Was a sudden stop at the origin of German hyperinflation?

ELENA SEGHEZZA[*] and PIERLUIGI MORELLI[**]
*University of Genoa
**Associazione Bancaria Italiana

Since the publication of Cagan's seminal contribution in 1956 and its further development by Sargent (1982) there has been a growing literature that seeks to explain German hyperinflation in terms of the monetary hypothesis. However, this article shows that the origins of this hyperinflation can be traced back to a sudden stop that occurred in the summer of 1922 at a time when expectations that the German economy would stabilise began to subside. The reversal of capital flows that took place in those months led in the short term to a dramatic depreciation of the mark, a significant increase in prices and a decline in output. This decline sparked bitter social conflict that fuelled a wage and price spiral. This spiral was accommodated by monetary authorities, leading in turn to explosive inflation.

Keywords: German hyperinflation, sudden stop

JEL classification: N14, N24

Analysis of hyperinflation during the Weimar Republic occupies a prominent place in studies on the origin and development of episodes of hyperinflation. The first interpretations of German hyperinflation date back to the interwar period. Two stand out: the *monetary view* and the *balance of payments view*.[1] The former sees hyperinflation during the Weimar Republic as mainly due to an excess in the money supply. To put it more precisely, in the years immediately following the end of the war, the Weimar Republic significantly expanded public spending. As tax revenue did not increase sufficiently to cover this increased public spending, the Reichsbank sought to do so by printing money, thus causing an accelerating increase in prices (see Bresciani-Turroni 1937).

---

[1] For a survey of the different hypotheses on German hyperinflation, see Kindleberger (1984a).

The *balance of payments* view, on the other hand, concludes that the high level of inflation that afflicted Germany in the early 1920s was due to the country's current account deficit resulting from the burden of reparations imposed by the Treaty of Versailles.[2] The best-known supporter of this view was Karl Helfferich, who summed it up as follows in *Money*:

The depreciation of the German mark in terms of foreign currencies was caused by the excessive burdens on to Germans…, the increase of the prices of all imported goods was caused by the depreciation of the exchanges; then followed the general increase of internal prices and wages, the increased need for means of circulation on the part of the public and of the State…and the increase of the mark issues. (Helfferich 1927, quoted by Bresciani-Turroni 1937, p. 45)

A second wave of studies on hyperinflation that take Germany as a case in point was set off by Cagan's seminal contribution in 1956. Although they put forward different hypotheses about the formation of expectations, almost all these studies accept the monetary view. According to this view, the acceleration and explosiveness of price growth in Weimar Germany resulted from covering large public deficits through the creation of money.

As shown by Dornbusch *et al.* (1990), one problem with the monetary view is that basically it refers to a closed economy, meaning that it disregards the role of the exchange rate, which plays a crucial role not only in the traditional balance of payments view with its focus on current account imbalances but also in relation to the financial part of balance of payments. The importance of this last aspect of German hyperinflation has long been neglected (see Gomes 2010, p. 97).

The fact is, however, that in the years immediately following World War I Germany was affected by a massive inflow of capital from abroad on the back of expectations of capital gains to be had from a possible appreciation of the mark. As a result of this, in the early part of 1922, a large share of the country's debt, both public and private, was held by non-residents. In this context the country was exposed to a sudden stop (see Calvo 1995, p. 1), that is to say, a sudden reversal of capital inflows. This reversal occurred after certain events in June 1922 that wiped out any hope among foreign investors that a solution could be found to the reparations problem and that the German economy could be stabilised. As a consequence, expectations of an appreciation of the mark faded, leading non-residents to sell their financial assets in the German currency.

As observed by Dornbusch (1985), an exchange rate crisis and the inflation that follows from it do not in themselves produce explosive inflation. However, as recent experiences in many emerging countries have shown, in certain contexts the fall in disposable income that follows from a sudden stop can intensify the distributive

---

[2] Expressions of this view can be found among others in Williams (1922), Helfferich (1927) and Graham (1930).

conflict (see, among others, Calvo and Reinhart 2000; Bordo 2007). For example, this was the case in some Latin American countries when several sudden stops occurred in the late 1980s and the first part of 1990s following an unforeseen change in expectations. On account of the fall in output caused by sudden stops, in some countries workers' demands for wage increases set off an upward spiral of nominal wages and prices that led to hyperinflation (see Liviatan and Piterman 1986; Montiel 1989).

A similar process affected Germany. Also in this case the economic stability of the country was compromised by a sudden change in expectations. In an important contribution written some years ago, Webb (1986) drew attention to the fact that some serious events that occurred in June 1922 definitively undermined confidence in the stability of the German economy. This article picks up this observation. However, unlike Webb, we argue that the sudden change in expectations about the future of the German economy led to the hurried substitution of assets denominated in marks with foreign assets rather than the substitution of marks with real goods. The dynamic of this process can be summed up as follows. In mid 1922 loss of faith in the future appreciation of the mark on the part of non-residents holding assets in marks brought about a reversal in capital flows to Germany, that is to say, a sudden stop. This was followed by a pronounced depreciation of the mark and a notable increase in the price of imports, and thus of wholesale prices. This increase was then followed by a considerable increase in consumer prices. The marked acceleration in the rate of inflation led to a bitter conflict between interest groups, each of which wanted to maintain intact its purchasing power and shift onto others the reduction in national income resulting from the sudden stop. The government and Reichsbank maintained an accommodating stance. This led to an inflationary spiral that then degenerated into hyperinflation.

Section I presents an intuitive account of the process we have just described. In Section II, with the aid of several causality tests we show that Weimar Germany's hyperinflation had its origin in an exchange rate crisis rather than an increase in note circulation. The growth of money followed the depreciation of the exchange rate. In Section III we attempt, essentially by means of an event study, to demonstrate that the notable depreciation of the mark in the summer of 1922 was triggered by various pieces of bad political news. The effect of the news was to alter expectations as regards the future prospects of the German currency and to produce a sudden stop. Section IV shows how the fall in output and the decrease in domestic disposable income due to the sudden stop exacerbated social conflict and triggered explosive inflation. The article ends with some concluding remarks.

I

As observed in the Introduction, traditional interpretations of episodes of hyperinflation tend to disregard the repercussions of capital movements on the exchange rate. However, the cases of hyperinflation that have occurred in many emerging countries, especially in Latin America in the 1980s and 1990s, have shown that under certain

circumstances explosive price growth may result from a sudden stop (see Montiel 1989; Dornbusch *et al.* 1990; Fischer *et al.* 2002).

Significant analogies with these historical experiences can be found in what happened in Germany in the early 1920s. Between 1919 and 1921 enormous amounts of foreign capital flowed into Germany (see, among others, Holtfrerich 1986, pp. 285ff; Ferguson 1998, p. 422), which allowed the country to cover the substantial current account deficit it had accumulated during this period (see Bonn 1922, p. 29).

Given that official data are unavailable, the estimates of capital inflow into Germany in the years immediately following World War I are based on the accumulated total of current account deficits. Although the estimates thus obtained diverge considerably,[3] there is unanimous recognition that the inflow of capital to Germany before mid 1922 was enormous. Non-residents (see Schuker 1988), mainly Americans (see Fourgeaud 1926, pp. 92–4), bought marks in the form of shares and securities, but above all bank deposits, in expectation of an appreciation of German mark (see Holtfrerich 1982).

According to the statistics of the *Deutsche Oekonomist* reported in League of Nations (1931), at the end of 1921 non-residents held three-fifths of the sight deposits of the major Berlin banks and around a third of their total deposits – approx. 41.6 billion paper marks, corresponding to one billion gold marks. During this period there was also a significant growth in investments in German securities, shares and even real estate by non-residents (see Holtfrerich 1986, pp. 285–96; Ferguson 1996; Ferguson and Granville 2000, p. 1062). This meant that in mid 1922 total assets in marks held by non-residents and invested in Germany were indeed substantial.

