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ENDOGENOUS MONEY INTERPRETATION OF THE OPERATIONS OF THE SWISS CENTRAL BANK (2005-2020)

Simona Bozhinovska,
simona.bozhinovska@univ-paris13.fr
CEPN, Université Sorbonne Paris Nord

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Keywords: central bank operations, foreign exchange accumulation, monetary policy implementation, Swiss National Bank

JEL Codes: E58, E42, E50, E43

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INTRODUCTION

As it has been the case for many other central banks of advanced economies, the balance sheet of the Swiss National Bank (SNB) expanded considerably post-2008, generating a complete turnabout in domestic liquidity conditions that continues to be sustained to date. However, despite the fact that all of these central banks experienced increases in domestic liquidity of similar scale, in the case of the SNB these could not be attributed to a prolonged use of various lending and asset-purchase programmes i.e. the so-called unconventional monetary policies (BIS, 2019a). The response of the SNB to the outburst of the global financial crisis instead involved the rather more conventional measure of limiting the appreciation pressures on the Swiss franc, through official interventions on the foreign exchange market. The sheer magnitude of foreign reserve accumulation caused an unprecedented increase of central bank balances in the system, therefore inducing a lasting upturn in the domestic liquidity conditions compared to the previous situation of structural indebtedness of the commercial banking sector towards the central bank, under which the SNB operated on a daily basis. Although initially the impact of the increases of foreign reserves on the monetary base had been neutralized on the central bank balance sheet, the SNB soon abandoned all further attempts at sterilization, allowing instead for the monetary base to rise in step with foreign reserves for more than a decade.

During the first couple of years under foreign exchange accumulation, the balance sheet of the SNB seems to have exhibited similar movements as in many other countries that engage in exchange rate policies: partial, but rather high and persistent levels of sterilization of foreign reserves in relation to the monetary base. This general observation concerning central bank balance sheets in countries that manage their exchange rate in some way, has been put forward by two different strands of literature. First, various studies dedicated to the empirical estimation of the so-called sterilization coefficients (Cavoli and Rajan, 2006; Lavigne, 2008; Ouyang et al., 2008; Aizenman and Glick, 2009; Cardarelli et al., 2009; Ouyang et al., 2010; Cavoli, 2017) consider the process of sterilization as an attempt to remedy the supposedly inevitable monetary impact of reserve accumulation, instigated by the central bank as a means to preserve some control over its monetary policy when simultaneously engaging in exchange rate management. Second, the empirical literature inspired by the compensation thesis (Lavoie and Wang, 2012; Angrick, 2018; Gerioni et al., 2022) which itself has roots in endogenous money theory, conceives the process of compensation of foreign reserve accumulation on

the central bank balance sheet as a result of the workings of the reflux mechanism or a by-product of the domestic interest rate targeting operations of the central bank.

However, the later adoption of a floor system as an operational framework in Switzerland amid substantial foreign exchange accumulation indicates a complete absence of sterilization in the years following the introduction of this operational framework, as it ultimately manifested as a sustained joint movement of foreign reserves and the monetary base on the balance sheet of the SNB. These developments impose the need to revisit the question of money in an open economy and the nature of central bank operations through the prism of monetary policy implementation and recent changes in operational procedures, which in turn have implications for the interpretation of the movements on the central bank balance sheet. The clear absence of a broader monetary effect rooted in the sizeable expansion of high-powered money that has already been sustained for years on end, leaves little room to assume a further quantitative effect from this increase of central bank reserves on broader economic conditions. At the same time, establishing a floor system would remove the need for a further use of monetary policy instruments that would ultimately manifest itself on the central bank balance sheet, as emphasized by the literature on the compensation thesis when discussing central bank operations in countries that accumulate foreign exchange reserves (Lavoie, 2001, 2014, p.462-77, 2019, p.99-101, 2021). Nevertheless, an analysis of the case of the SNB would still be possible from an endogenous money perspective even when the monetary base rises in step with foreign reserves, by taking into account insights from the recent changes in post-crisis operational frameworks of a number of central banks.

Versions of the floor system have been established by many central banks of advanced economies, as the sustained recourse to unconventional monetary policies generated a complete turnabout in their liquidity conditions, from the previous aggregate deficit position of their banking sectors vis-à-vis the central bank, to a situation of abundant reserves in the system (Ihrig et al., 2020; Grossmann-Wirth, 2019; Åberg et al., 2021). However, the operations of central banks under this operational framework remain consistent with endogenous money theory, even in the case where no further monetary policy operations would be necessary for the central bank to be able to uphold its short-term interest rate target set at the floor, due to substantial expansion of domestic liquidity incurred in the past (Lavoie, 2010, 2014, p.225). Recent experiences of central banks that have implemented these operational frameworks have been thoroughly analysed from an endogenous money perspective by Fullwiler (2013) and Bouguelli (forthcoming). As there seems

to be no reason to assume that the actual source of central bank reserve liquidity should impose any change of the mechanisms at play, the main assertions of this body of work could be thus applied to the Swiss case.

Accordingly, the present article provides an interpretation of the operations of the Swiss central bank consistent with endogenous money theory, building on recent insights from monetary policy implementation in countries that conduct their interest rate targeting operations in a context of surplus liquidity. More specifically, it analyses the evolution of the operational framework of the SNB over the course of 15 years: starting from the period prior to the outburst of the global financial crisis, leading to the first episodes of official interventions on the foreign exchange market, throughout the prolonged efforts of the central bank to maintain a stable exchange rate of the Swiss franc against the euro and the later adoption of negative interest rates. By providing an account of the monetary policy operations under both shortage and surplus in the aggregate liquidity position of the banking sector vis-à-vis the central bank, the claim that the compensating movements on the central bank balance sheet in response to foreign exchange accumulation are determined primarily by the method of interest rate maintenance employed by the monetary authorities at a given point in time, seems to be further reinforced by the experiences of the SNB in the course of the analysed period.

The article is structured as follows. Section 1 gives an account of the monetary policy strategy adopted by the SNB in the course of the analysed period, emphasising the difference between the decision to set the main interest rate target at a level consistent with the policy objectives of the central bank and its ability to uphold that target. Accordingly, this section throws light on the reasons behind the decision of the SNB to engage in exchange rate management as a response to the deteriorating global economic conditions, which ultimately resulted in waves of large-scale foreign exchange accumulation. Section 2 presents the balance sheet of the SNB, before and after its dramatic expansion in size, coinciding with the newly-instituted presence of the monetary authorities on the foreign exchange market. In addition, a number of particularities linked to the institutional structure of the country are presented, providing the basis for a more detailed account of the autonomous factors and the monetary policy operations of the SNB. Dedicated to the evolution of its operational framework throughout the years, section 3 describes the ways in which the SNB ensured a tight control over its main policy rate amid changing liquidity conditions, including the corresponding balance sheet movements that came about as a result. The last section concludes.

1 MONETARY POLICY STRATEGY AND EXCHANGE RATE CONSIDERATIONS

The design of the monetary policy strategy of the SNB that had been in place throughout the analysed period, had been outlined during 1999 and introduced by the end of the same year - an event that marks the last major conceptual change of in the design of the monetary policy strategy of this central bank. Moving away from a previously established framework of targeting the monetary base through the ongoing use of foreign exchange swaps as a main instrument of monetary policy (Spörndli and Moser, 1997), the subsequent strategy instead announces an interest rate variable as its main operational target, around which the day-to-day implementation of monetary policy is arranged. The constituent elements of the strategy seem to have been purposefully designed to allow for a considerable flexibility in the means through which the ultimate objective of monetary policy could be reached (SNB, 1999, p.19-23; Baltensperger et al., 2007; Jordan and Peytrignet, 2007; Jordan, Peytrignet and Rossi, 2010).

As it is the case for the vast majority of modern-day central banks, the mandate of the SNB sets out price stability as its primary objective, while also taking account of the economic developments in the country¹. However, the monetary policy strategy does not include a commitment to an intermediate target - one through which the ultimate objective of price stability is supposed to be achieved and the variable that would principally guide the decisions on the level of the operational target - instead, these decisions are based on an medium-term inflation forecast. The combination of a longer-term forecast of the price level with a looser definition of price stability (less than 2% per year, measured by the CPI) instead of a precise point inflation target, had been intended as one of the possible elements of flexibility in the design of the framework, compared to some inflation targeters². As a consequence, the monetary policy strategy of the SNB ‘does not provide for any fine-tuning of inflation, and the National Bank is also able to accept temporary deviations from the stability zone if circumstances so demand’ (Jordan and Peytrignet, 2007), or in other words, the monetary authorities do not need to immediately respond to any variation outside of a predetermined range, thus allowing for a wider discretionary space for the determination of the level of the policy rate.

¹ Outlined in Article 5 paragraph 1 of the National Bank Act of 3 October 2003, following the constitutional mandate of the central bank.

² See, for example, Hammond (2012) and Roger (2010).

Accordingly, in the elaboration of the monetary policy strategy of the SNB the exchange rate does not figure as an intermediate target of monetary policy, whereas the exchange rate considerations were primarily aimed to influence the decisions of the level of the main policy variable through the inflation forecast. In spite of the de jure flexible exchange rate regime since the 1970s, the SNB has retained the right to engage in foreign exchange transactions - however, the monetary authorities have refrained from intervening on the foreign exchange market for many years, including the first several years of the implementation of this monetary policy strategy - the last pre-crisis interventions involving foreign exchange purchases by the central bank date back to 1995 (SNB, 1996, p.16; Jordan, Peytrignet and Rossi, 2010, p.52). During these years, the SNB envisioned to address the possible exchange rate influences by the means of changes in its base rate and in accordance with its medium-term inflation forecast - this strategy had not been conceived to be pursued with the intention to aim at a certain exchange rate level as, according to the the Chairman of the Governing Board of the SNB during the first several years of its implementation, such policy approach ‘would be in opposition with its willingness to pursue an independent monetary policy in a world of flexible exchange rates³’ (Roth, 2007, p.19). Consequently, these circumstances have earned an IMF’s classification of a de facto ‘independently floating’ exchange rate regime, for the period between the introduction of this monetary policy strategy and the onset of the global financial crisis⁴.

However, the changes in the global economic conditions that soon followed, certainly had an impact on the policy response of the SNB. Following a first set of measures that, among others, included promptly and drastically lowering the level of its operational target to values near zero, the Swiss franc was now facing a significant appreciation pressures, that the SNB considered as a growing risk of deflation - throughout the period between March and December 2009 the SNB had thus turned to and engaged in foreign currency purchases in order to hinder further appreciation of the Swiss franc (SNB, 2010a, p.36-9). The SNB had attempted to prevent appreciation of the franc both against the euro and the US dollar, as around two-thirds of these purchases during 2009 were euro-denominated securities, while the remaining part were USD-denominated securities (SNB, 2010b, p.24). At the end of that year and in the context of a more favourable forecast, the SNB was ready to allow for a certain appreciation of the Swiss franc and thus concluded

³ Original in French, own translation.

