INFLATIONARY EXPECTATIONS AND UNCERTAINTY DURING THE GREAT DEPRESSION IN GERMANY

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ABSTRACT

The unusual severity of the Great Depression in Germany has often been interpreted as a unique failure of economic policy – with disastrous consequences for the Weimar republic. In this paper, we argue that criticisms of the Brüning government are misplaced. On the basis of asset prices, we infer that fear of inflation was widespread in 1931/ 32, limiting the room for manoeuvre. We conclude that the Britain's departure from gold – instead of facilitating such a step in Germany – actually made it much more difficult to adopt expansionary measures, because it increased uncertainty and fear of inflation.

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Following the global financial crisis in the autumn of 1998, there has been widespread concern about the dangers of deflation.[1] Also, Japan's extended slump has led to renewed interest in liquidity traps.[2] Since the outbreak of the Asian crisis in 1997, the dilemmas of economic policy in a deflationary environment are back on the agenda. Much of the contemporary debate has turned to the Great Depression as the canonical case of how falls in prices can get out of control, resulting in deflationary spirals. During the Great Depression, prices were falling in all industrialized countries. Yet few economies experienced a more pronounced deflation than Germany, where the consumer price index fell by 23 percent from peak to trough.[3] Using this celebrated case, we examine the extent to which policy choices in a deflationary environment can be constrained by prior historical experience and simultaneous decisions by other countries. In Germany, reductions of prices and wages were not simply a result of weak demand and tight credit conditions; they were also part of a deliberate deflationary policy, initiated by the Brüning government to combat the slump. Falling nominal wages were supposed to increase the country's competitiveness on the world market, acting as a 'surrogate devaluation'.

The new orthodoxy about the Great Depression argues that casting off the shackles of the gold standard was crucial for recovery. Eichengreen's classic account details how misconceived policy deepened the crisis and delayed the upturn in countries that remained on gold, and how those countries that broke the link to gold quickly resumed growth.[4] One of the most successful examples of such a break with tradition was Britain's departure from gold in September 1931. At the other end of the spectrum, Germany and France retained their commitment to specie backing despite the deflationary consequences, balance sheet problems, and financial uncertainty that it produced.[5] In the case of Germany, one specific reason has played a prominent role in discussions about policy options – fear of inflation. Prominent scholars have argued that expansionary measures, and especially a departure from gold, would have been impossible because memories of the hyperinflation continued to linger.[6]

In order to establish if fear of inflation severely undermined the range of options for government intervention, it has to be demonstrated that economic agents at the time did

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[1] Economist 1999.
[2] Krugman 1999a, b.
[3] For an overview, cf. Bernanke and James 1991.
[4] Eichengreen 1992a. Cf. also Eichengreen and Sachs 1985.
[5] Technically, since Germany suspended gold convertibility in 1931, it was off the gold standard – but did not engage in any of the expansionary measures used in other countries until 1932/ 3. Cf. James 1985, p.

indeed fear price increases – despite the rapid fall in prices. We begin by placing the decline in prices in Germany during the Great Depression in its historical context. This paper then seeks to measure expectations of future price increases in Germany. To that end, we use a range of indicators that allow us to reconstruct the price expectations implied by the behaviour of economic agents. Next, we explore the consequences of the fear of inflation that began to surface in the summer of 1931. The conclusion discusses implications for the political and economic history of the Weimar Republic, and examines the issue of international policy co-ordination more closely.

FINANCIAL CRISIS AND DEFLATION

Did incompetent policymaking turn the German recession that started in 1928 into economic – and ultimately, political – disaster? Numerous authors have claimed as much.[7] Despite being faced with an ever-deepening crisis, neither credit expansion nor deficit spending were used on any significant scale before 1932. Some authors even suggest that the German government deliberately exacerbated the crisis to liberate the Reich from the yoke of reparations.[8] It is therefore not surprising that, in recent accounts of the Great Depression, the German cabinet under chancellor Brüning is often cited as an example of blatant mismanagement:[9]

> It is vivid testimony to the power of ideology that leaders like Brüning were induced to cling to orthodoxy even as the world economy collapsed. He continued to advocate gold standard policies after abandoning the gold standard himself. He ruined the German economy – and destroyed German democracy – in the effort to show once and for all that Germany could not pay reparations.

Apologetic interpretations have emphasized that any German government would have found it hard to act decisively during the early 1930s, and that options for a more active policy were largely conspicuous by their absence.[10] Much of the literature on 'room for manoeuvre' during the Great Depression in Germany, citing the recent memory of hyperinflation and contemporary press comment, has argued that policymakers were constrained by fear of inflation.

Germany could therefore not have followed Great Britain in leaving the gold standard, even if it had wanted to, since the German public would have immediately anticipated a

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[6] Borchardt 1985.
[7] Holtfrerich 1990, Kroll 1959, Bombach 1976.
[8] Temin 1990, p. 82-3.
[9] Feinstein, Temin and Toniolo 1997, p. 110.
[10] Borchardt 1991, p. 146.

repeat of the inflationary experience 1919-23. Hence, the deflationary policies of the Brüning government between 1930 and 1932 were not only rational, but without alternative. Being unable to devalue directly, the only alternative was to let prices fall sufficiently to be competitive on world markets.[11] Expectations of price declines could only be reversed by the price level falling sufficiently low to make it sensible to expect a rebound in the future. On July 24th 1931, for example, Sir Horace Rumbold, the British ambassador to Berlin, wrote in his report to the Foreign Office: "By 17th July the fear of inflation was very strong".[12] Historians have spent considerable time and effort unearthing comments that attest to fear of inflation during the early 1930s.[13] By December 1931, the German economist Wilhelm Lautenbach was railing in a public lecture against what he saw as rampant 'inflation hysteria'.[14]

Yet fearing price increases in a context of rapidly falling prices implies that contemporaries were unable to grasp the nature of deflation.[15] At the peak of the deflation, during the spring and summer of 1932, prices of industrial goods were falling at an (annualized) rate of more than 15 percent. Once the price level had begun to weaken in 1928, prices continued to fall until 1932. Even by the last quarter of 1935, prices had only regained their Spring 1931 level.[16] There is some indirect evidence that the nature of deflations was not very clear to the wider public. Borchardt has shown how the term 'deflation' only came to be used with any frequency in the popular press after 1931.[17] The 1928 edition of the popular *Brockhaus* encyclopaedia defines deflation as a set of policy measures to reverse the price increases during an earlier inflationary episode.[18] There is no appreciation of the fact that deflationary pressures might arise as a result of economic shocks, nor any discussion of its adverse affects.

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[11] Brüning referred to his deflationary policies as a 'surrogate devaluation'. Brüning 1970.
[12] Cit. acc. to Borchardt 1985, p. 241. Cf. also Schulz 1985.
[13] The most prominent statement in favour is Borchardt (1991, p. 150; 1985).
[14] Borchardt 1985, p. 237.
[15] Holtfrerich (1990, p. 69) also suggests that 'inflation' was simply a term used for any kind of expansionary monetary or fiscal policy.
[16] Using the price series for industrial finished goods ('industrielle Fertigwaren'), Konjunkturstatistisches Handbuch 1936, p. 104.
[17] Borchardt 1985, figure 1, p. 238.
[18] Brockhaus 1929, article 'Deflation', vol. 4, p. 463.

