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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: (44 20) 7183 8801
www.cepr.org

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MONEY DEMAND UNDER FREE BANKING: SWITZERLAND 1851-1906†

Abstract
This paper studies money demand in Switzerland under free banking before the establishment of the Swiss National Bank. We find that, in addition to income and the interest rate of savings deposits, the number of banks was an important determinant of long run money demand. It also played a role in the monetary adjustment process. We also detect a strong positive long run impact of real income and the interest rate spread on the number of banks. Moreover, positive deviation of the number of banks from long run equilibrium leads to a decrease in the money stock and leads to a fall in interest rates and an increase in real income.

JEL Classification: E41, E42 and N13
Keywords: free banking, monetary dynamics, money demand and switzerland

Stefan Gerlach  hms.gerlach@gmail.com
CEPR

Peter Kugler  peter.kugler@unibas.ch
WWZ, University of Basel

† Much of the work on this paper was completed in 2011 when Gerlach was Managing Director of the IMFS at the Goethe University in Frankfurt, Germany.
1. Introduction

Before the foundation of Swiss National Bank in 1907, banknotes were issued by private banks in Switzerland. Thus all components of M1, except coins, were issues by private banks under a regime of free banking. Under such circumstances, an increase in the money supply may occur at the extensive margin through an increase in the number of banks or at the intensive margin through an increase in the money supply by existing banks. In this paper we explore the implications of this distinction for monetary developments in Switzerland from 1851 to 1906.

There are two reasons for why this is an interesting exercise. First, an increase in the number of bank has a direct effect on money demand as banknotes and sight deposits become more attractive by increased bank coverage of a country. One would thus expect that the growing number of banks increased the demand for money. Whether or not this is so is an empirical question that, as far as we know, has not yet been studied in the literature.

Second, Baltensperger and Kugler (2015, Chapter III.2) estimate money demand function for Switzerland before WW I and report a point estimate of 1.62 for the income elasticity. After the WW1, however, the income elasticity is not significantly different from 1 and exhibits an impressive stability over time. Since the growth of the banking system, which ended in the 1880s, occurred in a period of strong income growth, one obvious possibility is that high income elasticity estimated by Balternsperger and Kugler (2015, Chapter III.2) results from the fact that they do not incorporate the growth of the banking system in their analysis. As a consequence, its importance for money demand is instead attributed to income growth.

The paper is organized as follows: Section 2 gives a brief account of the development of free banking after the creation of the Swiss Franc in 1850 to the creation of Swiss National Bank during the years 1905-07. This period started with nearly unregulated competition in banknote issue , but the harmonization of privately issued banknotes required by federal banking law of 1881 undermined this system and finally led to the creation of SNB. Section 3 then considers a long run model of money demand in which we taking account explicitly of the number of banks. This leads to a model with three cointegrating relations, in which the number of banks depends on real income and the spread between the interest rates for mortgage loans and saving deposits which is also governed by a long run relationship. Our empirical results are reported in Section 4. The main finding is that the number of banks is an important variable in long run money demand as well as in the monetary adjustment process under free banking. Finally, Section 5 concludes.
2. Free banking in Switzerland 1850-1905/7

The components of M1 (coins, banknotes and sight deposits) were issued under different regimes before the foundation of Swiss National Bank.\(^1\) In 1850, Switzerland created the Swiss Franc as the national currency of the new federal state founded in 1848 with common coins. Switzerland stuck to a competitive solution for bank note issue until 1907, when the Swiss National Bank started operating. The authorization of banks and their regulation remained with the cantons and differed widely. Nevertheless, a crucial break took place in 1881, when the previously unregulated regime of competition in banknote issue was followed by the heavily regulated regime of the new Federal Banknote Act. As far as the creation of money in the form of bank deposits is concerned, Switzerland, like virtually all other countries, has stayed with a competitive system until today.

