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Inflation Expectations and the Recovery from the Great Depression in Germany [♭]

Volker Daniel[♮] and Lucas ter Steege[♯]

May 18, 2018

Abstract

A regime shift towards increased inflation expectations is credited with jump-starting the recovery from the Great Depression in the United States. Germany experienced a recovery as fast and strong in the 1930s. What role did inflation expectations play at the start of this remarkable economic upturn? To answer this question, we study inflation expectations in Germany across two different methods: we conduct a narrative study of media sources and estimate inflation expectations from a FAVAR model. Consistently across these approaches, we do not find a shift to increased expected inflation. This recovery was different, and its causes lie elsewhere.

JEL classification: E31; E32; E37; E12; N14; D84

Keywords: Inflation Expectations, Great Depression, Inflation Forecasting, Regime Change, Germany, Narrative Evidence

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1 Introduction

Inflation expectations play a central role in explanations for the recovery from the Great Depression in the United States. Central bankers frequently refer to the historical precedent for this policy prescription: President Roosevelt's credible commitment to inflate the economy in the Spring of 1933, which is regarded as a regime change that marks the beginning of the successful recovery of the U.S. economy (e.g. Eggertsson (2008)).[1]

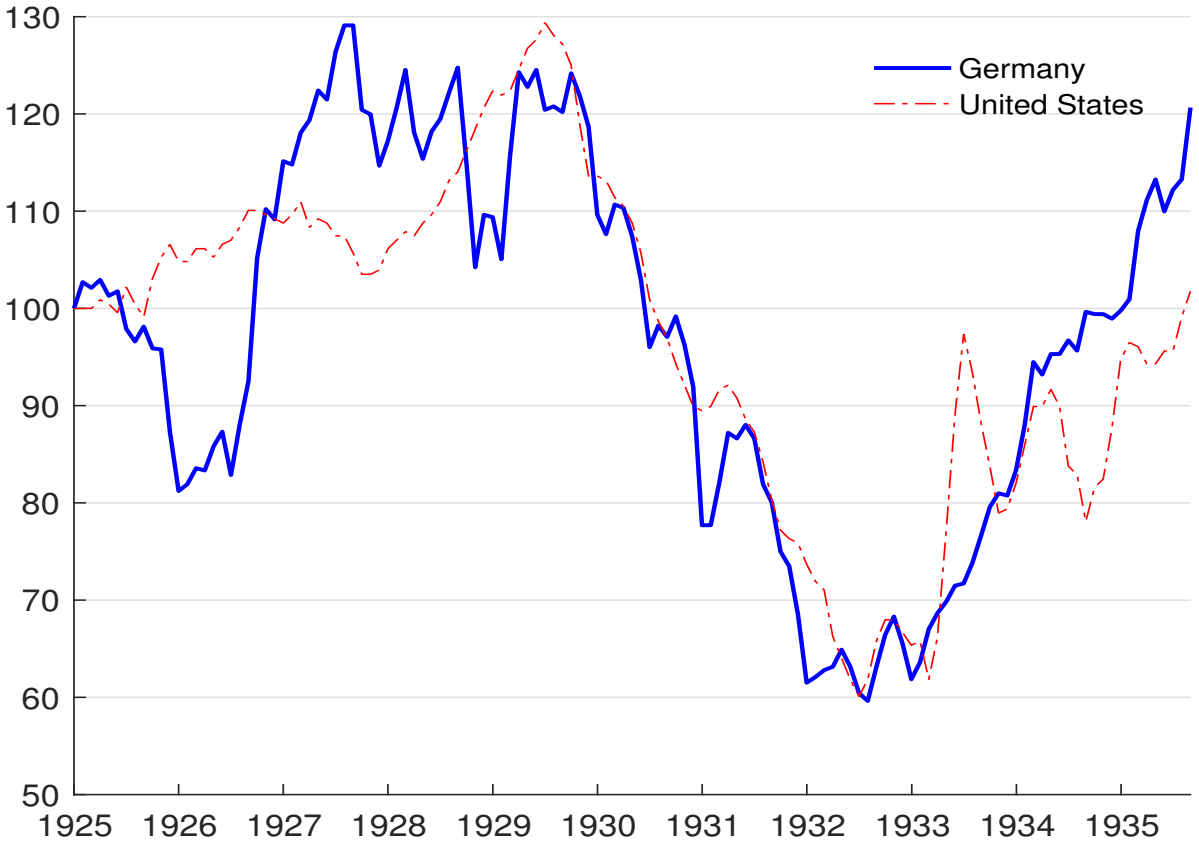
Figure 1 shows that Germany experienced a recovery that started in 1932 (Buchheim, 2008) and was as strong and fast as the recovery in the United States. At the same time, prices continued falling before 1933 (see Figure 2). In this paper, we investigate the role that inflation expectations played in the German recovery.

To address this question, we study inflation expectations across two methods. First, following Jalil and Rua (2016), we conduct a narrative identification of inflation expectations using media articles. Second, we estimate a factor-augmented vector autoregression (FAVAR) model from 1925 to 1935. Using an extensive dataset of monthly time series, we conduct one-month, six-month and twelve-month ahead forecasts of inflation rates.

Narrative evidence is helpful for a number of reasons and has been collected for the Great Depression in the United States, among others, by Jalil and Rua (2016), Nelson (1989) and Romer and Romer (2013). While quantitative inflation forecasts may depend on the specific method, and the choice of variables or parameters, narrative sources can verify and explain their outcomes. Quantitative forecasting methods usually have a backward-looking perspective, whereas narrative sources may incorporate ideas and considerations at any point in time that may be independent of reflections on the past. For this reason, they detect a regime shift that time series approaches fail to identify (see Romer (2013), Sargent (1982), Temin and Wigmore (1990)). Therefore, news sources are

[1] Chouliarakis and Gwiazdowski (2016) and Shibamoto and Shizume (2014) show that inflation expectations also played a pivotal role in Great Britain and Japan escaping the Great Depression, respectively.

