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«Negativzinsen: Neben- und Folgewirkungen»

Beitrag «Die bisherige Reaktion der Banken auf die Schweizer Negativzinsen und mögliche Konsequenzen für die Finanzstabilität»

Organisatorische Vorab-Bemerkungen

Der vorliegende Beitrag beleuchtet die Fragestellung insbesondere im Hinblick auf die Folgen für die Unternehmungen des Schweizer Bankensektors. Er basiert massgeblich auf einer empirischen Forschungsarbeit, deren ökonometrische Analysen ich aus Datenzugangs-Gründen alleine durchgeführt habe, die ich aber gemeinsam mit einem ausländischen Kollegen zu Papier gebracht habe. Für den vorliegenden Wettbewerb habe ich einen neuen Essay verfasst, um den Anforderungen in puncto Länge, Technik-Level und Datenverwendungs-Rechten gerecht zu werden, greife jedoch stark auf die zugrundeliegende Forschungsarbeit zurück. Diese stelle ich auf Nachfrage natürlich zu gegebener Zeit auch gerne zur Verfügung, sie soll aber naturgemäss primär in einer adäquaten wissenschaftlichen Fachzeitschrift veröffentlicht werden, je nach Vorankommen vor oder nach Publikation dieses Essays. Zwecks besserer Korrespondenz mit der zugrundeliegenden Forschung habe ich für den folgenden Essay die Option der englischen Sprache gewählt, doch natürlich lassen sich die Ergebnisse bei Bedarf gerne auch auf Deutsch zusammenfassen.

1. Introduction

Many economists have long considered negative interest rates impossible, as exemplified by Nobel Laureate Paul Krugman's 2013 statement that "the zero lower bound isn't a theory, it's a fact".[1] Yet since 2014 several large central banks have introduced negative rates on the reserves commercial banks have with them. Thus the European Central Bank (ECB) lowered its rate to -0.4% in 2014 and the Swiss National Bank (SNB) followed with–0.75% starting in January 2015. Yet many commercial banks maintained SNB reserves above the minimum level required by regulation, as SNB reserves do apparently carry sufficient benefits relative to other assets to make it to some extent worthwhile bearing these costs. By contrast, the negative rates have so far been transmitted to depositors only to a very limited extent, causing banks' "liability margin" between interbank rate and deposit rates to turn negative. Both the cost of direct negative rates to be paid to the SNB and the increased costs resulting from changes in banks' funding costs have by themselves hurt many banks' profitability, requiring them to look for suitable compensation mechanisms. By and large, the majority of retail banks – in contrast to many wealth management banks – have so far managed to maintain their overall profitability. Yet their responses have also changed banks' risk-taking in ways that could potentially threaten financial stability and hence the functioning of the economy as a whole if used extendedly or repeatedly. Thus our empirical work described on the following pages is of utmost importance both to policy-makers and more widely to anyone interested in the well-being of our economy.

Amongst academic economists, we are to the best of our knowledge the first to comprehensively study the effect of negative nominal rates on the universe of a country's retail banks, which are particularly relevant for households for deposits and mortgage borrowing. In addition, the quasi-experimental policy design in Switzerland and the supervisory data used allow us to offer a detailed anatomy of the effect on balance sheets, income, and risk-taking.

The remainder of this essay is structured as follows. Section 2 introduces the Swiss context, Section 3 the data we have used, and Section 4 our empirical methodology. Section 5 then presents our key results on respectively the costs of negative rates to banks, their compensation strategies, and the resulting risk implications. Finally, Section 6 concludes.

2. The Swiss context in which the negative rates were introduced

Prior to January 2015, monetary policy in Switzerland was conducted via open market operations. The SNB defined upper and lower bounds for the target interbank rate and injected or extracted liquidity from the market to navigate the 3-month CHF LIBOR within these bounds. By contrast, no interest was paid on central bank reserves. By contrast, on December 18, 2014, the SNB first announced a return of -0.25% on banks' sight deposit account balances for January 22, 2015. In a subsequent communication on January 15, 2015, the rate announcement was lowered further to -0.75% and the target bounds for the LIBOR rate were moved to -1.25% and -0.25% respectively. Presumably to ensure interbank transmission while limiting the strain on the system at large, the SNB applied negative rates only to *marginal* Swiss Francs, and exempted most *infra-marginal* reserves. With system-wide liquidity worth about 24 times the sum of banks´ Minimum Reserve Requirements (MRR), it exempted, more specifically, all central bank reserves below "*20 times the minimum reserve requirement for the reporting period 20 October 2014 to 19 November 2014 (static component), minus any increase/plus any decrease in the amount of cash held (dynamic component)*".[2] Importantly, for our analysis, the exemption was thus designed to manage aggregate liquidity and was not targeted towards specific banks. This policy design implied that banks could not anticipate the exact degree to which they were exposed to negative rates.