⁴ IMF’s Annual Reports on Exchange rate Arrangements and Exchange Restrictions for 2001-2007 (following the previously established IMF classification methodology).

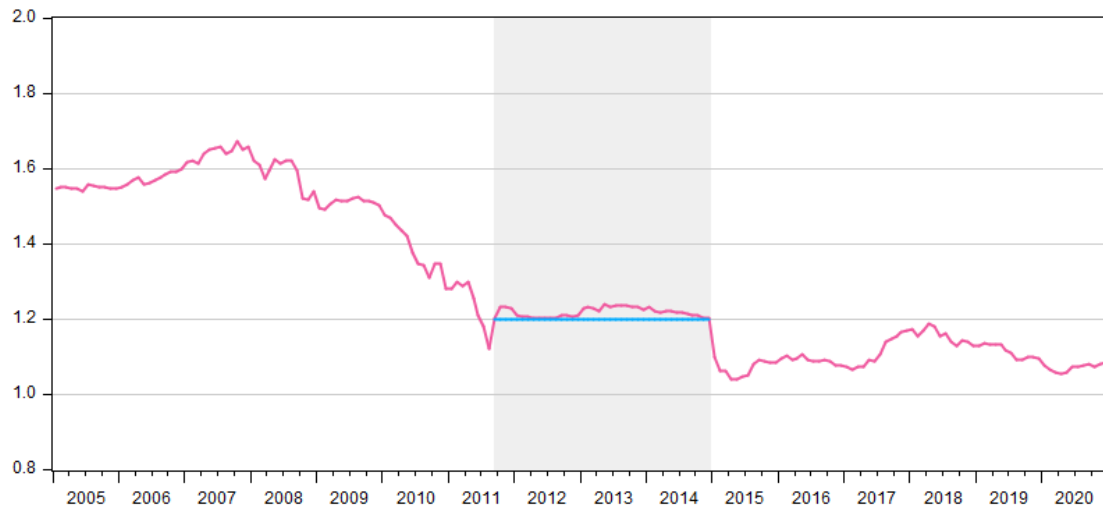


Figure 1: Nominal exchange rate of the Swiss franc against the Euro (2005-2020), monthly average as units of CHF per unit of EUR (Source: SNB)

these foreign exchange purchases, announcing further intervention ‘in the event of an excessive appreciation’ (SNB, 2011a, p.32). This occurrence represented a first step in the expansion of the balance sheet of the central bank, which would later become a continued practice until the end of the analysed period. However, at the time, without a change in the monetary policy strategy or modalities determining the exchange rate regime, the central bank responded to global conditions through direct intervention on the level of the exchange rate - these actions, as is inevitably the case for foreign reserve accumulation, have in turn resulted in increases in the level of domestic liquidity. The SNB announced the scale of these purchases only ex-post, thus avoiding to commit or make any announcements with respect to the aimed level of the exchange rate.

Despite the continued appreciation pressures on the Swiss franc, the SNB ceased to intervene further on the foreign exchange market in the first months of 2010, allowing thus for a certain appreciation of the franc against the euro (figure 1). However, when faced with the prospect of ever incoming flows following the sudden worsening of the sovereign debt crisis, the SNB countered these movements with a short but substantial foreign exchange effort - the central bank intervened only in the course of the month of May, during which it had accumulated a substantially higher amounts compared to the interventions of the previous year and resulting with an approximately 3 times higher annual effect in terms of domestic liquidity (*ibid.*, p.51). After the threat of ‘excessive appreciation’ had been mitigated, the SNB ceased any further foreign exchange intervention - an action fairly consistent with what was previously announced in terms of the intervention tactics of the

monetary authorities. However, the franc continued to appreciate in the following months and the inflation forecasts, at least for the first quarters of each forecast, were persistently close to zero.

Against this background, faced with a further exacerbation of the sovereign debt crisis which provoked another flight to safety and instigated an even stronger appreciation of the Swiss franc during the third quarter of 2011, the SNB had renounced communicating the episodes of foreign exchange interventions as transient and exceptional, instead announcing a policy of an exchange rate floor. As of 6 September 2011, the SNB announced a strong commitment to prevent any further appreciation of the franc beyond the level of 1.2 CHF for one euro, and by that, its preparedness ‘to buy foreign currency in unlimited quantities’ (SNB, 2011b). The following years were ones of continued interventions during which the SNB successfully enforced its exchange rate objective (figure 1). However, maintaining the exchange rate close to the floor did not require equal intervention effort for all the years this limit on the exchange rate level was in place - the intervention of the SNB for the period from May to August 2012 had resulted in the highest annual foreign exchange accumulation for the analysed period (SNB, 2013, p.34, 38), further accentuating the effect of the economic developments in the Eurozone on the Swiss franc. Without any substantial changes in the framework of monetary policy strategy but as a direct consequence of these interventions, the de facto classification of the exchanged rate regime during this period swayed between categories, on the spectrum of administered exchange rate regimes⁵.

Even after the suspension of the exchange rate floor at the beginning of 2015, the SNB continued to engage in foreign exchange intervention, along with its newly introduced monetary policy stance which involved further lowering the base rate into negative territories. From this moment forward and until the end of the analysed period, despite the absence of an announced limit or a targeted exchange rate path, the SNB continued to accumulate foreign exchange reserves each year, in most instances involving non-negligible yearly amounts⁶. Furthermore, for most of the years in question, despite these amounts the SNB had been communicating intervention episodes in rather brief intervals and typically as a response to episodes of ‘heightened uncertainty’, generated from economic events and conditions abroad

⁵ According to IMF’s AREAER, during the period of exchange rate floor, after a brief period of ‘other managed’, the exchange rate was classified as ‘stabilized arrangement’ during 2012, given that the Swiss franc remained at a rather narrow margin of 2% of the announced exchange rate floor (IMF, 2013). During 2014 and until the end of the exchange rate floor, the regime was classified as de facto ‘crawl-like’.

⁶ With the exception of 2018, where it had to acquire ‘only modest amounts of foreign currency compared with previous years’ (SNB, 2019, p.40).

(SNB, 2016, p.38, 2017, p.38, 2019, p.5; IMF, 2018, p.3104, 2021, p.3346). Under these conditions, the SNB had managed to attain a de facto floating exchange rate regime⁷, while simultaneously further expanding its own balance sheet in size.

Ultimately the SNB never stopped engaging in foreign exchange intervention since the announcement of its first purchase programme in March 2009 - these developments have been carried out without any substantial changes in the outline of its monetary policy strategy and happened under different official announcement with respect to the exchange rate objectives of the central bank. Nevertheless, the implications for monetary policy implementation - that is, the day-to-day operations of the central bank directed at targeting the level of the base rate consistent with this monetary policy strategy, had been substantial.

2 THE BALANCE SHEET COMPOSITION OF THE SNB AND ITS INSTRUMENTS FOR DOMESTIC LIQUIDITY MANAGEMENT

Unsurprisingly, in the course of the several years preceding the global financial crisis and the massive central bank foreign exchange accumulation that followed, the balance sheet of the SNB had been substantially smaller in size (figure 2). According to the monetary policy strategy in place, the central bank could engage in foreign exchange intervention in either direction, depending on the needs determined by the inflation forecast. Although the SNB did not accumulate foreign exchange reserves and by that expand its balance sheet, it continued to dispose of a certain level of foreign reserves during this period⁸ that could be used for intervention purposes, should it be deemed necessary to respond to depreciation pressures of the Swiss franc. As a consequence, the asset side had been determined by this existing stock of foreign reserves, even before the large-scale foreign exchange accumulation took place. Having this autonomous factor appear on its balance sheet, in addition to the demand for currency in circulation that usually grows at a very stable rate with time, contributed to making the balance sheet structure relatively, although not perfectly lean (Bindseil, 2004, p.49-50). Almost all of domestic liquidity management operations during this time appear on the asset side, being thus liquidity-providing, which shows that before the crisis the SNB had been conducting its operations in a situation of a structural shortage of liquidity (Rule, 2015, p.19).

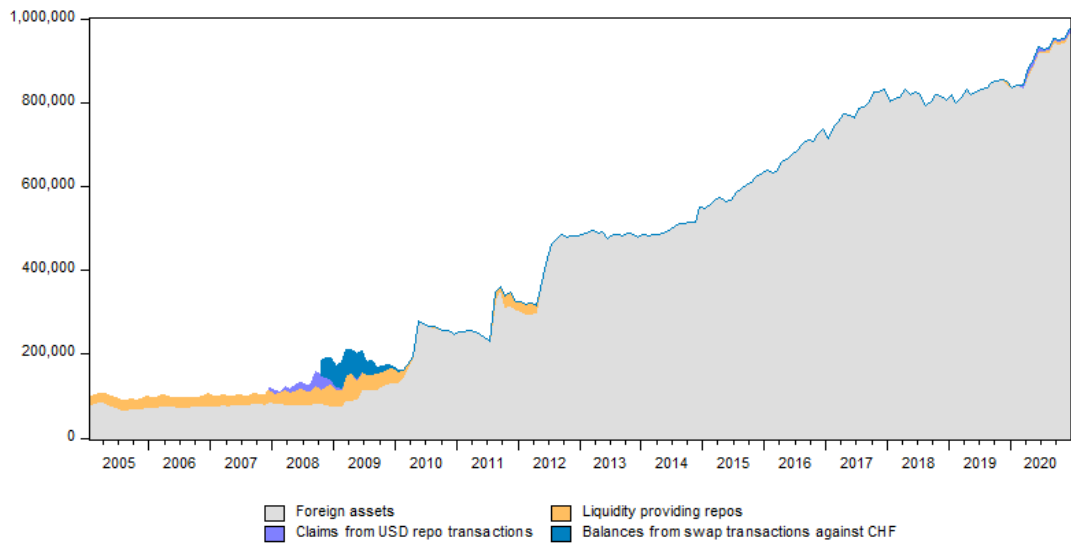
⁷ As opposed to free floating, which involves less frequent intervention.

⁸ Including reserves of monetary gold.