Despite evidence from diplomatic records and contemporary press reports, no consensus has emerged – critics have pointed out that fear of inflation would have implied patently irrational disregard for economic facts given the very considerable downward momentum of prices in all sectors of the German economy. Fear of inflation might have been clearly witnessed by some, but it is difficult to ascertain how wide-spread or deep it was. Some observers have argued that fear of inflation was not always genuine and hardly common, and was simply instrumentalized by certain politicians. For example, while the danger of inflation was talked up by interested parties, 21,000 proposals to combat the slump were sent to the Reichsbank and the Berlin business school, the majority of which suggested going off gold and adopting expansionary policies.[19] Consequently, critics of the apologetic view conclude that energetic political leadership could easily have overcome any lingering residual fears connected with the experience of hyperinflation.[20]

In assessing how probable a continued and significant fear of inflation was in the context of such a protracted and deep deflation, we also have to consider earlier historical episodes. How unusual were the early 1930s in the context of German economic history? A decline in the overall price level was not outside recent experience. Prices of industrial goods had fallen by almost 20 percent in 1925-6, and the general deflation of the 1880s and early 1890s cannot have faded completely from public memory (table 1). Once a deflation was underway, it normally persisted for 2 to 5 years. While a full appreciation of the underlying processes may have been lacking, deflations were not unusual events by the standards of Germany's economic history.

TABLE 1 - DEFLATIONS FROM 1856 TO 1926

	1856-59	1862-65	1874-79	1882-87	1892-94	1925-26
length of deflation (years)	3	3	5	5	2	2
CPI (percentage)	-15.9	-5.6	-11.6	-7.7	-7.5	-0.1
price index for investment goods (percentage)	-18.6	-8.3	-37.4	+2.2	-4.3	-18.9
cumulative net social product growth (percentage)	+5.8	+8.2	-0.6	+20.1	+6.4	-0.7

Source: Hoffmann 1965.

[19] Holtfrerich 1990, p. 70.
[20] Büttner 1989.

What is unusual about the years 1929-32 compared to earlier episodes is the magnitude of the deflation. The consumer price index fell by 22.5 percent, and the price of investment goods was reduced by an average of 48.3 percent.[21] NSP shrank by a cumulative 19.2%, whereas in four out of six previous deflations since the 1850s, it had continued to grow.

MEASURING INFLATIONARY EXPECTATIONS DURING THE GERMAN SLUMP

In the absence of survey data or unambiguous testimony in historical sources, a number of indirect methods can be used to infer inflationary expectations. This section briefly describes the estimation procedures, and applies them to the problem of inflationary expectations in Germany during the Great Depression.

A standard way of modelling inflationary expectations was first introduced by Mishkin, who uses a rational expectations approach to infer inflationary expectations from bond prices. Mishkin begins with Fisher's equation – the interest rate on a bond will be equal to the sum of the *ex ante* expected rate of inflation and the real return anticipated by investors:[22]

$$i_t \equiv rr_t + \mathrm{p}_t^e \qquad (1)$$

where i_t is the nominal interest rate earned by holding a bond until time t, rr_t is the expected real return to holding the bond, and π^e_t is the inflation rate anticipated by the bond market over the interval t-1 to t.

Since anticipated and actual rates of inflation can diverge, the interest earned by investors *ex post* may be higher or lower than the one expected at t-1. The realized return on a bond held from t-1 to t is

$$eprr_t \equiv i_t - \mathrm{p}_t = rr_t + \mathrm{p}_t^e - \mathrm{p}_t \qquad (2)$$

[eprr_t is the actual return, π_t is actual inflation between t-1 and t]

The mismatch between actual and expected inflation is captured by π^e_t-π_t. Economic agents will attempt to forecast actual inflation given the information that they have available at time

[21] Hoffmann 1965, table 148, p. 601. The figure for investment goods refers to the years 1929-33, as Hoffmann gives no figures for 1931 and 1932.
[22] Mishkin 1981.

t-1. Under the assumption of rational expectations, they will not consistently and continuously misjudge actual inflation. Hence, the mean expected difference between actual and anticipated inflation, conditional on the information set Ω at time t-1, should be zero:

$$E(\pi^{e}_{t}-\pi_{t}|\Omega_{t-1})=0 \qquad (3)$$

Forecast errors of rational economic agents – as captured by bond prices – should be uncorrelated with information available at t-1. The information available to later historians X_t is a subset of the full wealth of detail Ω_t that historical agents were able to use. If X_t is a valid predictor of real interest rates, we have

$$rr_t = \beta X_t + u_t \qquad (4)$$

where u_t is the error term. Combining equations (4) and (2) yields

$$eprr_t = \beta X_t + u_t - (\pi^{e}_{t}-\pi_t) = \beta X_t + u_t - \varepsilon_t \qquad (5)$$

Both ε_t and u_t will be orthogonal to the information set X_t; we can therefore estimate equation (5).

Before we can apply the Mishkin approach to Weimar Germany, we need to establish that the Fisher equation holds, i.e. that there is evidence to support the expectations hypothesis. Given that the null of non-stationarity for both interest rates and inflation rates (measured by the price index of industrial output) cannot be rejected (using both ADF and the DF tests), the Fisher equation in its weak form requires that interest and inflation rates share a common stochastic trend.[23] The Johansen maximum likelihood procedure, allows us to reject the null hypothesis of no cointegrating vector against the alternative of one or more vectors (test statistic 21.58 (monthly rate) and 26.3 (gold bonds) vs. a 95% threshold level of 19.96, sample 1926/ 1-1931/ 6), while the hypothesis of at most one cointegrating vector could not be rejected.[24] Thus we find that interest rates and inflation cointegrate, a finding that is reinforced by the fact that the residuals of a regression of interest rates on price changes appear to be *I(0)*

[23] The bond data for 6% issues is from Konjunkturstatistisches Handbuch 1936, p. 119. Gaps in the series were interpolated using the private discount rate.

(the Augmented Dickey-Fuller test is significant at the 95% level, ADF = -3.04**).[25] Note that most of the tests for non-stationarity reported here refer to sample periods that are shorter than is customary. Recent research strongly suggests that the use of high-frequency samples reduces this problem – there are significant increases in the power of ADF tests with higher sampling frequency.[26] Nonetheless, our results should be treated cautiously.