[1] https://krugman.blogs.nytimes.com/2013/10/15/five-on-the-floor/
[2] http://www.snb.ch/en/mmr/reference/pre_20141218/source/pre_20141218.en.pdf

What further distinguishes the implementation of negative rates in Switzerland is that it seemed motivated by concerns to restore the interest rate differential with the Euro in order to prevent excessive CHF appreciation, rather than to stimulate domestic demand. Since 2011, the SNB had continuously acquired assets in foreign currency to moderate pressure on the Swiss Franc, and to defend an exchange rate of 1.2 CHF vis-à-vis the Euro. Despite having communicated a renewed commitment to this exchange rate on December 18, the SNB unpegged the Franc on January 15. As a consequence, the move into negative rate territory was accompanied by an appreciation of the Swiss currency from 1.20 CHF/EUR in December 2014 to 1.04 CHF/EUR in April 2015. For an economy reliant on exports, this sudden appreciation constituted an adverse shock and exports fell between 2014 Q4 and 2015 Q1. Aided by a depreciation of the Swiss Franc to the Dollar and tax-financed subsidies for temporarily reduced working hours, however, they quickly recovered and annual GDP growth remained largely unaffected. The fact that monetary policy was largely exogenous to domestic credit growth in Switzerland supports our identification, while the simultaneous unpegging of the CHF-EUR exchange rate introduces potential concerns. These concerns, however, are alleviated by (a) the observation that economic growth – as a proxy for credit demand – did not react to a noteworthy extent; (b) our focus on the relatively homogenous group of domestically-owned retail banks; (c) the quasi-random individual exposure to negative rates, under the Swiss policy regime.

Figure 1 illustrates the evolution of the Swiss monetary policy target between July 2013 and June 2016, and the corresponding interest rates for overnight (SARON), 3- and 12-month interbank (LIBOR) loans, as well as federal government bonds with one-year maturity. All short-term rates drop to a level around -0.75% as of January 2015. The 3-month LIBOR rate and the overnight lending rate stay close to the target, while the return on one-year government bonds is more volatile and initially below target. Consistent with a standard yield curve, the return on 12-month interbank loans is on average slightly higher than the target rate. The main take-away, for our purposes, is the immediate transmission of the negative reserve rate to comparable short-term assets. The return on longer-term assets, instead, exhibits a weaker response. Government bonds, covered bonds, cantonal bonds, and bank bonds with an 8-year maturity continue an almost uninterrupted downward trend that approaches -0.75% only around June 2016. A notable exception is the return on non-financial corporation (NFC) bonds with the same 8-year maturity, which does not drop further after January 2015 and subsequently approaches 1% from below. In view of the effect on banks' balance sheets, these trends suggest that relatively safe financial assets with longer maturities became more attractive. However, Figure 1 also suggests an imperfect pass-through to banks' long-term borrowing costs, with the return on bank bonds remaining positive until June 2016.

3. Data Used

Our empirical analyses rely on supervisory data banks report to the Swiss Financial Market Supervisory Authority (FINMA) and the SNB. One of us has been allowed to use these data for empirical analyses, but with the important requirements that no information on any specific bank must be disclosed, nor must the data be used for any other purpose. We mainly rely on balance sheet information that is also available publicly at annual frequency, but that the supervisor receives at monthly frequency. That allows us to better trace the effects of negative rates month by month, as well as to verify that banks with different initial exposure to negative rates do really exhibit parallel trends before the introduction of the negative rates, so that any subsequent differences can be attributed to the negative rates. Monthly balance sheet information is complemented with quarterly information on bank risk-taking as well as semi-annual information on bank profitability. We compare behavior in the 18 months after to behavior in the 18 months before the negative rate introduction.

Starting from the population of all Swiss banks, we first restrict the focus of our baseline analyses to retail banks, defined as banks that, on average throughout the three years preceding our analysis, have earned at least 55% of their income from balance-sheet effective activities. These include net interest income and fees on loans, and exclude advisory fees and trading income. The criterion primarily eliminates wealth management (WM) banks, which derive most income from advisory fees, as well as Switzerland's two large universal banks. The advantage of doing so is that we exclude banks that receive

a significant share of their income in foreign currency and were hence affected in a noteworthy way by the exchange rate shock that occurred simultaneously with the introduction of the negative rates. Hence for these banks it would have been difficult to isolate the causal effect of the negative rates. For the same reason we exclude foreign-owned banks.[3] For the resulting sample of 50 banks and 36 months we can arguably fairly cleanly identify the effect of the negative rates. At the same time, results of our analyses are also of interest to foreign countries, as domestically owned retail banks are more comparable to banks elsewhere than is the more context-specific population of wealth management banks.