This flow of capital to Germany was incentivised by the widespread belief in financial circles that the German currency would appreciate over time (see Warburg 1921; Keynes 1922; Hawtrey 1923, p. 275; Holtfrerich 1986, pp. 293–7). This conviction is evidenced by the fact that the three-month forward exchange rate showed a premium on the spot exchange rate until the spring of 1922 and a discount only after July of that year (see Einzig 1937).

However, as shown in Table 1, in June 1922 events occurred that produced a change in expectations regarding prospects for the mark (see Holtfrerich 1986; Kindleberger 1984a): the decision of the Morgan Commission not to grant credits to Germany (11 June 1922) and the assassination of the minister of finance, Rathenau (24 June 1922). Changed expectations regarding the mark's prospects were not caused by economic factors but by largely unpredictable political events.[4]

---

[3] Graham (1930) estimated 15 billion gold marks, Keynes (1923) 12–15 billion, and the McKenna committee between 6.3 and 7.3 billion. On this point, see, among others, Schuker (1988) and Ferguson (1998).

[4] See Holtfrerich (1983, p. 410). Lopez and Mitchener (2018) rightly emphasise the role of political instability in post-World War I hyperinflation episodes.

Table 1. *Favourable and unfavourable events*

Favourable events	
21 March 1921	Favourable result in Upper Silesia's plebiscite
6 January 1922	Start of Cannes Conference
9 February 1922	End of railway strike
4 April 1922	Hopeful feelings about Genoa Conference
17 April 1922	Positive reaction to Rapallo Treaty
June 1922	Sudden stop
2 September 1922	Positive reports from Reparations Commission on moratorium
10 October 1922	Allied agreement with the Turks
15 November 1922	Response to Cuno appointment
15 December 1922	Reports that the United States favoured new reparations arrangements
Unfavourable events	
26 April 1921	Reparations Commission announced the total amount of reparations (132 billion gold marks)
5 May 1921	London schedule of reparations payment
24 August 1921	Murder of Erzberger
22 October 1921	Resignation of Wirth's Cabinet
1 February 1922	Railway workers' strike
18 February 1922	Postponement of Genoa Conference
9 June 1922	Failure of bankers' conference in Paris
24 June 1922	Murder of Rathenau
June 1922	Sudden stop
23 August 1922	Response to Poincaré's Bar-le-Duc speech
25 November 1922	Rumours that the French planned to invade the Ruhr
28 December 1922	Renewed rumours of French intransigence

The political events just mentioned destroyed all hope of the domestic and international conditions that would enable the stabilisation of the German economy.

Because of these unfavourable events, the confidence of individuals that over time the mark would appreciate faded (see Frère 1922). This change in expectations was followed by turbulent capital outflow. The considerable proportions of this outflow were reflected in the fact that the share of foreign deposits relative to total deposits in German banks fell from 36 per cent in 1921 to 11 per cent by the end of 1922.[5] On the basis of estimates (see Holtfrerich 1986, p. 287), between the end

---

[5] See League of Nations (1931). The decrease in these deposits was about two standard deviations below their mean in the period from 1919 to 1922, the index generally taken as a means of identifying a sudden stop. See, among others, Calvo *et al.* (2003) and Hutchison *et al.* (2010).

of 1921 and the end of 1922 deposits held by foreigners in German banks fell from 1.3 billion to 140 million gold marks.[6]

In 1922, also large German banks' deposits in foreign financial institutions began to increase significantly (see Cassis 2006, p. 174). Between 1920 and 1923, the share of such deposits in relation to the assets of these banks rose from 7.3 to 30.9 per cent (see Wixforth 2003).

The above data give us an indication of the dimensions of the capital flight that occurred in 1922 but fail to inform us about the precise moment it began. An indication in this direction can be obtained from the spread between the market interest rates on German and US long-term government bonds.[7] At the end of June, the spread between these interest rates was at 8.5 percentage points, at the end of July it rose to 10.9 percentage points and by the end of August it had reached 20.6 per cent (Figure 1). The widening of this spread suggests that investors engaged in significant sales of German government bonds.

Capital outflow from Germany from July 1922 onwards bore all the hallmarks of a veritable sudden stop due to a sudden change in expectations.[8] As happens in such circumstances, the flight of capital was accompanied by a significant depreciation of the mark (Figure 1). This can be seen from the fact that the mark rose from 272 to the dollar on 1 June to 318 on 12 June, when the Morgan Report came out, and to 355 on the day of the assassination of Rathenau on 24 June. By 31 July it was at 670 and by the end of August it had reached 1,725.[9] The significant depreciation in the exchange rate that occurred in mid 1922 led to a considerable increase in both wholesale and retail prices (Figure 2).[10]

As demonstrated by Figure 2, growth in both narrow[11] and broad[12] money followed the depreciation in the exchange rate and the marked growth in prices with some delay.

As in most other cases (see, among others, Calvo and Reinhart 2000; Bordo 2007), also in Germany, the sudden stop led to a fall in output and disposable income.[13] This was followed by an exacerbation of the distributive conflict, as part of which the productive

---

[6] This estimate is based on the trend of such deposits with the large Berlin banks (where they fell in the period under consideration from 0.9 billion to 100 million gold marks) and on the fact that, according to Whale (1930), the market share of these banks was then at 72 per cent.

[7] For the German securities we used the 3% Imperial bond and for the American titles the 3.5% Victory bond 1932–47. The data relative to these rates are taken from the historical archives of *The Times*.

[8] This view of the origin of German hyperinflation was first put forward by Calvo (2012, p. 10) and by Kiguel and Liviatan (1995, p. 47).

[9] As observed by Kindleberger (1984b, p. 28): 'Speculation in favour of the mark by foreigners (and some Germans) had been completely reversed.'

[10] For the consumer price index we used the workers' cost of living index.

[11] Expressed in terms of notes in circulation.

[12] Expressed in terms of narrow money and bank deposits.

[13] Among these factors, in particular the fall in foreign funding made inevitable the re-balancing of current accounts chiefly through a reduction in domestic absorption.
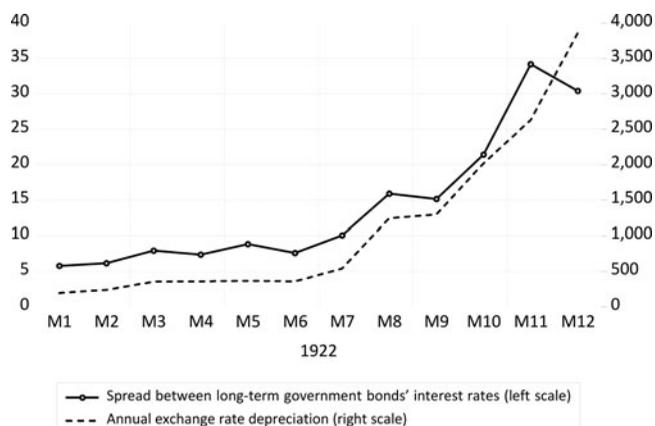
Figure 1. *Spread between long-term interest rates and exchange rate depreciation*
Note: The interest rate spread is measured in percentage points. The annual exchange rate depreciation is measured in percentage.

classes, workers and industrialists sought to maintain intact their purchasing power, shifting onto other interest groups the burden of diminished disposable income. The accommodating policy pursued by the Reichsbank drove this process, thus fuelling the inflationary spiral. With the acceleration of the rate of inflation output fell markedly. Consequently, between the second and the fourth quarter of 1922 the percentage of unemployed trade union workers rose from 0.6 to 2.8 per cent (see Holtfrerich 1986, p. 198; Feldman 1997, pp. 603–5). The disintegration of the German economy was halted by the process of stabilisation that began in the autumn of 1923.

II

In order to corroborate the sudden stop hypothesis we carried out some causality tests. Initially we ran a VAR Granger causality test in order to make a comparison between the monetary hypothesis and the sudden stop hypothesis. To this end we considered a VAR consisting of three variables: the consumer price index, the real exchange rate of the mark with respect to the dollar[14] and the real monetary base.[15] The data are monthly and the sample period used is between January 1921 and June 1923, that is to say, the period when inflation first started to accelerate and then became explosive. As suggested by the various tests of lag length criteria, three lags have been used.

