Why Are Negative Interest Rates Failing ?

An Analysis of the Swiss Case

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Contents

1 Abstract

The present paper attempts to shed light on the Negative Interest Rates policy applied in Switzerland. To do so, a basic neoclassical Money-in-Utility model is used in order to verify how accurate theory was in predicting the actual response that the Swiss economy had to this policy. The data used to analyse Swiss economic reaction to the policy is derived from studies and the database of the Swiss National Bank. The results leverage on the theory explained, showing some caveats to it, such as the importance of uncertainty in the short-run or the inefficient plunge in the official interests applied, and includes some suggestions for further research aiming to correct these mismatches between theory and reality. Finally, some practical recommendations are proposed in order to implement some of the theoretical recommendations.

2 Introduction

Can nominal interest rates go far below zero? On 22 January 2015, the Swiss National Bank (henceforth "SNB") reduced its nominal interest rates to -0.75%[1].From the moment negative nominal interest rates were imposed on the Swiss Average Rate Overnight (SARON), there have been major implications on interest setting, on the Swiss banks' balance sheets, and on consumers' optimal decisions. Even though the predicted hyper expansionary scenario – where negative interest theoretically enables both banks and people to borrow money till infinity – never happened, traces of liquidity trap conditions (Krugman, Dominquez and Rogoff, 1998) such as an increasing unemployment rate and a deflationary situation are starting to appear in the Swiss economy[2]. This has in turn put pressure on the SNB to mitigate the effects of the liquidity trap.

This paper analyses the mainstream neoclassical theory of negative interest rates and applies it to the Swiss situation to explain how the nominal shock has been passed on to the banks and subsequently, the final consumers (diluting the classic perfect competition theory on interest drop-down); and the impact of the causes and effects of the negative interest rates policy (also understood as NIRP) on our main macroeconomic variables. It seeks to distill possible caveats where the theory fails in reality and come up with measures to reduce the gap between theory and reality.

The rest of the paper is distributed as follows. Section 2 develops a basic Money-in-Utility (MIU) model to explain the impact of negative interest rates on the economy. Section 3 analyses key empirical data of the Swiss economy from the SNB databank to determine the real implications the negative interest rates policy has had on the Swiss economy. Section 4 compares the empirical evidence analyzed in Section 3 with the MIU model explored in Section 2 to verify the accuracy of the neoclassical model in predicting real consequences. Section 5 contains the final conclusions of this study, highlighting the recommended modifications that future studies can take into account when developing similar models.

[1]See footnote number 1

[2]Swiss National Bank (2015). *Annual Report 2015.* [online] Available at: `http://www.snb.ch/en/mmr/reference/annrep_2015_komplett/source/annrep_2015_komplett.en.pdf` [Accessed 10 June 2016].

Negative Interest Rates

From the Japanese experience in the mid-1990s to the recent movement towards negative interest rates in some European economies, the Zero Lower Bound (henceforth "ZLB") on nominal rates has received little academic interest. It was not until the economic explosion of the 2008 financial crisis that the ZLB became an increasingly important macroeconomic idea in the hands of policymakers as unconventional policies such as forward guidance and asset purchases did not completely succeed in importing inflation and lowering their overvalued exchange rate[3]. Due to the greater integration and interconnectivity of economies worldwide, the actions of several central banks have resulted in a quasi-domino effect due to the market expectations and the Central Banks' cooperation, forcing a global movement towards reducing interest rates, thereby prompting the need for innovation and the openness towards previously taboo or controversial policies (NIRP as an example)[4].

In this paper, a situation in which negative nominal rates exist is considered as a viable but not costless option as they effectively subsidize paper currency, deviating from the optimal nominal rate (Friedman, 1969). The paper takes as given the explanation that some level of negative nominal interest rates is possible due to the existence of costs of holding money, contrary to Hicks (1937), assuming that money pays always zero nominal interest. Therefore, it is an explanation of why most of the so-called "advanced" economies have been able to constantly lower interest rates without falling into liquidity traps, and even some of moving into a negative scenario (Japan is the last 'member', with its attempt to boost inflation)[5].

[3]Korniyenko, Yevgeniya and Loukoianova, Elena (December 2015). *The Impact of Unconventional Monetary Policy Measures by the Systemic Four on Global Liquidity and Monetary Conditions.* IMF Working Paper [online]. Available at: `https://www.imf.org/external/pubs/ft/wp/2015/wp15287.pdf` [Accessed 09 June 2016]

[4]A Simmons, Beth. (February 2006). *The future of central bank cooperation.* Bank of International Settlements [online] Available at: `http://www.bis.org/publ/work200.pdf` [Accessed 08 June 2016].

Sumo, Vanessa (Winter 2008). *Central Bank Cooperation.* Richmond Federal Reserve.[online]. Available at: `https://www.richmondfed.org/~/media/richmondfedorg/publications/research/region_focus/2008/winter/pdf/federal_reserve.pdf` [Accessed 09 June 2016]

[5]Bank of Japan (29 January 2016). *Introduction of "Quantitative and Qualitative Monetary Easing with a Negative Interest Rate".* Tokyo [online] Available at: `https://www.boj.or.jp/en/announcements/release_2016/k160129a.pdf` [Accessed 25 May 2016]

The Switzerland Experience

After the fall of Lehman Brothers in 2008, the SNB started increasing its assets – initially through the provisions to repo in CHF and USD and finally, using quantitative easing to appreciate the exchange rate EUR/CHF, thus enabling Switzerland to be more competitive in the international markets. The Swiss Franc had been appreciating since the bubble boost, as it was seen as a defensive currency and therefore, over-demand for it forced its appreciation, necessitating that the SNB act urgently against the market[6].

In September 2011, the SNB pegged the EUR/CHF to a minimum floor of 1.2, exposing itself to 'unlimited' actions and, by *de facto* imposing a fixed exchange rate[7], losing its direct influence on the macroeconomic policy (Mankiw, 2010). This parity was kept untouched until 15 January 2015[8] through the currency repo at the secondary market, allowing Switzerland to double its foreign currencies during that period[9]. After rumors that the European Central Bank was committed to depreciate the euro to boost the European economy, the SNB decided to readjust its monetary policy and break the peg EUR/CHF, thereby giving rise to the emergence of negative interest rates in Switzerland at -0.75% on 15th January 2015[10]. This move was presumably taken in order to avoid the massive cost of keeping an undervalued euro as pegged, especially for the SNB, which was already highly leveraged. It would also reduce the attractiveness of investing in Swiss francs and slow Switzerland's spiral into deflation by importing inflation and fostering consumers' consumption[11]. During that same period, the Swiss economy smoothly recovered from the global economic collapse of 2008 with an annual growth close to 1.5% and an unemployment rate round

[6]Dorgan, George (13 June 2016). *Weekly SNB Intervention Update: Sight Deposits and Speculative Position.* SNBCHF.com [online] Available at: `https://snbchf.com/snb/history-of-snb-sight-deposits/` [Accessed 13 June 2016].

[7]Swiss National Bank (06 September 2011). *Swiss National Bank sets minimum exchange rate at CHF 1.20 per euro* . Zurich [online] Available at: `http://www.snb.ch/en/mmr/reference/pre_20110906/source/pre_20110906.en.pdf` [Accessed 03 June 2016].

[8]Swiss National Bank discontinues minimum exchange rate and lowers interest rate to –0.75% `http://www.snb.ch/en/mmr/reference/pre_20150115/source/pre_20150115.en.pdf`

[9]Bosley, Catherine (05 February 2016). *SNB's FX Reserves Increase to Record Amid Depreciating Franc* . Bloomberg [online] Available at: `http://www.bloomberg.com/news/articles/2016-02-05/snb-foreign-currency-holdings-hit-record-amid-depreciating-franc` [Accessed 29 May 2016].

[10]See footnote number 1

[11]International Monetary Fund (2003). *Switzerland: Selected Issues* . [online]. Available at: `https://www.imf.org/external/pubs/ft/scr/2003/cr03149.pdf` [Accessed 02 June 2016].

3.5%[12], the latter arguably more attributable to the Greek uncertainty and the general economic slowdown[13].

3 The Model

This paper will follow a Money-in-Utility model as an extension of the Ramsey model (Ramsey, 1928), by postulating that money provides utility, thus not just considering it as an intermediary good that facilitates transaction, but also as a final good with a liquid store of value (Sidrauski, 1967).

In the present paper, a superneutrality model is developed in which uncertainty and labor-leisure are ignored, focusing instead on money demand, value of money, and the costs of inflation. This structural model will allow us to obtain the effect of money on the real economy, on prices and the optimal rate of inflation after following a Walshian derivation (Walsh, 1998). Additionally, it is based on a closed economy with only two representative agents (households and government); an infinite horizon; one consumption good; and no endogenous production.

