The historical origins of the safe haven status of the Swiss franc[1]

Ernst Baltensperger and Peter Kugler
University of Berne; University of Basel

An empirical analysis of international interest rates and of the behavior of the exchange rate of the Swiss franc since 1850 leads to the conclusion that World War I marks the origin of the strong currency and safe haven status of the Swiss franc. Before World War I, interest rates point to a weakness of the Swiss currency against the pound, the guilder and French franc (from 1881 to 1913) that is shared with the German mark. Thereafter, we see the pattern of the Swiss interest rate island develop and become especially pronounced during the Bretton Woods years. Deviations from metallic parities confirm these findings. For the period after World War I, we establish a strong and stable real and nominal trend appreciation against the pound and the dollar that reflects, to a sizeable extent, inflation differentials.

JEL codes: N23
Key words: Swiss franc, safe haven, Swiss interest island, deviation from metallic parity, real and nominal appreciation

1 Introduction

The Swiss franc is commonly considered a “strong” currency that serves as a “safe haven” in crisis periods. This raises the question of when the Swiss franc took on this property. Is it associated with the flexible exchange rate regime in place since 1973, or was it already in existence before then? Was the Swiss franc a “weak” currency even in the first decades after its creation in 1850?

In order to analyze these questions, we need a definition of a strong currency and its properties. However, there is no generally accepted definition of currency “strength”, only some characteristics commonly associated with it. The strength of a currency is related to its stability and its functioning as a reliable store of value. In a metallic monetary standard, this means that metallic parity is firmly maintained and does not change according to fiscal needs. First, then, this characteristic should be manifested in relatively low nominal and real interest rates, as investors are willing to accept a lower return on strong currency assets. Second, the mean deviations of exchange rates from metallic parities provide a measure of the relative strength of a currency. Weak currencies should be undervalued relative to the metallic parity against strong ones. Such a discount compensates the buyer of a “weak” currency for the risk of a suspension of

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metallic convertibility or a change in metallic content. Under a paper standard and flexible exchange rates, currency strength cannot be assessed as outlined above. International comparison of asset returns should then rely on interest rates adjusted for exchange rate changes, and the nominal and real appreciation trend of the exchange rate against other currencies has to be considered.

We should mention here that we follow an indirect approach to exploring the safe haven status of the Swiss franc. Indeed, currency strength is a necessary but not a sufficient condition for the status of a safe haven, which also requires a financial sector offering assets for investors looking for safety. However, the two conditions are related – a strong currency offers incentives for financial sector development, as witnessed by Switzerland during the 20th century. When high frequency data are available, we can test for safe haven status directly by analyzing exchange rate dynamics for crisis and non-crisis periods and checking the conjecture of a strong appreciation of safe haven currencies in crises (Ronaldo and Söderlind, 2010). This approach will not be followed here as we have no high frequency data for the crucial period before World War I.

Our paper is an extension of the work of Kugler and Weder di Mauro on the "Swiss interest rate island", the relatively low nominal and real Swiss interest rates. This phenomenon could be attributed to a relatively low inflation rate and exchange rate appreciation in the recent floating rate period since 1973. However, the econometric analysis of Kugler and Weder di Mauro provides evidence that the inflation and exchange rate corrected level of Swiss interest rates was statistically significantly lower than in other countries. In other words, there is a systematic long-run deviation from uncovered interest rate parity for the Swiss franc. This property of the Swiss franc is explained by the exceptional political, economic and monetary stability of Switzerland, which leads investors to pay a premium for holding Swiss franc fixed-income assets (Kugler and Weder di Mauro, 2002, 2005). Moreover, the Swiss franc offers diversification benefits (a low correlation with other assets in other currencies) that further justify the lower return (Kugler and Weder di Mauro, 2004). These results immediately lead to the question of how Swiss interest rates behaved under the monetary systems of earlier periods, namely, Bretton Woods, the interwar gold exchange standard, the classical gold standard, and various metallic standards prior to 1880. *A priori*, the stability bonus may be expected since World War I, whereas the diversification benefit is less plausible for fixed exchange rate periods. So far we have only spotty evidence indicating that the period of low Swiss interest rates started after World War I (Kugler and Weder di Mauro, 2002). Prior to 1914, data suggest that in the late 19th and early 20th centuries interest rates in Switzerland were higher than in other gold standard countries (see also Bordo and James, 2007).

Moreover, the earlier papers did not consider the nominal and real appreciation of the exchange rates as an indicator of the strength of the Swiss franc.

The rest of this paper is organized as follows. Section 2 provides an empirical analysis of Swiss interest rates from 1837 to 1970 from an international perspective. Deviations from metallic parities of the exchange rate against five major currencies before World War I are considered in Section 3. In addition, we analyse the trend behaviour of the nominal and real exchange rate against the pound and the dollar since World War I. Section 4 concludes.

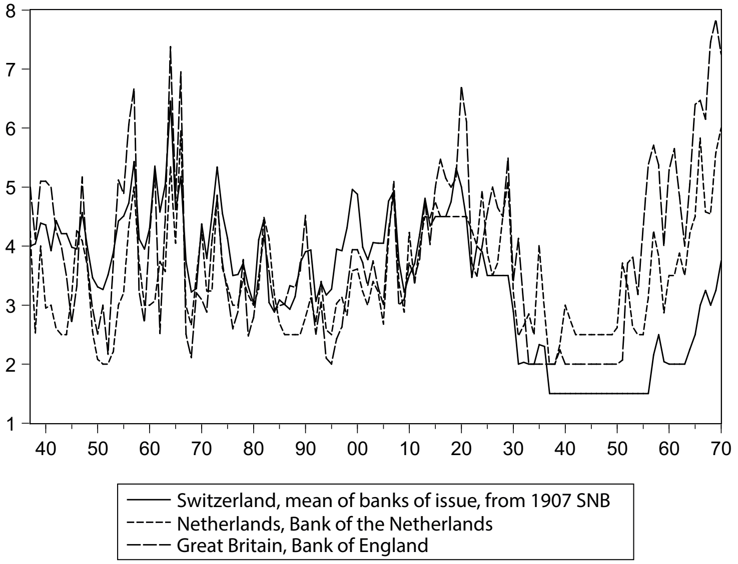
2 The "Swiss interest rate island", 1837–1970

In this section we provide an empirical analysis of the level of interest rates in Switzerland from an international perspective for the entire period of 1837 to 1970. These years are mostly characterized by fixed exchange rates of the Swiss franc; periods of flexible exchange rates in this era were considered as transitory episodes. In such a framework, the direct comparison of interest rates of different currencies is meaningful without exchange rate corrections. We consider Swiss interest rates in comparison to those in France, Germany, the Netherlands and Great Britain. These countries were economically and/or financially important for Switzerland during the period under consideration, and comparable interest rate data is available for them.

