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A simple microeconomic model for the analysis of Vollgeld

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Abstract

In June 2018 the "*Vollgeld*" initiative will be submitted to the Swiss people. We contribute to the ongoing discussion of a sovereign money system, by providing a price-theoretic model for the money supply under a "*Vollgeld*"-system. As banks would no longer have the ability to create money, they are merely intermediaries of funds. The central bank would be the only institution to create money. But the central bank is no longer the only supplier of monetary base for the banking sector on the money market. Banks could also lend from the public and private sector. As the analysis of our model shows, the degree of instability would increase under the "*Vollgeld*"-system and result in higher interest rate volatility.

Keywords: money supply process, monetary theory, sovereign money.
JEL codes: E51, E52.

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1 Introduction

In Switzerland, a referendum will be held in June 2018 on an initiative for monetary reform. The "*Vollgeld*" initiative [1] proposes a sovereign money system that is supposed to eliminate banks ability to create money out of nothing by issuing credit.[2] In the proposed sovereign money system, only the central bank is the monopolistic issuer of money. The SNB would therefore control the quantity of monetary base in Switzerland. In order to increase the quantity, the SNB can sell existing assets or create new money, which would be then distributed directly to the government or to households or lend to the banking sector. Apart from that change, all sight deposits in Swiss francs would be part of high-powered money or monetary base and are transferred outside commercial banks' balance sheets. In the current fractional reserve system, Swiss commercial banks have to hold in average 2.5% of deposit liabilities as reserves at the Swiss National Bank (SNB).

In their proposal, the "*Vollgeld*" initiative promises numerous advantages of the change from fractional reserve banking to sovereign money. Nevertheless, many academics as well as the SNB and other public agencies raised concerns about this change.[3] Of course, such a regime change, from a fractional reserve system to a sovereign money system, would have numerous consequences and there are many aspects that need to be discussed.[4]. In this paper, we focus on the provision of credit under a "*Vollgeld*"-system. We present a simple price-theoretic model for the banking system with a credit market and a market for high-powered money or monetary base and discuss the interactions between both markets. The SNB would be the only institution to create money. However, the banking system, in order to provide loans, can lend monetary base on the money market not only from the central bank, but also from the public and private sector. After deriving our model, we discuss several possible shocks and their implications. As will become clear, adapting a sovereign money system might result in an increase in volatility of interest rates and thus lead to severe consequences for banks profitability and exchange rate risks. A destabilization of the exchange rate is especially problematic for a small open economy and financially open econ-

[1] The text of the initiative and the corresponding interpretation of the Swiss Federal Council can be found here: https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-64444.html .

[2] McLeay et al. (2014) provide an explanation of banks ability to create money

[3] see for example Birchler and Rochet (2018), Jordan (2018), Rathke et al. (2018) or SNB (2018).

[4] Bacchetta (2017) provides a broad overview of the topic

omy like Switzerland.

The rest of this paper is organized as follows. Section 2 describes the main components of our model for the banking sector. Section 3 describes the effects of the implementation of a sovereign money system. Section 4 concludes.

2 A simple model for the banking market

We introduce a simple model for the banking market that builds on the model proposed by Bofinger and Schächter (1995) and Bofinger (2001). As stated above, the model features the market for bank loans and the money market for monetary base. The markets are linked via a multiplier relation and an interest rate relation. Banks provide loans to the non-banking sector. The supply and demand for these loans are modeled on the credit market. The intercept yields the equilibrium quantity of credit and the interest rate for credit. In order to provide these loans to non-banks, banks need a certain amount of high-powered money, which they usually lend from the central bank or other commercial banks at a refinancing rate that is set by the central bank. However, in the "*Vollgeld*"-system this mechanism is different, as high-powered money is predominantly or even exclusively provided by the public and private sector. Hence, the refinancing rate, or funding cost of banks, as well as the amount of monetary base, which is available for the banking sector, is dependent on the willingness of the public and private sector to lend to the banking sector. In the following section, the markets and the functioning of our model are described in more detail.