The representative household maximizes:

$$\sum_{t=0}^{\infty} \beta^t U\left(C_t, \frac{M_t}{P_t}\right) \qquad U\left(C_t, \frac{M_t}{P_t}\right) = \log C_t + \frac{(M_t/P_t)^{1-\nu}}{1-\nu}$$

$$\sum_{t=0}^{\infty} \beta^t (\log C_t + \frac{\left(\frac{M_t}{P_t}\right)^{1-\tau}}{1-\tau}) \qquad (1)$$

where C_t is a CES function over the consumption good and M_t follows a neutral elasticity of substitution, denoting the money supply on the economy. The endowment Y_t of consumption

[12] See Appendix

[13] Heinz Hausner, Karl and Simon, Silvia (2012). *The Impact of the Eurocrisis in Switzerland.* Intereconomics [online] Available at: `http://archive.intereconomics.eu/year/2012/2/the-impact-of-the-euro-crisis-on-switzerland/` [Accessed 09 June 2016].

good (2) and the transversality condition over the bonds holding (3) constrain the representative household decisions:

$$P_t C_t + B_t + M_t \leq B_{t-1}(1 + i_{t-1}) + M_{t-1} + P_t Y_t - T_t \qquad (2)$$

$$\lim_{t \to \infty} B_t \geq 0 \qquad (3)$$

From this scenario, the Euler equation (4) is obtained by equalizing the consumption and the intertemporal optima, and the money demand (5) after merging money, bonds and consumption intertemporal optima.

$$\frac{C_{t+1}}{C_t} = \beta(1 + i_t)\frac{P_t}{P_{t+1}} \qquad (4)$$

$$\left(\frac{M_t}{P_t}\right)^{-\tau} = \frac{1}{C_t}\,\frac{i_t}{1 + i_t} \qquad (5)$$

From the equation 5, the liquidity trap is extracted. The closer i_k is to 0% the more explosive the money demand. In that case, if $i_k = 0\%$ then the opportunity cost of holding money would also be zero, and therefore demand would move towards a saturation point tending towards infinity M_t.

Additionally, it is assumed that the government sets taxes to maintain a balanced budget such that $T_t = -(M_t^s - M_{t-1}^s)$ and that when money supply expands and the government collects seignorage, it is transferred to the citizens through lump-sum taxes such that: $Seignorage = (M_t^s - M_{t-1}^s)/P_t$.

Taking those formulas to a steady state, the money demand at time t+1 evaluated in period t gives:

$$\left(\frac{M_{t+1}}{M_t}\,\frac{P_t}{P_{t+1}}\right)^{\tau} = \frac{1+i_{t+1}}{1+i_t}\,\frac{i_t}{i_{t+1}} \qquad (6)$$

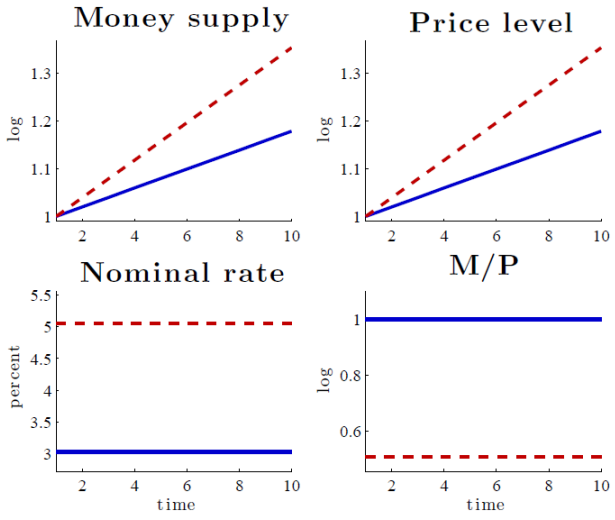
After stating that the increase of money supply is constant, the money demand constantly increases at the same rate (7) as the one previously expressed by M_t, and the Euler equation (8) in a constant

determined by exogenous variables such as the previously mentioned growth of the money supply, the intertemporal impatience and the interest rate from this equation.

$$\frac{P_{t+1}}{P_t} = \gamma_m \qquad (7)$$

$$1 + i_t = \frac{\gamma_m}{\beta} \qquad (8)$$

As a result of the assumptions and model taken, the model depends purely on money supply growth, and it is this one variable that defines the nominal interest rate, the real money and in a 1-to-1 proportions, and the inflation. The following graphs demonstrate how different money supply growths affect our target (in red higher growth than in blue).



As commented before, this model is upgraded by factoring in a simple cost of holding money, as a kind of opportunity cost of cash rather than bonds and a quadratic cost of holding physical cash (introduced at the constraint). That function can be represented by:

$$\tau'\left(M^d(i,c)\right) = iu'(c) \qquad (9)$$

where u' is the marginal utility from consumption. If there is finite cash demand when $i_t = 0\%$ (implying that the liquidity trap does not hold), then its level $m* = M^d(0, c)$ is given by $v'(m*) = 0$; and if cash demand continues to be finite for negative i_t as well, then v' must be strictly declining at $m*$. Therefore, $v(m*)$ is a global maximum of v. Positive i_t corresponds to $v' > 0$ and to an inefficiently low level of cash demand $m < m*$, while negative i_t corresponds to $v' < 0$ and to an inefficiently high level of cash demand $m > m*$ (Friedman, 1969). In that sense, assuming it has no implication on the consumption utility, a quadratic cost of holding money generates a change in the shape of the utility from cash, reducing it in an incremental way as its M_t increases, therefore diminishing the level of the optimal money holding (global maximum) and the value of M_t as it increases. Consequently, the opportunity cost of holding cash produces a downward sloping shape and both the opportunity cost and the cost of holding cash produce a final utility from holding cash, with a negative slope where a negative interest rate is feasible as M_t does not explode.

Costs changes allow for the liquidity trap to break downwards as the assumption that cash pays zero nominal interest rates no longer holds, and by following a Harberger triangle for the interest rates and cost of cash, even if the negative interest rates are theoretically possible they imply a deadweight loss, thus requiring that the benefits from that policy outweigh its costs.

Taking the mainstream model with the zero lower bound presented before, due to the introduction of the costs, that limit is broken as the money supply will not explode exponentially. Therefore, it will approximate towards an optimal level of money for every level of i_t. *De facto*, that implies that by the introduction of the costs the money supply function will have multiple equilibria as it will depend on the amount of cash existing, on external factors such as the cost of holding the cash, and on the money opportunity cost.

Negative interest rates increase consumption and investment through the control of real interest rates, by lowering liquidity-constraints on firms and households and by discounting future returns. On the currency market, this measure discourages capital inflows, leading to a lower demand of the currency, and thus a depreciation of it. On a more negative side, the policy erodes the banks'

profitability[14] due to the reduction of the net interest margins, and thus increases their own default risk. Furthermore, anomalies in the valuation of returns and payment streams would put pressure on the financial institutions to redesign the financial transaction functioning. [15]

As it will be explained in Section 4, the real experience with negative interest rates does not differ that much from the feelings the market had in the past with respect to low positive interest rates. For that reason, it will be more a matter of application and expectations about how long the policy will last, as well as the commitment by the Central Bank in dealing with the surrounding uncertainty, rather than a true or false question on whether negative interest rates are good for society.

4 Empirical evidence on key economic indicators[16]

This section analyses how the main macroeconomic variables have evolved over time before and after the negative interest rates policy was applied at the beginning of 2015[17], together with an analysis of its trend performance. The variables that are analysed in this section are: the Swiss GDP growth; unemployment rate in Switzerland; the exchange rate against the Euro (EUR) and the American Dollar (USD); M2; savings deposits and currency in circulation (YoY growth); total amount of loans given by Swiss banks; money velocity; bond interest at different maturities; SARON with official maximum and minimum official interest rates; core 1 inflation; cash holding by banks; SNB's reserves; loans' information; saving deposits; and banks' profits.

[14] Zesbos, Sara (22 February 2016). *What Negative Interest Rates Mean For Savers & Investors* Forbes [online] Available at: `http://www.forbes.com/sites/sarazervos/2016/02/22/negative-interest-rates-coming-soon-to-a-bank-near-you/#2d83a4953318` [Accessed 07 June 2016].See also World Bank, 2015

[15] World Bank (June 2015).*Negative interest rates in Europe: A Glance at Their Causes and Implication.* [online] Available at: `http://www.worldbank.org/content/dam/Worldbank/GEP/GEP2015b/Global-Economic-Prospects-June-2015-Negative-interest-rates.pdf` [Accessed 4 June 2016].

[16] All the data analyzed was extracted from the SNB database. Swiss National Bank, (2016). *Topic Overview* [online] Available at: `https://data.snb.ch/en/topics` [Accessed 21 May 2016]

[17] Swiss National Bank, (15 January 2015). *Swiss National Bank discontinues minimum exchange rate and lowers interest rate to –0.75%.* Zurich [online] Available at: `http://www.snb.ch/en/mmr/reference/pre_20150115/source/pre_20150115.en.pdf` [Accessed 21 May 2016].

Figure 1 shows the Swiss GDP's evolution. It exhibits a parabolic pattern from 2000 to 2008 with high figures in years such as 2000 and 2006 to 2008 when the Swiss GDP grew above the 4%, and a low negative growth in 2002, after the Dotcom bubble exploded, due to the Swiss exposure, even if it recovered relatively quickly into the positive field. After the financial crisis in 2008, GDP growth sank in 2009 to around minus 3% before rapidly returning to the positive field in a short period of time. However, after that recovery, the growth of the Swiss economy has not been as promising as it was in the moments prior to the crash, given that until 2015 the GDP growth was on average around 2% in real terms (which is below the average before the crisis), following the general trend of growth of its neighboring countries[18]. After the introduction of the negative interest rates policy, Switzerland seems to have suffered due to the uncertainty of this new policy[19]. However, the SNB expects to end the present year with growth between 1-1.5%[20]. Therefore, even if the negative interest rates policy was taken by the market under severe uncertainty[21], it has been shown that at least a moderate negative rate does not cause a huge short-medium term damage to the economy.