2.1 Discount rate data for Switzerland, France, Germany, the Netherlands and Great Britain

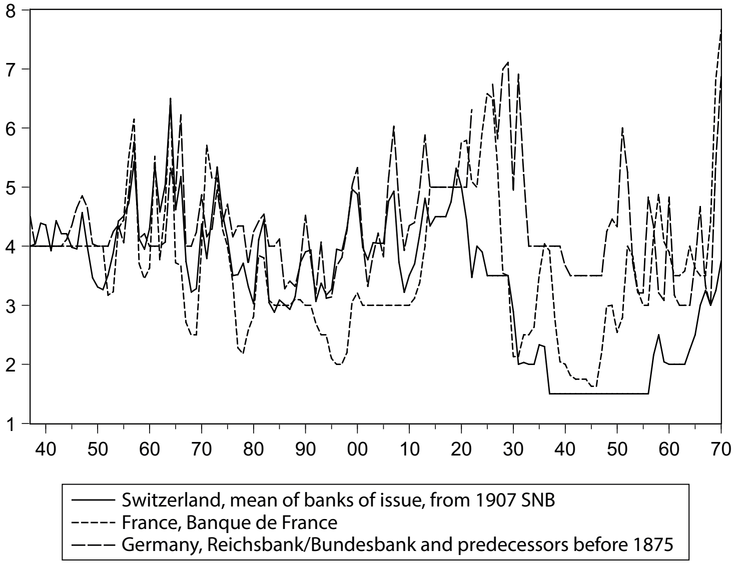
Our empirical analysis relies on discount rate data. This interest rate was the most important money market instrument for most of the period under consideration. Moreover, Homer and Sylla (2005) provide comparable annual (average) data for our five countries. For France, the Netherlands and Great Britain, the discount rate of the *de jure* or *de facto* central bank is reported. For Switzerland, the average rate of the banks of issue at four market places (Basel, Geneva, St. Gallen and Zürich) is taken up to the foundation of the SNB in 1907. For Germany, the same procedure is applied for the period before the foundation of the German Reichsbank in 1875. The data series are displayed in Figure 1 (Swiss, Dutch and British rate) and Figure 2 (Swiss, French and German rate), respectively.

Figure 1: Discount rates in Switzerland, the Netherlands and Great Britain, 1837–1970



Source: Homer and Sylla (2005), Tables 23, 27, 29, 33,34,61,63, 65, 69 and 71.

Figure 2: Discount rates in Switzerland, France and Germany, 1837–1970



Note: The interest rates for Germany from 1923-25 are omitted because of hyperinflation.

Source: Homer and Sylla (2005), Tables 23, 27, 29, 33,34,61,63, 65, 69, and 71.

A visual inspection of these data series suggests the following pattern. For the first 40 years of our sample, we note that the Swiss interest rate is higher than the Dutch and the British rates, lower than the German rate, and more or less at the same level as the French rate. This pattern changes around 1880 when we note a premium of Swiss interest rates over all other countries except Germany. World War I appears to trigger the transition to the "Swiss interest rate island", and from 1930 Swiss interest rates are always the lowest among the countries considered.[2]

Table 1 provides some descriptive statistics for the data series of Figures 1 and 2 and three sub-periods: 1837-1880, 1881-1913 and 1914-1970. Moreover, a simple ANOVA test for equality of means is reported.

Table 1: Descriptive statistics for discount rates in five countries, 1837–1970

Country	1837-1880		1881-1913		1914-1970	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Switzerland	4.19 (0.105)	0.697	3.81 (0.110)	0.626	2.56 (0.152)	1.149
France	3.97 (0.145)	0.965	2.96 (0.079)	0.423	3.78 (0.194)	1.463
Germany	4.36 (0.076)	0.504	4.17 (0.131)	0.748	4.45 (0.157)	1.157
Netherlands	3.38 (0.132)	0.875	3.28 (0.118)	0.678	3.58 (0.135)	1.012
Great Britain	3.95 (0.197)	1.306	3.40 (0.119)	0.683	4.01 (0.223)	1.726
ANOVA-Test	F(4,215) =	7.27***	F(4,160) =	17.67***	F(4,277) =	15.16***

Note: Standard errors of means in parentheses, *** indicates statistical significance at the 1% level.

First of all, we note that we can clearly reject the hypothesis of equality of the five interest rates in all sub-periods by the simple ANOVA test. However, the pattern of differences between the mean interest rates varies across the sub-periods. For the 1837- 1880 period, the difference is mainly created by the exceptionally low mean Dutch interest level of 3.38%. For all other countries, mean rates of approximately 4% are reported. Indeed, if we test for equality of means for Switzerland, France, Germany and Great Britain, we cannot reject the null hypothesis. This pattern changes during the classical gold standard. French

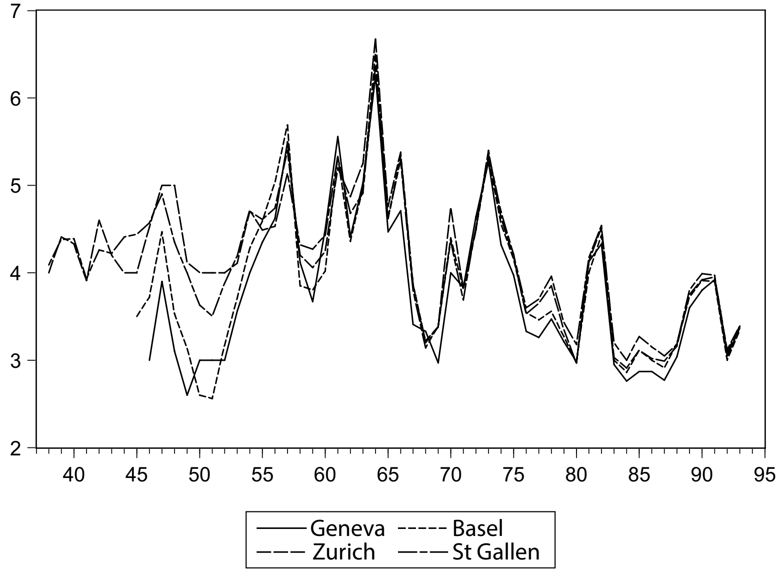
2 The US discount rate, which is not included in our analysis because of a lack of data for the 19th century, was slightly smaller than the Swiss one from 1935 to 1948 (Homer and Sylla, 2005, pp. 565-568).

and British discount rates converge to the low Dutch level of the previous subperiod and are now close to 3%, whereas the Swiss and German rates are only marginally reduced. After the breakdown of the classical gold standard in 1914 and up to the end of the Bretton Woods period, we find the "Swiss interest island" pattern. The Swiss discount rate is reduced to a mean of 2.5%, whereas all other countries show means relatively close to 4%.

Therefore, Swiss interest rates were in no way exceptional for the period 1837-1880. Moreover, the introduction of the Swiss franc does not seem to have had a notable influence on interest rates. A sign of weakness of the Swiss franc is only represented by a relatively high interest rate compared to the older currencies with a longer history (the British pound, Dutch guilder and French franc) in the 1881 -1913 period. This characteristic is, however, shared with the mark created after German unification in 1871. Thus, the data suggest a "new currency" interest rate premium during the classical gold standard. Moreover, the overissuance of banknotes by competing private and cantonal banks under the strong homogenization requirements of the 1881 federal banking law, which effectively removed the preconditions for competition in bank note issuance, contributed to the weakness of the Swiss franc during this period (Baltensperger, 2012, pp. 103-109).

The introduction of the Swiss franc did not have a notable average interest level effect. However, it appears that it contributed to a convergence of interest rates in the local markets in Basel, Geneva, St. Gallen and Zürich, as evidenced in Figure 3. We see a strong regional variation of discount rates in the 1840s. These gaps are closed in the 1850s, and from 1855 onwards we note only very small differences between the discount rates in the different locations. Of course, the second half of the 19th century witnessed the information and transport revolution (telegraphy, railways, and steamships), which lead to a higher degree of goods and financial market integration worldwide. The timing of interest rate convergence in Switzerland within five years of the introduction of the Swiss franc, as displayed in Figure 3, suggests that these trends towards more market integration were not the primary drivers of this convergence.