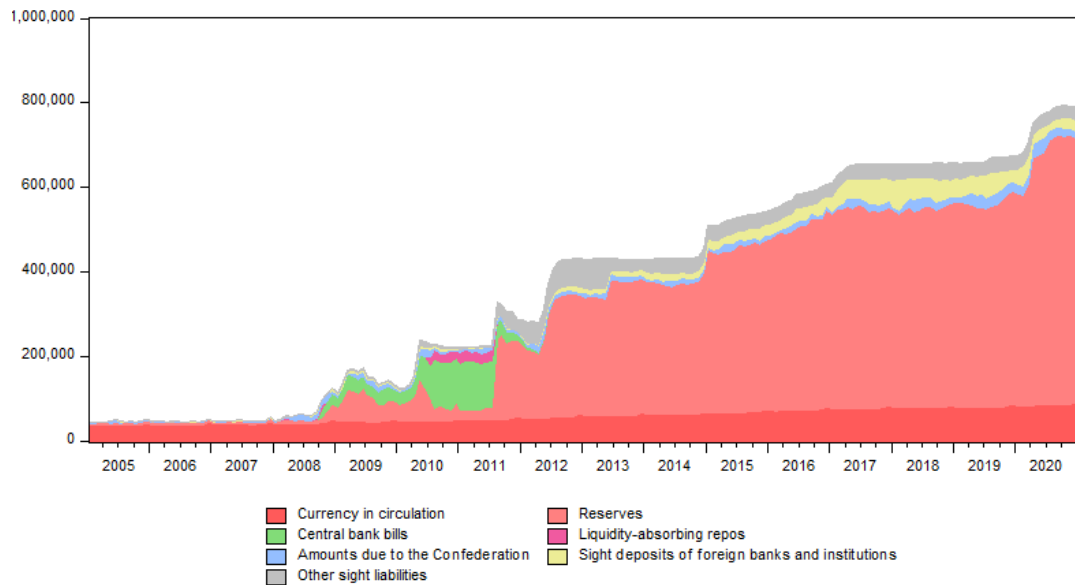
The remaining autonomous factor, the deposits of the Confederation at the SNB, appeared in very modest amounts not only during the pre-crisis period, but also throughout the phases of balance sheet expansion (figure 2b). Somewhat in line with the analysis of the operations of the Canadian central bank provided by Lavoie (2005, p.692-5), as part of the operational framework preceding the analysed period the SNB had the possibility to use transfers of Confederation deposits between its accounts at the SNB and at the commercial banks, for the purposes of domestic liquidity management (Spörndli and Moser, 1997, p.140; Borio, 1997, p.308; Borsani et al., 2007). Before they were discontinued at the end of 1999 along with further changes in the operational framework, the transfers of Confederation deposits could be used by the SNB for the purposes of fine-tuning - that is to say, operations that ‘serve to offset the undesired impact of exogenous factors on the supply of liquidity and to reduce sharp fluctuations in money market rates’ (Borsani et al., 2007, p.294), in addition to foreign exchange swaps which fulfilled the function of the main monetary policy instrument at the time. The operational framework that followed relied instead on the use of repurchase agreements - the weekly liquidity-providing repurchase operations soon became the main instrument for monetary policy in the next following years, while fine-tuning operations had been carried out through bilateral repo transactions, which were used only in exceptional cases⁹ when needed to even out undesired and sharp fluctuations in the money market (SNB, 2006, p.40, 2008, p.38).

Furthermore, additional changes in the agreement between the fiscal and monetary authorities soon followed, setting out rules on the amount of interest-bearing reserve deposits and time deposits that the Confederation could keep at the central bank. It was also expected to incite the fiscal authorities ‘to keep reserve deposits with the SNB within the interest-bearing level and to invest any surplus liquidity in the banking system’, thus reducing the fluctuations in market liquidity and volatility of money market rates (SNB, 2006, p.65). In a context of an aggregate shortage of liquidity, as it was the case at the time, keeping larger amounts of deposits of the Confederation at the central bank would counter the overall direction of the instruments of the central bank, which then were liquidity-providing. However, the role of these deposits did not change much even with a shift in domestic liquidity

⁹ The bilateral repo operations can be both liquidity-providing and liquidity-absorbing and have been used typically overnight - data on the concluded fine-tuning operations for the period until the end of 2008 can be found in the weekly *Important monetary policy data* reports by the SNB, in the section ‘Daily results of monetary transactions (Repos)’. These reports also include information on the direction, maturity and amounts of both fine-tuning and weekly main financing operations.



(a) Assets



(b) Liabilities

Figure 2: The balance sheet of the SNB (2005-2020), monthly data in millions of CHF (Source: SNB)

conditions - Confederation deposits during the analysed period were not used as an instrument of domestic liquidity management, reversing undesired movements in central bank reserves for the purposes of controlling policy rates. This component could be rather considered as one of the autonomous autonomous factor, outside of a direct control of the central bank but influencing the level of central bank reserves in the system. In addition, their presence on the balance sheet of the central bank could disrupt the direct link between foreign assets and the monetary base playing a rather limited role in the case of SNB, given their size not only before but also all through the expansion of official foreign reserves.

Liquidity conditions reversed with the outbreak of the global financial crisis, moving from an aggregate liquidity shortage of the commercial banking sector vis-à-vis the central bank, to a situation of aggregate surplus of central bank reserves. This turnabout happened progressively, and to a certain extent, even before the introduction of the foreign exchange purchase programme in March 2009. The SNB took several measures that involved an increasing supply of central bank liquidity in response to the ongoing financial turmoil, among which were the provision of full allotment amounts on its main financing repo operations, the introduction of repos with longer maturity, and the use of its former instrument of foreign exchange swaps used under the previous operational framework, however, this time providing Swiss franc central bank liquidity against the euro. Notably, the auctions of the EUR/CHF swap operations that were introduced in October 2008, played a role in the initial expansion of the balance sheet of the SNB (figure 2)¹⁰, further intensified by the foreign exchange interventions of the central bank.

As a consequence, the reversal of liquidity conditions generated a change in the direction of the monetary policy instruments employed by the central bank - during this phase, the instruments that were used by the SNB were liquidity-absorbing - including reverse repurchase agreements with a rather short maturity and issuance of its own central bank bills. This dynamic of growing foreign exchange reserves compensated by monetary instruments on the liability side continued through the SNB waves of interventions of March to June 2009 and May 2010, until the introduction of the exchange rate floor in September 2011. From this moment forward, the build up of foreign reserves were simultaneously accompanied by matching increases in the central bank reserves held by commercial banks.

Unlike other advanced economies that expanded their central bank balance sheet massively as a result of the adoption of asset purchase programmes after the global financial crisis, the SNB undertook that expansion through foreign exchange accumulation; yet, unlike many emerging market economies that saw the asset side of the balance sheet of their central banks grow as a result of their interventions on the foreign exchange market, the SNB did not respond by means of a sustained use of liquidity-absorbing monetary policy instruments that would modify the composition of the liability side of the central bank balance sheet - allowing instead

¹⁰The SNB provided Swiss franc liquidity against euros, depicted in figure 2a as ‘Balances from swap transactions in CHF’ on the asset side, consequently increasing central bank reserves on the liability side. The component ‘Claims from USD repo transactions’ shown in figure 2a, represents the repo operations through which SNB provided access to US dollar liquidity to market participants - however, this component does not contribute to the increase in domestic liquidity (SNB, 2010a, p.58) and its direct counterpart appears under ‘Other time liabilities’ on the liability side of the balance sheet of the SNB.

for the level of central bank reserves in the system to grow at a similar pace with the accumulation of foreign reserves (BIS, 2019a, p.8-9, 80–4). This distinctive characteristic of the balance sheet of the SNB, that is, a simultaneous increase of foreign reserves on the asset side and central bank reserves on the liability side, makes the analysis of the Swiss case particularly interesting for the question of sterilization. Moreover, it also calls attention to the the role that monetary policy implementation procedures and changes in the operational frameworks might play for the composition of the liability side of its balance sheet, whichever the source of surplus liquidity.

Before moving on to the analysis of the ways in which the SNB carried out its domestic liquidity management operations throughout the period under study, at least two somewhat connected observations stemming from the institutional arrangements in place, would need to be emphasised: the peculiar policy of the SNB in terms of the choice of the counterparts that are allowed access to its monetary policy operations and to the secured money market; coupled with the particular choice of the base rate that served as an announced monetary policy target for the most part of the analysed period.

The outline of monetary policy strategy launched at the end of 1999, also included changes in the operational target compared to past practice - the SNB started announcing the three-month LIBOR rate in Swiss francs as its base rate. Therefore, the instruments of domestic liquidity management of the SNB were directed towards the control of this rate, and in addition, this variable also was the choice of this central bank as the rate through which it envisions to influence economic conditions in the direction of its ultimate objective. This rather uncommon choice of an operational variable, accompanied by a target range instead of a point target for its value, had been advocated in the name of an added flexibility of the monetary policy strategy framework, as it was expected to allow for the SNB ‘to react flexibly to exchange rate shocks or sudden changes in liquidity distribution without signalling an immediate change in its basic policy orientation’ (Baltensperger et al., 2007, p.18). The most unusual characteristic, however, remains the choice of a money market rate set outside of the domestic money market, along with being an offered rate instead of an effective money market rate, as a declared operational target - most present-day central banks concentrate their efforts on controlling a shorter term and usually domestic money market rate. At the time, this decision was justified by the fact that that the repo market was still under development while the interbank market was dominated by a small number of large of large Swiss banks (Jordan, Peytrignet and Rossi, 2010, p.17), as well

as the ‘great openness of the Swiss economy and the close international ties of its financial sector’ (Jordan and Peytrignet, 2007, p.261). Under these circumstances, the choice of an operational target on a money market abroad seems to have been partly influenced by the particular institutional context, but nevertheless, it has also further entailed certain institutional changes that were conceived to facilitate its enforcement. Notably, this holds true when it comes to the access policy of the SNB with regards to the participation in its domestic payment system, the secured interbank market and the choice of the eligible counterparties in its monetary policy operations - identical access criteria apply (Kraenzlin and Nellen, 2015). Moreover, while holding a reserves account with the SNB is a prerequisite for getting access to the payment system and the secured money market, holding a reserve account with the central does not grant an automatic access to the payment system¹¹ - this particular access policy would also affect and reflect on the composition of the liability side of the balance sheet (figure 2b).

The changes in the framework of the monetary policy in 1999 were accompanied by changes in this access policy - previously restricted only to domestic commercial banks that were subject to supervision by the financial market authorities, the SNB at this time opened access also to foreign banks, without the requirement to establish a branch in Switzerland (BIS, 2011, p.413), so as to ‘reduce the dependence on two dominant Swiss banks for monetary policy implementation and to improve the general liquidity distribution’ and in that way ensure a better grasp on its operational target set on a foreign money market (Kraenzlin and Nellen, 2015, p.3; Auer and Kraenzlin, 2011, p.423-4). The access policy was revised again, granting access to an even wider range of counterparties - since the beginning of 2010, the SNB allowed participation to domestic insurance companies and money market funds (SNB, 2010a, p.47), thus expanding the possibility for non-banks to get access to reserve balances denominated in Swiss francs. In addition, after the immediate response through inter-central bank swap facilities that helped provide foreign banks without access to the Swiss repo system or banks failing to provide sufficient collateral with Swiss franc liquidity in the midst of the financial turmoil, foreign banks were encouraged to demand direct access, thus further increasing the number of total participants (Auer and Kraenzlin, 2011, p.413; Fuhrer, 2017, p.8). As a result, the reserve accounts on the liability side of the balance sheet of SNB are not held exclusively by domestic commercial banks - the accounts of

¹¹ The payment and settlement system, the Swiss Interbank Clearing (SIC) is a real-time gross settlement system where all payments are settled individually - furthermore, there is no specific retail payment clearing house in Switzerland (BIS, 2011; SNB, 2021b). For more information on the introduction and the first years of functioning of the Swiss repo market, see Kraenzlin (2007).

other market participants, including here foreign commercial banks but also the non-bank participants allowed to hold reserve balances, expanded to some extent along with the extended foreign exchange interventions¹².