The performance of the GDP growth has an inverse correlation with the unemployment rate, which has been relatively low for all the series, if compared to other neighboring countries (see Figure 2). The Swiss unemployment rate had a value lower than 2% in 2000 and around 2,5% from 2006-2009. Between these two periods it was stable at around 4%. In the aftermath of the Great Recession, the unemployment rate decreased but started to increase from 2011 onwards, with an interruption in 2014 (unemployment rate remained stable around 3,2%). When the NIRP was applied, the unemployment rate started to grow again, all the way to the present. A comparison of Figure 2 and the GDP growth indicates that when growth is above 2%, unemployment tends to fall.

[18]Eurostat (2016). *Real GDP Growth Rate - Volume.* Eurostat [online] Available at: `http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00115&plugin=1` [Accessed 12 June 2016].

[19]A Mather, Scott. (February 2016). *Negative Interest Rate Policies May Be Part of the Problem.* PIMCO [online] Available at: `https://www.pimco.com/insights/viewpoints/viewpoints/negative-interest-rate-policies-may-be-part-of-the-problem` [Accessed 31 May 2016].

[20]Swiss National Bank, (17 March 2016). *Monetary policy assessment of 17 March 2016.* Zurich [online] Available at: `https://www.snb.ch/en/mmr/reference/pre_20160317/source/pre_20160317.en.pdf` [Accessed 31 May 2016].

[21]Bank of International Settlements, (06 March 2016). *How have central banks implemented negative policy rates?* . [online] Available at: `http://www.bis.org/publ/qtrpdf/r_qt1603e.htm` [Accessed 11 June 2016].

In Figure 3, it is possible to see how the upper and lower bound of the official interest rates, the SARON and the SAR3M[22] have evolved. In the years before the financial boost, the official interest rates implemented by the SNB followed a parabolic path, with a level in 2000-2001 of 3.25%, to a reduced level around 2004 in order to stimulate the Swiss economy after the Dotcom bubble boost (pattern followed by many Central Banks[23]), and once again at 2000's level at around 2006-2007. Nevertheless, once the Great Recession started, the SNB, as visible in the graph, cut the official interest rates to match the rates forced by the market that was already trading both SARON and SAR3M lower than the official lower bound, from a 3.25% to 0.75-0% in order to spur growth, and face the post-crash uncertainty. Consequently, since 2008, the SARON and the SAR3M remained at 0% from 2008 until January 2015, the month in which the SNB reduced the level to the band -0.25%/-1.25% [24], allowing the SARON and the SAR3M to finally become negative. Nowadays, the SARON is around - 0.74%, and the SAR3M, with a longer maturity, fluctuates around -1%.

The impact of the interest rates on the currency in circulation until 2008 was negligible as represented in Figure 4 (the only exemption was a small effect in 2002 when interest rates were decreased). However, when the Great Recession struck, currency in circulation soared due to the sudden drop in the interest rates and the increase in M2 (see Figure 8). When M2 growth decreased in 2010, currency in circulation decreased steadily until reaching a 0% YoY growth at the end of 2014. Nevertheless, when negative interest rates were applied, M2 started to rise and subsequently currency in circulation rose again. Accounting for the whole post-bubble burst period, the currency has been gaining importance again for its potential store value, thus increasing in absolute and relative terms[25]. On the other hand, saving deposits growth (see Figure 4) has a more volatile behavior. This is more correlated to economic growth than to interest rates, as seen from a comparison of the

[22]SARON is the Swiss interbank overnight rate and SAR3M is the interbank rate but at 3 months' maturity. This definition comes from: Swiss National Bank, (2016). *Swiss Reference Rate* [online]. Available at: `http://www.snb.ch/en/ifor/finmkt/id/finmkt_repos_saron#t2` [Accessed 21 May 2016].

[23]Reuters (May 2016). *Central Banks Interest Rates* [online] Available at: `http://graphics.thomsonreuters.com/F/07/GLB_BRTS0710.gif` [Accessed 31 May 2016].

[24]Swiss National Bank, (15 January 2015). *Swiss National Bank discontinues minimum exchange rate and lowers interest rate to –0.75%.* Zurich [online] Available at: `http://www.snb.ch/en/mmr/reference/pre_20150115/source/pre_20150115.en.pdf` [Accessed 21 May 2016].

[25]Swiss National Bank. *Banknote Circulation.* Zurich [online] Available at: `http://www.snb.ch/en/iabout/cash/id/cash_circulation` [Accessed 08 June 2016].

GDP growth figure and interest rate evolution (Figure 1 and 3 respectively). It follows a protective relationship: when uncertainty is high (in the form of low GDP growth), savings increase, and when uncertainty is low, savings decrease. As a result, in 2009, saving deposits growth skyrocketed due to the Great Recession. When growth reappeared, it decreased and remained stable at above 10% while GDP growth was around 2%. Since the post-2007 uncertainty was somehow eliminated around late 2009, the saving YoY started reducing its growth (with the exception of the summer of 2012) tending towards a 0% growth around 2014. However, this trend was broken by the uncertainty created by the introduction of the negative interest rate policy, producing a sudden jump but with a clearly decreasing trend (similar to the trend before the measure was implemented) [26]. Ordinarily, it would be counterintuitive that savings increase despite the negative interest rates, which are intended to push people to consume more[27]. This can be explained by the increase in uncertainty over the negative interest rates policy, which spurred a move towards increased savings as a protective reaction against an uncertain future.

Figure 5 represents one of the most important reasons why Switzerland implemented a negative interest rates policy - the exchange rates of EUR/CHF and USD/CHF. As stated in the introduction, the Swiss franc is still seen as a defensive currency[28], thus overly-demanded in times of uncertainty, such as the post-crisis one. From 2000 to 2009, the exchange rate against the USD has appreciated steadily from an exchange of 1.6 Swiss Franc to Dollar to almost a parity of 1:1. Among other external factors, that movement has been dramatically influenced by the Dotcom bubble and the Great Recession and the fact that the Swiss economy highly leverages on its banking sector[29]. Similarly, the exchange rate with the EUR/CHF fluctuated around the 1.5-1.6 parity during those years. After the drop suffered in 2007 as a result of the start of the sub-prime crisis,

[26]Bank of International Settlements, (06 March 2016). *How have central banks implemented negative policy rates?* . [online] Available at: `http://www.bis.org/publ/qtrpdf/r_qt1603e.htm` [Accessed 11 June 2016].

[27]World Bank (June 2015). *Negative interest rates in Europe: A Glance at Their Causes and Implication.* Page 6 [online] . Available at: `http://www.worldbank.org/content/dam/Worldbank/GEP/GEP2015b/Global-Economic-Prospects-June-2015-Negative-interest-rates.pdf` [Accessed 4 June 2016].

[28]Murray-West, Rosie (10 April 2015). *What is a safe haven investment and how do you find one?* The Telegraph [online] Available at: `http://www.telegraph.co.uk/sponsored/finance/investments/climate-environment/11521822/what-is-safe-haven-investment.html` [Accessed 21 May 2016].

[29]Swiss Bankers Association, (2016). *The Swiss banking sector.* [online] Available at: `http://shop.sba.ch/1000018_e.pdf` [Accessed 21 May 2016]. See also footnote number 14.

the exchange rate with the US Dollar has been fluctuating around the 1:1 parity due to the SNB's market intervention to avoid a further appreciation (the CHF is seen as a hard currency)[30]. On the other hand, the exchange rate with the euro appreciated to almost 33% (from 1.6 to 1.2) in 2008, due to the uncertainty on the area. It is a clear consequence of the Great Recession because investors sought safe and defensive assets such as the CHF[31]. As a result, the SNB tried to stop the appreciation of the CHF through market interventions[32]. However, as the appreciation continued, the SNB decided in 2011 to peg the exchange rate with the euro to avoid further appreciation of the CHF due to the Euro Crisis (2010-2012)[33]. In January 2015, the SNB unexpectedly decreased the interest rates, breaking the peg with the euro, allowing the Swiss Franc to get appreciated[34]. The parity with the USD followed a similar pattern at the beginning with a major drop of a 15%, followed by a quick recover and stabilization around the 1:1 level.

The SNB policies that aimed to help the economy and to sustain the exchange rate peg (such as the purchase of Euros on the secondary market[35]) implied a significant expansion of the SNB balance sheet, specifically its foreign reserves (Figure 6). After the negative interest rates were implemented, the SNB's assets have increased again (from 2013 to 2014, they stalled as M2 did not expand). This balance sheet expansion followed a similar trend as the monetary authorities in other western countries such as the FED, BOE or BOJ (the ECB followed a more irregular trend)[36].

