Rosenkranz *et al.*
Swiss Journal of Economics and Statistics (2022) 158:20
https://doi.org/10.1186/s41937-022-00100-9

Swiss Journal of Economics and Statistics

ORIGINAL ARTICLE

Open Access

The limits of internal devaluation: Switzerland during the great depression

Peter Rosenkranz[1], Tobias Straumann[2*] and Ulrich Woitek[2]

Abstract

During the Great Depression, countries endowed with abundant gold reserves were not able to leave the gold standard and devalue their currencies until the mid-1930s. Instead, they were forced to go down the road of internal devaluation. We analyze the policies of the Swiss authorities by estimating a New Keynesian small open economy model. Our results show that the long adherence to the gold standard and the failure of internal devaluation imposed considerable costs on the Swiss economy. Moreover, counterfactual exercises suggest that a timely devaluation would have led to an early recovery from the Great Depression.

Keywords: Great Depression, Switzerland, New Keynesian business cycle model

JEL Classification: E12, E32, N14

1 Introduction

The basic relationship between the interwar gold standard and the duration of the Great Depression is well known. Most economic historians agree that countries staying on gold until the mid-1930s—the so-called gold bloc consisting of Belgium, France, the Netherlands, Italy, and Poland—experienced a longer economic crisis in the 1930s than the UK and the Scandinavian countries which left the gold standard as early as 1931 (Choudhri & Kochin, 1980; Eichengreen & Sachs, 1985; Campa, 1990; Bernanke & James, 1991; Eichengreen, 1992; Feinstein et al., 1997). Empirical studies have also demonstrated that the main determinants of 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).

Yet, we still lack a deeper quantitative understanding of why the gold bloc countries were not able to induce a sufficient depreciation of the real exchange rate by internal devaluation, i.e., by lowering nominal wages and prices. If they had succeeded, they would have been able to restore the price competitiveness of their tradable sectors which would have mitigated the severity of the economic crisis. To contribute to a better understanding of the limits of internal devaluation during the Great Depression, we investigate the policies of the Swiss authorities. Switzerland is a particularly interesting case because the Swiss National Bank (SNB) disposed of such large amounts of gold reserves that it managed to withstand any period of capital outflows without raising the official discount rate in a dramatic way. All other countries were forced to tighten their monetary policies when faced with speculative attacks on their currencies. The Swiss case thus enables us to study the mechanism of internal devaluation without the inference of monetary policy shocks.

We approach the problem in two steps. First, we provide the historical background and discuss the dynamics of wages and prices. Our descriptive approach shows a high degree of asynchrony of wage and price

*Correspondence: tobias.straumann@econ.uzh.ch

[2] Department of Economics, University of Zurich, Zürichbergstrasse 14, CH-8032 Zürich, Switzerland
Full list of author information is available at the end of the article

movements due to different business cycles of the external sectors and the domestic economy. From 1929 to 1932, wholesale prices fell by a third and consumer prices by a fifth, then leveled out, whereas nominal wages did not start to move downwards until 1932 and declined by only 10 percent until 1936 when the Swiss franc was devalued which marked the end of the Great Depression in Switzerland. The reason for the late decline of nominal wages was the boom of the domestic economy, in particular of the building sector, that lasted until 1931.

Thus, in the first phase of the depression, wages failed to adjust because of institutional constraints, but due to the persistence of domestic demand, and as prices rapidly declined, real wages rose from 1929 until 1931 which put the exporting sectors in a particular difficult situation after the nominal exchange rate strongly appreciated in the wake of the devaluation of the British pound, the US dollar and many other currencies. By 1936 when the Swiss franc was devalued real wages were still higher than in 1929, although nominal wages had drifted downwards for several years. By contrast, consumer prices became very sticky in the second phase of the depression. The reason was that the long duration of the crisis led to all sorts of protectionist and regulatory measures aimed at stabilizing economic activity and securing political peace. Of course, the increasing rigidity of prices led to the exact opposite. The lesson to be drawn from the Swiss experience is that even in a liberal market economy the extent to which wages and prices could be lowered was limited. Wage movements depended on the domestic business cycle, whereas price movements increasingly became a function of corporatist compromises.

The second part of the paper is devoted to the econometric analysis of the costs and limits of the policies pursued by the Swiss authorities. We estimate the structural parameters of a New Keynesian small open economy model for Switzerland in the spirit of Clarida (2000, 2001) and Galí Monacelli (2005), going beyond the calibration exercise in Bordo (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.

Fig. 1 Real Exports and Imports of Switzerland, 1929–1939 (1929 = 100). *Data Source*: SNB (1944)

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., 2017).

2 The Swiss economy, wages and prices

Switzerland, a small open economy, immediately felt the collapse of world demand after 1929. Real exports accounting for 20 percent of Gross Domestic Product fell by more than 50 percent until June 1932 and only slightly recovered until the Swiss franc was devalued in September 1936. By contrast, the domestic economy showed a remarkable resilience in the first phase of the depression. Accordingly, in real terms imports increased

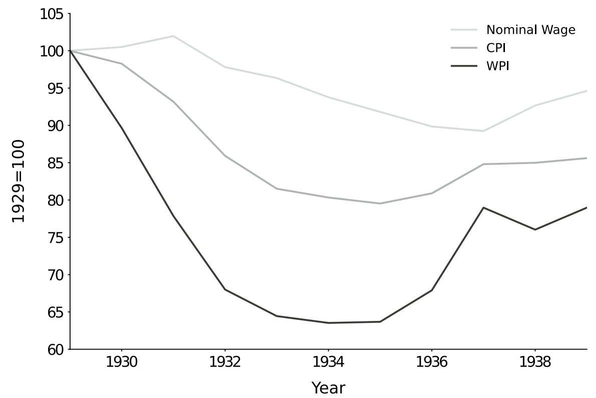


Fig. 2 Wholesale Price Index (WPI), Consumer Price Index (CPI) and Nominal Wage in Switzerland, 1929–39 (1929 = 100) *Data Source*: SNB (1944)

by 6 percent between 1929 and 1931 before they started to decline. Yet, while exports bottomed out after 1932, imports continued to shrink until they reached 68 percent of the 1929 level (Fig. 1). The reason for the resilience of the domestic economy was the construction boom. From 1927 to 1931, the estimated building activity increased from CHF 940 million to CHF 1295 million and did not start to decrease until 1932 (Ritzmann-Blickenstorfer, 1996, p. 891).

The asynchrony of world and domestic demand had far-reaching consequences for the movement of Swiss wages and prices. In sync with the collapse of world trade wholesale prices declined by a third between 1929 and 1933, pushing down consumer prices nearly 20 percent within the same period of time. By contrast, the average nominal wage remained stable before entering the downward slope in 1932. By 1936, the beginning of the recovery, it had decreased by 10 percent (Fig. 2). As the decline of CPI was more accentuated then the decline of the average nominal wage, the average real wage was still about 5 percent higher in 1936 than in 1929. In other words, internal devaluation was happening, but only to a limited extent and at a considerable cost.

Yet, the asynchrony of external and domestic business cycles does not explain the full extent of the wedges shown in Fig. 2. First, the large gap between WPI and CPI persisted after 1933, suggesting considerable price rigidity. A historical analysis of the political economy of crisis management explains the reason. As the crisis wore on and nominal wages began to fall after 1931, the popular support for internal devaluation gradually eroded. Business associations and agricultural pressure groups prompted the Swiss government to pass regulations protecting individual economic sectors and fixing prices. Instead of enabling the downward adjustment, the government sought to cushion the negative effects of an overvalued currency by containing competition (Rutz, 1970). 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 newly introduced rigidities proved to be fatal.

