A Small Open Economy in the Great Depression: the Case of Switzerland*

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Abstract

In historical accounts of the world economic crisis of the 1930s, Switzerland is known for its staunch defense of the gold standard and the rise of corporatist policies. Yet, so far, the literature has not discussed the implications of these two features. This paper tries to show how the combination of hard–currency policy and nominal rigidities introduced by corporatist policies proved to be fatal for growth. Estimating a New Keynesian small open economy model for the period 1926–1938, we show that the decision to participate in the Gold Bloc after 1933 at an overvalued currency can be identified as the main reason for the unusual long lasting recession and that price rigidities from 1931 to 1936 significantly slowed down the adjustment process.

Keywords: Great Depression, Switzerland, New Keynesian Business Cycle Model

JEL Classification: E12, E32, N14

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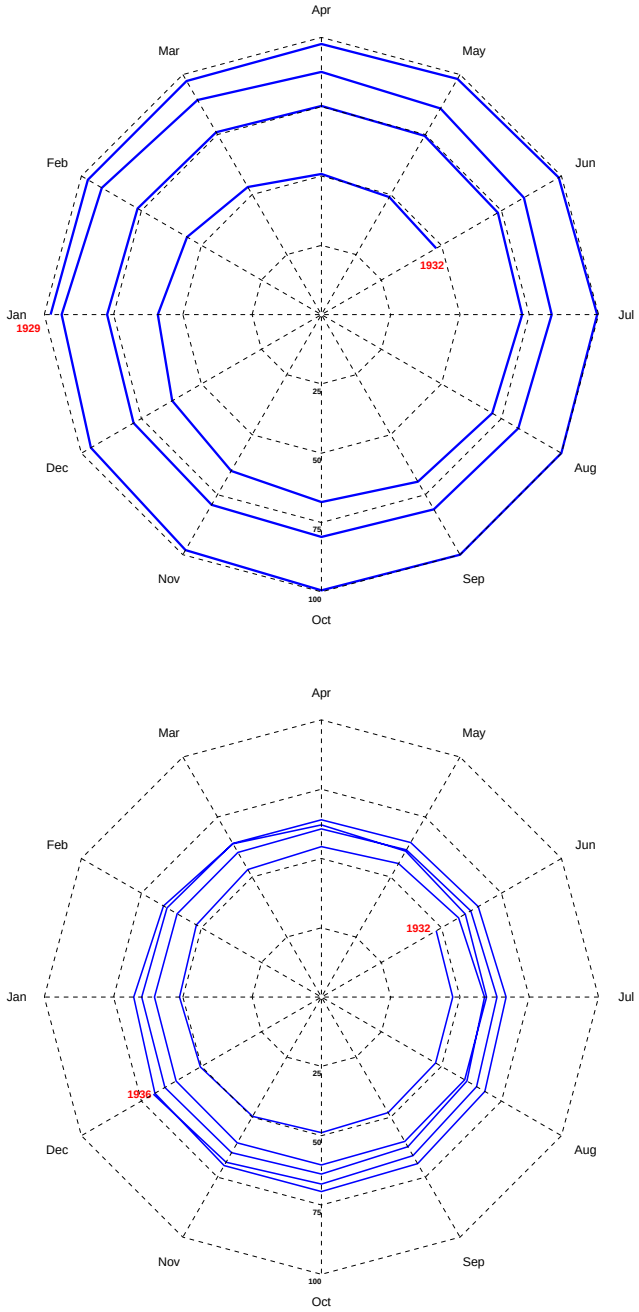
1 Introduction

Recent research has shown that Switzerland's dismal performance during the 1930s was mainly due to its exchange rate policy (Bordo *et al.*, 2007; Bordo and James, 2007). Thanks to a high gold cover ratio, the Swiss National Bank was able to defend the old parity against any speculative attack, thus preventing an early devaluation of the Swiss franc that would have restored the competitiveness of Switzerland's exporting sectors. This exchange rate policy was motivated by a variety of reasons, yet the widespread gold standard mentality certainly played a key role. The strong belief that a devaluation would lead to inflation and that the gold standard was the only reliable guarantee for prosperity and stability, led economies to stay on gold as long as possible - a decision which implied a lagged recovery from the Great Depression (e.g. Balderston, 2003; Feinstein *et al.*, 2008).[1] As Straumann (2010, p. 129–142) shows, this was also the case for Switzerland. Only when the last major trading partner, France (Table 1), decided to devalue its currency, Switzerland was ready to change course. In September 1936, the franc was devalued by 30 percent.

To demonstrate the consequence of Switzerland's defense of the gold standard, we adapt the famous "contracting spiral of world trade"–graph, first published by the Austrian Institute for Business Cycle Research (*Österreichisches Institut für Konjunkturforschung*) in 1933 (Eichengreen and Irwin, 1995), to Swiss exports (Figure 1). Real exports fell by 50 percent until June 1932, followed by a weak recovery to about 60–70 percent of the October 1929 level. The consequence of the decision to join the Gold Bloc in 1933 (together with Belgium, France, Italy, Netherlands, and Poland) was that exports stayed at this level until end of 1936. Due to the overvalued Swiss franc, the Swiss exporting sectors profited less from the recovery of the world economy than small European countries with a devalued currency such as the Scandinavian countries.

[1] "*A further aspect of great significance was the widespread belief in financial and political circles that it was essential to return to the pre–war gold standard if the growth and prosperity of the pre–1914 era were to be re–established, whatever the sacrifices their countries would have to make in oder to force down wages and prices so that the pre–war value of the currency could be restored.*" (Feinstein *et al.*, 2008, p. 1)

Figure 1: Swiss Exports, January 1929 – December 1936



Real exports, October 1929=100; Source: *Monatsstatistik des auswärtigen Handels der Schweiz*, 1929–1932

Table 1: Major Trading Partners in the Interwar Period

County	Export Share	Import Share
Germany	17.43%	27.25%
France	13.09%	16.15%
Italy	8.22%	7.62%
United Kingdom	12.19%	5.53%
United States	7.24%	6.57%
Total	58.18%	63.12%

Average country shares of total exports and imports during 1929–1936. Source: Swiss Economic and Social History Online Database (`www.fsw.uzh.ch/hstat`), Tables L.18, L.19, L.22 ,L.23.

The Swiss National Bank's defense of the old gold parity was particularly detrimental as Switzerland's prices were extraordinarily sticky during this period. As a matter of fact, regulations protecting individual economic sectors and fixing prices dramatically increased during the crisis. Instead of enabling the downward adjustment, the government sought to cushion the negative effects of an overvalued currency by containing competition. Almost any pressure group, in particular Swiss farmers, was able to obtain protection and subsidies. In many historical accounts, the rise of these corporatist policies in the 1930s has been hailed as the beginning of a fruitful cooperation between capital and labor. But in the context of an orthodox gold standard policy, these rigidities proved to be fatal. Therefore, understanding the nature of Switzerland's economic crisis during the 1930s requires not only a thorough analysis of the exchange rate policy, but also a better grasp of how prices adjusted before and after 1929.

Besides the exchange rate policy and the stickiness of prices, there is a third feature defining the course of Switzerland's economic crisis. The ample gold reserves may have prevented the Swiss National Bank from leaving the gold standard at an early state of the crisis. But on the other hand, they also allowed the central bank to refrain from increasing interest rates in the face of speculative attacks. From 1931 to 1936 when the devaluation enabled the central bank to reflate the economy nominal interests remained close to zero. By contrast, Belgium and France, which also defended the gold standard until the mid–1930s were forced to increase their interest rates whenever investors mistrusted their currencies. Switzerland's real interest rates were still substantial from 1931 to 1936, but the usual constraints of the gold standard did not

apply to Swiss monetary policy.