---

[14] The sources are the following: the wholesale price index and the workers' cost of living index are taken from Holtfrerich (1986); the nominal exchange rate of the German mark against the US dollar and the US price index from the Federal Bank Reserve of Saint Louis. The real exchange rate was calculated by multiplying the nominal exchange rate of the mark against the US dollar by the ratio between the level of prices in the USA and in Germany.

[15] Nominal narrow money divided by the consumer price index.
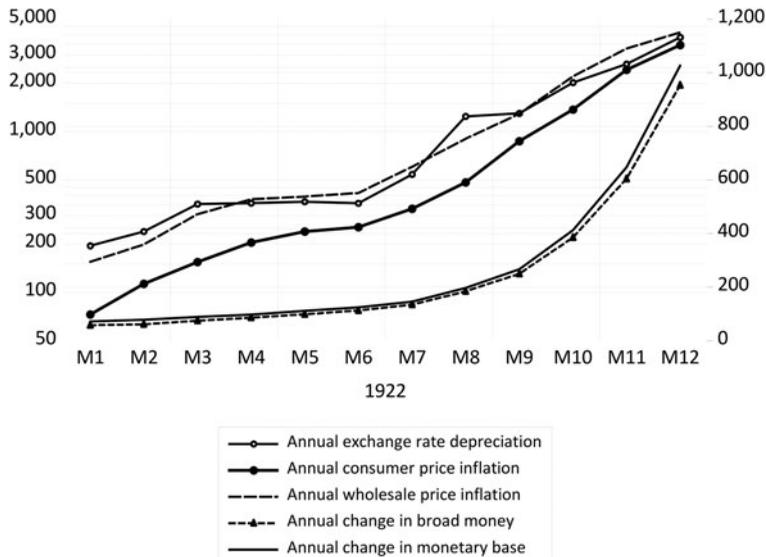
Figure 2. *Inflation, money supply and exchange rate depreciation*
Note: All variables are in percentages. To simplify comparison they are all measured on a log-arithmic scale.

The variables used are logarithmic and expressed in first differences.[16] Before proceeding to the causality tests, Table 2 tests the hypothesis of stationarity of the variables in first differences using the ADF and the Dickey-Fuller (GLS) tests, both with the constant and with the constant and the trend.

The results of these tests show that the first differences in real exchange rate (RER) and the real monetary base (RMB) are stationary. Inflation (INFL) proves to be stationary in three out of four tests.[17]

After establishing the stationarity of the variables, we proceeded to the estimate of the VAR Granger causality test. The results are given in Table 3.

The results in column (1) show that the null hypothesis – the interest variable does not cause inflation – is rejected in the case of the real exchange rate, while it is accepted in the case of real monetary base. As evidenced by the last column in Table 3, real exchange rate changes seem to have had notable effects not only on price growth but also on changes in real monetary base. Furthermore, neither money nor prices seem to prove significant in explaining the variation in the exchange rate.

These results acknowledge that the sudden stop hypothesis is able to explain the origin of German hyperinflation better than the monetary view. In this latter view a distinction is conventionally made between two different approaches: the monetary

---

[16] The statistical characteristics of the variables used are given in Table A1 in the online Appendix.
[17] Full confirmation of the stationarity of inflation is obtained using the Hodrick-Prescott filtered variable.

Table 2. *Unit Root Test (Jan. 1921 – June 1923; lag-length included obs. 25)*

	Intercept	Trend and intercept
Augmented Dickey–Fuller		
Real exchange rate	−5.85***	−5.76***
Consumer prices	−2.70*	−3.67**
Notes in circulation in real value	−4.84***	−4.75***
Real government revenue	−6.44***	−6.66***
Real fiscal deficit	−5.27***	−5.16***
Dickey–Fuller GLS		
Real exchange rate	−5.81***	−5.92***
Consumer prices	−2.11**	−3.80***
Notes in circulation in real value	−4.76***	−4.90***
Real government revenue	−3.35***	−4.80***
Real fiscal deficit	−3.44***	−6.09***

Note: The number of lags has been chosen according to the Schwarz Information Criterion. The null hypothesis is that the variable has a unit root. ***rejected at 1%, **rejected at 5%, *rejected at 10%.

view in the narrow sense of the term and the monetary-fiscal view put forward by Sargent (1982), which regards episodes of hyperinflation as always originating from fiscal imbalances. Conversely, according to the monetary view in the narrow sense of the term, these episodes can also result from an excessive growth in bank credit and thus from the behaviour of private individuals.[18]

In order to compare the sudden stop view with Sargent's monetary-fiscal view we repeated the estimate of the VAR Granger test in Table 3, replacing the monthly variations of the monetary base in real terms (RMB) with those of government revenue in real terms (RGR).[19] The results of this test are provided in Table 3′.

These show that, as in the case of the monetary view in the narrow sense (referred to in Table 3), the null hypothesis – the variable of interest has no influence on inflation – is rejected in the case of the real exchange rate, while it is accepted in the case of real government revenue. This corroborates the sudden stop view as opposed to the monetary-fiscal view.[20]

---

[18] For this distinction, see Dornbusch (1985). In ascribing episodes of hyperinflation solely to fiscal imbalances financed through money, the fiscal view holds that the stabilisation of an economy afflicted by hyperinflation presupposes fiscal re-equilibrium. Conversely, the monetary view assumes more simply a drastic reduction in the money supply.

[19] As is clear from Table 2, this variable too is stationary.

[20] As emerges from Table A2 in the online Appendix, similar results to those given in Table 3′ are obtained if the real fiscal deficit (RFD) and not the real government revenue (RGR) is used in the estimate of the VAR Granger test. This variable is taken from Bresciani-Turroni (1937, Table 1) and, as can be seen from Table 2, is stationary.

Table 3. *Granger causality/Block exogeneity Wald test (Jan. 1921 – June 1923)*

		Dependent variables		
		Inflation	Real exchange rate	Real monetary base
Excluded variables	Real monetary base	1.35	0.19	–
	Real exchange rate	20.99★★★	–	17.27★★★
	Inflation	–	0.39	1.74
	All	21.80★★★	2.78	20.25★★★

Note: Monthly change of variables. ★★★rejected at 1%, ★★rejected at 5%, ★rejected at 10%.

One limitation of the VAR Granger test estimated in Tables 3 and 3′ can be the shortness of the time sample under consideration. In order to test whether this shortcoming conditions the results obtained we proceeded to a robustness test of the result in Table 3 by conducting an estimate of a Bayesian VAR, in other words, an approach useful for achieving shrinkage. As Table 3″ shows, the Block exogeneity Wald test obtained using this estimate confirms the result in Table 3: it is the real exchange rate and not the monetary base that explains inflation in the period under consideration, that is to say, between January 1921 and June 1923.[21]

The VAR Granger test estimated in Table 3, and confirmed by the estimate in Table 3″, provides some indications about the causal connection between the variables under consideration. It does not, however, give any indications as to the intensity of the causal links. In order to measure this intensity we used a forecast error variance decomposition (FEVD), a methodology used first by Montiel (1989) and later by Dornbusch *et al.* (1990) and Fischer *et al.* (2002) to analyse the origin of hyperinflations. The results of the FEVD relative to the standard VAR Granger test estimated in Table 3 are given in Table 4.

Panels A, B and C present three different orderings of the variables, while Panel D simply summarises the average values of the three previous orderings. Table 4 provides further evidence that the dynamics of the exchange rate significantly influence the other three variables of the system, in particular the dynamics of the rate of inflation. Conversely, the influence on this latter variable of changes in real monetary base is always lower than that of changes in the real exchange rate, irrespective of the order of the variables in the VAR.[22]

---

[21] As emerges from Table A4 in the online Appendix, this result is confirmed also when the variables are filtered using the Hodrick-Prescott filter. The stationarity of these variables was preliminarily ascertained in Table A3.

[22] The impulse response functions are reported in the online Appendix (Figure A2).