Throughout the period analyzed, the SNB has accomplished its mandate as core inflation (see Figure 7), which is the SNB's main priority, has never been above the 2% level.[37] However, a negative inflation period emerged from after the European Crisis summer in 2012 to 2014. From 2014 to

[30]Dorgan, George (22 November 2014). *History of SNB Interventions.* SNBCHF.com [online] Available at: `https://snbchf.com/chf/2014-chf/financial-crisis-snb-interventions/` [Accessed 22 May 2016].

[31]Murray-West, Rosie (10 April 2015). *What is a safe haven investment and how do you find one?* The Telegraph [online] Available at: `http://www.telegraph.co.uk/sponsored/finance/investments/climate-environment/11521822/what-is-safe-haven-investment.html` [Accessed 21 May 2016].

[32]number 30

[33]See footnote number 30

[34]See footnote number 24

[35]See footnote number 30

[36]Chemi, Eric (15 December 2015). *What could the Fed buy with its USD 4.5 trillion?* CNBC [online] Available at: `http://www.cnbc.com/2015/12/15/what-could-the-fed-buy-with-its-trillions.html` [Accessed 31 May 2016].

[37]Swiss National Bank (2016). *Questions and answers on monetary policy strategy.* [online] Available at: `https://www.snb.ch/en/iabout/monpol/id/qas_gp_strat_1#t6` [Accessed 22 May 2016].

January 2015, it remained at 0%. Just before the negative interest rates policy was implemented, positive inflation reappeared. Initially, when the policy was implemented, uncertainty about its effects contributed to deflation. However, one year after the policy's application, uncertainty has decreased[38] and the M2 has increased (it takes 6-9 months to transmit the effect from money creation to inflation[39]), the negative inflation is disappearing, with a forecasted positive inflation for 2017[40].

Although the maintenance of an artificially low level of exchange rate (peg with the Euro from 2012 to January 2015), implied that inflation was supposed to soar due to the accumulation of foreign reserves and the creation of money followed by the SNB to sustain the exchange rate, this was not the case. Moreover, the actual inflation forecasts, which take yet into account the negative interest rates, state that around the first months of 2017, inflation will be constantly increasing till the 1% level[41].

The SNB money creation has helped to create a steady decrease of the money velocity[42] from 2.5 in 2008 to the actual 1.5 due to the fact that the GDP grew less than M2 did since 2008 (Figure 8). When the economy was performing well, the monetary base did not increase, implying a further velocity growth. In contrast, when economic growth was stagnant, the SNB increased the monetary base, pushing down the money velocity. Negative interest rates have had a null effect over M2 Money Velocity (Figure 9). Figure 10 shows the money multiplier for Switzerland (M2/M0 for Switzerland and Europe, M3/M0 for the rest of the economies[43]). The M2/M0 money multiplier fluctuated around 14 until 2008 after reaching a value of 16 in 2011. Since then, it has decreased steadily to a value of 12 in 2016. The M3/M0 money multiplier increased from 16 to 18 over eight

[38] Bank of International Settlements, (06 March 2016). *How have central banks implemented negative policy rates?*. [online] Available at: `http://www.bis.org/publ/qtrpdf/r_qt1603e.htm` [Accessed 11 June 2016].

[39] Svenson, Lars E.O. *Inflation Targeting as a Monetary Policy Rule.* Journal of Monetary Economics. [online] Available at: `http://www.sciencedirect.com/science/article/pii/S0304393299000070` [Accessed 22 May 2016].

[40] Swiss National Bank, (18 June 2015).*Monetary policy assessment of 18 June 2015.* Zurich [online] Available at: `http://www.snb.ch/en/mmr/reference/pre_20150618_1/source/pre_20150618_1.en.pdf` [Accessed 21 May 2016].

[41] Idem

[42] Understanding the nominal GDP as the money times its velocity. See Friedman, 1987

[43] Société Générale, (September 2015). *Econote*, pg. 13 [online] Available at: `http://www.societegenerale.com/sites/default/files/documents/Econote/2015-09_MHD_Taux\%20d'interets\%20bas.pdf` [Accessed 25 May 2016].

years (2000-2008) and then reached 16 again in 2011. Since then, it has been decreasing slowly until reaching a value close to 12 today. Its basic importance lies in the definition of the ratio, being the nexus between the central bank money supply and the commercial bank money, under a fractional-reserve banking system (Krugman and Wells, 2009). Thus, the reduction of the money multipliers shows that the possible leverage over the M0 is being reduced, decreasing the power of these commercial banks over the economy.

The interest rate policy has an immediate and direct impact on bonds' interest. Figure 11 displays the evolution of the interest paid for the Confederate Bonds at their 1, 5 and 10 years maturity. In that sense, it is easy to appreciate how the bonds return has been closely linked to the official interest rates. It shows how the dispersion before crisis was great, with nearly 4% in 2003 (between 1 year and 10 years' maturity bonds) but declined during the Great Recession. After the first shock in 2007-2008, there was a clear downward sloping trend as the capital market was flooded with cheap money and the market saw Switzerland as a secure country to invest in. It is necessary to highlight how after 15 January 2015, when the SNB decided to implement a negative interest rate approach, bonds' interests immediately dropped by such amount (approximately, 0.75%). In that sense, the cheap money and the security issue provoked a situation whereby holding a bond implies paying interests for it (i.e., a negative interest rate).

Another variable where the official interest rates normally have a direct impact is loans growth (Figure 12), where loans are defined as the money given by Swiss banks to domestic and foreign firms[44]. The loans' YoY growth is stationary around zero without any clear pattern for the whole period. Hence, the effect of the negative interest rates policy cannot be distinguished at a glance, even if other important economic episodes such as the Great Recession or the Dotcom bubble can be easily noticed in the data. Nonetheless, following an opportunity cost approach, a relevant increase after January 2015 would be expected, as in 2002 and 2009, in order to avoid paying money to the Central Bank, but this has not been the case. Nonetheless, in absolute terms, there is a positive

[44]Swiss National Bank (2016). *Mortgage loans and other domestic and foreign loans* [online] Available at: `https://data.snb.ch/en/topics/banken#!/cube/bakredinausbm` [Accessed 22 May 2016].

trend that became steeper from the middle of 2015 onward; showing that banks are starting to reformulate its loans policy due to the negative interest rate applied by the Swiss National Bank.

Figure 13 shows the different asset types owned by the banks, and how the total amount declined in 2008, but has been slowly increasing again since 2011, along with deposits, after remaining constant from 2007 to 2011. Looking deeper into the major changes appeared, there has been a huge increase of liquid assets (mainly bonds) since 2008, although the greatest increase occurred in 2011, coinciding with the Basel III proposition for Switzerland[45]. The amount of money invested in mortgages increased steadily along the whole period covered, notwithstanding the Great Recession. The only variable that dropped in 2008 and has since then continued decreasing is "due from banks" (the fall that occurred at the end of 2015 was due to a regulation change[46]). Looking at the negative interest period it is shown how the customer deposits have kept constant, not dropping as dramatically as was suggested by the liquidity trap theory mentioned in Section 2, and the total assets of banks increased during the period, with greater investment and preference toward more liquid investments.

Figures 14 and 15 represent the interest set on new loan agreements and to new firms. Figure 14 shows how mortgages with fixed interest rates (Switzerland has a preference towards the fixed payment model[47]) and loans to invest with payment of fixed interests are charged with a 1.5% interest. On the other hand, mortgages with variable interest rates pay a 1% interest because they have to be closer to the interest rate set by the SNB (see Figure 3). This is supported by data in Figure 15 on the interest rates for new businesses. For these new firms, mortgages with variable interest rates face a much higher interest (3% instead of the previous 1%) as on average, business loans have a greater default rate than customer ones. Conversely, mortgages that yield a constant return pay almost the same rate as before (the differential has narrowed and is disappearing today). Nevertheless, the most important fact is that new saving deposits and sight deposits are not charged

[45]Bank for International Settlements (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems* [online] Available at: `http://www.bis.org/publ/bcbs189.pdf` [Accessed 29 May 2016].

[46]Swiss National Bank (2016). *Notes-Banks* [online] Available at: `https://data.snb.ch/en/topics/banken#!/doc/explanations_banken#banks_devel_201511_rev_bil` [Accessed 22 May 2016].

[47]Expatica (2016). *Your Guide to Swiss Mortgages* [online] Available at: `http://www.expatica.com/ch/housing/Getting-a-mortgage-in-Switzerland_108440.html` [Accessed 24 May 2016].

to hold money. This goes against the theory's assumption that banks always charge the market interest rate to their clients, regardless of whether it is positive or negative[48].

For that reason, the Swiss banks' future profitability is not clear. It depends positively on the amount of credit granted by the Swiss banks, which in turn depends on the total assets these banks have (as visible in Figure 13, assets have a clear upward trend). These assets have been pushed up through the reduction in the interest rates imposing a greater opportunity cost between lending to the corporate/consumer sector and the alternative of keeping cash or investing in national bonds (see Figure 11). Altogether, it is having a positive impact on lending, riding out of the initial uncertainty present in the Swiss financial institutions when the NIRP was implemented, and reproducing the theory predictions regarding the increase in money supplied by the banking sector.