In this paper, we try to account for these different aspects of the Swiss crisis. Our contribution is threefold. First, we provide a new monthly dataset covering the performance of the real economy from January 1926 to December 1938. Second, we estimate the structural parameters of a New Keynesian small open economy model for Switzerland in the spirit of Clarida *et al.* (2000, 2001) and Galí and Monacelli (2005), going beyond the calibration exercise in Bordo *et al.* (2007). We explicitly take into account the fact that Switzerland was not forced to increase nominal interest rates during the Gold Bloc period due to the massive gold inflow starting with the German crisis in June 1931 and intensifying after Britain went off gold. Following Ireland (2004), the model incorporates a vector autoregressive measurement error component capturing the dynamics in the data which are not represented by the economic part. This feature allows to assess the model's suitability for the data under analysis. Moreover, it is possible to compare the relative importance of the structural shocks (foreign demand shock and terms of trade shock) with the contribution of the measurement error block by looking at the decomposition of the forecast error variance. The results show that the economic part of the model contributes a significant variance share. The structural approach enables us to embark on a counterfactual experiment by simulating the Swiss economy in the case of a devaluation of the Swiss franc in September 1931, the month at which the UK left gold.

Our results show that the terms of trade shock played an important role for the Swiss economy during the Interwar Period. While foreign demand was recovering after 1932, the terms of trade further deteriorated. Consequently, the latter effect dominated the foreign demand impulse and led to a long lasting recession, which only ended when Switzerland left gold in September 1936. As a result, our counterfactual analysis implies that in case of an earlier devaluation of the Swiss franc, the economy would have recovered a lot faster and reached its steady state level shortly after leaving gold: the decision to defend the parity turned out to be extremely costly. This finding is in line with the successful recovery of Sweden after leaving gold together with the UK (Rathke *et al.*, 2011).

Our third contribution is that we provide a thorough discussion of how prices behaved from 1926 to 1938. In particular, we detect severe price rigidities, induced by a high degree of cartellization and regulatory measures, as an important characteristic of the Swiss economy in the Interwar Period. More-

over, our estimation results not only confirm this finding but also emphasize the cost of it. A counterfactual analysis shows that a lower degree of price stickiness would have been beneficial for the Swiss economy. This result highlights the potential benefits of an internal devaluation and the cost of corporatist policies.

2 The Model

The underlying model corresponds to the basic New Keynesian small open economy model as introduced by Galí and Monacelli (2005) and Galí (2008). Already in the Interwar years, the Swiss economy was characterized by a high degree of openness[2]. Thus, we believe it is important to model open economy characteristics explicitly. Moreover, we follow Calvo (1983) by modeling nominal price rigidities. This seems to be an important stylized fact for the period under analysis: a large share of domestic prices and wages was fixed by the government. Not only did it own the national monopoly for mail, telegram and telephone services and the Swiss federal railway, but also began to stabilize agricultural prices in the midst of the depression (Rutz, 1970, p. 180–184).

Price rigidities became an issue already in the 1920s, illustrated by the increasing difference between wholesale and consumer prices after the recession of 1921/22 (Kaufmann 1952, Marbach 1952, p. 747; see upper part of Figure 2). Especially the degree of cartelisation of the Swiss economy was blamed for this development.[3] The ministry of economics (*Eidg. Volkswirtschaftsdepartement, EVD*) installed a committee to study price formation (*Preisbildungskommission*) in 1926, but without any control rights.[4]

[2]E.g. in 1928 exports accounted for 20 % of GDP (Source: *Die Volkswirtschaft*, 1924–1944).

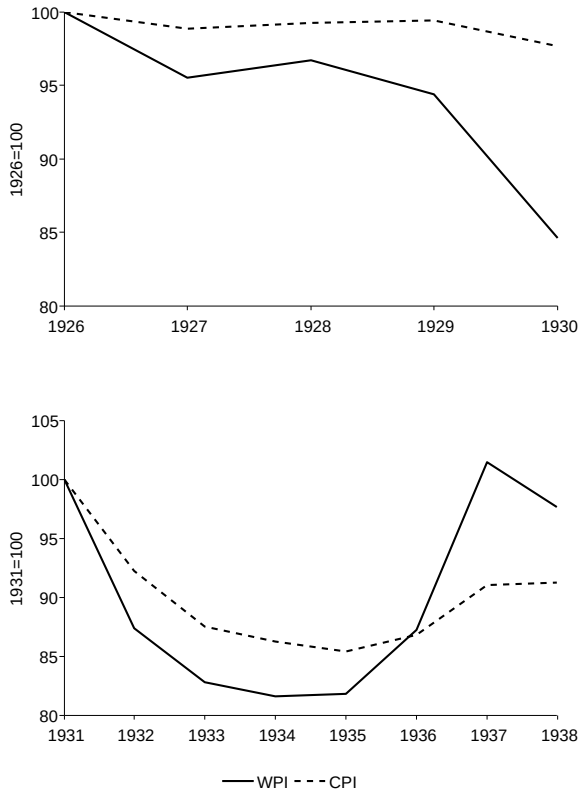
[3]Commenting on the first results of the cartel enquête of the *Preisbildungskommission* in 1937, Fritz Marbach, a member of the commission from 1931 to 1965 and president from 1939 on, stated that free pricing was the exception rather than the rule ("[...] *im allgemeinen darf man aber wohl behaupten, dass der Kartellpreis und nicht der 'freie Preis' die Regel ist*"; Marbach 1937, p. 34). He repeats this assessment in his overivew article on cartells in the 1955 edition of the *Handbuch der Schweizerischen Volkswirtschaft* ("*Der freie Preis ist in der schweizerischen Wirtschaft eine Aussnahme.*" Marbach, 1955, p. 19). The stability of cartellisation in Switzerland can be explained by the attitude of the public (see Katzenstein 1985, 2003 and the discussion in Straumann 2010, p. 344–345 for the importance of democratic corporatism for European small open economies). Illustrating this phenomenon, Marbach joked that the Swiss are in principle in favour of free markets, under the condition that they are exempt ("*Der Schweizer ist dem Prinzip des freien Wettbewerbes (allerdings nimmt er sich dabei nur all-zuleicht selber aus) im grossen und ganzen recht gewogen.*" Marbach, 1952, p. 754). For an overview of cartelisation in Switzerland, see Eidgenössisches Volkswirtschaftsdepartement (1957) and Schröter (2011).

[4]For the following, see Lautner (1950, p. 1–12), Eidgenössische Zentralstelle für

A department for price controls (*Preiskontrollstelle*) was founded in 1931, in response to the Great Depression. Its main purpose was to monitor the influence of import restrictions on prices and to prevent unjustified price increases. In the beginning, it lacked effectiveness, because it depended heavily on voluntary cooperation. The lower part of Figure 2 illustrates this lack of effectiveness: wholesale prices kept falling faster than consumer prices. As a consequence and in fear of inflationary pressure due to the devaluation of the Swiss franc in September 1936, the Swiss parliament decided to implement direct price controls in 1936. The *Preiskontrollstelle* was authorized to collect necessary data and regulate prices. These regulations had two purposes: to protect consumers against unjustified price increases, and also to protect producers from price dumping. For example, milk prices were pegged by compulsory cartels and quotas, and export of watches became only possible conditional to complying with the price regulations of the watch industry (Hug, 1938, p. 364–366). Almost all prices were regulated (goods and services, gas, electricity, rents), and from September 1936 on, could only be increased with official approval, and even with approval, the adjustment had to be stepwise (Hug, 1938, p. 362). The effectiveness of this regulatory intervention can be seen from the lower part of Figure 2: while wholesale prices started to increase steeply after 1936, the increase in consumer prices was only moderate. In 1950, the central office for war economics (*Eidgenössische Zentralstelle für Kriegswirtschaft*) reported overall success: due to the interventions, consumer prices adjusted much slower in the period 1939–1946 than in 1914–1921, when there was no intervention (Eidgenössische Zentralstelle für Kriegswirtschaft, 1950, p. 898).

Kriegswirtschaft (1950, p. 877–887), and Marbach (1952).