The monetary reform of 1850 brought an important change. After its introduction, the Swiss Franc established itself without problems and quickly as the new federal state’s national currency. Legally, Swiss banks were still allowed to issue notes denominated in foreign currencies. A few banks did make use of this possibility for some time, in addition to issuing notes in Swiss Francs. However, with the Swiss Franc now firmly established as the dominant national currency, the demand for foreign currency notes more or less vanished; in consequence, the practice was soon terminated.

The period from 1850 to 1881 thus can be characterized as a period of free, unregulated note issue competition, but now with a common, dominant currency, the Swiss Franc. The authority to license and regulate banks still belonged to the cantons as no federal restrictions existed before 1881. The cantons were liberal in permitting new banks and in regulating their business. As a consequence, a large number of note issuing banks competing with each other entered the market, some private and some public, the latter in the form of cantonal banks established by the cantons themselves. In 1880, no less than 36 note issuing banks existed.\(^2\) The cantonal banks were not granted a monopoly or other privileges by their cantons, so the note issue business remained highly competitive.

This system was successful in the sense that it provided banknotes with stable purchasing power while (almost) avoiding financial turbulence and bank failures (Weber, 1988 and 1992).\(^3\) The issue

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\(^1\) This Section summarizes the analysis of Baltensperger and Kugler (2015, Chapter III.1).
\(^2\) Jöhr (1915) presents a comprehensive list of all Swiss note issuing banks between 1825 and 1906; see Table III.3.
\(^3\) Switzerland was not totally exempt from banking problems in this period, though. However, these problems had little to do with banks’ note issue business. In 1870, the Banque Cantonale du Valais failed as a result of the financing of public (cantonal) deficits and bad investments (causing a political scandal involving the
of banknotes involved considerable costs: production (printing) costs, personnel costs of bank counter service and – particularly important – the costs of the metal reserves necessary for reasons of confidence and trust, and the costs of banknote clearing. Note clearing was a central element of concern: the demand for banknotes was dependent on their acceptance at full value which led the formation of clearing networks including entire groups of banks. For all these reasons, banks’ note issue business remained small and of limited importance throughout most of this period. Complaints about the complicated nature and the inefficiency of the payments system remained frequent. Several authors, e.g. Jöhr (1915) or Ritzmann (1973), stressed this state of dissatisfaction and the inefficiencies causing it and thus came, in contrast to Weber, to a negative assessment of note issue competition in this period. The Federal Banknote Act of 1881, introducing common standards of quality in banknote issue, was the result of these perceived inefficiencies.

The period from 1881 to 1905 can be characterized as a period of strictly limited banking freedom: a system with now legally prescribed currency denomination for banknotes and a heavily regulated and harmonized note issue business, but still without a centralized government monopoly in note issue. Banks were severely constrained with regard to their liquidity reserves, their equity capital, their banknote redemption and their issuing policies. The regulatory standardization and mutual acceptance of notes issued by different banks improved the efficiency of the money and payments system. These conditions, however, undermined competition as it introduced an externality creating incentive to an over-issue of banknotes leading to a tendency towards monetary and currency weakness – a state of affairs which would ultimately lead to full nationalization of banknote issue and the foundation of the Swiss National Bank. In 1891 a revision of the constitution was accepted by the voters which introduced the exclusive right of the Confederation to issue banknotes. Conflicts about the legal form of the central bank and the location of its headquarter implied that the Federal Act on the Swiss National Bank came into effect only 14 years later in October 1905. The SNB started its operation in June 1907.

Figure 1 depicts the development of the shares of coins, banknotes and sight deposits in M1 over the period 1851-1906. This Figure shows that Switzerland was a “coin economy” at the time of the introduction of the Swiss Franc: approximately 87% of M1 were coins in 1851 and the remaining 13% were shared equally by banknotes and sight deposits. In the following years we observe a resignation of several cantonal government members). The Banque Générale Suisse, founded 1853 in Geneva after the model of the French Crédit Mobilier, had to suspend payments in 1859 and was liquidated in 1869. The Eidgenössische Bank, founded 1864 in Berne, had to be restructured by the end of the 1870s.