Figure 3: Discount rates in Basel, Geneva, St. Gallen and Zürich, 1837–1893



Source: SNB historical series 4, T1.1a (*http://www.snb.ch/de/iabout/stat/statpub/histz/id/statpub_histz_actua*l).

2.2 Econometric estimates of multiple breaks in international interest rate differentials of the Swiss franc

The empirical results presented in the preceding section are purely descriptive. Moreover, the sample splits were obtained by visual inspection. These results give some useful first indications, but have to be qualified by a more formal approach given the auto- and cross-correlation of the interest rate series considered. Moreover, even if we had mostly fixed exchange rates during our sample period, the transitory periods of floating exchange rates during the world wars and in the interwar years may have led to longer-lasting changes in interest rate differentials. Therefore, this section provides an econometric analysis of the breaks in interest rate differentials of the Swiss franc against the franc, mark, guilder and pound, taking into account their autocorrelation. To this end, we estimate an AR(1) process for the interest rate differential and apply the Bai-Perron (2003) sequential break point test procedure. The estimation results are reported in Table 2. The last column shows the long-run level of the interest rate differential implied by the AR estimates.

Table 2: Bai-Perron break regressions for Swiss interest rate differentials

$(i_{CH,t} - i_{f,t}) = \alpha + \rho(i_{CH,t-1} - i_{f,t-1}) + \varepsilon_t$

Maximum number of breaks: 5, significance level of 10%

Maximum number of breaks: 5, significance level of 10%

Country/Period	α	ϱ	R^2	SE	DW	α/(1- ρ)
France						
1838-1888	0.112	0.454***				0.205
	(1.45)	(4.37)				
1889-1913	0.411***	0.643***	0.773	0.675	1.50	1.15
	(3.19)	(4.83)				
1914-1970	-0.334***	0.773***				-1.47
	(-2.70)	(8.16)				
Germany						
1838-1921	-0.101*	0.602				-0.254
	(1.77)	(6.20)	0.715	0.708	1.80	
1926-1970	-1.23***	0.448***				-2.23
	(-3.99)	(3.81)				
Netherlands						
1838-1920	0.334***	0.500***				0.668
	(3.80)	(5.38)				
1921-1950	-0.609 ***	0.254	0.781	0.516	1.95	-0.816
	(-4.80)	(1.58)				
1922-1970	-1.31***	0.230				-1.70
	(-3.55)	(1.01)				
Great Britain						
1838-1914	0.214**	0.373***				0.341
	(2.13)	(2.87)				
1915-1951	-0.420***	0.335**	0.778	0.770	1.92	-0.631
	(-3.12)	(2.21)				
1952-1970	-1.89***	0.409***				-3.20
	(-5.37)	(3.90)				

Note: t-values in parentheses; *, ** and *** indicate statistical significance at the 10, 5 and 1% level, respectively.

Essentially, Table 2 confirms the results of our descriptive analysis reported in the last section. It provides, however, more information on the exact timing and magnitude of changes in the long-run mean interest rate differential for the currencies considered. For the French franc, we have no statistically significant intercept estimate for the 1838-1888 period. This pattern is replaced for 1889-1913 by a clear long-run interest premium of 1.15%, and after 1914 by a 1.47% discount for the Swiss franc. The mark displays a slightly positive mean interest rate premium of 0.25% before 1921, which increases in absolute value to 2.23% in the second half of the sample. The guilder is characterized by an interest discount against the Swiss franc (0.67%) up to 1920. Then this pattern is reversed in two steps to a long-run mean differential of -0.82 (1921-1950) and then -1.7% (1952-1970). For the pound, we find a similar pattern as for the guilder up to 1951. In the last 20 years of our sample, the weakness of the pound and the associated financial crises and devaluations during the Bretton Woods years are reflected in a very large average interest differential of -3.1%.

If we estimate the model for French and German interest rate differentials for the period 1951-1970 in order to compare this directly with the Dutch and British results, we obtain a slight reduction in absolute value for Germany (-1.82%) and an increase for France (-2.24%). Interestingly, the pattern of these mean interest rate differentials from 1950 to 1970 corresponds closely to the mean deviations from uncovered interest rate parity for these currencies reported by Kugler and Weder di Mauro (2002, Table 1) for the years 1980-1998 and three-month euro currency rates of -2.41% (French franc), -0.83% (mark), -1.00% (guilder) and -3.01% (pound). Thus, at least for money market rates, the change in the exchange rate regime did not have a large impact on the "Swiss interest rate bonus". This suggests that political and economic stability, and not diversification benefits, were of outmost importance for short-term interest rates.

In conclusion, we find a mixed picture for the international money market interest rate status of the Swiss franc before and during World War I. We have no significant difference with the French franc before 1888, and a slight advantage against the mark. The guilder, pound and French franc (after 1888) had interest advantages of between 0.3% and 1.15 % until the 1920s. Thereafter, the pattern of the Swiss interest rate island developed, becoming strongly pronounced during the Bretton Woods years. This pattern was preserved in the flexible exchange rate period, at least until the recent zero interest rate policy years.[3] Our conjecture is that this mainly reflects the relative political, economic and monetary stability of Switzerland during the 20th century. In this context, it is important to note that Swiss interest rate developments cannot simply be attributed to non-involvement in the two world wars alone, as the cases of Sweden and Argentina, for example, show. Both neutral, these countries suffered from economic and/or political instabilities leading to relatively high interest rates during the 20th century (Homer and Sylla, 2005, pp. 530-536 and 633-637) .

3 The near-zero money market interest rates prevalent in many countries in recent years leave not much room for a Swiss interest rate advantage. The Swiss interest rate bonus then should be reflected by an expected depreciation of the Swiss franc, which is difficult to create given the high demand for a safe currency in crisis periods.

3 The Swiss franc on the foreign exchange market, 1850–2010

In this section, we consider direct evidence on the development of the exchange rate of the Swiss franc against major currencies under metallic monetary standards (1850–1914) and under the period of transition to a paper monetary standard since World War I. The period from 1850 to 1914 is analysed in the first part, where the deviations from metallic parities of the Swiss franc against five currencies (the French franc, German mark, Dutch guilder, British pound and Italian lira) are considered.

For the period since 1914, we provide an analysis of the development of the real and nominal exchange rate of the franc against the US dollar and the British pound. The selection of these currencies is motivated by their international importance over the last 100 years. The pound was the leading international currency before the Great Depression and World War II, and thereafter this role was assumed by the dollar, which was clearly the most important currency worldwide under the Bretton Woods system. Moreover, these two currencies experienced a high degree of stability for many years before their decline after the Great Depression and the breakdown of the Bretton Woods system. For most of the other major currencies of the "long" 19th century, a long-run assessment is not very meaningful as they were replaced sooner (mark) or later (French franc, guilder and lira).

3.1 Deviations from metallic parities of the Swiss franc before World War I

Before we turn to the data and empirical results, we should recall some basics of exchange rate determination under a metallic standard with and without a central bank. The exchange rate regime between two currencies was determined spontaneously by the internal monetary regime selected by the two countries and private arbitrage operations. First, for currencies that shared the same metallic standard (say, silver or gold) under a regime of full convertibility and free international movement of money and the monetary metal, private arbitrage resulted in an equilibrium exchange rate corresponding to the relative metallic content of the currencies being exchanged.[4] Second, for currencies with a different metallic monetary standard, the arbitrage-equilibrium exchange rate evolved according to the relative price of the two metals.[5] Third, when convertibility

4 Arbitrage operations involved exchanging the overvalued against the undervalued currency, converting it to the monetary metal, which is then converted again into the overvalued currency, yielding an arbitrage gain.