Figure 2: Producer and Consumer Price Indices, 1926–1938



Source: Swiss Economic and Social History Online Database (`www.fsw.uzh.ch/hstat/`), Table H.1

As stated in the introduction, we do not include a gold standard mechanism. To motivate our choice of model, we follow Bernanke (1995) and decompose Swiss money supply ($M1$) in the period 1922–1936 into contributions of the money multiplier ($M1/BASE$, $BASE$: monetary base), the inverse of the gold backing ratio ($BASE/RES$; RES: international reserves), the ratio of international reserves to gold ($RES/GOLD$), and the gold reserves of the Swiss National Bank, expressed in domestic currency ($GOLD = PGOLD \times QGOLD$):

$$M1 = \frac{M1}{BASE} \times \frac{BASE}{RES} \times \frac{RES}{GOLD} \times PGOLD \times QGOLD \qquad (1)$$

The results reported in Table 2 and Figure 3 indicate that Switzerland did not fully commit to the *rules of the game* of the Gold Standard during the Interwar Period: the ratio of the monetary base to international reserves ($BASE/RES$) is not stable. Therefore, we refrain from including a particular Gold Standard mechanism into the model as opposed to e.g. Bordo, Helbling, and James (2007).

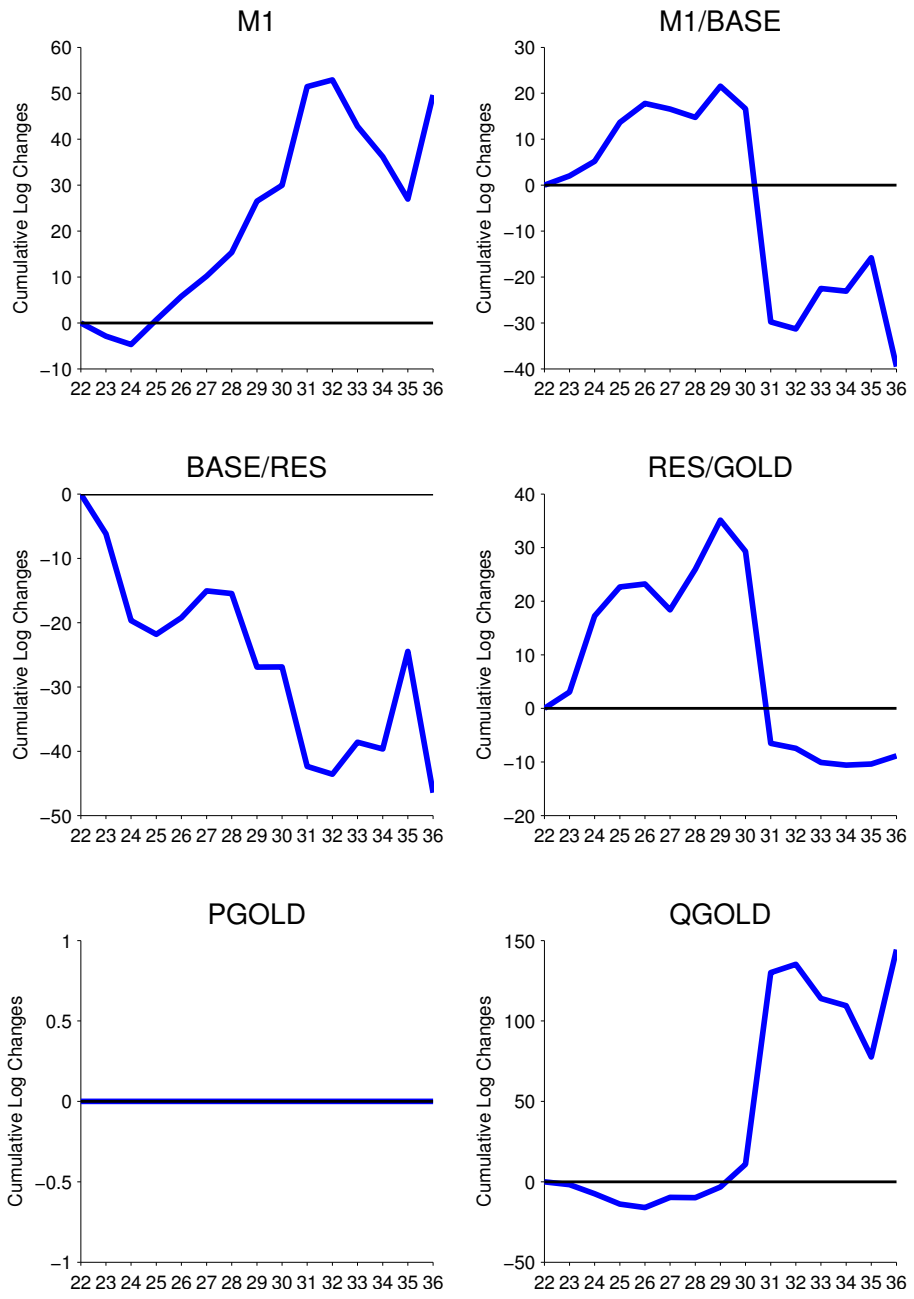
Table 2: Decomposition of Swiss Money Supply, 1922–1936

Year	$M1$	$\frac{M1}{BASE}$	$\frac{BASE}{RES}$	$\frac{RES}{GOLD}$	$PGOLD$	$QGOLD$	$\frac{RES}{BASE}$
1922	2395	2.10	1.60	1.12	3.44	186.00	0.62
1923	2327	2.14	1.50	1.15	3.44	182.76	0.66
1924	2285	2.21	1.31	1.33	3.44	172.63	0.76
1925	2411	2.41	1.29	1.40	3.44	161.95	0.78
1926	2538	2.51	1.32	1.41	3.44	158.51	0.76
1927	2652	2.48	1.38	1.34	3.44	168.79	0.73
1928	2792	2.43	1.37	1.45	3.44	168.48	0.73
1929	3122	2.60	1.22	1.59	3.44	180.04	0.82
1930	3232	2.48	1.22	1.50	3.44	207.51	0.82
1931	4006	1.56	1.05	1.05	3.44	683.12	0.95
1932	4066	1.53	1.04	1.04	3.44	719.30	0.97
1933	3675	1.68	1.09	1.01	3.44	581.59	0.92
1934	3439	1.67	1.08	1.00	3.44	555.89	0.93
1935	3136	1.79	1.25	1.01	3.44	404.24	0.80
1936	3934	1.41	1.01	1.02	3.44	788.52	0.99

Notes: M1, the monetary base (BASE), the gold reserves (GOLD), and the total reserves (RES) are measured in millions of Swiss francs. The gold parity (PGOLD) corresponds to the price of one gram of gold in Swiss francs. QGOLD denotes the quantity of gold reserves in tons.

Data Source: Swiss National Bank
`www.snb.ch/n/mmr/reference/histz_gm/source` (T1.3 and T2.2)
`www.snb.ch/n/mmr/reference/histz_snb/source` (T1.1)
`www.snb.ch/en/mmr/reference/histz_snb_book/source` (page 31)

Figure 3: Decomposition of Swiss Money Supply, 1922–1936



Source: Swiss National Bank, see Table 2 for further detail

The home economy is infinitesimal small and does not affect the economy of the rest of the world. Moreover, markets are assumed to be complete, i.e. agents trade a full set of state contingent bonds. Economic agents form rational expectations, the representative household maximizes expected lifetime utility and firms maximize expected profits. Ultimately, we would like to assess

whether an overvalued currency or the worldwide economic downturn was the main determinant of the long lasting recession in Switzerland. Consequently, we model both terms–of–trade and foreign demand as exogenous structural shocks. Using the dynamic stochastic general equilibrium approach allows to measure over–/undervaluation of the Swiss franc and to conduct counterfactual analysis in a straightforward way. A more detailed description of the model can be found in Appendix A.

