INFLATION, POLITICAL INSTABILITY AND STOCKMARKET VOLATILITY IN INTERWAR GERMANY

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What determined the volatility of asset prices in Germany between the wars? This paper argues that the influence of political factors has been overstated. The majority of events increasing political uncertainty had little or no effect on the value of German assets and the volatility of returns on them. Instead, it was inflation (and the fear of it) that is largely responsible for most of the variability in asset returns.

Few periods in history show a closer connection between political events and economic change than the Weimar Republic. The extent to which the collapse of democracy was a result of misguided economic policies (and a structurally weakened economy in general) produced heated debate. That the politically induced uncertainty and the inflation during the early years of the Republic were economically harmful has also been contended, even if some scholars continue to argue that the inflation had many benign effects. Holtfrerich (1991) argues that inflation was not only necessary to integrate returning soldiers into the economy, but that Germany may have saved the world economy from a major recession in the early 1920s. Since it was relatively economically buoyant at the same time when the UK and the US experienced post-war recessions, its high demand for imports from these countries helped to avert a complete collapse. An older literature had also assumed that high inflation had facilitated investment. Industry-level studies, such as the one of the machine-tool industry by Lindenlaub, have failed to provide much evidence in favour of this. The benign effects of inflation have been challenged by Ferguson (1995, 1996), who argues that neither political nor economic benefits

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were sufficient to compensate for the havoc wrought, and that policy alternatives were readily available.

Stock Market Volatility

Stock prices have two characteristics that distinguish them from the prices of most other assets. First, data on the US stock market shows returns that are markedly higher than can be explained by most models of economic behaviour. Because stocks showed average returns of 7.0 percentage points per year over the period 1921-96, most authors conclude that simple investors are 'leaving big bills sitting on the sidewalk.' This is true even after taking into account the second striking characteristic of stock prices – their high volatility. Price movements are often too sharp to be accounted for by changes in underlying profitability or the risk-free rate, suggesting that 'animal spirits' play a large part in the setting of share prices. Shiller (1981) showed that movements in dividends are markedly less sharp than those in share prices, and that – since shares simply represent an entitlement to future dividend payments – the largest component responsible for changes in prices must be the way future cash flows are discounted. This will depend on the risk-free rate used as well as the probability of the firm in question continuing to make payments.

Schwert (1989) examined what how strongly the volatility of macroeconomic variables was correlated with stock market volatility. He finds that most variability cannot be explained, but that a number of variables exhibit some correlations. Output volatility, interest rate and bond volatility show positive correlations. Stock prices are more likely to fluctuate sharply if leverage in the corporate sector is high, or if the economy is in recession. Nonetheless, especially during the Great Depression, most of the volatility cannot be accounted for. Schwert suggests that this may be to do with uncertainty about the survival of the capitalist system in the US – a non-zero probability, changing from period to the next, that the country might "go communist". Such a possibility is known to economists as the "peso problem" – asset prices being

influences by fluctuations in the perceived likeliness of a large future event occurring.

Bittlingmayer (1998) extended this approach to Germany in the interwar period. The likely impact of "peso-style" problems had already been noted by Becht and DeLong (1992), who excluded the interwar years from their study of volatility in Germany. Bittlingmayer uses monthly data on the German share index to show that volatility was particularly high during the periods when political events "clustered", especially during the first years of the Weimar Republic. In particular, he argues that the armistice and the revolution, combined with the putsches, strikes and insurrections of the early 1920s, combined with the Ruhr invasion, were directly responsible for the very high level of stock price volatility. He also finds that stock market volatility had a strongly negative effect on industrial production.[1] Uncertainty and volatility in general are often thought to have negative effects because of the irreversible nature of investments (Pindyck 1991, Bernanke 1983). The value of waiting tends to increase with the level of uncertainty and the degree to which investments, once made, become irreversible. Bittlingmayer remains agnostic as to the exact causal relationships – instead of arguing that stock price volatility caused output declines, he suggests that political events determined the course of both output and stock prices.