2.1 The credit market

In the "*Vollgeld*"-system, the central bank has full control over the money stock, that is determined on the macroeconomic money market. We assume, that this market is a complete mirror image of the credit market, meaning that the demand for money is equal to the demand for credit and correspondingly supply of money is equal to supply of credit. To present these rather complicated relationships in a relatively simple model, we base the model on a very simplified balance sheet of the banking sector. As sight-deposits are transferred outside of commercial banks balance sheets, we assume the asset side of the balance sheet to contain only loans from banks to non-banks $L_{B/NB}$ that correspond to loans from the central bank to the banking-sector $L_{CB/B}$ and long-term deposits D on the liabilities side. These long-term de-

posits are liabilities from the public and private sector that banks can use as funds to lend them out again. For simplicity, we assume that only one maturity for these long-term deposits exist. In the "*Vollgeld*"-system, banks are thus only intermediaries that collect funds before making a loan.

Assets		Liabilities	
Credit from Banks to Non-Banks	$L_{B/NB}$	Credit from Central Bank to Banks	$L_{CB/B}$
		Long-Term Deposits	D

Table 1: Bank's balance sheet

Supply of bank loans

We assume that the loan supply is driven by profit-maximization of each bank. The bank's balance sheet reveals the revenues from and costs for bank's credit business. Considering all revenues and costs, the profit function of a representative bank j is equal to:

$$\pi_B^j = i_L \cdot L_{B/NB}^j - i_D \cdot D^j - i_R \cdot L_{CB/B}^j - CD_j. \tag{1}$$

$$with\ CD^j = \frac{\beta \cdot L_{B/NB}^{j2}}{y}. \tag{2}$$

The asset side of the balance sheet reveals the revenues. Banks lend out loans to the public and private sector at a price i_L. Their revenues are therefore given by $i_L L_{B/NB}^j$. Accordingly, the liability side exposes the costs for banks credit business, i.e. the refinancing costs. Banks can lend from the public and private sector at $i_D D^j$ or at the central bank at $i_R L_{CB/B}^j$. Additionally, we add credit default costs CD^j. As other scholars like Fuhrmann (1987) and Freixas and Rochet (2008), we assume credit risk costs to increase disproportionally with the amount of credit. Furthermore, credit default costs depend positively on the credit default probability β and negatively on national income y. For simplicity, we set the interest rate for long-term deposits i_D equal to the refinancing rate for central bank loans i_R, implying that refinancing costs are equal among the two alternatives:

$$\pi_B^j = i_L \cdot L_{B/NB}^j - i_R \cdot (D^j + L_{CB/B}^j) - CD_j. \tag{3}$$

Using the balance sheet identity from Table 1, we can simplify the profit function:

$$L^j_{B/NB} = L^j_{CB/B} + D^j. \tag{4}$$

Plugging (2) and (4) into (3) and simplifying the equation, we get:

$$\pi^j_B = (i_L - i_R) \cdot L^j_{B/NB} - \frac{\beta \cdot L^{j2}_{B/NB}}{y}. \tag{5}$$

We take the first-order condition of the profit function with respect to the credit volume $L^j_{B/NB}$ to derive the optimum credit supply of one representative bank j:

$$\frac{\partial \pi^j_B}{\partial L^j_{B/NB}} = (i_L - i_R) - \frac{2 \cdot \beta \cdot L^j_{B/NB}}{y} \stackrel{!}{=} 0. \tag{6}$$

$$L^{*j}_{B/NB} = \frac{(i_L - i_R)}{2 \cdot \beta} \cdot y. \tag{7}$$

Assuming there are n identical banks, total optimal credit supply equals:

$$L^S_{B/NB} = \sum_{j=1}^{n} L^j_{B/NB} = n \cdot L^j_{B/NB} = \frac{(i_L - i_R)}{2 \cdot \beta} \cdot n \cdot y. \tag{8}$$

Demand for bank loans

The demand for credit depends mainly on income and the cost of credit. Thus it is equal to:

$$\begin{aligned} &L^D_{B/NB} = a - b \cdot i_L. \\ &with\ a = \mu + \gamma \cdot y. \end{aligned} \tag{9}$$

The demand for bank credit depends thus negatively on the interest rate for bank credit i_B and positively on income y.

Equilibrium on the credit market

If the supply of bank loans (equation (8)) is equal to the demand for bank loans (equation (9)), the credit market is in equilibrium. Hence, we get the following equilibrium credit volume and interest rate:

$$L^*_{B/NB} = \frac{n \cdot (a - b \cdot i_R)y}{n \cdot y + 2 \cdot b \cdot \beta}. \tag{10}$$

$$i^*_L = \frac{n \cdot i_R \cdot y + 2 \cdot a \cdot \beta}{n \cdot y + 2 \cdot b \cdot \beta}. \tag{11}$$

2.2 Multiplier

As sovereign money eliminates the ability of banks to create credit, the multiplier relation, i.e. the relation of money stock M to monetary base or high-powered money B, is always equal to 1.

$$m = \frac{M}{B} = 1. \tag{12}$$

As stated above, we assume that credit demand equals money demand and credit supply equals money supply. As the multiplier is constantly equal to 1, the demand and supply for credit in our model always equals demand and supply for monetary base or high-powered money.