3 Data and Estimation Method

We use monthly data of industrial production, inflation, and net exports, ranging from January 1926 to December 1938. An official industrial production index is not available before 1965 (Cascioni, 2000, p. 281). Already in the 1930s, this situation was deemed unsatisfactory, at least from the viewpoint of the Federal Statistical Office.[5] The problem of the missing Swiss production index (*Das Problem einer schweizerischen Produktionsstatistik*) was discussed at the 1936 meeting of the the Swiss Statistical Society (*Schweizerische Statistische Gesellschaft*). The overview in the *Statistisches Handbuch der Weltwirtschaft* published by the German staitistical office in 1936 (Statistisches Reichsamt, 1936) showed that of the 80 countries in the collection, 54 had industrial production statistics, Switzerland not being among them. To explain the situation, industrial representatives (building, engineering, textile and printing) listed the general reluctance of the industry providing the data,[6] the high cost of data collection, and the availability of high quality trade statistics, which sufficed the needs of the mainly export oriented Swiss industry, therefore making a production index superfluous.[7] Because of the lack of contemporaneous data, we could switch to the sectoral estimates provided by David (1995), but these series are only at an annual frequency. Therefore, we decided to use the business cycle indicators published in the period of interest as a proxy, and take SBB (Swiss Federal Railway) freight data, as well as indicators for silk

[5] "*Ein grosser Teil der schweizerischen Bevölkerung ist auf Gedeih und Verderb auf den Ertrag der industriellen Anlagen und auf ihre Beschäftigung in ihnen angewiesen. Wie gross ist dieser Ertrag? Wir kennen ihn nicht.*" (Schwarz, 1936, p. 147)

[6] "*Dann muss die Verbandsleitung auch mit einer Abneigung der Mitglieder rechnen, Dinge bekanntzugeben, welche die Grundlagen des Geschäfts betreffen. Diese Einstellung wäre besonders seitens der welschen Mitglieder zu gegenwärtigen, welche sich schon heute über einen angeblich überwuchernden 'esprit de police' der Verbände beklagen.*" (Marti, 1936, p. 176)

[7] See the contributions by Cattani (1936), Bühler-Krayer (1936), Fischer (1936), and Marti (1936).

and watch production[8], which represent the two most important Swiss export industries in the Interwar Period.

Inflation data is calculated based on the consumer price index taken from the Federal Statistical Office[9]. Based on household accounts from 1912, 1920, and 1921 for skilled labourers, unskilled labourers and employees, the index was first published in January 1922 by the Federal Office of Labour (*Eidgenössisches Arbeitsamt*), first only for food. Because of critique by employee organisations and trade unions, it was extended to other expenditure groups and, after the revision in 1926, consisted of food, fuel (soap), clothing and rent.[10] As already mentioned, there are high quality trade statistics available for Switzerland, both by volume and value, at monthly frequency.[11] The Federal Customs Office (*Eidgenössische Oberzolldirektion*) publishes these data since 1885. We use the *Monatsstatistik des auswärtigen Handels der Schweiz*, 1926–1938.[12]

The solution of the model described in Section 2 leads to a non–linear system of expectational first order difference equations, which we log–linearize around its deterministic steady state, before solving it using the method proposed by Klein (2000). The solution of the model provides the policy functions, which can be written in state space form as

$$\begin{aligned} \mathbf{y}_t &= \mathbf{Z}\boldsymbol{\alpha}_t; \\ \boldsymbol{\alpha}_t &= \mathbf{T}\boldsymbol{\alpha}_{t-1} + \mathbf{R}\boldsymbol{\eta}_t, \end{aligned} \tag{2}$$

where $\mathbf{y}_t$ is a 3×1 vector of observables (stationary output, inflation, and net exports), and $\boldsymbol{\alpha}_t$ is the 2×1 unobservable state vector driven by the two structural shocks in $\boldsymbol{\eta}_t$. The model is of course a highly stylized representation of the Swiss economy in the 1930s. Therefore, we follow Ireland (2004) and incorporate a dynamic measurement error with VAR structure into the state vector to allow for off–model dynamics in the data:

$$\boldsymbol{\gamma}_t = \mathbf{A}\boldsymbol{\gamma}_{t-1} + \boldsymbol{\epsilon}_t; \boldsymbol{\epsilon}_t \sim N(\mathbf{0}, \boldsymbol{\Sigma}). \tag{3}$$

[8]Source: SNB monthly reports (1926–1929, 1936–1938) and *Die Volks-wirtschaft* (1930–1936).

[9]Landesindex für Konsumentenpreise, `www.statistik.admin.ch` (cc-d-05.02.17.xls).

[10]See Gordon (1939) and Koch (2000) for an overview. The index prior to 1926 is described in detail in Eidgenössisches Arbeitsamt (1923), the revised index in Bundesamt für Industrie, Gewerbe und Arbeit (1935).

[11]See Acklin (1939) and Balmer and Zurwerra (2000) for an overview.

[12]All data are available on request.

The structure of the extended state space model is therefore

$$\begin{aligned} \mathbf{y}_t &= \begin{pmatrix} \mathbf{Z} & \mathbf{I}_2 \end{pmatrix} \begin{pmatrix} \boldsymbol{\alpha}_t \\ \boldsymbol{\gamma}_t \end{pmatrix}; \\ \begin{pmatrix} \boldsymbol{\alpha}_t \\ \boldsymbol{\gamma}_t \end{pmatrix} &= \begin{pmatrix} \mathbf{T} & \mathbf{0} \\ \mathbf{0} & \mathbf{A} \end{pmatrix} \begin{pmatrix} \boldsymbol{\alpha}_{t-1} \\ \boldsymbol{\gamma}_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{R} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_2 \end{pmatrix} \begin{pmatrix} \boldsymbol{\eta}_t \\ \boldsymbol{\epsilon}_t \end{pmatrix}. \end{aligned} \tag{2'}$$

The setup allows to estimate the structural parameters of the model using Maximum Likelihood or Bayesian MCMC methods. We choose the Bayesian approach, since in this framework, it is straightforward to impose parameter restrictions using the prior distribution. The restrictions are necessary because there is no guarantee that the estimation algorithm results in parameter estimates which make sense from an economic point of view. If this turns out to be too restrictive, the measurement error variance will dominate the variance of the structural model.

We impose uniform priors with reasonable ranges for the structural parameters to be as loose as possible (see Table 3).[13] To generate the parameter chain, we use the tailored randomized MCMC method proposed by Chib and Ramamurthy (2010). The procedure is a modification of the standard Metropolis-Hastings algorithm (e.g. Chib and Greenberg, 1995). In each simulation step, the parameters are randomly combined into blocks. A proposal draw is generated from a multivariate t-distribution with a scale matrix derived at the conditional maximum of the posterior. The proposal is accepted if the value of the posterior at the new parameters is higher than for the old parameters. If not, it is accepted with an acceptance probability drawn from a uniform distribution $U(0,1)$, to ensure that we find a global maximum.

[13] For the VAR-component, we require that the maximum absolute eigenvalue of $\mathbf{A}$ is less than 0.6 to ensure that the persistence in the model comes from the structural shocks. In addition, the matrix $\boldsymbol{\Sigma}$ has to be positive semidefinite, and the maximum measurement error variance is not allowed to take values of more than 60 percent of the variance of the corresponding observable time series. This is similar to García-Cicco *et al.* (2010), who restrict the measurement error variance "to absorb no more than 6 percent of the variance of the corresponding observable time series" (p. 2519). Since the vectorized variance covariance matrix of the VAR part is given by $\text{vec}(\boldsymbol{\Sigma}_{\boldsymbol{\gamma}}) = (\mathbf{I}_4 - \mathbf{A} \otimes \mathbf{A})\,\text{vec}(\boldsymbol{\Sigma})$, our choice is not overly restrictive.

Table 3: Structural Parameters: Posterior Distribution

Parameter	Prior Dist.	Median	90 % Bands	Gewekes χ^2
β	calibrated	-	-	-
γ	calibrated	-	-	-
θ	$U \sim [5,7]$	6.425	[5.312,6.946]	0.358
η	$U \sim [1.5,3]$	2.660	[1.861,2.967]	0.875
σ	$U \sim [1.5,3]$	2.705	[2.026,2.969]	0.835
a	$U \sim [3,6]$	3.097	[3.009,3.373]	0.337
ω	$U \sim [0.4,1]$	0.995	[0.993,0.996]	0.878
$\rho_{y^\star}$	$U \sim [0,1]$	0.989	[0.983,0.993]	0.355
ρ_δ	$U \sim [0,1]$	0.999	[0.997,1.000]	0.189
$\sigma_{y^\star}$	$U \sim [0.01,0.03]$	0.020	[0.014,0.029]	0.615
σ_δ	$U \sim [0.01,0.03]$	0.010	[0.010,0.010]	0.371

Results are based on 400000 draws, where the first 150000 are discarded as burn-in draws. SBB freight data is used for industrial production.