Along with other authors, we find that the coefficient on the inflation variable is less than unity (the midpoint estimate is 0.75).[27] Note, however, that the coefficient is not significantly different from one – a χ^2 test yields a statistic of 0.35, which is insufficient to reject the restriction at customary levels. The same is true if the cointegrating vector from a VAR with 6 lags is used.[28] Tax effects are probably responsible for finding coefficients less than unity.[29] Note also that our estimate of the coefficient on the inflation variable is smaller (yet not statistically significantly so) than coefficients found in the case of three high-inflation countries in the Third World (Argentina 1976-87, Brazil 1971-84, and Mexico 1979-1991).[30]

We follow Cecchetti's approach to the implementation of the Mishkin method.[31] Included in the OLS regression are the nominal interest rate, as well as the money supply, output, and prices. The actual specification of a variable x is $\Delta x = \log(x_t / x_{t-12})$.[32] Instead of using the first, thirteenth and twenty-fifth lag, as Cecchetti does, we implement Hendry's general-to-

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[24] These results were generated using a maximum lag of 3 months in the VAR. Series have a mean, the cointegrating equation has an intercept, but no series has a trend.

[25] Also, producer prices appear to granger-cause monthly interest rates (one month lag, 6% significance) and the interest rate on gold bonds (0.1% significance).

[26] Choi and Chung 1995, Hooker 1993.

[27] Evans and Lewis 1995, Mishkin 1992, Gagnon 1996. Crowder and Hoffmann (1996) find evidence of a unit coefficient in the US case.

[28] Microfit 2.0 was used for VAR estimation.

[29] Summers 1983. Note that the finding of a coefficient less than unity implies that the German bond market did not react with extreme sensitivity to increases in actual inflation before the outbreak of the crisis. This suggests that the memory of hyperinflation was particularly potent given the political turmoil during the later period, whereas the relative calm in the late 1920s underpinned a relatively mature bond market. Note that the term structure of bonds and deposits, however, suggests that even during the 1920s, fear of a resurgence of inflation persisted. Cf. Balderston 1991, 1992.

[30] Cf. Phylaktis and Blake 1993, table 2, p. 595.

[31] Cecchetti (1992, 1989). As Cecchetti (1992, p. 148; cf. also Mishkin 1992, appendix 2) points out, the only other necessary condition is that the real interest rate is stationary. For the period preceding the forecasts, 1926-1930, we can reject the null of non-stationarity at the 90 percent level using an ADF(3) test. Note, however, that the sample periods for all tests for non-stationarity reported here are much shorter than is customary. Even if the use of high-frequency samples remedies this problem somewhat (on the significant increase in the power of ADF tests with high sampling frequency, cf. Choi and Chung 1995) our results in this regard should be treated cautiously. On the power of ADF tests in short samples with high frequency, cf. also Hooker 1993.

[32] Similar to Cecchetti (1992, p. 149), we do not chose this transformation for the nominal interest variable.

specific modelling approach, estimating a full set of a maximum of 13 lags, and then testing down.[33]

If we were to use the fitted values from an OLS regression as the expected real interest rate level, this would imply that economic agents 'knew' the right specification for the entire sampling period. This is clearly unrealistic. We therefore use rolling 1-month ahead forecasts of the real interest rate to infer *ex ante* rates – i.e. the initial model is estimated for 1926/ 8 to 1930/ 1, and on the basis of this estimate, a forecast for 1930/ 2 is calculated. In the next round, the sample period for initial estimation is expanded to 1926/ 8 - 1930/ 2, and on the basis of the new equation, a forecast for 1930/ 3 is generated. Agents are therefore expected to only 'know' the data that is available to them up to the point in time when they make their 'forecast'. Estimation results for the initial periods are:

TABLE 2: FORECASTING EQUATIONS - MISHKIN APPROACH

	public bonds			*monthly rates*		
model	(1)			(2)		
Variable	Coefficient	Std.Error	t-value	Coefficient	Std.Error	t-value
i(-1)	0.773	0.89	0.39	0.86	0.09	9.3
π(-1)	-0.19	0.914	-0.21	-1.22	0.03	-38.1
π(-4)				0.29	0.03	9.9
m(-1)				-0.001	0.0006	-1.5
m(-3)	0.11	0.066	1.72			
m(-8)				0.0006	0.0004	1.4
UNIT(-3)	0.15	0.087	1.74			
Q(-3)	-9.6	5.17	-1.87			
C	-5.4	13.9	-0.4	2.3	1.6	1.8
Sample	1928/ 7-1930/ 12			1926/ 5-1930/ 11		
R^2	0.99			0.986		
LM – F				0.169		
ARCH - F	0.2			0.29		
Normality χ^2	0.39			4.6		
Reset F	1.78			0.35		

Note: Estimation method is RLS. The dependent variable is the real interest rate on public bonds (model 1) and on monthly money (model 2).

The two specifications in table 2 use different dependent variables – either the average return on public bonds, or the monthly interest rate from the interbank market.[34] Differences in the

[33] Cecchetti 1992, p. 149. Cecchetti (1992, 1989) was able to use a considerably larger dataset, spanning the years

sample period used are due to the maximum lag of a dependent variable that was included in the models. In both equations, no significant coefficient on output could be found, and the variable was consequently excluded from the regression equations. Both models pass a number of tests. In particular, they are free from autocorrelation, as evidenced by the low F-statistics on the LM tests. Heteroscedasticity-constistent standard errors are almost identical to the common standard errors. The residuals of our regression are normally distributed. Reset-tests give no evidence of model misspecification. We ultimately favour the model based on public bonds because the normality of residuals is more firmly established. Also, there is another reason for preferring the public bond data. As the banking sector faced a liquidity crunch in the summer of 1931, the fundamental assumption underlying the Mishkin approach – i.e. that the real interest rate as well as liquidity premia are constant – begins to be questionable. In the case of interbank rates, it is clear that liquidity is at a premium during the summer of 1931. Bond yields, however, should be much less affected by short-term liquidity needs and show little change during the banking crisis.[35]

Ultimately, we are not only interested in measuring expected inflation. The purpose of the exercise is to gauge the room for 'manoeuvre' during the crisis. Hence, we are ultimately interested in the level of expected inflation conditional on a change in policy that would have attempted to slow the economic collapse. This is not directly observable. As an alternative, we can examine periods when such a new course of action was regarded as more likely – such as Britain leaving the gold standard, the introduction of currency controls, and electoral successes of the Nazi party. If our estimates of expected inflation increase during these periods (and diverge significantly from actual price changes), then it is possible to argue that a new policy might have triggered rapid increases in inflationary expectations. Figure 1 gives the implied inflation rate from our preferred model (1), where $\pi_t^e = i - \hat{eppr}_t$ (using our preferred model specification (1) with monthly updating of the information set):

1919 to 1940, and could consequently estimate with a maximum lag of 25 months.

[34] Konjunkturstatistisches Handbuch 1936, p. 112. Note that our main findings do not depend on the interpolated values during the second half of 1931, as innovations were already large and significant before markets were closed temporarily.

[35] The issue of possible changes in liquidity preference is dealt with in more detail below. I thank Peter Temin for insisting that I examine this point in more detail.