Second, a 10 percent decrease of the nominal wage was sizeable, but not sufficient given that the nominal exchange rate of the Swiss franc between 1931 and 1935 appreciated by 40 percent against the currencies of most of its trading partners. This nominal appreciation was the result of the devaluation of the British pound in September of 1931, followed by many countries tied to sterling, and of the US dollar in April 1933. Moreover, the gold bloc formed in spring 1933 by Belgium, France, Italy, the Netherlands, Poland, and Switzerland, aiming at maintaining gold convertibility at current parities, was too small to make Swiss exports recover. Cracks appeared as early as one year after its formation. In 1934, Italy introduced capital controls, and Belgium left the gold standard and devalued in March 1935. Finally, it collapsed completely, after the left-wing Popular Front formed a new French government in May 1936 and embarked on expansionary fiscal policies, thus stopping the process of internal devaluation and encouraging capital flight. In September 1936, the French government decided to suspend the gold standard and to devalue. The Netherlands and Switzerland followed (Eichengreen, 1992; Feinstein et al.,1997).

The reason for the formation of the gold bloc was that in 1933 all these countries disposed of sufficient gold and foreign exchange reserves, thus lacking a reason to suspend the gold standard. Switzerland was special in that it disposed of the highest amount of gold reserves relative to GDP, enabling the central bank to keep its discount rate low in the face of capital outflows, while all other central banks were forced to stem capital outflows by increasing the official discount rate. To show that the conventional gold standard mechanism did not apply to Swiss monetary policy, 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 ($GOLD = PGOLD \times QGOLD$):

Table 1 Decomposition of Swiss Money Supply, 1922–1936 *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 (p. 31)

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

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

$$M1 = \frac{M1}{BASE} \times \frac{BASE}{RES} \times \frac{RES}{GOLD} \times PGOLD \times QGOLD \tag{1}$$

The results reported in Table 1 show that the ratio of the monetary base to international reserves (BASE/RES) is not stable, and hence, the cover ratio was significantly varying over time. In fact, it went up from 78% in 1925 to almost 100% in 1931. Consequently, during the Great Depression large outflows of foreign exchange and gold reserves (as in 1935) did not fully translate into a decrease of the monetary base proportional to the cover ratio. This special feature of Switzerland makes the analysis of the limits and costs of internal devaluation easier, as the influence of monetary policy remains constant over time. This will be relevant for the setup of the model explained in the next section.

3 The model

The underlying model corresponds to the basic New Keynesian small open economy model as introduced by Monacelli (2005) and Galí (2008). Already in the Interwar years, the Swiss economy was characterized by a high degree of openness. 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 prices 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). One should bear in mind, however, that there might be other rigidities affecting the marginal costs of firms, which would also lead to sticky output prices, and that the estimated Calvo parameter might actually "summarize" all the influences the model does not directly capture. In addition, the results in Table 1 motivate the decision not to include a particular Gold Standard mechanism into the model as opposed to, e.g., Bordo (2007).

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. Moreover, we allow for monopolistic competition and nominal rigidities to assess the role of price rigidities and its importance during the Interwar Period in Switzerland. The home economy is infinitesimal

Table 2 Posterior Distributions of Structural Parameters

Parameter	Prior Dist.	Median	s.d.	90% Bands	NSE
θ	$U(5, 7)$	6.42484	0.50915	[5.31162 , 6.94593]	0.00801
η	$U(1.5, 3)$	2.65994	0.34587	[1.86075 , 2.96740]	0.01032
σ	$U(1.5, 3)$	2.70467	0.29601	[2.02552 , 2.96884]	0.00650
a	$U(3, 6)$	3.09672	0.12358	[3.00868 , 3.37349]	0.00144
ω	$U(0.4, 1)$	0.99452	0.00078	[0.99311 , 0.99568]	0.00002
$\rho_{y^\star}$	$U(0, 1)$	0.98893	0.00291	[0.98322 , 0.99266]	0.00007
ρ_δ	$U(0, 1)$	0.99911	0.00115	[0.99650 , 0.99996]	0.00002
$\sigma_{y^\star}$	$U(0.0001, 0.001)$	0.00041	0.00420	[0.00020 , 0.00082]	0.00015
σ_δ	$U(0.0001, 0.001)$	0.00010	0.00007	[0.00010 , 0.00010]	0.00000

The discount factor β and the preference parameter γ are calibrated (β=0.99; γ=0.25). θ: elasticity of substitution (domestic varieties); η: wage elasticity of labor supply (inverse); σ: elasticity of substitution (inverse); a: substitutability between domestic and foreign goods; ω: Calvo parameter. Parameters of exogenous AR(1)-processes: foreign demand $\rho_{y^\star}$;terms of trade ρ_δ, with standard deviations $\sigma_{y^\star}$ and σ_δ.

Results are based on 400,000 draws, where the first 150,000 are discarded as burn-in. The NSE is based on a 15% autocovariance taper

small and does not affect the economy of the rest of the world, and markets are assumed to be complete, i.e., agents trade a full set of state contingent bonds. In every period, economic agents form rational expectations, the representative household maximizes expected lifetime utility, and firms maximize expected profits.

The solution of the model leads to a nonlinear 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

$$\begin{aligned} \mathbf{x}_t &= \mathbf{Z}\boldsymbol{\alpha}_t; \\ \boldsymbol{\alpha}_t &= \mathbf{T}\boldsymbol{\alpha}_{t-1} + \mathbf{R}\boldsymbol{\nu}_t, \quad \boldsymbol{\nu}_t \sim N(\mathbf{0}, \mathbf{Q}), \end{aligned} \tag{2}$$

where $\mathbf{x}_t$ is a 3×1 vector of observables (output, inflation, and net exports), and $\boldsymbol{\alpha}_t$ is the 2×1 unobservable state vector driven by the two structural shocks in $\boldsymbol{\nu}_t$ with variance $\mathbf{Q}$. 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 a vector autoregressive (VAR) structure into the state vector to allow for off-model dynamics in the data. The setup allows to estimate the structural parameters of the model using Bayesian Markov Chain Monte Carlo (MCMC) methods. A more detailed description of the model setup and the estimation strategy can be found in Appendices C and E.

4 Data

For the estimation exercise, we use monthly data of industrial production, inflation, and net exports, ranging from January 1926 to December 1938. An official industrial production index for the period of interest is not available, a situation which was caused by the reluctance of the industry sector to provide the necessary background data. The overview in the *Statistisches Handbuch der Weltwirtschaft* published by the German statistical 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. 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.[1]

Inflation data are calculated based on the consumer price index taken from the Federal Statistical Office.[2] As already mentioned, there are high quality trade statistics available for Switzerland, both by volume and value, at monthly frequency.[3] We use the *Monatsstatistik des auswärtigen Handels der Schweiz*, 1926–1938, calculate exports and imports at constant prices (July 1926), and add the ratio of exports over imports to our vector of observables.[4]

Since our estimation approach requires stationary data, we detrend log industrial production prior to estimation

[1] Source: SNB monthly reports (1926–1929, 1936–1938) and *Die Volkswirtschaft* (1930–1936).

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

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

[4] All data are available on request.

