, the activation of the CCyB in 2013 results in a higher CCyB/RWA ratio that restricts demand for residential investments.

[14]The predeterminedness of $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$ plus standard regularity conditions yield the usual noraml asymptotic throoy for OLS estimates. Below, we discuss endogeneity issues for $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$.

Control variables, $x_{i,t}$, are vacancy rates and population growth rates at the municipality level. Further, a Second Home Initiative (SHI) dummy is constructed at the municipal level. The second home ordinance came into force on January 1, 2013 that limited the future supply of vacation homes. We classify municipalities in year 2013 as SHI critical if they appear in the appendix of the ordinance.[15] For the years 2014 and 2015, we modify the dummy according to the updates provided by the Federal Office for Spatial Development periodically (add/drop municipalities). Additional variables at the district level include unemployment rates.

Fixed effects for municipalities and years are α_i and λ_t. The year effects capture the trends in interest rates and other economic variables. The dependent variable is estimated in first differences to account for heterogeneous trends across local characteristics and because house prices are measured as an index, whose level has no economic interpretation. Following Bertrand, et al. (2004) and Angrist and Pischke (2009), standard errors are heteroskedasticity-robust and are clustered by MS regions to control for correlation within groups.

A concern in estimating equation (1) is that local house prices may be correlated with local demand shocks, in which case the OLS estimate of the predetermined self-financed investment, $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, and its interaction with $\frac{CCyB_{r,t}}{RWA_{r,t}}$ on house prices may understate the true effect, see Ozer-Balli and Sorensen (2013). To identify the causal effect of self-financed investments on local house prices, we employ an instrumental variables strategy that ac-

[15] https://www.admin.ch/opc/de/classified-compilation/20121659/index.html. See Hilber and Schöni (2016) for a discussion of the second home initiative and its effects of local house prices.

counts for the potential endogeneity of the local housing market. We exploit the fact that during our sample period, the duration of obtaining a building permit (i.e., time-to-plan, TTP) is regionally dependent and volume dependent. Large construction projects for multi-family homes in general take more time than do single family homes. Further, there is large heterogeneity across local municipalities. The level of regional heterogeneity is considerable. The time to obtain a building permit, for example, is longer in Western Switzerland, suggesting that cultural factors may be an issue.[16] Further, because the variation over time to obtain a building permit is low with no trend at the municipal level this means that time-to-plan should not be correlated with house prices. These two characteristics are highly correlated with $\frac{I^g_{k,i,t}}{TOT_{k,i,t}}$ but not with $\Delta ln(HP_{i,t})$. In the empirical results below, we also consider regressions that use time-to-plan as an instrument for $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$.

5. Estimation results

This section presents OLS regressions for equation (1). Robustness checks are with respect to housing type, geographic location, and instrumental variable. Standard errors are robust and are clustered at the MS region level.

The main empirical finding is that local house prices respond differently to new residential construction by different property buyers in a policy environment of low-interest rates and tighter macro-prudential regulation. Investments by self-financed investors have a positive effect on local house prices, but investments by bank-financed homeowners have a negative ef-

[16]Studies by Brügger et al. 2009, Eger and Lassman (2015), and Fischer (2012) use language zones in Switzerland as a causal factor to explain variation in goods trade, employment, and house prices across regions.

fect. In particular, the interaction between the share of new investment by self-financed investors to total investment and the CCyB to RWA ratio is positive. This says that local house prices increase faster in areas with a high share of investments by self-financed investors and where banks have to set aside high levels of capital because of macro-prudential regulation. By contrast, the coefficient for the same interaction term with bank-financed investments is negative. Our empirical findings are conditional on a particular policy environment and may not hold for changes to the policy environment.

This section has three parts. The first subsection presents OLS regressions of the baseline specification (1). The second subsection presents regressions that highlight the importance of geographic concentration between rural and urban areas. The third subsection reconfirms the findings from the baseline model using house price data for multi-family homes.

5.1 Baseline regressions

Table 2 presents OLS regressions for equation (1). Column 1 presents a regression that regresses the log change in house prices on the macro-prudential measure, $\frac{CCyB_{r,t}}{RWA_{r,t}}$, with municipality fixed effects. The coefficient for $\frac{CCyB_{r,t}}{RWA_{r,t}}$ is -0.35 and is statistically significant. This says that a one-percentage increase in the $\frac{CCyB_{r,t}}{RWA_{r,t}}$ ratio results in a fall in local house prices by -0.35%. Next, column 2 presents the same regression but with year effects, which capture the transition to an ultra-low interest rate environment. The R^2 jumps from 0.03 to 0.17 and the coefficient on $\frac{CCyB_{r,t}}{RWA_{r,t}}$ drops from -0.35 to -0.07 and is statistically insignificant. Macro-prudential measures captured by $\frac{CCyB_{r,t}}{RWA_{r,t}}$ still have a negative effect on local house, however the degree of

time variation is inadequate to capture local house price changes with respect to the time effects. This result suggests that low interest rates, captured by the time fixed effects, act as an opposing force for the macro-prudential measures captured by $\frac{CCyB_{r,t}}{RWA_{r,t}}$. Column 3 adds the interaction term, $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, to the regression in Column 2. The coefficient of the interaction term is 1.7 and is statistically significant. An increase in self-financed investment in the post macro-prudential period leads to an increase in local house prices. Column 4 presents the same regression as in Column 3 but adds four control variables. This extended model does not change the interpretation that self-financed investments increase local house prices in areas where $\frac{CCyB_{r,t}}{RWA_{r,t}}$ increased considerably.