4. Empirical Strategy for Identifying the Causal Effect of Negative Rates on Bank Behavior

To identify the effect of marginally higher negative rate exposure on bank behavior, we rely on a Difference-in-Difference (DiD) design, in which the change from *Pre-* to *Post*-negative rate period for more affected banks is compared to that for less affected banks. As $Post_t$ period we use the 18 months from January 2015 until June 2016, whereas our Pre_t period are the 18 months from July 2013 until December 2014. Our main treatment variable is continuous and given by the level of SNB reserves in December 2014, minus the bank-specific exemption, relative to total assets (TA). For each bank *i*, we refer to this variable as *Exposed Reserves* (ER_i):

$$ER_i = \frac{\text{SNB Reserves}_{i,12/2014} - \text{SNB Exemption}_{i,2014}}{\text{Total Assets}_{i,12/2014}}$$

We use a continuous treatment variable, because banks were affected by negative rates to many different degrees rather than in a binary fashion. Denoting a generic dependent variable in period *t* as $Y_{i,t}$, our benchmark model is:

$$Y_{i,t} = \alpha + \beta \times ER_i + \gamma \times Post_t + \delta \times (ER_i \times Post_t) + \varepsilon_{i,t}. \quad (1)$$

The coefficient of interest, δ, captures the difference in the pre-post change of the dependent variable, between banks with different levels of exposed reserves, or more intuitively: the effect of negative rate exposure on $Y_{i,t}$. It is worth mentioning that our definition of the treatment variable assumes the same relationship between $Y_{i,t}$ and ER_i for positive and negative levels of ER_i. This is because a marginal unit of ER_i has the same (opportunity) cost for banks with $ER_i < 0$ as for banks with $ER_i > 0$. As robustness checks we have also repeated our estimates with a binary treatment indicator based on whether initial ER were above or below the sample median, as well as with alternative treatment measures. These include ER plus a bank's initial interbank position, a bank's initial level of all liquid assets, and a bank's initial distance of its deposit rates from the zero lower bound. All of these robustness checks confirm our main results. Furthermore, to make our estimates even more robust, we furthermore saturate the model with bank and time fixed effects (FE) to control for time-invariant, bank-specific heterogeneity and for period-specific factors:

$$Y_{i,t} = \hat{\alpha} + \hat{\delta} \times (ER_i \times Post_t) + FE_i + FE_t + u_{i,t}. \quad (2)$$

Next, to capture not only the average treatment effect for the post-treatment period, we also estimate month-by-month effects. To this end, we interact our treatment variable with dummy variables for 35 of the 36 sample months, using July 2013 as the reference date:

$$Y_{i,t} = \alpha' + \sum_{s=08/2013}^{06/2016} \delta'_s \times (ER_i \times FE_s) + FE_i + FE_t + \varepsilon_{i,t}. \quad (3)$$

[3] Cooperative banks do not enter our sample either, because they hold reserves at a shared clearing bank, which therefore we do not observe at the level of individual banks.

We estimate our models using ordinary least squares and cluster our standard errors at the bank level (Bertrand et al., 2004). In the two tables below we estimate the results from estimating Equation (2), whereas our graphs display the results from estimating Equation (3).

A central identifying assumption of our setup is that – absent negative rates – time trends in the dependent variables would be parallel for banks with different levels of exposed reserves. This is supported by jointly plotting intertemporal trends in key outcomes for banks with initial exposed reserves respectively above and below the sample median, which we do not show here for lack of space. It is also supported by estimating effects month-by-month using Equation (3) and plotting these monthly estimates in Figures 4-6 below: While we see significant effects after the introduction of the negative rates, we see no noteworthy effects in any of the 17 of 18 months before their introduction, confirming that that introduction was indeed a special event.