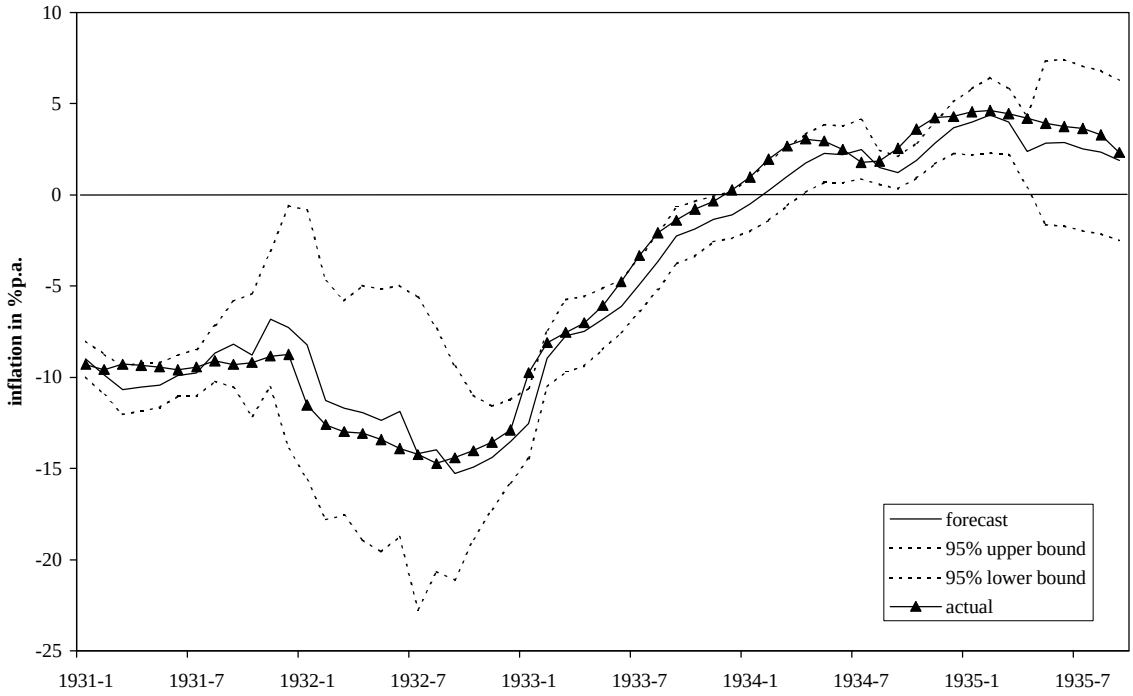

FIGURE 1 - ONE-STEP-AHEAD FORECAST OF EXPECTED INFLATION AND ACTUAL INFLATION (FROM MODEL 1, TABLE 1)

From the summer of 1931 onwards, expectations become highly uncertain. While the mean forecast is only marginally above actual inflation, the confidence intervals widen significantly. At a time when prices were falling at about 10 % (annualized), the Mishkin model suggests that (i) expectations of as little as 0.5 % deflation p.a. would have been compatible with basic rationality during some months in 1931/ 1932, and (ii) after a long period when inflation forecasts were anticipated correctly to within a few percentage points, a very wide range of outcomes was possible.

Germans were indeed jittery about a resurgence of inflation. Figure 2 plots the standard error of the inflation forecast. The sharp rise in uncertainty begins with the banking crisis, accelerates with the British departure from gold, and is only reversed once the reparations settlement in Lausanne has been achieved. As soon as exogenous policy events such as the banking crisis or the British decision to abandon the gold standard increase the likelihood of the German government adopting a more active policy, inflationary expectations appear to have increased.

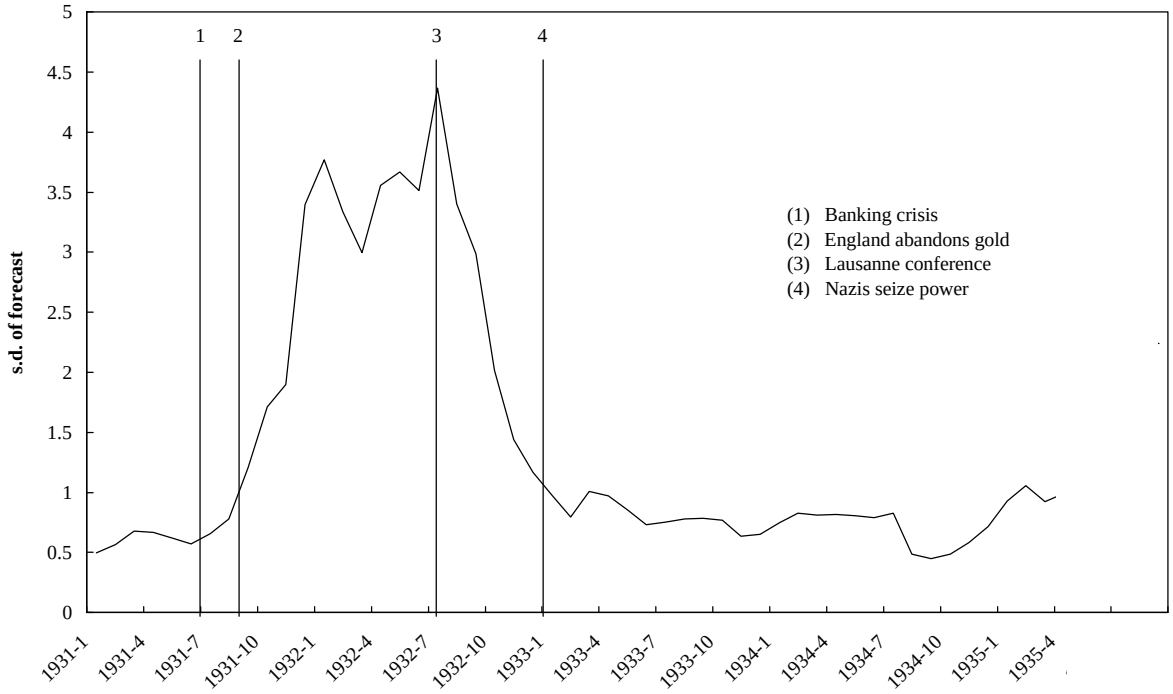

FIGURE 2 – STANDARD DEVIATION OF INFLATION FORECAST (FROM MODEL 1, TABLE 1)

Note that, for an important part of this period, data on bond prices and yields is not directly available. Stock exchanges were closed in the fall of 1931 and early 1932. We used the market prices established in telephone trading, as recorded by the Reichsbank.[36] However, since the disturbances are clearly visible long after the interpolation period, it is evident that our results are not driven by this. Also, forecasts from a model using only monthly interest rates – which are available without interruption – give broadly similar results.