2.3 Market for monetary base

Demand for monetary base

As the multiplier is equal to 1, the optimal credit volume equals the demand for monetary base of the banking sector:

$$B^D = L^*_{B/NB} = \frac{n \cdot (a - b \cdot i_R)y}{n \cdot y + 2 \cdot b \cdot \beta}. \tag{13}$$

Supply of monetary base

The supply of monetary base is dependent on the available monetary base and the willingness of non-banks to lend it to banks:

$$B^S = \begin{cases} h \cdot B + \frac{(1-h)\cdot B \cdot i_R}{\sigma} & for \quad h \cdot B + \frac{(1-h)\cdot B \cdot i_R}{\sigma} < (B-\alpha) \\ B - \alpha & for \quad h \cdot B + \frac{(1-h)\cdot B \cdot i_R}{\sigma} \geq (B-\alpha) \end{cases} \tag{14}$$

B is the overall available monetary base in the economy. $(B-\alpha)$ equals the available monetary base for banks, i.e. α equals the amount of monetary base that is held by the private and public sector for transaction purposes. The supply of monetary base depends negatively on σ, which is a risk measure of the public and private sector for lending money to the banks, and positively on the price for monetary base, i.e. i_R. h is the share of monetary base that the central bank lends directly to the banks. Thus, for h = 0, the commercial banks have to collect all funds for their credit business from the public and private sector. The central bank has full control over the amount of monetary base B. As B is limited, at some point, the non-banks are not willing to lend more funds to the banking sector, independently of the banks willingness to pay for additional funds. In this situation, only the central bank could increase the available funds by increasing the monetary base.

2.4 Graphical illustration

Figure 1 shows a graphical representation of the model. The intercept of credit demand and credit supply on the credit market determines the optimal credit volume. Due to the multiplier relation of 1, the optimal credit volume equals the optimal amount of high powered money, the banking system needs, to provide the credit. In the model by Bofinger and Schächter (1995) the central bank chooses a refinancing rate at which it is willing to provide the amount of monetary base, the commercial banks demand. However, in the "$Vollgeld$"-system, there are multiple supplier of monetary base. Thus, the intersection of demand for and supply of monetary base determines the amount of monetary base available to the banking sector at the price i_R. This again influences the credit supply of banks. As we will see in the next section, this feedback effect from the market of high-powered money to the credit market might result in higher interest rate volatility due to the introduction of "$Vollgeld$".