A challenge to our identification arises potentially from the removal of the exchange rate peg that occurred simultaneously with the introduction of the negative rates. The unpegging came as a surprise to financial markets and led to heavy losses among currency traders betting on a depreciation of the CHF. Their losses transmitted to direct brokers, both foreign and domestic, who had financed the traders' bets with Lombard Loans.[4] This could be problematic if the losses were systematically correlated with ER. In response to this challenge, we do not include direct brokers in our sample and focus entirely on domestically owned retail banks. We further isolate our analysis from exchange rate exposure by excluding internationally active WM and universal banks from our sample. For retail banks themselves, the exchange rate shock could have mattered insofar as the more export-oriented of their corporate clients may have suffered from reductions in competitiveness. With hindsight, these clients have coped well, aided *inter alia* by tax-financed schemes to support shorter working hours and by the international price setting power of many Swiss exporters.[5] For this channel to affect our conclusions, it would, in any case, be necessary that differences in the demand from corporates are correlated with banks' exposed reserves.

Another identification challenge arises if the treatment of one bank in our sample affects the behavior of another – less treated – bank. Since our sample covers about 27% of the Swiss mortgage market, and does not include any of the "big players", we are confident that individual treatment does not affect market conditions for other banks in the same market.

5. Empirical Results

In this section we first describe the additional costs negative rates have caused to banks, then point out how they have nonetheless largely safeguarded their profitability, and finally analyze potential implications in terms of bank risk-taking.

5.1. A Threefold Drain on Bank Profitability

Firstly, Figure 1 shows that the negative rates have quickly been transmitted from SNB accounts to alternative bank assets with comparably short maturity and high liquidity. The transmission to the interbank market, as evidenced by the 3-month CHF Libor rate, was driven by the incentive of banks with high initial exposed reserves to move some of their liquidity from SNB reserves to other banks that had initially not fully exhausted their SNB exemptions. As these latter banks could still increase their SNB reserves until reaching their exemption at no cost, it was profitable for them to accept money from other banks, charge a rate marginally less negative than the SNB, and deposit the money at no charge at the SNB. For the more affected banks this allowed to reduce their burden of interest to be paid, but only marginally so. Likewise, as soon as banks and other investors started increasing their demand for federal

[4] See, for example, "Swiss central bank moves to negative deposit rate" (*Financial Times*; 18.12.2014) and "Swiss franc storm claims scalp of top FOREX broker " (*Financial Times*; 20.01.2015), where the latter is referring to a UK entity.

[5] To avoid lay-offs in the face of temporarily lower demand for a firm's products, *short-term work* schemes had employees work only e.g. 50% of regular hours but receive 80% of their full wage, where the difference was paid by the government. For the government this was cheaper than the unemployment benefits due if the person were laid off entirely. See e.g. https://www.ch.ch/en/short-time-work/ .

government bonds, the returns on those were bound to turn negative as well. Hence any liquidity stored in CHF started to cause direct costs, which has been the first burden on banks' profitability.

Secondly, an additional burden has been caused by the fact that banks have by and large been very hesitant to pass the negative rates on to their deposit customers. One reason has been the fear that most households would find negative deposit rates outrageous and respond by giving up their deposit accounts. This could be damaging for the bank firstly because the same households might then also be lost for other, more profitable business such as wealth management fees or lending, and secondly because they might be hard to win back when deposits are needed again in the future. The relevance of such fears is hard to verify for the time being for lack of experience, but the fears seem reasonable at least as long as there are other banks that, for example because they are less exposed to the negative rate regime, offer deposit accounts without negative rates.[6] This self-imposed Zero Lower Bound (ZLB) on deposit rates did affect banks' liability margin. Normally this margin between the interbank rates considered as an investment benchmark and deposit rates banks had to pay to obtain a CHF have been positive. But now that interbank rates have turned negative while deposit rates have been kept floored at zero, liability margins have turned negative, as illustrated in Figure 2.

Thirdly, without cutting deposit rates into negative territory most banks have not managed to reduce the demand for their deposit accounts and the resulting amounts of deposit funding, despite incentives to reduce at least the portion of their assets stored with the SNB. As a result they had to cut liabilities elsewhere, including in the bond funding market. As Figure 5 illustrates, this has reduced the share of their funding attributable to bond funding and has instead even increased their share of funding attributable to deposits, resulting in an overall increase in their average cost of funding. This has in essence constituted a third drain on their profitability.

5.2. Banks' Responses to Safeguard Profitability

Despite these three drains on profitability, Table 1 – which presents the results from estimating Equation (2) above — reveals that the average Swiss retail bank in our sample has managed to maintain its overall profitability. Here columns (1)-(6) show the results from estimating the DiD effect of each additional percentage point of total assets initially invested in exposed reserves, on four different outcomes scaled by total assets as well as on another two scaled by business volume, i.e. total assets plus assets under management. Columns (7)-(12) then present the estimated effects on the year-on-year growth rates of numerators only. The first thing that stands out is that, as evidenced by Columns (6) and (12), overall gross profits – both when measured as level scaled by total business volume and when measured as year-on-year growth rate — have increased rather than decreased more the higher a bank's initial exposed reserves. How did banks achieve this? As Columns (4) and (5) show for respectively total asset and business volume scaled levels, and Columns (10) and (11) for annual growth rates, banks have managed to increase both their loan fee income and their total net fee income. More interesting however is the increase, evidenced in particular in Column (1), in net interest income, i.e. in interest earned less interest paid. Interest paid, as shown in Columns (3) and (9) has gone up not least because assets that would previously have earned banks a positive return such as money lent to other banks, have now started to cost. Yet on average interest earned has gone up even more. How did banks get there?