These elements outline the broad institutional context in which the SNB conducted its day-to-day liquidity management operations. Before exploring further the connection between foreign reserves and the monetary base on the balance sheet of the SNB, section 3.1 details the ways in which this central bank implemented monetary policy prior to its use of foreign exchange interventions, as ultimately an endogenous money interpretation of its operations does not rest only on a particular liquidity condition. Section 3.2 describes the ways in which the SNB handled the initial increase in reserves and its response through the use of liquidity-absorbing instruments. The adoption of an exchange rate floor also accompanied by the so-called floor system with regard to targeting of the base rate, which established the conditions of a simultaneous increase in foreign reserves and central bank reserves, is presented in section 3.3. Lastly, section 3.4 gives an account of the operations of the SNB during the period of negative base rates that followed the discontinuation of the exchange rate floor policy.

3 CHANGES IN THE OPERATIONAL FRAMEWORK OF THE SNB

3.1 *Interest rate targeting before foreign exchange intervention*

In the course of the period preceding the foreign exchange interventions, the SNB approached the conduct of its monetary policy operations rather in line with what was announced at the moment of the introduction of its monetary strategy. Responding to the results from the inflation forecasts during the monetary policy assessments, which remained programmed at the end of every quarter, the Governing Board determined the policy stance and set forth the level of its operational variable. The changes in the policy direction that happened throughout that time were decided exclusively during these scheduled meetings and moreover, they recurrently involved increases of 0.25 percentage points of the level of the operational target (Jordan, Peytrignet and Rossi, 2010, p.31). Even though in principle the central bank retained the possibility to adjust its policy stance between these assessments,

¹²Except for the rise in reserve deposits of commercial banks in 2013, which was done at the expense of ‘Other sight liabilities’ as a result of PostFinance obtaining a domestic banking licence (SNB, 2014, p.41). Furthermore, the reserve balances of non-banks are not part of the monetary base (including the definition of ‘Reserve money’ of the IMF IFS dataset), see also Kraenzlin (2007, p.253) and Borsani et al. (2007, p.284-5).

it was not deemed necessary to act in such manner. The period leading up to the worsening of the global economic conditions was characterized by gradual increase in the policy rate of the SNB.

Accordingly, as the policy stance was communicated through the targeted value of the three-month LIBOR in Swiss francs disclosed in the middle of a one percentage point wide range (SNB, 2006, p.121, 2008, p.131), these changes in the direction of the monetary policy implied movements of the entire target range. Despite the fact that the announcements of the SNB included an upper and lower limit on the movements of its target that this central bank was ready to tolerate, there are however notable differences between this setting and the so-called symmetrical corridor, which was the operational framework in place in a number of advanced economies during that time, for instance at the Bank of England and at the Bank of Canada. The central banks that set up interest rate corridors were typically targeting overnight money market rates, therefore the deposit and lending standing facilities that define the floor and ceiling of the corridor were essentially limits on the movements of its target. In the case of the SNB during this period, the announced range represented a chosen range of values that this longer-term foreign money market rate could take, that would still be considered in line with the objectives of its monetary policy strategy. Unlike the symmetrical corridor operational frameworks, where ‘changes to the monetary policy stance, that is, of the target short-term interest rate, may be made without any change in reserve market conditions by simply moving the standing facilities corridor in parallel with the target rate’ (Bindseil, 2004, p.252), for the SNB to attain an interest rate target it would have to modify the level of reserves in the system.

Regardless of its unusual choice of a foreign longer-term money market rate as a target variable, the operational framework that was in place did impose some limits in the movements of the shorter-term domestic market rates. Considering that at the time the turnover on the repo market was slightly more significant compared to the unsecured interbank market, in addition to the large majority of trades being concluded overnight (Guggenheim et al., 2011, p.22), the most prominent candidate for this short-term market rate would be SARON, the overnight rate on the secured money market¹³. The SNB enforced a type of an upper limit on short-term market rates, through the use of its liquidity providing instrument of an overnight maturity - the liquidity-shortage financing facility. Through this standing

¹³SARON (Swiss Average Rate Overnight) is calculated on the basis of concluded transactions of the overnight maturity in the secured market. First introduced at the end of August 2009 (SNB, 2010a, p.57), the values of SARON in figure 3 that precede this date, are based on historical data (and are published by SIX Group).

facility, the central bank thus ensured access to its own liabilities to commercial banks, should unexpected shocks in autonomous factors arise, that would leave the commercial banks devoid of sufficient settlement balances, a situation that could cause a spike in short-term interbank rates. However, the rate at which the SNB was ready to provide this had been rather high during this time, at a level of two percentage points above the money market rate effectuated the previous working day, with the central bank justifying the choice of this rate as ‘intended to prevent commercial banks from using the facility as a permanent source of refinancing’ (SNB, 2006, p.41). In actual fact, between 2005 and the end of 2007 the commercial banks demanded recourse to this facility only occasionally, with the annual amounts remaining fairly low (SNB, 2006, p.41, 2007, p.41, 2008, p.40).

By comparison, a standing facility that would provide the commercial banks with the possibility to deposit the central bank reserves above their payment and settlement needs at the end of the day, at a positive interest rate considering the absence of reserve remuneration, had not been made available by the SNB. Therefore, as the interbank rates with very short-term maturity could in principle take any value between zero and two percentage points above the previously established money market rate, the operational framework in place in the pre-crisis years closely resembles the so-called no-interest-on-reserves system (Lavoie, 2010, 2014, p.222). Within this wide range of possibilities in respect to the actual level of the short-term money market rates, the central bank could steer these rates in the desired direction, by adjusting the aggregate level of reserves in the system. Taking into account the rather unusual choice of official operational target, the monetary policy implementation framework that characterized this period does not seem to have been conceived so as to ensure a tight grip of the SNB over the shorter-term of the maturity spectrum - this central bank has instead allowed for a certain volatility in the domestic money market rate.

The use of reserve requirements with averaging provisions over the course of one month were also used to even out demand for reserves in the course of the maintenance period (Bindseil, 2004, p.197-201; Fullwiler, 2017, p.63-4). The introduction of the reserve requirements happened as a succession of a measure that was used for a number of years before, the so-called cash liquidity provisions that required commercial banks to hold a certain level of coins, banknotes, reserve balances with the SNB and postal balances. The possibility of averaging of these provisions had been introduced in 1988 as an attempt to diffuse a problem of an excessive volatility of interest rates at the end of each month that corresponded to the moment when the SNB verified their compliance, together with the introduction

of the maintenance period that remained in place ever since - from the 20th of one month until the 19th of the following month. The reserve requirements took their current form¹⁴ in the course of 2004 when changes that enhanced their function of stabilising reserve demand were introduced, such as limiting their fulfilment only to the components of the monetary base, namely central bank balances and cash in vault (SNB, 2005, p.40; Borsani et al., 2007; Kraenzlin, 2007, p.253-4). Moreover, they apply only to domestic banks and foreign banks that have established their own branches in Switzerland, foreign banks with access to monetary policy operations with the SNB are not required to hold established amounts of central bank liquidity (Kraenzlin, 2007, p.254; Jordan, Rinaldo et al., 2009, p.352). As a result, the central bank reserves that appear on the liability side of the balance sheet of the SNB throughout this period (figure 2b) could be considered attributable mainly to the enactment of these requirements by domestic and domestically chartered banks, which due to the averaging provisions were used by these banks for their daily payment and settlement needs. However, since this balance sheet component contains all reserves that can be used by commercial banks for settling payments, it would also include any reserves exceeding the required amounts that commercial banks decide to hold. During this period, the banking sector in aggregate held reserves slightly above the requirements, which on an annual basis reached 22% of the required amounts in 2005, 20% in 2006 and 18% in 2007 (SNB, 2006, p.43, 2008, p.42).

Against this background and taking into account the aggregate liquidity shortage of the banking system vis-à-vis the central bank during this period, the monetary operations would need to be directed towards providing the appropriate amount of central bank reserves so as to steer the short-term rates towards the desired level, and in the case of the SNB, achieve its longer-term operational target. Between 2005 and 2007, the SNB relied principally on the use of open market operations for this purpose, notably on its daily auctions of liquidity-providing repurchase agreements with a maturity of one week, also known as main financing operations. Conducted by means of a fixed rate tender with a discretionary allotment amounts, eligible counterparties to the monetary operations of the SNB participated in the auctions by submitting a bid of an amount for the pre-announced fixed rate (SNB, 2006, p.39), while the SNB maintained the possibility to decide on the actual amount of central bank liquidity supplied on the auction, distributing it between

¹⁴The minimum reserve requirements (as they are called in Switzerland) are to be fulfilled as at least 2.5% of the calculation base, which includes the total of sight and time deposits of banks plus 20% of their savings deposits, where this base is obtained as an average over the three months preceding the reporting period (for more information, see BIS (2020)).

the participating banks on a proportional basis to the size of each bid, with a minimum level of allotment to each individual participating bank (Jordan and Kugler, 2004, p.384). In other words, while the interest rate and the maturity of the auction were previously communicated to market participants, this had not been the case for the allotment targeted by the SNB, such that actual supplied amounts were made known after the closing of the auction (Kraenzlin and Schlegel, 2012, p.173).

By adopting this type of tender on its liquidity-providing operations the SNB benefited from maintaining the possibility to adjust the total supply of central bank reserves so as to make it correspond to its forecasting needs (Bindseil, 2004, p.163). Therefore, on an operation day, the SNB would carry out the daily allotment of central bank reserves through seven-day repos in the morning before the LIBOR got fixed and announced, calibrating the amounts according to its forecasts on the movements in the autonomous factors (Jordan and Kugler, 2004, p.383-4; Jordan, Ranaldo et al., 2009, p.351). Taking into account the absence of foreign exchange intervention of the SNB in the course of these several years, the liquidity factors outside of the direct control of the central bank covered by the forecast would have needed to be narrowed to the demand for banknotes by commercial banks and public sector flows. Furthermore, another available course of action under this framework would be to further resort to the use of bilateral fine-tuning operations in the course of the day in the event of large and unpredictable swings of these factors away from the expected values would remain available, thus countering excessive swings in the rates with shorter maturity on the domestic money market, such as the overnight secured rate. The liquidity forecasts on which the SNB based its allotment decisions remained known by the monetary authorities only - unlike certain central banks, the SNB refrains from publishing its own autonomous factor forecasts (Veyrune and Guo, 2019, p.39).