Table 3′. *VAR Granger causality/Block exogeneity Wald test (Jan. 1921 − June 1923)*

		Dependent variables		
		Inflation	Real exchange rate	Real government revenue
Excluded variables	Real goverment revenue	4.04	2.16	
	Real exchange rate	24.01★★★		13.10★★★
	Consumer prices		4.77	2.45
	All	27.08★★★	5.01	26.19★★★

Note: Monthly change of variables. ★★★ rejected at 1%; ★★ rejected at 5%; ★ rejected at 10%.

Table 3″. *Bayesian VAR Granger causality/Block exogeneity Wald test (Jan. 1921 − June 1923)*

		Inflation	Real exchange rate	Real monetary base
Excluded variables	Real monetary base	0.71	5.38★★	
	Real exchange rate	20.90★★★		11.59★★★
	Inflation		3.48★	0.92
	All	25.46★★★	5.90★	12.19★★★

Note: Monthly change of variables. ★★★ rejected at 1%; ★★ rejected at 5%; ★ rejected at 10%.

It is common knowledge that in a standard VAR the result of the FEVD can be influenced by the order of the variables. A robustness test was also carried out for this estimate. We estimated a structural VAR (SVAR) which modifies the Cholesky decomposition, on which the FEVD in the standard VAR is based, in order to make the order of real exchange rate and real monetary base irrelevant.[23]

It is clear from Table 4′ that in both the short and the long term the inflation dynamic is explained by shocks to the real exchange rate with percentages that are always above 50 per cent and with a slight tendency towards growth, while the contribution of the real monetary base is slightly above 30 per cent in the first six months

---

[23] The relationship between the orthonormal unobserved structural innovations, u_t, and the VAR errors, ε_t, is $\varepsilon_t = A^{-1}Bu_t$ − where matrix A governs the structure of contemporaneous feedback of variables in the VAR, while matrix B concerns the correlation structure of the errors. In the Cholesky decomposition the matrix A is a lower triangular matrix. In a VAR in which the exchange rate is ordered first and the monetary base second, making their position indifferent implies that we must set A(1,2) = A(2,2) = 0, that is, the exchange rate does not react simultaneously to monetary shock. With this restriction we can estimate the VAR and proceed to the FEVD without worrying about the relative position of the exchange rate and monetary base. The impulse response functions of this SVAR are reported in Figure A3 of the online Appendix. They do not differ from those obtained using the standard VAR which are reported in Figure A2.

Table 4. *Composition of forecast error variance of variables in the VAR system (forecast at 24 months)*

	Variance decomposition of		
	Inflation (INFL)	Real exchange rate (RER)	Real monetary base (RMB)
due to	VAR ordering: RER − RMB − INFL		
INFL	18.4	4.0	15.5
RER	60.0	84.0	46.7
RMB	21.5	12.0	37.8
	VAR ordering: RMB − RER − INFL		
INFL	21.5	3.9	15.5
RER	39.6	74.5	30.1
RMB	38.9	21.6	54.4
	VAR ordering: INFL − RER − RMB		
INFL	67.7	26.9	58.4
RER	27.4	70.5	24.3
RMB	5.0	2.6	17.3
	VAR ordering: Average		
INFL	35.9	11.6	29.8
RER	42.3	76.3	33.7
RMB	21.8	12.1	36.5

and then falls to under 20 per cent after two years. The basic exogeneity of the real exchange rate is also confirmed. This is explained with percentages consistently slightly below 90 per cent.

The results of the tests we have just described thus confirm the plausibility of the sudden stop hypothesis, namely the idea that German hyperinflation originated in an exchange rate crisis caused by a sudden stop. The next section seeks to explain when and why this sudden stop occurred.

III

It was pointed out in the Introduction that the balance of payments hypothesis assumes that German hyperinflation had its origin in an exchange rate crisis. That hypothesis maintained, however, that this crisis resulted from Germany's efforts to meet its reparations obligations. This is not the place to debate this question once again.[24] There is already a substantial literature that shows that in actual fact the effective burden of the reparations the Weimar republic had to pay was sustainable (see, among others, Schuker 1988; Ritschl 2012).

---

[24] An illustration of this can be found in Feldman (1997).

Table 4′. *Composition of forecast error variance of variables in the SVAR system (Jan. 1921 – June 1923)*

		Due to shock on		
		Real exchange rate	Real monetary base	Inflation
Variance decomposition of				
Real exchange rate	6	87.6	9.2	3.3
	12	87.2	9.4	3.4
	24	87.2	9.4	3.4
Real monetary base	6	34.4	58.7	6.9
	12	36.9	52.0	11.1
	24	44.3	39.2	16.5
Inflation	6	53.3	31.9	15.2
	12	56.0	26.2	17.8
	24	58.8	19.6	21.5

Note: Forecast at 6, 12 and 24 months.

The assumption we make here, unlike the position underlying the balance of payments hypothesis, is that the crisis of the German mark resulted from a precipitous reversal of capital flows, in other words, a sudden stop. This hypothesis makes it crucial to determine the moment when this process occurred.

An initial technique for identifying the moment when the sudden stop occurred can be the use of the SVAR historical decomposition. This approach enables us to ascertain whether the influence of variations in the real exchange rate on the rate of inflation increased over time, becoming more pronounced during the course of 1922.

In Figure 3 we give the results of this analysis across the whole period of the estimate. As can be seen, starting from the beginning of 1922, but in particular from July to December, the role of the real exchange rate in determining the variations in the inflation rate grows considerably. In particular, the phase of acceleration in inflation that occurred in mid 1922 seems to be driven primarily by the RER (Figure 3).

In order to obtain statistical confirmation of the visual impression presented by Figure 3, we regressed, by OLS, the stochastic component of inflation on the contribution of the real exchange rate and the real monetary base over three time intervals of one year, which finished in December 1921, December 1922 and June 1923, respectively. As can be seen from Figure 4, the estimates confirm the visual impression and show that the role of the exchange rate in explaining the price dynamic grew during 1922, the period when the first episodes of acceleration occurred. In particular, if the exchange rate in 1921 explains a little less than 40 per cent of the variations in prices, in 1922 it explains a little less than two-thirds of the total.
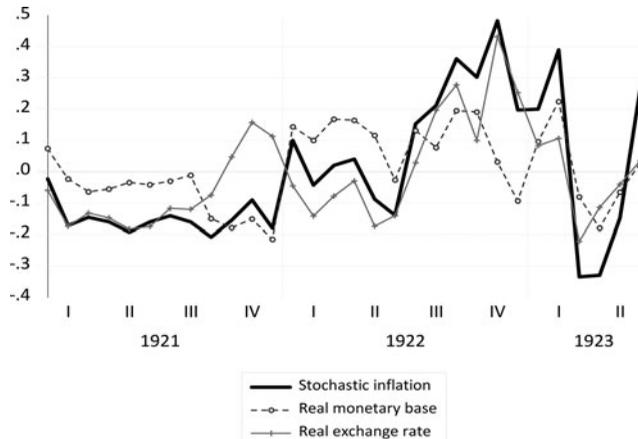
Figure 3. *Historical decomposition of inflation*
Note: The variables are measured in percentages.

The empirical evidence outlined above shows that the influence of variations in the real exchange rate increased significantly during the course of 1922 and particularly from the latter half of the year onwards.[25]

We can now try to establish which shock during this time frame led to the occurrence of a sudden stop. In order to clarify this point, we proceeded to an econometric analysis. In particular, we tested if some important pieces of political news had a significant influence on the behaviour of investors and on the exchange rate of the mark.[26]

To this end we followed the 'narrative approach' (see Romer and Romer 1989; Ramey 2011), which takes as its point of reference events recognised as important by public opinion. Following Feldman (1997, p. 418), we assume that good news fuels hopes that a solution to the reparations problem will be found and the German economy will be stabilised; the opposite applies in the case of bad news. In this perspective we verify how the events listed in Table 1 influenced individual expectations and, as a consequence, the exchange rate. Since we do not have daily data for the forward exchange rate of the mark in the 1920s,[27] we attempted to determine the short-term equilibrium exchange rate using the uncovered interest parity condition.

---

[25] Indications in this direction can be obtained from the VAR Granger causality test given in Table 3 separately for the two distinct periods: January 1921 to June 1922 and January 1922 to June 1923. The results of these estimates, shown in Tables A5a and A5b in the online Appendix, show that the influence of RER on INFL is significantly higher in the second time period.