As Figure 3 shows, an important compensatory mechanism has been an increase in mortgage rates that in turn has allowed banks to increase the asset margin between mortgage rates earned and mortgage refinancing costs to be paid. This is true even when we use the swap rates for maturities aligned with those of the analyzed mortgages and hence budget in a full hedging of the interest rate risk resulting from long-term mortgages financed with shorter-term liabilities.

An interesting question of course is how banks have managed to increase mortgage rates net of refinancing costs despite competition in the mortgage market. One argument many banks have made is that the swaps used to hedge interest rate risk has become more expensive as the short-term received

[6] Some banks have reportedly discussed negative deposit rates with selected (high net worth or corporate) customers for deposits above very high thresholds. These cases do not show up in our data on regular customers however.

has turned negative with the interbank rate. Hence the bank has ended up paying both on the long-term and the short-term rate leg of the swap deal. Yet our analyses, not displayed here for lack of space, reveal that mortgage rates have not been raised more by banks using interest rate swaps than by banks not using any such swaps. This speaks against increased hedging cost as a reason for higher mortgage rates. So do intertemporal plots of long-term swap rates that have collapsed for a while after the drop of short-term rates into the negative. Hence even if banks may have had to pay for the short-term leg of their swap deals as long as this has not been ruled out in their swap contracts, long-term rates may have adjusted accordingly to restore the market equilibrium in the swap market.

Alternative explanations for the rate increase voiced by various proponents have been collusion on behalf of the banks, as well as increases in risk-taking in the mortgage market that would have allowed banks to charge higher credit risk premiums. In our data we have investigated – again not shown for lack of space — whether mortgage rates have been raised relatively more by banks who have been active particularly in cantonal mortgage markets with higher degrees of market concentration, as these should have had more market power. But our evidence in favor of such a pattern is relatively weak. What we cannot exclude is collusion by banks to raise rates simultaneously, as voiced by various proponents in the public, even though such collusion would arguably have been challenging given the large number of market participants. In Subsection 5.3 below however we discuss to what extent the higher mortgage rates can be explained by more risk-taking.

Besides increasing mortgage rates however, banks have also changed the structures of their balance sheets. Most obviously, as evidenced by Figure 4, banks with higher initial ER, have subtracted larger shares of their total assets from the SNB and have shifted larger shares to other banks so as to save some of their interest expenses while still maintaining sufficient liquidity. The potential for such reallocation has however been limited by the limited availability of exemptions for other banks. Furthermore, as discussed above, after a while rates close to the SNB's direct charge have been transmitted also to the interbank market. Hence a second response has been to shrink balance sheets, as evidenced most clearly by the reduction in bond funding that also stands behind the time patterns displayed in Figure 5. More importantly, banks have shifted a larger share of their total assets into interest-earning loans and mortgages, as displayed in Figure 6. These changes have helped to safeguard, at least during the first 18 months after the introduction of negative rates, the profitability of the average retail bank. By contrast, profitability implications for wealth management banks, which we have also investigated but do not display here for lack of space, appear to have been significantly less benevolent. Furthermore, the adjustments described above raise the question whether the side-effects may have been increases in risk-taking. This is what we look at next.

5.3. Implications for Banks' Risk-Taking

Table 2 displays the results from estimating Equation (2) above for various risk-taking outcomes. To start with, Column (1) shows that for each extra percentage point of total assets initially held in the form of Exposed Reserves, banks have increased the average regulatory risk weight on their assets by an extra 0.35 percentage points. This is largely the result of reducing the fraction of their assets stored with the SNB, which in the Swiss implementation of the Basel regulation has received a risk-weight of 0 during the period studied, whereas loans, mortgages, etc. all receive positive risk weights, with precise levels depending on the characteristics of counterparty and collateral. Even if the underlying economic risk need not correspond perfectly to the risk assumptions implemented by supervisor, it is likely to at least be positively correlated with it, so that these increases in relative risk weights might also lead to higher losses in critical episodes. To the extent to which higher risk weights have forced banks to also increase their equity they may be deemed to be sufficiently prepared for such increases in losses. The same is true of increases in the capital requirement changes attributable to respectively market and operational risk displayed in respectively Columns (4) and (5).