Stock Returns during the Weimar Republic

Stock returns in general are known to exhibit a number of special characteristics. First, compared to the normal distribution, there appear to be "too many" large and small price movements, i.e. the return distribution often has "fat tails". Second, the number of price movements around the mean of the distribution is larger than in the case of the normal distribution. A comprehensive measure of these characteristics is sample kurtosis:[2]

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[1] Bittlingmayer 1998, p. 2247-53.
[2] Campbell, Lo and McKinley 1997, p. 17.

$$\hat{K} \equiv \frac{1}{T\hat{s}^4}\sum_{t=1}^{T}(x_t - \hat{m})^4$$

where T is the number of observations, σ is the variance, μ is the mean, and x_t is the return at time t. Also, stock returns often exhibit (weak) skewness – i.e. a tendency to be more often above than below the sample mean in the case of positive skewness. Sample skewness is defined as

$$\hat{K} \equiv \frac{1}{T\hat{s}^3}\sum_{t=1}^{T}(x_t - \hat{m})^3$$

In the case of the normal distribution, skewness is equal to zero and kurtosis is equal to three.

Typical values found in empirical studies of the stock market show skewness between –0.29 and 0.07, and excess kurtosis (i.e. K-3) equal to 2.4 to 4.1.[3] Typical volatility ranges from a standard deviation of 4.3 to 5.8.

Table 1 compares stockmarket returns in interwar Germany with results from the US and German data on the period before WWI and after WWII. We use the index of real share prices constructed by Gielen.[4] It is the first series that takes full account of the value of dividend payments, thus giving a full impression of the total return that shareholders could have realized if they had reinvested all dividends. It is thus in line with other "performance" indices such as the DAX, and provides a better basis for judging the overall change in value than pure price indices (such as the Dow Jones Industrial Average).

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[3] Campbell, Lo and McKinlay 1997, p. 21. The values given here are based on monthly returns for the value-weighted or the equal-weighted index for all stocks on the AMEX and the NYSE.
[4] Gielen 1994.

TABLE 1

BASIC CHARACTERISTICS, STOCK RETURNS GERMANY AND THE US

country	index type (weighting)	period	mean	st.dev.	skewness	excess kurtosis	minimum	maximum
US	Value	1962-94	0.96	4.33	-0.29	2.42	-21.81	16.51
	Equal	1962-94	1.25	5.8	0.07	4.14	-26.8	33.17
Germany	Value	1870-1913	0.4	3	-0.28	2.4	-14.9	11.7
	Value	1919-1933	0.16	14.7	0.08	7.3	-52.08	61.1
	Value	1949-92	0.8	4.4	-0.21	2.91	-26.2	15.1

Stockmarket returns in interwar Germany were unusually low – an average return of 0.16 percent per month over the period. Excess kurtosis is present in all series, but Weimar Germany exhibits it in the extreme – 7.3 instead of a maximum of 4.14 on the equally-weighted US index in the postwar period. Also, the range of observed price movements is notably larger. While no other index fell by more than 26.8 percent or rose by more than 33.2 percent (US equally-weighted index), the sharpest fall in Germany in a single month wiped more than half of the value off equities. Also, the most rapid increase brought a rise of more than 61 percent. Using the standard deviation of stock returns as a measure of overall variability, it emerges that Weimar's stockmarket was more than three times as volatile as the average of other markets (and periods).

The contrast with pre-war Germany is particularly striking (figures 1 and 2). Other authors have noted the unusual stability of German share prices before WWI.[5] Not only did prices fluctuate about 80% less (the standard deviation of stock returns is merely one fifth of that seen in Germany 1919-33), but the maximum and minimum change in prices were also much smaller. Becht and DeLong noted that, in contrast to the American stock market, the German one did not exhibit "excess volatility", i.e. that the variability of price changes relative to the variability of dividends was not too high.

[5] Becht and DeLong 1992.