On the other hand, the net interest rates held by Swiss banks are decreasing as time passes, under the negative interest scenario. The actual policy has produced a reduction of the net interest due to the fact that the reduction in the mortgage rates has not been translated into lower interest rates to depositors. Lower interest rates would mean imposing negative interest rates on savers, thus charging them around a 0,75% of their savings in the concept of normative interests. However, this psychological barrier of the Zero Lower Bound is generally not broken by banks as they fear that savings may flow out of their liabilities if deposits get charged (some institutions are starting to impose a fee on deposits, especially on the large ones[49]), thus not reproducing a perfect drop-down model nd overturning the assumption that banks assign perfectly the money supplied by the Central Bank.

Based on the two reasons stated above, Figure 16 shows the net profit in the Swiss banking industry. It shows a seasonal movement (with an unusually negative behavior in 2014), with minimums in January and maximums in December. Big Swiss banks (UBS and Credit Swiss) should be excluded from consideration because their international portfolio is not representative of the Swiss situation. Looking closer at the rest of the industry, the trend shows a similar pattern under the NIRP than

[48]Investopedia (2016). *Negative Interest Rate Policy (NIRP).*[online] Available at: `http://www.investopedia.com/terms/n/negative-interest-rate-policy-nirp.asp` [Accessed 23 May 2016].

[49]Bank of Canada (November 2015). *The International Experience with Negative Policy Rates.* Pg. 14 [online] Available at: `http://www.bankofcanada.ca/wp-content/uploads/2015/11/dp2015-13.pdf` [Accessed 31 May 2016].

it had under positive conditions prior to 2015. Both in the short run and long run, it will depend on the clash between the two forces and how the banking sector adapts to this new reality that the net profits and thus, the viability that the Swiss banking sector might have.

Real economic variables such as real GDP, unemployment rate, money velocity and loan rates were not affected by the negative interest rates policy.However, other monetary variables such as the currency in circulation, M2 and the exchange rate with the Euro have suffered the impact of the policy. Another variable that has not suffered the expected effect is saving deposits, which increased. This is evidence that the negative interest rates policy has failed to achieve all of its goals.

Additionally, the good reputation of Switzerland can allow the country to finance itself at negative rates for up to 10 years. Banks are on the same situation too. For instance, the SARON/SARXM[50] has been negative since the negative interest rates policy was implemented. The inflation, especially the forecasted one, established that even if it is negative now, in one year's time, it is expected to be around 1% in positive terms[51] (lagged positive impact was overtaken in the short run by the uncertainty of this new policy[52]). Thus, creating inflation by printing money and importing it through the peg policy, followed until 2015, will have an effect at the end. As a consequence of the money creation and the exchange rate control, the reserves accounted at the SNB steadily increased and stabilized in the moment prior to the reduction in the interest rates. When the negative interest rates were imposed, SNB balance sheet started to expand again. It is remarkable that banks' balance sheets show that under negative interest rates, deposits have not sunk, even if they decreased in the first months, and lending has been steadily increasing in the form of mortgages.

[50]SARXM extends for the Swiss Average Rate at X Months. This definition comes from:. Swiss National Bank, (2016). *Swiss Reference Rate* [online]. Available at: `http://www.snb.ch/en/ifor/finmkt/id/finmkt_repos_saron#t2` [Accessed 21 May 2016].

[51]See footnote number 20

[52]See footnote number 19

5 Theory vs. Reality

The present section will be conducted as follows. The evolution of the main variables contained in Section 3 will be briefly examined in comparison to what theory predicts, in order to prove whether the neoclassical theory used holds or not. In the event it does not hold, some possible improvements or variables that should be taken into account in future studies to reduce the reality-theory gap will be provided as well as measures to help to improve the economy apart from the negative interest rate.

As stated in Section 2, the negative interest rates policy should, theoretically, force depositors to withdraw their money from the banks as people would be suffering from the costs of saving money. Therefore, a rational agent would presumably withdraw its savings and save them at home or spend them. As the neoclassical model has no real interaction (no labor exposure), any money shock will be sooner or later translated into inflation. Therefore, the negative interest rates policy is seen as a neutral one as it does not directly affect the total output, being more a matter of allocation of it (it should be highlighted that the value of money expressed by M_t/P_t remains constant). Nevertheless, the direct implications seen above also produce indirect ones on the real economy, through the interest rates (assumed to be constant for all the levels) as they modify the valuation of assets, investments and consumption decisions.

In Section 3, it was shown that Swiss GDP growth has been, on average, higher than that of the European Union for the past 15 years, both before and after the 2007 crisis. However, Swiss growth has not recovered a sustained and vigorous growth path since the Great Recession. To solve this problem, the SNB approved the application of negative interest rates[53], but they have not had the desired effect because GDP growth entered into a clear downward trend (see Figure 1), although the Swiss Bank espects to end the present year with an expansion close to 1%[54]. That is in line with the theory mentioned previously, that even if the model does not include the possible uncertainty

[53]Swiss National Bank, (15 January 2015). *Swiss National Bank discontinues minimum exchange rate and lowers interest rate to –0.75%.* Zurich [online] Available at: `http://www.snb.ch/en/mmr/reference/pre_20150115/source/pre_20150115.en.pdf` [Accessed 21 May 2016].

[54]See footnote number 20

that might arise when applying the policy at the beginning, the model predicts that the money influx along with the reduction in the interest rates will generate an important improvement in the economy in the short run. In the long run, all the changes will have no implication as the cost of deviating from the optimal 0% interest rate will be inflation and that the GDP growth will tend towards its natural rate. Moreover, as the SNB has started to supply further money along with the negative interest policy (see Figure 6 and 8), money velocity and money multiplier should decrease at the beginning. Once they recover their natural value, they will stabilize. As a result of the expansion, the unemployment rate should decrease giving more strength to the economic recovery. These implications are also predicted by the model, even if it does not delve into different types of money, as a short run movement will have no effect in the long run on the variables mentioned above (neutral model).

Other important variables such as the exchange rate (which is likely to be modestly affected[55]) and the interest rate on bonds and interbank lending (SARON and SAR3M) are not even introduced by the model. It uses as an assumption the fact that the economy is closed to others and that the interest rates create a perfect drop-down from the Central Bank to the customers. The lack of introduction of these two variables means that it might be difficult to interpret the real variables in comparison with the theory as most of the actual Swiss situation is influenced by the two variables. Specifically, the banking sector, flooded with cheap money due to the diverse interest rates reductions, is still reluctant to fully expand the amount of loans given, thus not increasing the real money supply as much as the Central Bank is attempting to. This move, achieved through the interest rates distortion, allows the bank to avoid lending all its reserves and therefore, ride them out of the storm. As explained in Section 3, as the majority of the old Swiss loans were written in fixed terms, the interest reduction has not had such a dramatic effect in the short run, even if there is a question mark over the banks' profitability in the long run. Additionally, even if banks have not still moved decisively into charging their wealthy customers a part of the negative rate

[55]World Bank (June 2015). *Negative interest rates in Europe: A Glance at Their Causes and Implication.* Page 9 [online] . Available at: `http://www.worldbank.org/content/dam/Worldbank/GEP/GEP2015b/Global-Economic-Prospects-June-2015-Negative-interest-rates.pdf` [Accessed 4 June 2016].

(based in the assumption that cash has a quadratic holding cost), that could be helpful in order to mitigate the NIRP's negative implications on the banking sector.

The following ideas try to target the misconceptions the model has to help forecast reality in a more accurate way. Firstly, it is important to determine whether the interest rates drop is perfect or not, as this will create distortions and a lower impact on the economy of the interests' policy used. For that reason, the model should not restrict financial institutions to only act as neutral agents, thus enabling them to design policies maximizing their profits. Secondly, on a more micro level, banks' profitability should also be stated in the model, treating them as the institutions that channel the credit and ultimately the effect of the policies to the real economy. Thirdly, the model's failure to include the assumption that there is no uncertainty after the policy is implemented undermines the model's behavior, especially in the short run, because such an assumption is a good variable that could explain the unexpected evolution the real Swiss economy had in the first months. Fourthly, as mentioned above, the fact of having a model that only deals with a closed economy supposes that there is no currency movement, and thus, that the whole interest rates policy had to respond throughout a greater inflation, which is not accurate in reality. Fifthly, in this paper a neoclassical model has been used for simplicity, even if a neo-Keynesian dynamic model with sticky prices might be more adequate to capture the relationship between inflation and interests rates.

In order to implement these changes to the basic model to adapt it more precisely to reality, several policies can be implemented. The first one would be to allow banks to benefit from negative interest rates conditioned on covenants such as requirements of lending a certain amount of new loans to businesses. For example, it could be established that banks have to lend a quantity equivalent to X% of its balance sheet in order to benefit from negative interest rates from loans. Another possible policy would be to punish banks that only hold money but do not lend money, by charging them with a larger negative interest rate for holding money. Another policy would be to force all banks to charge their clients. Thus, these policies are some ways to ensure that banks will really apply the NIRP by charging its clients. However, demand for credit is also weak due to

the high leverage of Swiss firms and households[56], and measures to reduce this leverage are also needed. In this regard, the Swiss can consider another novel idea – the famous "Helicopter money drop" proposed by Friedman, which reduce the transaction cost from using the banking sector as intermediary in boosting money availability, therefore, eliminating the inefficiencies resulting by linking the monetary base and the real money supply[57]. Thus, giving money to all citizens would expand consumption and trigger a virtuous circle that would eventually bring about the much-needed recovery.