By contrast, it is likely not true for the increases in interest rate risk displayed for different measures of interest rate risk in Columns (6) – (9). These measures differ mostly in the assumptions made about the effective maturity of assets and liabilities for which the maturity is not officially determined, but results go in the same direction for all measures except for the interest rate risk incurred only on the foreign-

currency portions of banks' balance sheets. Likely a key reason for these increases is the increase in the fraction of bank assets funded with deposits rather than bonds and other liabilities as described above. This change in banks' funding structure has for some banks led assets of given maturity to be funded by on average shorter liabilities, and has hence caused increases in interest rate risk.

Only interest rate risk in foreign currency only has even declined somewhat, as (not displayed here for lack of space) banks have moved some of their liquidity from CHF to less interest-expensive foreign currencies and have thereby reduced the average maturity of their foreign currency assets relative to that of their foreign currency liabilities. Yet the increases in interest rate risk on their CHF positions concern far larger fractions of bank portfolios, and are not covered with higher capital requirements through automatically higher Pillar I regulatory capital requirements. Furthermore, qualitatively there have been reports of increased risk-taking specifically in mortgage markets in dimensions other than loan-to-value ratios that would not be covered by the bank capital requirements of the Swiss standardized approach of regulation, but we have no conclusive evidence on mortgage-specific risk-taking.

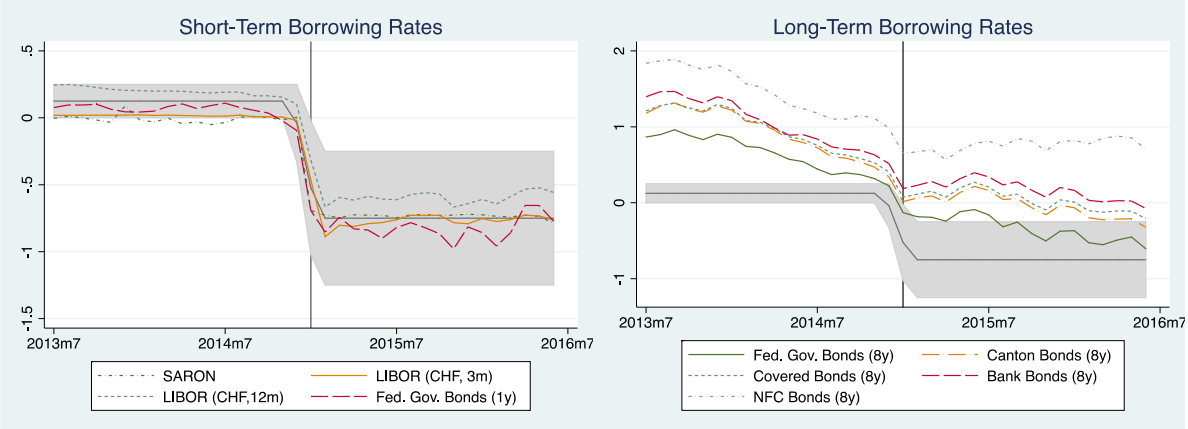
Besides the results displayed here, we have also found but report only in text form for lack of space, that the negative rates have led to a reduction in the capitalization of some banks, as well as to their share of assets held in liquid form given the increased cost of doing so. As far as we can tell, these developments are not a cause of significant concern so far, as most Swiss banks have started out with relatively high levels of both capitalization and liquidity. Yet developments are worth monitoring as the prolonged or repeated use of negative rate regimes could well have even more adverse effects on financial stability when applied in less benevolent circumstances.

6. Conclusion

In the empirical analysis of bank balance sheets, earnings reports and risk-taking measure reported in full in our academic paper and summarized in this essay, we have shown first how the negative rates have caused additional costs for domestic retail banks. We have then illustrated that the average retail bank has, for the time being, managed to largely compensate these negative effects on its profitability by restructuring its balance sheet, increasing its fee income, and charging higher mortgage rates. Last, we show how these compensatory responses have in turned increased the average bank's credit risk, as well as market, operational and interest rate risk. At the same time, it has reduced bank capitalization and liquidity. None of these effects seems extremely worrisome for the time being, yet these impacts need to be monitored closely to ensure that they do not destroy financial stability and hence the functioning of the economy as a whole in the future.

