Securitisation, loan growth and bank funding: the Swiss experience since 1932

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Securitisation, loan growth and bank funding: the Swiss experience since 1932 [*]

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Abstract

This paper empirically analyses securitisation in Switzerland from a macroeconomic and bank balance sheet perspective based on a novel and near-comprehensive data set on a specific form of securitisation over the sample period from 1932 to 2014. The Swiss Pfandbrief is a distinct covered bond with a similar institutional framework as the U.S. Federal Home Loan Bank System

that offers a countrywide, standardised form of mortgage securitisation. Our results suggest that growth in the volume of the Swiss Pfandbrief is unrelated to excessive loan growth and exhibits stabilising characteristics compared with other bank liabilities such as interbank funding.

JEL: E43, E44, E51, G12, G21, G23, N24
KEYWORDS: Securitisation, covered bonds, mortgage loans, bank balance sheet management, business cycles, financial cycle, financial stability

1 Introduction

Securitisation, especially of real estate related assets, was at the core of the global financial crisis of 2007 to 2009. The credit supply side failure before and during the global financial crisis appears to have been related to securitisation. Recent studies show that mortgage credit supply increased excessively and became more risky due to securitisation (Shin, 2009; Mian and Sufi, 2009; Jiménez et al., 2014). While the existing microeconomic evidence is strong, it is based on a short episode embracing the ramp-up to the global financial crisis and focuses on securitisation in particularly affected countries such as the U.S. (mortgage-backed securities, MBS, and asset-backed securities, ABS) and Spain (covered bonds, CB, and ABS).

It is important to note that particular forms of securitisation have continued to function well during and after the global financial crisis. A notable example is the Swiss Pfandbrief. Growth in the volume of outstanding Swiss Pfandbrief has even accelerated since the onset of the global financial crisis and has helped to stabilise the Swiss banking system (Moser, 2014). Another example, and institutionally closest to the Swiss Pfandbrief, is the U.S. Federal Home Loan Bank (FHLB) System that served as a "lender of next-to-last resort" (Ashcraft, Bech and Frame, 2010). Before the Federal Reserve System

started to inject liquidity into the U.S. financial system, the FHLB System proved to be an important source of funding for the U.S. financial system at the beginning of the global financial crisis.

Against this background, we assess the role of securitisation from a macroeconomic and bank balance sheet perspective. To perform such an assessment we compiled a unique dataset that exhibits information about issuances of the complete set of Swiss Pfandbriefe since the founding of Switzerland's central mortgage bond institutions in 1931. To our knowledge, this data harvest constitutes what is likely the longest and most complete data set on securitisation for a given country.[1] In combination with data on the banking system's balance sheet, our newly complied set of data on securitisation allows to analyse the effects of this form of securitisation on loan acitivty and real economic activity while taking into account other aggregate bank balance sheet dynamics over a long sample period.

We highlight the distinct institutional characteristics of the Swiss Pfandbrief compared with similar forms of securitisation and provide empirical evidence of the relation among loans, securitisation and bank funding over a long period of time. In light of the ongoing discussions on what institutional framework of securitisation favours prudent lending (Jordan, 2008, Bernanke, 2009, Paulson, 2010), on how to regulate securitisation to foster financial stability (EBA, 2015, EU, 2015) and on how to revive securitisation markets to foster bank lending (BoE and ECB, 2014), our paper is policy relevant insofar as it adds a distinct perspective by documenting a long history of securitisation via a distinct covered bond framework.

We take an agnostic approach and let the long-run data speak in the empirical analysis because, to the best of our knowledge, there is no literature that establishes strong theoretical restrictions on the relation among securitisation, mortgage (and other) loans, general economic activity and interest

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[1]Before 1931, there had not been a sizable issuing of mortgage bonds in Switzerland. Even though other forms of securitisation have emerged in the late 1990s, they have not gained a notable market share in Switzerland (Malamud, 2015).

rates. Thus, a VAR framework appears to be the natural choice to empirically analyse the lead and lag among the macroeconomic variables under question because we are interested in making statements about the drivers of loan growth and securitization (Sims, 1980). In a first step, we start with a simple VAR to analyse the relation among loan growth, Swiss Pfandbrief growth, GDP growth, the level of interest rates and the slope of the yield curve. We focus on the assessment of Granger causality in our baseline VAR system as we do not impose a model structure to identify specific shocks. In a second step, we incorporate the full banking sector into our VAR framework, i.e., we incorporate the full balance sheet of the banking sector by adding a variable on other assets and a variable on other liabilities. This allows us to analyse common dynamics of the Swiss Pfandbrief and loan activity controlled for by the investment and funding dynamics otherwise present in the banking sector. The data frequency is annual, and the sample period spans 1932 to 2014.

Three major lessons emerge from the first VAR analysis. First, controlling for the interest rate level and the slope of the term structure, Swiss Pfandbrief growth does not have any significant effects on future total and mortgage loan growth. Furthermore, growth in total loans and mortgage loans does not spur the future issuance of Swiss Pfandbriefe. While growth in other loans Granger causes future Swiss Pfandbrief growth, the reverse does not hold true. Therefore, the issuance of Swiss Pfandbriefe does not induce more or excessive lending. However, growth in lending other than mortgage loans indicates future Swiss Pfandbrief growth. The latter finding suggests that funding via the Swiss Pfandbrief is considered as a funding instrument among others rather than being dedicated to mortgage loan funding only. Second, a high level of interest rates predicts low future growth in mortgage loans and the Swiss Pfandbrief. This observation highlights the intimate link between the two markets. With low interest rates, borrowing for homeowners becomes more affordable, resulting in mortgage loan growth. Moreover, a low interest

rate level induces investors to search for yield which lowers banks' cost to issue a Swiss Pfandbrief. Third, while a steep yield curve predicts lower future growth in the Swiss Pfandbrief, future loan growth is not significantly affected. In other words, the issuance of Swiss Pfandbrief strongly depends on the level and the slope of the yield curve. Because the Swiss Pfandbrief is a rather long-term funding instrument, a comparatively high level of interest rates and a steep yield curve make it relatively unattractive. These three findings survive various robustness checks.

Enriching the VAR framework with the banking sector's balance sheet, further insights emerge. First, Swiss Pfandbrief growth is associated with negative future growth in other liabilities and in assets other than loans, while growth in other assets indicates positive future growth in GDP and loans. We interpret these findings as evidence of the countercyclical nature of the Swiss Pfandbrief. Growth in Swiss Pfandbrief indicates negative growth of the banking sector which, in turn, is associated with negative future growth of the total economy. Second, Swiss Pfandbrief growth predicts negative future growth of other liabilities than Swiss Pfandbrief. A more detailed liability side analysis reveals that interbank funding and long-term funding via own bonds and time deposits are responsible for this observation. We interpret these findings as evidence of i) a substitution effect between different long-term funding sources and ii) the stabilizing character of the Swiss Pfandbrief. Funding via Swiss Pfandbrief allows one to partially absorb decreasing interbank funding. This characteristic was clearly present during the recent global financial crisis.

The remainder of the paper is organised as follows. Section 2 presents the stylized facts of the Swiss Pfandbrief and the Swiss banking sector since 1932. In addition, it describes our complete data set and its sources. Sections 4 and 5 present the econometric framework and our empirical results. Section 6 discusses the results in light of the findings for similar funding markets. Section 7 concludes. The appendix presents details of various robustness

checks.

2 The Swiss Pfandbrief and stylized facts

This section spans the history of the Swiss Pfandbrief by providing stylized facts about the variables employed in our empirical analysis. The first subsection discusses the main characteristics of the Swiss Pfandbrief. The second subsection describes the development of the Swiss Pfandbrief and provides comparative statistics. The third subsection gives an overview of the growth in loans and other bank assets in Switzerland since 1932 and places these developments within the historical perspectives provided by Schularick and Taylor (2012) and Jorda et al. (2014). The fourth subsection illustrates the relative importance of the Swiss Pfandbrief as a funding tool for banks over the past 80 years. The final subsection presents an overview of other data used in this study.