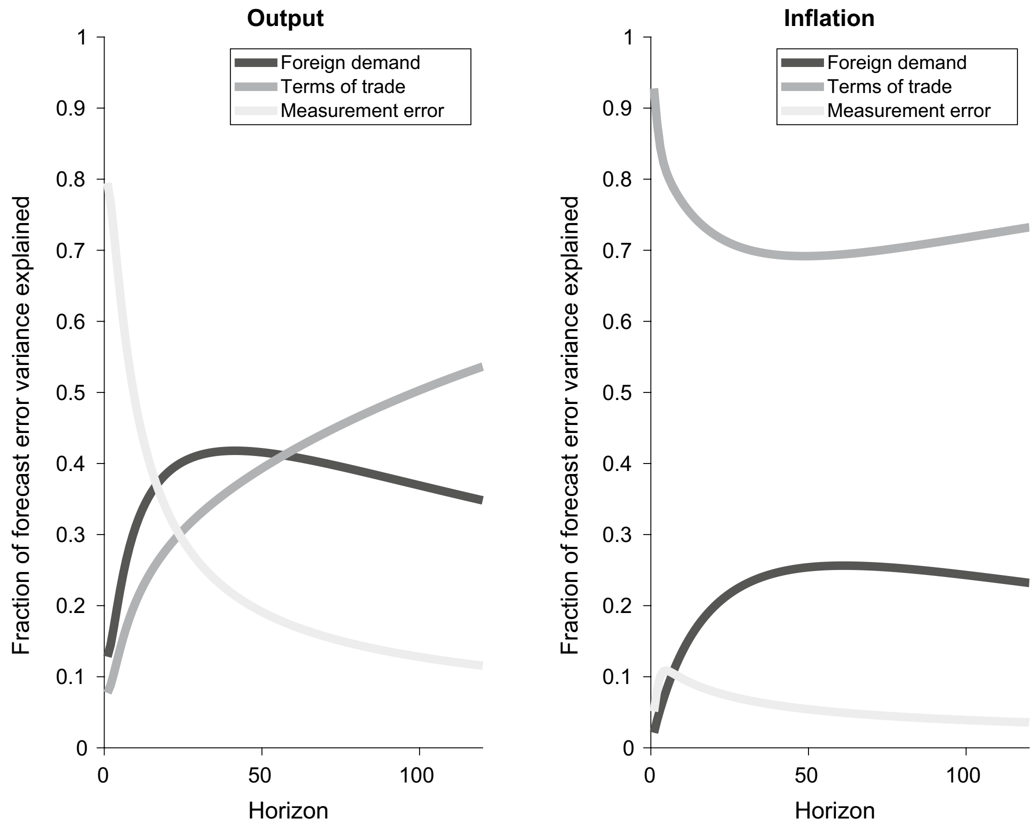


Fig. 3 Forecast Error Variance Decomposition. Results are based on median outcomes of the posterior distribution

(second-order polynomial). Furthermore, in all our time series we observe a strong seasonal pattern. Therefore, we also deseasonalize the time series before the estimation. In particular, for output we use the cyclical component of a quadratically detrended and X–12 deseasonalized time series. For the log export/import ratio, we use a demeaned and X–12 seasonally adjusted time series, while for inflation, we use year-to-year growth rates of the monthly consumer price index.

5 Results

5.1 Parameter distributions

With the algorithm described in Sect. 3, we draw 400,000 replications, discarding the first 150,000 as burn-in. Results of the posterior distribution of the structural parameters[5] are presented in Table 2 and show a presence of high persistence in foreign demand, terms of trade, and prices. The median estimate for ω is unusually high. One might speculate whether this is due to the fact that it captures more than price rigidity. This finding underlines the fact that rigidities seem to be an important feature of the Swiss economy at this time.

5.2 Forecast error variance decomposition

The decomposition of the forecast error variance, presented in Fig. 3 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. Based on the contribution of the structural shocks relative to the measurement errors, the model choice turned out to be appropriate and well-suited for explaining macroeconomic fluctuations of the Swiss economy during the Interwar Period.

[5] The posterior distributions of the measurement error components can be found in Appendix D.

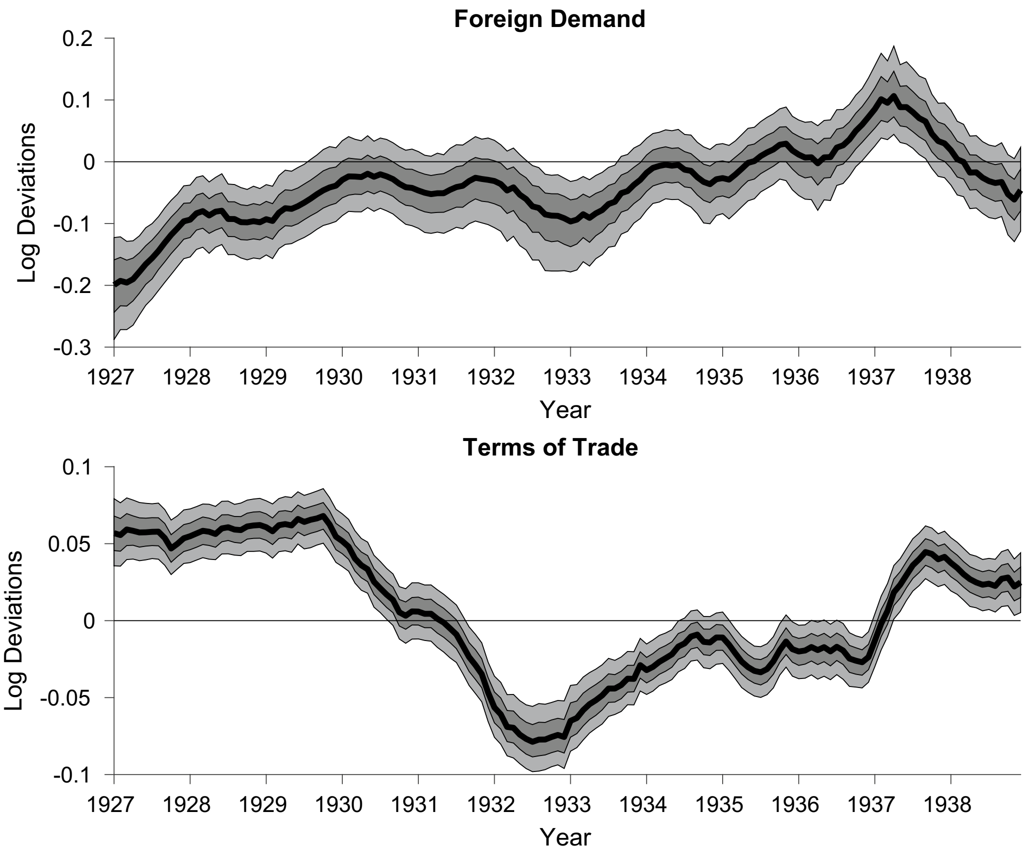


Fig. 4 Estimated Exogenous States. Results are based on 5000 draws from the posterior distribution. Light-gray shaded area represents 95% probability bands, dark-gray shaded area represents 68% probability bands, black line represents median

Furthermore, the structural model is more important for inflation than for output—this finding could be interpreted as supportive evidence for price rigidity being an important feature of the Swiss economy in this period. But of course, other frictions may also play a role. One could also argue that output is measured by a proxy (SBB freight data). Hence, the contribution of off-model dynamics is higher than for inflation. In other words, 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 the long run the measurement error only accounts for about 10 percent of the variation in output. Inflation is mainly driven by movements in terms of trade both in the short and in the long run. Regarding the two structural shocks, foreign demand is slightly more important than terms of trade in the short run, which in turn becomes more important in the long run.