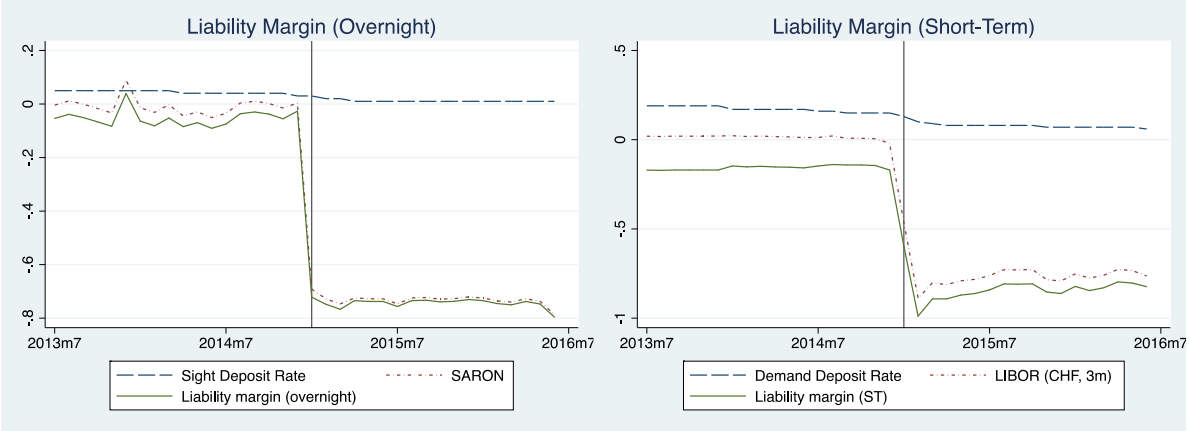
7. Appendix with selected Figures and Tables

Figure 1: Transmission of the Negative Rate to Interbank and Bond Markets



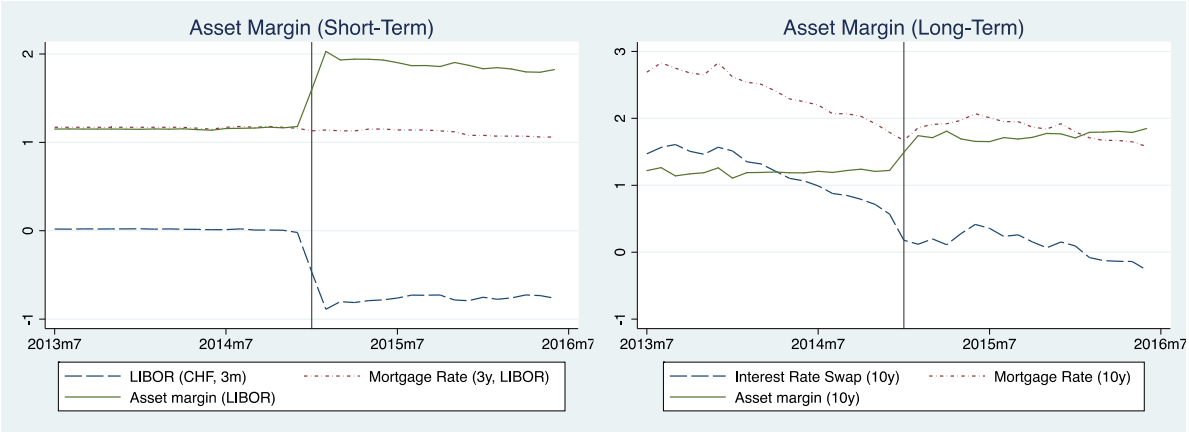
Notes: The figure shows that the negative rates charged on SNB deposits were quickly passed through to other similarly liquid assets with short maturities. Pass-through for longer maturities was similar for federal government bonds, but less pronounced for other borrower types.