[56]The Wall Street Journal (1 April 2015). *Europe's Low Interest in Investment.* The Wall Street Journal. [online] Available at: `http://www.wsj.com/articles/europes-low-interest-in-investment-1427930951` [Accessed 22 May 2016].

[57]Friedman, Milton (1969). *Optimum Quantity of Money.* Aldine Publishing Company. p. 4.

6 Conclusions

According to the model presented in Section 2, real economy and inflation should have improved as well as the whole set of variable related to them, triggering a vigorous recovery. However, real economy has not reacted to the NIRP as expected and the real variables remain weak by Swiss standards. Moreover, nominal variables (inflation is still in negative field) and other indicators such as money velocity, money multiplier or loans growth have also not reacted as predicted. The fact that banks do not charge clients appears to be the main problem as they do not transfer the interest, thus accumulating more risk without further profits. This means that in the long run, the banking sector has to find a different way to offset losses that come from the negative interest rates. To solve this situation, a set of policies have been proposed, ranging from punishing those banks that do not lend money with different interest rates, to giving strong incentives to banks to lend some share of its assets in exchange for very generous conditions. Additionally, some changes to the basic model have been suggested to reduce the gap theory-reality. However, it should be noted that further research on the adoption of these policies and changes to the model has to be done in order to determine in how they affect each other.

7 Appendix

7.1 Economic Data Figures[58]

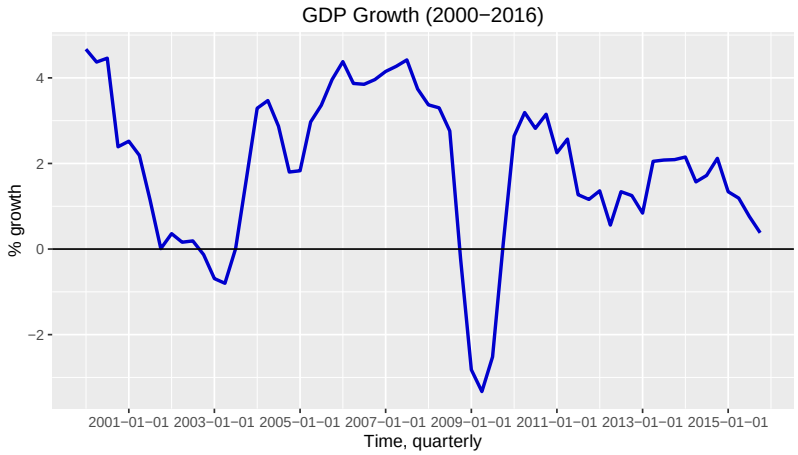


Figure 1: GDP growth from 2000 to 2016 and also a specific graph for the period 2008-2016

Figure 2: Unemployment rate (2000-2016)

[58] All graphs are compiled by authors based on data from the SNB database. Swiss National Bank, (2016). *Topic Overview* [online] Available at: `https://data.snb.ch/en/topics` [Accessed 21 May 2016]

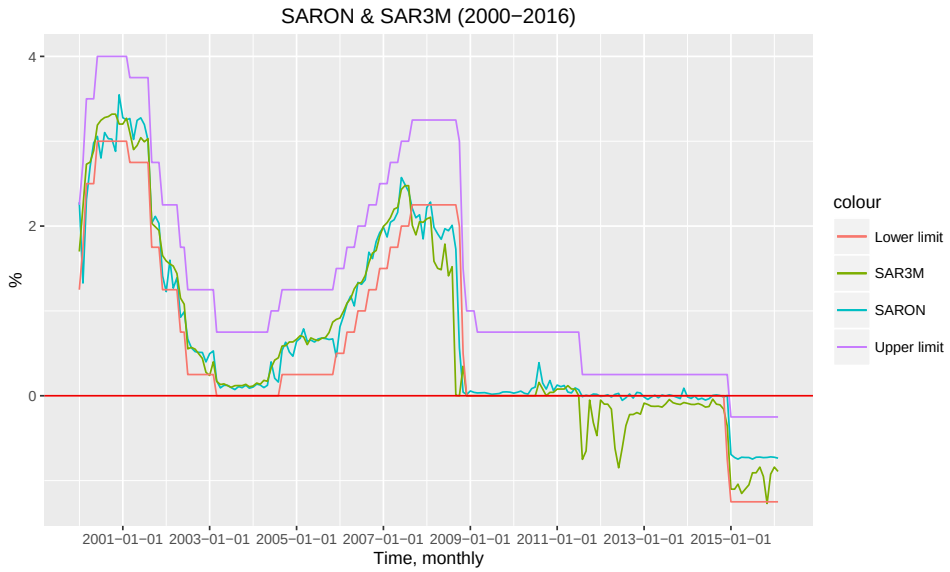


Figure 3: SARON and SAR3M (2000-2016)

Figure 4: Currency in circulation and Savings deposits (in both cases: YoY growth) (2000-2016)

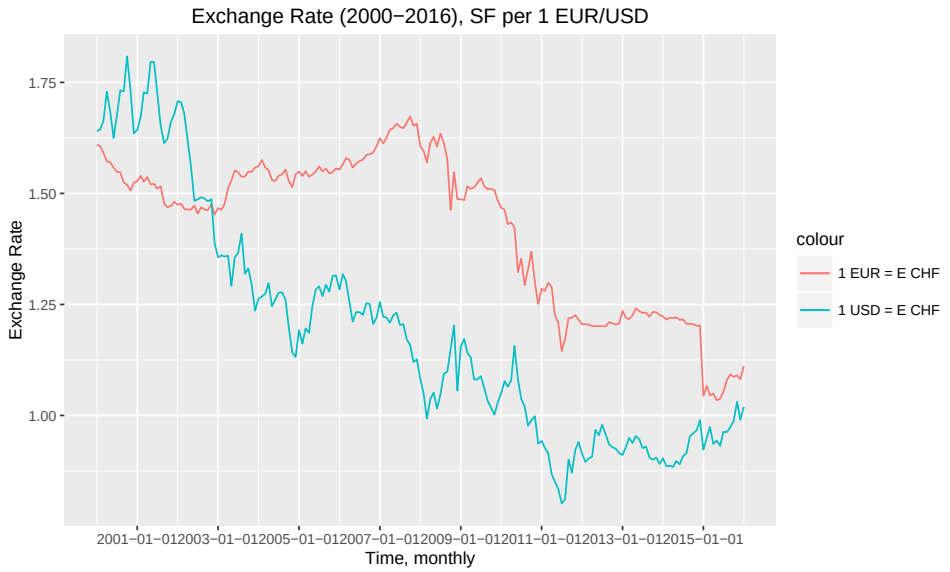


Figure 5: Exchange rate with the EUR and the USD (2000-2016)

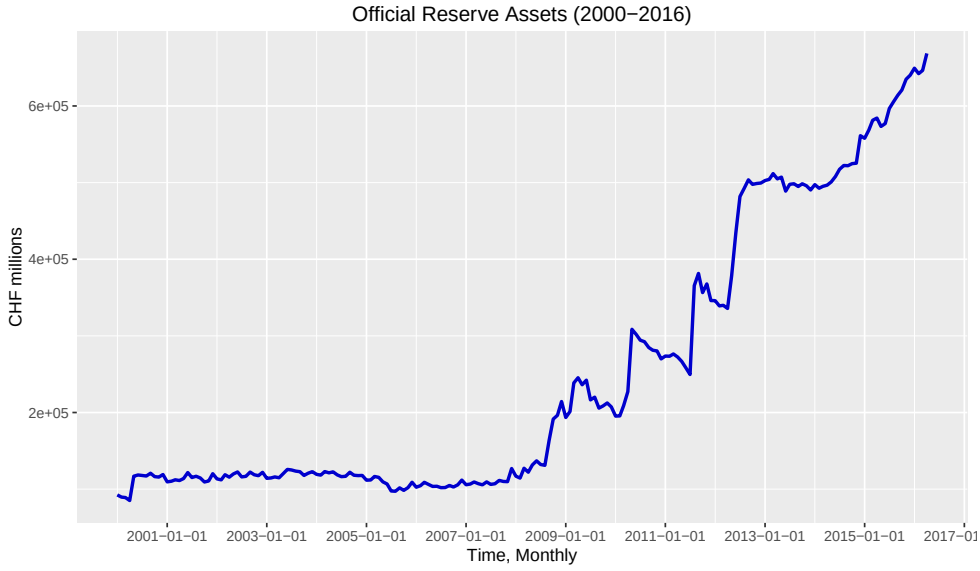


Figure 6: Total assets of the SNB (2000-2016)