5.3 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 Fig. 4 are based on 5000 draws from the posterior distribution and using the Kalman filter to generate the time series. The foreign demand state shows the pattern of the business cycle for the main trading partners of Switzerland: 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 show that the Swiss franc stayed overvalued until autumn 1936. The sharp amelioration of the terms of trade time series almost perfectly coincides with the devaluation of the Swiss franc on September 26 in 1936. This finding is even more remarkable, since we did not include any data on exchange rates or terms of trade in

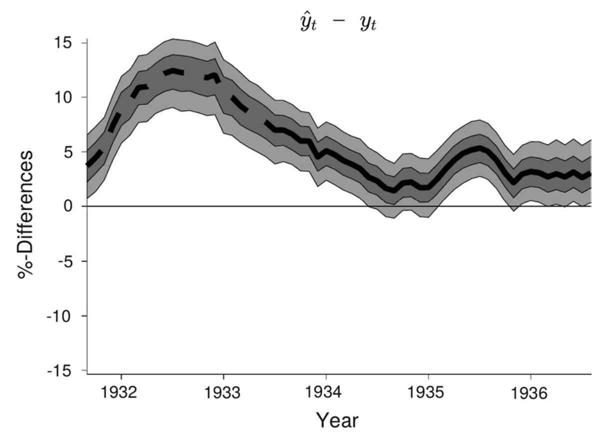


Fig. 5 Estimated Gain of Leaving Gold in September 1931/July 1933. Results are based on 5000 draws from the posterior distribution. Light-gray shaded area represents 95% probability bands, dark-gray shaded area represents 68% probability bands, black line represents median

the estimation exercise. 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 reveals that terms of 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.

5.4 Counterfactual experiments

5.4.1 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

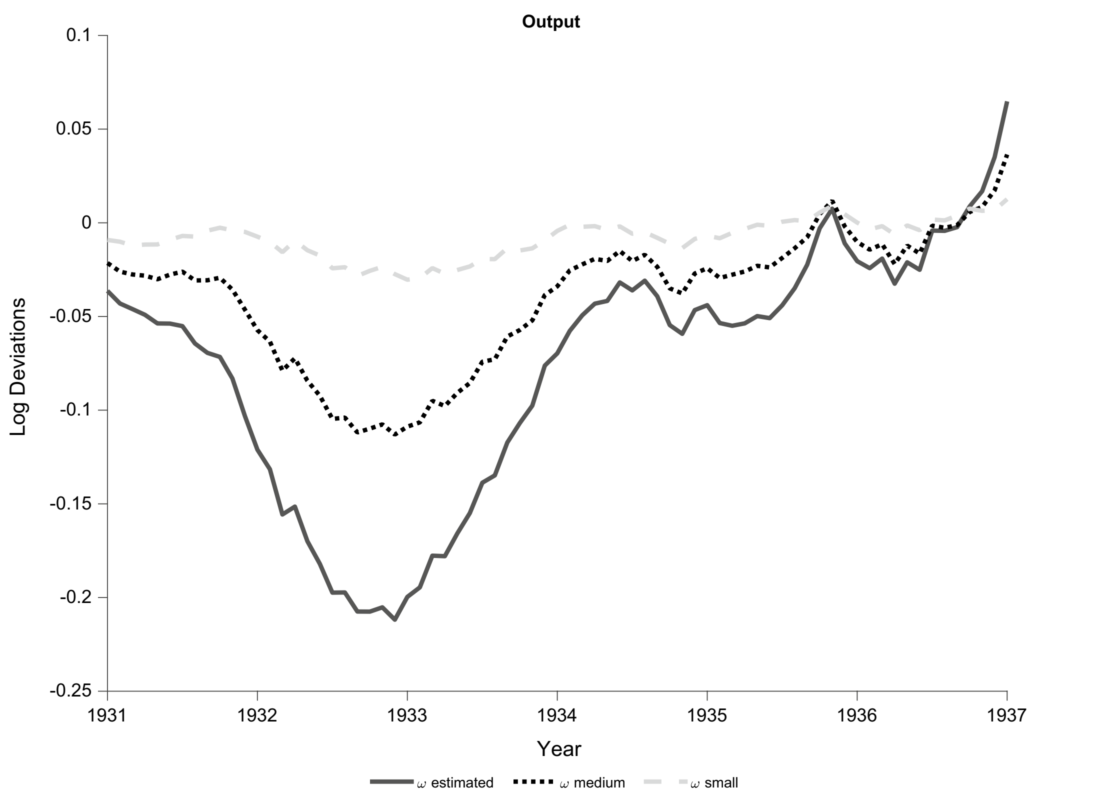


Fig. 6 Counterfactual Price Rigidities.*Notes* Results are based on 5000 draws from the posterior distribution, median outcomes are reported. Small ω implies an average duration of prices being effective of 50 months, while medium ω implies 100 months. ω estimated implies a median duration of prices of 182 months

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 and the Kalman filter to generate the counterfactual time series of interest. 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 Fig 5, this difference turns out to be always positive after 1932. This is in line with our 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.

5.4.2 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 cartelization have been beneficial? We look at these questions through the lens of the estimated model and draw 5000 times from the posterior distributions of the parameters, setting 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 (calculated at the median of the posterior distribution) to 50 months; and (ii) medium intervention (medium ω): the average duration of prices being effective reduces from 182 to 100 months. Price stickiness turns out to be very high compared to the results found in the literature. As argued above, the estimated Calvo parameter might actually "summarize" all the influences the model does not directly capture.

Bearing this caveat in mind, we estimate the counterfactual level of output implied by the structural part of the model by generating counterfactual data. Figure 6 shows the results and emphasizes the potential benefits of policies that reduce price rigidities. In particular, the extent to which the economy is exposed to cyclical fluctuations is significantly reduced with a lower ω. Hence, the model implies that the severity of the Great Depression might have been amplified by the rise of corporatist policies.