Figure 2: Interbank Rates, Deposit Rates, and resulting Liability Margins



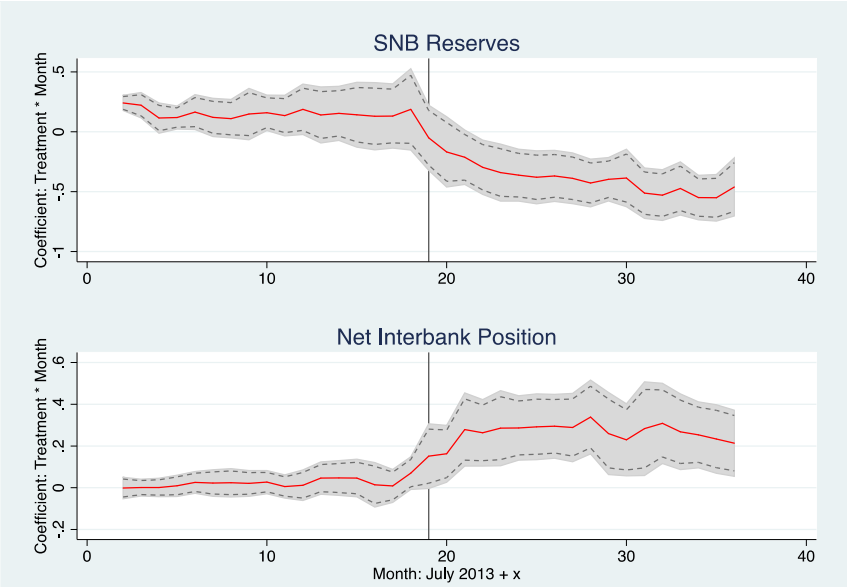
Notes: The figure shows how the negative rate was passed through to the interbank market, but not to the deposit market, where rates were mostly floored at zero. As a consequence, the liability margin usually earned by banks between interbank and deposit rates turned negative.

Figure 3: Mortgage Rates, Mortgage Refinancing Costs, and resulting Asset Margins



Notes: The figure shows how banks managed to increase their asset margin for mortgages, to compensate for the squeezed liability margin illustrated above, by maintaining or even increasing mortgage rates when refinancing costs fell. Source: SNB.

Figure 4: Banks' Reallocation of Liquidity



Notes: This figure shows monthly coefficients of estimating Equation (3) for the outcomes of respectively SNB reserves and the net interbank position in percent of total assets. The red lines display the resulting point estimates, the dotted lines the 90% confidence intervals and the shaded areas the 95% confidence intervals.

Figure 5: Banks' Costly Change of their Funding Structure

Notes: This figure shows monthly coefficients of estimating Equation (3) for the outcomes of respectively deposit and bond funding in percent of total assets. The red lines display the resulting point estimates, the dotted lines the 90% confidence intervals and the shaded areas the 95% confidence intervals.

Figure 6: The Increasing Importance of Mortgage Funding

Notes: This figure shows monthly coefficients of estimating Equation (3) for the outcomes of respectively mortgages and loans in percent of total assets. The red lines display the resulting point estimates, the dotted lines the 90% confidence intervals and the shaded areas the 95% confidence intervals.

Table 1: Bank Profitability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	NII (% of TA)	Interest Earned (% of TA)	Interest Paid (% of TA)	Loan Fees (‰ of TA)	Net Fee Income (‰ of Business Volume)	Gross Profits (% of Business Volume)	NII (yoy growth)	Interest Earned (yoy growth)	Interest Paid (yoy growth)	Loan Fees (yoy growth)	Net Fee Income (yoy growth)	Gross Profits (yoy growth)
Post*T	0.01***	0.03***	0.02***	0.04*	0.17***	0.02***	-0.07	0.10*	0.68**	2.04*	0.65**	3.93***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.05)	(0.00)	(0.08)	(0.05)	(0.27)	(1.18)	(0.31)	(0.57)
T	ER	ER	ER	ER	ER	ER	ER	ER	ER	ER	ER	ER
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Obs.	300	300	300	300	300	300	300	300	300	300	294	300
R2	0.40	0.60	0.52	0.10	0.13	0.18	0.00	0.02	0.08	0.04	0.01	0.12

Standard errors clustered by bank. *** p<0.01, ** p<0.05, * p<0.1

Notes: This table displays estimates of Equation (2), a DiD analysis with both time and bank fixed effects, for nine different risk-taking outcomes. Using semi-annual earnings reports, it traces 50 domestically owned retail banks for three semesters before and three semesters after the introduction of negative rates.

Table 2: Bank Risk-Taking

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RWA (% of TA)	RWA (yoy growth)	CapReq Share, Credit Risk	CapReq Share, Market Risk	CapReq Share, Op. Risk	IRR: CHF, Bank Ass.	IRR: FX, Bank Ass	IRR: CHF, Avg. Ass.	IRR: CHF, 2y Ass.
Post*T	0.35***	0.01	-0.03	0.02***	0.03*	0.10***	-0.09**	-0.02	0.18***
	(0.11)	(0.09)	(0.22)	(0.01)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	600	600	600	600	600	600	600	600	600

Standard errors clustered by bank. *** p<0.01, ** p<0.05, * p<0.1

Notes: This table displays estimates of Equation (2), a DiD analysis with both time and bank fixed effects, for nine different risk-taking outcomes. Using quarterly risk-taking data, it traces 50 domestically owned retail banks for six quarters before and six quarters after the introduction of negative rates.