Figure 1: *Industrial production in Germany and the United States 1925 to 1935*

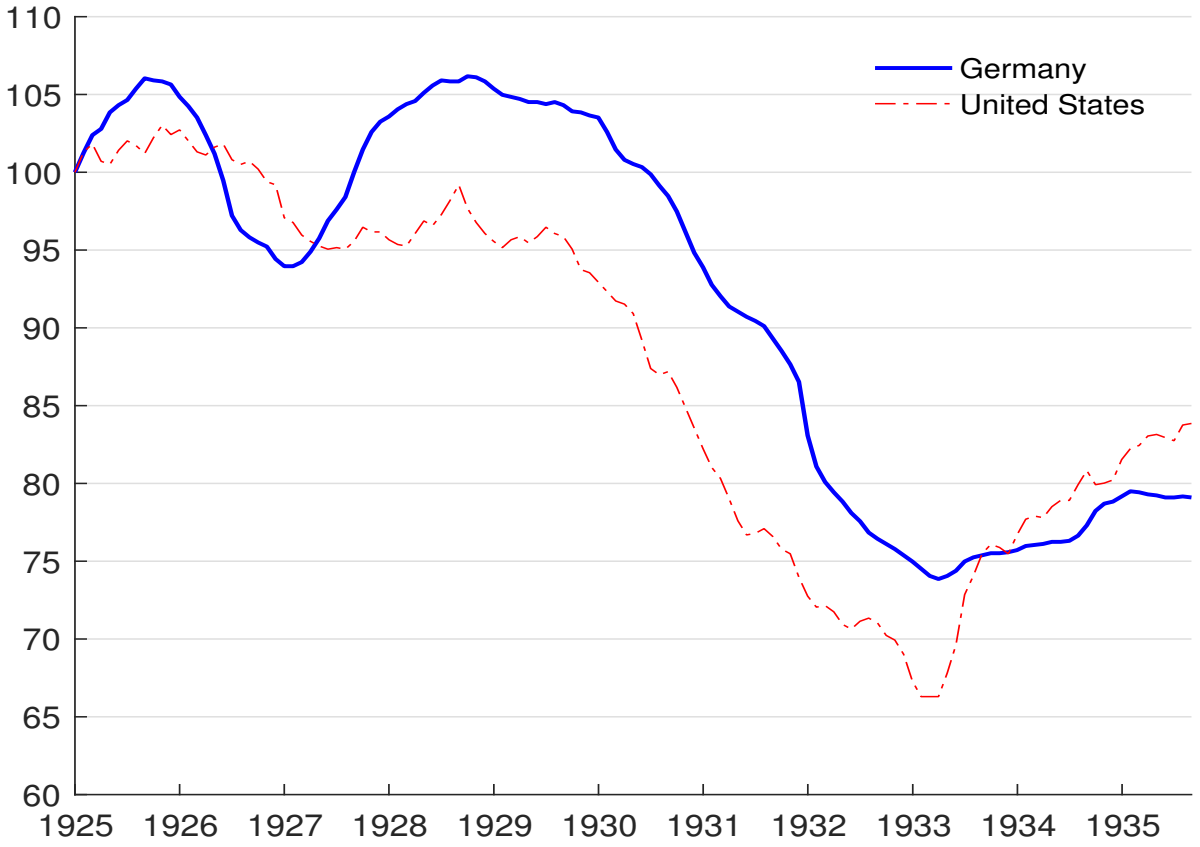


Notes: Industrial production in Germany and the United States, monthly, Jan 1925 = 100. *Sources:* Wagemann (1935), Governors of the Federal Reserve Board, Statistical Release G. 17, (2013).

capable of identifying what was known to the general public and which information could be considered relevant for changes in inflation expectations and, moreover, could point to the actual sources of such shifts. This is important, because a shift towards inflation expectations should not be a purely statistical outcome, but it should be experienced by contemporaries as the result of an abrupt policy change, an event or a shock in order to be identified as a regime change (Jalil and Rua, 2016).

The second approach is based on direct time series forecasts using a FAVAR model. Factor models have by now gained considerable popularity for forecasting economic time series. Boivin and Ng (2005) and Eickmeier and Ziegler (2008) evaluated different fore-

Figure 2: *Prices in Germany and the United States 1925 to 1935*



Notes: Monthly prices of industrial finished goods in Germany and U.S. index of wholesale prices of finished products, 1925 = 100. *Sources:* Wagemann (1935), NBER Macrohistory database (1997).

casting methods and found that factor-based forecasts perform well in practice, and additionally tended to perform better compared to simpler small scaled models. Therefore, a factor model is a natural candidate for our question at hand. A key advantage of factor models is that they allow us to incorporate a large amount of information into the analysis while at the same time keeping the estimation procedure tractable. Furthermore, since factor models are estimated based on the comovement between the time series in the dataset, a significant expansionary shift visible in a large number of time series would be picked up by the factors, and this should be informative about future inflation rates if the underlying cause of such an expansionary shift were due to changes

in expected inflation rates.

We also considered other approaches to estimate inflation expectations in a historical context (for an overview see Binder (2016)). One prominent method to estimate inflation expectations, which uses the Fisher equation that relates expected real interest rates to nominal interest rates and expected inflation, was first proposed by Mishkin (1981). He showed that rational expectations imply that inflation expectations can be inferred from realized real interest rates. For the Great Depression in the United States, Cecchetti (1992) applies this approach and finds a shift in inflation expectations in 1933 at the beginning of the recovery, at the same time that Temin and Wigmore (1990) detected a regime change towards a more expansionary macroeconomic policy. For Germany, Voth (1999) applied the Mishkin method during the interwar period and detected inflation uncertainty and fears of inflation in 1931 and 1932, but his results did not point toward a shift in inflation expectations. One potential problem with German interwar financial market data is that the nominal rate or bond yield series are very likely not to be risk free. This makes it difficult to disentangle expected inflation from risk or liquidity premia, a point that Voth similarly recognized in his work.[2] Although we do not pursue this approach in this paper, we do provide replicated results from Voth (1999) in Appendix A.1.