2.1 The Swiss Pfandbrief

The Swiss Pfandbrief has a variety of special characteristics compared with other countries' CB. First, only two issuers are legally permitted to issue Swiss Pfandbrief. The Pfandbrief Act of 1930 limits the right to issue Swiss Pfandbrief to two distinct central mortgage bond institutions, namely the "Pfandbriefzentrale der Schweizerischen Kantonalbanken" (Pfandbriefzentrale) and the "Pfandbriefbank Schweizerischer Hypothekarinstitute" (Pfandbriefbank). Banks originate mortgage loans but are forced to go through these third party special purpose vehicles to securitise their mortgages via a covered bond. To issue a Swiss Pfandbrief, a member bank pledges mortgages[2] to its mortgage bond institution, which thereafter issues a Swiss Pfandbrief.

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[2]The Swiss Pfandbrief Act accepts only mortgages as collateral. Commercial mortgages are accepted, however, the overwhelming part of collateral consists of residential mortgages.

In return, the member bank receives a loan from its mortgage bond institution. The institutional framework is different from other CB regimes in which originators of mortgage loans mostly issue CB directly or do so via special purpose vehicles directly owned by the originators.

The two mortgage bond institutions are supervised special-purpose banks and, as such, are supervised by the Swiss Financial Market Supervisory Authority FINMA. The Pfandbrief Act stipulates that the two central mortgage bond institutes are user-owned: Pfandbriefzentrale by the Swiss cantonal banks and Pfandbriefbank by regional, savings, Raiffeisen and other Swiss banks that run a mortgage business (including big banks). However, the Swiss Federal Council approves the statutes of the central mortgage bond institutions and has the right to announce one board member. Mortgage bond institutions are legally obliged to accept any bank from their respective potential membership pool that runs a notable mortgage business and whose headquarters are Swiss domiciled. To foster stable funding of mortgage loans via CB funding, mortgage bond institutions were exempted from direct taxes and the stamp duty. Beyond tax exemptions, the Pfandbrief Act does not provide any other government privileges. While the intention of the Pfandbrief Act was to provide banks with a long-term funding tool to finance mortgage loans, funds are fungible and banks are not legally restricted in their investment choices (Bundesblatt, 1925, and Horat, 2007).

The institutional framework of the Swiss Pfandbrief shows striking similarities with the U.S. FHLB System. The FHLB System provides term funding by granting its members advances raised via the issuance of debt (Frame, Hancock and Passmore, 2012). The FHLB system is a government sponsored enterprise (GSE) that was created in the midst of the Great Depression to become a mortgage related source of funding for thrifts and credit unions. Nowadays approximately 8'000 member financial institutions, including commercial banks and insurance companies, are FHLB members. FHLB advances can more generally be used to finance small and agriculture busi-

nesses. However, funds are fungible and evidence by Frame, Hancock and Passmore (2012) suggests that FHLB advances are used to fund other assets as well. The FHLB System consists of 12 cooperatively owned wholesale banks that primarily fund themselves via the issuance of debt that is guaranteed by the system as a whole (Ashcraft, Bech and Frame, 2010). Each FHLB is a separate legal entity that is cooperatively owned by its members.

A CB is generally perceived to be a particularly safe investment. This perception of safety is related to four characteristics of CB. First, mortgages pledged to guarantee the CB stay on the issuers' balance sheets. Hence, mortgage-issuing banks are in the first loss position. Second, CB feature a dynamic replenishment duty, i.e. covered bond issuers must replenish non-performing mortgages and ensure that the interest rate payments by mortgages pledged cover the interest rate of the loans. Third, with European mortgages, the mortgagor is usually liable for the loan at all times to the full extent of its assets and future income. Forth, covered bonds are usually subject to stringent rules such as a minimum loan-to-value ratio, mandatory minimum overcollateralisation and minimum collateral requirements. Next to being on the conservative side among CB regimes[3], the Swiss Pfandbrief features several additional safety cushions compared to other CB regimes. In particular, central mortgage bond institutions can only accept mortgages as collateral (other forms of collateral are only temporarily accepted to bypass a gap in mortgages pledged). Furthermore, central mortgage bond instutions are subject to capital requirements; today a maximum leverage ratio of 50 is allowed for. Due to their membership structure, central mortgage bond institutions provide a countrywide diversification effect (both central mortgage bond institutions cover banks from all over the country). The central mortgage bond institutions run neither a maturity nor a currency mismatch, i.e., issued covered bonds and granted loans are of the same maturity and currency.

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[3]See ECBC (2014) for a comparison of CB regimes.

The Swiss Pfandbrief and the FHLB System share many safety features. While the FHLB System accepts different forms of mortgage-related assets (including MBS), the FHLB System runs a leverage ratio of roughly 25, provides countrywide diversification and does not run a maturity or currency mismatch. In addition, beyond the explicit collateral it can hold, the FHLB System enjoys priority over most other creditors in the event of member default ("super-lien").

2.2   Development and international comparison

Apart from the first years after the introduction of the Swiss Pfandbrief, growth in volumes roughly matched GDP growth rates in the first half of the sample period. As figure (1) shows, the amount of Swiss Pfandbrief made up between 4 and 6% of the GDP during that period. However, driven by the overall expansion of the Swiss banking sector, the growth in Swiss Pfandbrief volumes strongly exceeded GDP growth since the middle of the 1980s. While this development slowed before the global financial crisis, the Swiss Pfandbrief gained momentum at the onset of the global financial crisis and soon came back to its pre-crisis trajectory, reaching approxminately 14% of GDP at the end of 2014. This number means that Swiss Pfandbrief volume outstanding accounted for roughly 30% of all listed Swiss domestic bonds, exceeding the volume of Confederation bonds (Guggenheim, Meichle and Nellen, 2016).

[about here Figure (1)]

While the Swiss Pfandbrief owns the largest share in the Swiss capital market, the degree of securitisation in Switzerland remains relatively low in international comparison. For example, Spanish cédulas hipothecarias (Spanish CB) accounted for 33% of GDP at the end of 2013 (Hypostat, 2014). In contrast, the U.S. CB market never reached a relevant size, resting below 1%

of total mortgage loans at all times (Hypostat, 2014). However, U.S. securitisation overwhelmingly relies on MBS, accounting for more than 55% of total mortgage loans and more than 40% of GDP at the end of 2013. At the end of 2013 (2006 / 2008), the FHLB System's outstanding debt made up 4.91% (6.64% / 8.65%) of GDP and 6.29% (6.92% / 8.55%) of total mortgage debt outstanding in the U.S.[4] Considering other forms of securitisation, it might not come as a surprise that the U.S. FHLB System accounts for a smaller proportion of mortgage funding and GDP than the Schweizer Pfandbrief. The low share of securitised funding of the Swiss banking sector, however, is due to the structure of the Swiss financial system which is centred around banks.

Growth in the volumes of the Swiss Pfandbrief in recent years coincided with an increase in the number of issuances per year (Figure (2)). This observation holds for both central mortgage bond institutions but is particularly pronounced for the Pfandbriefbank.

[about here Figure (2)]

There are two explanations for this difference between the two central mortgage bond institutions. First, the Pfandbriefbank issued so-called "Limmat Pfandbriefe" that were meant to rechannel funds from Swiss banks that were basically unaffected by the global financial crisis in 2008/2009 to Swiss banks that were heavily exposed to the turmoil around the Lehman event (Moser, 2014). The former banks gained deposits from customers who were withdrawing deposits from the latter banks. These funds were partially rechanneled by Limmat Pfandbriefe. However, even if we account for these special transactions (the green line in Figure (2) indicates outstanding volumes without "Limmat Pfandbriefe"), the volumes issued by the Pfandbriefbank remain significantly higher in recent years. This finding reflects that

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[4]U.S. data are taken from FHLB System's financial statements (online) and the Federal Reserve System's database (online).

the two big, internationally active, Swiss banks have made significantly more use of the Swiss Pfandbrief as a funding tool since the first jitters in money markets occurred in 2007/2008.

The growing importance of the Swiss Pfandbrief during and after the global financial crisis presents another striking similarity to the FHLB System. As noted by Ashcraft et al. (2010), the FHLB system acted as "the lender of next-to-last resort" at the onset of the global financial crisis. As highlighted above, between 2006 and 2008 the increase in the FHLB System's total assets relative to GDP and outstanding mortgage debt was substantial. As described by Ashcraft et al. (2010), the FHLB System increased its advance lending by 36.7% to USD 875 billion during the second half of 2007.

The increase in the number of issuances and the strong growth in the amount of outstanding Swiss Pfandbriefe are also associated with more flexibility regarding the maturity of newly issued Swiss Pfandbriefe. As figure (3) displays, maturities of the Swiss Pfandbrief were at least 12 years or longer until the middle of the 1990s. At the end of the 1990s the maturity structure of Swiss Pfandbrief became more diverse which helps explain the growth in volumes and issuances in recent years.