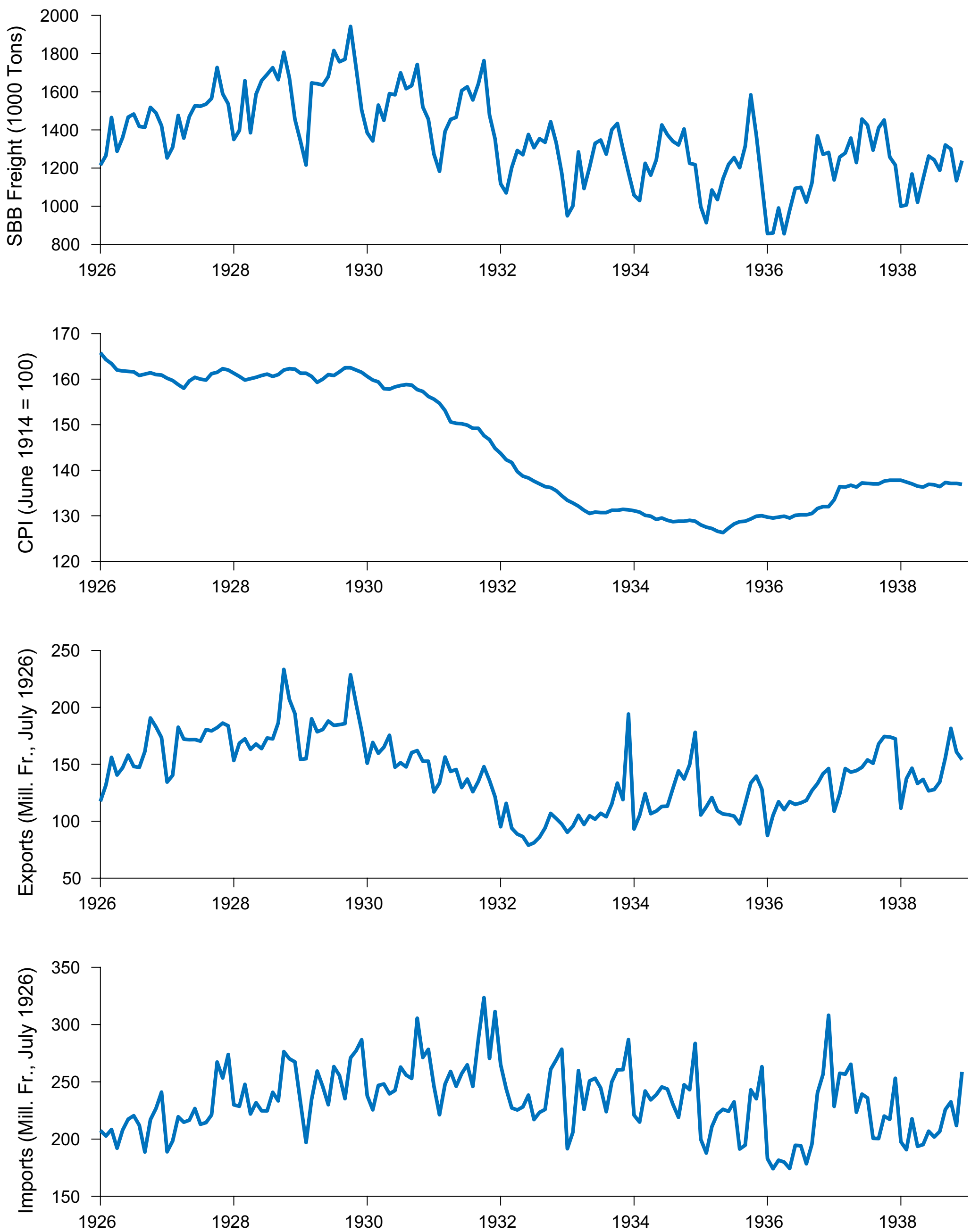
6 Conclusion

In July 1933, six European countries—Belgium, France, Italy, the Netherlands, Poland, and Switzerland—formed the gold bloc after the Roosevelt Administration devalued the US dollar and declined to participate in the London Economic Conference. The idea was to maintain the gold standard and restore price competitiveness vis-à-vis the countries with a devalued currency by internal devaluation. The strategy failed, and in the end all six countries abandoned the gold standard in one form or another. There was some downward adjustment of wages and prices, but the effort was not sufficient to offset the appreciation of the real exchange rate resulting from the devaluation of sterling, the US dollar and many other currencies around the globe. In September 1936, the gold bloc ended after France, the Netherlands, and Switzerland abandoned the gold standard (Feinstein et al., 1997).

In this paper, we investigate the reasons for the failure of internal devaluation and the cost of maintaining the gold standard by investigating the policies of the Swiss authorities during the Great Depression of the 1930s. First, by plotting and interpreting nominal wages and prices, we can identify two reasons for the limits of internal devaluation: the asynchrony of the external and the internal business cycle which delayed the decline of nominal wages relative to prices, and the increasing resistance to internal devaluation as the crisis wore on which lead to an increase of price rigidities.

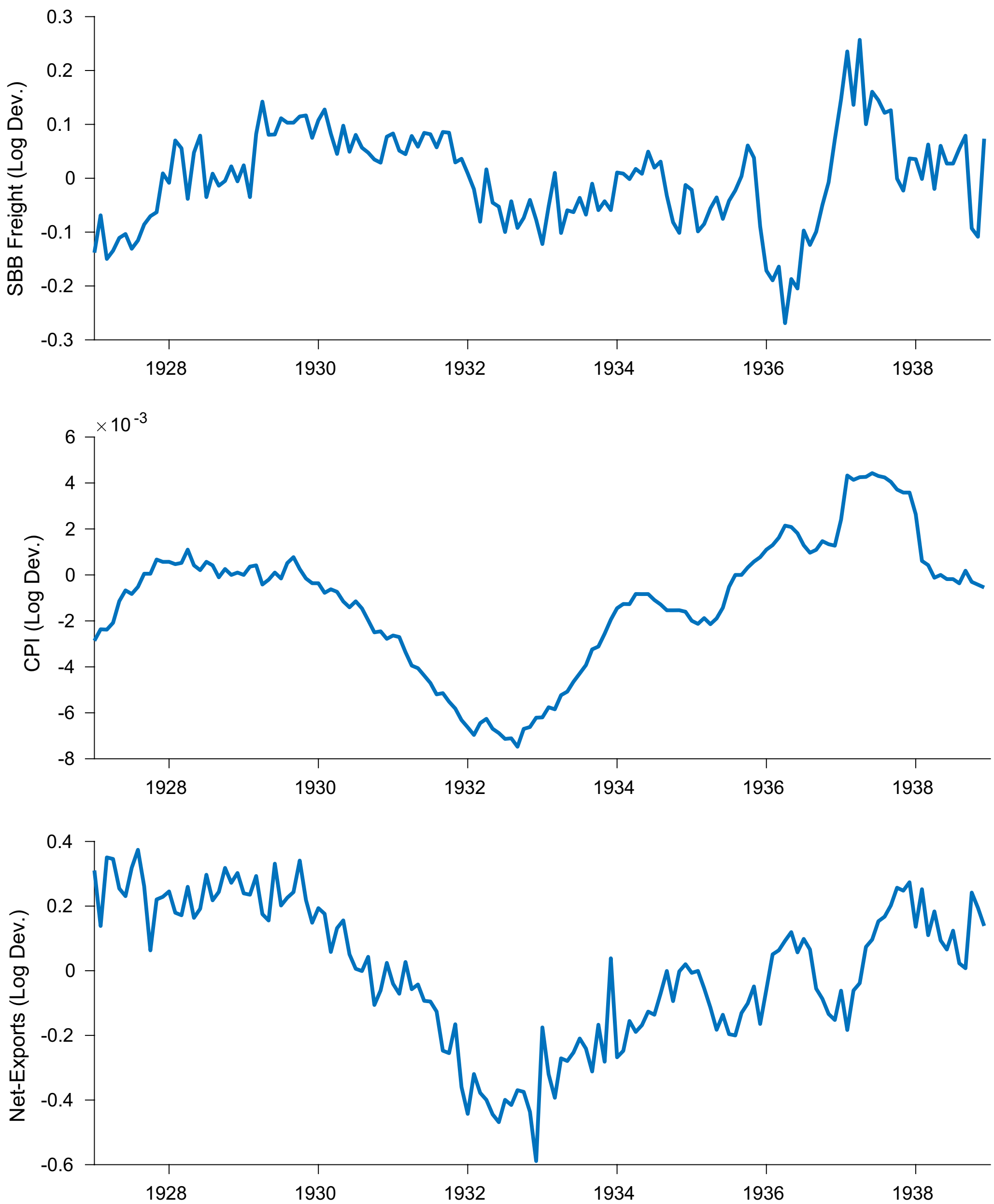
Secondly, by using a New Keynesian small open economy framework, we show that the adherence to the gold standard in combination with only limited internal devaluation prolonged the recession of the Swiss economy. Our counterfactual analysis suggests that the increase of foreign demand in the second half of 1931 should have had a positive effect on Swiss output. But as the terms of trade deteriorated as a result of the devaluation of the currencies of major trading partners, the Swiss economy could not profit from the recovery of the global economy. An early devaluation of the Swiss franc in 1931 or 1933 would have considerably shortened the duration of the economic crisis.

Appendix A: Raw data



Details on the data sources can be found in Sect. 4.

Appendix B: Data in log deviations



Details on the data sources and transformations can be found in Sect. 4.