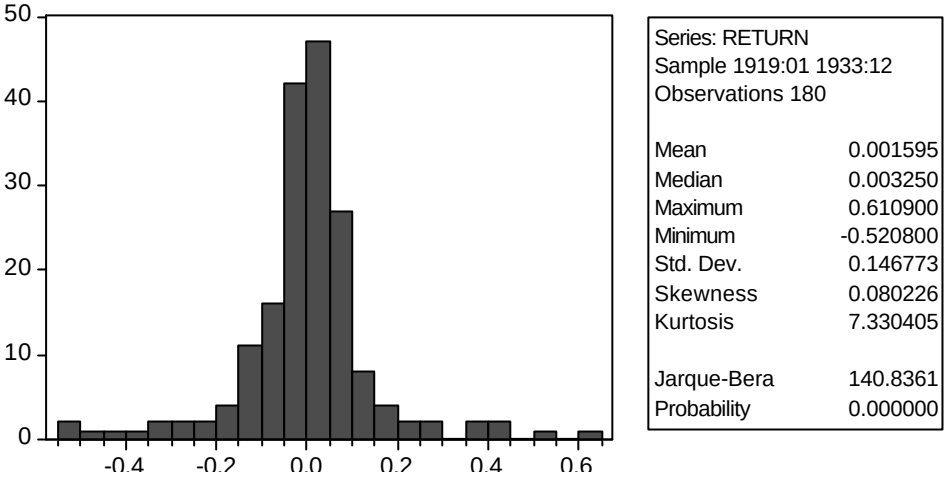

Figure 1: Return distribution, German stock market, 1919-33

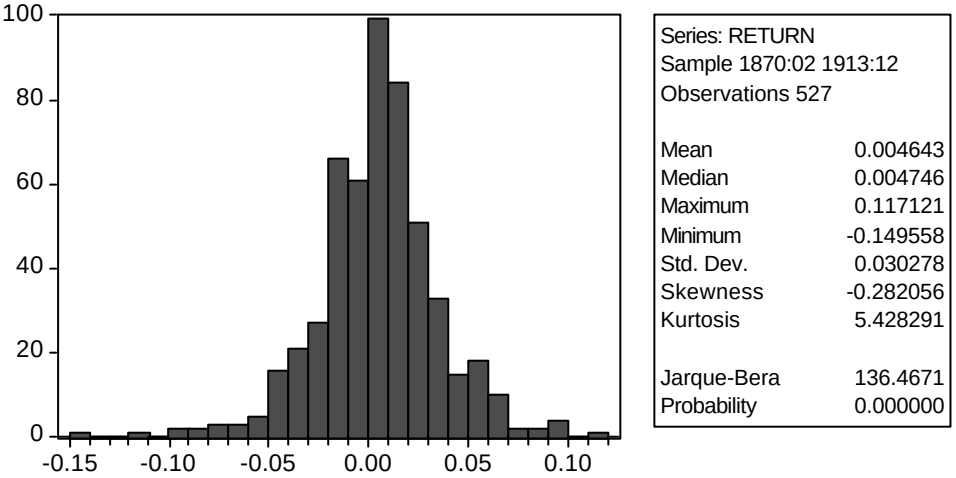

Figure 2: Return distribution, German stock market, 1870-1913

To what extent did volatility change with political events? Bittlingmayer (1998) presents a graph showing rolling estimates of the standard deviation of stock returns. Vertical lines indicate the timing of major political events such as the Armistice, the Occupation of the Ruhr, or the London Conference. While it is possible to identify a large number of events that can be expected to have an impact, there is no clear ex ante criterion that would suggest that only these events should be included – wouldn't an observer with no additional knowledge of the Weimar economy assume that the turmoil of the early 1930s, with the electoral successes of the Nazi and Communist party, rule by decree, constant budget crises, the so-called "Preussenschlag" (that deposed the legitimate government of the largest state) and the final ceding of power to

Hitler, should have had at least a similar impact, if political events were indeed so important in triggering "peso-problems"? The data suggest that the Great Depression saw markedly lower variability than the early years of the Republic – the standard deviation of stock returns was a mere 6%, less than one third than the 22% observed between 1919 and 1924.