Yield Spreads

It could be argued that the conditions of the German bond market following the banking crisis were highly unusual, and that the changes in yields did not reflect a fear of increased inflation in the future. Rather, it measures a change in liquidity premia, differences in default risk, movements in the real rate of interest, or time-varying risk premia. We can resolve the issue of liquidity risk by examining the spread of mortgage bonds (*Pfandbriefe*) and rye bonds over public bonds. Not all bonds will be affected equally by changes in liquidity premia. *Pfandbriefe*, for example, are notoriously illiquid because of small issue size and limited free float. The

[36] Beer 1998.

same is not true of public bonds, which were predominantly issued in large tranches by the Reich or individual Länder. Since the possibility of an internal default of the Reich was very small even in 1931, and *Pfandbriefe* had a history of zero default since their inception, the spread between the two will largely reflect differences in two factors, i.e. liquidity premia and the 'gold clause'.[37]

The bond market was devastated by the effects of the hyperinflation. A strong and stable demand for bonds disappeared together with the German *rentier* (Balderston 1993). All issuers found it difficult to tap the market for longer maturities or for larger issues. These facts alone indirectly suggest that strong fear of resurgent inflation was never far from the surface. This view is reinforced by the fact that a very large number of bonds – virtually all except issues by the state – had 'gold clauses', which guaranteed the value of coupon and principal payments in the case of another departure from the gold standard. The vast majority of bonds issued during the Weimar period thus contained a hedge against inflation, albeit an imperfect and indirect one – gold clauses could always be abrogated by parliament.

During the period 1919-23, bonds denominated in sugar, rye, coal, gold and potassium had been issued. By the late 1920s, most of these bonds had been redeemed. Rye bonds, however, continued to be traded.[38] They also make an ideal benchmark against which inflationary expectations can be judged – the stabilization of the Mark in 1923/ 24 was carried out using rye to back the currency. Bonds denominated in rye were therefore regarded as the ultimate hedge against inflation.

We can use the difference in the yields of these instruments to examine inflationary expectations. Bonds with a 'gold clause' can be thought of as containing a conditional put option on repayment in gold. Thus, any increase in inflation should make these instruments relatively more valuable than bonds without the option – even if the devaluation has not yet occurred, we can think of the rise in ex ante inflation as increasing the probability that the value of the underlying will be below the strike value of the option. While prices are rising, the yield of the gold-backed bonds should be lower than that of the instrument which merely guarantees nominal repayment.[39] If rye prices are flat, then the yield spread between Mark and rye-denominated bonds will ceteris paribus be an indicator of anticipated inflation.

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[37] An internal default was never considered a possibility, even by the most pessimistic observers. In contrast, an external default was certainly much more likely once the crisis deepened.

[38] Wolfgang 1931, p. 131-2.

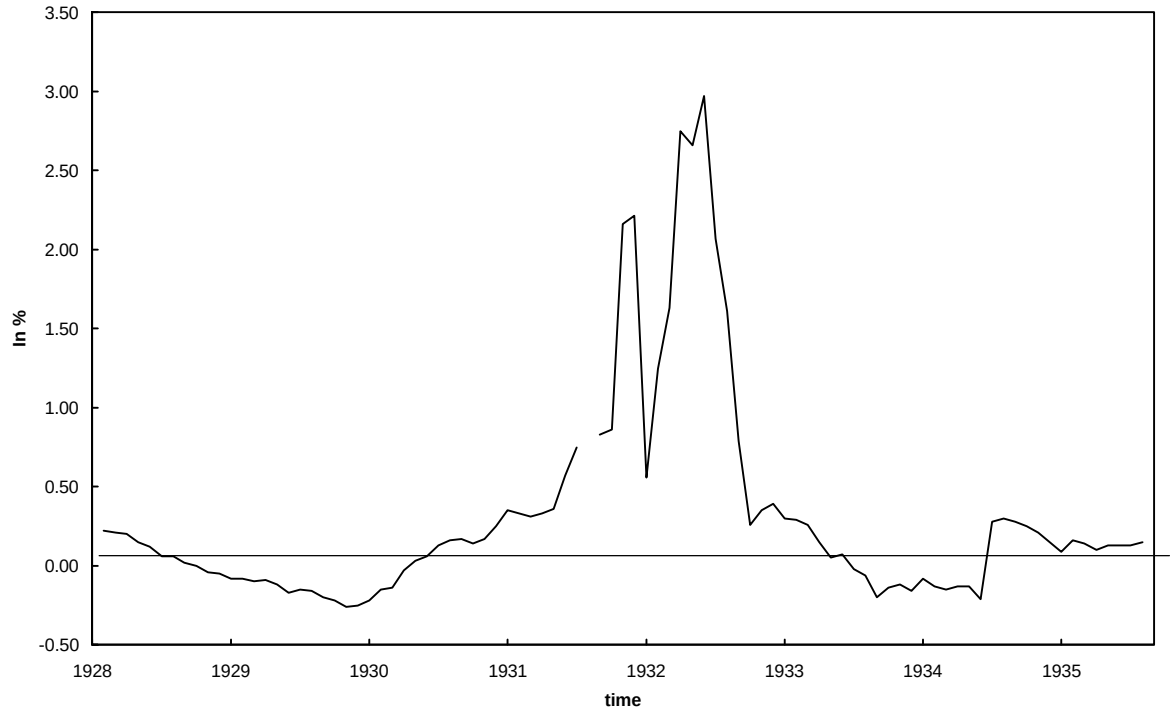

FIGURE 3 - SPREAD OF GOVERNMENT BONDS OVER GOLD-BACKED BONDS

There are thus two factors working in opposite directions - after July 1931, the change in liquidity needs ought to have increased the spread of Pfandbriefe and rye bonds over Reichsanleihen (or diminished a negative spread), whereas increasing fear of inflation should have caused a rise in the difference. Figure 3 shows that the differential widens dramatically, with the more liquid Reichsanleihen carrying higher yields to maturity.[40] Hence the (positive) spread of Reichsanleihen over Pfandbriefe is a lower bound on the change in inflationary expectations, as this is the net spread, i.e. after liquidity effects have presumably tightened the spread from the level it would have reached if Pfandbriefe had been equally liquid.[41] Rye bonds show a broadly similar pattern during the crucial period 1931/ 32. In July 1931, the

[39] Note that the rise in French interest rates after 1931 is also driven by expectations of devaluation (Hautcoeur and Sicsic 1998, p. 18).

[40] Since the German exchanges were closed from August 31 to April 32 (having briefly reopened in September), we had to use other sources for yields during this period. Securities continued to be traded by telephone or in informal gatherings; the *Frankfurter Zeitung* published selected prices for the period of the stock exchange closure in its issue from 12th April 1932. We use the price of the 1929 Hilferding loan, which was relatively frequently traded and liquid, to interpolate the price series for public bonds. Montly prices of the Hilferding loan used for the interpolation for the period 1929-31 were collected from *Frankfurter Zeitung*. For August, no bond prices were published; instead, interpolation with the monthly money rate was carried out.

[41] Note that, because the data is only available in aggregate form, it is not possible to match maturities perfectly. However, since the number bonds from which the index is derived is large, it is unlikely that dramatic changes in sample composition over short periods of time determined the results.

yield spread of public bonds over gold bonds was 0.75%, the spread over rye bonds 0.82%. By September 1931, when the trading floors were reopened for a brief period, the differential had widened to 0.83% and 1.98%, respectively.[42] In April 1932, when continuous trading resumed, the spread jumped to 2.75% and 3.49%, after which it began to decline gradually. The evidence from yield spreads between assets that guarantee nominal and real returns is therefore consistent with our finding that fear of inflation cannot be ruled out given the other evidence from the bond market, and that it was strongest in the second half of 1931 and the first half of 1932.