[about here Figure (3)]

2.3   Banking sector's asset side

Does the growth in the Swiss Pfandbrief simply reflect loan growth in Switzerland? A first visual inspection of the dynamics of Swiss mortgage bonds and loan volumes indeed leaves this impression. The dynamics of the ratio between Swiss Pfandbrief volumes and GDP is broadly consistent with the pattern observable in the ratio of total loans to GDP depicted in figure (4).

[about here Figure (4)]

The loan-to-GDP ratio in Switzerland has steadily increased since the 1970s, in line with the evidence for a panel of countries provided by Schularick

and Taylor (2012). In addition, the increase in the ratio of loans to GDP in the past decades has been mainly driven by growth in mortgages (Jorda et al., 2014) which, by definition, should be linked to mortgage bonds, i.e,. the Swiss Pfandbrief. However, the Swiss Pfandbrief is not the major source of bank funding in Switzerland. We discuss the composition of bank funding in the next subsection.

Figure (4) additionally shows that the expansion of the Swiss banking sector since the 1970s has been primarily driven by the growth in other assets than loans. The global financial crisis stopped a strong upward growth trend in assets other than loans. However, as a share of GDP, other assets are still more important than loans.

2.4   Banking sector's liability side

Figure (5) shows how the importance of different, broadly defined, bank liability categories varied over time by depicting their shares relative to the total balance sheet size.

Apart from the Swiss Pfandbrief, we distinguish between sight deposits of (non-bank) customers and interbank funding. Interbank funding includes money market paper issued by the banks plus their interbank liabilities (the sum of sight and time liabilities towards other banks). In addition, we summarize the savings accounts and term deposits of non-bank customers as well as medium-term notes issued by banks, bonds, warrants and convertible notes into the category "long-term funding". This categorisation reflects our choice to structure the liability side into demandable short-term funding and stable long-term funding and at the same time distinguish between interbank and other liabilities.

Several observations of the time series in figure (5) are noteworthy. First, our long-term funding category is the main funding source comprising between 40% and 70% of banks' balance sheets. Interestingly, its importance was highest at the beginning of the sample period but as a share of the bal-

ance sheet, it steadily lost ground to other funding sources over the sample period. Second, the share of interbank funding increased until the global financial crisis. Since the crisis, sight deposits have gained considerable importance as a funding source for banks. Finally, the Swiss Pfandbrief only constitutes a relatively small part of banks' liabilities. The importance of the central mortgage bond institutions' loans to banks' funding rather mirrors the importance of the U.S. FHLB System's advances to commercial banks. At the end of 2013, the FHLB System advances accounted for 6.11% of total commercial bank liabilities. The Swiss Pfandbrief's greater importance in terms of GDP and outstanding mortgage debt is related to the greater importance of the banking sector in Switzerland.

[about here Figure (5)]

2.5   Other data and sources

Our annual sample period runs from 1932 to 2014. The source of the data on banks' assets and liabilities is the SNB's annual, statistical publication "Banks in Switzerland" which is publicly available on the SNB's website. The current issue of that publication contains the numbers for the last five years. Historical data back to 1906 can be found on the SNB website. Historical statistics allow us to focus on Swiss franc related business but not to differentiate between domestic and foreign assets and liabilities. The data encompass all banks that are shareholders of the mortgage bond institutions (banking categories 1 to 5 in "Banks in Switzerland").

We use nominal, annual GDP from 1980 to 2014 from the Swiss Federal Statistical Office as the starting point to construct a long-term nominal GDP series. Since different methods to estimate GDP have been employed over our sample period, we cannot directly concatenate GDP levels. Hence, we extend the sample backwards by using annual growth rates of nominal GDP (at current prices) for the period from 1932 to 1979. Our source for this data

is Hiestand et al. (2012). It is publicly available from "Historical Statistics of Switzerland Online".

In addition, we employ interest rate data from Homer and Sylla (2005) to control for (short-term) interest rate levels and the slope of the term structure of interest rates over our entire sample period. For the years 1932 to 1975, we use the private discount rate from 3-month bills from Table 71 in Homer and Sylla (2005) as the short-term interest rate and combine it with information obtained from the SNB about the 3-month Eurodollar CHF money market rate from 1976 to 1999 and the 3-month CHF Libor from 2000 to 2014. As a proxy of long-term rates, we use data from Homer & Sylla (2005) from 1932 to 1989 and data on ten-year government bond yields from the SNB from 1990 to 2014.

Finally, we use a long time series of the Swiss consumer price index (CPI) to obtain real variables. The source of this data is the SNB and the Swiss Federal Statistical Office.

3   Securitization and lending dynamics

3.1   Econometric framework

To the best of our knowledge, there is no literature that establishes strong theoretical restrictions on the relation among mortgage securitisation, mortgage loans, general economic activity and interest rates. However, the literature on the role of securitisation in the global financial crisis of 2007-2009 suggests that there are potential feedback effects between securitisation and loan markets. Thus, we start with a simple VAR framework (Sims, 1980) to empirically analyse the relation among loan growth, Swiss Pfandbrief growth, GDP growth, the level of interest rates and the slope of the yield curve. We focus on the assessment of Granger causality in our baseline VAR system.

The VAR is represented by

$$z_{t+1} = \Gamma(L)z_t + u_{t+1} \tag{1}$$

in which z denotes the state vector, i.e., the vector of variables that enter the VAR system. Γ is the matrix of VAR coefficients, L indicates the lag operator, and u represents the error terms.

The baseline VAR system aims at capturing the interaction between loan and securitization dynamics controlling for major potential drivers of loan demand such as the state of the economy and refinancing costs. Hence, the state vector z contains the following variables: real (CPI deflated) growth rate of total loans ($\Delta loans_t^{total}$), real growth rate of Swiss Pfandbriefe ($\Delta pfand_t$), real growth rate of GDP (Δgdp_t), short-term interest rate levels (r_t) and the term spread, i.e., a proxy of the slope of the term structure (ts_t). The choice of proxies for loan demand (GDP growth and interest rate data) reflect the restricted availability of data over the sample period from 1932 to 2014.

Table 1 gives the pairwise contemporaneous correlations of the variables in the VAR system. We observe strong contemporaneous correlations between the growth in total loans and Swiss Pfandbriefe. This observation is not too surprising because total loans are dominated by mortgage loans, and we would think of covered bonds being linked to mortgage loan market developments (see section 2.2). In addition, we observe a strong negative correlation between interest rate levels and the term spread. All of the other pairwise correlation coefficients are below 0.3 in absolute values.

[about here Table (1)]

The VAR analysis focuses on the assessment of Granger causality, i.e., what variables in the VAR system provide statistically significant information about future values of other variables in the presence of their past values. We do not impose restrictions on the VAR parameters because, to the best of our knowledge, there are no clear-cut theoretical restrictions on the lead-lag

relations of the variables under study. For example, Kashyap et al. (1993) argue that positive economic growth might enable agents to finance higher debt levels, i.e., positive GDP growth should indicate positive future loan growth. By contrast, Bernanke and Gertler (1995) hypothesise that this relation could even be negative when private agents exploit good economic conditions to pay down their debts.

All variables are z-standardized before estimating the VAR and we apply a lag length of two years, as suggested by standard information criteria (AIC and SIC). The baseline sample period runs from 1932 to 2014. Applying a lag length of two years, our VAR obeys

$$z_t = \Gamma_0 + \Gamma_1 z_{t-1} + \Gamma_2 z_{t-2} + u_t \tag{2}$$

in which Γ_0 denotes a 5-by-1 vector of intercepts and Γ_1, Γ_2 are 5-by-5 matrices of coefficients for the one-year and two-year lagged values of the variables in z.

3.2 Empirical results

Table 2 provides the sum of the coefficients of the lagged variables in the respective VAR equation, i.e., the sum of the elements in the matrices Γ_1 and Γ_2 associated with one of the VAR variables in the column header. In parentheses, below the sum of the coefficient estimates, we present the p-value of the Granger causality test. The null hypothesis of the Granger causality test is that the respective variable does not provide additional information about future values of a variable in the presence of the lagged values of the other variables in the VAR system. For example, the first row of table 2 provides the sum of the coefficients of the lagged loan growth terms in the VAR equations. The first element of this row tells us that past loan growth Granger caused future loan growth over our sample period. The p-value is 0. In addition, the sum of coefficients is positive, which signals that past

positive loan growth indicated future positive loan growth in the presence of lagged values of the other variables in the VAR system.