Political Events and the Timing of Price Changes

When did the largest changes in the performance index of German stocks occur during the interwar period? If the Bittlingmayer hypothesis is correct, we should expect that a number of events such as the London Ultimatum, the French invasion of the Ruhr, the assassination of Erzberger, the publication of the Peace Treaty terms, the Hitler putsch, the communist uprising in the Ruhr and the turmoil in Saxony and Thuringia caused sharp falls on the German exchanges. Events such as the stabilization of the Mark, on the other hand, should have had a favourable impact. We begin by examining the ten largest positive and the ten largest negative price movements of the German stock market between 1919 and 1933.

The largest price decline came in August 1923, when the so-called "government of the economy" fell and was replaced by the Stresemann government. Bad as the general situation of the economy was, with inflation increasingly spiralling out of control, neither August 1923, December 1923, nor September 1922 can seriously be called the high points of political uncertainty in interwar Germany – yet they registered the three largest price declines of 52, 50, and 45 percent respectively. September 1922 registered almost exclusively good news, with successful agreements with Belgium on reparations being negotiated and the Reparations commission filing a positive report on the chances for a moratorium. The Hitler Putsch in Munich, definitely one of the periods of greatest uncertainty, however, did see the fourth-largest price fall. Interestingly, the stock market crash of 1927 – instigated by the Reichsbank leaning on the banks to curtail lending to the

stock market – does not make the top ten largest monthly declines (being in 58th place on the total list of price declines).

Even more oddly, some of the largest price increases occurred when the Reich was in crisis. In September 1923, with the crisis between Bavaria and the Reich at a high point and a state of emergency having been declared throughout the Reich, the share price index rallied by more than 50 percent. The third-largest increase in share values occurred in January 1923, when France invaded the Ruhr to ensure reparations payments and Litauen invaded Memelland.

TABLE 2
TEN LARGEST PRICE MOVEMENTS, 1919-1933

	greatest price increases			*greatest price declines*		
rank	month	price change	events	month	price change	events
1	1923M06	0.6109		1923M08	-0.5208	Cuno government replaced by Streseman
2	1923M09	0.5119	Crisis in Bavaria, state of emergency in the whole Reich	1923M12	-0.5007	
3	1923M01	0.4335	France invades the Ruhr Litauen invades Memelland	1922M09	-0.4507	Positive report from Reparations commission, agreement with Belgium
4	1924M01	0.4075		1923M11	-0.4091	Hitler Putsch in Munich, Stresemann government resigns
5	1923M05	0.3848		1923M03	-0.3700	
6	1923M04	0.3676		1921M12	-0.3297	
7	1923M10	0.2786	Reichswehr enters Saxony and Thuringia to stamp out communist insurgency; street fighting in Hamburg	1924M04	-0.3273	
8	1924M08	0.2655	French troops leave the Ruhr	1931M09	-0.2942	Britain leaves the gold standard
9	1921M11	0.2087		1922M05	-0.2558	
10	1921M09	0.2052		1923M07	-0.2427	

Indeed, many salient events that have often been seen as signs of extreme instability, such as the murder of Erzberger in August 1921, hardly left a trace at all. Stock prices rose by 7.8% for the month. In June 1923, the month of Rathenau's assassination, prices fell by 14.4%. Not a small change, to be sure, but hardly a strong reaction – in the list of largest price declines, the month is in 18th place.

Gerald D. Feldman has observed that the relationship between political events and the inflationary process changed considerably in the early 1920s. By 1922, events themselves began to have only a minor impact on inflationary expectations. Instead, they only mattered in so far as they contained additional information about likely *future* events that might influence the exchange rate.[6]

Our brief comparison of the timing of political events on the one hand side, and of major changes in the German stock price index on the other hand suggests that negative political news was almost as likely to cause price declines as it was to cause price increases. It is difficult to see political events as a major cause of stock market swings if both negative and positive news, for example, could cause price falls of almost 50 percent in a single month. Some of the most salient events during the period, such as the London Ultimatum, barely caused a reaction at all – stock prices increased by 1.6 percent.