Columns 5 and 6 repeat the regressions for self-financed investors in Columns 3 and 4 in Table 2 but for bank-financed homeowners. The regression estimates are nearly identical except for the coefficient of the interaction term, $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$. The coefficient of the interaction term is negative and statistically insignificant. The coefficient of -0.12 in Column 6 suggests that macro-prudential measures captured by the $\frac{CCyB_{r,t}}{RWA_{r,t}}$ ratio stymied credit demand. As a consequence, house prices responded in a muted manner to new property investment by bank-financed homeowners.

Table 3 presents regressions with the number of flats defining the investment share k, $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, in municipality i. The replacement of project costs with number of flats per project offers a simple robustness test for the proxy measure of investment share. The regression results with number of flats yield similar coefficient estimates as the regressions in Table 2 with building costs and confirm the interpretation of the baseline regression.

Next, Table 4 presents regressions that use time-to-plan as an instrument for the predetermined variable $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$. Time-to-plan is the difference in months between the issuance and submission of building permits and acts as a further causality test for $\overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$. The duration to obtain a building permit differs across municipalities and building type, however its variation across time is low. Time-to-plan for single-family homes tends to be much shorter than for multi-family homes. The level of regional heterogeneity is considerable. Further, because the variation over time to obtain a building permit is low with no trend at the municipal level this means that time-to-plan should not be correlated with house prices. Again, the regressions in Table 4 show that the time-to-plan variable yield similar results to the baseline estimates in Table 2.

5.2 Geographic concentration of self-financed investors

The importance of geographic concentration by type of property buyer is documented in this subsection. The geographic splits are motivated by Figures 3 and 4. The main empirical finding is that the coefficient for the interaction term with self-financed investments is positive for urban municipalities, while the coefficient for the interaction term with bank-financed investments is negative for the rural municipalities. This result suggests that the effect of macro-prudential measures is not uniform across regions. This also reiterates the view that the effect of CCyB measures affected banks in rural areas the strongest and that self-financed property buyers concentrated their investment projects in urban areas, which experienced the largest price gains.

We classify municipalities into four groups according to distinct urban and

rural characteristics as defined by the Swiss Statistical Office (see Appendix A2 for definitions). The first group, *city centers*, are 34 municipalities in the core of medium or large agglomerations. The second group, *agglomerations*, are 460 urban municipalities in small, medium, or larger agglomerations. The third group, *peri-urban*, are 1,006 municipalities outside of agglomerations with fragmented urban and rural characteristics. The fourth group, *rural*, are 789 municipalities with rural characteristics.

Information from the four geographic areas enter as dummy variables in the regressions. They include or exclude specific municipalities based on urban or rural characteristics. For example, the dummy $CityCenter = 1$ is +1 for the 34 municipalities in the core of the medium or large agglomerations and 0 otherwise. Similarly, $CityCenter = 0$ excludes the 34 city municipalities and includes the remaining municipalities. The geographic dummy variables are interacted with the interaction term, $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$ to capture the regional house price effect from self-financed or bank-financed investment.

Table 5 presents regressions with self-financed investment measured by project costs according to the four geographic groups. The regression results show that the interaction of the geographical dummy variables with $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$ yield positive and highly statistically significant coefficient estimates for the two regions that capture urban municipalities. The coefficients for the interaction term with the city centers and agglomeration dummy variables are 2.7 and 2.5 in the regressions with controls (see columns 2 and 4). The same coefficients for the peri-urban and rural municipalities are 0.8 and 0.9 and statistically insignificant (see columns 6 and 8).

Table 6 presents regression results for bank-financed investments for four geographical areas. The results for city centers and agglomeration municipalities show that the coefficients of the interaction term, $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$, are 0.9 and 0.3 in the regressions with controls. The estimates are consistent with the regression estimates in Table 5, however the coefficients are considerably larger for self-financed investments than for bank-financed investments. These results suggest that house prices were rising in urban municipalities for both types of property buyers, however the house price effect for self-finance investment is more than 2.5 greater than bank-financed investments. The regression coefficients for $\frac{CCyB_{r,t}}{RWA_{r,t}} \times \overline{\frac{I^g_{k,i}}{TOT_{k,i}}}$ instead change sign from positive to negative for the two regressions capturing the house price effect in rural municipalities. The largest negative and statistically significant coefficient of -0.26 is for peri-urban municipalities.

5.3 Geographic concentration and multi-family homes

This subsection considers two changes to the geographic splits of Tables 5 and 6. First, the price index for multi-family homes is used instead of the weighted average between single and multi-family homes based on existing housing stock in a municipality. This change relaxes the assumption that single- and multi-family home projects are near substitutes and that price developments for single- and multi-family homes co-move within a municipality. To confirm our previous results, we would expect the coefficient of the interaction term to be positive for urban areas and negative for rural areas. Second, the property buyers are self-financed multi-family home investors (i.e., self-financed investors excluding single-family home projects)

and other multi-family home investors (i.e., the remaining multi-family investment projects). Other multi-family home investors include private individuals, real estate developers, local public authorities, foundations, and cooperatives. This category of other multi-family home investors is much broader than the definition of self-financed investors, which are primarily for single-family homes. Unlike for self-financed multi-family home investors in which it is known they take up little or no bank credit, the level of bank credit to finance multi-family home projects for other multi-family home investors is unknown but it is assumed not to be zero. If the demand for bank credit is not influenced by the restrictiveness of the macro-prudential environment, then the house price response should be identical for the two types of investors.

Tables 7 and 8 present the regression results using multi-family home prices for two types of multi-family property buyers using the format of geographic concentration presented in Tables 5 and 6. Table 7 presents regressions for self-financed multi-family home investors and Table 8 presents regressions for other multi-family home investors. The regressions in the two tables confirm the previous result that geographic concentration matters. The house price response to new investment projects measured by the coefficient of the interaction term is positive for agglomeration areas and negative for rural areas, see columns 3 to 4 and 7 to 8 in Tables 7 and 8. This result confirms the previous findings based on house prices for single-and multi-family homes.