Our central finding is that there was no shift in inflation expectations in Germany at the start of the recovery from the Great Depression in 1932. The narrative study identifies temporary fears of inflation on a number of occasions that can explain increases in expected inflation according to our estimates. Newspaper articles reveal no regime shift towards inflation expectations at any point in time. Starting with the British exit from the gold standard in September 1931, German newspapers regularly mentioned

[2] Another reason for a likely distortion was that interest rates and many prices at the time were controlled by effective cartels and government regulations. We thank Carsten Burhop, Werner Plumpe, Mark Spoerer and Jochen Streb for this very important indication.

currency devaluation and inflationary policies as viable policy options. Fears of inflation appeared during discussions about an extensive expansionary policy in January 1932, after the formation of the Papen government in June 1932 and as a reaction to Hitler's seizure of power in 1933. However, according to the news account, none of the events caused an enduring change in inflation expectations. Each time inflation came into the minds of the general public, the government and Reichsbank were eager to rule out any price-increasing policies. This finding is in line with what Straumann (2009) argues was the case for several European countries at the time.

The forecasts from the FAVAR model also show no indication of a sudden regime shift in inflation expectations that would be comparable to the U.S. experience. While the time series forecasts reveal positive expected inflation rates during the summer of 1932, consistent with the narrative evidence these expectations did not last. This result holds across all forecast horizons. In sum, across both approaches we find that inflation expectations were not the cause of the remarkable recovery from the Great Depression in Germany, and the answer to this question must be sought elsewhere.[3]

2 Narrative Account

To discover a possible shift in inflation expectations in Germany at the start of the recovery from the Great Depression, we follow Jalil and Rua (2016) and first provide a general overview of newspaper coverage about inflation through a word search of newspaper articles. We then conduct a detailed narrative study of media sources over a two-year period.

[3] This result is backed by what Cohen-Setton, Hausmann, and Wieland (2017) argue for the case of France, where extensive supply-side policies in 1936 induced a remarkable inflation that by no account could be regarded as the key factor in ending the Depression in France. For possible explanations regarding the German recovery see, for example, Spoerer and Streb (2013).

2.1 General overview of inflationary news coverage 1930 to 1933

To detect media coverage on possible inflation expectations, we study Vossische Zeitung, one of Germany's national newspapers of record during the Weimar Republic. Vossische Zeitung had a daily circulation of approximately 68,000 in 1931, and it covered the main events and debates of the time (Binkowski and Schottenloher (1985), Institut für Zeitungskunde (1932)).

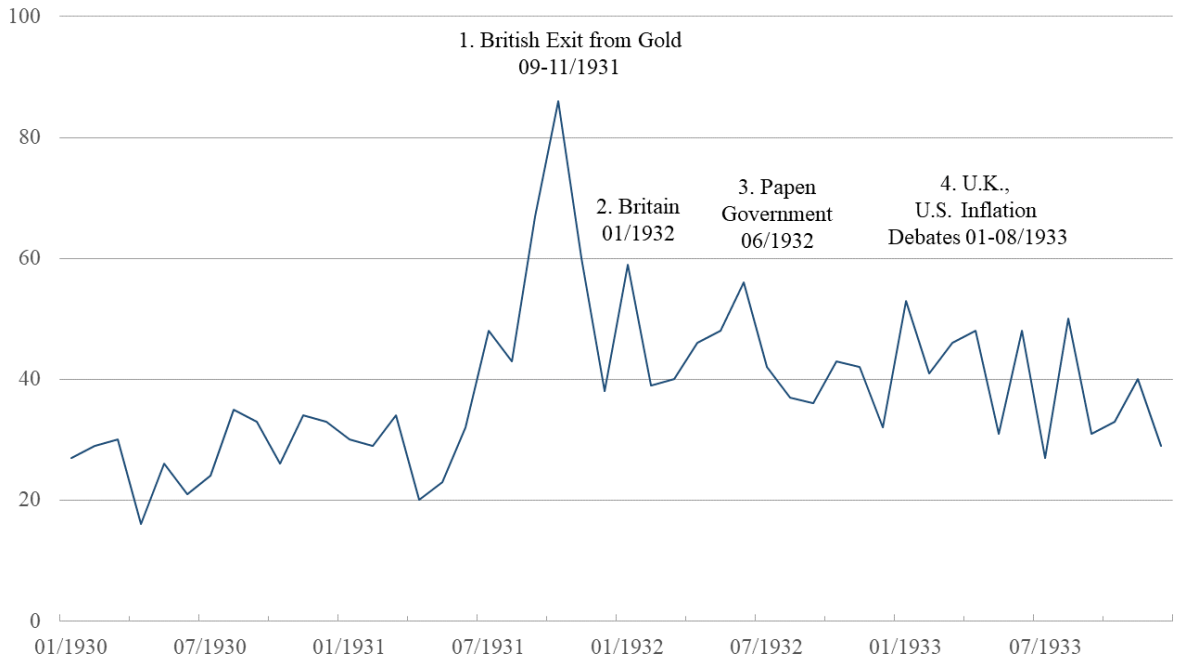
In the on-line database provided by the De Gruyter publishing house, we searched all issues of the newspaper from 1930 to 1933 and counted the number of articles that contained the German terms for 'inflation'. Specifically, we used a combination of the terms, word stems and abbreviations of the German words 'Inflation' (inflation) and 'Teuerung' (dearness).[4] If there were a sudden shift in inflation expectations, there should have been an increased public interest likely reflected in more articles about inflation in one of the leading newspapers at the time.

We depict the resulting series in Figure 3. Before summer 1931, fewer than 30 articles per month on average mentioned inflation; in September and October, the mentioning of inflationary terms increased threefold to a total number of 86 articles. This signifies more than two articles per day on average. After fall 1931, inflation coverage occurred to a lesser extent in Vossische Zeitung, although appearances remained at a higher average than before, with some months clearly above the number of articles per month before fall 1931. This was the case for November 1931 as well as for January and June 1932. In 1933, inflation coverage was lower but still had spikes above average in January, April, June and August. Accordingly, in Figure 3, we identify four spikes (or periods of spikes) of increased inflation mentions – Fall 1931, January 1932, June 1932, January to August

[4] We also considered terms like 'Geldentwertung' (debasement), 'Preissteigerung' (price increase), 'Preisanhebung' (price lift), 'Preiserhöhung' (price rise), and 'Preisheraufsetzung' (price raise, markup).

1933 – that could point to a shift in inflation expectations in the news and which we discuss separately in greater detail below.

Figure 3: *Inflation mentions in Vossische Zeitung 1930-1934*



Notes: The monthly frequency of articles that contain terms related to inflation in Vossische Zeitung. We also indicate prevalent topics in the news in four periods of increased news coverage.