Appendix C: Model setup

Households

The economy is populated by an infinitely lived representative household who seeks to maximize

$$\mathrm{E}_0\left[\sum_{t=0}^{\infty}\beta^t U(C_t,N_t)\right] \quad \text{with} \quad U(C_t,N_t)=\left(\frac{C_t^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\eta}}{1+\eta}\right)$$

by optimally choosing consumption C_t and labor input N_t. Its period t budget constraint looks as follows:

$$P_tC_t+Q_tB_{t+1}=W_tN_t+B_t, \tag{3}$$

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

$$C_t=\left((1-\gamma)^{\frac{1}{a}}\left(C_t^h\right)^{\frac{a-1}{a}}+\gamma^{\frac{1}{a}}\left(C_t^f\right)^{\frac{a-1}{a}}\right)^{\frac{a}{a-1}}, \tag{4}$$

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 Constant Elasticity of Substitution (CES) aggregate of domestic goods, and $C_{t,j}^h$ a domestic variety j. The exact composition C_t^h and C_t^f is optimally chosen by the households according to the demand functions

$$C_t^h=\left(\frac{P_t^h}{P_t}\right)^{-a}C_t(1-\gamma) \quad ; \quad C_t^f=\left(\frac{P_t^f}{P_t}\right)^{-a}C_t\gamma. \tag{5}$$

Moreover, P_t^f captures the foreign price of the foreign produced good, the preference parameter $\gamma\in[0,1]$ represents a measure of home bias[6], $a>0$ 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 at period t can be summarized as

$$\max_{\{C_\tau,N_\tau,B_{\tau+1}\}}\mathrm{E}_t\left[\sum_{\tau=t}^{\infty}\beta^{\tau-t}\left(\frac{C_\tau^{1-\sigma}}{1-\sigma}-\frac{N_\tau^{1+\eta}}{1+\eta}\right)\right] \quad \text{s.t.} \quad P_\tau C_\tau+Q_\tau B_{\tau+1}\le W_\tau N_\tau+B_\tau, \tag{6}$$

yielding the following two standard optimality conditions:

$$\frac{N_t^\eta}{C_t^{-\sigma}}=\frac{W_t}{P_t}; \tag{7}$$

$$\mathrm{E}_t[Q_{t,t+1}]=Q_t=\beta\mathrm{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\right]. \tag{8}$$

Equation (7) 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 Eq. (8).

Firms

Firm j produces output $Y_{t,j}$ using the production technology

$$Y_{t,j}=N_{t,j}, \tag{9}$$

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

$$\min_{\{N_{t,j}\}}\frac{W_t}{P_t^h}N_{t,j}, \qquad \text{s.t.} \qquad Y_{t,j}=N_{t,j}. \tag{10}$$

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

$$\frac{W_t}{P_t^h}-\Psi_t=0\Leftrightarrow\Psi_t=\frac{W_t}{P_t^h}=W_t^r. \tag{11}$$

In equilibrium, goods market clearing implies

$$Y_t=C_t^h+C_t^{h\star}, \tag{12}$$

which implies that aggregate output Y_t is fully absorbed by domestic consumption of the domestically produced good C_t^h and foreign consumption of the domestic good $C_t^{h\star}$. This leads to the demand functions for variety j,

$$C_{t,j}^h+C_{t,j}^{h\star}=\left(\frac{P_{t,j}^h}{P_t^h}\right)^{-\theta}Y_t. \tag{13}$$

$P_{t,j}^h$ 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

[6] Since it is equal to the import share, it can also be interpreted as a natural measure of openness (Galí, 2008).

fixed by the government. The pricing mechanism used here goes back to Calvo (1983). $\bar{P}^h_{t,j}$ denotes the price set by firm j in period t, which implies $P(P^h_{t+\tau,j} = \bar{P}^h_{t,j}) = \omega^\tau$. Moreover, since all firms are identical and face identical demand curves, $\bar{P}^h_{t,j} = \bar{P}^h_t$.

Therefore, period t profit of firm j, conditional on being allowed to reset its price is

$$\pi_{t,j} = \left(\bar{P}^h_t - P^h_t \Psi_t\right)(C^h_{t,j} + C^{h\star}_{t,j}) = \left(\bar{P}^h_t - P^h_t \Psi_t\right)\left(\frac{\bar{P}^h_t}{P^h_t}\right)^{-\theta} Y_t, \tag{14}$$

where $P^h_t \Psi_t$ 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,

$$\max_{\{\bar{P}^h_t\}} \quad \mathrm{E}_t\left[\sum_{\tau=0}^{\infty} \omega^\tau Q_{t,t+\tau}\left(\bar{P}^h_t - P^h_{t+\tau}\Psi_{t+\tau}\right)\left(\frac{\bar{P}^h_t}{P^h_{t+\tau}}\right)^{-\theta} Y_{t+\tau}\right], \tag{15}$$

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 $\bar{P}^h_t$ is

$$\mathrm{E}_t\left[\sum_{\tau=0}^{\infty} \omega^\tau Q_{t,t+\tau} \frac{\Lambda_{t+\tau}}{\Lambda_t} Y_{t+\tau} \left((1-\theta)\left(\frac{\bar{P}^h_t}{P^h_{t+\tau}}\right)^{-\theta} + \theta\left(\frac{\bar{P}^h_t}{P^h_{t+\tau}}\right)^{-\theta-1} \Psi_{t+\tau}\right)\right] = 0. \tag{16}$$

Global characteristics

Exchange rate & terms of trade

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

$$P^f_t = S_t P^\star_t, \tag{17}$$

where $P^\star_t$, P^f_t, 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

$$\Phi_t = \frac{P^f_t}{P_t} = \frac{S_t P^\star_t}{P_t}, \tag{18}$$

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, are defined as

$$\Delta_t = \frac{P^f_t}{P^h_t} = \frac{S_t P^\star_t}{P^h_t}, \tag{19}$$

and follows an exogenous[7] and stationary first-order autoregressive (AR(1)) process in logs,

$$\ln(\Delta_t) = \rho_\delta \ln(\Delta_{t-1}) + \epsilon^\delta_t, \qquad \epsilon^\delta_t \sim N(0, \sigma^2_\delta), \tag{20}$$

where $\rho_\delta < 1$ characterizes the persistence parameter and σ^2_δ the variance of the shock ϵ^δ_t.

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 $C^\star_t = Y^\star_t$.

Foreign consumption $C^\star_t$ is equal to foreign demand $Y^\star_t$, which follows an exogenous and stationary AR(1) process in logs,

$$\ln(Y^\star_t) = (1-\rho_\star)\ln(Y^\star) + \rho_\star \ln(Y^\star_{t-1}) + \epsilon^\star_t, \quad \epsilon^\star_t \sim N(0, \sigma^2_{y^\star}), \tag{21}$$

with a persistence parameter $\rho_\star$ smaller than one and a variance $\sigma^2_{y^\star}$ of the shock $\epsilon^\star_t$.

International trade

Exports are denoted in domestic goods and given by

$$EX_t = C^{h\star}_t. \tag{22}$$

For imports (denoted in domestic goods), we have

$$IM_t = \frac{P^f_t}{P^h_t} C^f_t \tag{23}$$

International risk sharing

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

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

[7] We are aware of the fact that this specification is not fully consistent with the underlying model, because prices are endogenously determined. Schorfheide (2007) point out that an estimation of the full structural model including endogenous terms of trade turned out to be too restrictive and therefore lead to implausible estimates. Consequently, we decided to follow Schorfheide (2007) by treating the terms of trade as an exogenous process.

where $P_t^\star$ denotes the foreign consumer price index, and which implies the following international risk sharing condition:[8]

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

As a result, complete markets lead to this this simple relationship linking the real exchange rate to the ratio of the marginal utilities of consumption of domestic and foreign households.

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

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

ζ_t can be seen as a measrure of price dispersion. The full set of optimality conditions can be found in the next section.

Optimality conditions

.