GARCH models

Investors observe price changes at a rate p at time *t*. Also, they have access to the information set up until time *t*-1. Based on these observations, economic agents will be able to form a prediction of the inflation rate p conditional on W as well as a conditional variance forecast h. The difference between the expected and realized inflation rate will be $e = p\text{-}p^e$. How does the conditional variance of the inflation forecast vary with the arrival of 'news' about past inflation and other factors? Following the work of Engle and Bollerslev, modelling the uncertainty of economic variables through autoregressive conditional heteroskedasticity models (GARCH) has become increasingly common. The generalized form is

$$h_t = w + \sum_{i=1}^{p} a_i e_{t-1}^2 + \sum_{i=1}^{q} b_i h_{t-1} \qquad (6)$$

where w, a and b are parameters. In a GARCH model with $p=q=1$, the effect of a single shock dies out gradually over time. The adjustment parameter a measures the speed with which the conditional variance of the inflation forecast changes as a result of an unexpected change in inflation, and b measures the extent to which a shock to conditional volatility persists.

In empirical work, GARCH (1,1) models have been preferred in most cases.[43] Table 3 shows the results for estimating Garch models for two sample periods: January 1925 to September 1935, and July 1931 to April 1932. Because price changes violate the normality

[42] Note that the price of Goldpfandbriefe and of rye bonds did not remain constant – the value of the data is not undermined by non-trading. Data on rye bonds is from Statistisches Reichsamt (various years).

[43] Bollerslev 1992. To test for the possibility of asymmetric responses, EGARCH and TGARCH estimation was carried out, but the leverage factor turned out to be insignificant.

assumption, we used the robust covariance matrix procedure by Tim Bollerslev and Jeff Wooldridge.[44]

TABLE 3
ESTIMATES OF CONDITIONAL INFLATIONARY UNCERTAINTY: GARCH (1,1)-MODELS

regression	1	2	3	4
sample period	*1926:01-1935:09*	*1926:01-1935:09*	*1931:07-1932:04*	*1931:07-1932:04*
ω	9.9	0.28	0.078	0.12
	(2.15)***	(0.12)**	(0.077)	(0.055)
α	1.42	1.17	3.11	2.89
	(0.065)***	(0.139)***	(1.59)***	(1.56)*
β	-0.69	-0.066	-0.024	-0.11
	(0.032)***	(0.099)	(0.04)	(0.04)
Likelihood	351	343	14.6	11.7
Akaike	6.1	5.96	3.72	3.34

* indicates significance at the 90% level
** indicates significance at the 95% level
** indicates significance at the 99% level
Notes: Standard errors in parentheses. Estimation method is maximum likelihood with Bollerslev-Wooldridge robust standard errors and covariances. Equations (2) and (4) use a dummy variable (=1 for January 1932, 0 otherwise) to capture the effect of the fourth emergency degree

The coefficient a is larger than unity throughout, suggesting that unexpected increases in inflation lead to unusually large upward revisions of the one-step-ahead forecast of the conditional variance. Weimar investors obviously grew extremely nervous once actual inflation began to depart from their inflation forecast. Equations 2 and 4 use a dummy for the fourth emergency decree, which reduced the price level by governmental fiat. Persistence of shocks, measured by b, varies between samples, but is never large once we control for the effect of government intervention in the price setting process.

Regressions 3 and 4 report results for the period starting with the banking crisis until the reopening of the exchanges in April 1932, during which Britain left the gold standard and the most severe austerity measures (such as the fourth emergency decree) were implemented.

While the results for the shorter period have to be treated with care, the findings are nonetheless striking. The coefficient on a is markedly larger than before, indicating that conditional variances increase much more sharply in response to a larger mismatch between predicted and actual rates of inflation than during the relatively calm period until the summer of 1931.

[44] Bollerslev and Wooldridge 1992.

The Term Structure of Interest Rates

The term structure of interest rates is known to contain information about future changes in inflation.[45] A standard way to examine the extent to which changes in inflation between periods *m* and *n* can be predicted from the slope of the term structure is to estimate:

$$p_t^m - p_t^n = a_{m,n} + b_{m,n}\left[i_t^m - i_t^n\right] + h_t^{m,n} \qquad (7)$$

where π denotes the rate of inflation, i refers to the interest rate, α is the intercept, and η is the residual. $\alpha_{m,n}$ will reflect the difference between ex ante real rates of return between the two periods.[46] As information on the exact maturity of long-term bonds is unavailable, the analysis has to be adapted to the data constraints. For imperial and interwar Germany, we can use the long-term bond yields as compiled by the Bundesbank.[47] The private discount rate is also available for pre-war and interwar period. The results of applying equation are summarized in table 4.

TABLE 4: TERM STRUCTURE EQUATIONS

model		(1)			(2)	
Variable	Coefficient	Std.Error	t-value	Coefficient	Std.Error	t-value
$\Delta\pi_{-1}$	-0.47	0.159	-2.94	-0.44	0.147	-3.03
Δi_{-1}	1.22	0.64	1.91	1.22	0.629	1.93
C	-0.54	0.6	-0.89	-0.699	0.584	-1.1
Sample	1880-1913			1880-1929		
R^2	0.25			0.25		
Heterosc.-F	1.76			1.86		
LM - F	2.1			1.58		
ARCH - F	0.19			0.23		
Normality χ^2	1.53			1.1		
Reset F	1.08			1.13		

Note: Estimation technique is OLS, which, under plausible assumptions (Mishkin 1990), will yield unbiased and efficient estimates.

[45] Mishkin 1990b, c. The abundant literature on the topic cannot be reviewed in this paper. Classic papers also include Fama (1990) and Campbell and Shiller (1987).

[46] Mishkin 1990c, p. 78-81.

[47] Bundesbank 1976, p. 278.

For both sample periods used in table 4, the slope of the term structure has predictive power. It is significant at the 6 % level. Both models pass a number of tests. They are free from autocorrelation, show no evidence of ARCH or heteroscedasticity, and Ramsey's reset test (up to the second power) does not suggest any misspecification.. We conclude that the difference between bond yields and the private discount rates forecasts changes in inflation. If our earlier argument is true, and Germans were afraid of inflation during the Great Depression, then this should be reflected in a particularly steep yield curve. The long-term mean of the difference between bond yields and the private discount rate is 0.97. In 1931, it jumps to 3.45% (from 0.22% in 1930), and to 3.32% in 1932. Based on model (1) in table 4, this implies increases in inflation by 2.52% and 5.3% p.a. Information from the yield curve therefore reinforces our earlier finding that Germans expected accelerating price increases in 1931/ 32.