To investigate whether any of these spikes corresponded to an inflationary shock, we checked all articles containing inflation during the four mentioned time periods. Table 1 indicates the events or topics that went along with inflationary words ordered chronologically by the four spikes and months of occurrence. In each month, we examined the context in which inflationary terms occurred by reading the relevant articles. We classified articles with reference to a specific current event as dealing with such event. In many cases, inflation was exclusively mentioned in reference to the hyperinflation of 1923 with no relation to the present. In that case, we classified it as "Hyperinflation in retrospect". If an article compared actual events to past periods we classified the article

as referring to an actual event. Articles not counted as part of either an actual event or the hyperinflation of 1923 referred to a wide range of topics from literature, culture and sports and were of no relevance to our research question.

Table 1: *Months and events with increased inflation mentions in Vossische Zeitung*

Spike	Month	# Articles	Event/Topic 1	Event/Topic 2
1	September 1931	67	Hyperinflation in retrospect (24)	British exit from gold (19)
	October 1931	86	Germany's economic policy (37)	British exit from gold debate (20)
	November 1931	62	Exit from gold policy debate (24)	Hyperinflation in retrospect (19)
2	January 1932	59	Hyperinflation in retrospect (30)	Exit from gold policy debate (15, in part Wagemann's Plan)
3	June 1932	56	Papen government (21)	Hyperinflation in retrospect (17)
4	January 1933	53	Inflation debate globally (24, in part Hitler)	Hyperinflation in retrospect (19)
	April 1933	48	Inflation debate U.S (36)	Hyperinflation in retrospect (9)
	June 1933	50	Inflation debate U.S (20)	Hyperinflation in retrospect (18)
	August 1933	50	Inflation debate globally (20)	Hyperinflation in retrospect (18)

Notes: The first column indicates the assignment of each month to one of the four spikes indicated in Figure 3. Columns 2 and 3 indicate the selected months and the number of articles per month that mention inflation. The last two columns show the two main events/topics involving inflation. Numbers in brackets indicate the number of articles per topic, and in some cases a certain aspect of the event or debate.

Table 1 lists chronologically the months with a large number of articles about inflation (column 2), the classification to one of the four spikes (column 1), the number of articles including inflation (column 3) as well as the two topics - or events - related to inflation with the most mentions (columns 4 and 5). In columns 4 and 5, we further indicate in brackets the number of articles that we related to the two topics. These two inflationary topics or events were prevalent in the vast majority of articles mentioning inflation in the designated months. More than two-thirds of the articles in our sample each month referred to these two subjects. Apart from mentions of the hyperinflation of 1923, we

find references to at least one actual political event or debate in each month. We also indicated such relevant events for each spike in Figure 3.

In September 1931, inflationary news predominantly covered the British exit from the gold standard and related this event to expected inflationary tendencies in Britain. In the following months the discussion about Britain remained prominently in the news at least until January 1932 as indicated by the topics in Table 1. As one consequence of the British exit from the gold standard, the news account in Vossische Zeitung reveals that after fall 1931, inflationary policies and a devaluation of the Reichsmark were also discussed in Germany. German economic conditions were regularly compared to the situation in other countries, such as Britain, but also to Germany's own experience with hyperinflation. Importantly, the news account also shows that such considerations were regularly opposed by the German government and central bank.

In January 1932, at a time of ongoing inflationary debates in Britain and the United States, a plan for a more expansionary economic policy proposed by the head of the statistical office, Ernst Wagemann received some media attention. In June 1932, the new Papen government was allegedly expected to conduct inflationary policies. In January 1933, this was the case when Hitler seized power. Inflationary policies in the United States were in the focus of the now controlled media for the remainder of 1933. The word counts visualized in Figure 3 are therefore remarkably in line with Borchardt's 1985 notion that fears of inflation prevailed after political events associated with currency devaluation, credit expansion or expected government deficits.

2.2 A detailed narrative study of media sources September 1931 to August 1933

We next investigate chronologically the relevant political events and debates with respect to a possible shift to inflation expectations by a careful narrative study of media sources. For this study, we read weekly issues of the economic periodical 'Der Deutsche Volkswirt' (DDV) over a two-year period from September 1931 to August 1933. DDV had the advantage of a weekly frequency that permitted a careful reading of articles over a prolonged time period. We divided our analysis by the spikes in the news coverage as shown in the previous section; however, we carefully included potentially inflationary events during other periods. As one of the leading and influential periodicals in its field at the time (Röpke, 1933), DDV had a weekly subscription of up to 6,000 and provided a weekly summary of political events and the state of the economy (Sattler, 1982).

At relevant dates we considered two major daily newspapers: 'Vossische Zeitung' (VZ) and 'Berliner Lokal-Anzeiger' (LA). We read both papers one week before and after such dates in order to observe immediate reactions but also to identify diverging opinions about the events. While both DDV and VZ could be considered economically liberal and politically centrist, with a daily circulation of approximately 200,000 in 1932 LA leaned to the nationalist conservatives. While VZ and DDV were backing Brüning and later Schleichers economic policies, LA stood unconfined with the German National People's Party (DNVP), their leader Alfred Hugenberg and later the Hitler government. As a form of robustness check, we considered further news sources that spanned the entire political spectrum as well as the scientific publications of the Institute for Business Cycle Research.[5]

[5] We provide an overview of the articles cited here in an online Appendix.

2.2.1 September to December 1931 - Britain's exit from gold and inflation debates in Reichstag

The first potentially inflationary situation occurred in September 1931. After Britain left the gold standard on September 21, on several occasions the German government and Reichsbank announced that they were 'not considering devaluing the Reichsmark for the possible loss of currency stability and inflationary consequences' (VZ 25-30.09.31). DDV argued that Britain's decision to leave gold was supposedly driven by Keynes' instruction as a means against deflation and warned that similar measures in Germany could cause inflation due to its experience with hyperinflation in 1923. It mentioned that fears of inflation were already apparent. DDV further accused the right-wing press of exploiting this situation by calling for more autarky, to leave the gold standard and instead to establish an unconvertible 'interior currency' in Germany (DDV 25.09.31). This claim was not far flung when considering news coverage about the party convention of the DNVP on the weekend before Britain's exit from gold. At the meeting, Alfred Hugenberg had called for a disencumbering of the indebted industry and agriculture, the break of international treaties, and the turning away from international currency agreements such as the gold standard. Hugenberg also identified deflation as a major problem for the German economy at this point of the crisis (LA 20.09.31, see also the social democratic Vorwärts on 19.09.31). General industry interest groups, in contrast, publicly opposed currency experiments but endorsed a public credit expansion (VZ 30.09.31).