[26] This hypothesis is based on the idea that markets are efficient and that accordingly each important piece of information is incorporated into the current exchange rate.

[27] The data for this variable are only available on a weekly basis and are provided in Einzig (1937).
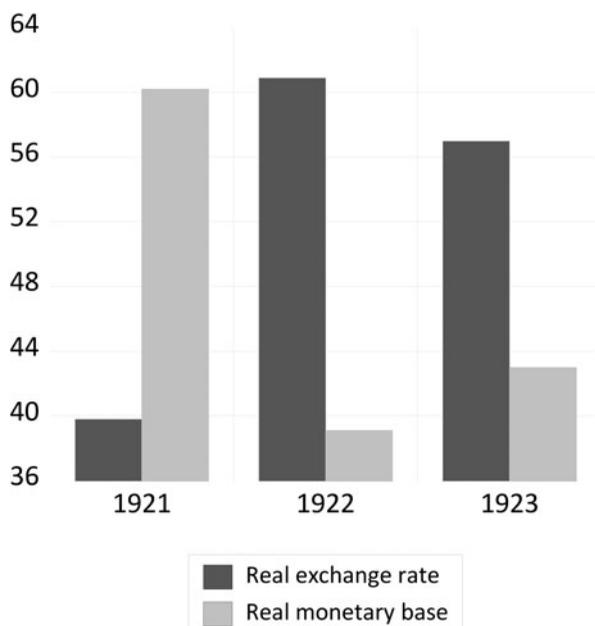
Figure 4. *The relative influence of the real exchange rate and of the real monetary base on inflation*

The estimate uses the daily data of the mark–dollar exchange rate, s_t, the interest rate on the 3 per cent German Imperial bond, i, the interest rate on the 3.5 per cent Victory bond 1932–47, $i\star$,[28] and the variable 'news', with a value of 1 for the unfavourable events and -1 for the favourable events listed in Table 1, and a value of 0 during the other periods.[29]

Prior to the estimate we tested the stationarity of the variables. As emerges from Table 5, both the first difference of the exchange rate and the first difference of the spread between long-term interest rates are stationary, whichever test is used.

We then went on to estimate an equation specified as follows:

$$s_t - s_{t-1} = b_0 + b_1 \Delta(i_{t-1} - i^*_{t-1}) + b_2 news_t + \varepsilon_t \qquad (1)$$

The estimate was made by OLS for the period 1 January 1921 to 31 December 1922 and its results are shown in Table 6.

In column (1) we show the basic equation, where the change in the Reichsmark–US dollar exchange rate was set as a function of the change in the spread between the long-term interest rates. In the estimate this spread is significant and, as expected,

---

[28] The mark–dollar exchange rate data and the long-term interest rate data come from the historical digital archives of *The Times*.
[29] The statistical characteristics of the variables are given in Table A1 of the online Appendix.

Table 5. *Unit root tests (sample 1 Jan. 1921 – 31 Dec. 1922)*

	Intercept	Trend and intercept
Augmented Dickey–Fuller		
Mark–dollar exchange rate	−18.94★★★	−19.27★★★
Spread long-term interest rates	−25.56★★★	−25.56★★★
Dickey–Fuller GLS		
Mark–dollar exchange rate	−13.34★★★	−19.22★★★
Spread long-term interest rates	−25.56★★★	−25.60★★★

Notes: The number of lags has been chosen according to the Schwarz Information Criterion. The null hypothesis is that the variable has a unit root. ★★★rejected at 1%, ★★rejected at 5%, ★rejected at 10%.

positive. In column (2) we incorporated into the basic equation the variable *news*. Also this variable is significant and has the expected sign. In column (3) the variable *news* has been divided into *bad news* and *good news*. The results of the estimate show that both

Table 6. *OLS estimates of the change in the exchange rate (dependent variable $s_t − s_{t−1}$)*

Variable	(1)	(2)	(3)	(4)
Constant	0.006996★★★	0.006902★★★	0.006857★★★	0.00668★★★
	(0.0021)	(0.0020)	(0.0022)	(0.0021)
$\Delta(i_{t−1} − i^*_{t−1})$	0.009705★★★	0.008449★★★	0.008453★★★	0.007743★★★
	(0.0021)	(0.0021)	(0.0021)	(0.0021)
News		0.022007★★★		
		(0.0065)		
News★ante				0.015055★★
				(0.0077)
Bad news			0.02242★★★	
			(0.0091)	
Good news			−0.021543★★	
			(0.0097)	
Bad news★post				0.055892★★★
				(0.0184)
Good news★post				−0.027013★
				(0.0151)
Adj R–squared	0.03	0.05	0.05	0.05
SER	0.05	0.05	0.05	0.05
DW	1.87	1.87	1.87	1.87
Bad news + Good news = 0 Wald test t–stat			0.06	1.22
Prob			0.95	0.222

these variables are significant and have the expected signs. What is more, the Wald test provides no evidence of a significant statistical difference between the coefficients of the different types of news.

In order to test the robustness of the results of the estimates just described we used an extended version of the Ramey and Shapiro (1998) approach, in particular the approach proposed by Edelberg *et al.* (1998) and further refined by Romer and Romer (2010). As in that contribution we used a VAR with an exogenous variable: political news. Two reasons prompted the use of this type of model. Firstly, it helps overcome possible problems of endogeneity in the OLS estimates and in particular those between changes in the real exchange rate and changes in the spread. Secondly, the use of the VAR methodology makes it possible to show the impulse response function (IRF) of the exchange rate to political news.

The VAR includes the following three variables: the first difference in the mark–dollar exchange rate, the first difference in the spread between the German and the US long-term interest rates, and the variable *news*. In order to identify the innovations in the three variables under consideration we used the Cholesky decomposition, first ordering the variable *news* in the VAR system. As for the OLS estimates, the VAR system was estimated on daily data from 1 January 1921 to 31 December 1922. For each variable five lags were considered, in line with the results of the various tests of lag length criteria.[30] The VAR estimated in this way proves to be stable in that all the roots lie inside the unit circle.

The Cholesky decomposition renders the various impulses in a VAR system orthogonal by imposing order on the variables. For our purposes, having first ordered the variable *news*, this means that while the change in the exchange rate or in the interest rate spread reacts immediately to impulses in the variable *news*, this last variable reacts only with lags to shocks to the first two variables.

The estimate thus obtained enables us to evaluate the response of the exchange rate to a standard impulse of political news. Figure 5 shows the dynamic response of the change in the real exchange rate to political news over a span of ten working days.

As can be seen from Figure 5, the dollar–mark exchange rate reacts significantly to political news at the moment it is announced. In the first three days it accumulates an elasticity value close to 8 per cent. Subsequently, the effects of political news on the change of the real exchange rate tend to decrease and become insignificant after the sixth day. However, because we are referring to the first difference in the real exchange rate, the increases accumulated in subsequent periods have permanent effects.[31]

---

[30] In particular, five lags are indicated by the Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan–Quinn information criterion (HQ).

[31] In order to evaluate the extent to which the results thus obtained are influenced by the order imposed on the variables in the Cholesky decomposition, we carried out an estimate of the elasticity of the exchange rate in reaction to political news based on the methodology of generalised impulses
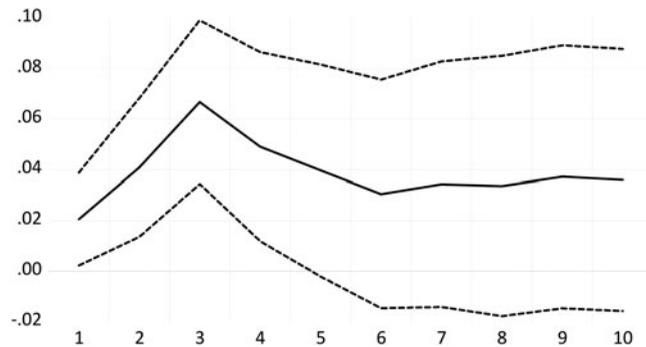
Figure 5. *Impulse response of exchange rate to political news (VAR model)*

Since the results of the test described above may be influenced by the fact that, given that the news variable is discrete in nature, the impulse response functions obtained from the VAR can be biased and misleading, we have also computed the impulse response functions using local projections methodology. This methodology does not require specification and estimation of the unknown true multivariate dynamic system itself.[32] The estimate of the news elasticity of the real exchange rate by the local projections methodology can be found in Figure 6.