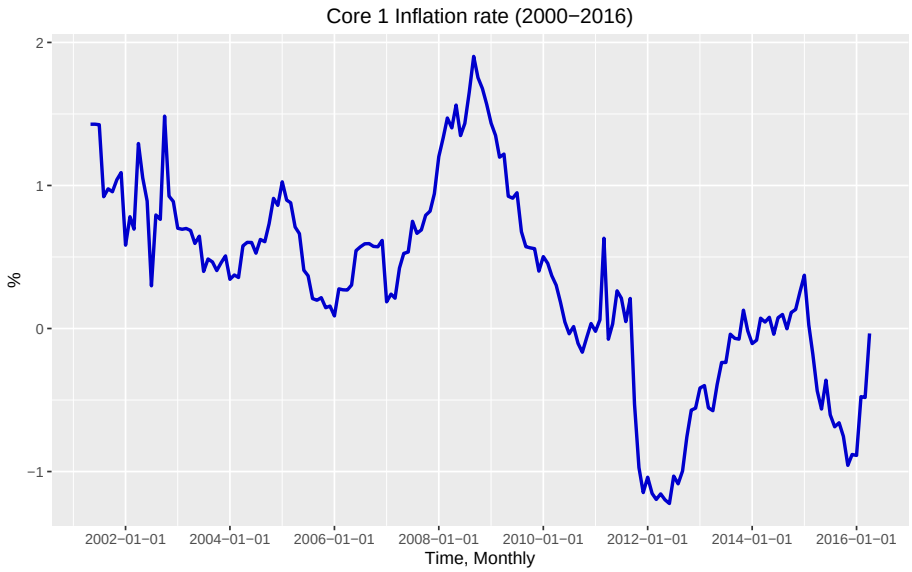


Figure 7: Core 1 inflation (i.e. food and energy excluded) (2000-2016)

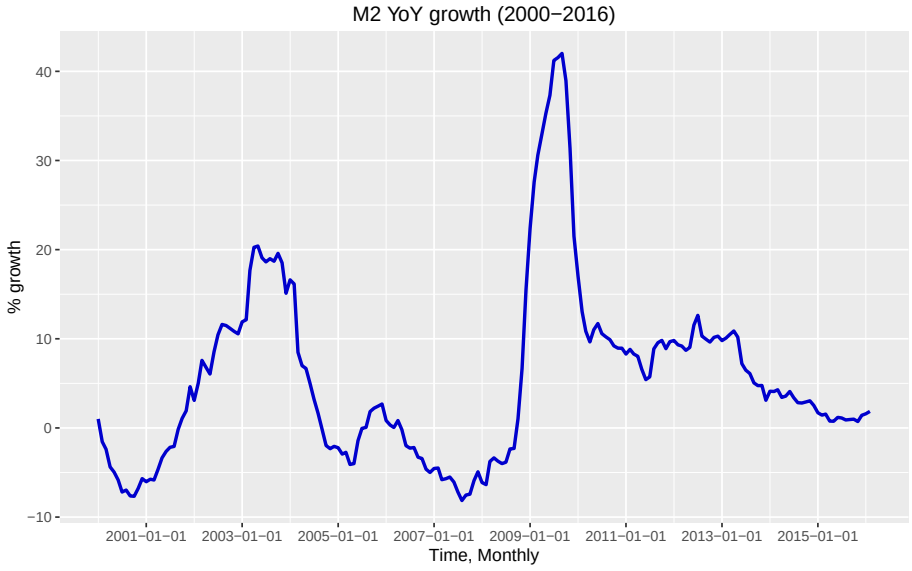


Figure 8: M2 YoY growth (2000-2016)

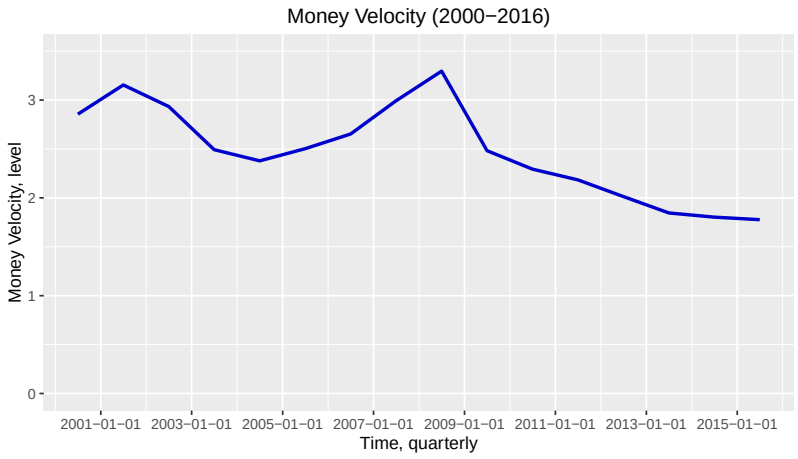


Figure 9: Money Velocity (2000-2016)

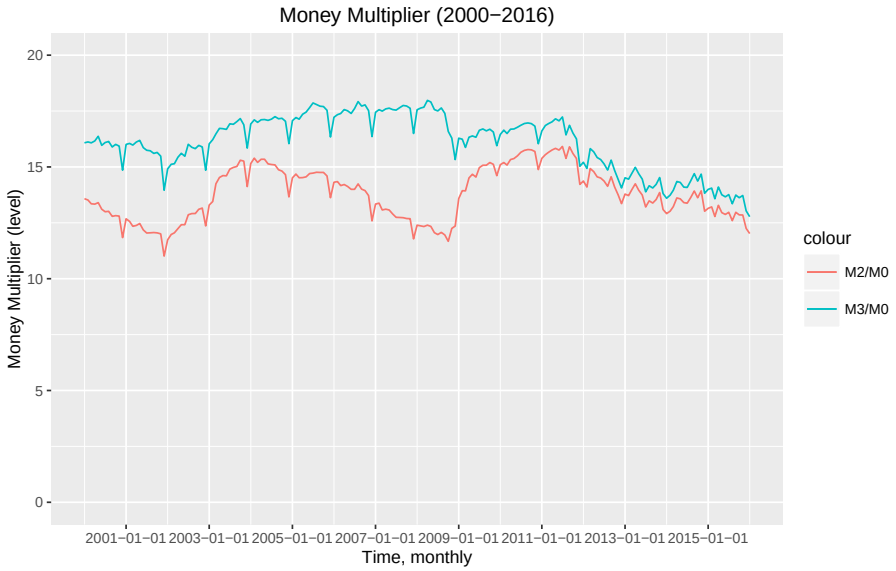


Figure 10: Money Multiplier (2000-2016)

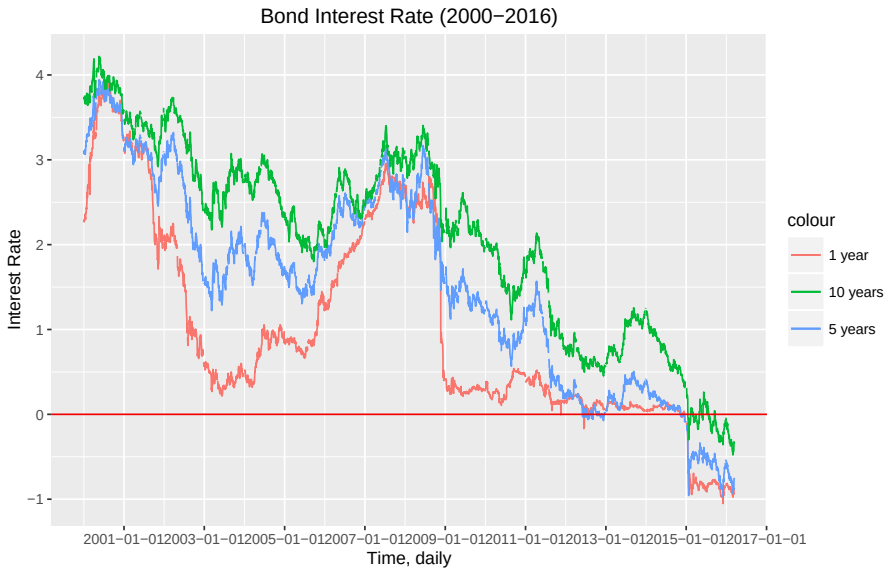


Figure 11: Interest rate offered by Swiss bonds at different maturities (2000-2016)