Two weeks later, the political right announced a vote of no-confidence against the Brüning government for the following parliamentary debates (VZ 12.10.31). For the remainder of the parliamentary week, inflation became a persistent issue during the important speeches. Speakers from the moderate left to the center-right defended the government for their policy of economic stability while denouncing the nationalists for allegedly turning Germany into inflationary chaos should their no-confidence vote succeed.

On October 16 – the day of the vote – DDV declared that the fall of the government as threatened by the 'right-wing-opposition, raised fears of another inflation'. In the same issue, DDV even mentioned 'panic buying and a retention of the sellers'. VZ had noticed surging stock markets already three days earlier (VZ 13.10.31) and had remarked that a 'government of currency stability' was at stake being confronted by a 'block of inflationists' (VZ 14/15.10.31).

After Brüning's victory in the confidence vote, DDV (23.10.31) summarized the dramatic events of the preceding week as 'commotion of mistrust in the banks and towards the stability of the currency'. It recognized an increase in acquirements and an expansion of retail sales as a consequence of the panic buying in the preceding week (DDV 30.10.31). In November, news regarding inflation abated (DDV 06.11.31), and no 'inflationary events' appeared in the media. Possible inflationary tendencies in England and other countries that had left the gold standard were frequently discussed (e.g., VZ 01.11.31), while potential currency experiments in Germany were regularly opposed by politicians and interest groups (VZ 06-10.11.31, 24.11.31, 28.11.31).

One consequence of the currency devaluations in other countries was that economic discussions in Germany shifted to a decrease of prices and wages as a means to keep Germany's competitiveness on world markets, which basically constituted the opposite of inflation expectations. The result was the presidential decree of December 8, which forcibly cut prices, rents, wages and interest rates as of January 1, 1932 (DDV 27.11.31-18.12.31).[6] First price reductions as a reaction to the decree came within a few days (VZ 18.12.31). During the debate about the decree and in the following weeks, news coverage revealed no indication of a potential increase in prices in the future as a consequence of the drastic cut in the present.

In sum, the spike in the media coverage about the British exit from gold and discus-

[6] We provide a detailed description of the presidential decree in Appendix A.2.

sions about inflation in fall 1931 constitute no regime shift towards inflation expectations. Likewise, we do not detect a change toward expansionary policies at this point in time.

2.2.2 January to May 1932 - Expansionary policies are ruled out

In January 1932, Ernst Wagemann, head of the Institute for Business Cycle Research and president of the statistical office of the Reich, published a plan to counter the depression in Germany. The proposal comprised work programs financed by a moderate credit expansion, taking into account mild inflation (DDV 22.01.32, VZ 20.01.32, LA 20.01.32, see also Wagemann (1932)). While some observers pointed out positive examples from other countries and the industry leaning press hoped for a 'reflation of the devalued economy', DDV - and as it argued 'all experts' - declined Wagemann's idea as either too small and therefore useless or devastatingly inflationary: A credit expansion necessary for an effective work program would result in inflation because of Germany's experience in 1923 (DDV 29.01.32-19.02.32).

Under the impression of this continuing discussion, the German government announced on January 30 that it was under no circumstances considering currency experiments or a change of the Reichsbank law (VZ 30.01.32). Following this virtual refusal of the Wagemann plan, no news appeared thereafter that pointed to inflationary fears or concrete expansionary policies, and therefore no permanent shift in inflation expectations.

Further public work programs were frequently discussed in the following months and drew support from the agricultural and industrial interest groups, some banks and trade unions (DDV 19.02.32, VZ 30.01.32). Hitler's National Socialist German Workers Party (NSDAP) put credit financed work programs into their party manifesto, and its electoral success may in part be attributed to this unique feature. What all proponents of work programs had in common was that they stressed that their plans were too small to be

inflationary (see VZ 14.04.32, also Borchardt (1985)).

2.2.3 June to December 1932 - The Papen government

After Brüning's centrist minority government came to an end on May 30, stock markets rose and bond prices fell, cash withdrawals and increased property acquisitions were reported (DDV 03.06.32, VZ 01-03.06.32). VZ noted that 'certain circles advocating currency experiments observed their time coming while scared capitalists engaged in stocks as a safeguard'. DDV interpreted the situation that 'under the prospect of the next, more right-wing government, the general public takes flight into real assets' and concluded: 'The events of the last days are object teaching how credit expansion and currency experiments in Germany would take effect. We only hope, the next government will understand' (DDV 03.06.32). LA took a different stance. It suspected 'certain circles' of engaging in the stock market in order to 'stage a flight into real assets'. At the same time, 'the left-wing press gave the impression that new inflation was about to come'. Both were intended to 'increase nervousness', 'panic' and a 'catastrophe mood' in Germany (LA 01.06.32). Regardless of whether LA was right, the media coverage about the danger of inflationary tendencies certainly induced or reflected fears among parts of the public.

When it was announced that Franz von Papen would form the next government (LA 01.06.32), the 'dark nightmares' of inflationary measures suddenly appeared possible (DDV 03.06.32). The new chancellor appeared willing to form a majority in Reichstag with Hugenberg's nationalists potentially even backed by Hitler's inflationary national socialists. The media speculated that Reichsbank president Luther could resign for his diverging views on stable economic policies (VZ 02.06.32, see also Vorwärts 02.06.32).

After his appointment, however, Papen immediately met with the central bank president making clear that Luther would stay in office, and they both publicly declared

that 'any currency or credit experiments, that could possibly endanger the value of the currency were out of question' (VZ 03.06.32). This action seems to have been enough to stop the flight into real assets, and stock markets calmed down (VZ 04.06.32, LA 04.06.32). DDV noted that the 'severe psychosis had faded after the new government left no doubt about currency stability' (DDV 10.06.32). In the following weeks, no indications of lasting fears of inflation or expected price increases appeared in the news account.