The main results depicted in table 2 are as follows. We find no significant evidence of past loan growth having Granger caused future growth in the volume of the Swiss Pfandbrief. The sum of the coefficients is close to zero, and the p-value of the Granger causality test is 0.37. However, there seems to be evidence of a feedback from growth in Swiss Pfandbrief to total loan growth. In contrast to what one might expect, past, positive growth in Swiss Pfandbrief volumes is associated with negative growth in total loan volumes. Hence, there is no evidence that past growth in Swiss Pfandbrief has fostered total loan growth in Switzerland. Rather, past growth in Swiss Pfandbrief indicates negative total loan growth.

Past high loan growth indicates higher GDP growth over our sample period. The sum of the lagged loan growth coefficients in the GDP growth equation is 0.4, and the p-value of the Granger causality test is 0.01.

Short-term (real) interest rate levels Granger cause both loan growth and Swiss Pfandbrief growth. In both cases, high interest rates signal future low growth of loans and Swiss Pfandbrief. This result is intuitively appealing because the demand for loans is expected to fall with rising interest rates. Similarly, funding via Swiss Pfandbrief becomes relatively more expensive and, thus, growth in Swiss Pfandbrief volumes declines. Moreover, a high term spread in the past is associated with lower future growth in Swiss Pfandbrief. A potential explanation for this finding is as follows: Over most of our sample period, the Swiss Pfandbrief was a long-term funding source (see figure 3). When long-term funding is expensive relative to short-term funding, i.e., long-term rates are higher than short-term rates (a positive term spread), then the issuance of Swiss Pfandbrief is less attractive and hence growth in Swiss Pfandbrief volumes subsequently slows or reverses.

[about here Table (2)]

Overall, the findings suggest that the Swiss Pfandbrief is used as a stable

funding instrument independent of the lending and business cycle. Banks rely more heavily on it when its relative cost is low. The fact that past CB growth indicates negative loan growth in the future suggests that CB funding is countercyclical. The appendix contains a variety of robustness checks that confirm these results.

4 Banking sector's balance sheet perspective

The previous VAR focused on the dynamics between loan and CB growth. In this section, we enlarge the former VAR framework by the missing parts of the aggregated banks' balance sheets, namely other assets (oa) and other liabilities (ol). Hence, we broaden the scope of the analysis by taking banks' other balance sheet dynamics into account. The VAR state vector then obeys $z_t = [\Delta loans_t^{total}, \triangle oa_t, \Delta pfand_t, \triangle ol_t, \Delta gdp_t, r_t, ts_t]'$. Other assets (oa) primarily comprise banks' trading portfolios, while other liabilities (ol) is the sum of interbank liabilities, sight deposits and term funding, as defined in section 2.

The VAR estimates[5] presented in table 3 validate the main results from the previous section. Past Swiss Pfandbrief growth does not drive loan growth. However, Swiss Pfandbrief growth is marginally significantly associated with negative growth in other liabilities and other asset growth. In addition, the estimates show that growth in other assets Granger causes growth in GDP and loans. This finding suggests that past positive growth in banks' assets other than loans coincided with positive loan and GDP growth rates. In turn, this implies that a decline in other assets signals a recession.

[about here Table (3)]

In a second step, we take a closer look at the liability side of banks' balance sheets, particularly the evidence that past growth in Swiss Pfandbrief

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[5]Due to the inclusion of two additional variables, information criteria suggest an optimal lag length of one year.

Granger causes negative growth in other liabilities. We argue that two different effects could be reflected in this finding. It could be the case that this evidence reflects a substitution effect between different long-term funding categories. Alternatively, this evidence could reflect a stabilizing effect of funding through the Swiss Pfandbrief by mitigating funding stress via other liabilities. The experiences from the recent global financial crisis highlighted in section 2 may point to this explanation.

We attempt to shed light on this issue by running a VAR that explicitly distinguishes between the two additional funding categories "interbank" liabilities (ib) and "long-term funding" (ltf) instead of the broad category "other liabilities". The state vector of the VAR then takes the following form $z_t = [\Delta loans_t^{total}, \triangle oa_t, \Delta pfand_t, \triangle ib, \Delta ltf_t \Delta gdp_t, r_t, ts_t]'$. The results are summarized in table (4).

The VAR estimates leave the impression that both effects - substitution of other long-term funding and interbank funding - are reflected in the data. Past growth in the Swiss Pfandbrief marginally significantly Granger causes growth in long-term funding and interbank liabilities. Past, positive Swiss Pfandbrief growth is associated with future negative growth in interbank liabilities and long-term funding. Furthermore, the VAR estimates highlight the rather procyclical nature of these two liability categories. In both cases, past growth in loans and other assets Granger cause future positive growth in interbank and long-term liabilities. In other words, the expansion of the Swiss banking sector over our sample period depicted in figure (4) was primarily financed by these two liability categories.

[about here Table (4)]

5   Discussion

The search for safe securitisation has been ongoing for a while and has reached its peak since the global financial crisis. While the FHLB System has gained

some attention, for the first time, we document the functioning of the Swiss Pfandbrief as another "out-of-sample" form of securitisation that was barely negatively affected by the global financial crisis. The institutional frameworks of these two distinct forms of securitisation share many features with proposals to redesign the financial system after the financial crisis of 2007-2009. Particularly worth noting may be proposals related to narrow funding banks, such as those by the Group of Thirty (2009) and by Gorton and Metrick (2010). The Swiss Pfandbrief and the FHLB System share many features with these proposals. While the proposals mainly target the U.S. shadow banking system, their real-world pendants generate a comparatively much lower extent of securities than what seems to be needed by the U.S. shadow banking system. Other proponents advocated to increase the share of CB securitisation in the U.S. (Paulson, 2009; Soros, 2010, and Campbell, 2013).

Next to the perceived safety, the CB's institutional framework is believed to incentivize banks to underwrite mortgages more carefully, avoiding some of the pitfalls associated with the originate-to-distribute model (Jordan, 2008, Bernanke, 2009, Keys et al., 2010, and Purnanandam, 2011). However, the case of Spain provides strong evidence that the standard CB setup may fail in this respect too (Jiménez et al., 2014). We provide long-term macroeconomic evidence that mortgage securitisation via third-party special-purpose vehicles is used to neither fund excessive mortgage nor other lending. Whether this claim can be validated for the Swiss Pfandbrief in an individual bank level analysis is beyond the scope of this paper and is left for future research. The Swiss Pfandbrief provides a natural laboratory to test whether this setup induces banks to lend more prudently, as other mortgage-related securitisation has been nearly inexistent.

We further provide evidence that the Swiss Pfandbrief represents a stable source of funding for the banking sector. Similar findings are reported for the FHLB System by Ashcraft, Bech and Frame (2010) and Frame, Hancock

and Passmore (2011). These characteristics of the Swiss Pfandbrief and the FHLB System may be further emphasised by comparing it to the European experiences with CB funding. While the CB market in Europe remained relatively more stable compared to other securitised or uncovered funding instruments, as the financial turmoil intensified and funding markets came under increased pressure, many European CB markets were adversely affected. Spreads in secondary markets widened, and primary markets stalled (ECB, 2008). Against this background, the ECB announced a CB purchase programme (CBPP; 2009/2010) in May 2009 (Beirne et al., 2011). Interestingly, differences in national CB markets seemed to be related to the health of the respective country's banking sector and its covered bond legislation, which may provide different degrees of safety (see also Packer et al., 2007). The subsequent European sovereign debt crisis revealed related phenomena as yields and issuance activities in national CB markets mirrored their respective sovereign's health (ECBC, 2016). In response to the sovereign debt crisis, the ECB installed a second CB purchase programme (CBPP2; 2011/2012). In its ongoing endeavour to spur the euro area economy, in addition to other quantitative easing instruments the ECB also put up CBPP3 (2014-). CBPP programmes seem to have helped revive CB issuance activities and have further narrowed CB spreads (ECBC, 2016).