If there is no direct, negative impact of political uncertainty on the *level* of stock prices, there may still be a relationship between the frequency of political events such as major disruptions on the one hand side, and the overall *variability* of stock prices on the other. The impressionistic comparisons between political events and stock price movements cannot answer this question.

Garch Models of Stock Price Volatility

To test if the political uncertainty was crucial for asset price volatility, we need to define a consistent set of events that, *a priori*, should be associated with political instability. The range of possible options is not small. Changes of government have often been cited as a source of instability, and Weimar Germany certainly saw a fair number of them. Between 1919 and 1933, the Reich had no fewer than 21 cabinets. The average Reich Chancellor lasted for some nine months in office. Elections for parliament were also frequent. Finally, periods with major putsches, foreign invasion, and assassination

[6] Feldman 1993, p. 505-6.

attempts can be defined as suffering from political uncertainty. We use these to construct a time series of dummy variables, taking the value of 1 in the case of political events and zero otherwise if "uncertainty-inducing" political events took place. Appendix 1 details the periods used.

In addition, we construct an additional index to examine political instability. We calculate the cumulative number of governments that have been in power in interwar Germany, divided by the number of years since the inception of the Republic in 1919. The resulting figure gives the average (annualized) number of governments at any point in time:

$$I = \frac{\sum_{t=1}^{14} C_t}{t}$$

An analogous index can be constructed from the measure of political instability.

Following the work of Engle and Bollerslev, modelling the uncertainty of economic variables through autoregressive conditional heteroskedasticity models (GARCH) has become increasingly common. The simplest form is, using lags of one period only

$$y_t = x_t\gamma + \varepsilon_t$$
$$\sigma^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$$

The first equation relates the returns on an asset y to a set of explanatory variables x; while the second equation fits an a model to the forecast (conditional) variance of asset returns. where ω, α, γ and β are parameters, σ^2 is the variance, and ε the error in the returns equation. If $\alpha+\beta<1$, the condition of stationarity is fulfilled. Predictions of future volatility in this model are based on the long-term average value ω, the size of the unpredicted return in the last period, as well as the conditional volatility in the last period. 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.[7] Because the distribution of asset returns has a tendency to violate the normality assumption, we used the robust covariance matrix procedure by Tim Bollerslev and Jeff Wooldridge.[8] To test for the influence of political events, we include the dummy variables described at the beginning of this section in the volatility equation. The coefficient on the additional variable is λ; we effectively test if l is different from zero and if it has an effect that is large enough to explain a substantial part of the overall variation of s.

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

indicator of political instability	change in government	general elections	major disruptions
sample period	*1919:01-1933:12*	*1919:01-1933:12*	*1919:01-1933:12*
ω	0.0003	0.0002	0.0002
	(0.7)	(0.94)	(1.1)
α	0.373***	0.35***	0.35***
	(3.0)	(2.75)	(2.97)
β	0.68***	0.68***	0.7***
	(7.96)	(7.5)	(9.19)
λ	-0.0001	0.0015	-0.0019*
	(-0.37)	(0.63)	(1.8)
Likelihood	176.9	177.6	178.0
Akaike	-1.91	-1.92	-1.92

* 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.

We find a high degree of persistence in shocks, with $a+b$ greater than or close to unity (though not significantly different from it). This implies that shocks to the level of variability took a long time to die out. The source of these shocks,

[7] 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.

however, is not well identified in the regressions in table 3. Neither changes in government nor elections were significantly related to increases in volatility, according to the GARCH models. We find insignificant coefficients for changes in government as well as for general elections. Even more surprisingly, major disruptions appear to have a weakly negative association with stock price volatility. This result should, of course, not be taken to mean that there is a causal relationship between lower volatility and putsches, insurgencies etc.

Next, we consider the slightly more complex indicators of political uncertainty presented earlier. The two indicator variables measure the cumulative number of "events", correcting for changes in the length of the sample.