4 Results

4.1 Parameter Distributions

With the algorithm described in the previous section, we draw 400000 replications, discarding the first 150000 as burn-in. Geweke's χ^2-test is used to assess convergence of the parameter chains (Geweke, 1992). Results of the posterior distribution of the structural parameters[14] are presented in Table 3 and show a presence of high persistence in foreign demand, terms of trade, and prices. This finding underlines the fact that price rigidities seem to be an important feature of the Swiss economy at this time.

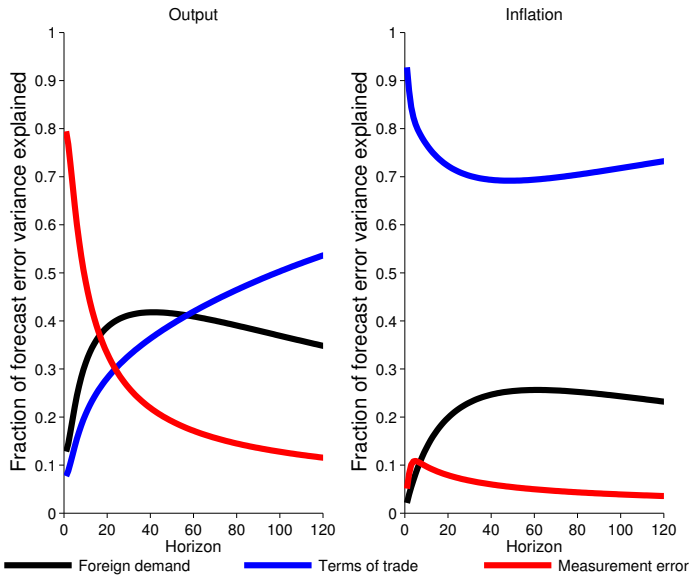
4.2 Forecast Error Variance Decomposition

The decomposition of the forecast error variance of output and inflation shows that the structural model, even though being quite stylized, contributes a significant part to the dynamics in the data, especially in the long run. The structural model is more important for inflation than for output – this demonstrates again that price rigidity is an important feature of the Swiss economy in this period. Inflation is mainly driven by movements in terms of trade both in the short and long run. Off-model dynamics are more important for output, which indicates that the model is not able to capture all the dynamics of this eventful period, especially in the short run. However, the structural part of the model becomes more and more important at longer horizons so that in

[14]Posterior distribution of measurement error components can be found in Appendix B.

the long run the measurement error only accounts for about 10 percent of the variation in output. Regarding the two structural shocks, foreign demand is slightly more important than terms of trade in the the short run, which in turn becomes more important in the long run.

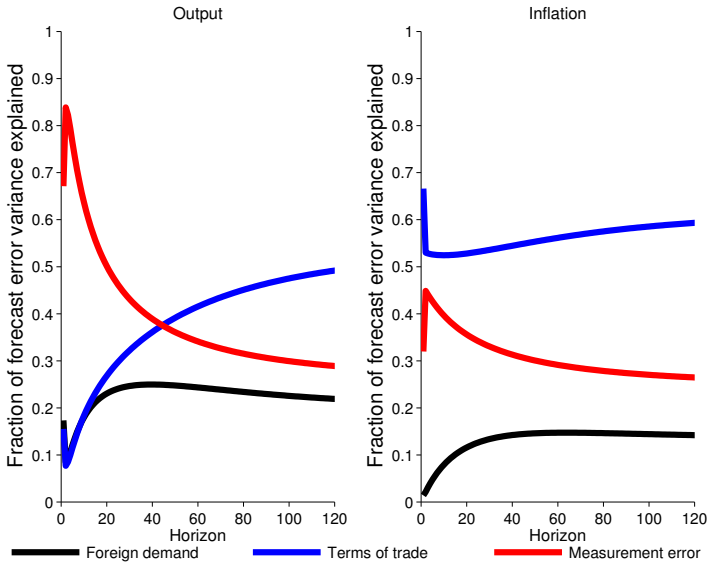
Figure 4: Forecast Error Variance Decomposition (SBB)



Results are based on median outcomes of the posterior distribution, SBB freight data is used for industrial production.

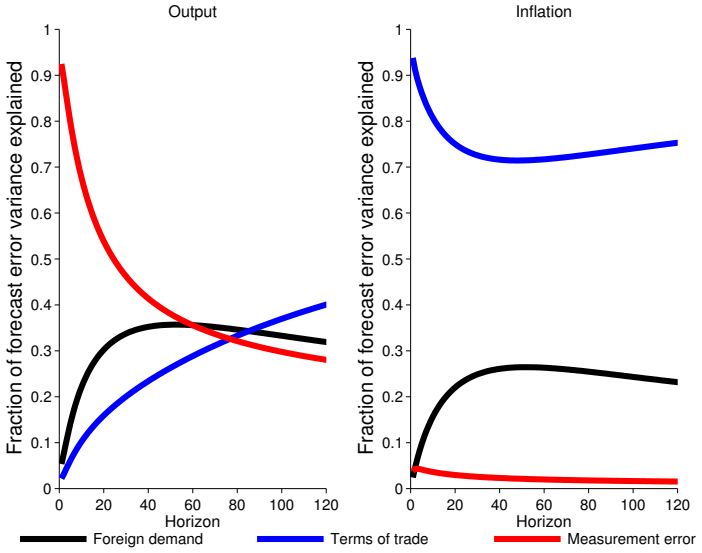
Figures 5 and 6 report the relative importance of the shocks in case we use silk or watch production as a proxy for industrial production instead of SBB freight data. While the results reveal a worse model fit in general for these two specifications, we find qualitatively similar results for the forecast error variance decomposition. Hence, the importance of terms of trade for the Swiss economy turns out to be a robust finding.

Figure 5: Forecast Error Variance Decomposition (Silk)



Results are based on median outcomes of the posterior distribution, silk production is used for industrial production.

Figure 6: Forecast Error Variance Decomposition (Watches)



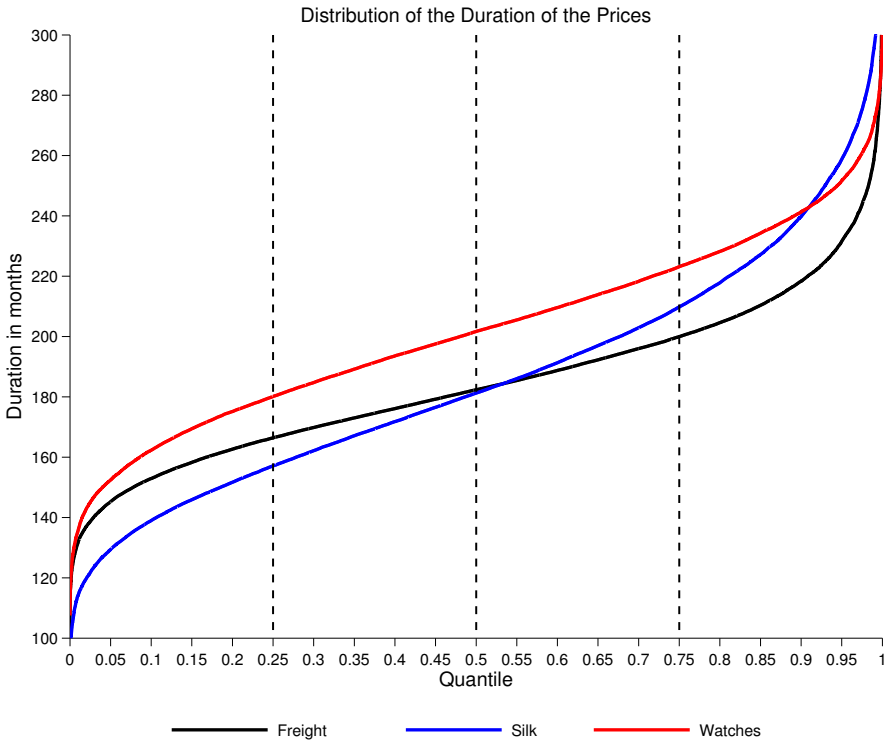
Results are based on median outcomes of the posterior distribution, watch production is used for industrial production.