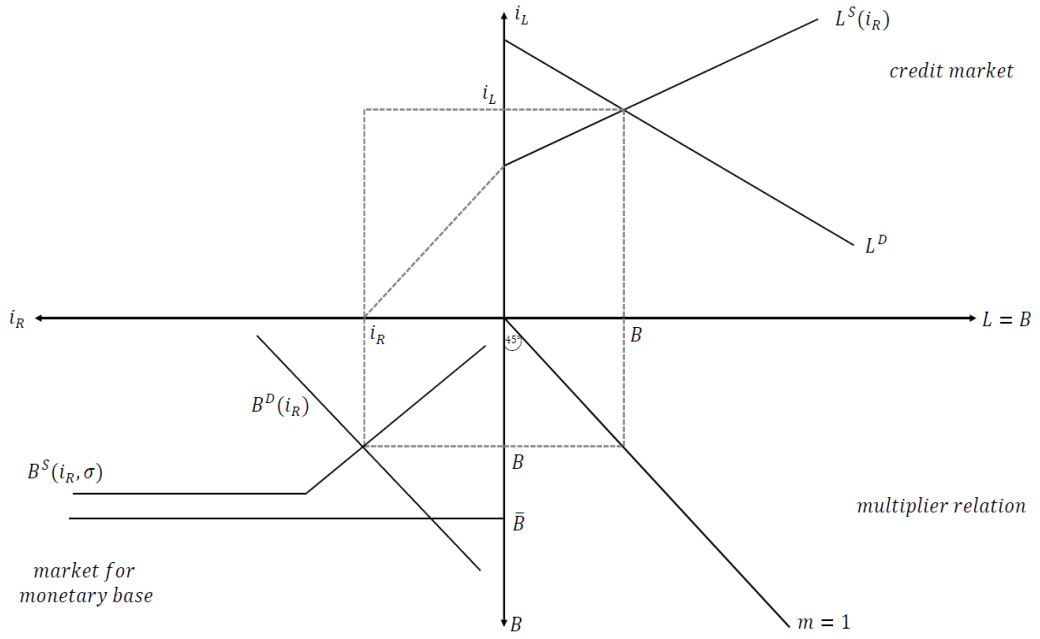

Figure 1: The complete model

3 Effects of implementing a "Vollgeld"-system

Due to the introduction of "*Vollgeld*", our model diverges from the original model by Bofinger and Schächter (1995) and Bofinger (2001) as more shocks can occur that might destabilize the economy. Similar to the original model, shocks can occur on the credit market, shifting the credit demand and credit supply curve upwards or downwards. However, due to the implementation of the "*Vollgeld*"-system, there might additionally be shocks on the market for monetary base.

Credit demand shock

We assume the economy is hit by a positive credit demand shock. As can be seen in Figure 2, this shock shifts the L_D curve upwards to L_D^1. The increased credit demand leads to an increase in demand for high-powered money, shifting the demand curve for monetary base to the left. Usually, the banking sector only lends monetary base on the money market from the central bank, which would accommodate the supply to meet the increased demand of banks. In that case, the refinancing rate i_R would remain constant (Point B). However, in the "*Vollgeld*"-system, the banking sector can lend

monetary base not only from the central bank, but also from the public and private sector. Assuming, the central bank would not increase their loans to the banking sector, the rise in demand for monetary base would result in a higher price for monetary base. The new intercept in the market for monetary base lies in point B^1 / i_R^1 (Point C) and thus below the new optimum credit volume and above the initial refinancing rate i_R^0. As we assume that banks are profit maximizing, this higher price for monetary base results in an upwards shift of the credit supply curve. In this point the model is again in equilibrium. However, as should be noted, the cost for credit are higher due to the higher refinancing costs and the credit volume is below the optimum volume after the demand shock.

Of course the central bank could create new money or provide the banks with loans. This would shift the monetary base supply curve downwards, to the optimum point of B^1 / i_R^0 and it would prevent the system of rising interest rate volatility. However, if the central bank would adjust the supply of monetary base constantly to avoid the rise in interest rates, the change towards the "*Vollgeld*"-system might be redundant.