Futures prices

Further corroborating evidence comes from the price of futures contracts for foreign exchange and agricultural commodities. Let $S_{j,t}$ be the spot rate of good j at time t, and $F_{j,t}$ the price of a one-period ahead forward contract. With investors neutral to risk and efficient markets,

$$F_{j,t} = E_t\left[S_{j,t+1}\right] \qquad (8)$$

where E_t denotes expectations.[48] Inflationary expectations can then be measured as

$$\pi_t^e = \frac{12}{T}(f_{j,t} - s_{j,t+s}) \qquad (9)$$

where lower case letters denote natural logarithms, and T is the number of months to settlement.[49]

We can use this method for both forward Reichsmarks and the price of two agricultural commodities, wheat and rye.[50] A discount on forward Marks implies that agents expect the exchange rate to depreciate.[51] During the years 1919-23, a decline in the Mark's external value was often viewed as synonymous with an increase in the rate of inflation. Since Frenkel's seminal contribution, inflationary expectations during the German hyperinflation

[48] We are abstracting from cost-of-carry.
[49] Hamilton 1992.
[50] A sceptical view -- at a very general level -- can be found in Mishkin (1990a). The results in our own work, as well as in the literature (Hamilton 1992) suggest that the problems he identifies are less severe than might be supposed.
[51] That is, if expectations are rational in the sense of Muth (1960).

have routinely been modelled using forward rates.[52] For the period from February 1921 to August 1923, Frenkel demonstrated that β in a regression $S_t = a + bF_{t-1}$ is not significantly different from unity.[53] Germans during the early 1930s would have immediately associated any fall in the external value of the Mark with an imminent rise in inflation.[54] In the German case, we do not need to subscribe to a theory of imported price inflation. In a country where, at the height of the hyperinflation, prices had been changed daily even at the retail level based on the current dollar/ mark exchange rate any sudden fall in the gold value of the mark would lead to a rapid rise in expected inflation and the velocity of money.[55]

After the banking crisis, and immediately before Britain announced that it was going to leave the gold standard, three-month forward Reichsmarks traded at a discount of more than 1.6%, implying an annual depreciation of the exchange rate of 6.8%.[56] During the autumn of 1931, when the markets expected the Reichsmark to follow Sterling's devaluation, the forward discount widened to as much as 75% annualized – a level not seen since the darkest days of the hyperinflation, in April 1923, when three month forward Marks stood at an (annualized) discount of 65% (cf. figure 4).[57] Given discounts of this order of magnitude, is reasonable to suppose that such differences are likely to be dominated by expectations of exchange rate and price changes.[58]

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[52] Frenkel 1977, Webb 1986, 1989.

[53] Frenkel 1977, p. 655.

[54] In the case of the 1926 stabilization of the Franc Poincaré there is debate if there is granger-causality running from the exchange rate to inflation or vice versa. Sicsic 1982, Eichengreen 1982b.

[55] Eichengreen 1982a, p. 135.

[56] Most other currencies show rising premia against Sterling, especially in August and September. Cf. Einzig 1937, p. 470-71.

[57] Einzig 1937, p. 294. The market rates on forward Reichsmarks are from Einzig 1937, p. 450-70. Note that there are no observations for August 1931 - the dotted line marks the interpolation from July to September. My figures for the hyperinflation differ slightly from those in Webb (1986, p. 776-77) since he used one-month forward rates.

[58] Frenkel 1977, p. 654. The bank rate differential vis-a-vis Britain was +5.5% in July and August of 1931; the difference in call money rates varied between +3.87% in November and +4.3% in June. Given the rate differential, forward Reichsmarks should have traded at a premium.

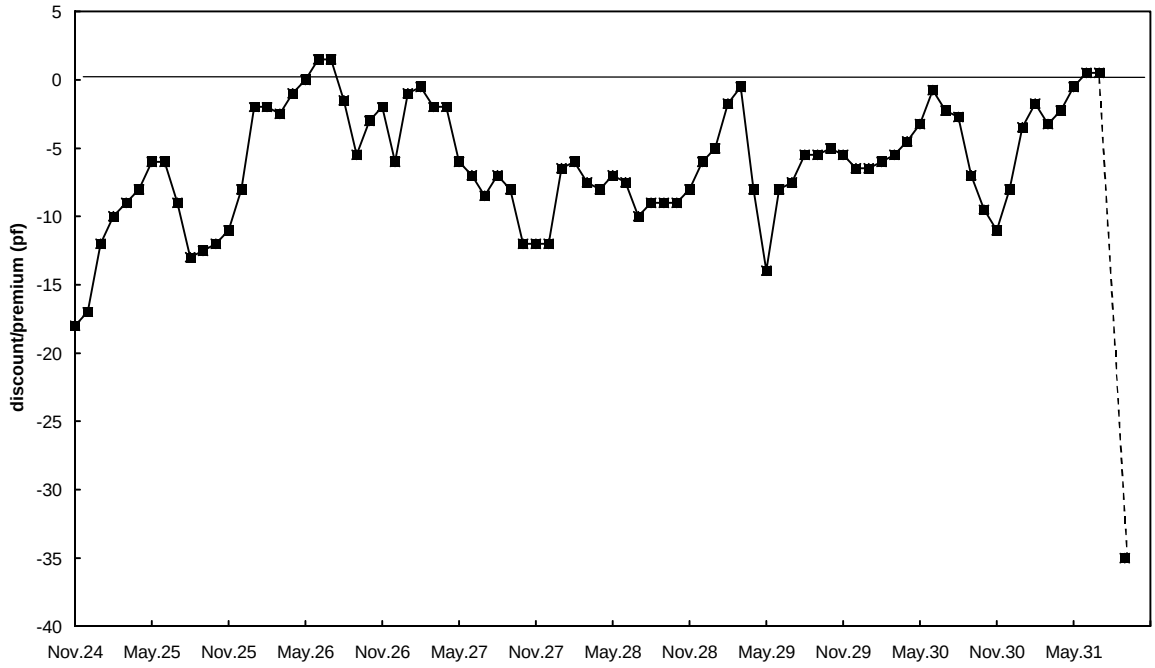

FIGURE 4 - 3 MONTHS FORWARD DISCOUNT/ PREMIUM ON REICHSMARKS, 1924-31

Data on wheat futures also indicate that agents expected price increases, conditional on a major economic policy change.[59] During 1931 and 1932, the future price of rye and wheat as quoted on the Berlin exchange was almost always above the spot price.[60] Instead of comparing futures and spot prices, which may diverge for a number of reasons such as storage cost etc., we follow the literature in comparing futures prices with different settlement dates.[61] The actual change in spot prices between October and December 1931 was -2.78% (annualized). In the first week of August, when the December contract began to trade, the expected price change for the futures contract between October and December is +0.05% (annualized). After the suspension of the gold standard by the Bank of England, in the last week of August, this figure had risen to 8.5% p.a. Also, the rate of price increases was expected to accelerate rapidly. For most of August, the October future was almost always trading below the September contract, implying that prices were expected to fall over the next month. At horizons of up to three months, however, there was (unwarranted) fear of inflation at precisely those times when a change in policy became more likely.