5 Arbitrage operations were more complicated in this case than in the case of identical metallic standards. If the exchange rate of, say, the Dutch (silver) guilder against the (gold) pound was higher than the silver-to-gold ratio, arbitrageurs could buy guilders for pounds, convert them into silver, sell the silver to buy gold, and convert the gold again into pounds, thereby making an arbitrage gain. Thus, in the long run the exchange rate was flexible but followed the relative price developments of silver and gold.

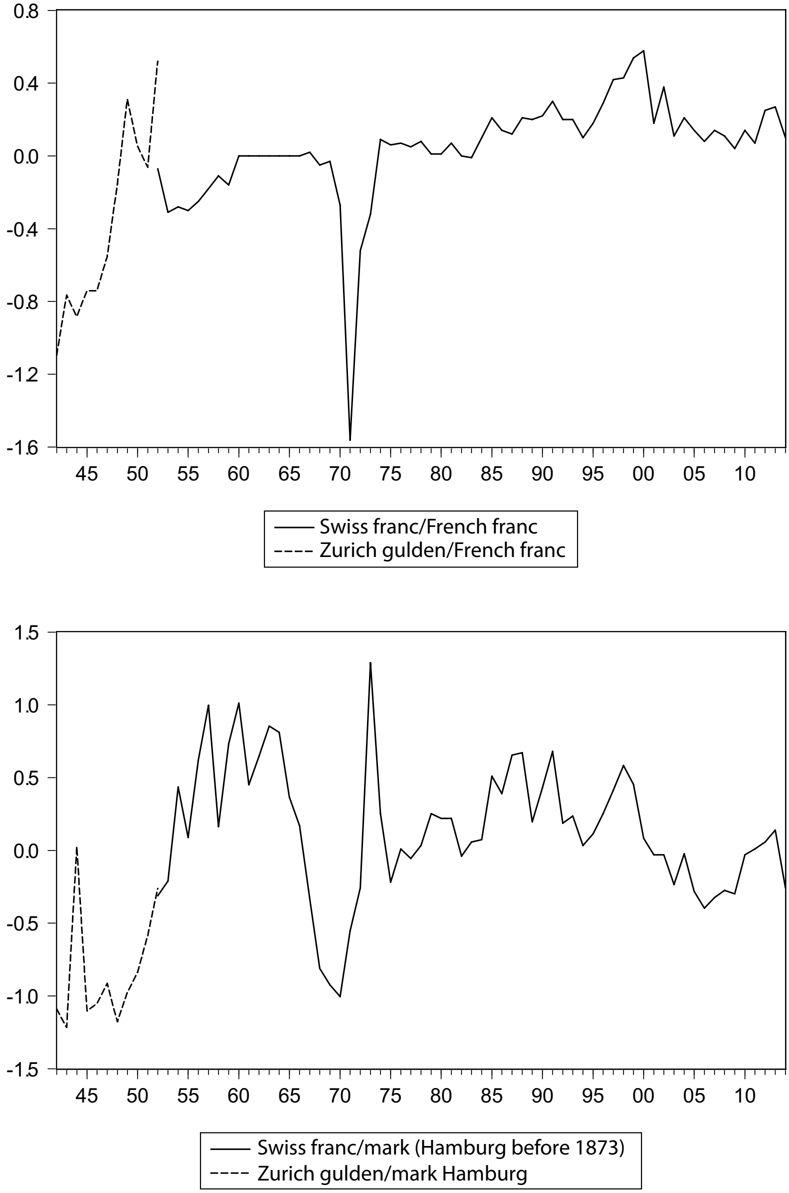
was suspended for at least one of the currencies, no arbitrage was possible, and the exchange rate was fully flexible and determined by the volume of fiat money issued. Of course, arbitrage operations were restricted by transaction costs, which became, however, very low by the time of the information and transport revolution of the 19th century, which was triggered by the introduction of telegraphy, steamships and railways.

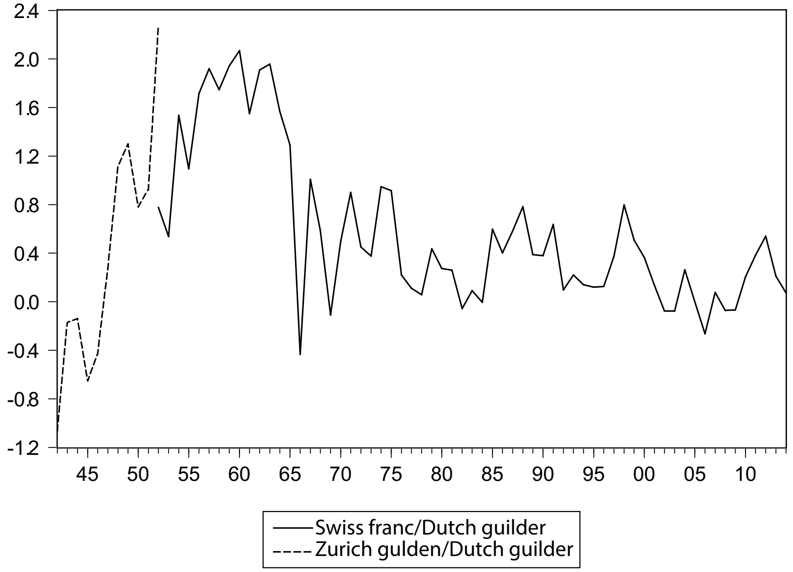
Exchange rate data are available for the Swiss franc from 1852 onwards in the *Handbook of Exchange Rates* by Denzel (2010). From 1842 to 1852 there are quotations of the Zürich gulden, a 9.51 gr am fine silver currency, against a couple of foreign currencies. Therefore, we include this data as a "predecessor" to the Swiss franc in our analysis. The exchange rate against the French franc (4.5 grams silver or 0.2901 grams gold), the mark (Hamburg: 8.66 grams silver; German Empire from 1873 onwards: 0.3905 grams gold), the Dutch guilder (9.45 grams silver or 0.6048 grams gold from 1876 onwards), the British pound (7.32 grams gold) and the Italian lira (Piedmont before 1861: 4.5 grams silver or 0.2901 grams gold) are considered. The Swiss franc (and the Zürich gulden) shared metallic standards with all currencies except the pound before the adoption of the full French bimetallic standard in Switzerland in 1865. Therefore, the metallic parities were easy to calculate in most cases given the metallic contents of the currencies listed above. For the years prior to 1865 and the pound, we calculated the time-varying metallic parity of the silver Zürich gulden and Swiss franc against the gold pound using the London market price of gold and silver data provided by Officer and Williamson (2015).

The exchange market data is based on bills of exchange drawn between Zürich and various foreign places (Paris, Amsterdam, London, Hamburg until 1872 and Berlin thereafter, Genoa until 1861 and Milan thereafter), as provided by Denzel (2010, pp. xxii-xlix and 313–326). The exchange rate is quoted in Swiss francs per unit of foreign currency. The data are annual and obtained as averages of monthly observations. Given this market data and the metallic parities, we calculate the deviations from parities in percentage points. This allows us to obtain some information on the strength of a currency – if it is undervalued with respect to the metallic parity, markets see a risk with respect to its convertibility or other restraints on arbitrage operations, such as capital controls, in the future. Thus if the Swiss franc is weak relative to the pound (i.e. the pound is strong), we expect positive deviations of the pound exchange rate from parity. This measure is only meaningful if actual convertibility is given.