To determine whether self-financed multi-family home investors have a larger effect on multi-family house prices than other multi-family home in-

vestors, we compare the coefficient of the interaction term of the two types of property buyers in Tables 7 and 8. The results again suggest that location matters. The coefficient estimates of self-financed multi-family home investors for city centers is 2.0 and highly statistically significant at the 1 percent level, wherease the same coefficient estimate for other multi-family home investors is 2.1 but is not statistically significant. The results for the agglomeration area however suggest that there is no deference between the effect of the two investor groups on house prices. For the peri urban and rural areas, the house price effect is either small in the case of other multi-family home investors (0.79) or shows no effect for rural areas.

6. Conclusion

This paper identifies the effect of housing investments by self-financed property buyers, an overlooked investor class, on the local housing market. Self-financed property buyers are not subject to macro-prudential regulation because they do not rely on mortgage credit when investing in new residential housing projects. The empirical estimates for Switzerland suggest that local house prices increase faster in areas with new housing investment by self-financed property buyers. The house price effect linked to self-financed property buyers is also strongest in urban areas where the regional CCyB/RWA ratios are the highest. This evidence suggests that self-financed property buyers bypass regulatory measures designed to curtail the demand for local housing and complicates the interpretation of imbalances linked to the Swiss credit cycle for new residential investment.

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Appendix

A1. Examples of the importance of house prices in SNB macroprudential policy

Press release: February 2, 2013

Countercyclical buffer: proposal of the Swiss National Bank and decision of the Federal Council

"The SNB's proposal is motivated by strong growth in both bank credit and *real estate prices* over several years, which has resulted in imbalances on the residential mortgage and real estate markets."

Press release: December 14, 2017

SNB's Monetary Policy Assessment

The SNB states that "[i]mbalances on the mortgage and real estate markets persist. While growth in mortgage lending remained relatively low in 2017, *residential property prices* rose again slightly. In the residential investment property segment, *the strong price growth* continued. The SNB will continue to monitor developments on these markets closely, and will regularly reassess the need for an adjustment of the countercyclical capital buffer."

A2. Municipality classification

		Urban		Rural	
Code	Description	City Center	Agglomeration	Peri-urban	Remote
111	Core city in large agglomeration	1	0	0	0
112	Urban work municipality in large agglomeration	0	1	0	0
113	Urban residential municipality in large agglomeration	0	1	0	0
121	Core city in medium agglomeration	1	0	0	0
122	Urban work municipality in medium agglomeration	0	1	0	0
123	Urban residential municipality in medium agglomeration	0	1	0	0
134	Urban touristic municipality in small agglomeration	0	1	0	0
136	Urban industrial municipality in small agglomeration	0	1	0	0
137	Urban service municipality in small agglomeration	0	1	0	0
216	Peri-urban industrial municipality with high concentration	0	0	1	0
217	Peri-urban service municipality with high concentration	0	0	1	0
226	Peri-urban industrial municipality with medium concentration	0	0	1	0
227	Peri-urban service municipality with medium concentration	0	0	1	0
235	Peri-urban farming municipality with low concentration	0	0	1	0
236	Peri-urban industrial municipality with low concentration	0	0	1	0
237	Peri-urban service municipality with low concentration	0	0	1	0
314	Touristic municipality of a rural center	0	0	0	1
316	Industrial municipality of a rural center	0	0	0	1
317	Service municipality of a rural center	0	0	0	1
325	Centrally located rural farming municipality	0	0	0	1
326	Centrally located rural industrial municipality	0	0	0	1
327	Centrally located rural service municipality	0	0	0	1
334	Peripheral located rural touristic municipality	0	0	0	1
335	Peripheral located rural farming municipality	0	0	0	1
338	Peripheral located rural mixed municipality	0	0	0	1

Notes: We define two broad groups (urban and rural) and four narrow groups (city center, agglomeration, peri-urban and remote) based on the 25 municipality types from the municipality typology as of 2012 from BfS. 1 means that a municipality belongs to the respective group.

Table A1: Municipality classification

A3. House price indexes

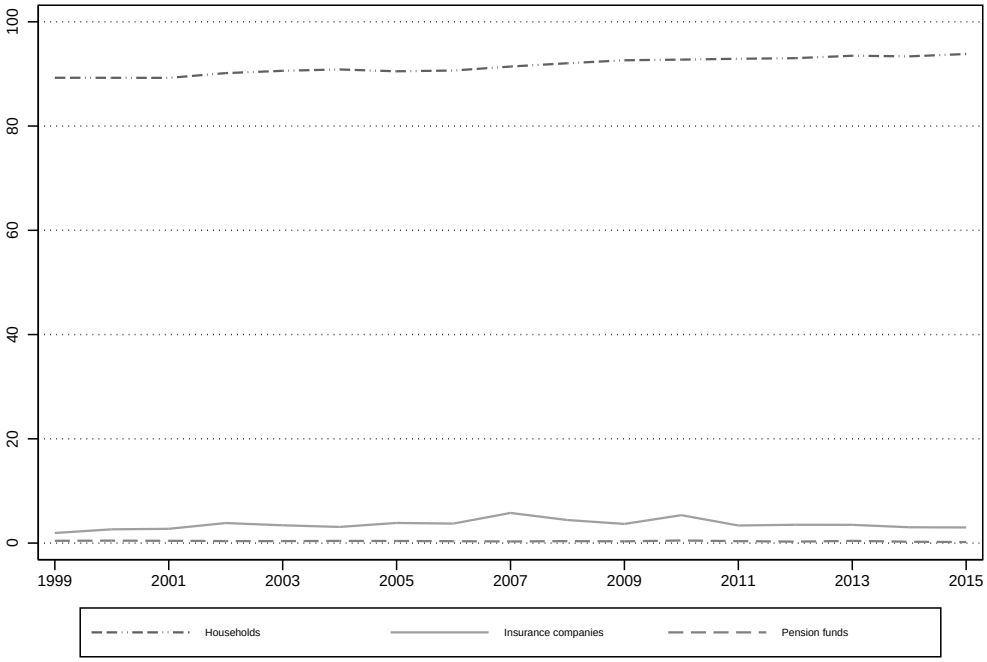
House price index for multi-family homes at the municipality level

An annual (net) rental rate is first calculated for every apartment in the multi-family building. There are nine different types of apartments, each with different characteristics. Rents are determined using a hedonic regression analysis developed by Wüest Partner. Information on the individual apartments are from over 50'000 rental contracts issued by institutional owners that engage in the services of Wüest Partner. The house prices are calculated using information from local rents and municipal discount rates.