Hanson and Sunderam (2013) present a model that helps explain several past collapses of primary markets for near-riskless securities in the last 40 years. In a setup where originators issue too many information-insensitive securities in good times, investors' incentives to invest in information acquisition are low. The endogenously low degree of information can lead to primary market collapses in bad times due to adverse selection problems. The low presence of informed investors in bad times results in too many uninformed investors staying away from the market. Their model suggests that policies regulating originators' capital structure could promote a more robust market design. While a CB by its very nature relies on the capital of banks as loan

originators, the European CB markets are closely tied to the banking sector's health. In contrast, the capital cushion of the Swiss Pfandbrief is extended by an additional layer, namely, the capital requirements of central mortgage bond institutions. Moreover, the safety of the Swiss Pfandbrief is backed by additional elements such as the perfect maturity match of outstanding bonds and loans and the countrywide diversification of the collateral base. These elements seem to support the Swiss Pfandbrief's information-insensitivity in bad times.

The stylized facts and econometric results of our paper support this view. The Swiss Pfandbrief's primary market has never experienced a market shutdown. Similar episodes of primary market evaporation as reported in Hanson and Sunderam (2013) and as seen during the global financial crisis for other securitised instruments have not occurred. In contrast, our results highlight that the importance of the Swiss Pfandbrief as a funding instrument increases in bad times such as the early 1990s, the global financial crisis of 2007 to 2009 and the subsequent European sovereign debt crisis. Particularly during the 1990s, the Swiss Pfandbrief market remained robust despite sharp housing price drops, severe mortgage loan losses by banks (though particularly related to commercial mortgages), a banking crisis accompanying a prominent regional bank failure and a deep recession (BCBS, 2004, and Staub, 1998). During the global financial crisis of 2007-2009 and the subsequent European sovereign debt crisis, an unprecedented growth in Swiss Pfandbrief issuing has taken place. Furthermore, despite being sizable in relation to the Swiss franc bond market, the Swiss Pfandbrief market has so far remained small in comparison to other securitisation markets such as the US MBS market and the Spanish CB market. Against this background, it is difficult to argue that overissuing of Swiss Pfandbriefe is taking place in good times. In line with the long-term econometric evidence provided, the unprecedented growth is rather due to the unprecedented low and negative level of interest rates. Furthermore, growth acceleration is associated with negative GDP growth and

bank sector deleveraging.

The striking similarity between the FHLB System and the Swiss Pfandbrief naturally raises the question of whether the stability, countercyclicality and stabilisation characteristics of these forms of funding through securitisation depend on implicit government guarantees. Considering the rescue of the two other GSEs, Fannie Mae and Freddie Mac, it is not surprising that the FHLB System and its capital market instruments are perceived to be guaranteed by the U.S. government (Ashcraft, Bech and Frame, 2010). While Swiss legislators designed the Swiss Pfandbrief to be self-sufficient, the Swiss Pfandbrief escaped a more recent stress test with the rescue of UBS in 2008 after the mortgage related banking crisis in the 1990s. However, against the background of the rescue operations during the global financial crisis, the more relevant question at hand is, why have the FHLB system and the Swiss Pfandbrief continued to function comparatively better than other securitisation markets? We relate the better performance of these markets to their unique institutional framework and the related additional safety cushions. Notwithstanding the relatively good performance, the risk management instrument of these systems is crucial and may have to be adapted to changing environments to provide information-insensitive securities in bad times. This is particularly true in an environment of strong interdependence among sovereigns' financial health, government guarantees and financial stability (Allen et al., 2015).

Another issue related to financial stability and securitisation markets is asset encumbrance (CGFS, 2013). Ahnert et al. (2016) provide a model of asset encumbrance through the issuance of CB, bank funding and financial fragility. Bankers maximize the expected equity value subject to potential runs by unsecured investors, i.e., they analyse the trade-off between increasing equity value through additional investments funded through the issuance of CB and the increased potential for a bank run by unsecured depositors. Bankers can fund more profitable investment opportunities if they issue more

covered bonds: with increasing asset encumbrance the expected equity value increases and the potential for a run decreases. However, as more CB are issued, the potential for an unsecured bank run increases because an adverse balance sheet shock hits holders of unsecured debt first. Limits to asset encumbrance and minimum capital requirements are perceived to be constraint-efficient in restoring financial stability.

They offer several testable implications. First, higher CB liquidation values reduce roll-over risk and should, thus, raise encumbrance levels. Second, a lower cost of unsecured debt funding reduces roll-over risk and should also raise encumbrance levels. Third, lower outside options, such as decreasing interest rate levels due to unconventional monetary policies, increases encumbrance. Fourth, encumbrance levels should be higher for better-capitalized banks and for more-profitable investments. Fifth, greater risk-aversion in unsecured debt-markets increases roll-over risk and, thus, reduces asset encumbrance. The first three hypotheses are partly reflected in our empirical finding that short-term interest rates are the intimate link between CB and loan markets. However, this links seems to be even stronger when market uncertainty evaporates unsecured funding markets. While we cannot speak to the forth hypothesis, the evidence provided by Ashcraft, Bech and Frame (2010) and this paper seems to contradict the fifth hypothesis. Both frameworks were able to provide funding in turbulent times and increased encumbrance levels when risk-aversion reached peak levels. Hypothesis four and the more general issue of whether the additional capital requirements imposed by the central mortgage bond institutions are sufficient to restore financial stability are left for future research based on individual bank-level data.

6 Conclusions

We provide long-term, macroeconomic evidence on a special form of securitisation via a third-party issued CB, the Swiss Pfandbrief. The institutional framework of the Swiss Pfandbrief is close to that of the U.S. FHLB System. The evidence provided suggests that this distinct form of securitisation does not foster credit supply side failures and provides a stable source of funding to the banking sector.

A first set of our main empirical results suggests that growth in Swiss Pfandbrief volume did not trigger the build-up of "excessive" loan growth in Switzerland over our sample period from 1932 to 2014. Also, loan growth did not drive Swiss Pfandbrief growth. Hence, we do not find evidence of a positive feedback loop between loan growth and Swiss Pfandbrief growth. Rather, these markets are linked through their reaction to short-term interest rate levels. In that sense, the Swiss Pfandbrief (or the associated loans from the central mortgage bond institutions to the originators of mortgage loans) represents a regular source of bank funding among other sources.

A second set of our main empirical results suggests that positive growth in the Swiss Pfandbrief indicates future lower GDP and bank asset growth. We interpret this evidence as reflecting the countercyclical nature of funding via the Swiss Pfandbrief. Bank deleveraging is smoothed through funding via Swiss Pfandbrief issuing. We further provide evidence that Swiss Pfandbrief growth is associated with negative growth of other funding tools. We interpret this evidence as reflecting a stabilizing characteristic of Swiss Pfandbrief. When funding via other liabilities decreases, the banking sector is partially able to compensate lost funding via loans from the central mortgage bond institutions. These latter findings show remarkable similarities to the U.S. FHLB System's role as a "lender of next-to-first resort" in the early stages of the financial crisis.

From a more general perspective, our findings raise questions related to three issues left for future research: First, do different institutional arrange-

ments for securitisation matter for bank risk-taking on the asset side? Second, does the evidence on countercyclical and stabilizing qualities of third-party securitisation found for the Swiss Pfandbrief and the U.S. FHLB System suggest a rationale for public sector involvement in relation to the institutional framework beyond structural industry policy? Third, the freeze of other securitisation markets during and after the global financial crisis painfully revealed the fragility of these markets. Are implicit government guarantees a necessary condition for stable securitisation markets, or can effective institutional frameworks and respective risk management practices provide a form of self-sustained securitisation?

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Tables

	$\Delta loans_t^{total}$	$\Delta pfand_t$	Δgdp_t	r_t	ts_t
$\Delta loans_t^{total}$	1	0.59	0.27	0.01	-0.15
$\Delta pfand_t$		1	0.02	-0.17	0.03
Δgdp_t			1	-0.16	0.15
r_t				1	-0.86
ts_t					1

Table 1: VAR system: Pairwise, contemporaneous correlations

Notes: Table 1 provides the pairwise, contemporaneous correlation coefficients of the variables that enter the baseline VAR system over the full sample period from 1932 to 2014. These variables are: total loan growth, growth in the volume of Swiss Pfandbriefe, GDP growth, the short-term real interest rate level and the term spread.