4 This weakness of the Swiss Franc, in particular against the French Franc, with relatively high and positive deviations from metallic parity is documented by Baltensperger and Kugler (2015a).
trend decline (increase) in the roles of coin (sight deposits) resulting in shares of 7% and 74% in 1906, respectively. By contrast, the development of the banknote share is less monotonic: it experienced a strong increase in the 1870s, in the aftermath of the liquidity crisis triggered by the inconvertibility of the French Franc during the Prussian-French war. It increased again after the switch to federal regulation of banknote issue (in 1881) and reached a peak of 30% in 1891. This illustrates the incentives to over-issue for banks as mentioned above. The weakness of the Swiss Franc at the foreign exchange market and the associated loss of monetary metal and increasing costs of banknote issue led to a decline of the banknote share to 19% in 1906.

*** Figure 1 here ***

3. A SIMPLE MODEL OF MONEY DEMAND UNDER FREE BANKING

Let $m_t$, $y_t$, $p_t$, $nb_t$, $rs_t$, $rm_t$ denote the logarithm of M1, real income, the price level, and the level of the interest rates on saving deposits and mortgage lending, respectively. The two interest rates were selected as they are the only relevant rates which are consistently available for our sample period. We start with a modified money demand function that includes the number of banks as an additional demand factor. Omitting the intercept term, we have:

$$ m_t = b_{15}p_t + b_{14}y_t + b_{12}nb_t + b_{16}rs_t + u_{1t}, $$

where $u_{1t}$ is a stationary and auto-correlated deviation from long run money demand, and where all parameters are expected to be positive except the interest rate semi-elasticity, $b_{16}$.

The number of banks is considered an endogenous variable and depends positively on real income as an indicator of economic activity and the spread between the credit and the saving rates as an indicator for the profitability of banking. Omitting the constant, we have:

$$ nb_t = b_{24}y_t + b_{23}(rm_t - rs_t) + u_{2t}, $$

where $u_{2t}$ is a stationary and auto-correlated deviation from long run equilibrium, and where all parameters are expected to be positive.

Moreover, we add long run relationship between the two interest rates:

$$ rm_t = b_{36}rs_t + u_{3t}. $$

If $b_{36}$ is different from 1, the interest rate spread is nonstationary and two non-cointegrated I(1) variables enter equation (2).
This simple model immediately shows the effect of estimating a standard money demand function omitting the number of banks: the positive correlation of number of banks with real income leads to a positive bias of the estimate of the income elasticity of money demand. Below we explore if the high income elasticity estimated of Baltensperger and Kugler (2015, Chapter III.1) arises for this reason.

4. **Empirical Results**

4.1 **Unit root and cointegration properties**

In this section we show the annual data for our analysis and provide the unit root analysis for the Swiss money stock M1, nominal income (GDP), price level (consumption deflator), number of banks the savings interest rate and the interest rate on mortgages, the only bank credit interest rate which is available for the 19th century. Note that all variables except interest rates are in logs and are multiplied by 100 (so that their first differences can be thought of as percent changes). Moreover, because of lack of real GDP data for the entire period we have to consider nominal GDP and use the consumption deflator in order to obtain data on real GDP for model estimation. The series are plotted in Figure 1.

*** Figure 2 here ***

All variables except interest rates have an obvious trend. Therefore, we run unit root and stationarity tests including a deterministic trend for log M1, log GDP, log consumption deflator and log number of banks. Table 1 contains the results of the Phillips-Perron unit root test and Kwiatkowski-Phillips-Schmidt-Shin stationarity test.