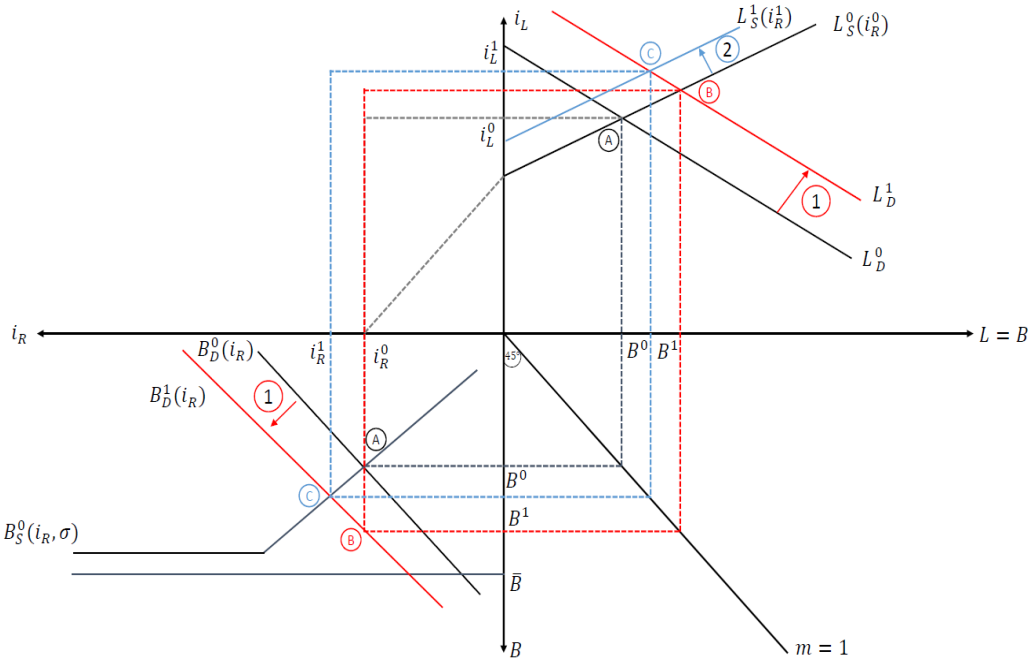

Figure 2: Credit demand shock

Credit Supply Shock

Another possible shock would be a credit supply shock to the model as is shown in Figure 3. We assume the parameter β rises, meaning the credit default probability increased. This results in an increased slope of the credit supply curve, implying that banks are more careful in providing credit. The new intercept on the credit market would be at a lower credit volume at higher credit cost (Point B). This shift in the slope of credit supply in the credit market results in an upwards shift of high-powered money demand. As the overall monetary base in the economy is not affected by the decrease in credit volume, the new intercept on the market for monetary base is in point B^1 / i_R^1 (Point C), i.e. the financing costs for banks decreased. The feedback effect on the credit market is a downwards shift of the supply curve due to the cheaper liquidity. Thus, although the banks perceive a higher credit default probability, the cheap liquidity of monetary base increases their profit margin and allows for expanding their credit business. To compensate for the cheaper monetary base, the central bank would have to decrease the amount of monetary base in the economy, i.e. engage in a restrictive monetary policy. As Bacchetta (2017) points out, reducing the monetary base might not be possible or would make monetary policy very costly under a "$Vollgeld$"-system.

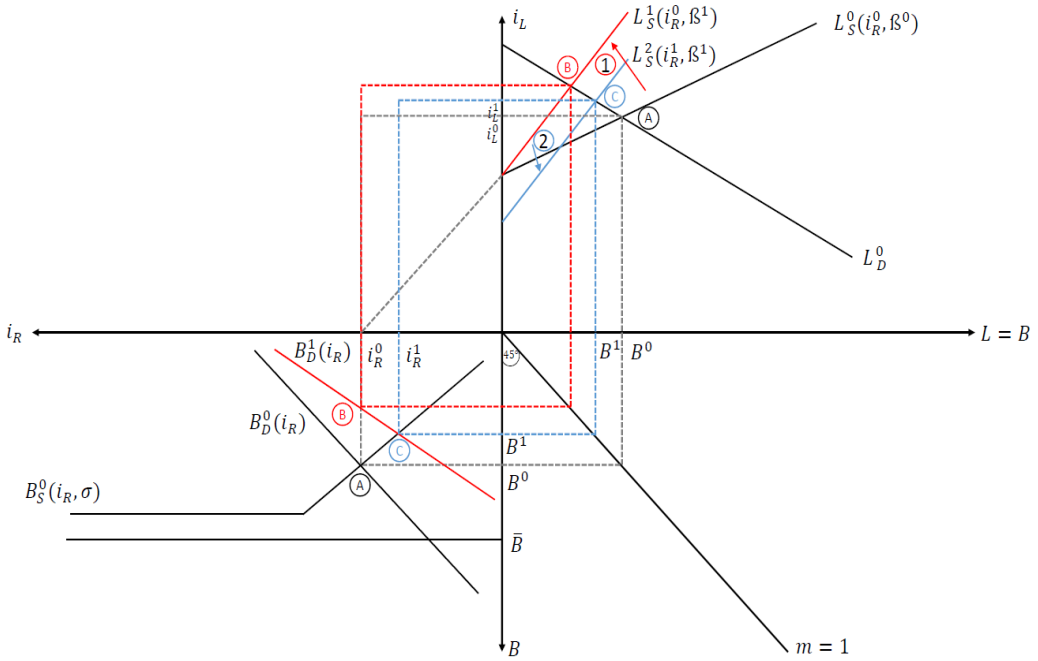

Figure 3: Credit supply shock

Shock in supply of high-powered money

Finally, Figure 4 shows the impact of a shock in the supply of high-powered money. We assume, non-banks perceive a higher risk in lending to banks, i.e. parameter σ rises. This leads to a steeper slope of the supply curve for monetary base. The available monetary base remains constant. The new intercept of high-powered money supply and demand is in point i^1_R and B^1 (Point B), where the financing costs for banks, i^1_R, are higher than before. As banks are assumed to maximize their profits, they pass these higher costs on to the credit market. This results in an upwards shift of the credit supply curve. The new intercept of credit demand and credit supply lies thus in a point of lower credit volume B^1 at higher credit costs i^1_L. To compensate for the rising interest rates, the central bank has to adjust the monetary base according to the willingness of the non-banking sector to lend to the banking sector.