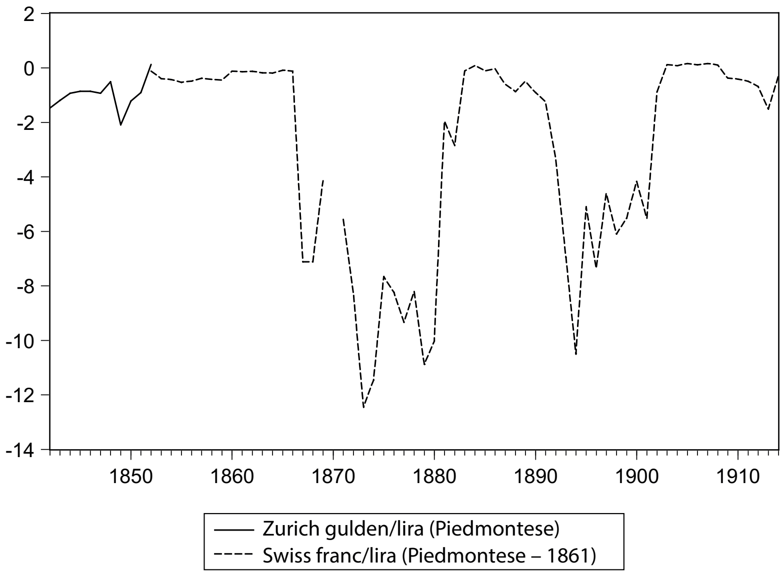
These series are displayed in Figure 4. From 1842 to 1852 we have data for the Zürich gulden, and from 1852 to 1914 for the Swiss franc. The data overlap in 1852 allows us to assess the strength of the Swiss franc in comparison to the Zürich gulden.

Figure 4: Deviations from metallic parity, Swiss franc (1852–1914) and Zürich gulden (1842–1952), percentage points




2.4
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
45 50 55 60 65 70 75 80 85 90 95 00 05 10
Swiss franc/Dutch guilder
Zurich gulden/Dutch guilder


3
2
1
0
-1
-2
45 50 55 60 65 70 75 80 85 90 95 00 05 10
Swiss franc/British pound
Zurich gulden/British pound



The graphic representations of these deviations suggest the following observations. First, we note more volatile exchange rates for the years before 1875. This reflects the decrease in transaction costs and the move to the international gold standard in the last quarter of the 19th century. Second, we note some large deviations from parity for the Italian lira for the periods of suspended convertibility resulting from excess paper money creation (1866-80 and 1893-1905). Moreover, the Swiss franc was, in general, overvalued against the lira, even for the years with convertibility. As a consequence of the suspension of convertibility in reaction to the Franco-Prussian war, even the French franc suffered from this problem (1871-77) too, but to a lesser extent. Third, we note an equal or mostly lower deviation from parity for the Swiss franc than the Zürich gulden in 1852. In this sense, the Swiss franc appears to have been a successful replacement for the Zürich gulden for international transactions. Fourth, we note a mixed picture of over- and undervaluation of the Swiss currencies against the French franc, the mark, the pound and the Dutch guilder before 1875. Only in the second half of our sample is a consistent undervaluation of the Swiss franc visible.

Table 3 reports some descriptive statistics for the deviations from parity. For the French franc and the Italian lira, only years with convertibility were included in the sample. Moreover, Table 4 provides some information on the linear relationship between the series obtained by a principal component analysis. We note that, on average, the Swiss franc was undervalued – the mean ranges from 8.6 bps to 57 bps for the French franc and the Dutch guilder, respectively. Applying a standard t-test indicates that all these mean estimates are significantly different from zero. The principal component analysis shows an interesting pattern, the first significant component with high loadings on the mark, guilder and pound exchange rate represents all non-French influences on the foreign exchange value of the Swiss franc. The second component is a French franc factor with a corresponding loading of 0.89. This pattern is reflected by the relatively high correlation between the exchange rates against the mark, guilder and pound.

Table 3: Deviations from parity of the Swiss franc exchange rate against five currencies, 1852–1914 (in percent)

Exchange rate of Swiss franc	Mean	Standard deviation	Min	Max
French franc (1852-1870, 1878-1914)	0.086	0.193	-0.311	0.578
Mark	0.142	0.452	-1.005	1.289
Dutch guilder	0.571	0.634	-0.432	2.069
British pound	0.271	0.461	-0.407	2.102
Lira (1852-1865, 1881-1886, 1906-1914)	-0.429	0.644	-2.459	0.160

In order to assess the stability over time and the statistical significance taking into account autocorrelation and heteroskedasticity (Newey-West standard errors), we applied the sequential break point analysis of Bai and Peron (2003) with a significance level of 5% to four exchange rates and the years with convertibility. The lira was left out, as it does not have sufficient continuous observations with convertibility. This exercise provides some interesting insights. First, the French franc is undervalued (mean = -.7.3 bps, t-statistic = -1.76) for the periods 1852-70 and 1878-83. This pattern is reversed for the years 1884-1914 (21.5bps, t=5.74). The mark shows no statistically significant deviation from parity and no break is indicated (14.2bps, t=1.58). For the guilder and the pound, we find identical patterns: for the period 1852-65 we have a very strong overvaluation (154 bps, t=8.86 for the guilder; 83bps, t=3.56 for the pound) that is strongly reduced for the second subsample 1866-1914 (29.3 bps, t=5.08; 12.5 bps, t=2.60).

Table 4: Principal component analysis of deviations from parity of the Swiss franc exchange rate against the French franc, mark, Dutch guilder and British pound, 1852–1870 and 1878–1914

Eigenvalues				
Number	Value	Proportion	Cumulative proportion	
1	2.473871	0.6185		
2	1.140736	0.2852	0.6185	
3	0.195955	0.0490	0.9037	
4	0.189438	0.0474	0.9526	
			1.0000	
Eigenvectors (loadings)				
Variable	PC 1	PC 2	PC 3	PC 4
French franc	-0.179640	0.879502	0.389886	0.205414
Mark	0.534829	0.401871	-0.730997	0.134538
Dutch guilder	0.577485	-0.223620	0.421499	0.662452
British pound	0.590083	0.122353	0.368742	-0.707716
Correlations				
	French franc	Mark	Dutch guilder	British pound
French franc	1.000000			
Mark	0.114895	1.000000		
Dutch guilder	-0.423010	0.618063	1.000000	
British pound	-0.138849	0.765971	0.753438	1.000000

Finally, we applied a threshold error correction model to our exchange rate data for the period 1866-1914 for the guilder and the pound, as well as a reduced sample for the French franc (1878-1914). For the mark, this model provides no sensible results.[6] In this framework[7] we take into account non-linear adjustment, as the exchange rate may adjust differently depending on whether we have a "small" or a "large" past deviation from parity for the exchange rate y:

$$\Delta y_t = \lambda_1(y_{t-1} - yp_t - a_1) + \varepsilon_t,\ if\ abs(y_{t-1} - xp_t) < \tau$$
$$\Delta y_t = \lambda_2(y_{t-1} - yp_t - a_2) + \varepsilon_t,\ if\ abs(y_{t-1} - xp_t) \geq \tau$$
$$\lambda_1, \lambda_2 \leq 0;$$

6 There is no significant regime change for this currency. The linear model shows a surprisingly slow adjustment estimate (λ=-0.328, t-value = -2.74) and no significant deviation from parity (â=0.00087, t-value=0.84).

7 This approach is used by Bernholz and Kugler (2011) and Kugler (2011) for the dynamic adjustment of exchange rates in different local markets.