TABLE 4
ESTIMATES OF CONDITIONAL INFLATIONARY UNCERTAINTY: GARCH (1,1)-MODELS

indicator of political instability	government instability indicator	disruptions indicator
sample period	*1919:01-1933:12*	*1919:01-1933:12*
ω	0.000347	0.00009
	(0.69)	(0.44)
α	0.374***	0.35***
		(2.73)
β	0.68***	0.69***
	(7.96)	(7.5)
λ	-0.0001	0.00006
	(-0.37)	(0.57)
Likelihood	176.9	177.1
Akaike	-1.9	-1.9

* 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.

The more aggregate indicators appear to fare similarly poorly in our GARCH models. The cumulative number of governments, divided by the number of months since the inception of the Republic, shows a negative coefficient, whereas the disruptions indicator has a positive sign. Neither of them is statistically significant, and the coefficients are very small in size. With the

[8] Bollerslev and Wooldridge 1992.

exception of the persistence of shocks themselves, few factors seem useful in explaining the variability of stock prices in interwar Germany.

There is, however, one alternative variable that can help us make sense of the variability of asset returns – inflation. That stock prices respond negatively to inflation is a well established fact in the finance literature (Campbell and Ammer 1988, Ammer 1994, Ely and Robinson 1997). There are also good reasons to think that if uncertainty about future inflation is high, stock returns will exhibit higher volatility.

Figure 3 plots the natural logarithm of the absolute value of the rate of inflation alongside the volatility of stock prices. While co-movement is not perfect, the main cycles are clearly common to both series. In particular, the spike in the autumn of 1923 can be observed in both series -- both the rate of inflation and stock market volatility reached extremely high levels.

To test this relationship more closely, I use three further tests. First, I regress the conditional volatility of stock prices, as derived from the GARCH(1,1) baseline, on a constant and the conditional volatility of the inflation series. Second, I use the natural log of the absolute value of inflation as a predictor. Finally, I use the conditional variance of inflation in the the variance equation of a GARCH model.

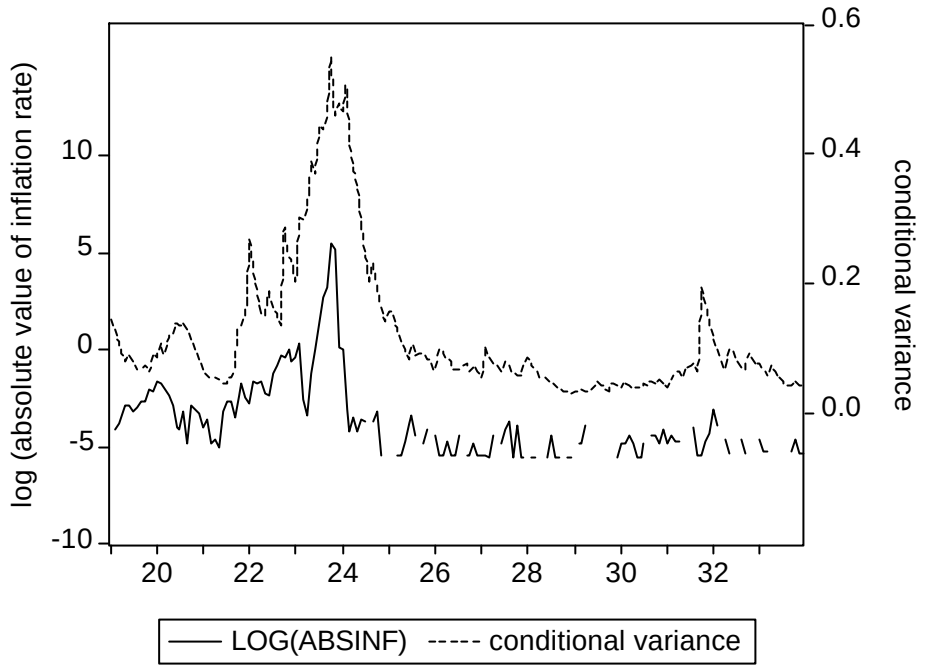

Figure 3

The results lend qualified support to the hypothesis that inflation was the prime culprit behind the extremely high volatility of asset prices during the period 1919-23. None of the estimation procedures copes without difficulty with the major swings in our series. While the OLS regressions suffer from serial correlation, the GARCH model scores well on the log likelihood and the Akaike criteria. However, the negative coefficient on the Garch component directly violates the assumptions of the estimation procedure, which rules out negative conditional variances. Since the estimation procedure needs to find the optimum of a highly non-linear function, difficulties of this kind can occur either because of inefficiencies in the software procedure or because the data actually violate some of the assumptions underlying the use of GARCH.[9] The estimates suggest that, for every percentage point rise in the absolute value of the inflation rate, the variability of stock prices increased by 7 percent.