The news elasticity of the exchange rate, both in terms of the level and the dynamics of the impulse reflects what could be seen in Figure 5. In particular, also in this case the peak is reached on the third day up to a maximum of 7.2 per cent, after which the impulse tends to be cancelled out, becoming insignificant after the fifth day.

This evidence suggests that news, especially the news listed in Table 1, had on average important and long-lasting effects on the real exchange rate of the mark and consequently on the domestic rate of inflation.

It remains to be established whether and at what point the importance of these effects became more pronounced. To this end we consider the recursive coefficients of the estimates in Table 6. This analysis shows us that, starting from the summer of 1922, the coefficients of *bad news* and *good news* followed diverging trends (Figures 7a and 7b).

While the *good news* coefficient has a tendency to fall, in the case of *bad news* it tends to rise. This increase seems to suggest a widespread conviction that stabilisation in Germany had become unattainable. The consolidation of this conviction led to a dramatic depreciation of the mark. From late August, albeit with some delay with respect

_____

(Pesaran and Shin 1998). The results obtained with this methodology confirm the results obtained with the Cholesky decomposition.

[32] This methodology was initially put forward by Jordà (2005). On its use, see also Kilian and Kim (2009).
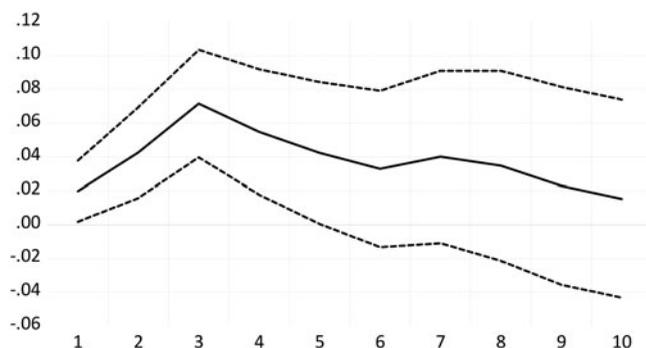
Figure 6. *Impulse response of exchange rate to political news (local projection)*

to the actual exchange rate depreciation,[33] also the three-month forward exchange rate started to show a significant discount: between the end of July and the end of August it rose from 10 to 150 per cent. Given the evidence produced we can conclude that the months between July and August 1922 represented a benchmark for expectations about Germany's economic prospects. Accordingly, Figures 7a and 7b show that from August of that year onward the influence of bad news on the exchange rate became considerably more pronounced.

This is confirmed in the estimates in column (4) in Table 6, which gives the values of the coefficients of news after 24 August 1922. A comparison of the results in this column with those in column (3) in the same table shows that after late August the bad news coefficient rose from 0.022 to 0.056, while the good news coefficient tended to lose significance.

It would seem, therefore, that starting from the end of August expectations of a growing depreciation of the mark were becoming more concrete. Confirmation of the worsening of expectations about the mark comes from the marked widening of the spread between the interest rates of German and American long-term government bonds: this grew between the middle and the end of August from 13.8 to 20.6 per cent.

Some scholars argue that the change in expectations that occurred in the summer of 1922 concerned Germany's public finances rather than the prospects of the mark. In particular, Webb (1986) maintains that due to the bad news of June 1922 the prospects of public finances worsened considerably. In this context, Germans expected a higher monetisation of debt and therefore a higher level of inflation. This would have prompted them to increase demand for consumer goods, thus fuelling the inflationary

---

[33] See Figure A1 of the online Appendix. Therefore, the size of the forward exchange rate discount, used by Frenkel (1977, 1980) as a proxy for expectations regarding inflation, proved in July to be considerably lower than the actual depreciation in the exchange rate and wholesale and consumer prices growth. This fact allows us to exclude the possibility that the origin of German hyperinflation can be seen as a process of self-fulfilling expectations.
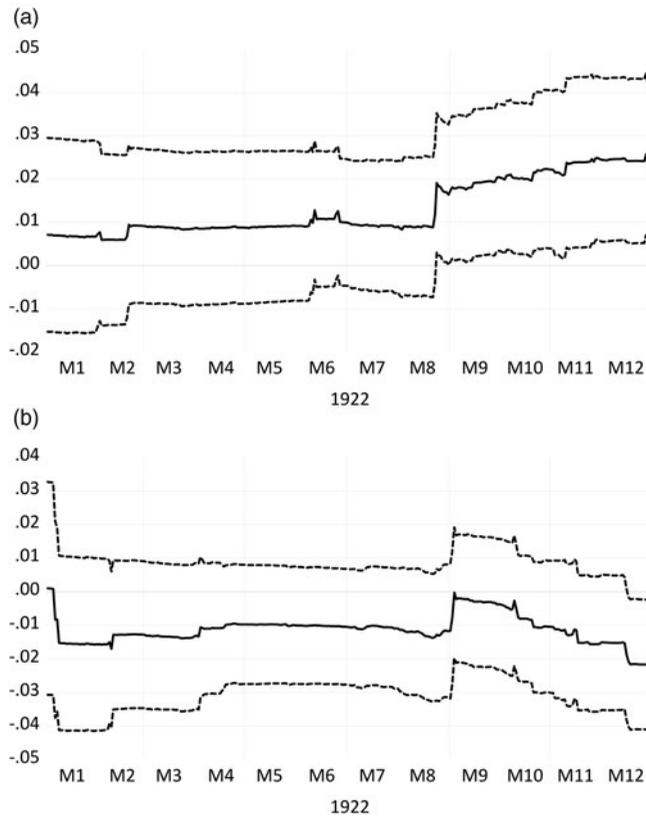
Figure 7 a. *Recursive bad news coefficients b. Recursive good news coefficients*

process. This hypothesis is consistent with the fiscal view. However, it is at odds with the evidence of the different dynamics of retail prices and wholesale prices. As shown by Table 7, in the second half of 1922, in particular from July onwards, the wholesale price index followed that of imports and the spread between wholesale and retail price indices widened markedly.

The more dynamic trend of wholesale prices compared to retail prices seems to confirm the existence of a causal link that goes from the depreciation of the exchange rate to import prices and to wholesale prices, and from these to retail prices, rather than vice versa, as Webb's (1986) version of the fiscal view would have it, from consumer prices to wholesale prices and from these to the exchange rate.

IV

The previous sections have shown how the origin of German hyperinflation is to be sought in a sudden stop and the consequent exchange rate crisis. However, as observed by Dornbusch (1985), the acceleration in inflation brought about by the

Table 7. *Prices indices in second half of 1922 (June = 100)*

Months of 1922	Imports prices	Wholesale prices	Consumer prices[a]
June	100	100	100
July	146	143	134
August	342	273	191
September	454	408	300
October	953	805	520
November	2,258	1,641	1,073
December	2,567	2,098	1,575

[a]Workers' cost-of-living.
Sources: Bresciani-Turroni (1937) and Holtfrerich (1986).

depreciation in the exchange rate would not have transformed into explosive inflation without an accommodating monetary policy.

The accommodating monetary policy of the central bank was in response to the worsening of the social conflict caused by the fall in output and disposable income following the sudden stop.

As in other cases of sudden stops (see, among others, Liviatan and Piterman 1986; Montiel 1989), the worsening of the social conflict took the form of a clash between the productive classes, workers and industrialists, on the one hand, and rentiers, on the other hand (see Kindleberger 1984a; Maier 1978; Pittaluga and Seghezza 2012).