	$\Delta loans_t^{total}$	$\Delta pfand_t$	Δgdp_t	r_t	ts_t
$\gamma_1^{tloans} + \gamma_2^{tloans}$	0.84 (0.00)	0.13 (0.37)	0.40 (0.01)	0.23 (0.02)	-0.38 (0.00)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	-0.18 (0.06)	0.60 (0.00)	-0.25 (0.12)	-0.11 (0.40)	0.19 (0.17)
$\gamma_1^{gdp} + \gamma_2^{gdp}$	-0.18 (0.25)	-0.10 (0.64)	0.15 (0.32)	0.06 (0.34)	0.06 (0.39)
$\gamma_1^{r} + \gamma_2^{r}$	-0.21 (0.05)	-0.27 (0.02)	-0.19 (0.09)	0.99 (0.00)	-0.05 (0.38)
$\gamma_1^{ts} + \gamma_2^{ts}$	-0.16 (0.24)	-0.34 (0.02)	-0.01 (0.31)	0.34 (0.06)	0.39 (0.16)

Table 2: VAR estimates: baseline results

Notes: Table 2 provides the sum of the coefficients from the baseline VAR estimation and, in parentheses below, the p-value of the null hypothesis that the respective variable's past values do not Granger cause the variable in the column header. The lag length is two years as suggested by standard information criteria. The variables of the baseline VAR are described in the notes of table 1. The sample period runs from 1932 to 2014.

	$\Delta loans_t^{total}$	Δoa_t	$\Delta pfand_t$	Δol_t	Δgdp_t	r_t	ts_t
$\Delta loans_{t-1}^{total}$	0.75 (0.00)	0.06 (0.75)	0.13 (0.30)	0.35 (0.06)	0.43 (0.01)	0.00 (1.00)	−0.10 (0.55)
Δoa_{t-1}	0.48 (0.02)	0.07 (0.78)	0.13 (0.39)	0.33 (0.14)	0.45 (0.04)	−0.11 (0.50)	−0.04 (0.85)
$\Delta pfand_{t-1}$	−0.04 (0.65)	−0.19 (0.09)	0.64 (0.00)	−0.17 (0.10)	−0.14 (0.14)	−0.03 (0.69)	0.07 (0.50)
Δol_{t-1}	−0.29 (0.23)	0.41 (0.17)	−0.15 (0.43)	0.16 (0.56)	−0.17 (0.50)	0.14 (0.49)	0.03 (0.90)
Δgdp_{t-1}	−0.03 (0.78)	−0.18 (0.16)	−0.03 (0.63)	−0.14 (0.25)	0.10 (0.35)	0.18 (0.05)	−0.16 (0.17)
r_{t-1}	−0.29 (0.11)	0.21 (0.34)	−0.30 (0.03)	−0.05 (0.79)	−0.37 (0.05)	1.03 (0.00)	−0.12 (0.54)
ts_{t-1}	−0.17 (0.34)	0.21 (0.33)	−0.33 (0.02)	0.04 (0.20)	−0.09 (0.63)	0.25 (0.10)	0.50 (0.01)

Table 3: VAR: Banking sector's balance sheet perspective

Notes: Table 3 presents estimates from a VAR that adds growth in other assets (assets other than loans; oa) as well as growth in other liabilities (ol) from banks' balance sheets to the baseline VAR system. Below the estimates in parentheses is the p-value of the null hypothesis that the estimate is equal to zero. The VAR lag length is one year, as suggested by standard information criteria. The sample period runs from 1932 to 2014.

	$\Delta loans_t$	Δoa_t	$\Delta pfand_t$	Δib_t	Δltf_t	Δgdp_t	r_t	ts_t
$\Delta loans_{t-1}$	0.74 (0.00)	0.26 (0.17)	0.14 (0.21)	0.38 (0.03)	0.39 (0.03)	0.49 (0.00)	−0.09 (0.47)	−0.01 (0.95)
Δoa_{t-1}	0.46 (0.00)	0.37 (0.06)	0.14 (0.25)	0.32 (0.07)	0.40 (0.03)	0.47 (0.01)	−0.18 (0.17)	0.04 (0.82)
$\Delta pfand_{t-1}$	−0.07 (0.46)	−0.20 (0.09)	0.63 (0.00)	−0.19 (0.08)	−0.21 (0.07)	−0.15 (0.13)	−0.03 (0.72)	0.07 (0.45)
Δib_{t-1}	−0.08 (0.64)	0.02 (0.91)	−0.09 (0.45)	0.16 (0.40)	−0.12 (0.55)	−0.22 (0.20)	0.31 (0.03)	−0.23 (0.19)
Δltf_{t-1}	−0.28 (0.03)	−0.02 (0.90)	−0.11 (0.27)	0.00 (0.98)	0.06 (0.70)	−0.05 (0.73)	−0.02 (0.83)	0.14 (0.30)
Δgdp_{t-1}	0.02 (0.87)	−0.19 (0.17)	−0.02 (0.81)	−0.15 (0.24)	−0.07 (0.62)	0.12 (0.30)	0.18 (0.05)	−0.18 (0.13)
r_{t-1}	−0.17 (0.35)	0.23 (0.33)	−0.24 (0.09)	−0.08 (0.72)	0.32 (0.15)	−0.33 (0.10)	0.99 (0.00)	−0.14 (0.48)
ts_{t-1}	−0.08 (0.66)	0.26 (0.27)	−0.29 (0.05)	−0.02 (0.92)	0.41 (0.07)	−0.07 (0.73)	0.24 (0.13)	0.47 (0.02)

Table 4: VAR: Banking sector's balance sheet perspective (zoom on liability side)

Notes: Table 4 provides estimates of a VAR that is similar to that presented in table 3 but it replaces the category other liabilities (ol) with two specific bank liability categories: long-term funding (ltf) and interbank liabilities (ib). Below the estimates in parentheses is the p-value of the null hypothesis that the estimate is equal to zero. The VAR lag length is one year as suggested by standard information criteria. The sample period runs from 1932 to 2014.
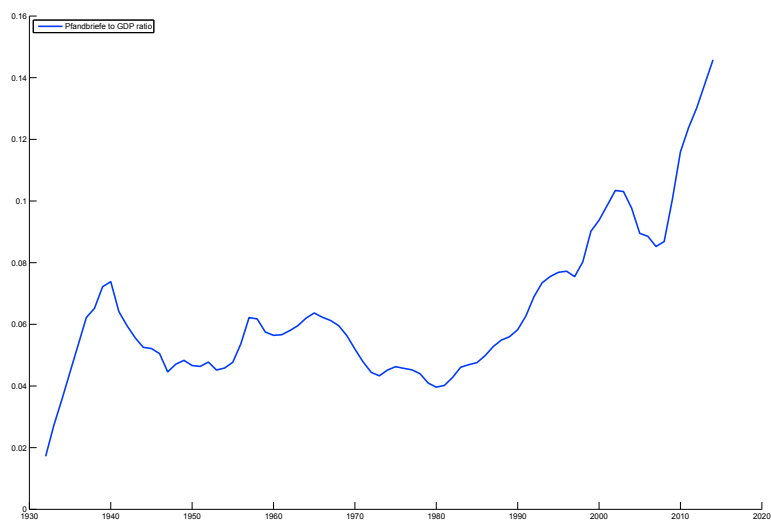
Figures

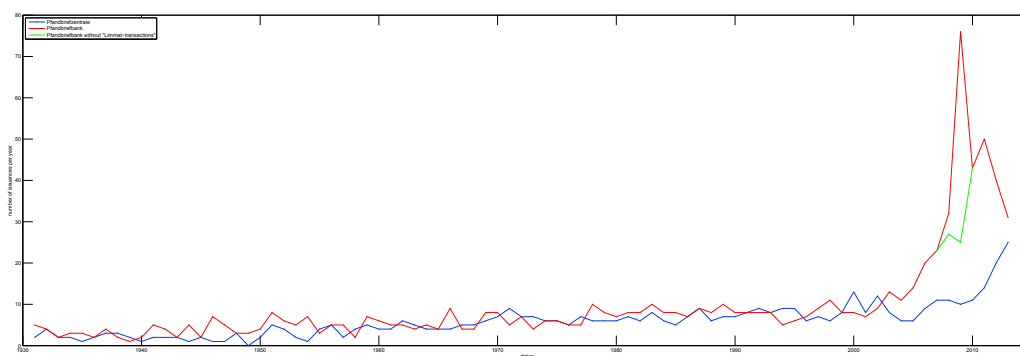Figure 1: Swiss Pfandbrief volume relative to GDP