- Consumption Composite Index:

$$C_t = \left((1-\gamma)^{\frac{1}{a}}\left(C_t^h\right)^{\frac{a-1}{a}} + \gamma^{\frac{1}{a}}\left(C_t^f\right)^{\frac{a-1}{a}}\right)^{\frac{a}{a-1}} \tag{29}$$

- Consumer Price Index:

$$P_t = \left((1-\gamma)\left(P_t^h\right)^{1-a} + \gamma\left(P_t^f\right)^{1-a}\right)^{\frac{1}{1-a}} \tag{30}$$

- Demand Functions:

$$C_t^h = \left(\frac{P_t^h}{P_t}\right)^{-a} C_t(1-\gamma) \tag{31}$$

$$C_t^f = \left(\frac{P_t^f}{P_t}\right)^{-a} C_t\gamma \tag{32}$$

- Intratemporal Labor Leisure Trade-off:

$$\frac{N_t^\eta}{C_t^{-\sigma}} = \frac{W_t}{P_t} \tag{33}$$

- Terms of Trade:

$$\Delta_t = \frac{P_t^f}{P_t^h} \tag{34}$$

- Real Exchange Rate:

$$\Phi_t = \frac{P_t^f}{P_t} \tag{35}$$

- Real Marginal (average) Cost of Production:

$$\Psi_t = \frac{W_t}{P_t^h} \tag{36}$$

- Aggregate Production Function:

$$Y_t = \frac{N_t}{\zeta_t} \tag{37}$$

- Calvo Pricing:

$$A_{1,t} = Y_t\Psi_t + \omega\beta\mathrm{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}(\Pi_{t+1})^{-1}(\Pi_{t+1}^h)^{\theta+1}A_{1,t+1}\right] \tag{38}$$

$$A_{2,t} = Y_t + \omega\beta\mathrm{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}(\Pi_{t+1})^{-1}(\Pi_{t+1}^h)^{\theta}A_{2,t+1}\right] \tag{39}$$

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

- Domestic Inflation:

$$1 = \left((1-\omega)\left(\frac{\theta A_{1,t}}{(\theta-1)A_{2,t}}\right)^{1-\theta} + \omega\left(\Pi_t^h\right)^{\theta-1}\right)^{\frac{1}{1-\theta}} \tag{40}$$

- Exports:

$$EX_t = C_t^{h\star} = \gamma \Delta_t^a Y_t^\star \tag{41}$$

- Imports:

$$IM_t = \Delta_t \left(\frac{P_t^f}{P_t}\right)^{-a} \gamma C_t \tag{42}$$

- Inflation Rate of Domestic Goods

$$\Pi_{t+1}^h = \frac{P_{t+1}^h}{P_t^h} \tag{43}$$

- Domestic Inflation Rate

$$\Pi_{t+1} = \frac{P_{t+1}}{P_t} \tag{44}$$

- National Accounting Identity:

$$Y_t = C_t^h + C_t^{h\star} \tag{45}$$

- International Risk Sharing Condition:

$$\left(\frac{C_t^\star}{C_t}\right)^{-\sigma} = \Phi_t \tag{46}$$

- Foreign Demand (Exogenous Process):

$$\ln(Y_t^\star) = (1-\rho_\star)\ln(Y^\star) + \rho_\star \ln(Y_{t-1}^\star) + \epsilon_{\star,t}, \quad \text{with } \epsilon_t^\star \sim N(0,\sigma_\star^2) \tag{47}$$

- Terms of Trade (Exogenous Process):

$$\ln(\Delta_t) = \rho^\delta \ln(\Delta_{t-1}) + \epsilon_t^\delta, \quad \text{with } \epsilon_t^\delta \sim N(0,\sigma_\delta^2) \tag{48}$$

Appendix D: Posterior distribution of non-structural parameters

See Table 3.

Table 3 Posterior Distributions of Non-Structural Parameters

Parameter	Prior Dist.	Median	s.d.	90% Bands	NSE
a_{11}	Stationary	0.91811	0.10430	[0.74537 , 1.08219]	0.00586
a_{21}	Stationary	-0.77384	0.14996	[−1.03986 , −0.54967]	0.01050
a_{31}	Stationary	−0.01105	0.00340	[−0.01695 , −0.00582]	0.00015
a_{12}	Stationary	0.25689	0.07748	[0.12600 , 0.37911]	0.00337
a_{22}	Stationary	−0.01734	0.11253	[−0.20049 , 0.17242]	0.00430
a_{32}	Stationary	0.00086	0.00277	[−0.00356 , 0.00551]	0.00011
a_{13}	Stationary	−0.00016	0.08020	[−0.06849 , 0.01915]	0.00494
a_{23}	Stationary	0.00133	0.30604	[−0.08974 , 0.35201]	0.02172
a_{33}	Stationary	0.00001	0.00437	[−0.00117 , 0.00440]	0.00029
$\sqrt{\text{VAR}(\kappa_y)}$	Positive definite	0.00254	0.00335	[0.00202 , 0.00313]	0.00018
COV (κ_y, κ_{nx})	Positive definite	−0.00142	0.00032	[−0.00195 , −0.00088]	0.00001
COV (κ_y, κ_π)	Positive definite	−0.00002	0.00001	[−0.00004 , 0.00000]	0.00000
$\sqrt{\text{VAR}(\kappa_{nx})}$	Positive definite	0.00443	0.00414	[0.00363 , 0.00545]	0.00011
COV $(\kappa_{nx}, \kappa_\pi)$	Positive definite	0.00000	0.00002	[−0.00003 , 0.00003]	0.00000
$\sqrt{\text{VAR}(\kappa_\pi)}$	Positive definite	0.00000	0.00020	[0.00000 , 0.00000]	0.00003

The VAR matrix is restricted to have a maximum absolute eigenvalue of 0.6. 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 not larger than 60 percent of the variance of the corresponding data series. Results are based on 400,000 draws, where the first 150,000 are discarded as burn-in draws

Appendix E: Estimation procedure

The solution of the model provides the policy functions, which can be written in state space form as

$$\begin{aligned} \mathbf{x}_t &= \mathbf{Z}\boldsymbol{\alpha}_t; \\ \boldsymbol{\alpha}_t &= \mathbf{T}\boldsymbol{\alpha}_{t-1} + \mathbf{R}\boldsymbol{\nu}_t, \quad \boldsymbol{\nu}_t \sim N(\mathbf{0}, \mathbf{Q}), \end{aligned} \tag{49}$$

where $\mathbf{x}_t$ is a 3×1 vector of observables (output, inflation, and net exports), and $\boldsymbol{\alpha}_t$ is the 2×1 unobservable state vector driven by the two structural shocks in $\boldsymbol{\nu}_t$ with variance $\mathbf{Q}$. We follow Ireland (2004) and incorporate a dynamic measurement error with a vector autoregressive (VAR) structure into the state vector to allow for off-model dynamics in the data.

$$\boldsymbol{\kappa}_t = \mathbf{A}\boldsymbol{\kappa}_{t-1} + \boldsymbol{\epsilon}_t, \quad \boldsymbol{\epsilon}_t \sim N(\mathbf{0}, \boldsymbol{\Sigma}). \tag{50}$$

The structure of the extended state space model is therefore

$$\begin{aligned} \mathbf{x}_t &= \begin{pmatrix} \mathbf{Z} & \mathbf{I}_3 \end{pmatrix} \begin{pmatrix} \boldsymbol{\alpha}_t \\ \boldsymbol{\kappa}_t \end{pmatrix}; \\ \begin{pmatrix} \boldsymbol{\alpha}_t \\ \boldsymbol{\kappa}_t \end{pmatrix} &= \begin{pmatrix} \mathbf{T} & \mathbf{0} \\ \mathbf{0} & \mathbf{A} \end{pmatrix} \begin{pmatrix} \boldsymbol{\alpha}_{t-1} \\ \boldsymbol{\kappa}_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{R} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_3 \end{pmatrix} \begin{pmatrix} \boldsymbol{\nu}_t \\ \boldsymbol{\epsilon}_t \end{pmatrix}. \end{aligned} \tag{49'}$$

We impose uniform priors with reasonable ranges for the structural parameters to be as loose as possible (see Table 2). 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 (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 $\text{vec}(\boldsymbol{\Sigma}_{\kappa}) = \left(\mathbf{I}_{3^2} - \mathbf{A} \otimes \mathbf{A}\right)\text{vec}(\boldsymbol{\Sigma})$, our choice is not overly restrictive.