House price index for new single-family homes at the municipality level

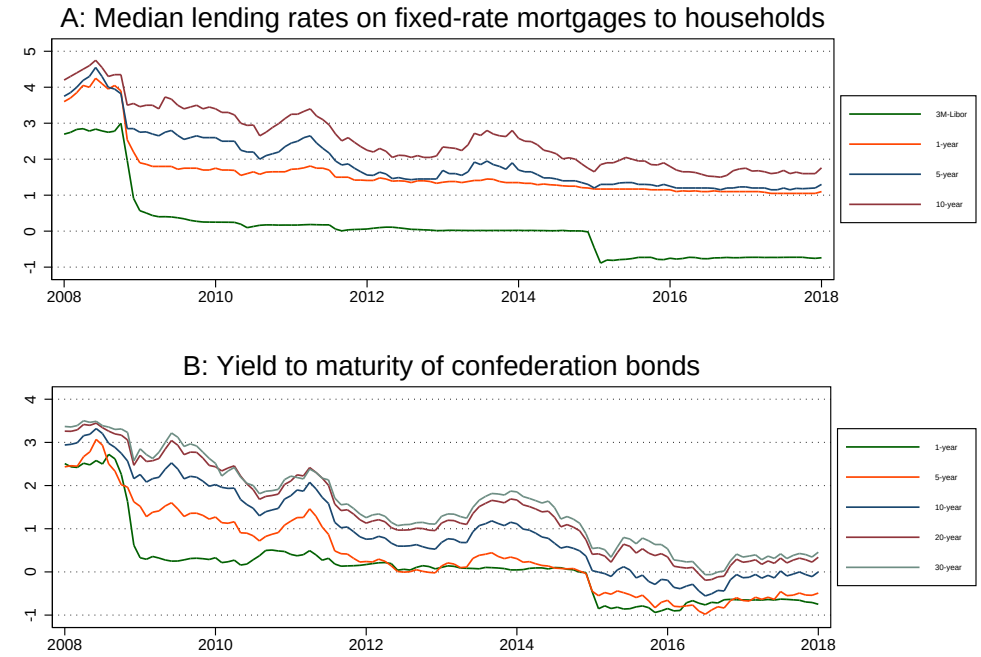
The construction of the index for new single-family homes is similar to multi-family homes. It is based on a (annual) hedonic regression analysis based on transaction prices.

Figures



Notes: The y-axis is in % and shows the amount of mortgages for bank-financed homeowners and total credits for self-financed investors over total liabilities. Source: SNB and annual reports.

Figure 1: Dependence on mortgage credit from banks



Notes: The y-axis is in %. Sources: Bloomberg, SNB

Figure 2: Lending rates and government bond yields

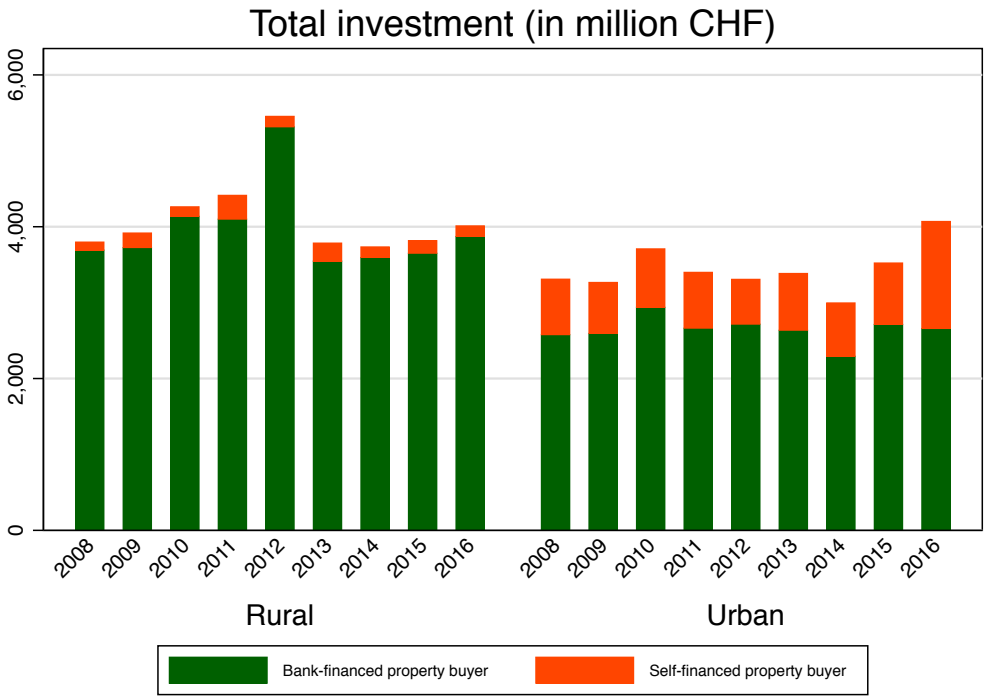
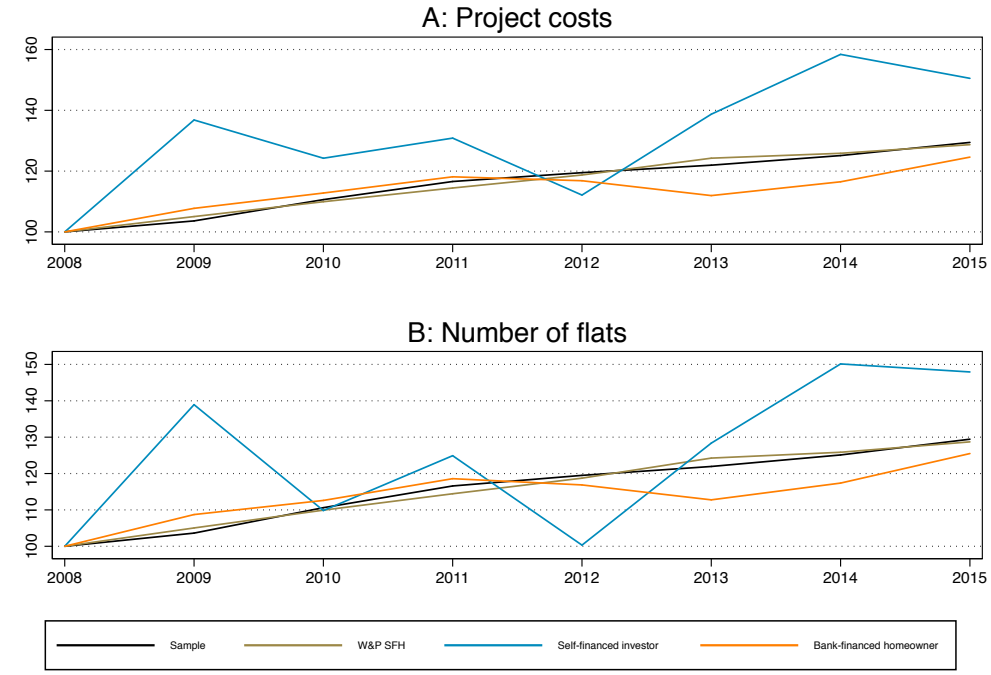