The SNB had thus been able to control the interest rate of its choice by modifying the conditions on the provision of central bank liquidity, namely the price and distributed amounts on the auctions of its main refinancing operations. The context of aggregate liquidity-shortage created by the position of the autonomous factors during this period imposed a continued reliance of the banking sector on the central bank for the provision of reserve balances, given the necessity to dispose of these reserves as a means to achieve final settlement. In pre-crisis times, the instruments that constituted the operational framework were sufficient for the purpose of the SNB. The actual operational target, the three-month LIBOR in Swiss francs, managed to stay approximately in the middle of its targeted range

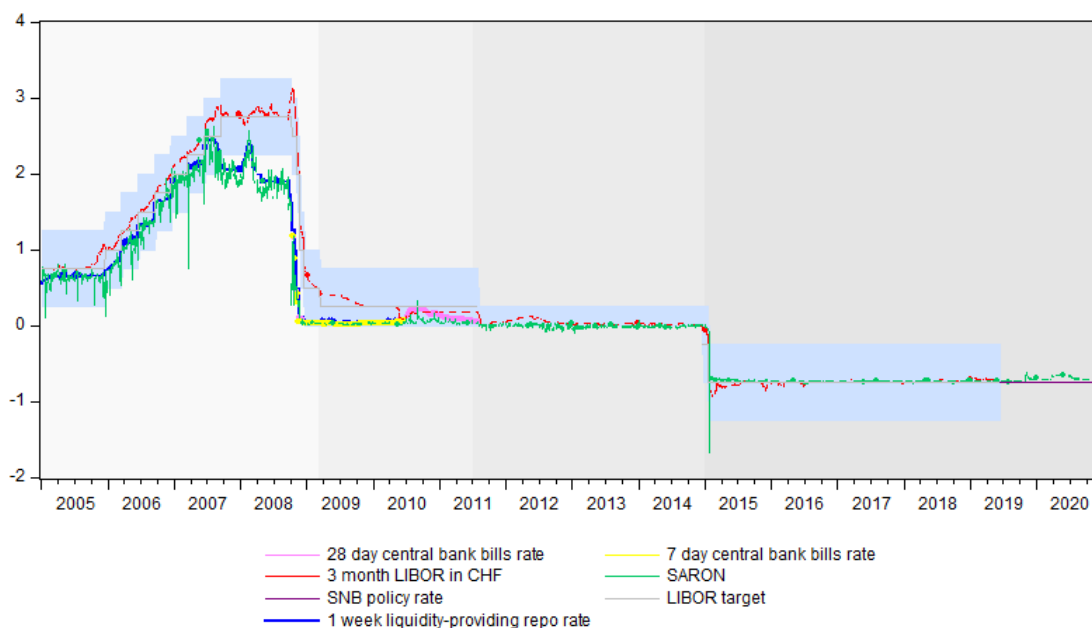


Figure 3: Interest rate targeting and change of operational framework of the SNB (Source: SNB and SIX Group)

(Abbassi et al., 2010, p.315-6). Moreover, the shorter-term secured domestic money market rate, although more volatile, moved rather in unison with the operational target and stayed mostly below the price of the longer-term rate on the auctions of seven-day liquidity-providing repo operations of the central bank (figure 3). The period up to the third quarter of 2007 was thus characterized by a rather stable and narrow spread between the longer-term unsecured money market rate abroad and the domestic short-term secured money market rate (Jordan, Peytrignet and Rossi, 2010, p.55 figure 33), which made the enforcement of this framework of the monetary policy implementation possible and rather effective. However, the outburst of the global financial crisis, and later, the continued foreign exchange interventions that followed, resulted in lasting changes in the ways in which monetary policy implementation was carried out by the SNB.

3.1.1 *First response to the outburst of the global financial crisis*

After an initial recourse to liquidity-providing fine-tuning operation as an immediate response to the first signs of market distress and with values of the LIBOR closely approaching the upper target limit, the SNB undertook one last increase in the target range of 50 basis points during the scheduled assessment at the end of the third quarter of 2007, while at the same time offering significantly lower rates on the regular main financing operations due to considerable increases in risk premia (SNB, 2008, p.39-40; Chailloux et al., 2008, p.34). This moment would set out the

course of action on its monetary policy operations for the next twelve months until the intensification of the financial market distress of September 2008, with both the terms of the targeted level of the operational variable and the ways in which the LIBOR and the short-term money market rate being managed. Against the backdrop of persistent and rather volatile risk premia for unsecured money market transaction that continued to characterize the early phase of the global financial turmoil, the SNB continued to rely on modifying the rates on its secured repo operations, in response to the movements on this premia and with the purpose of countering the upward pressure on the LIBOR. Consequently, while the SNB managed to maintain the official policy rate relatively close to the target, the domestic short-term secured money market rates followed the price that the SNB was charging on the provision of reserves and remained therefore noticeably lower. The domestic and foreign banks that had access to the secured money market and central bank operations could engage in very short-term refinancing domestically, at a relatively lower rate than compared to the money markets abroad. As in the pre-crisis period, the SNB continued to allot the amounts that corresponded to the liquidity forecasts and engage in fine-tuning operations to stabilize overnight market rates, albeit much more regularly under these circumstances.

The SNB would thus continue to follow the results of the inflation forecasts at the quarterly assessments, which despite the deterioration of global economic conditions remained somewhat within the bounds of the tolerated range. As such, an official change in the policy stance through the level of its operational target at this point was still deemed unnecessary. However, accompanying measures were put in place as part of its announced intention of calming the money market, such as providing central bank liquidity through repos with a longer-term maturity (BIS, 2008; SNB, 2009, p.51). In this early phase of the crisis, the balance sheet composition of the SNB remained rather unchanged and its expansion in size was yet to follow. The only element that contributed to an increase of the balance sheet without an equivalent rise in domestic liquidity provision, were the repo auctions in US dollars that the SNB started conducting by the very end of 2007, with the purpose of providing dollar liquidity to its own counterparties and alleviate pressures on international money markets. Carried out on the basis of a swap agreement with the Fed¹⁵, these operations were put in place as a part of a larger coordinated action with a number of other central banks (SNB, 2009, p.53; Goldberg et al., 2011).

¹⁵For a timeline of decisions and announcements concerning the US dollar swap arrangements between the SNB and the Federal Reserve during this period, see Goldberg et al. (2011, p.8).

The LIBOR appeared under an even more significant upward pressure by September 2008, although this time brought about by foreign banks outside of Switzerland. In the context of a heightened financial market distress and frozen unsecured markets following an increased perceptions of counterparty risk, the ‘CHF-specific spike in the cost of obtaining unsecured funds was caused by a combination of the need by banks outside Switzerland to continuously roll over maturing interbank loans and the shrinking supply for these funds’ (Auer and Kraenzlin, 2011, p.411). Prior to the crisis, many foreign and mostly European banks without direct access to the liquidity operations and the secured interbank market were granting loans denominated in Swiss francs and were engaging in short-term refinancing through the unsecured market with Swiss banks and foreign banks that have direct access to Swiss liquidity, which at the peak of financial market distress they were no longer ready to provide (Jordan, Peytrignet and Rossi, 2010, p.49; Auer and Kraenzlin, 2011). The open access policy of the central bank in pre-crisis times set out the condition for the enforcement of a longer-term money market target abroad, while the reduction of the price on liquidity provision that was carried out during the initial phase of the crisis seems to have managed to keep the LIBOR close to the target. However, under these circumstances, the previously employed measures seemed no longer appropriate when faced with the turmoil of September 2008. As a direct response, the SNB provided Swiss franc liquidity against euros to foreign banks with no direct access to its monetary policy operations through the enforcement of swap arrangements with the ECB and the central banks of Poland and Hungary (SNB, 2010a, p.49), with the ultimate intention of bringing down the LIBOR. Furthermore, as an accompanying measure to the introduction of the swaps in Swiss francs, the central bank adopted a full-allotment rule on its liquidity-providing operations. From that moment forward, the SNB was ready to supply any demanded amount on its repo auction auctions, which was done in an effort to ‘allocate liquidity to foreign banks that were seeking CHF more directly’ (BIS, 2019b, p.72) and by that further contribute to easing up the upward pressures on the LIBOR.

Despite the fact that these measures were not intended to increase the monetary base, such was their ultimate effect on the balance sheet of the SNB as central bank reserves held by commercial banks increased in size. Along with the aforementioned measures, the SNB also started to issue its own interest-bearing debt certificates, thereby introducing for the first time a monetary policy instrument for liquidity-extraction by the central bank, apart from the fine-tuning overnight bilateral operations that had been used until then (SNB, 2009, p.46). Although these central

bank bills happened to carry most of the weight of liquidity-extraction in the subsequent period, during this time the issued amounts remained modest. This is rather unsurprising when taking into account the particular circumstances and the subsequent drop in interbank activity (Guggenheim et al., 2011) that made banks hold ample amounts of central bank balances, as well as the substantial changes in the level of the official target at this particular point in time (figure 3) that brought interest rates very close to zero, decoupling the quantity of reserves from their price. The changes in the monetary policy stance happened very rapidly - by way of both scheduled and emergency monetary policy decisions, the targeted level of the LIBOR had been brought from 2.75% to 0.5% in the course of two months (SNB, 2009, p.38-9; Jordan, Peytrignet and Rossi, 2010, p.31).

In an effort to keep the appreciation pressures on the Swiss franc in check the SNB turned to foreign exchange intervention shortly afterwards. This decision unavoidably resulted in a shift in the aggregate liquidity position of the commercial banking sector vis-à-vis the central bank and correspondingly imposed a need for a major change in the ways in which the SNB conducted its monetary policy operations. By doing so, it also inevitably modified the composition of the balance sheet of the SNB.

3.2 Foreign exchange intervention and monetary policy implementation in a context of surplus liquidity

The next phase of monetary policy implementation had been brought about by the first official foreign exchange purchase operations of the SNB, announced in March 2009. Two noticeable waves of intervention, albeit different in duration and scale, would characterize this period of occasional intervention in the absence of an announced exchange rate target. Carried out over the course of 2009 and in the midst of still very delicate global financial conditions, the increase in domestic liquidity provision coming from the first wave of interventions would coincidentally contribute to easing out pressures on the markets for central bank reserves and induce a greater reliance on liquidity-absorbing instruments in the day-to-day operations of the SNB. Nevertheless, the indisputable shift in aggregate liquidity conditions would arise following the much briefer, but more intense interventions of May 2010.