At a time when the country's income was falling, the unions called for real wages to be kept stable. Faced with this demand, industrialists took an accommodating attitude.[34] This attitude sprang from their concern about the possible contagion of the Bolshevik revolution and fear of union strength (see Feldman 1983, p. 390; Holtfrerich 1983, p. 407). They therefore urged the government to adopt expansive fiscal and monetary policies so as to maintain GDP growth high and unemployment at minimum levels (see Feldman 1997, p. 447). Given that this was the prime goal, it is not surprising that the leading representative of the industrialists, Hugo Stinnes, argued that inflation was a 'political necessity'.[35] In this context, a tacit alliance grew up between the industrial lobby and the workers' unions. These two interest groups were not hostile to inflation because it enabled them to shift onto rentiers much of the fall in national income.[36]

After a currency crisis generally two mechanisms can determine a further inflation rate acceleration. The first mechanism follows from the Tanzi effect, in other words,

---

[34] This helps explain the sharp growth in monetary wages between August 1922 and June 1923.
[35] See Houghton Account, NA, 862.00/1199.
[36] As Maier (1978, p. 52) writes: 'Hyperinflation thus involved an implicit coalition of labour and industry at the expense of rentiers . . . Inflation represented a second-best or perhaps maxmin strategy of curtailing predictable losses in a situation where the preferred policy of stabilization at full employment appeared unavailable.'

Table 8. *Government revenue, floating debt and discounted commercial bills in second half of 1922*

Months	Ratio of taxes to total expenditures	Floating debt (millions of gold marks)	Commercial bills discounted by the Reichsbank (trillions of paper marks)
June	74.8	100	6.9
July	66.8	129	18.3
August	56.7	171	164.6
September	20.8	552	3,660.1
October	24.5	388	1,058,129.9
November	30.2	290	347,301,037.7
December	16.8	588	322,724,949.0

Source: Graham (1930).

from the fact that as inflation increases, the real value of tax revenue tends to fall,[37] thus leading to fiscal deficits which, when they cannot be covered by debt, produce an excessive money supply (see Dornbusch 1985, pp. 24–5).

The second mechanism results from the fact that in phases of inflation acceleration and negative real interest rates, the demand for credit rises significantly. When this demand is satisfied, bank loans and the monetary multiplier increase (see Tullio 1985, p. 353). The result is a notable increase in monetary base.

In Germany in the latter half of 1922, both of these mechanisms were at work. On the one hand, mounting reductions in real government revenue began in August 1922.[38] However, the government sought to maintain a high level of spending in real terms. This implied a significant increase in fiscal deficit, in the floating debt held by the Reichsbank and in the money base created by the Treasury (Table 8).

On the other hand, in order to maintain workers' purchasing power, re-negotiations of wages between unions and industrialists became increasingly frequent (see Colles 1922, p. 464). As wage increases affected production costs, this inevitably led to price increases, which, in turn, had an effect on production cycles. Firms were unable to pay wages and buy capital goods, raw materials and intermediate goods using the cash flows coming from the previous period's production, since their purchasing power was eroded due to rising inflation. Especially after the sharp depreciation of the mark between 1921 and 1922, businessmen had to resort to bank credits to keep up production cycles. This helps explain why the growth of bank loans was quite considerable in 1921 and 1922 (see Prion 1924, p. 172).

---

[37] As this is based on the nominal revenue of the previous year.
[38] According to Graham (1930), between June and December 1922 government revenue decreased from 305 to 119 billion gold marks.

Table 9. *Money and money multiplier in Germany, 1920–4*

	1920	1921	1922	1923	1924
Deposits in all commercial banks (a)	83,891	154,989	2,216,067	1,481,019,370	4,977
Saving deposits (b)	43,100	46,500	136,180	–	–
Total money in circulation (c)	81,388	122,500	1,295,231	2,274,000,000	3,891
a/c	1.03	1.27	1.71	0.65	1.28

Source: Graham (1930).

When, in mid 1922, the banks had insufficient liquidity to meet the demand for loans, the Reichsbank decided to address this situation by introducing liquidity into the system and considerably increasing the discount of commercial bills (Table 8) (see Graham 1930; Webb 1984). Between June and December 1922 the monetary base created by refinancing operations increased by 1,416 billion in paper marks, that is to say, more than that created by the Treasury channel, which rose in the same period by 1,111 billion paper marks. At the same time, given the high level of bank loans, the significant growth of the monetary base was accompanied, between 1920 and 1922, by a particularly sharp increase in the money multiplier (Table 9).

The acceleration of the inflation rate eroded the real value of the public debt in the national currency. This erosion inflicted significant capital losses on rentiers, the principal holders of government bonds.

V

In the years following the Treaty of Versailles, Germany benefited from a massive inflow of capital from abroad. This influx was driven by expectations of an appreciation of the Reichsmark. Foreign investors were confident that the reparations problem would be resolved and that the German economy would be stabilised. However, in the summer of 1922, in the wake of some bad events foreign and domestic investors lost confidence in the future appreciation of the German currency. This change in expectations was followed by a sudden stop. The reversal of flows of capital led to a significant depreciation of the mark, an accelerating rate of inflation and a fall in output and disposable income.

As is often the case in emerging countries hit by a sudden stop, also the German government was unable to adopt policy measures designed to offset its consequences. Opposition to these measures came primarily from labour and industry. In particular, the unions demanded that workers' purchasing power be kept stable. These demands were accepted by industrialists because they were convinced that any possible

rejection would lead to unrest and potentially to a revolutionary coup similar to the Bolshevik uprising in Russia. This condition could only be met through a continuous depreciation of the mark and a significant increase in the exposure of companies to debt. In this way, they received loans from banks to pay workers and to buy intermediate goods, and repaid them with money that had lost value due to a fall in the exchange rate.

Income support for the productive classes by means of the measures outlined above took the form of a broad-based redistribution process at the expense of other social classes, notably rentiers (see Morelli and Seghezza 2014).

Supplementary materials and methods

To view supplementary material for this article, please visit https://doi.org/10.1017/S0968565020000062

References

BONN, M. J. (1922). *Die Stabilisierung der Mark*. English trans. *The Stabilization of the Mark*. Chicago: First National Bank of Chicago.

BORDO, M. D., CAVALLO, A. F. and MEISSNER, C. M. (2007). Sudden stops: determinants and output effects in the first era of globalization, 1880–1913. NBER working paper 13489.

BRESCIANI-TURRONI, C. (1937). *The Economics of Inflation: A Study of Currency Depreciation in Post-war Germany*. London: Allen & Unwin.

CAGAN, P. (1956). The monetary dynamics of hyperinflation. In M. Friedman (ed.), *Studies in the Quantity Theory of Money*. Chicago: Chicago University Press.

CALVO, G. A. (1995). Varieties of capital market crisis. Inter-American Development Bank, Research Department Publication 4008.

CALVO, G. A. (2012). The price theory of money, Prospero's liquidity trap, and sudden stop: back to basics and back. NBER working paper 18285.

CALVO, G. A. and REINHART, C. M. (2000). When capital inflows come to a sudden stop: consequences and policy options. In P. Kenen and A. Swoboda (eds.), *Reforming the International Monetary and Financial System*. Washington, DC: IMF.

CALVO, G. A., IZQUIERDO, A. and TALVI, E. (2003). Sudden stops, the real exchange rate and fiscal sustainability: Argentina's lessons. NBER working paper 9829.

CASSIS, Y. (2006). *Capitals of Capital: A History of International Financial Centres, 1780–2005*. Cambridge: Cambridge University Press.

COLLES, W. M. (1922). Wage movements at home and abroad: the high water mark. *Manchester Guardian Commercial*, 6 April.

DORNBUSCH, R. (1985). Stopping hyperinflation lessons from the German inflation experience in the 1920s. NBER working paper 1675.

DORNBUSCH, R., STURZENEGGER, F. and WOLF, H. (1990). Extreme inflation: dynamics and stabilization. *Brookings Papers on Economic Activity*, **2**, pp. 1–64.

EDELBERG, W., EICHENBAUM, M. and FISHER, J. D. M. (1998). Understanding the effects of a shock to government purchases. Federal Reserve Bank of Chicago, Working Paper Series, Research Department, WP-98-7.

EINZIG, P. (1937). *The Theory of Forward Exchange Rate*. London: Macmillan.