Figure 3: Building costs per type of property buyer



Note: Price indexes are normalized to 2008.

Figure 4: House prices of self-financed investor and bank-financed homeowner

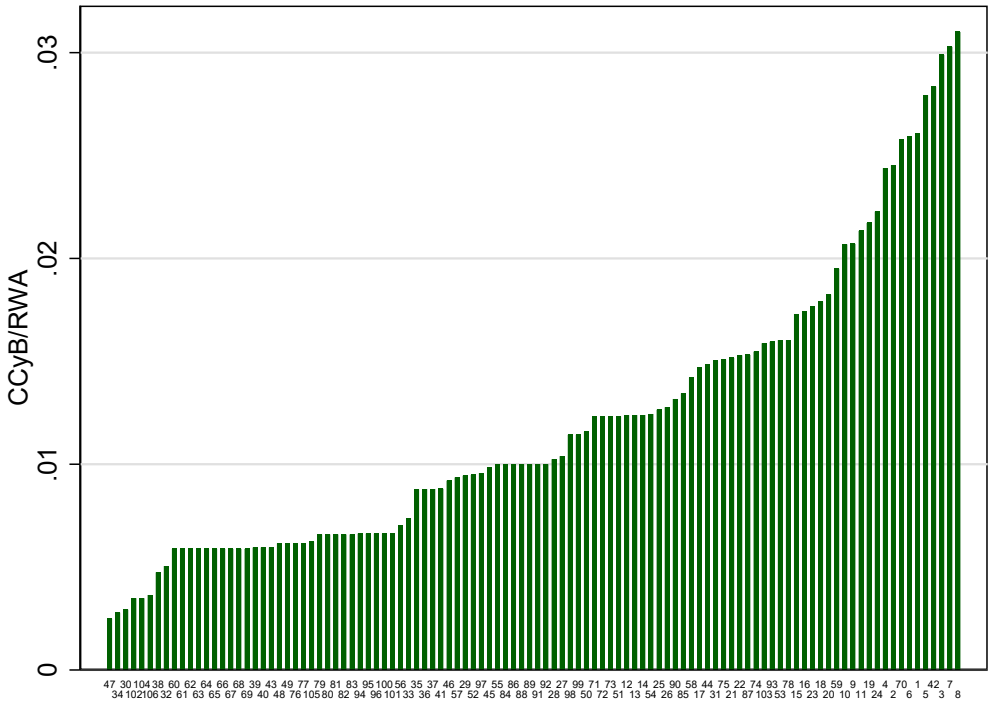


Figure 5: (CCyB)/(Risk weighted assets) over MS regions (106)