An even lower and now tighter announced range for the LIBOR of 75 basis points accompanied these official foreign asset purchases, where the targeted level was set out near the bottom of the range instead of the middle. The SNB had

thus imposed a near zero target on its longer-term money market rate abroad, at a level of 0.25%. The increases in the provision of central bank liquidity, ensured a level of reserves enough to bring the LIBOR at a relatively lower level. First and foremost, this happened through a continued use of a number of previously established instruments and crisis response measures¹⁶, such as regular auctions of liquidity-providing repos with full-allotment rules and swaps in Swiss francs against the euros. However, one additional element contributed to bringing the LIBOR down during this phase. As pointed out by Auer and Kraenzlin (2011, p.415), ‘while the exchange rate interventions were part of the SNB’s unconventional measures to avert deflation risks in Switzerland, an unintended side effect of the interventions was the resolution of the international CHF liquidity shortage’. Therefore, the foreign exchange purchases which were above all intended to put a stop on the appreciation of the franc, had the inevitable liquidity-providing secondary effect. Since these operations coincidentally happened to enhance the liquidity effect that the central bank was attempting to achieve while aiming for an interest rate target of its choice, the SNB did not respond with more substantial countermeasures in order to offset their effect.

Meanwhile, shorter-term domestic money market rates remained consistently close to zero over the course of the year. Once a week, the SNB held auctions of central bank bills with a maturity of seven days, presenting an opportunity for commercial banks to place their central bank balances, that they happen to hold in higher amounts compared to their payment needs and cannot use for any other purpose, into these interest-bearing central bank instruments. However, the rate attained in these auctions of short-term central bank bills was set very close to zero, reaching an annual average of 0.02% for 2009 (SNB, 2010a, p.54). The fairly small difference in opportunity cost compared to holding unremunerated central bank reserves, imposed through the remuneration rate on the only liquidity-absorbing central bank instrument during this period, could also partly explain the rise of sight deposits of banks along with the rise of foreign assets from the exchange rate intervention on the central bank balance sheet and consequently, the limited compensating effect of the introduction of central bank bills on the monetary base.

Conversely, and on a daily basis, the SNB continued to ensure auctions of liquidity-providing repos with the maturity of one week and fully extend the demanded amounts, at an unvarying rate of 0.05%. These auctions were predominantly

¹⁶Information on each recourse to a monetary policy instrument by the SNB during this period, can be found in Table A5₁ of the *Monthly statistical bulletin* dataset (this publication covers the period between 2008 and 2015), including the type of instrument, their liquidity effect (providing or absorbing), maturity, interest rate, type of procedure, aggregate bids and allotted amounts.

used by foreign central banks abroad with access to monetary policy operations - the SNB reports that only 8% of the distributed liquidity on the basis of short-term repos in the course of 2009 were demanded by domestic banks (SNB, 2010a, p.54). Considering the fact that the SNB continued to use the previously introduced measure of swap arrangements in Swiss francs against the euro intended for foreign commercial banks without direct access to central bank reserves, it appears that the operations of the SNB throughout 2009 have been focused primarily on easing out the liquidity pressures on international markets, seeking to bring down its unusual operational target, which had been maintained as the key policy variable throughout these turbulent times. The 3-month LIBOR in Swiss francs carried on being slightly higher than the targeted level, coming close to this value only by the end of the year (figure 3). At the same time, the ample amounts of central bank liquidity on domestic money markets kept the overnight secured rate (SARON) at a level not far from zero, but still somewhat between the rate that could be obtained by placing reserves in short-term central bank bills and the price of obtaining central bank liabilities through the daily repo auctions. Following an improvement of global financial conditions and steady provision of sufficient liquidity, resulting in a considerable slowdown in the reliance the foreign exchange swaps in Swiss francs, this measure was eventually discontinued (SNB, 2011a, p.45).

The foreign exchange purchases of May 2010 imposed the need for a further transformation of the operational framework, in step with these latest changes in liquidity conditions. These purchases, significantly larger in size compared to the earlier foreign exchange intervention, caused a significant expansion of the balance sheet of the SNB (figure 2). The rapid and sizeable increase in Swiss franc reserves that inevitably followed, had a rather strong immediate effect on money market interest rates. In the course of a few weeks, the 3-month LIBOR dropped significantly, from values close to the targeted level of 0.25% to 0.08% at the beginning of June 2010 (*ibid.*, p.50)¹⁷. As opposed to the challenges when faced with the liquidity implications of the previous wave of intervention, where the international liquidity pressures were to be addressed in order to lower the LIBOR and keep it close to target, this time the SNB needed to take further action and established a set of instruments that would help raise this money market rate abroad, in an attempt to comply with the decisions on the official monetary policy stance. The considerable increase in the provision of central bank liquidity removed

¹⁷ The lowest registered value of the 3-month LIBOR in Swiss francs for this phase of implementation (March 2009 - July 2011), had been 0.07667% on 7 June 2010 (Source: *Monthly Statistical Bulletin*, Table A4₂).

the need for a recurrent use of liquidity-providing instruments¹⁸, including for the previously well-established main financing operations, which were ultimately discontinued (SNB, 2011a, p.50).

From this moment forward, the operational framework in place relied almost exclusively on liquidity-absorbing instruments. The central bank bills at that point were issued only at longer-term maturities, with weekly auctions of one-month central bank bills and regular auctions of three-month, six-month and one-year central bank bills (*ibid.*, p.48). In addition, the daily operations of the SNB took the form of one-week reverse repos. Moreover, the full-allotment rule, initially introduced as a response to the crisis, no longer applied - the central bank reclaimed the possibility to influence targeted rates through the adjustment of reserve quantities. Therefore, the manner in which the SNB maintained the level of its operational variable of the 3-month LIBOR near the targeted value during this phase, somewhat echoes its pre-crisis practice, with the notable difference that under these circumstances the monetary policy instruments in place needed to be directed in the opposite direction. In other words, as a result of considerable movements particularly in one of the autonomous factors, the domestic liquidity management operations of the central bank were now being addressed through imposing an opportunity cost for banks of holding these large amounts of central bank balances.

The auctions of central bank bills were thus intended to absorb one part of the surplus liquidity, while the daily repurchase repos were more pointedly intended at keeping the 3-month LIBOR close to target. At the regular auctions of central bank bills, the commercial banks holding reserves substantially higher compared to their payment needs could demand to exchange these amounts with the central bank, for an interest rate higher than zero and a highly-liquid security that could serve as a collateral on secured transactions. The withdrawal of liquidity at a shorter term had been conducted by means of auctions of reverse repos, where the SNB announced a fixed rate, while accepting the amounts that correspond to its liquidity forecasts. The SNB had thus modified the rate on the seven-day repos on several occasions before the introduction of an exchange rate floor, ranging between 0.14% and 0.4% and keeping the LIBOR at a slightly lower than the target, but at a quite steady level. With the narrowing of the spreads, due to more quiet global financial conditions and ample central bank liquidity, the SNB had been able to revert to controlling the LIBOR, primarily through the newly introduced

¹⁸The liquidity-shortage facility remained a possibility, charged at 50 basis points above SARON since the beginning of 2009, instead of 200 basis points previously in use (SNB, 2009, p.54).

instrument of reverse repos. As a result, unlike the previous intervention phase where the SNB used liquidity-providing repos in order to bring the LIBOR down, the rates on the auctions of the liquidity-absorbing repos during the later phase served as a form of lower limit on the movements of this longer-term rate (SNB, 2011a, p.49). The substantial increase in domestic liquidity following the second wave of interventions of May 2010, modified the way in which the SNB needed to approach the issue of controlling its longer-term unsecured operational target, on foreign markets. Regarding the shorter-term domestic money market rates, the SARON remained very close to zero during this phase of monetary policy implementation, although the SNB tolerated a certain volatility, in the absence of the tighter limits on its movements compared to the framework in place during the first wave of interventions.

These developments were clearly reflected on the balance sheet of the central bank (figure 2). During the first wave of interventions, it can be noticed that some of the increase in central bank assets had been compensated by the emissions of central bank bills. Accordingly, this increase had been also accompanied by a significantly higher level of central bank reserves held by the aggregate banking sector compared to the amounts imposed by the mandatory reserve requirements. For example, whereas in the years before the crisis banks were holding reserves roughly 20% in excess of imposed amounts on a yearly basis, the annual average ratio of compliance with the requirements had reached 669% for 2009 (SNB, 2010a, p.56). As previously noted, this had been the case already during the last quarter of 2008, as part of the response of the central bank to the outburst of the financial crisis, preceding the first foreign exchange interventions by a few months. The balance sheet further reflects the changes in the operational framework that accompanied the first wave of official foreign asset purchases, as some of the liquidity created following the decision to stop the appreciation of the Swiss franc had been indeed compensated by issuing short-term central bank bills, but only partially, since market turmoil was not over yet, while the efforts of the SNB to bring down the LIBOR by means of providing abundant central bank liquidity continued during the course of the year. An increasing share of liquidity-absorbing instruments took over the liability side of the balance sheet at the expense of the aggregate amounts of central bank reserves, only following the changes in the operational procedures that were implemented in the aftermath of the substantial foreign exchange hike of May 2010. Given the relatively stable level of demanded banknotes, the subsequent movements in the level of central bank reserves, modified the size of the monetary base.

In their analysis of the foreign exchange operations of the SNB during this period, Humpage (2013) and Bordo et al. (2015) distinguish two types of intervention the movements between foreign reserve accumulation and the monetary base on its balance sheet: non-sterilized at first, since these early interventions had been accompanied by an enlarged Swiss monetary base; followed by sterilized intervention at the later stage, as the hike in foreign asset purchases of the central bank balance sheet involved a proportionally lower increase in the monetary base. This distinction, based on the literature on the effectiveness of foreign exchange intervention, implies a rather different interpretation of the link between foreign exchange accumulation and the monetary base on the central bank balance sheet and the macroeconomic implications, compared to an endogenous money perspective. Provided that the base interest rate is considered as the exogenous variable through which the central bank influences economic conditions, which is a key theoretical concept of demand-led endogenous money, the ways in which the domestic liquidity stemming from foreign exchange interventions gets managed is ultimately a question of the choice of an operational framework through which the base interest rate could be achieved. Therefore, the size of the monetary base by itself does not have a substantial importance for the direction of monetary policy, as it cannot have a quantity effect on broader economic variables.