This model is usually motivated by transaction costs – if the deviation from parity is too small to recover transaction costs of arbitrage, we have no or only a minor adjustment of the exchange rate ($\lambda_1 \sim 0$). For large deviations, we have full or nearly full adjustment to parity as arbitrage is profitable ($\lambda_2 \sim -1$). Moreover, we allow for a systematic overvaluation ($a < 0$) or undervaluation ($a > 0$) of the Swiss franc exchange rate which may be different across the two regimes. The threshold τ is not known and is therefore estimated using a grid search minimizing the sum of squared residuals.

The results of this analysis are presented in Table 5. First, we note that the estimated threshold τ is very low, ranging between 0.26% and 0.38%. This is consistent with results for the guilder/pound exchange rate provided by Kugler (2014), which shows a strong reduction of the threshold estimate for adjustment of the exchange rate during the 19th century. For the French franc, we report a relatively weak adjustment within the τ-band and a high adjustment coefficient in absolute value outside the band which is, however, not statistically different from -1. According to the arbitrage model, under transaction costs we would expect no adjustment within the band. However, this adjustment may be triggered by non-arbitrage payments caused by exports and imports of goods, services and capital. What is extremely interesting is that the a-coefficients estimates, which are statistically highly significant, have different signs: within the band we have a positive estimate, indicating a long-run undervaluation of the Swiss franc of approximately 16bps; whereas for the large deviation from parity we find a negative intercept term, indicating a long-run overvaluation of the Swiss franc of 9bps. The same pattern is provided by the Dutch guilder, with a 22bps undervaluation within the band and a 55bps overvaluation outside the band. Interestingly the intercept estimate differs between regimes, whereas the adjustment parameter is very close to -1 in both regimes. For the pound, we find a random walk behavior of the exchange rate within the τ-band in line with the arbitrage model, and we therefore cannot estimate a_1 in a reliable way as λ_1 is not statistically different from zero. However, the a_2 is also negative, but is not statistically significant. These findings indicate that in "normal" times there is a tendency for undervaluation of the Swiss franc, whereas in "extreme" times we have a tendency for an overvaluation. Thus it appears that some properties of the "strong" Swiss franc since World War I were already present in the "long" 19th century.

Table 5: Estimation results threshold autoregressive model log of the Swiss franc to the French franc, guilder and pound exchange rate, 1866-1914 and France 1878-1914

$$\Delta y_t = \lambda_1(y_{t-1} - yp_t - a_1) + \varepsilon_t,\ if\ abs(y_{t-1} - xp_t) < \tau$$
$$\Delta y_t = \lambda_2(y_{t-1} - yp_t - a_2) + \varepsilon_t,\ if\ abs(y_{t-1} - xp_t) \geq \tau$$
$$\lambda_1, \lambda_2 \leq 0;$$
$$Var(\varepsilon_t) = \sigma^2 / n_t$$

Heteroskedasticity caused by varying number of monthly observations (n_t) in some years is taken into account in estimation by transforming the observations (multiplication by $1/n_t^{1/2}$).

	a_1	λ_1	a_2	λ_2	τ	R^2	DW
French franc	0.00159 (0.00036)	-0.496 (0.192)	-0.00926 (0.0036)	-1.977 (0.727)	0.0038	0.312	2.54
Dutch guilder	0.00220 (0.00060)	-1.071 (0.159)	-0.0055 (0.00213)	-1.081 (0.346)	0.0038	0.550	2.31
British pound	-0.0050 (0.0120)	0.109 (0.238)	-0.00108 (0.00094)	-0.671 (0.0629)	0.0026	0.338	2.08

Note: Standard errors in parentheses.

3.2 Purchasing power parity and trends in the real exchange rate for the Swiss franc, 1914-2010

In this section, we will consider the development of the Swiss franc since 1914. Recall that this period witnessed the transition to an international paper standard, which was completed with the adoption of flexible exchange rates for major currencies in 1973. During this period, we had very different monetary standards for the Swiss franc. After the breakdown of the classical gold standard in 1914, Switzerland experienced roughly ten years of inconvertibility of banknotes and flexible exchange rates. The exchange rate against the dollar was *de facto* fixed again in late 1924 at the pre-war parity, and gold convertibility was resumed in 1929. The revived gold standard did not have a long life, however, soon falling victim to the Great Depression. Switzerland, as a member of the gold block, maintained the old gold parity longer than most other countries, but finally reduced the gold content of the franc by about 30% and suspended gold convertibility in the autumn of 1936. Subsequently, the country was on a paper standard and operated with exchange controls and (after 1941) a split dollar market for trade and financial transactions. Switzerland did not join the Bretton Woods institutions after World War II, but *de facto* fixed the exchange rate according to the rules of the Bretton Woods system. In this framework, the international payment system was liberalized and in 1958 all major currencies adopted convertibility for current transactions. The inconsistency of US monetary and fiscal policy with the fixed gold price of 35$/oz. during the 1960s then led – after attempts to save the system by exchange rate adjustments – to the breakdown of the Bretton Woods agreement in 1971-73. Since then, we have lived in a world with inconvertible paper monies and correspondingly fully flexible exchange rates.

This short account of the development of the Swiss franc and the international monetary system makes clear that for this period, deviations from metallic parity are no longer a useful yardstick for assessing the strength of a currency. Instead we use the relative purchasing power parity model including the possibility of a deterministic trend in the real exchange rate, mainly caused by different relative productivity and terms of trade developments in two countries. Therefore, we can differentiate between two sources of nominal strength of a currency: first, a “PPP component” stemming from relatively low trend inflation and a more stability-oriented monetary policy; and second, a “real component” resulting from relative productivity gains or terms of trade effects.

This analysis is carried out for the pound and dollar exchange rate with the Swiss franc using annual data from 1914-2010 and the consumer price index (CPI) of the three countries involved. The data source is the *Monthly Statistical Bulletin* of the SNB for the exchange rates and the Swiss CPI. British and US inflation data are taken from Officer and Williamson (2013). The annual series used are averages of monthly data. First of all, we have to check whether the PPP model is meaningful with this data. We therefore run some static regression cointegration tests (reported in Table 6). We selected this approach instead of a multivariate method, such as Johansen’s test based on an error correction system, because the switches in the exchange rate regime lead to changes in the adjustment dynamics and a constant EC model over the entire sample is clearly miss-specified.

Table 6: Regression residual deterministic cointegration tests for Swiss franc/pound and Swiss franc/dollar, 1914-2010

$$\boldsymbol{y_t = b_0 + b_1 x_t + b_2 t + \varepsilon_t}$$

y: log exchange rate, ***x***: log relative CPI

Exchange rate	**Method**	b_1	b_2	R^2	DW	Engle-Granger t	Hansen Test
SFr/£	OLS	0.9235*** (0.0616)	-0.00996*** (0.00145)	0.9807	0.4095	-4.636**	
	FMOLS	0.9167*** (0.0860)	-0.00986*** (0.00213)	0.9805	0.4270		0.3736
SFr/$	OLS	1.123*** (0.2329)	-0.00887*** (0.00187)	0.8850	0.2771	-3.602*	
	FMOLS	1.242*** (0.2578)	-0.00727*** (0.00248)	0.8830	0.2863		0.35649

Notes: Newey-West standard errors in parentheses. *, **, *** indicates significance at the 10, 5 and 1% level, respectively.