To generate the parameter chain, we use the tailored randomized MCMC method proposed by Ramamurthy (2010). The procedure is a modification of the standard Metropolis–Hastings algorithm (e.g., Chib & 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.

Abbreviations

SNB: Schweizerische Nationalbank; CPI: Consumer price index; WPI: Wholesale price index; M1: Money supply; BASE: Monetary base; RES: International reserves; GOLD: Gold reserves (in domestic currency); PGOLD: Gold price; QGOLD: Gold quantity; VAR: Vector autoregressive model; MCMC: Markov Chain Monte Carlo.

Acknowledgements

We thank Gabriela Wüthrich and Gian Rotfuchs for reliable research assistance. We are grateful to Sarah Lein, two anonymous referees, participants of the European Historical Economics Society Conference in Dublin 2011, the Annual Meeting of the Swiss Society of Economics and Statistics 2012 in Zurich, the Annual Congress of the European Economic Association 2012 in Malaga, the SSES Annual Congress 2021 in Zurich, and seminar participants at the University of Zurich and the University of Tübingen for comments and suggestions.

Author contributions

PR, TS, and UW contributed equally to the paper. All authors read and approved the final manuscript.

Funding

During his doctoral studies, Peter Rosenkranz was funded by the ProDoc Research Module (SNF) Heterogeneity in Human Behaviour and Macroeconomics (2009-2011).

Availability of supporting data

The data are available upon request from the authors.

Declarations

Competing interests

Not applicable.

Author details

[1]Public Management, Financial Sector & Regional Cooperation Division, East Asia Department, Asian Development Bank, 6 ADB Avenue, Mandaluyong City 1550, Metro Manila, Philippines. [2]Department of Economics, University of Zurich, Zürichbergstrasse 14, CH-8032 Zürich, Switzerland.

Received: 10 September 2021 Accepted: 15 November 2022
Published online: 05 December 2022

References

Acklin, K. (1939). Handelsstatistik. In: Schweizerischen Gesellschaft für Statistik und Volkswirtschaft (Ed.), *Handbuch der schweizerischen Volkswirtschaft*, Vol. 2, 20–21, Bern: Benteli.

Balmer, H. & Zurwerra, A. (2000). Aussenhandelsstatistik. In: Bohley, P. , Jans, A. , Malaguerra, C. (Eds.), *Wirtschafts- und Sozialstatistik der Schweiz*, chap. 6.4, 529–566, Stuttgart, Wien: P. Haupt.

Bernanke, B., & James, H. (1991). The Gold Standard, Deflation, and Financial Crisis in the Great Depression: An International Comparison. In R. Hubbard (Ed.), *Financial Markets and Financial Crises* (pp. 33–68). University of Chicago Press.

Bernanke, B. S. (1995). The macroeconomics of the great depression: A comparative approach. *Journal of Money, Credit, and Banking, 27*, 1–28.

Bordo, M., Helbling, T., & James, H. (2007). Swiss exchange rate policy in the 1930s. Was the delay in devaluation too high a price to pay for conservatism? *Open Economies Review, 18*, 1–25.

Calvo, G. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics, 12*, 383–398.

Campa, J. M. (1990). Exchange rates and economic recovery in the 1930s: An extension to Latin America. *Journal of Economic History, 50*, 677–682.

Chari, V., Kehoe, P., & McGrattan, E. (2002). Can sticky price models generate volatile and persistent real exchange rates? *Review of Economic Studies, 69*, 533–563.

Chib, S., & Greenberg, E. (1995). Understanding the metropolis-hastings algorithm. *American Statistician, 49*, 327–335.

Chib, S., & Ramamurthy, S. (2010). Tailored randomized block MCMC methods with application to DSGE models. *Journal of Econometrics, 155*, 19–38.
Choudhri, E. U., & Kochin, L. A. (1980). The exchange rate and the international transmission of business cycle disturbances: Some evidence from the great depression. *Journal of Money, Credit, and Banking, 12*, 565–574.
Clarida, R., Galí, J., & Gertler, M. (2000). Monetary policy rules and macroeconomic stability: Evidence and some theory. *Quarterly Journal of Economics, 115*, 147–180.
Clarida, R., Galí, J., & Gertler, M. (2001). Optimal monetary policy in open versus closed economies: An integrated approach. *American Economic Review, 91*, 248–252.
David, T. (1995). Une indice de la production industrielle de la Suisse durant l'entre-deux-guerres. *Revue Suisse d'Histoire, 45*, 109–130.
Eichengreen, B. (1992). *Golden Fetters: The Gold Standard and the Great Depression, 1919–1939*. Oxford University Press.
Eichengreen, B., & Sachs, J. (1985). Exchange rates and economic recovery in the 1930s. *Journal of Economic History, 45*, 925–946.
Feinstein, C. H., Temin, P., & Toniolo, G. (1997). *The European Economy between the Wars*. Oxford University Press.
Galí, J. (2008). *Monetary policy, inflation, and the business cycle: An introduction to the New Keynesian framework*. Princeton University Prerss.
Galí, J., & Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *Review of Economic Studies, 72*, 707–734.
García-Cicco, J., Pancrazi, R., & Uribe, M. (2010). Real business cycles in emerging countries? *American Economic Review, 100*, 2510–2531.
Ireland, P. (2004). A method of taking the model to the data. *Journal of Economic Dynamics and Control, 28*, 1205–1226.
Klein, P. (2000). Using the generalized Schur form to solve a multivariate linear rational expectations model. *Journal of Economic Dynamics and Control, 24*, 1405–1423.
Lubik, T. A., & Schorfheide, F. (2007). Do central banks respond to exchange rate movements? A structural investigation. *Journal of Monetary Economics, 54*, 1069–1087.
Rathke, A., Straumann, T., & Woitek, U. (2017). Overvalued: Swedish monetary policy in the 1930s. *International Economic Review, 58*, 1355–1369.
Ritzmann-Blickenstorfer, H. (Ed.). (1996). *Historische Statistik der Schweiz*. Zürich: Chronos Verlag.
Rutz, W. (1970). *Die schweizerische Volkswirtschaft zwischen Währungs- und Beschäftigungspolitik in der Weltwirtschaftskrise - wirtschaftspolitische Analyse der Bewältigung eines Zielkonflikts*. Polygraphischer Verlag.
Reichsamt, Statistisches (Ed.). (1936). *Statistisches Handbuch der Weltwirtschaft*. Berlin: Verlag für Sozialpolitik, Wirtschaft und Statistik.
Wolf, N. (2007). Should i stay or should i go? Understanding Poland's adherence to gold, 1928–1936. *Historical Social Research, 32*, 351–368.
Wolf, N. (2008). Scylla and Charybdis. Explaining Europe's exit from gold, January 1928-December 1936. *Explorations in Economic History, 45*, 383–401.

Publisher's Note