4.3 Price Rigidities

Another robust finding are severe price rigidities. Figure 7 depicts the distribution of the average duration of a price being effective implied by the estimated posterior distributions of ω. The remarkably high degree of price stickiness of

the watches model is in line with an observed high degree of cartellization of the export sector as described in Section 2.

Figure 7: Average duration of prices ($\frac{1}{1-\omega}$)



Average duration in months implies by the estimated posterior distributions.

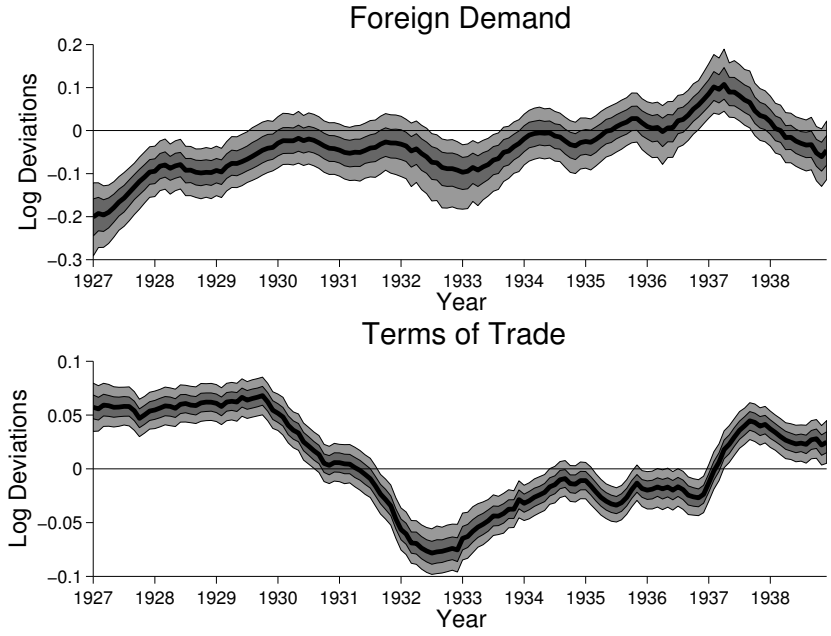
4.4 Estimated States

The fact that terms of trade and foreign demand are modeled as exogenous processes allows us to extract the model implied time series. The smoothed states displayed in Figure 8 are based on on 5000 draws from the posterior distribution. The foreign demand state shows the pattern of the business cycle for the main trading partners of Switzerland:[15] a downturn starting mid 1928, the lower turning point in 1932/33, and the recession 1936/37. This development should have helped Switzerland to escape earlier from the Great Depression. However, the terms of trade state shows that the Swiss franc stayed overvalued until autumn 1936. A sharp decline after the outbreak of the Great Depression in 1929 can be observed, and the terms of trade did not reach equilibrium until the devaluation of the Swiss franc in September 1936. The forecast error variance decomposition of output revealed that terms of

[15] See Table 1 for the import and export shares of the main trading partners in this period.

trade are more important than foreign demand. Consequently, the positive effect of increasing foreign demand after 1932/33 was overcompensated by the overvaluation of the Swiss franc, and the escape from the Great Depression did not start before September 1936.

Figure 8: Foreign Demand and Terms of Trade



Results are based on 5000 draws from the posterior distribution. Solid line denotes the median results, while the dotted line corresponds to the 90% highest posterior density interval.

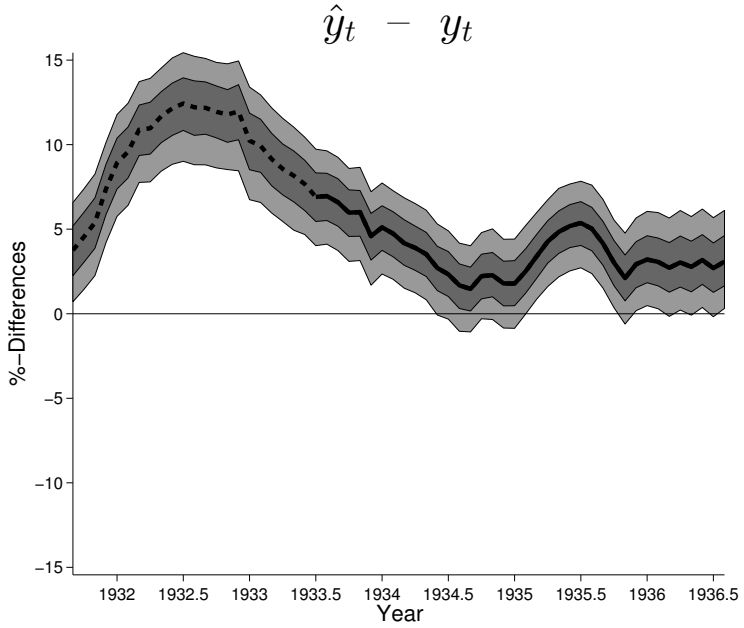
4.5 Counterfactual Experiments

4.5.1 Leaving Gold in 1931/33

What would have been the consequence of Switzerland leaving the Gold Standard together with Britain on September 21, 1931? What would have happened in case Switzerland did not participate in the Gold Block in July 1933 but devaluated their currency instead? To address the issue, we simulate the case of an early devaluation by setting the terms of trade state equal to one (i.e. the terms of trade are in equilibrium) and use 5000 draws from the posterior parameter distribution. We calculate the differences between the predicted log deviations of output from the actual deviations, which is equal to percent differences in levels. As can be seen from Figure 9, this difference is always positive after 1932. This is in line with out previous interpretation: obviously, the overvaluation of the Swiss franc against the sterling bloc and the US dollar caused the Swiss exporting sectors to profit less from the increasing demand

after 1932/33 than small European countries with a devalued currency such as the Scandinavian countries. At least, there was some growth: in real terms, exports increased by 16 % between 1932 and 1934. But in 1935, when sterling further weakened, the upward trend of exports decelerated.

Figure 9: Estimated Gain of Leaving Gold in September 1931 / July 1933



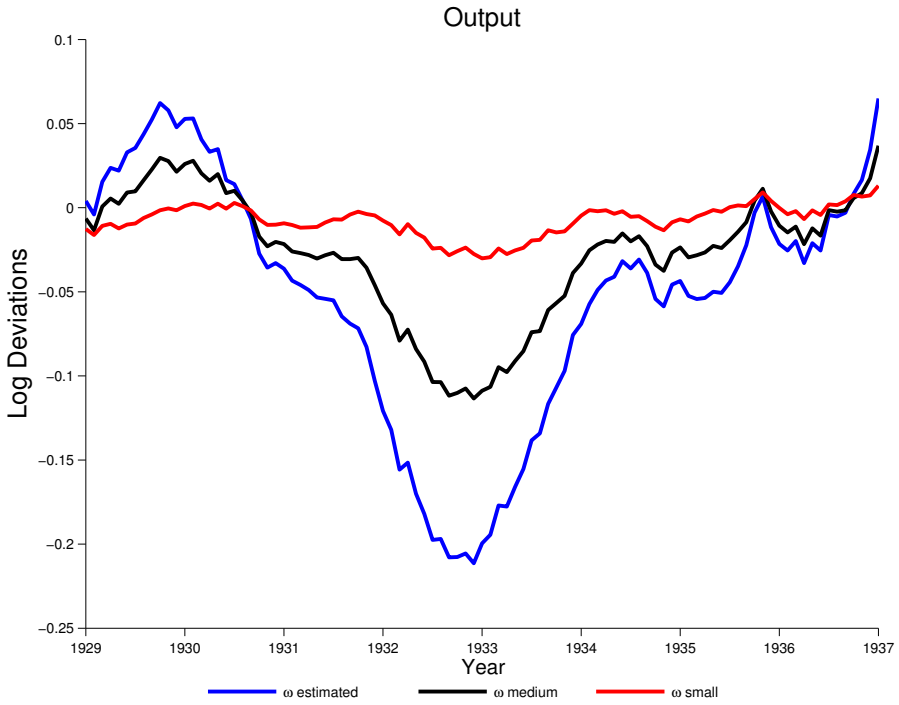
Results are based on 5000 draws from the posterior distribution. Light-gray shaded area represents 95 % probability bands, dark-gray shaded area represents 68 % probability bands, black line represents median.