In July 1932, the Lausanne Conference reached an agreement, which for Germany would mean a cut in reparations by 90 percent and hence new financial scope for action to fight the depression. DDV stated that the quasi-end of reparations as negotiated in Lausanne would provide the conditions for an economic upturn in Germany. At the same time, it curiously noted that many observers (especially from the right-wing press) did not praise this remarkable success (DDV 15.07.32, also VZ 09.07.32). The agreement implied a gain in sovereignty: implementing Lausanne would mean the end of international supervision of the Reichsbank as under the Young Plan and room to maneuver in monetary policy, a point that Hans Luther was quite pessimistic about. The president of the Reichsbank warned that Germany should by no means start conducting autarky policies and devalue from gold as a consequence of the new gained freedom since such measures could lead to high rates of inflation (VZ 09.07.32). After the agreement, bond markets grew, possibly expecting quick discount rate cuts or a change of the Reichsbank law (VZ 09.07.32); however, no news pointed toward expected inflation in the following weeks.

In late August 1932, under the impression of growing political violence and two election campaigns, chancellor Papen was willing to use the newly gained financial scope and announced an expansionary economic program. While work programs had been discussed in the preceding months, DDV noted that the 'timing and announcement of

the Papen program was psychologically quite effective' and that market participants were apparently surprised by its dimension (DDV 02.09.32, VZ 29.08.32). The plan comprised moderate sized work programs, tax reductions for hiring and subsidies for building repairs. It was financed by central bank loans and wage reductions. In addition, the Reichsbank would reduce the discount rate (DDV 09.09.32). Positive sentiment continued over the course of the next weeks as more details emerged, and the government underscored that it would refrain from currency experiments (DDV 09.09.32, VZ 26.08.32, 27.08.32). The Reichsbank had already declared earlier that it was funding projects only if no inflationary policies were implemented (VZ 24.08.32).

Although apparently in part intended to fight deflation (it was at least mentioned once: VZ on 28.08.32), the media did not expect inflationary tendencies of the measures. The social democratic newspaper Vorwärts noted that the Reichsbank's involvement in the program would not necessarily mean that inflationary consequences were ruled out. It also highlighted the strong stock market surges; however, it did not link them to fears of inflation: 'stocks of firms that would possibly benefit most from wage reductions proposed by the program gained most' (Vorwärts 30.08.1932). Hence, if the program had positive effects on the economy, contemporary observers did not expect them through inflation but rather through wage reductions, a rather small credit expansion, subsidies and incentives (DDV 21.10.32).

The narrative evidence, therefore, provides no indications for a lasting shift to inflation expectations as a result of this program. The central bank had made it clear from the beginning that it would not accept and support inflationary policies. Even though the stock market boom could have involved some inflationary considerations, the media did not provide such an interpretation. In December 1932, under the short-lived Schleicher government, further work programs showed a comparable reaction without expected price increases mentioned in the media.

2.2.4 January to August 1933 - The Hitler government and U.S. inflation

Hitler's seizure of power on January 30, 1933 came as a shock to a large part of the German public – politically and economically. The NSDAP had favored a costly large-scale extension of work programs. In contrast to other politicians, to reach their goals, national socialist speakers appeared willing and aggressive enough to use drastic measures: autarky, currency devaluation, a large budget deficit and the violation of international treaties.

As a possible consequence, DDV reported a dramatic fall in bond prices and increases in stock prices allegedly motivated by fears of inflation: 'The economy is paralyzed again by uncertainty about what will come, despite assertions that economic and currency experiments would be ruled out' (DDV 02.02.33). VZ, however, observed relatively calm stock markets and interpreted them as a reaction to the new government's and Reichsbank's rejection of 'currency and economic experiments' (VZ 31.01.33). LA interpreted the increases on stock markets as positive sign of fading uncertainty under the new government (LA 30-31.01.33).

After the shock of the first days, possible fears of currency experiments were no longer mentioned in the media. On the one hand, the government repeatedly announced that it had no such plans and stressed the 'importance of absolute security for the well-being of the German people and the economy'. On the other hand, pressure on the free press intensified and economic opinion articles occurred less frequently (some exceptions: DDV 10.02.33, 24.02.33, VZ 02-04.02.33). In one of those articles, Hans Luther, president of the Reichsbank, warned in February that the fall of the international constraints under the Lausanne treaty could be exploited to put the central bank under political influence with unpredictable consequences for financial stability (DDV 24.02.33). VZ discussed the possibility that as part of the consolidation of powers under the new government (Gleichschaltung), the Reichsbank might be the next institution to become disempowered

and highlighted Luther's achievement of currency stability (VZ 10.03.33). Nevertheless, Luther's resignation a week later was not being debated critically. VZ (17.03.33) and other newspapers printed Luther's open farewell letter, in which he mentioned his relentless stance for central bank independence but also underlined that Hitler himself had assured him that no currency experiments were planned. His successor, Hjalmar Schacht, declared currency stability a central objective of the Reichsbank (see VZ 07.04.33) and continued to pursue an orthodox policy (James, 1993).

Despite possible expectations of drastic policy changes under a Hitler government beforehand, we find no shift to inflationary policies or expected inflation in the first months of the new government. The Hitler dictatorship clearly did not conduct an openly inflationary policy. In fact, Hitler himself opposed inflationary policies and regarded the power of the state (in the shape of SA and concentration camps) as a decisive safeguard against it (James, 1986). In a unique example of this power, on May 16, the Munich police accused 200 small businessmen of raising prices and detained them in the Dachau concentration camp. The incident was made public as a cautionary tale, and the public was requested to give notice of imitators (VZ 21/22.05.33, also Völkischer Beobachter 20.05.1933; see Domröse (1974)).[7] One factor demonstrating the resoluteness of the regime in terms of price increases may be due to the implementation of a general freeze on pay increases shortly beforehand. The freezing of wages in itself meant that price increases became less likely in the short and medium term and made such activities even more unpopular among the working population.

Between April and August, the news coverage mentioning inflation focused mainly on the United States, where president Roosevelt pursued a shift to inflation expectations in April (VZ 19-22.04.33), and in June, the world economic conference in London put the currency discussion on a global level (DDV 28.04.33, 05.05.33, 02.06.33, 16.06.33,

[7] We thank Harold James for emphasizing this important incident.