*** Table 1 here ***

Overall Table 1 indicates that the series are I(1) even if we get mixed results for two series. In four cases (M1, number of banks and interest rates) the unit root hypothesis cannot be rejected at the 10% level and the stationarity hypothesis is always rejected at the 5% level. For nominal GDP neither the unit root nor the stationarity hypothesis can be rejected at standard significance levels and the data are inconclusive. For the consumption deflator we reject the unit root hypothesis on the 10% level and the stationarity hypothesis at the 5% level.
The results of Johansen’s multivariate cointegration analysis are reported in Table 2. The reported trace test indicates three cointegrating relationships. Besides the equations for money demand and number of banks, we expect a long run relationship between the two interest rates. In addition, for the estimation of the system we restrict the price and income elasticities of money demand to unity. These restrictions appear to be consistent with the data as the unrestricted estimate of the nominal income elasticity of money demand is 1.19 with a standard error of 0.12. Therefore, the 1.62 point estimate of Baltensperger and Kugler appears to be positively biased by the omission of the number of banks in the money demand equation. Moreover, all coefficients have the expected sign and are highly significant. We note a strong positive impact of the number of banks on money demand (the estimated elasticity is 0.81) as well as of the interest spread and real income on the number of banks. The change in the mortgage rate is estimated to be roughly 1.65 times that of the savings rate in the long run.

*** Table 2 here ***

4.2 EC Model Estimates

In this section we first present the estimates of the standard EC-model in equation (2).

*** Table 3 here ***

Table 3 shows estimates which have mostly the expected sign, in particular when they are statistically significant. We see that an excess money stock (deviation from long run money demand) is corrected by a decline in the mortgage rate real income and in interest rates. A positive deviation of the number of banks from long run equilibrium corrects itself gradually (4.4% per annum), by a decrease in the money stock (12% per annum) and leads to a fall in interest rates and an increase in real income. Interestingly, “too many banks” has a negative effect on the price level. Finally, a too high mortgage rate corrects itself quickly (53% per annum) and leads to a temporary increase in real income and a temporary fall in the price level. The saving rate shows a positive reaction to lagged changes in the number of banks in the first difference terms (not reported in Table 3).

In sum, our results indicate an important role of the number of banks as determinant of the long run money demand as well as in the monetary adjustment process under free banking. First, we

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5 The Akaike criterion as well as a sequential likelihood ratio test indicates that a lag length of 2 is optimal for the level system and correspondingly 1 for the EC system, whereas the Schwarz and Hannan-Quinn criterion indicate a value of 1 (0) for the level (EC) system. As some of the first difference terms are highly significant we adopted the former lag length.
found a highly statistically and economically significant positive effect of the number of banks on money demand in addition to those of income and the interest rate. Second, four of our six variables react statistically significantly to a disequilibrium with respect to the number of banks. Moreover, the adjusted $R^2$ is clearly the highest for the EC equation for the number of banks (0.49) indicating a strong and highly significant reaction of the number of banks to changes in the other variables.

Finally, we checked the stability over time of our model. The obvious reason for such an analysis is the fundamental institutional and regulatory change for the banknote issue business by the Federal banking act of 1881 which could have changed monetary dynamics. To this end we first estimated the cointegration coefficients using a regression approach, namely Fully Modified Ordinary Least Squares. By this approach we avoid a potential bias of the cointegration estimates obtained by the Johansen’s EC systems approach caused by a possible structural break in the adjustment process. Second, we estimated the corresponding EC equations and tested for structural breaks.

Table 4 reports the results of the Chow and the Quandt-Andrews stability tests for the six EC equations as well as the FMOLS cointegration coefficient estimates which were used to calculate the three EC terms. The latter are mostly relatively close to those reported in Table 2 the main exception being the interest semi-elasticity of money demand which is now substantially lower in absolute value (approximately 37.9 compared to 101). The resulting EC equations estimates are close to those reported in Table 3 and are not displayed here. For most EC equations the Chow test with break date 1881 points to no structural break: only for the two interest rates we can reject the null hypothesis of stability at the 5% level. This finding is confirmed by the Andrews-Quandt test with an unknown break date: for all equations except the two interest rates no significant break can be found. In the latter cases the maximum F-statistics indicates a break in 1882 for the mortgage rate and the savings rate at the 5% and 10% level, respectively. Thus we have only a very weak indication of instability of the EC equations and we can rely on the results shown in Tables 2 and 3.