[59] Data on rye futures are less useful. While the spot price of wheat has a correlation coefficient of 0.51 with the price index used above, the figure for rye is 0.14 (1930/ 10-1932/ 11).
[60] The data on futures prices are from Statistisches Reichsamt (various years).

Summary

Having examined evidence from yield spreads, the Mishkin approach, and futures prices, we consistently find evidence that fear of inflation can be detected from the summer of 1931 onwards. Inflationary expectations appear highly sensitive to changes in the likelihood of a more expansionist policy. Given that prices were falling at the time, it may appear surprising that an approach based on rational expectations (such as the Mishkin model) can generate sustained departures from actual inflation. The apparent contradiction is actually not uncommon, and is a variation of the so-called 'peso problem' (forward rates of the peso for extended periods appear to underpredict the dollar exchange rate). The solution to the puzzle in the Mexican case – a non-zero probability of a major discontinuity occurring – is actually also responsible for the German data. Having experienced one hyperinflation within living memory, economic agents were highly sensitive about possible changes to the monetary regime or the exchange rate.

Such 'long memory" is not unusual by the standards of today's OECD countries. Gagnon examines the impact of past inflation on ten-year bond prices.[62] He finds clear statistical evidence that expectations about future inflation are strongly influenced by the experience of inflation over the ten preceding years. Surely, if the relatively mild bout of price increases in most OECD countries lingered in public memory, the traumatic consequences of the German hyperinflation should have had a much more lasting impact.

The timing of the upward turn thus reinforces contemporary observations about the events preceding the banking crisis and Britain's departure from gold. During a conference held by the Friedrich List society in September 1931, memories of the summer's events were still fresh. When exploring opportunities for monetary expansion, one participant commented how the declining reserves of the Reichsbank in June and July had spurred fear of inflation and aggravated the run on deposits.[63] As the financial adviser at the British Embassy in Berlin put it: "The reasons against Germany's departure from the gold standard are sufficiently well known... The fear of inflation is such that a fall in the quotation of the mark as expressed in dollars would immediately lead to panic...".[64] After the banking crisis, during the few days

[61] Hamilton 1992.
[62] Gagnon 1996, p. 9.
[63] Reg. Rat a.D. Dr. Stern, cit. acc. to Borchardt 1991, p. 144.
[64] Cit. acc. to Borchardt 1985, p. 242.

when the stockmarket was open, there was a buying frenzy – driven, as the contemporary journalists commented, by investors who were trying to buy inflation-proof assets.[65]

DETERMINANTS OF INFLATIONARY EXPECTATIONS AND UNCERTAINTY

Ferderer and Zalewski have recently shown in a cross-section of countries how higher interest-rate uncertainty aggravated the Great Depression. We suggest that fear of inflation and uncertainty about the future price changes also had a direct effect on the range of policy options available to governments. Cutting the link with gold was particularly hard for the countries that had experienced monetary turmoil after WWI, and which had spent so many political and social resources trying to return to gold.[66]

Also, the British decision to leave the gold standard was not the 'window of opportunity' for Germany to follow suit, as some authors have argued. Instead of making this step easier, Germany's position as a second mover compounded the difficulties. If economic agents were already nervous about domestic inflation when a foreign country left the gold standard, it is not difficult to guess how much more rampant 'inflation hysteria' would have been had the Brüning government (or some other coalition) adopted such a policy. Next, we need to examine if there was a range of policy options that could have been pursued without igniting widespread panic. To this end, we estimate multi-factor GARCH model of inflation uncertainty.

[65] Bauer 1931, p. 246.
[66] Feinstein, Temin and Toniolo (1997), p.114-20.

TABLE 5
ESTIMATES OF CONDITIONAL INFLATIONARY UNCERTAINTY: GARCH (1,1)-MODELS

regression	1	2	3	4
sample period	*1926:01-1935:09*	*1926:01-1935:09*	*1926:01-1935:09*	*1926:01-1935:09*
ω	29.3	33.97	25.24	34.5
	(5.6)***	(15.1)**	(5.58)***	(16.6)**
α	0.83	1.51	1.08	1.04
	(0.07)***	(1.67)	(0.23)***	(0.88)
β	-0.13	-0.75	-0.33	-0.46
	(0.02)***	(0.36)**	(0.24)	(0.69)
revenue	-0.022	-0.02	-0.0052	
	(0.004)***	(0.011)*	(0.0018)***	
discount rate			-2.46	
			(0.744)***	
emergency decree		0.03		0.02
dummy		(236.9)		(118)
expenditure				-0.02
				(0.015)
Likelihood	339.4	343.8	332.9	340
Akaike	6.2	6.3	6.1	6.2

* indicates significance at the 90% level
** indicates significance at the 95% level
** indicates significance at the 99% level
Notes: Standard errors in parentheses. Estimation method is maximum likelihood with Bollerslev-Wooldridge robust standard errors and covariances.

Table 5 shows the effect of a number of policy instruments. The emergency decree has a small and statistically insignificant effect on the conditional variance of inflation, and expenditure of the Reich appears to be insignificant (and wrongly signed) as well. In contrast, Reich revenues do reduce uncertainty about the course of inflation, and so do higher interest rates. The policy of trying to balance the budget by cutting expenditures and raising taxes, continued after the introduction of exchange controls in the summer of 1931, has long been regarded as a textbook example of bad economic policy. It appears that not all of the Brüning government's austerity measures were equally harmful. In a country where memories of the hyperinflation were still vivid, showing fiscal rectitude did apparently calm the nerves of the public. Also, higher discount rates lead to a reduction in conditional volatility. Hence, the same policy mix that allowed the stabilization of the currency in 1924 – higher taxes and tight monetary policy – were also useful in reducing inflationary uncertainty.[67] That this was necessary at all is largely due to exogenous shocks – the failure to obtain a loan in the summer of 1931 that could have saved the German banks, and the British departure from gold.

Hence, the debate about policy options during the German slump has been correct in emphasizing the crucial role of inflationary expectations. Uncertainty and fear of inflation are clearly visible in all asset markets, and it was through the deflationary – and in all likelihood

[67] Sargent 1986.

economically harmful – austerity policies of the Brüning government that a minimum degree of public confidence could be restored. Given the adverse effects of uncertainty in its own right, there were also direct positive effects as a result of the tax hikes and high interest rates. Brüning's own comment that he fell 50 metres before the finishing line has often been cited as a sign of ineptitude – focussing on the issue of reparations instead of the economic collapse. The sharp reduction in uncertainty on most counts from the summer of 1932 onwards demonstrates that Brüning's emphasis on the reparations issue was not quite as misguided as some scholars have argued. Once the Lausanne conference effectively freed Germany from the shackles of reparations, public confidence in the currency returned. The expansionary measures adopted in 1932 and 1933 were less likely to fan the flames of inflationary expectations precisely because the economic and political situation appeared to be stabilizing. This paper therefore strongly suggests that, far from dealing a deadly blow to the German economy without a good reason, the Brüning government's economic policy was not only without an alternative, but may have been beneficial in calming the nerves of the public at a critical juncture, and preparing the ground for the expansion that started in the second half of 1932.

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