23.06.33, 30.06.33, 14.07.33, 04.08.33). In Germany, no policy measures were implemented with the expressed intention of raising price levels, while the government and Reichsbank repeatedly ruled out inflationary policies (VZ 07.04.33, 02.06.33, 10.08.33, 26.08.33, DDV 18.04.33). The few incidents in which government intervention resulted in increased prices of particular goods were carefully discussed and the scope of such increases was restricted. This was, for instance, the case for minimum prices on animal fats to support suffering farmers and a revision of the cartel law (VZ 22.05.33, 23.05.33, 15.07.33, 18.07.33, 29.08.33). In sum, we find no regime shift to inflation expectations under the Nazi government at the start of the recovery even when considering a later starting date of the recovery in 1933.[8,9]

3 Time series evidence

In this section, we employ a factor model to estimate inflation expectations. Factor models have gained considerable popularity for forecasting economic time series. Boivin and Ng (2005) evaluated different forecasting methods and found that for prices and one month forecast horizons, factor-based forecasts performed better than simple AR(1) forecasts. Eickmeier and Ziegler (2008) also show that factor models perform very well compared to simpler benchmark models or small scaled models. Therefore, a factor model is a natural candidate for our question at hand.

We start by presenting the structure of the model and the dataset used for estimation.

[8] A later start of the recovery during the early stages of the Hitler dictatorship has been suggested, for instance, by Overy (1996) and Abelshauser (1999).

[9] As a result of the likely bias of the media account due to suppression and government control, we verified that there were no inflation expectations in the first months of the Third Reich by examining further sources: the briefings to the press of the Reich Ministry of Public Enlightenment and Propaganda (*Reichsministerium für Volksaufklärung und Propaganda*), and the reports of the secret state police (*Gestapo*) both for the year 1933, available in the German federal archives (*Bundesarchiv in Berlin-Lichterfelde*) and the Prussian Privy State Archives of the Prussian Cultural Heritage Foundation (*Geheimes Staatsarchiv Preußischer Kulturbesitz, Berlin*). We thank Mark Spoerer for emphasizing this point.

Afterwards, we present our estimation results.

3.1 The empirical model

The factor model we use relates a large number of time series Y to a small number of common but unobserved factors f. The dynamics of these factors are described by a VAR process. Formally, the model is given by

$$Y_t = \Lambda f_t + e_t \tag{1}$$

$$f_t = B_1 f_{t-1} + \cdots + B_L f_{t-L} + v_t \tag{2}$$

$$e_t \sim \mathcal{N}(0, \Omega), \quad v_t \sim \mathcal{N}(0, \Sigma) \tag{3}$$

In Equation (1) Y_t is a 109×1 vector of observed variables, f_t is a 3×1 vector of common latent factors[10], Λ is the corresponding 109×3 matrix of factor loadings, and e_t is a 109×1 vector of idiosyncratic errors. We assume that e_t and v_t are uncorrelated and that Ω is a diagonal matrix. Equation (2) specifies the dynamics of the factors as a VAR of order 12, with corresponding 3×3 coefficient matrices B_l. Using 12 months as the lag order is the most commonly used lag length for monthly VAR models. As in any factor model, we have to deal with the issue that the common factors and loadings are not separately identified. We solve this issue following common practice and restricting the upper 3×3 block of Λ to be the identity matrix. The model is estimated using Bayesian methods. The specification of the prior distributions for the parameters follows Ritschl and Sarferaz (2014). We describe the prior distributions and the estimation procedure in detail in Appendices A.3 and A.4.

With this model, our goal is to produce h-step out-of-sample forecasts of inflation rates,

[10] We chose 3 factors because the information criterion suggested by Bai and Ng (2002) determined this to be the optimal number of factors for the majority of subsamples.

conditional on information available at some point in time T. This is easily done using the state-space form of the model in Equations (1) and (2), which implies the following expressions for the forecasts

$$F_T = [f_T' \; f_{T-1}' \dots f_{T-L}']' \tag{4}$$

$$f_{T+h|T} = JB^h F_T + J\sum_{j=0}^{h-1} B^j \tilde{V}_{T+j} \tag{5}$$

$$Y_{T+h|T} = \Lambda f_{T+h|T} + \tilde{e}_{T+h} \tag{6}$$

Equation (4) combines the relevant factor values into a single column vector, according to the lag length in the factor VAR. Equation (5) then uses the VAR system to produce a forecast of the factors. The matrix J refers to the matrix that selects the first three rows of the companion form forecasts of the common factors, and the matrix B is the companion form coefficient matrix. Lastly, Equation (6) uses the factor forecasts to produce the h-step ahead forecast of the panel. Note that in Equations (5) and (6) we add random errors drawn from their respective posterior distributions in order to accurately reflect the uncertainty associated with the forecasts.

One critical issue with any forecast concerns the appropriate choice of the information set at any particular point in time. It would be inappropriate to estimate the model over the entire sample once and base forecasts on these estimates. This is because the Gibbs sampling algorithm we use estimates the common factors moving backwards through time, and thus necessarily includes information from future time periods. To avoid this, we use a recursive forecasting procedure and estimate the econometric model first on a sample that ends in December 1929. With this sample we produce forecasts of inflation rates for the following one, six, and twelve months. We subsequently add one month at a time to the original dataset and estimate the econometric model again. This approach

ensures that we do not include information into the information set that was actually not available to agents.

3.2 Data

We use a rich dataset from Wagemann (1935), which consists of 109 time series covering important time series such as production and employment, various price indexes, trade, banking and monetary aggregates, and nominal interest rates. The data are of monthly frequency. All the time series, except for nominal interest rates, were seasonally adjusted prior to estimation and transformed into 100 times the monthly difference in natural logarithms of the adjusted series. The nominal interest rate series are divided by 12 to convert them to monthly rather than annual interest rates. The panel with these definitions then starts in February 1925 and ends in June 1935. A complete list of the variables used to extract the common factors is provided in Appendix A.5. When estimating the common factors, we used standardized values of the time series, so that each series has zero mean and variance 1 for each estimation sample. This is a commonly used transformation of the data that ensures comparability across time series. When constructing the forecasts, we convert them back by adding the mean and the standard deviation of each variable in every run of the sampling procedure to measure inflation expectations that can be compared to actually realized inflation rates.