4.5.2 Alleviating Price Rigidities

What would have been the implications for the Swiss economy of a lower degree of price stickiness? Would a policy intervention decreasing the degree of cartellization have been beneficial? We draw 5000 times from the posterior distribution and set ω equal to a lower counterfactual value. As a consequence, firms are in this experiment allowed to reset their price level more frequently. We analyze two different scenarios: (i) strong intervention (small ω): the average duration of prices being effective reduces from 182 to 50 months, and (ii) medium intervention (medium ω): the average duration of prices being effective reduces from 182 to 100 months. As a next step, we estimate the counterfactual level of output implied by the structural part of the model. Figure 10 depicts the results and emphasizes the potential benefits of policies that reduce price rigidities. In particular, the extend to which the economy is exposed to cyclical fluctuations is significantly reduces with a lower ω. Hence,

the severity of the Great Depression might have been amplified by the rise of corporatist policies.

Figure 10: Counterfactual Price Rigidities



Results are based on 5000 draws from the posterior distribution, median outcomes are reported. Small ω implies an average duration of prices being effective of 50 months, while medium ω implies 100 months. ω estimated implies a median duration of prices of 182 months.

5 Conlusion

As Choudhri and Kochin (1980) show, countries staying on gold, such as Netherlands, Belgium, Italy or Poland, faced a much more severe depression than the Scandinavian countries or Spain, which never returned to gold. The Gold Bloc countries stayed depressed, while the countries leaving gold early recovered by 1935 (Eichengreen and Sachs, 1985; Campa, 1990; Bernanke and James, 1991). The main determinants for the timing of abandoning the gold parity were deflationary pressure, the existence of banking crises, the gold cover ratio, and the extent of trade integration (Wolf, 2007, 2008).

The decision of Britain to abandon the gold standard on September 21, 1931 was seen as a catastrophe by contemporary Swiss policy makers.[16] Because of

[16] An example is the evaluation of this step as "disastrous" in the 25th Anniversary

the fear of inflationary pressure caused by a floating exchange rate and the fact that the accumulated gold stock was big enough to avert speculative attacks, Switzerland managed to stay on gold until September 26, 1936.

What were the consequences of this policy for the Swiss economy? In a New Keynesian small open economy framework, we show that foreign demand deviations from equilibrium started to increase in the second half of 1931. This should have had a positive effect on Swiss output. However, at the same time, the terms of trade deteriorated. Since the contribution of the terms of trade shock to the forecast error variance of output was higher than the contribution of foreign demand, the second effect dominated, and it took the Swiss economy until autumn 1936 to start recovering from the Great Depression.

Festschrift of the Swiss National Bank published in 1932: "*Am 21. September 1931 gab das durch große Goldabzüge bedrängte und dadurch in seinen Reserven bedrohte England die Goldwährung auf. Dieser Schritt war um so verhängnisvoller, als zahlreiche Staaten dem Beispiel Englands unmittelbar folgten*" (Schweizerische Nationalbank, 1932, p. 301/302).

Appendix A The Model

A.1 Households

The economy is populated by an infinitely lived representative household, which maximizes its expected lifetime utility according to

$$\max_{\{C_t,N_t,B_{t+1}\}_{t=0}^{\infty}} \mathrm{E}_t\left[\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\eta}}{1+\eta}\right)\right] \quad \text{s.t.} \quad P_tC_t+Q_tB_{t+1}\leq W_tN_t+B_t \tag{4}$$

where Q_t denotes the price of a one-period discount bond paying off one unit of domestic currency at time $t+1$, $\mathrm{E}_t\left[Q_{t,t+1}\right]\equiv Q_t=\frac{1}{R_t}$. Moreover, we impose a standard no-Ponzi condition, $\lim_{\tau\to\infty}\mathrm{E}_t\left[\frac{B_{t+\tau}}{\prod_{j=0}^{\tau}R_{t+j}}\right]=0$, which implies that the period budget constraint always holds with equality. B_t, W_t, σ, η, and β denote Bond holdings, the nominal wage, the inverse of the elasticity of substitution, the inverse of the wage elasticity of labor supply, and the discount factor respectively. C_t denotes a consumption composite index, i.e.

$$C_t=\left((1-\gamma)^{\frac{1}{a}}\left(C_t^h\right)^{\frac{a-1}{a}}+\gamma^{\frac{1}{a}}\left(C_t^f\right)^{\frac{a-1}{a}}\right)^{\frac{a}{a-1}}, \tag{5}$$

where C_t^f refers to one single foreign good, $C_t^h\equiv\left(\int_0^1\left(C_{t,j}^h\right)^{\frac{\theta}{\theta-1}}\mathrm{d}j\right)^{\frac{\theta}{\theta-1}}$ corresponds to a Dixit-Stiglitz CES aggregate of domestic goods, and $C_{t,j}^h$ a domestic variety j. The exact composition C_t and C_t^h is optimally chosen by the household. Moreover, $\gamma\in[0,1]$ represents a measure of openness, $a>0$ governs the substitutability between domestic and foreign goods, and $\theta>0$ denotes the elasticity of substitution between domestic varieties.

The household's utility maximization problem yields the following two standard optimality conditions:

$$\frac{N_t^{\eta}}{C_t^{-\sigma}}=\frac{W_t}{P_t}; \tag{6}$$

$$\mathrm{E}_t\left[Q_{t,t+1}\right]=Q_t=\beta\mathrm{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\right]. \tag{7}$$

Equation (6) captures optimal static labor supply decision, i.e. marginal rate of substitution between labor and leisure is equal to the real wage rate, while the inter–temporal Euler equation is represented by equation (7).

A.2 Firms

Each firm j produces according to

$$Y_{t,j} = N_{t,j}, \tag{8}$$

with labor as the only input factor. Profits are maximized by minimizing costs for a given amount of output, i.e.

$$\min_{N_{t,j}} \frac{W_t}{P_t^h} N_{t,j}, \qquad \text{s.t.} \qquad Y_{t,j} = N_{t,j}. \tag{9}$$

The resulting first order condition contains the real marginal costs of production, which is denoted by Ψ_t. W_t represents the nominal wage. Since marginal costs are constant, Ψ_t is also equal to the real average cost or real unit cost of production:

$$\frac{W_t}{P_t^h} - \Psi_t = 0 \Leftrightarrow \Psi_t = \frac{W_t}{P_t^h} = W_t^r. \tag{10}$$

In equilibrium, goods market clearing implies

$$Y_t = C_t^h + C_t^{h\star}, \tag{11}$$

which yields the demand functions for variety j,

$$C_{t,j}^h + C_{t,j}^{h\star} = \left(\frac{P_{t,j}^h}{P_t^h}\right)^{-\theta} Y_t. \tag{12}$$

$P_{t,j}^h$ denotes the price of domestic variety j, and P_t^h corresponds to the price index of domestic goods.

Prices are sticky in the sense that with a probability ω firms are not allowed to optimally update their price at the beginning of the period. As stated above, price stickiness is an important stylized fact for the period under analysis: a large share of domestic prices and wages was fixed by the government.

The pricing mechanism used here goes back to Calvo (1983). $\bar{P}_{t,j}^h$ denotes the price set by firm j in period t, which implies $P(P_{t+\tau,j}^h = \bar{P}_{t,j}^h) = \omega^\tau$. Moreover, since all firms are identical and face identical demand curves, $\bar{P}_{t,j}^h = \bar{P}_t^h$. Therefore, period t profit of firm j, conditional on being allowed to reset its price is

$$\pi_{t,j} = \left(\bar{P}_t^h - P_t^h \Psi_t\right)\left(C_{t,j}^h + C_{t,j}^{h^\star}\right) = \left(\bar{P}_t^h - P_t^h \Psi_t\right)\left(\frac{\bar{P}_t^h}{P_t^h}\right)^{-\theta} Y_t, \tag{13}$$

where $P_t^h \Psi_t$ corresponds to the nominal unit costs.