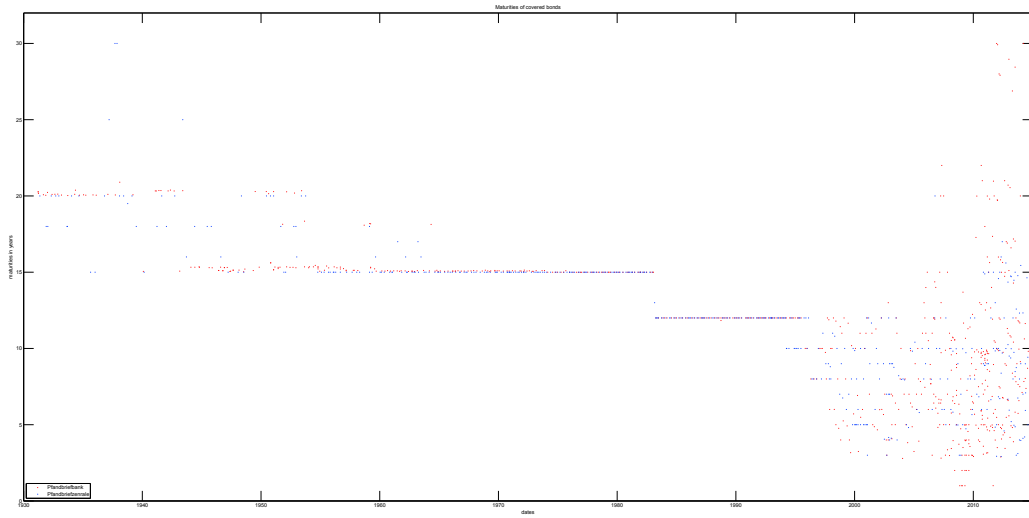Figure 2: Number of Swiss Pfandbrief issuances over time

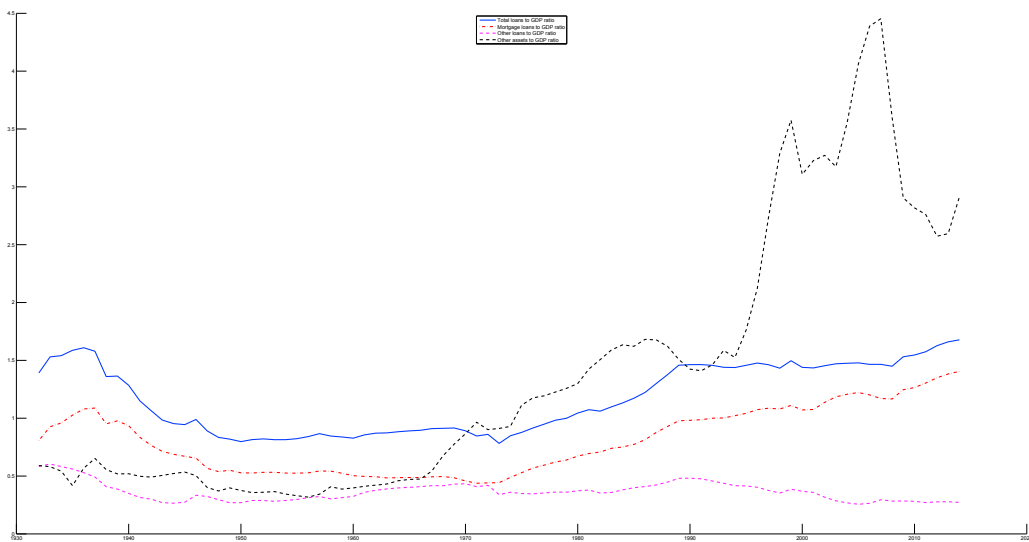Figure 3: Maturities of Swiss Pfandbrief issuances

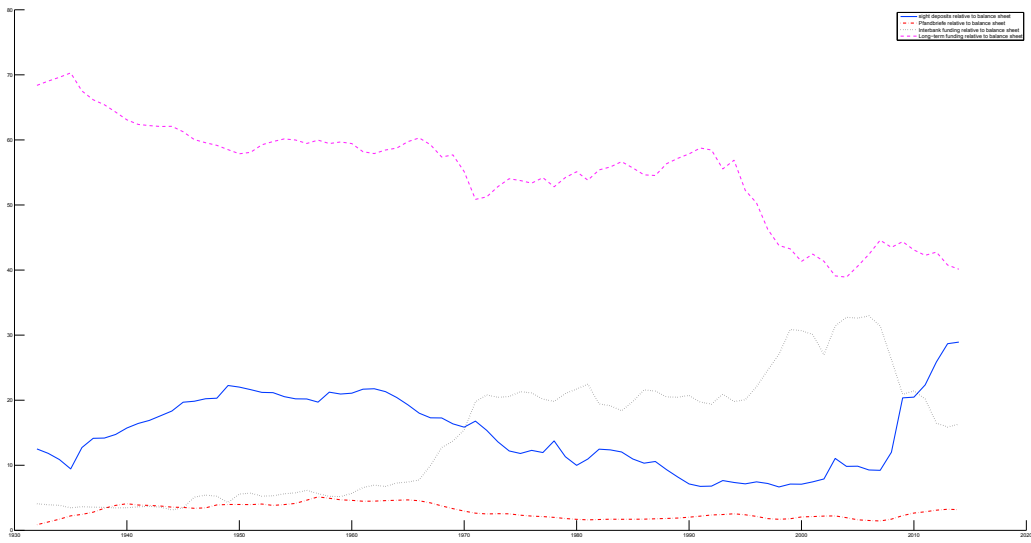Figure 4: Ratio of bank asset categories to GDP

Figure 5: Bank funding categories relative to balance sheet size

7 Appendix

The appendix provides an overview of several robustness checks.

7.1 Distinction between mortgage and other loans

We ran the VAR from equation 2 but replaced total loan growth with growth in mortgages or growth in other loans. The results from the respective Granger causality tests, presented in table 5 show that the results for mortgage loans are similar to the baseline results reported in table 2. This evidence confirms that growth in the Swiss Pfandbrief has not fostered loan growth in Switzerland over our sample period. In addition, interest rate levels indicate future growth in mortgage loans and the Swiss Pfandbrief. This finding also corroborates our baseline results and reflects that mortgages were the dominant form of loans in Switzerland over our sample period.

However, table 5 also reveals interesting differences compared with the baseline results. Past growth in other loans significantly signals future GDP growth. This is not the case for growth in mortgage volumes. This finding is related to the fact that the majority of mortgage loans are granted to households, while the vast majority of other loans consists of loans to firms. Hence, the category "other loans" might be a better gauge of the expected state of the economy. This is in line with findings by Bäurle and Scheufele (2016) who do not find significant effects of mortgage loan growth on GDP growth. This explanation might also help to clarify why past growth in other loans Granger causes growth in the Swiss Pfandbrief volume despite that the Swiss Pfandbrief only securitises mortgage loans. This finding further confirms the view that the Swiss Pfandbrief serves as a stable source of funding rather than a driver of lending or business cycles.

	$\Delta loans_t^{mort}$	$\Delta pfand_t$	Δgdp_t	r_t	ts_t
	Panel A: Mortgage loans				
$\gamma_1^{mloans} + \gamma_2^{mloans}$	0.77 (0.00)	0.05 (0.69)	0.14 (0.28)	0.22 (0.05)	−0.32 (0.02)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	−0.11 (0.21)	0.62 (0.00)	−0.20 (0.32)	−0.13 (0.35)	0.20 (0.20)
$\gamma_1^{gdp} + \gamma_2^{gdp}$	−0.07 (0.72)	−0.02 (0.92)	0.34 (0.02)	0.14 (0.23)	−0.08 (0.56)
$\gamma_1^{r} + \gamma_2^{r}$	−0.11 (0.04)	−0.28 (0.02)	−0.25 (0.08)	0.96 (0.00)	−0.01 (0.27)
$\gamma_1^{ts} + \gamma_2^{ts}$	−0.19 (0.12)	−0.36 (0.01)	−0.11 (0.24)	0.30 (0.05)	0.46 (0.08)
	$\Delta loans_t^{other}$	$\Delta pfand_t$	Δgdp_t	r_t	ts_t
	Panel B: Other loans				
$\gamma_1^{oloans} + \gamma_2^{oloans}$	0.56 (0.00)	0.28 (0.03)	0.62 (0.01)	0.09 (0.44)	−0.19 (0.08)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	−0.18 (0.20)	0.61 (0.00)	−0.20 (0.20)	−0.05 (0.84)	0.09 (0.67)
$\gamma_1^{gdp} + \gamma_2^{gdp}$	0.00 (0.55)	−0.23 (0.15)	−0.03 (0.49)	0.15 (0.27)	−0.06 (0.51)
$\gamma_1^{r} + \gamma_2^{r}$	−0.27 (0.27)	−0.26 (0.01)	−0.15 (0.03)	0.99 (0.00)	−0.04 (0.47)
$\gamma_1^{ts} + \gamma_2^{ts}$	−0.17 (0.64)	−0.30 (0.01)	0.06 (0.13)	0.28 (0.13)	0.47 (0.10)