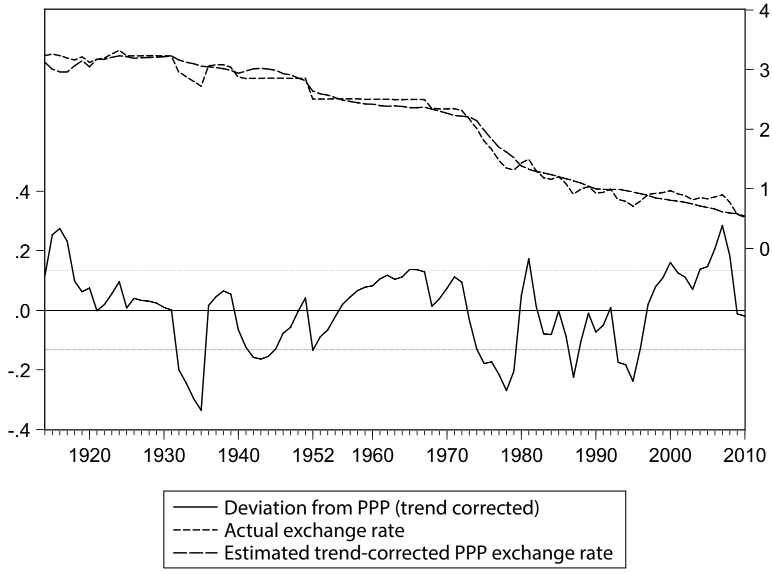
The results presented clearly point to deterministic cointegration between the two exchange rates and the relative price level with unit elasticity as implied by PPP. First, the Engle-Granger test rejects the null hypothesis of no cointegration, and second, the Hansen (1992) parameter instability test does not reject the null hypothesis of cointegration. Moreover, OLS as well as FMOLS estimates indicate that the slope coefficient is statistically clearly different from zero, but not from one.[8] The deterministic trend is highly statistically significantly different from zero. These estimates indicate that we have an annual real trend appreciation of the Swiss Franc amounting to 1% and 0.9% for the pound and the dollar, respectively. These results are confirmed by unit root tests for the real exchange rate including a deterministic trend: the ADF-test statistic for the null hypothesis of a unit root is -4.498*** (£) and -3.472** ($), respectively.

Figure 5 visualizes the PPP relationship using restricted estimates with unit elasticity. The trend coefficient is slightly changed to -0.0084 (£) and -0.0097 ($), respectively.

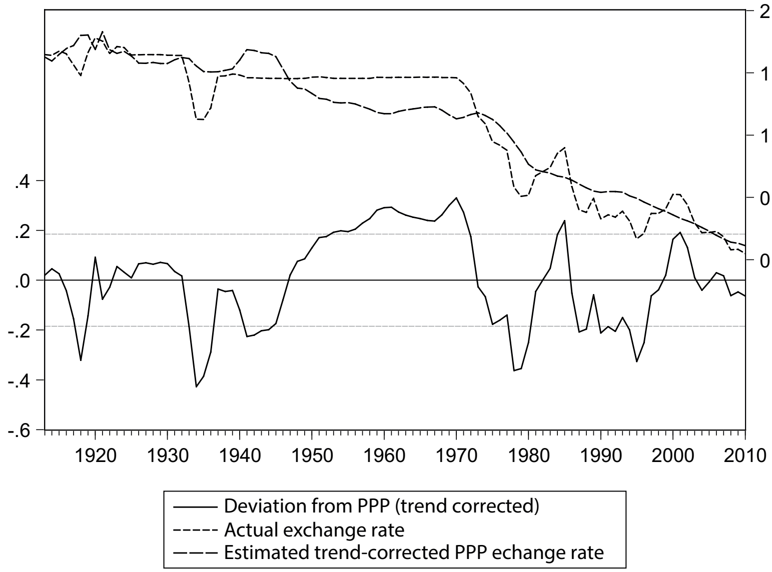
8 OLS as well as FMOLS estimates are super-consistent. However, FMOLS corrects for possible endogenous regressors that invalidate statistical tests based on autocorrelation corrected covariance matrix of OLS estimates (Hamilton, 1994, pp. 571-629).

Figure 5: Fitted values and residuals from the trend-corrected PPP model, Swiss franc, 1914-2010

SFr/£, log



SFr/US$, log

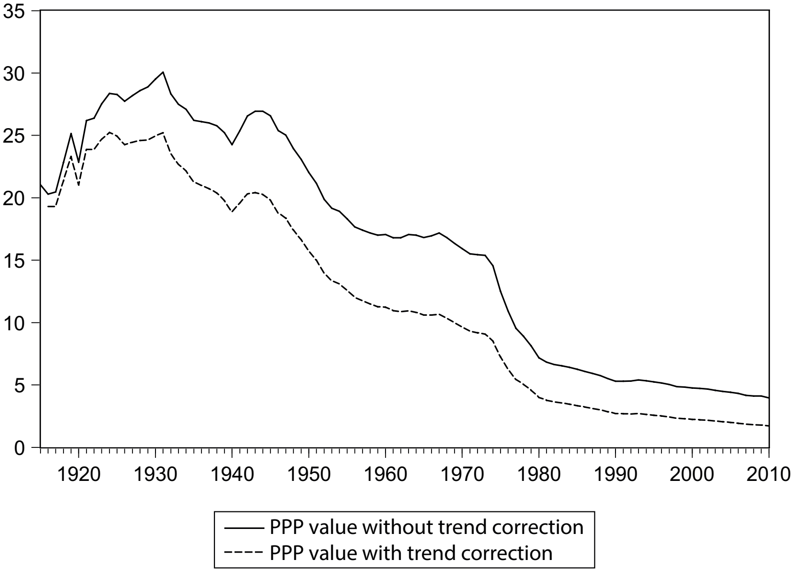


We see from Figure 5 that the pound exchange rate is less volatile than the dollar exchange rate: the residual from the log PPP regression (left-hand scale) has a standard deviation of 0.13 (approximately 13%), whereas this value is very close to 20% for the dollar. The fixed exchange rate periods, in particular the Bretton Woods years, are neatly visible and we clearly see the accumulated appreciation pressure of the Swiss franc against the dollar during this period. Interestingly, the pound exchange rate appears to be in long-run equilibrium in 2010, whereas the dollar is around 7% below the equilibrium value.

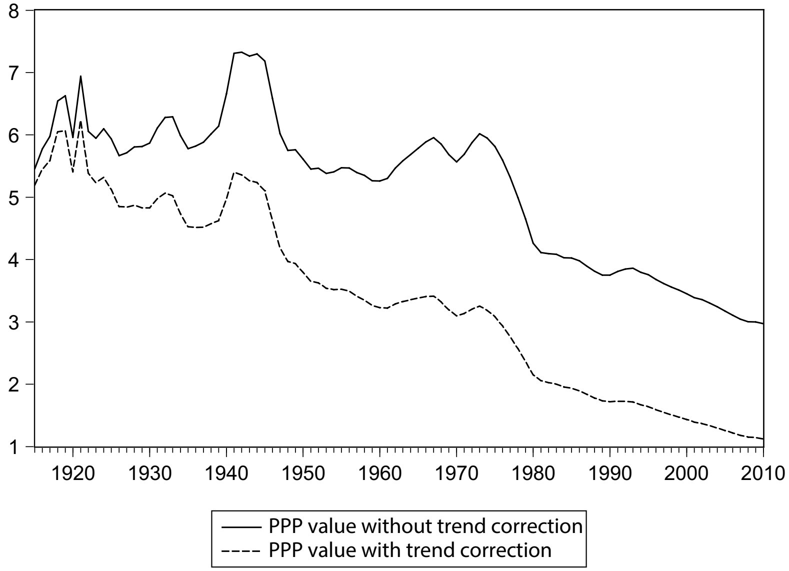
Figure 5 does not allow for a differentiation between the two sources of the nominal appreciation of the Swiss franc. It gives no information on how much of the long-run exchange rate developments is due to a pronounced price stability/ low inflation policy of the SNB and how much is due to the real appreciation of the Swiss franc. Figure 6 provides some information on this. It shows the hypothetical development of the exchange rate without any real appreciation and the fitted values presented before including the deterministic trend in the exchange rate. The "pure" PPP component of the appreciation of the Swiss franc against the pound is impressive. It implies that the value of the pound fell from the gold standard parity of 25.20 francs in 1925 to approximately 4 francs in 2010. The further reduction through real appreciation to 1.7 francs appears relatively small compared to the decline of the pound caused by an over-expansive monetary policy during the last nearly 100 years. For the dollar this picture is different: we note a fall from the gold standard parity of 5.18 francs to a PPP value of approximately 3 francs. The real appreciation reduced this equilibrium value to 1.1 francs, nearly one third of the "pure" PPP component.