FELDMAN, G. D. (1983). The historian and the German inflation. In N. Schmukler and E. Marcus (eds.), *Inflation Through the Ages: Economic, Social, Psychological and Historical Aspects*. New York: Columbia University Press.

FELDMAN, G. D. (1997). *The Great Disorder: Politics, Economics, and Society in the German Inflation, 1914–1924*. Oxford: Oxford University Press.

FERGUSON, N. (1996). Constraints and room for manoeuvre in the German inflation of the early 1920s. *Economic History Review*, **49**, pp. 635–66.

FERGUSON, N. (1998). The balance of payments question: Versailles and after. In M. F. Boemeke, G. D. Feldman and E. Glaser (eds.), *The Treaty of Versailles: A Reassessment after 75 Years*. Cambridge: Cambridge University Press.

FERGUSON, N. and GRANVILLE, B. (2000). Weimar on the Volga: causes and consequences of inflation in 1990s Russia compared with 1920s Germany. *Journal of Economic History*, **60**, pp. 1061–87.

FISCHER, S., SAHAY, R. and VÉGH, C. (2002). Modern hyper- and high inflations. *Journal of Economic Literature*, **40**, pp. 837–80.

FRENKEL, J. A. (1977). The forward exchange rate, expectations, and the demand for money: the German hyperinflation. *American Economic Review*, **67**, pp. 653–70.

FRENKEL, J. A. (1980). The forward exchange rate, expectations, and the demand for money: the German hyperinflation: a reply. *American Economic Review*, **70**, pp. 771–5.

FRÈRE, M. (1922). *Report by the Intelligence Service on the balance of Germany accounts*. Paris, 19 Oct. 1922. PRO, Fo 371/7486/311/166–93.

FOURGEAUD, A. (1926). *La dépréciation et la revalorization du mark allemande*. Paris: Payot.

GOMES, L. (2010). *German Reparations, 1919–1932: A Historical Survey*, New York: Palgrave Macmillan.

GRAHAM, F. (1930). *Exchange, Prices, and Production in Hyperinflation: Germany*. Princeton, NJ: Princeton University Press.

HAWTREY, R. G. (1923). *Currency and Credit*. London: Longman.

HELFFERICH, K. (1927). *Money*. New York: Adelphi Co.

HOLTFRERICH, C. L. (1982). Domestic and foreign expectations and the demand for money during the German hyperinflation, 1920–1923. In C. P. Kindleberger and J. P. Laffargue (eds.), *Financial Crises: Theory, History and Policy*. Cambridge: Cambridge University Press.

HOLTFRERICH, C. L. (1983). Political factors of the German inflation 1914–23. In N. Schmukler and E. Marcus (eds.), *Inflation Through the Ages: Economic, Social, Psychological and Historical Aspects*. New York: Columbia University Press.

HOLTFRERICH, C. L. (1986). *The German Inflation, 1914–1923*. New York: De Gruyter.

HUTCHISON, M., NOY, I. and WANG, L. (2010). Fiscal and monetary policies and the cost of sudden stops. *Journal of International Money and Finance*, **29**, pp. 973–87.

JORDÀ, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, **95**, pp. 161–82.

KEYNES, J. M. (1922). Speculation in the mark and Germany's balances abroad. In *Reconstruction in Europe: Manchester Guardian Commercial Supplement*, 28 September 1922, pp. 480–2. Reprinted in E. Johnson and D. E. Moggridge (eds.), *The Collected Writings of J. M. Keynes*, vol. XVIII, pp. 47ff., London.

KEYNES, J. M. (1923). *A Tract on Monetary Reform*. London: Macmillan.

KIGUEL, M. A. and LIVIATAN, N. (1995). Stopping three big inflations: Argentina, Brazil and Peru. In R. Dornbusch and S. Edwards (eds.), *Reform, Recovery and Growth: Latin America and the Middle East*. Chicago: University of Chicago Press.

KILIAN, L. and KIM, Y. J. (2009). Do local projections solve the bias problem in impulse response inference? CEPR Discussion Paper Series 7266.

KINDLEBERGER, C. P. (1984a). *A Financial History of Western Europe*. London: Allen and Unwin.

KINDLEBERGER, C. P. (1984b). A structural view of the German inflation. In G. Feldman, C. Holtfrerich and P. C. Ritter (eds.), *The Experience of Inflation*. Berlin: De Gruyter.

LEAGUE OF NATIONS (1931). *Memorandum on Commercial Banks, 1919–1929*. Geneva.

LIVIATAN, N. and PITERMAN, S. (1986). Accelerating inflation and balance of payments crises, 1973–1984. In Y. Ben-Porath (ed.), *The Israeli Economy*. Cambridge, MA: Harvard University Press.

LOPEZ, J. A. and MITCHENER, K. J. (2018). Uncertainty and hyperinflation: European inflation dynamics after World War I. NBER working paper 24624.

MAIER, C. (1978). The politics of inflation in the twentieth century. In F. Hirsch and J. Goldthorpe (eds.), *The Political Economy of Inflation*. Oxford: Martin Robertson.

MONTIEL, P. J. (1989). Empirical analysis of high-inflation episodes in Argentina, Brazil and Israel. *IMF Staff Papers*, **36**, pp. 527–49.

MORELLI, P. and SEGHEZZA, E. (2014). Conflict inflation and delayed stabilization. *Journal of Macroeconomics*, **39**, pp. 171–84.

PESARAN, M. A. and SHIN, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, **58**, pp. 17–29.

PITTALUGA, G. B. and SEGHEZZA, E. (2012). The role of rentiers in the stabilization processes of the twenties. *European Review of Economic History*, **16**, pp. 188–210.

PRION, W. (1924). Deutsche Kreditpolitik 1919–1922. *Schmollers Jahrbuch*, **49**, pp. 381–405.

RAMEY, V. (2011). Identifying government spending shocks: it's all in the timing. *Quarterly Journal of Economics*, **126**, pp. 1–50.

RAMEY, V. and SHAPIRO, M. D. (1998). Costly capital reallocation and the effects of government spending. *Carnegie-Rochester Conference Series on Public Policy*, **48**, pp. 145–84.

RITSCHL, A. (2012). The German transfer problem, 1920–33: a sovereign-debt perspective. *European Review of History*, **6**, pp. 943–64.

ROMER, C. D. and ROMER, D. H. (1989). Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. *NBER Macroeconomic Annual*.

ROMER, C. D. and ROMER, D. H. (2010). The macroeconomic effect of tax changes: estimates based on a new measure of fiscal shocks. *American Economic Review*, **100**, pp. 763–801.

SARGENT, T. J. (1982). The ends of four big hyperinflations. In R. E. Hall (ed.), *Inflation: Causes and Effects*. Chicago: University of Chicago Press.

SCHUKER, J. A. (1988). American 'reparations' to Germany, 1919–33: implications for the Third-World debt crisis. *Princeton Studies in International Finance*, 61, July.

TULLIO, G. (1985). Inflation and currency depreciation in Germany, 1920–1923: a dynamic model of prices. *Journal of Money, Credit and Banking*, **27**, pp. 350–62.

WARBURG, M. (1921). Speech before R. W. M. Scholz, 12.12.20, in WA, X, 'Pol.Corr.1921', Warburg.

WEBB, S. (1984). The supply of money and Reichsbank financing of government and corporate debt in Germany, 1919–1923. *Journal of Economic History*, **44**, pp. 499–507.

WEBB, S. (1986). Fiscal news and inflationary expectations in Germany after WWI. *Journal of Economic History*, **46**, pp. 769–94.

WHALE, P. B. (1930). *Joint Stockbanking in Germany: A Study of the German Credit Banks before and after the War*. London: Macmillan.

WILLIAMS, J. G. (1922). German foreign trade and the reparation payments. *Quarterly Journal of Economics*, **36**, pp. 482–503.

WIXFORTH, H. (2003). German banks and their business strategies in the Weimar Republic: new findings and preliminary results. In M. Kasuya (ed.), *Coping with Crisis: International Financial Institutions in the Interwar Period*. Oxford: Oxford University Press.