5. Conclusions

In this paper we have studied the demand for money in Switzerland before the establishment of the Swiss National Bank, which started operations in 1907. We draw two main conclusions.

First, the money stock M1, the number of banks, the mortgage rate, real income, the price level as well as the saving rate are connected by three cointegrating relations. Besides nominal income (with unit elasticity) and the savings rate, the number of banks enters the equations for long run money demand with an estimated elasticity of 0.81. Moreover, we note a strong positive long run impact of
real income (elasticity estimate is 0.79) and the interest rate spread (mortgage minus savings) on
the number of banks. The change in the mortgage rate is indicated to be roughly 1.65 times that of
the savings rate in the long run.

Second, the Error Correction estimates show that an excess money stock (deviation from long run
money demand) is corrected by a decline in the mortgage rate, real income and in interest rates. A
positive deviation of the number of banks from long run equilibrium corrects itself gradually, by a
decrease in the money stock and leads to a fall in interest rates and an increase in real income.
Finally, a too high mortgage rate corrects itself quickly and leads to a temporary increase in real
income and a temporary fall in the price level. Moreover, it structural break tests indicate that
monetary dynamics was not strongly affected by the Federal Banking Law of 1881 which changed
the institutional framework for banknote issue considerably. In sum, our empirical analysis of the
Swiss experience with free banking in the 19th century points to an important role of the number of
banks as determinant of the long run money demand as well as in the monetary adjustment process
under free banking in a developing economy.
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Table 1: Unit Root and Stationarity Tests, 1851-1906

| Series                      | PP    | PP with trend | KPSS   | KPSS with trend |
|-----------------------------|-------|---------------|--------|-----------------|
| Log M1                      | -1.631|               | 0.182**|                 |
| Log consumption deflator    | -3.124*|              | 0.148**|                 |
| Log GDP                     | -2.960|               | 0.118  |                 |
| Log number of banks         | -2.991|               | 0.238***|                |
| Savings rate                | -1.109|               | 0.551**|                 |
| Mortgage rate               | -1.024|               | 0.554**|                 |

Notes: Lag length for the nonparametric autocorrelation correction selected automatically according to Newey-West and Bartlett kernel. *, **, *** indicates significance at the 10, 5 and 1% level, respectively.

Table 2: Cointegration Test and Estimates, M1, Real Income, Price level, Interest Rates and Number of Banks, Switzerland, 1851-1906

\[
m_t = b_{14}y_t + b_{15}p_t + b_{16}rs + b_{13}nb_t + u_{1t}
\]
\[
nb_t = b_{24}y_t + b_{22}(rm_t - rs_t) + u_{2t}
\]
\[
rm_t = b_{36}rs + u_{3t}
\]

| equation | \(b_{i2}\)       | \(b_{i3}\)       | \(b_{i4}\)       | \(b_{i5}\)       | \(b_{i6}\)       | Johansen Test |
|----------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| i=1      |                   | 0.8101*** (0.1125)| 1                 | 1                 | -100.5699*** (16.7196)| 120.4056*** (r=0) |
| i=2      | 148.0361*** (20.9883)| 0.7881*** (0.1071)|                   |                   |                   | 80.5328*** (r<=1) |
| i=3      |                   |                   | 1                 |                   | 1.6482*** (0.07796) | 45.1695*r<=2   |

Standard errors in parenthesis; *, **, *** indicates significance at the 10, 5 and 1% level, respectively.
Table 3: EC Model Estimates M1, Real Income, Price level, Interest Rates and Number of Banks, Switzerland, 1851-1906

\[ \Delta x'_t = (\Delta m_t, \Delta nb_t, \Delta rm_t, \Delta y_t, \Delta p_t, \Delta rs_t) \]

\[ \Delta x_{it} = \gamma_{i1} u_{i1t-1} + \gamma_{i2} u_{i2t-1} + \gamma_{i3} u_{i3t-1} + \sum_{j=1}^{6} c_{ij} \Delta x_{jt-1} + \varepsilon_{it}, \quad i = 1,2, \ldots 6 \]