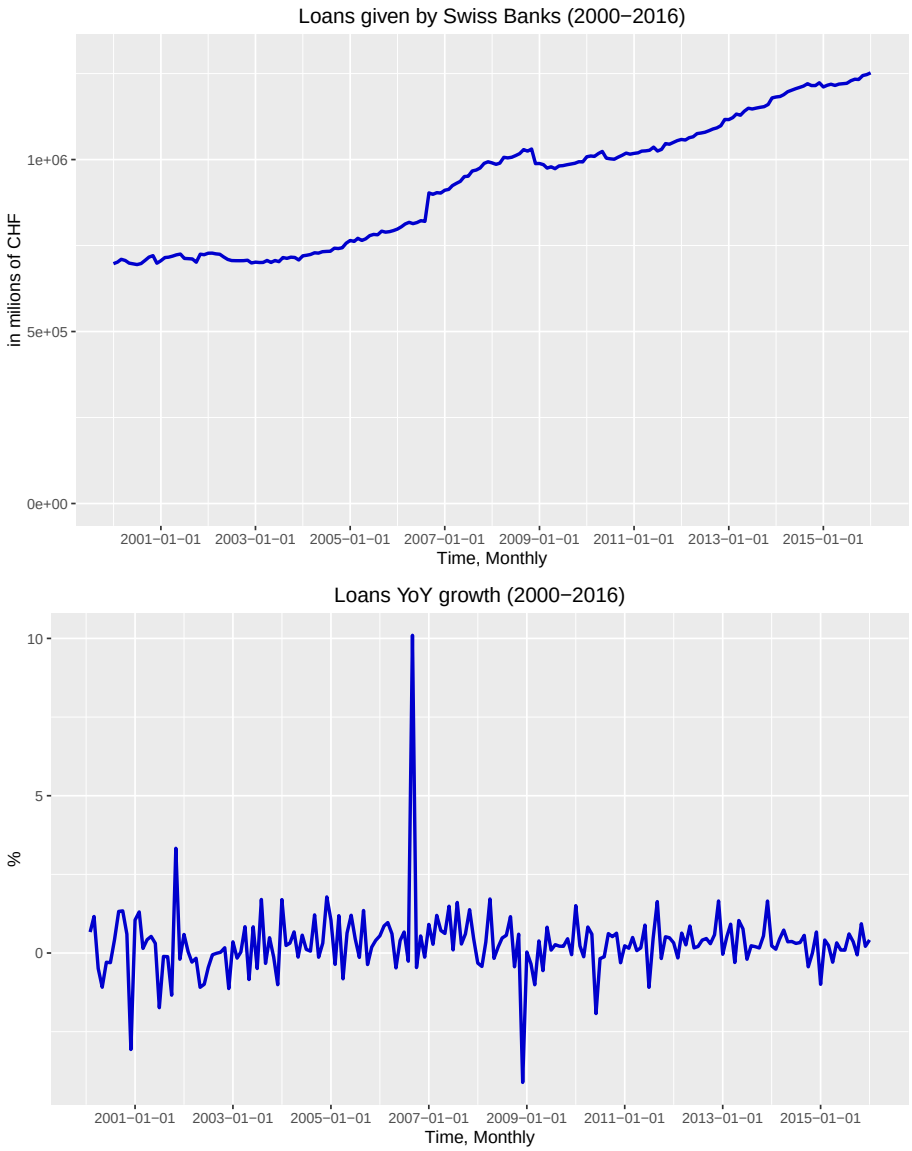


Figure 12: Total Loans given in Switzerland to foreign and domestic firms by national banks (2000-2016)

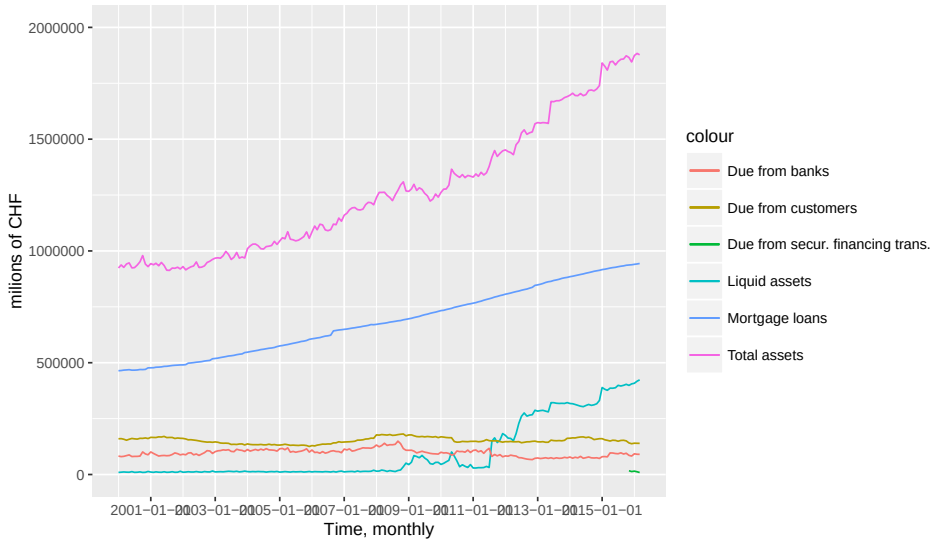


Figure 13: Assets of all Swiss banks (in millions of CHF) (2000-2016)

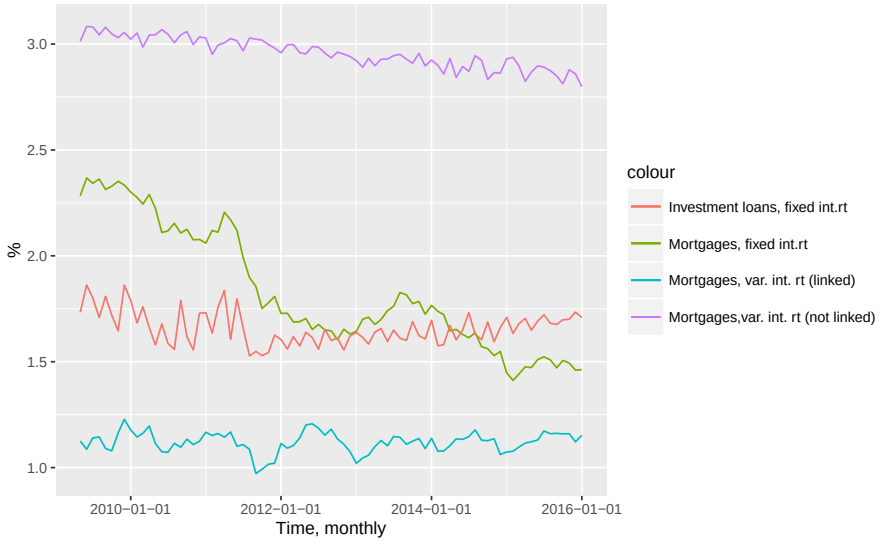


Figure 14: Interest rates on new loans agreements (2009-2016)

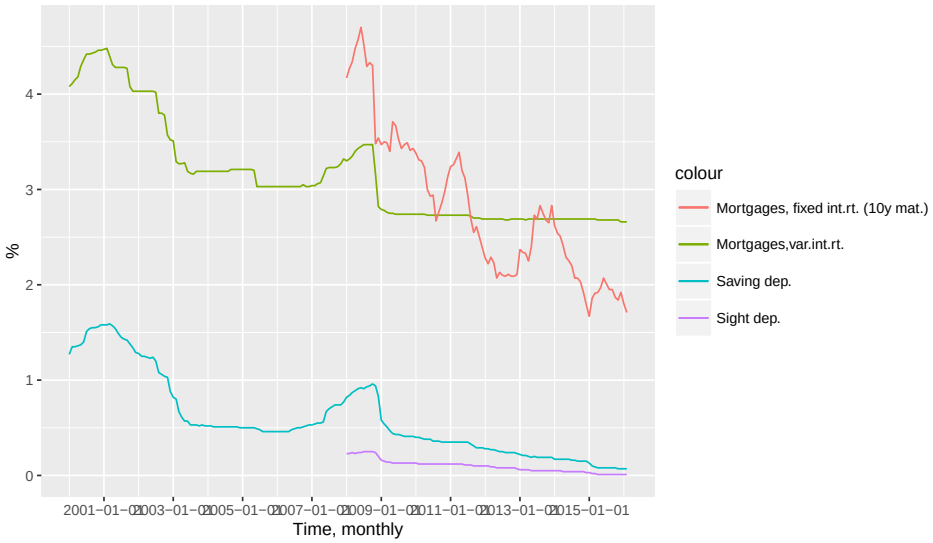


Figure 15: Interest rates on new business (median values for all variables) (2000-2016)

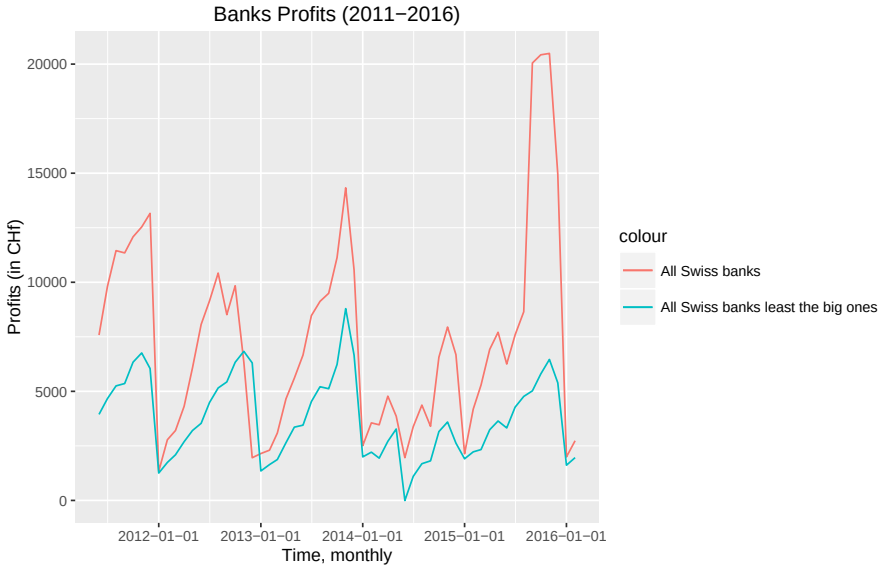


Figure 16: Swiss Banks Profits (2011-2016)

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