Table 5: VAR estimates: distinction between mortgages and other loans

7.2 Loan-to-GDP ratio and securitisation

So far we have analysed the lead-lag relation between securitisation and loan growth. Securitisation in Switzerland only makes up a relatively small proportion of banks' funding mix (see section 2.3) which might explain why there is no significant lead-lag relation in the data. However, as emphasised in Schularick and Taylor (2012), non-monetary liabilities, such as the Swiss Pfandbrief, could be a driver of excessive loan growth leading to remarkable increases in the ratio of total loans to GDP (see figure 4).

To assess whether securitisation helped to drive the loan-to-GDP ratio, we run the VAR from equation 2 for the state vector $z_t = [log\left(\frac{loans}{gdp}\right)_t, \Delta pfand_t, r_t, ts_t]'$. Again we apply a lag length of two years in accordance with standard infor-

mation criteria. The results are summarised in table 6. They confirm our baseline results. First, past growth in the Swiss Pfandbrief did not Granger cause the loan-to-GDP ratio, i.e., there is no impact on excessive loan growth from growth in volumes of the Swiss Pfandbrief. Second, we do not find any feedback from the loan-to-GDP ratio to growth in the Swiss Pfandbrief volumes. Again, this observation indicates that the Swiss Pfandbrief is used as a stable funding instrument rather than as an instrument to fund excessive loan growth.

Qualitatively identical results are found for mortgage loans and other loans.

	$log\left(\frac{loans}{gdp}\right)_t$	$\Delta pfand_t$	r_t	ts_t
$\gamma_1^{tloan/gdp} + \gamma_2^{tloan/gdp}$	0.98 (0.00)	−0.01 (0.82)	−0.04 (0.91)	−0.01 (0.98)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	0.03 (0.21)	0.64 (0.00)	−0.00 (0.94)	0.05 (0.87)
$\gamma_1^{r} + \gamma_2^{r}$	−0.03 (0.86)	−0.27 (0.02)	0.87 (0.00)	0.06 (0.21)
$\gamma_1^{ts} + \gamma_2^{ts}$	−0.05 (0.44)	−0.37 (0.01)	0.18 (0.23)	0.58 (0.03)

Table 6: VAR estimates: Securitisation and the loan-to-GDP ratio

7.3   Impact of the global financial crisis

How large is the impact of the recent global financial crisis on the lead-lag relations we have analysed so far? We opted for a simple assessment of this question and estimated our baseline and the loan-to-GDP ratio VARs for a restricted sample period that covers the time from 1932 to 2006. As the results presented in table 7 show, the main results still pertain. Both loan and Swiss Pfandbrief growth were driven by past interest rate levels. There is no significant information from past loan growth or loan-to-GDP ratios for the future growth of Pfandbriefe and vice versa. In sum, the impact of the recent global financial crisis on our results is limited.

	Panel A: Loan growth				
	$\Delta loans_t^{total}$	$\Delta pfand_t$	Δgdp_t	r_t	ts_t
$\gamma_1^{tloans} + \gamma_2^{tloans}$	0.86 (0.00)	0.15 (0.28)	0.42 (0.01)	0.24 (0.02)	−0.36 (0.00)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	−0.17 (0.08)	0.62 (0.00)	−0.22 (0.20)	−0.12 (0.41)	0.20 (0.14)
$\gamma_1^{gdp} + \gamma_2^{gdp}$	−0.27 (0.17)	−0.16 (0.32)	0.04 (0.54)	0.07 (0.39)	0.01 (0.45)
$\gamma_1^{r} + \gamma_2^{r}$	−0.43 (0.03)	−0.41 (0.02)	−0.60 (0.02)	0.98 (0.00)	−0.21 (0.35)
$\gamma_1^{ts} + \gamma_2^{ts}$	−0.37 (0.14)	−0.47 (0.01)	−0.41 (0.10)	0.34 (0.21)	0.25 (0.66)

	Panel B: Loan-to-GDP ratio			
	$\log\left(\frac{loans}{gdp}\right)_t$	$\Delta pfand_t$	r_t	ts_t
$\gamma_1^{tloan/gdp} + \gamma_2^{tloan/gdp}$	0.98 (0.00)	0.00 (0.82)	−0.01 (0.98)	−0.01 (0.99)
$\gamma_1^{pfand} + \gamma_2^{pfand}$	0.03 (0.17)	0.66 (0.00)	−0.01 (0.96)	0.06 (0.86)
$\gamma_1^{r} + \gamma_2^{r}$	0.01 (0.96)	−0.35 (0.02)	0.78 (0.00)	0.01 (0.27)
$\gamma_1^{ts} + \gamma_2^{ts}$	−0.02 (0.93)	−0.45 (0.01)	0.10 (0.37)	0.55 (0.15)

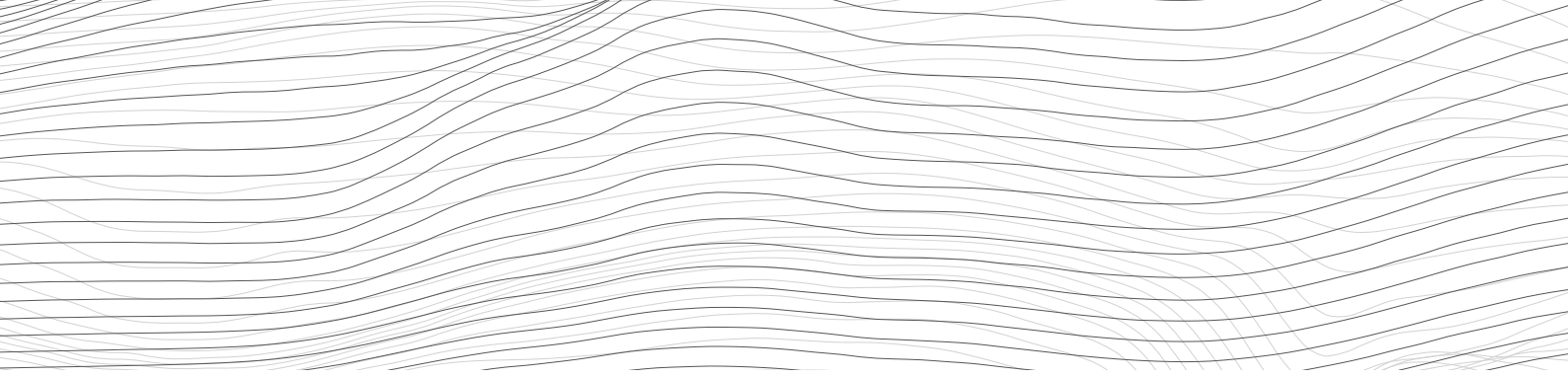Table 7: VAR estimates: sample period 1932 to 2006

7.4 Other robustness checks

This section briefly summarises further robustness checks that we do not report in detail but are available upon request. First, we restricted our sample period even further to the time from 1932 to 1985 in order to exclude the potential impact of the Swiss-specific real estate crisis in the early 1990s. All of our main results remain qualitatively the same. Second, we analysed "gap" variables, i.e., we did not analyse growth rates but deviations of loans, the Swiss Pfandbrief volume and GDP from trends in the VAR. We experimented with various definitions of trends such as (one-sided or two-sided) Hodrick-Prescott filters, linear time trend or a combination of linear and quadratic time trends. Qualitatively, the main result of hardly any information from past loan volumes for future dynamics of the Swiss Pfandbrief and vice versa

still holds. In addition to the inclusion of banks' balance sheet data, we distinguish between mortgage and other loans in the estimation of the VAR. It turns out that the qualitative results reported in the main body of the paper remain unaltered.

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