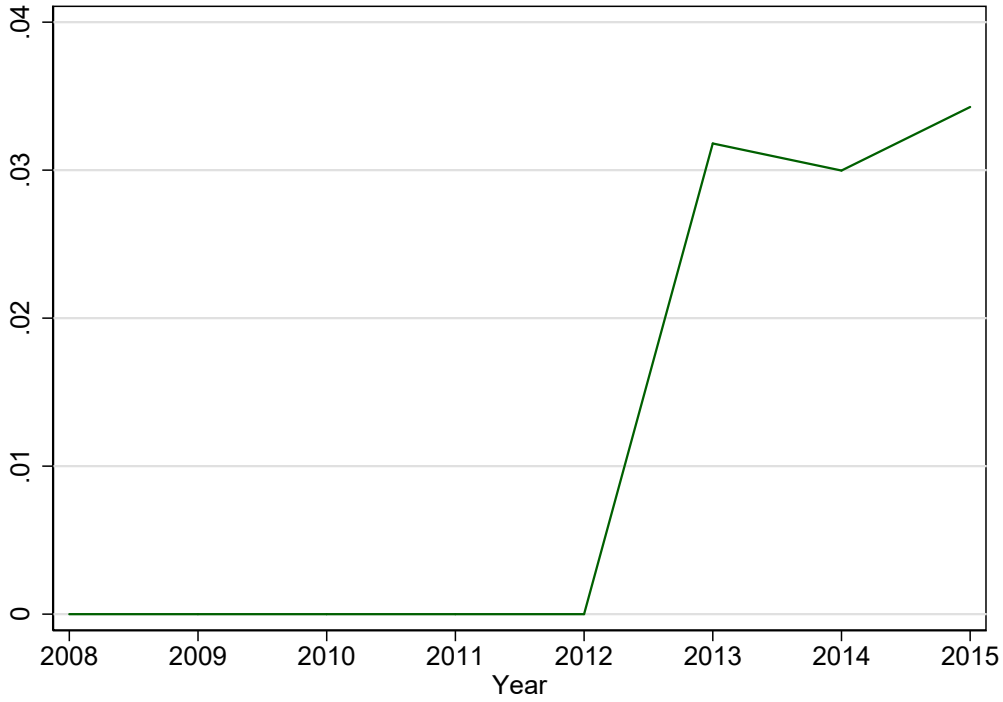


Figure 6: (CCyB)/(Risk weighted assets) over time

Tables

	Bank-financed homeowners		Self-financed investors	
Housing type	**Count**	**%**	**Count**	**%**
Multi-family homes	8'349	14.0	594	92.2
Single-family homes	51'348	86.0	50	7.8
Usage type				
To rent	2'744	4.6	412	64.0
To sell	3'091	5.2	59	9.2
To consume	48'099	80.6	27	4.2
Location type				
City center	2'644	4.4	175	27.2
Agglomeration	16'062	26.9	291	45.2
Peri-urban	21'174	35.5	89	13.8
Remote	19'817	33.2	89	13.8
Total number of projects	59'697	100	644	100
Project characteristics	**Mean**	**SD**	**Mean**	**SD**
Project costs (in Mio. CHF)	0.9	1.4	13.6	32.3
Time-to-plan (in month)	3.4	3.0	7.2	7.1
Number of floors	2.1	1.1	4.0	1.9
Number of flats	1.9	3.5	37.8	43.8
Number of buildings	1.1	0.5	2.6	2.6

Notes: Percentages for usage type do not sum up to 100 due to incomplete information. Location type is classified according to the municipality typology as of 2012 from BfS (definition in Appendix A2). Source: Wüest Partner.

Table 1: Summary statistics

	Dependent variable: Δ House price (in logs)					
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB/RWA	-0.3537***	-0.0652	-0.0910	-0.0180	-0.0142	0.0534
	(0.063)	(0.092)	(0.092)	(0.096)	(0.098)	(0.102)
CCyB/RWA × $\overline{I^{SFI}/TOT}$			1.7440***	1.8559***		
			(0.500)	(0.502)		
CCyB/RWA × $\overline{I^{BFH}/TOT}$					-0.1346	-0.1216
					(0.096)	(0.098)
Population growth rate				0.0499***		0.0495***
				(0.013)		(0.014)
Vacancy rate				-0.0006		-0.0006
				(0.000)		(0.000)
SHI municipality				0.0118***		0.0115***
				(0.004)		(0.004)
Unemployment growth rate				-0.0037		-0.0035
				(0.054)		(0.054)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	No	Yes	Yes	Yes	Yes	Yes
R^2	0.027	0.166	0.167	0.171	0.166	0.170
N	18312	18312	18312	18312	18312	18312

Notes: Standard errors are clustered at the MS level (106 cluster). The regressions track 2,289 municipalities as per December 31 2016 over 8 years ($N = 18,312$). All specifications include municipality fixed effects and except for Column (1) year fixed effects. $\overline{I^g/TOT}$ measures the average investment share of investor type g in each municipality over 2008 - 2012 relative to the municipality total. $CCyB/RWA$ refers to the cantonal countercyclical capital buffer exposure in relation to total interest bearing assets. *Population growth rate* at the municipality level is the annual change of the population in a municipality relative to the stock of the population at the beginning of the year. The *Vacancy rate* at the municipality level compares the number of flats that are to sell or rent to the total stock of flats. *SHI municipality* is a dynamic dummy that is 1 for municipalities that appear in the second home initiative ordinance after 2013, zero otherwise. *Unemployment growth rate* at the district level is the annual change of registered unemployed persons in relation to the total stock of unemployed at the beginning of the year.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table 2: Investment volume

	Dependent variable: Δ House price (in logs)					
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB/RWA	-0.3537***	-0.0652	-0.0942	-0.0211	-0.0248	0.0446
	(0.063)	(0.092)	(0.092)	(0.096)	(0.097)	(0.101)
CCyB/RWA × $\overline{F^{SFI}/TOT}$			1.8045***	1.9081***		
			(0.425)	(0.425)		
CCyB/RWA × $\overline{F^{BFH}/TOT}$					-0.1114	-0.1021
					(0.094)	(0.097)
Population growth rate				0.0498***		0.0495***
				(0.013)		(0.014)
Vacancy rate				-0.0006		-0.0006
				(0.000)		(0.000)
SHI municipality				0.0118***		0.0115***
				(0.004)		(0.004)
Unemployment growth rate				-0.0035		-0.0033
				(0.054)		(0.054)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	No	Yes	Yes	Yes	Yes	Yes
R^2	0.027	0.166	0.167	0.172	0.166	0.170
N	18312	18312	18312	18312	18312	18312

Notes: Same notes as in Table 2 apply. However, $\overline{F^g/TOT}$ refers to the average number of flats supplied by investor type g relative to the municipality total of supplied flats for the pre-shock period between 2008 and 2012.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table 3: Number of flats