| i | \( \gamma_{i1} \) | \( \gamma_{i2} \) | \( \gamma_{i3} \) | Adj R\(^2\), | se |
|---|-----------------|-----------------|-----------------|--------------|-----|
| 1 | -0.06418 \( (0.0555) \) | -0.1185** \( (0.0533) \) | -12.6482 \( (10,0871) \) | 0.03767 | 3.6028 |
| 2 | -0.0032 \( (0.0226) \) | -0.04357** \( (0.02809) \) | -6.2763 \( (4,1056) \) | 0.4878 | 1.4664 |
| 3 | -0.0045*** \( (0.0013) \) | -0.00075** \( (0.0012) \) | -0.5302** \( (0.2291) \) | 0.3023 | 0.08182 |
| 4 | 0.1000 \( (0.0881) \) | 0.2004** \( (0.0846) \) | 34.2238** \( (16,0071) \) | 0.1262 | 5.7173 |
| 5 | -0.0971 \( (0.0644) \) | -0.1242** \( (0.0619) \) | -24.4909** \( (13,7319) \) | 0.0527 | 4.1825 |
| 6 | -0.001043 \( (0.00080) \) | -0.00086 \( (0.00088) \) | 0.1790 \( (0.1655) \) | 0.3143 | 0.05912 |

Note: Standard errors are given in parentheses.
Table 4: Stability tests for the single EC Equations 1851-1906

\[ \Delta x'_t = (\Delta m_t, \Delta nb_t, \Delta rm_t, \Delta y_t, \Delta p_t, \Delta rs_t) \]

\[ \Delta x_{it} = \gamma_{i1}u_{1t-1} + \gamma_{i2}u_{2t-1} + \gamma_{i3}u_{3t-1} + \sum_{j=1}^6 c_{ij}\Delta x_{jt-1} + \epsilon_{it}, \quad i = 1, 2, \ldots, 6 \]

| i | Chow F-Statistics 1881 | Quandt-Andrews Maximum F-statistics | Break year Q-A Test |
|---|------------------------|-------------------------------------|---------------------|
| 1 | 1.1715                 | 1.3430                              | 1874                |
| 2 | 1.3052                 | 1.9802                              | 1877                |
| 3 | 2.3206**               | 2.4857**                            | 1882                |
| 4 | 0.5430                 | 0.5996                              | 1877                |
| 5 | 0.7104                 | 1.6875                              | 1872                |
| 6 | 2.3199**               | 2.4064*                             | 1882                |

*, **, *** indicates significance at the 10, 5 and 1% level, respectively.

FMOLS regression estimates 1851-1906, standard errors in parentheses

| equation | \( b_{i2} \) | \( b_{i3} \) | \( b_{i4} \) | \( b_{i5} \) | \( b_{i6} \) |
|----------|--------------|--------------|--------------|--------------|--------------|
| i=1      |              | 0.7326***    | 1            | 1            | -37.8630***  |
| i=2      | 89.7064***   | (20.9883)    | 0.7479***    | (0.09466)    | (8.5956)     |
| i=3      |              |              | 1            |              | 1.4003***    |
|          |              |              |              |              | (0.06204)    |
Figure 1. The Composition of M1 in Switzerland 1851-1906

Data source: Swiss economic and social history data base: M1 1851-1907 (Table Q3),
http://www.fsw.uzh.ch/hstat/nls_rev/overview.php
Figure 2: Data Series Swiss Money Demand Estimation, 1851 - 1906

Data source: Swiss economic and social history data base: M1 (Table Q3), GDP (Table Q16a,b), number of banks (Q8) and consumption deflator (H17); http://www.fsw.uzh.ch/hstat/nls_rev/overview.php. SNB historical series: saving deposit and mortgage interest rates, 2.4.3 http://www.snb.ch/de/iabout/stat/statpub/histz/id/statpub_histz_actual