[9] In this case, Eviews was used for estimation purposes. Despite some marked advantages, its GARCH estimation procedure is known to occasionally encounter difficulties. Future revisions of this paper will include further results derived from other software packages.

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

additional explanatory variable	conditional variance of inflation	log of absolute value of inflation	conditional variance of inflation
estimation method	*OLS*	*OLS*	*GARCH*
sample period	*1919:01-1933:12*	*1919:01-1933:12*	*1919:01-1933:12*
ω	0.11***	0.247***	0.00047
	(15.4)	(22.5)	(0.42)
α			1.194**
			(4.7)
β			0.156
			(-1.36)
λ	0.05***	0.07***	0.1*
	(6.97)	(13.7)	(1.8)
DW	0.29	0.36	
R^2	0.21	0.52	
Likelihood			321.0
Akaike			-3.5

* 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 in the GARCH case is maximum likelihood with Bollerslev-Wooldridge robust standard errors and covariances.

Despite some statistical shortcomings, inflation appears to offer a better explanation of stock price volatility than the tumultuous political history of the period. Of course, it would be too simply to assume that inflation and political uncertainty did not influence each other. As Webb (1986, 1989) has shown, the discount on the Mark on the foreign exchanges did widen dramatically in response to certain political events such as the London Ultimatum, causing an increase in expected inflation. To the extent that this change in expectations fed through to higher actual inflation (Webb 1986), it may have had an impact on the rate of inflation, and thus on stock price variability.

Conclusion

Were political events largely responsible for the high variability of output? Recent work in finance has suggested as much. Because of the clear link between the variability of asset prices and the level of industrial production, political uncertainty has been seen as the villain of the piece. A closer look reveals that many of the momentuous discontinuities during the early years of the Weimar Republic failed to leave a trace in asset prices. Also, negative

events were as likely to coincide with price rises as with price declines. A more systematic analysis of the link between political events and asset price volatility failed to find significant effects.

This paper also offers an alternative explanation of the high volatility of asset prices. Given the well-known link between high inflation and stock market declines, we examined if uncertainty about the rate of inflation might have influenced the variability of stock prices. The available statistical evidence suggests that such a link appears more likely, even if no definitive conclusions can be drawn from the evidence assembled in this paper. This, however, does not lead to an outright rejection of the link between political uncertainty and asset price volatility. The German inflation between 1919 and 1923 was primarily a political phenomenon, produced by the weakness of the Republic emerging from the ashes of the lost war. The main purpose of this paper, then, has been to provide a clearer mapping from political circumstances to volatility, stressing the importance of the inflationary nexus.

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Appendix

change in Reichskanzler	general elections for parliament	major disruptions	
		from	to
16.2.19	19.1.19	6.1.19	15.1.19
23.6.19	6.6.20	1.3.19	2.5.19
27.3.20	4.5.25	1.9.19	30.9.19
25.6.20	7.12.25	8.10.19	8.10.19
4.5.21	20.5.28	13.1.20	13.1.20
26.10.21	14.9.30	13.3.20	17.3.20
22.11.22	31.3.32	15.3.20	10.5.20
12.8.23	6.11.32	24.6.21	24.6.21
6.10.23		11.1.23	14.7.24
30.11.23		15.10.23	31.10.23
3.6.24		1.11.23	30.11.23
15.1.25		22.10.23	24.10.23
20.1.26		8.11.23	9.11.23
17.5.26		20.7.32	20.7.32
17.12.26			
12.6.28			
27.3.30			
7.10.31			
9.10.31			
3.12.32			
30.1.33			