	Dependent variable: Δ House price (in logs)					
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB/RWA	-0.3537***	-0.0652	-0.0796	-0.0065	-0.0710	-0.0002
	(0.063)	(0.092)	(0.092)	(0.096)	(0.110)	(0.113)
CCyB/RWA × $\overline{TTP^{SFI}}$			0.0503***	0.0529***		
			(0.016)	(0.016)		
CCyB/RWA × $\overline{TTP^{BFH}}$					0.0023	0.0032
					(0.018)	(0.018)
Population growth rate				0.0496***		0.0497***
				(0.014)		(0.014)
Vacancy rate				-0.0006		-0.0006
				(0.000)		(0.000)
SHI municipality				0.0117***		0.0115***
				(0.004)		(0.004)
Unemployment growth rate				-0.0036		-0.0036
				(0.054)		(0.054)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	No	Yes	Yes	Yes	Yes	Yes
R^2	0.027	0.166	0.167	0.171	0.166	0.170
N	18312	18312	18312	18312	18312	18312

Notes: Same notes as in Table 2 apply. However, $\overline{TTP^g}$ refers to the average number of month between building permit submission and issuance date of investor type g in the pre-shock period between 2008 and 2012.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table 4: Time-to-plan

	Dependent variable: Δ House price (in logs)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CCyB/RWA	-0.091	-0.018	-0.091	-0.018	-0.090	-0.017	-0.092	-0.019
	(0.092)	(0.096)	(0.093)	(0.096)	(0.093)	(0.096)	(0.093)	(0.096)
City Center=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$	1.606***	1.723***						
	(0.527)	(0.529)						
City Center=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$	2.642***	2.722***						
	(0.664)	(0.698)						
Agglomeration=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$			1.212*	1.296*				
			(0.657)	(0.656)				
Agglomeration=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$			2.354***	2.500***				
			(0.577)	(0.582)				
Periurban=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$					2.177***	2.283***		
					(0.461)	(0.464)		
Periurban=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$					0.652	0.779		
					(0.945)	(0.947)		
Rural=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$							1.850***	1.979***
							(0.538)	(0.543)
Rural=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$							0.952	0.931
							(0.862)	(0.880)
Population growth rate		0.050***		0.050***		0.050***		0.050***
		(0.013)		(0.013)		(0.013)		(0.013)
Vacancy rate		-0.001		-0.001		-0.001		-0.001
		(0.000)		(0.000)		(0.000)		(0.000)
SHI municipality		0.012***		0.012***		0.012***		0.012***
		(0.004)		(0.004)		(0.004)		(0.004)
Unemployment growth rate		-0.004		-0.004		-0.004		-0.004
		(0.054)		(0.054)		(0.054)		(0.054)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.167	0.171	0.167	0.171	0.167	0.171	0.167	0.171
N	18312	18312	18312	18312	18312	18312	18312	18312

Notes: Standard errors are clustered at MS level (106 cluster). Definition of variables follows Table 2. All specifications include municipality and year fixed effects. These regressions consider only self-financed property buyers (SFI). *City Center* is a dummy that is equal to 1 for 34 core cities of a larger or medium agglomeration, 0 else. *Agglomeration* is one for 460 municipalities in agglomerations, 0 else. *Periurban* is 1 for 1,006 peri-urban municipalities, 0 else. *Rural* is 1 for 789 remote municipalities, 0 else. Classification of municipality types is according to Table A1 in the Appendix.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 5: Regional split with self-financed investor

	Dependent variable: Δ House price (in logs)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CCyB/RWA	-0.020	0.048	-0.042	0.023	-0.015	0.050	0.001	0.060
	(0.098)	(0.101)	(0.099)	(0.102)	(0.099)	(0.102)	(0.100)	(0.104)
City Center=0 × CCyB/RWA × $\overline{I^{BFH}/TOT}$	-0.128	-0.114						
	(0.096)	(0.099)						
City Center=1 × CCyB/RWA × $\overline{I^{BFH}/TOT}$	0.845**	0.887**						
	(0.415)	(0.436)						
Agglomeration=0 × CCyB/RWA × $\overline{I^{BFH}/TOT}$			-0.135	-0.122				
			(0.097)	(0.100)				
Agglomeration=1 × CCyB/RWA × $\overline{I^{BFH}/TOT}$			0.203	0.291*				
			(0.158)	(0.162)				
Periurban=0 × CCyB/RWA × $\overline{I^{BFH}/TOT}$					0.039	0.031		
					(0.130)	(0.131)		
Periurban=1 × CCyB/RWA × $\overline{I^{BFH}/TOT}$					-0.290***	-0.259**		
					(0.109)	(0.108)		
Rural=0 × CCyB/RWA × $\overline{I^{BFH}/TOT}$							-0.215**	-0.165*
							(0.102)	(0.099)
Rural=1 × CCyB/RWA × $\overline{I^{BFH}/TOT}$							-0.047	-0.075
							(0.138)	(0.137)
Population growth rate		0.049***		0.051***		0.048***		0.049***
		(0.014)		(0.013)		(0.014)		(0.013)
Vacancy rate		-0.001		-0.001		-0.001		-0.001
		(0.000)		(0.000)		(0.000)		(0.000)
SHI municipality		0.011***		0.012***		0.011***		0.011***
		(0.004)		(0.004)		(0.004)		(0.004)
Unemployment growth rate		-0.003		-0.002		-0.002		-0.003
		(0.054)		(0.054)		(0.053)		(0.054)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.167	0.171	0.167	0.171	0.168	0.171	0.167	0.170
N	18312	18312	18312	18312	18312	18312	18312	18312