Conditional on being allowed to reset its price level, firm j maximizes the expected current market value of profits while the price remains effective. In particular,

$$\max_{\bar{P}_t^h} \quad \mathrm{E}_t \left[\sum_{\tau=0}^{\infty} \omega^\tau Q_{t,t+\tau} \left(\bar{P}_t^h - P_{t+\tau}^h \Psi_{t+\tau} \right) \left(\frac{\bar{P}_t^h}{P_{t+\tau}^h} \right)^{-\theta} Y_{t+\tau} \right], \tag{14}$$

where $Q_{t,t+\tau} = \beta^\tau \frac{\Lambda_{t+\tau}}{\Lambda_t}$ denotes the stochastic discount factor for nominal payoffs. The first order condition with respect to $\bar{P}_t^h$ is

$$\mathrm{E}_t \left[\sum_{\tau=0}^{\infty} \omega^\tau Q_{t,t+\tau} \frac{\Lambda_{t+\tau}}{\Lambda_t} Y_{t+\tau} \left((1-\theta) \left(\frac{\bar{P}_t^h}{P_{t+\tau}^h} \right)^{-\theta} + \theta \left(\frac{\bar{P}_t^h}{P_{t+\tau}^h} \right)^{-\theta-1} \Psi_{t+\tau} \right) \right] = 0. \tag{15}$$

A.3 Global Characteristics

A.3.1 Exchange Rate & Terms of Trade

We assume that the law of one price holds, i.e.

$$P_t^f = S_t P_t^\star, \tag{16}$$

where $P_t^\star$, P_t^f, S_t denote the foreign price of the foreign produced good denoted in foreign currency, the foreign price of the foreign produced good denoted in domestic currency, and the nominal exchange rate, expressed as the price of foreign currency in terms of domestic currency respectively. The real exchange rate is

$$\Phi_t = \frac{P_t^f}{P_t} = \frac{S_t P_t^\star}{P_t}, \tag{17}$$

and corresponds to the price of a foreign good in terms of domestic consumption bundles, while the terms of trade, the price of a foreign good in terms of domestic goods, is defined as

$$\Delta_t = \frac{P_t^f}{P_t^h} = \frac{S_t P_t^\star}{P_t^h}, \tag{18}$$

and follows an exogenous and stationary AR(1) process in logs,

$$\ln(\Delta_t) = \rho_\delta \ln(\Delta_{t-1}) + \epsilon_t^\delta, \qquad \epsilon_t^\delta \sim N(0, \sigma_\delta^2), \tag{19}$$

where $\rho_\delta < 1$ characterizes the persistence parameter and σ_δ^2 the variance of the shock ϵ_t^δ.

A.3.2 Foreign Country

The domestic economy is an infinitesimal small open economy whereas the foreign economy can be thought of as an aggregate of infinitely many identical infinitesimal small open economies. Therefore, in the aggregate, net exports of all foreign economies will sum up to zero, which implies $C_t^\star = Y_t^\star$.

Foreign demand is denoted by $Y_t^\star$ and it follows an exogenous stationary AR(1) process in logs,

$$\ln(Y_t^\star) = (1-\rho_\star)\ln(Y^\star) + \rho_\star \ln(Y_{t-1}^\star) + \epsilon_t^\star, \quad \epsilon_t^\star \sim N(0, \sigma_{y^\star}^2), \tag{20}$$

with a persistence parameter $\rho_\star$ smaller than one and a variance $\sigma_{y^\star}^2$ of the shock $\epsilon_t^\star$.

A.3.3 International Trade

Exports are denoted in domestic goods and given by

$$EX_t = C_t^{h\star}. \tag{21}$$

For imports (denoted in domestic goods), we have

$$IM_t = \frac{P_t^f}{P_t^h} C_t^f \tag{22}$$

Net exports (denoted in domestic goods) are the difference between exports and imports,

$$NX_t = EX_t - IM_t. \tag{23}$$

A.3.4 International Risk Sharing

International risk sharing under complete markets implies that the stochastic discount factor among different countries is equal (Chari *et al.*, 2002),

$$Q_{t,t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\sigma} \frac{P_t}{P_{t+1}} = \beta \left(\frac{C_{t+1}^\star}{C_t^\star}\right)^{-\sigma} \frac{S_t P_t^\star}{S_{t+1} P_{t+1}^\star}, \tag{24}$$

which implies the following international risk sharing condition:[17]

$$\left(\frac{C_t^\star}{C_t}\right)^{-\sigma} = \Phi_t. \tag{25}$$

Note that complete markets imply this simple relationship linking the real exchange rate to the ratio of the marginal utilities of consumption of domestic and foreign households.

A.4 Market Clearing and Aggregate Production Function

The firm level production function is represented by

$$N_{t,j} = Y_{t,j}. \tag{26}$$

Labor market clearing implies

$$N_t = \int_0^1 N_{t,j} \mathrm{d}j, \tag{27}$$

which enables us to compute the aggregate production function

$$\begin{aligned} N_t =& \int_0^1 Y_{t,j} \mathrm{d}j = \int_0^1 \left(\frac{P_{t,j}^h}{P_t^h}\right)^{-\theta} \left(C_t^h + C_t^{h\star}\right) \mathrm{d}j = \\ =& Y_t \underbrace{\int_0^1 \left(\frac{P_{t,j}^h}{P_t^h}\right)^{-\theta} \mathrm{d}j}_{\zeta_t} = Y_t \zeta_t \qquad \Leftrightarrow \\ Y_t =& \frac{N_t}{\zeta_t}. \end{aligned} \tag{28}$$

Appendix B Additional Estimation Results

[17] $\left(\frac{C_t^\star}{C_t}\right)^{-\sigma} = \underbrace{\left(\frac{C_0^\star}{C_0}\right)^{-\sigma} \frac{1}{\Phi_0}}_{\mu} \Phi_t = \mu \Phi_t$ represents the general form of the risk sharing condition. Without loss of generality we set the initial condition μ equal to one.

Table 4: Non–Structural Parameters: Posterior Distribution

Parameter	Prior Dist.	Median	90 % Bands	Gewekes χ^2
a_{11}	stationary	0.918	[0.745,1.082]	0.948
a_{21}	stationary	-0.774	[-1.040,-0.550]	0.693
a_{31}	stationary	-0.011	[-0.017,-0.006]	0.322
a_{12}	stationary	0.257	[0.126,0.379]	0.431
a_{22}	stationary	-0.017	[-0.200,0.172]	0.358
a_{23}	stationary	0.001	[-0.004,0.006]	0.588
a_{13}	stationary	0.000	[-0.068,0.019]	0.451
a_{23}	stationary	0.001	[-0.090,0.352]	0.515
a_{33}	stationary	0.000	[-0.001,0.004]	0.581
$\sqrt{\text{VAR}(\nu_y)}$	positive definite	0.050	[0.045,0.056]	0.282
$\sqrt{\text{VAR}(\nu_{nx})}$	positive definite	0.067	[0.060,0.074]	0.349
$\sqrt{\text{VAR}(\nu_\pi)}$	positive definite	0.001	[0.000,0.001]	0.457
$\text{COV}(\nu_y, \nu_{nx})$	positive definite	-0.001	[-0.002,-0.001]	0.700
$\text{COV}(\nu_y, \nu_\pi)$	positive definite	0.000	[0.000,0.000]	0.446
$\text{COV}(\nu_{nx}, \nu_\pi)$	positive definite	0.000	[0.000,0.000]	0.564

The VAR matrix is restricted to have a maximum absolute eigenvalue of 0.6 and its entries are only allowed to take on absolute values smaller or equal to 2. The variance-covariance matrix of the measurement error is restricted to be positive definite and its entries on the main diagonal are only allowed to take on values, which are not larger than 60 percent of the variance of the corresponding data series. Results are based on 400000 draws, where the first 150000 are discarded as burn-in draws. SBB freight data is used for industrial production.

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