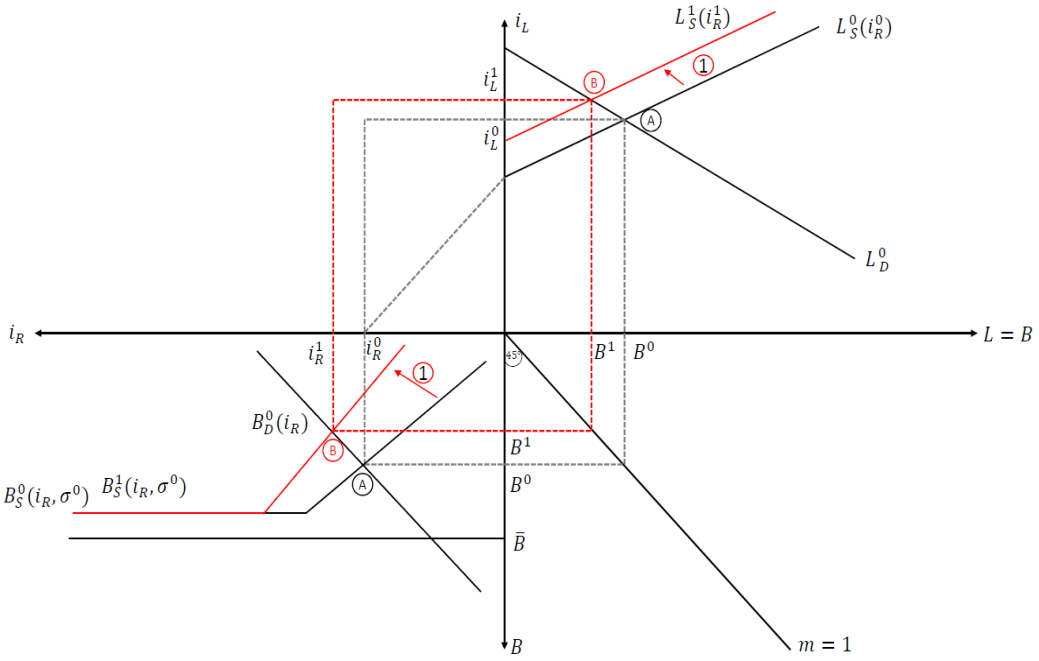

Figure 4: High-powered money supply shock

4 Conclusion

In this paper, we present a price-theoretic model for the money supply under a "*Vollgeld*"-system. Banks are assumed to operate profit-maximizing and provide credit to non-banks. Due to the introduction of "*Vollgeld*", they are no longer able to create money by providing credit, but are merely intermediaries of funds, which they had to collect before they can pass them on as loans to non-banks. The central bank is the only institution that can create new money. However, the banking system can lend monetary base on the money market not only from the central bank but also from the public and private sector. This change results in a new supply curve on the market for high-powered money, that is dependent on the financing rate i_R. Thus, compared to the situation without "*Vollgeld*", a higher degree of instability is possible, as shocks might not only occur on the credit market but also on the market for monetary base. If the central bank would not react to these shocks and leave the monetary base constant or increases it every year evenly with GDP growth, shocks in the demand or supply of credit as well as shocks in the supply of monetary base can lead to high level of interest rate volatility. This interest rate instability has severe implications for the profitability of banks and the exchange rate. The instability could result in

a destabilization of the Swiss franc. These exchange rate risks might be especially significant for small open economies and financially open economies like Switzerland. But even if the central bank would try to react to these shocks by adjusting the money supply, it is not clear whether the strategy of monetary targeting would be feasible, as has been pointed out for example by Bacchetta (2017). Higher volatility in the financing costs for banks and credit costs for non-banks as well as potential competition among banks for monetary base might damage especially those banks, which are largely dependent on their credit business. As Birchler and Rochet (2017) point out, these are mainly regional banks or cooperative banks like Raiffeisenbank in Switzerland. Werner (2013) shows, that these small-scale banks have a stabilizing influence on the economy and are vital for sustainable growth, as they lend predominantly to households and small and medium-sized enterprises. As he describes, Germany avoided major asset bubbles as the banking sector consists mainly of these small banks.

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