Notes: Standard errors are clustered at MS level (106 cluster). Definition of variables follows Table 2. All specifications include municipality and year fixed effects. These regressions consider only bank-financed property buyers (BFH). *City Center* is a dummy that is equal to 1 for 34 core cities of a larger or medium agglomeration, 0 else. *Agglomeration* is one for 460 municipalities in agglomerations, 0 else. *Periurban* is 1 for 1,006 peri-urban municipalities, 0 else. *Rural* is 1 for 789 remote municipalities, 0 else. Classification of municipality types is according to Table A1 in the Appendix.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 6: Regional split with bank-financed homeowner

	Dependent variable: Δ Multi-family house price (in logs)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CCyB/RWA	-0.035	-0.041	-0.036	-0.042	-0.033	-0.040	-0.036	-0.043
	(0.099)	(0.099)	(0.098)	(0.098)	(0.099)	(0.099)	(0.099)	(0.099)
City Center=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$	1.228***	1.223***						
	(0.440)	(0.437)						
City Center=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$	2.018***	2.046***						
	(0.464)	(0.466)						
Agglomeration=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$			0.266	0.305				
			(0.518)	(0.513)				
Agglomeration=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$			2.559***	2.513***				
			(0.701)	(0.699)				
Periurban=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$					2.021***	1.993***		
					(0.475)	(0.472)		
Periurban=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$					-0.403	-0.334		
					(0.836)	(0.835)		
Rural=0 × CCyB/RWA × $\overline{I^{SFI}/TOT}$							1.525***	1.527***
							(0.491)	(0.488)
Rural=1 × CCyB/RWA × $\overline{I^{SFI}/TOT}$							-0.102	-0.122
							(0.700)	(0.686)
Population growth rate		0.091***		0.091***		0.091***		0.091***
		(0.012)		(0.012)		(0.012)		(0.012)
Empty flat rate		0.001**		0.001**		0.001**		0.001**
		(0.000)		(0.000)		(0.000)		(0.000)
SHI municipality		-0.001		-0.001		-0.001		-0.001
		(0.003)		(0.003)		(0.003)		(0.003)
Unemployment growth rate		-0.040		-0.040		-0.040		-0.040
		(0.045)		(0.045)		(0.045)		(0.045)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.481	0.483	0.482	0.484	0.482	0.484	0.481	0.483
N	18312	18312	18312	18312	18312	18312	18312	18312

Notes: Standard errors are clustered at MS level (106 cluster). Definition of variables follows Table 2. All specifications include municipality and year fixed effects. These regressions consider only self-financed property buyers (SFI). *City Center* is a dummy that is equal to 1 for 34 core cities of a larger or medium agglomeration, 0 else. Note that the dependent variable is the log house price change for multi-family homes only. *Agglomeration* is one for 460 municipalities in agglomerations, 0 else. *Periurban* is 1 for 1,006 peri-urban municipalities, 0 else. *Rural* is 1 for 789 remote municipalities, 0 else. Classification of municipality types is according to Table A1 in the Appendix.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 7: Regional split with self-financed multi-family home investor

	Dependent variable: Δ Multi-family house price (in logs)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CCyB/RWA	-0.036	-0.042	-0.037	-0.043	-0.036	-0.042	-0.036	-0.042
	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)
City Center=0 × CCyB/RWA × $\overline{I^{BFI}/TOT}$	1.693***	1.653***						
	(0.387)	(0.384)						
City Center=1 × CCyB/RWA × $\overline{I^{BFI}/TOT}$	2.178	2.211						
	(1.401)	(1.410)						
Agglomeration=0 × CCyB/RWA × $\overline{I^{BFI}/TOT}$			0.829***	0.791***				
			(0.309)	(0.301)				
Agglomeration=1 × CCyB/RWA × $\overline{I^{BFI}/TOT}$			2.514***	2.483***				
			(0.574)	(0.562)				
Periurban=0 × CCyB/RWA × $\overline{I^{BFI}/TOT}$					2.245***	2.216***		
					(0.487)	(0.479)		
Periurban=1 × CCyB/RWA × $\overline{I^{BFI}/TOT}$					0.791**	0.746**		
					(0.342)	(0.339)		
Rural=0 × CCyB/RWA × $\overline{I^{BFI}/TOT}$							1.853***	1.822***
							(0.383)	(0.380)
Rural=1 × CCyB/RWA × $\overline{I^{BFI}/TOT}$							-1.460	-1.583
							(2.603)	(2.498)
Population growth rate		0.091***		0.091***		0.091***		0.091***
		(0.012)		(0.012)		(0.012)		(0.012)
Empty flat rate		0.001*		0.001*		0.001*		0.001*
		(0.000)		(0.000)		(0.000)		(0.000)
SHI municipality		-0.001		-0.001		-0.001		-0.001
		(0.003)		(0.003)		(0.003)		(0.003)
Unemployment growth rate		-0.041		-0.040		-0.040		-0.041
		(0.045)		(0.045)		(0.045)		(0.045)
Municipality fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.481	0.483	0.482	0.484	0.482	0.484	0.482	0.484
N	18312	18312	18312	18312	18312	18312	18312	18312

Notes: Standard errors are clustered at MS level (106 cluster). Definition of variables follows Table 2. All specifications include municipality and year fixed effects. These regressions consider only large bank-financed property buyers (BFI). These are large construction and development companies, banks as well as real estate investment trusts. *City Center* is a dummy that is equal to 1 for 34 core cities of a larger or medium agglomeration, 0 else. Note that the dependent variable is the log house price change for multi-family homes only. *Agglomeration* is one for 460 municipalities in agglomerations, 0 else. *Periurban* is 1 for 1,006 peri-urban municipalities, 0 else. *Rural* is 1 for 789 remote municipalities, 0 else. Classification of municipality types is according to Table A1 in the Appendix.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 8: Regional split with other multi-family home investor