In the case of Switzerland, the initial increase in the monetary base that accompanied the early foreign exchange interventions, happened in the context of a particularly low interest rate target of the SNB, which enforced the so-called decoupling of the quantities of reserves from interest rates (Borio and Disyatat, 2010), as effective domestic money market rates were close to the level of remuneration of central bank reserves, therefore practically zero. In this floor-like setting, the monetary base could increase as a result of increased aggregate reserves within the system, while the short-term money market rates would remain close to the target, without the need for more substantial compensatory measures on the part of the central bank that would additionally manifest themselves on its balance sheet. However, the same rules do not necessarily apply when it comes to the actual operational target of the SNB throughout this period, which happened to be a longer-term rate on the money markets abroad, which required a prolonged provision of Swiss franc liquidity abroad in order to bring it down and closer to the target. By contrast, in light of the significant increase in domestic liquidity following the interventions of May 2010 and a reduced spread between short-term domestic money market rates and the LIBOR, the introduction of liability-side instruments and their increased role in liquidity-absorption, were ultimately directed at bringing

the LIBOR up and closer to the targeted level. In a certain sense, the aggregate reserves were no longer completely decoupled from the interest rate target - the subsequent neutralisation of a portion of the monetary base had been conducted as a means to achieve an operational target other than zero, in a context of abundant liquidity resulting from foreign exchange interventions. The decision of the central bank to sterilize has more to do with monetary policy implementation and achieving the base rate target, whose level is determined by the monetary policy strategy of the central bank, rather than an attempt to influence broader economic conditions through the size of the monetary base.

Therefore, the interpretation of the movements in the balance sheet components could not be separated from the context in which the monetary policy was implemented. The expansion of the central bank balance sheet came as a result of the attempt of the central bank to influence economic conditions through a variable other than the base interest rate, in this case, to counteract a further appreciation of the Swiss franc and this prevented the looming deflationary pressures that were threatening its primary objective of price stability. However, the specific balance sheet composition ultimately depends on the particular implementation framework put in place, or in other words, it is ultimately an outcome of actions directed at controlling the base interest rate. The decision of the SNB to employ liquidity-absorbing instruments during this period, does not seem to stem from a direct concern of the monetary authorities about the effects of the actual size of the monetary base, or any expansionary effects this expansion could potentially entail. This would become more apparent in the following period, notably with the decision of the SNB to simultaneously maintain a floor system for interest rate targeting and a minimum exchange rate target, which would eventually generate an increase in the monetary base in step with the foreign exchange accumulation.

3.3 Domestic liquidity operations during the exchange rate floor

When faced with further appreciation pressures on the Swiss franc in August 2011, the SNB initially responded by lowering the interest rate, narrowing the target range to 25 basis points and thus ‘aiming for a three-month LIBOR as close to zero as possible’ (SNB, 2012, p.36). Bringing its longer-term money market operational target down required an additional increase in the provision of Swiss franc liquidity, which the SNB initially provided by suspending all the liquidity-absorbing instruments previously in place, which were introduced in the first place with the precise aim to prevent the LIBOR from falling far beneath the previously

targeted level. Therefore, the auctions of liquidity-absorbing repos and of central bank bills were discontinued, and in addition, the SNB repurchased a large part of the previously issued central bank bills with longer maturities (SNB, 2012, p.50). Soon afterwards, the SNB announced its commitment to defend an official minimum exchange rate against the euro, as opposed to engaging in occasional foreign exchange interventions, as it had been the case until that moment. Given that the reserves of commercial banks held at the central bank were and remained unremunerated, bringing the interest target close to zero implied an enforcement of a so-called floor system of interest rate targeting, which had also been commonly used by central banks that saw their balance sheet expand as by way of engaging in unconventional monetary policy measures, particularly asset purchase programmes (BIS, 2019a). By doing so, the SNB had allowed for the possibility to engage in significant foreign exchange interventions and simultaneously ensure the targeted level of its operational variable, without a further use of additional monetary policy instruments - the introduction of this framework entailed at first minimal and later with no further action on the part of the SNB. The implications for the composition of the central bank balance sheet are thus a simultaneous increase of foreign exchange reserves and of the monetary base, in the absence of other monetary policy instruments that would disrupt the direct link between these two components (figure 2).

This setting somewhat differs from the operational framework previously in place: during the pre-crisis period, reaching the targeted interest rate level required adapting the provision of central bank liquidity; in the midst of the financial market turmoil and disrupted interbank markets, the increased holding of central bank liquidity by commercial banks was far from uncommon; whereas the years of intermittent foreign exchange intervention, liquidity-absorbing instruments were primarily employed as a means to attain the targeted interest rate level. At the beginning of this implementation phase, in order to ‘accelerate the increase in the supply of liquidity’ and by that intending to ensure a prompt compliance of the LIBOR to this new and lower targeted level, the SNB additionally used foreign exchange swaps against a number of currencies, as well as short-term liquidity-providing repos (SNB, 2012, p.48). Unlike before, these repos were concluded on a bilateral basis instead of a regular auction, and moreover, they were provided at negative rates of interest, ranging from -0.55% to -0.15% (*ibid.*, p.50). The SNB did this in an attempt to ease up liquidity pressures with individual commercial banks in order to ensure a level of LIBOR close to the floor and was ready to offer even more advantageous conditions to commercial banks on a bilateral basis. These

early period measures would soon disappear from the central bank balance sheet¹⁹, discontinued by the SNB as a result of the significant increases of central bank reserves in the system stemming from the substantial foreign exchange interventions as of mid-2012 (SNB, 2013, p.41). This hike in central bank liquidity would remove the need for further central bank interest rate targeting operations, as from this moment until the break of the exchange rate floor and the introduction of negative interest rates, the operational framework remained unchanged and involved no further use of monetary policy instruments (SNB, 2015, p.55). The proceedings from the foreign exchange interventions of mid-2012 would conclusively bring secured interbank activity to a standstill, after a previous slowdown that corresponded to the earlier changes in liquidity conditions (Fuhrer, 2017).

Given the results of the scheduled inflation forecast representing a major element of its monetary policy strategy, the SNB made the decision to set and maintain its policy rate at the level of zero. Combined with the fact that central bank reserves held by commercial banks were in fact unremunerated, this situation allowed the SNB to perfectly achieve its target without further action. These circumstances make it rather obvious that the choice of base rate, however, remains separated from the choice of the implementation framework through which this target could be achieved, the latter ultimately influencing the central bank balance sheet composition. The SNB would continue to maintain the possibility to influence economic conditions through changes in the first step of the transmission mechanism should the need arise, without further changes in the composition of the liability side. More precisely, this could be done by remunerating the reserves at the level of the interest rate target set out by the central bank, when the level is other than zero. Such was the case with interest-on-reserves (Ihrig et al., 2020), as both asset purchase programmes and foreign exchange intervention impose thus similar challenges for interest rate targeting - a substantial increase in aggregate central bank reserves. There seems to be little reason to interpret the liquidity management operations of those central banks that have chosen the exchange rate as the additional policy variable through which the authorities would attempt to influence economic conditions, as anything other than interest rate targeting operations.

The monetary base would continue to significantly expand during this period, on the account of an increase of central bank reserves, with no accompanying

¹⁹In contrast to the swap operations concluded with other central banks (which previously appeared as a separate entry on the central bank balance sheet), the foreign exchange swaps concluded between the SNB and its counterparties get registered under foreign exchange assets, with an increase in central bank reserves as a direct counterpart on the liability side.

inflationary pressures of the economy. On the contrary, the SNB would maintain the zero interest rate target over the next several years, until the very beginning of 2015 when breaking the peg. The years that followed would be marked precisely by an implementation of an interest rate target other than zero through changes of reserve remuneration in the context of high and rising central bank liquidity, albeit this time the movement away from zero would be directed towards negative territory, as had happened in the case of the ECB.

3.4 *Abandoning the exchange rate floor and period of negative policy rates*

The foreign exchange reserves and the monetary base continued to move in step even during the subsequent period, despite the significant changes brought on by the discontinuation of the exchange rate floor and the introduction of negative interest rates (figure 2). The SNB kept intervening occasionally on the foreign exchange market, principally with purchases intended to oppose an appreciation of the Swiss franc, thus continually expanding domestic liquidity in the process. By changing the rules concerning the remuneration of central bank reserves held by banks, the SNB made significant adjustments in the operational framework while maintaining some of the characteristics of the previous one, notably the separation between the quantity of domestic liquidity in aggregate and the targeted level of the policy rate.

Along with the changes of the level of its operational target to -0.75%, the SNB imposed the same rate of remuneration on central bank reserves. Similarly to the zero interest rate floor previously in place, as long as the provision of central bank liquidity remains considerable, money market rates stay close to the floor imposed by the rate of remuneration of these reserves. However, with the introduction of negative interest rates on central bank balances, holding amounts higher than their payment needs would no longer imply only an opportunity cost of holding excess reserves for commercial banks. As means to circumvent the negative impact that the cost of holding central bank reserves would impose on the profitability of banks, especially with respect to the substantial amounts held with the SNB during this period, the introduction of negative interest rate had been accompanied by the establishment of a two-tier system, for which a negative rate was to be charged only on reserve balances in excess of an individual exemption threshold. The exempted amounts were to be determined on an individual basis, as specified by the reserve

requirement of each bank for the maintenance period preceding the introduction of negative interest rates, multiplied by a fixed threshold factor (SNB, 2016, p.50)²⁰.

Although the reserve requirements were maintained without interruption throughout all phases of implementation, their role of stabilizing short-term money rate that marked the pre-crisis operational framework, had been no longer applicable, considering the significant changes in the liquidity position of the system that soon followed. Therefore, the main characteristics of these requirements remained unchanged since their introduction and they continued to be mandatory, but played no significant role for monetary policy implementation in the case of the operational frameworks that were introduced in the aftermath of the outburst of the global financial crisis. The decision to provide exemption thresholds by multiplying the reserve requirements of individual banks, which are in fact determined as a function of the size of their deposits, helped establish an exemption system based on the size of the liabilities of the respective banks, for both Swiss commercial banks and foreign banks with domestic branches. As a response, interbank activity picked up on the secured market since the introduction of the two-tier system compared to the previous period of a zero interest rate floor (Fuhrer, 2017), as now ‘banks with unused exemption amounts had an incentive to trade with banks subject to negative interest on their excess reserves, distributing liquidity as efficiently as possible within the system’ (Jobst and Lin, 2016, p.42). Reaching the targeted level of the base interest rate continued to depend on an ample supply of central bank liquidity, as it is the case for other floor-like frameworks. However, in this particular case of a two-tier system, the supply of liquidity relevant for determining money market rates would be the amount in excess of the exemptions. Therefore, in order for money market rates to stay close to target, which also equals the negative rate of remuneration of reserves, ‘in aggregate, the sum of all exemption thresholds must be smaller than the sum of all sight deposits’ (Maechler and Moser, 2020, p.8).