Figure 6: Fitted PPP values with and without real-trend correction, Swiss franc, 1914-2010,

SFr/£



SFr/US$



These results lead to the question of what is behind this trend real appreciation of the Swiss franc against two currencies of highly developed countries with a similar real per capita income level. In our view, the most convincing explanation is the so-called Balassa effect. In contrast to the US and UK, Switzerland is characterized by a highly productive exports sector, while the productivity of the domestic sector producing non-tradable or protected goods is relatively low. Under these circumstances, competition in the labor market leads to excessive (compared to productivity) wages and correspondingly high prices in the domestic sector. This creates an appreciation of the real exchange rate calculated with a general price index such as the CPI. However, we should mention that the importance of the Balassa effect is controversial in the literature and some authors have suggested terms of trade effects as the main source of real Swiss franc appreciation.[9] We will not discuss this issue further here, as the "real" origin of the real appreciation of the Swiss franc is not a major concern of this paper.

Table 7 contains some results on the dynamic adjustment of exchange rates and relative price levels. To this end, an error correction (EC) model was estimated for three sub-periods: 1916-1945, 1946-1971, and 1973-2010. The selection of these periods is motivated by international monetary regimes. The first period is characterized by flexible exchange rates, interrupted by a short gold standard interlude from 1925-1931/36; the second period is of course motivated by the fixed-rate system of Bretton Woods; and in the last period we have a flexible exchange-rate regime for the currencies considered. Besides the error correction coefficients $\boldsymbol{Y_1}$ and $\boldsymbol{Y_2}$ we report the R^2 and the residual standard error of the two EC equations. For World War I, World War II and the interwar period, we find a highly significant adjustment of the exchange rate to PPP disequilibria and no statistically significant response of the relative price levels. The adjustment of the dollar rate is marginally faster than that of the pound rate: 41% and 34% of a deviation from PPP is corrected within one year. Moreover, standard error (SE) and R^2 estimates indicate that the dollar rate is less volatile and more predictable than the pound rate. Thus the dominance of flexible exchange rates is mirrored in the estimated exchange rate dynamics. For the Bretton Woods period we observe, as expected, reversed adjustment dynamics. The relative price level adjusts to deviations from PPP and there is no statistical evidence in favor of an adjustment of the exchange rate. This process is particularly fast for the pound, where we find a 70% adjustment within one year (compared to 26% for the dollar). This is probably caused by the highly open Swiss and British economies, with strong effects of the exchange rate on the CPI in both countries. In contrast, the US CPI

9 The Balassa effect is supported by the econometric analysis of real exchange rate and labor productivity in OECD countries for the period 1970-92 provided by McDonald and Ricci (2007). The use of total factor productivity data from 1984-2008 leads Gubler and Sax (2014) to the opposite conclusion and the confirmation of the robust effect of terms of trade on the real exchange rate stressed by Sax and Weder (2009).

hardly reacts to the exchange rate given the high degree of closeness of the US economy in the early postwar period. The post 1973 period is characterized by exchange rate adjustment and no significant CPI reactions to deviations from PPP in all three countries. This adjustment is marginally faster than in the 1916-1945 period and the predictability of exchange rate fluctuations of the pound appears higher in the post-1973 period than in the earlier period, whereas the same is not true for the dollar.

Table 7: EC model estimates for franc/pound and franc/dollar for sub-periods, 1914–2010

y: log exchange rate, ***x***: log relative CPI

$$\Delta y_t = \gamma_1(y_{t-1} - b_0 - x_{t-1} - b_2 t) + a_{11}\Delta y_{t-1} + a_{12}\Delta x_{t-1} + \varepsilon_{1t}$$

$$\Delta x_t = \gamma_2(y_{t-1} - b_0 - x_{t-1} - b_2 t) + a_{21}\Delta y_{t-1} + a_{22}\Delta x_{t-1} + \varepsilon_{2t}$$

	γ_1	γ_2	R^2 Δy	R^2 Δx	SE Δy	SE Δx
SFR/£ 1916-1945	-0.344 (0.169)	0.09992 (0.0871)	0.139	0.0601	0.0942	0.0486
SFR/£ 1946-1971	-0.0166 (0.146)	0.699 (0.263)	0.151	0.534	0.0308	0.129
SFR/£ 1973-2010	-0.481 (0.113)	0.0229 (0.0384)	0.418	0.620	0.0774	0.0263
SFR/$ 1916-1945	-0.408 (0.120	0.0834 (0.0824)	0.394	0.109	0.0804	0.0554
SFR/$ 1946-1971	-0.0228 (0.0291)	0.264 (0.0440)	0.0448	0.777	0.0101	0.0152
SFR/$ 1973-2010	-0.377 (0.124)	-0.0007 (0.0163)	0.283	0.678	0.0971	0.0129

Note: Standard errors in parentheses.

4 Conclusion

In conclusion, our results point to the disaster of World War I as the origin of the safe haven status of the Swiss franc. This status mainly reflects the relative political, economic and monetary stability of Switzerland during the 20th century. This finding is based on an empirical analysis of Swiss interest rates in an international perspective and of the behavior of the exchange rate of the Swiss franc since 1850. We find a mixed picture for the international money market interest rate status of the Swiss franc before and during World War I. We have no significant difference with the French franc before 1888, and a slight advantage against the mark. The guilder, pound and French franc (after 1888) had an interest discount of 0.3% to 1.15% until the 1920s. Thereafter, we see the pattern of the Swiss interest rate island develop, becoming especially pronounced during the Bretton Woods years. This pattern was preserved in the flexible exchange rate period, at least until the most recent zero interest rate policy years. Deviations from metallic parities of the Swiss franc provide some interesting insights. Firstly, the French franc was undervalued (mean = -.7.3 bps) for the period 1852-70/1878-83. This pattern was reversed for the years 1884-1914 (21.5 bps). The mark shows no statistically significant deviations from parity, and no break is indicated. For the guilder and the pound, we find identical patterns. For the period 1852-65 we have a very strong overvaluation (154 bps and 83 bps, respectively), which is much reduced for the second subsample 1866-1914 (29.3 bps and 12.5 bps, respectively). For the period after World War I, we established a strong real and nominal trend appreciation against the pound and dollar, the only two other major currencies that survived the political and economic disasters of the 20th century. The real appreciation followed a stable deterministic trend, with an appreciation rate of nearly 1 percent per annum. Removing the real trend from the nominal exchange rate shows a strong equilibrium appreciation of the Swiss franc caused by inflation differentials, in particular after World War II. As with interest rates, we see an acceleration of this development in the Bretton Woods years and its continuation after the transition to flexible exchange rates.

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