Although the three-month LIBOR in Swiss francs had been initially maintained as the operational target through which this central bank communicates its monetary policy strategy, the SNB had been preparing in the meanwhile to replace the LIBOR with SARON as its policy rate, a decision which was ultimately put into effect in mid-2019 (Maechler and Moser, 2022). This transition towards a shorter-term domestic money market rate had been launched without major changes of the

²⁰ More precisely, it had been based on the required amounts for November 2014, multiplied by 20. For the counterparts that held sight deposits accounts but were not subject to reserve requirements, a fixed level exemption threshold had been established (SNB, 2016, p.50).

operational framework in place, through which the SNB nonetheless managed to maintain the secured overnight rate fairly close to the targeted level until the end of the analysed period, without a regular recourse to the commonly used instruments (SNB, 2017, p.59, 2019, p.59). However, the steady aggregate increase in the liquidity position of the system, issued from the occasional foreign exchange purchases that the SNB continued to engage in even after the suspension of the peg, eventually imposed the need for further revisions of the framework. Notably, by the end of 2019, new calculation rules on the exemption amounts were imposed together with an increase in the threshold factor, so as to take into consideration the effects of prolonged foreign exchange intervention on domestic liquidity (SNB, 2020, p.62)²¹. Another upward revision of this threshold factor had been introduced shortly after, albeit this time with the intention to weaken the negative interest burden of the banking system caused by the effects of the pandemic (SNB, 2021a, p.66)²². In addition, the SNB engaged more frequently in fine-tuning operations by the end of the analysed period, aimed to contain money market rates close to the target and in particular, to prevent an upward pressures on the SARON. At this stage, the SNB undertook these fine-tuning operations by placing quotes that commercial banks could accept in exchange for central bank liquidity, setting in that way a price on the overnight provision of reserves. The recourse to these operations would thus impose an upper limit to the movement of the overnight rate, since commercial banks would have no reason to dismiss the central bank quote and instead turn to the interbank market for reserve balances at a less attractive rate (Maechler and Moser, 2020, p.10).

Administering negative target levels on money market rates through the adoption of a two-tier system of reserve remuneration, imposes no change whatsoever in the balance sheet composition compared to the previous period of a zero interest rate floor - the central bank balance sheet would thus exhibit traits similar to other floor-like arrangements. The exemption thresholds on reserves do not perform a liquidity-absorbing function, but serve only as a means to determine the reserve remuneration of individual banks and help reach the targeted money market rate with smaller impact on central bank profits, compared to the possibility of imposing negative interest rates on all holdings of central bank reserves. Moreover, as these

²¹ With this new method, the exemption threshold is calculated by multiplying the moving average of the minimum reserve requirements over the preceding 36 reference periods by the applicable threshold factor, minus the cash holdings in the last reference period (SNB, 2020, p.62).

²² The threshold factor, or the number by which the required amounts of individual banks get multiplied so as to obtain their exemption thresholds, increased from 20 to 25 in 2009, and to 30 in 2020 (SNB, 2020, p.62; Maechler and Moser, 2020, p.9).

amounts of unremunerated balances continue to remain on a transferable reserve account of the relevant banks with the central bank and can also be used for the daily settlement of their payment needs, therefore cannot be separated from the monetary base. In the absence of a recourse to the commonly used monetary policy instruments, the adoption of this framework finally resulted in a simultaneous movements in foreign exchange reserves and the monetary base on the balance sheet of the SNB (figure 2).

As it could be seen above, the decoupling of the aggregate level of reserves in the system from the level of the interest rate target would hold true even in the case where the floor gets achieved through negative remuneration of reserve balances. However, when it comes to a system that consists of multiple tiers, achieving the targeted level on the money market can be quite different from the average remuneration rate that commercial bank pay on the central bank liabilities. Despite the target level that dwells further in negative territory compared to the central banks of other advanced countries that adopted negative rates, the average remuneration rate of the SNB had been negative yet comparatively closer to zero in the first years of implementation, which could be attributed to the significant size of the exempted amounts (Bech and Malkhozov, 2016, p.36). Moreover, whereas the central bank indisputably maintains the technical ability to set an operational target of its choice even under these circumstances, the precise level would still be guided by the monetary policy strategy and its policy objectives. At the moment of the introduction of the negative interest rate, the SNB made the decision to discontinue the floor on the movements of the exchange rate of the Swiss franc against the euro, and instead attempt to influence economic conditions through further lowering the first step of the monetary policy transmission mechanism, in the hope of bringing the yield curve further down, while still occasionally engaging in foreign exchange operations. This policy choice does not by itself invalidate the ability of the central bank to determine the prices on its own liabilities, even in a context of increasing surplus liquidity. It could have been instead motivated by fear of substantial losses if the exchange rate floor was to be discontinued at a later date, under the assumption that a peg on the Swiss franc against the euro had been principally intended as a temporary stabilizing measure (Pinter and Pourroy, 2019). Finally, the question of the ultimate effect of the introduction of negative interest rates for the Swiss economy (Rossi, 2019) could be considered larger in scope than the indisputable ability of the SNB to maintain control over the price on its own liabilities, even when foreign exchange accumulation that remains considerable in size and sustained in time.

CONCLUSION

The article provides an endogenous money analysis of the operations of the central bank of Switzerland, where the neutralization of foreign exchange reserves on the central bank balance sheet could be considered an outcome of the efforts of the SNB to uphold its short-term interest rate target in a context of a surplus aggregate liquidity position of the banking sector vis-à-vis the central bank, rather than being intended to have broader consequences on economic conditions. Accordingly, the extent of the sterilization or its complete absence, could be primarily attributed to the chosen method of interest rate maintenance at a given point in time, given the liquidity conditions created by the autonomous factors, themselves outside of the monetary policy function of the central bank. Building on insights from monetary policy implementation, including recent experiences of central banks that ensured a tight grip of their respective interest rate targets under different sources of increased domestic liquidity, the article traces out the evolution of the operational framework of the SNB over a number of years and gives an account of the ways in which the changes of these interest rate targeting procedures reflected on the central bank balance sheet, notably through the size of central bank reserves in the system.

During the pre-crisis period, the SNB had been conducting its daily operations in a context of structural indebtedness of the banking sector towards the central bank, determined by the overall position of the remaining autonomous liquidity factors, as during this time the SNB refrained from intervening on the foreign exchange market. The operational framework in place did not involve limiting the movements of short-term money market rates by imposing a corridor, instead the SNB implemented a version of the so-called no-interest-on-reserves system. Given the fact that the commercial banking sector had been dependent on the central bank for the provision of reserve liquidity, the SNB managed to maintain control over short-term money market rates by regularly providing commercial banks with reserves in amounts that matched their demand. Despite its unusual choice of an interest rate target, of a longer-term maturity and set on money markets abroad, the SNB managed to achieve values relatively close to the desired levels, due a rather low and stable interest rate spread during the period. Under these circumstances, the amount of reserves held by the commercial banks on the central bank balance sheet was rather unsubstantial, as banks had no incentive to hold amounts that surpass their payment and settlement needs and the fulfilment of mandatory reserve requirements.

In the midst of the global financial turmoil, in addition to promptly lowering the level of its main policy rate the SNB took on the task to impede a further appreciation of the Swiss franc, as it came to threaten the attainment of the objectives set out by its monetary policy strategy. From this time forth, the daily operations of the SNB started to take the shape of a floor system, that this central bank would continue to use throughout the following years, as the magnitude of foreign exchange intervention was substantial enough to soon bring domestic money market rates close to zero. However, considering the fact that the SNB maintained its longer-term money market abroad as its official policy rate, bringing this rate down to the targeted level required a more generous supply of central bank liquidity, including additional efforts to provide central bank reserves to foreign money market participants with a limited access to domestic reserve liquidity. As a result, the targeted levels for the three-month LIBOR had been set on a slightly higher level than domestic money market rates during this phase. Consequently, on the central bank balance sheet the initial increase in central bank reserves could be considered a by-product of the efforts of the SNB to bring down its unusual interest rate target abroad at the desired level in a context of unsettled financial market activity, under a floor-like system.

However, the wave of foreign exchange interventions of mid-2010 contributed to an even greater increase in the supply of central bank reserves, thus having eased the strain on the provision of domestic liquidity as an accompanying effect. As money market conditions started to stabilize and the spread narrowed down, the LIBOR got closer to the level of domestic money market rates. Meanwhile, the amount of reserves held by commercial banks decreased owing to a more extensive reliance of banks on the liquidity-absorbing instruments provided by the central bank, including the issuance of central bank bills. This time, the SNB seems to have employed additional liquidity management operations as a means to bring the LIBOR farther up and closer to its targeted level, compared to domestic money market rates. Instead of interpreting this process as an intended act of sterilization of foreign exchange reserves with a broader expected influence, it could be instead argued that commercial banks were placing the reserves above their demanded amounts in the interest-bearing alternatives with longer maturity put forward by the SNB. During this phase as well, the degree of sterilization of the foreign exchange rate flows on the central bank balance sheet seems to have been primarily determined by the choice of the method of interest rate maintenance.

In the wake of an even greater increase in domestic liquidity from foreign exchange interventions that coincided with the newly established commitment of

the SNB to maintain a minimum level of the Swiss franc against the euro, the size of central bank reserves held by commercial banks seems to have reached levels sufficient enough to make possible for the SNB to uphold its interest rate target without the help of any monetary policy instruments at its disposal. By bringing the target for LIBOR as close to zero as possible, the resulting increase in domestic liquidity under this operational framework ensured a near-perfect control of the SNB over money market rates, while establishing a direct link between foreign reserve accumulation and central bank reserves on its balance sheet. The SNB continued to rely on the use of a floor system for its interest rate targeting operations not only throughout the exchange rate peg period, but also during the following phase of occasional exchange rate intervention with negative values of its main operational target. However, the absence of a corresponding effect of the sheer expansion of central bank reserves in a situation of foreign exchange accumulation does not seem to have produced a quantitative effect on broader economic variables. Moreover, the mechanisms of interest rate targeting under a floor system seem to apply regardless of the source of increasing domestic liquidity outside of the monetary policy function of the central bank, including foreign exchange accumulation. These insights from the case of the SNB ultimately support the interpretation of the compensating movements on the central bank balance sheet, or their complete absence, as an outcome of the efforts of the monetary authorities to uphold an interest rate target in a context of surplus liquidity.

Finally, there are also theoretical implications from analysing the recent experiences of the SNB during the period of foreign exchange accumulation. Notably, the theoretical literature on endogenous money in an open economy needs to be amended to account for these recent changes of operating procedures, such as the adoption of a floor system. The interpretation of the compensation process relies on the assumption that the central bank ensures a supply of reserves that closely corresponds to the demand by commercial banks, in order to maintain control over its operational target. However, it would be important to point out that this situation only applies in the cases where the central bank in question implements an operational framework other than a floor system. As endogenous money theory has already been revised to account for the adoption of a floor system by relaxing the assumption of an endogenous monetary base in these cases, the same could be said to apply for its open economy variant. As long as it is assumed that the quantity of central bank reserves does not influence money creation and broader monetary conditions, money could be considered endogenous even with an absence of compensating movements on the central bank balance sheet.

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