A brief note on data transformations is in order. We convert the time series to month-to-month changes for two reasons. First, from the point of view of forming expectations about future inflation rates it is much more sensible to assume that what agents keep track of is the month-to-month change in price levels or aggregate activity, rather than assuming that the relevant growth rates span an entire year. Second, the underlying econometric theory is mostly developed for the case of stationary time series, and most studies that forecast economic time series use period-by-period log differences of the

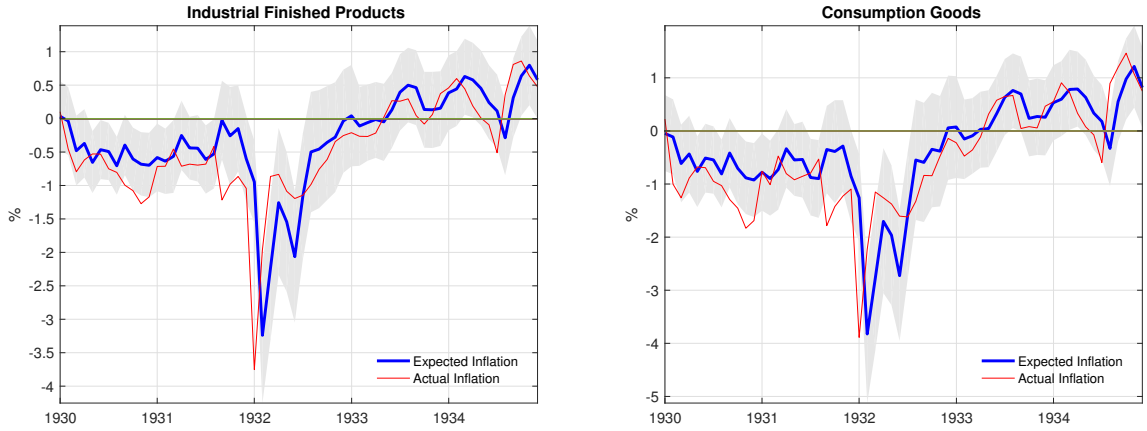
variables. Stock and Watson (1999), Stock and Watson (2002b), Stock and Watson (2002a), Eickmeier and Ziegler (2008) all use transformations of this sort, and we stick to this common practice in this paper.

3.3 Results

We start by considering one-month-ahead forecasts for two important inflation series, namely, inflation of industrial finished products and inflation of consumption goods. In what follows, we report the median of the posterior distributions together with 95 % of the posterior probability mass. Additionally, actual monthly inflation rates are reported as a point of reference. As Figure 4 illustrates, the forecasts closely track the actual monthly inflation series, albeit with a one-month delay. This is to be expected given the linearity of the forecasting model. We observe two facts about expected inflation. First, throughout 1930 and 1931 continued deflation was expected each month as the consistent negative forecasted series show. The large deflation shock of January 1932 also fueled expectations of further large deflation rates. Given that by this time Germany had already faced continued deflation rates that were pursued by the German administration even more strongly in December 1931, there is no reason expectations should have been any different.[11] Second, while the deflation period was to a large extent expected to continue during the early 1930s, the evidence for expected inflation rates after the summer of 1932 is mixed. While inflation expectations together with actual inflation revert back toward lower deflation rates, both inflation and deflation are consistent with agents' forecasts from mid-1932 onwards. Actual inflation rates were consistently negative until the end of 1932 for both series, and the evidence does not support the view that Germany experienced a similarly clear-cut reversal in inflation expectations as the United States did.

[11] We provide a detailed description of the measures taken in December 1931 in Appendix A.2.

Figure 4: One-month ahead forecasts



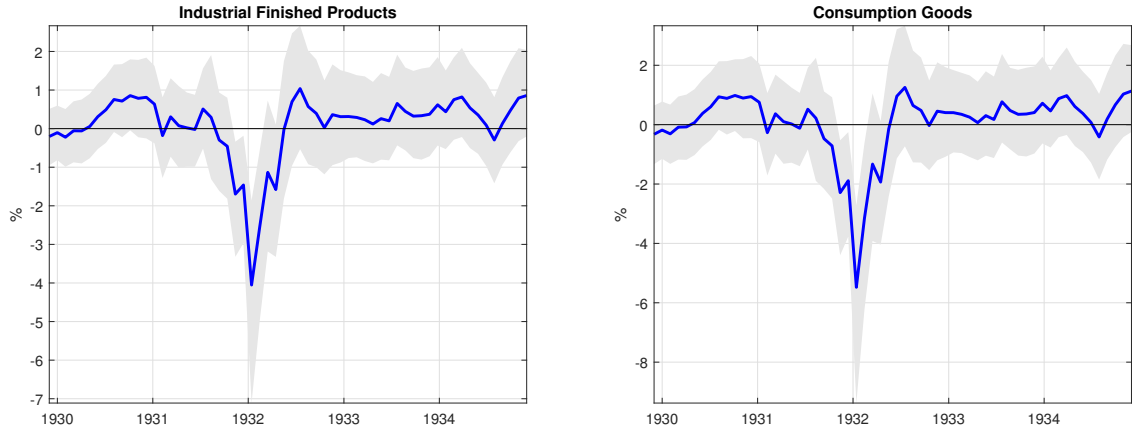
Notes: Medians of posterior distribution shown in blue, 95 % of the posterior probability mass in gray.

We next move toward forecasts over the following six months from each point in time. The results from this exercise are reported in Figure 5. The two graphs show for each point in time what expected inflation was six months from that particular point onwards. For example, the value for January 1931 measures expected inflation for July 1931 based on information available until January 1931. At first glance the plot seems to indicate that over longer horizons there was indeed an upward shift in inflation expectations starting in mid-1932. However, a comparison with expected inflation rates from the early 1930s shows that this is rather a reversal of expectations that the public already held, which was only disrupted by the abnormally large deflation period. This conclusion holds true for both inflation rates considered here, and both series are in fact very similar.[12]

As a last check, we have also computed forecasts for an entire year from each point in time onward; these results for which are shown in Figure 6. The pattern we observed for six months ahead expected inflation remains until mid-1932. What is striking about

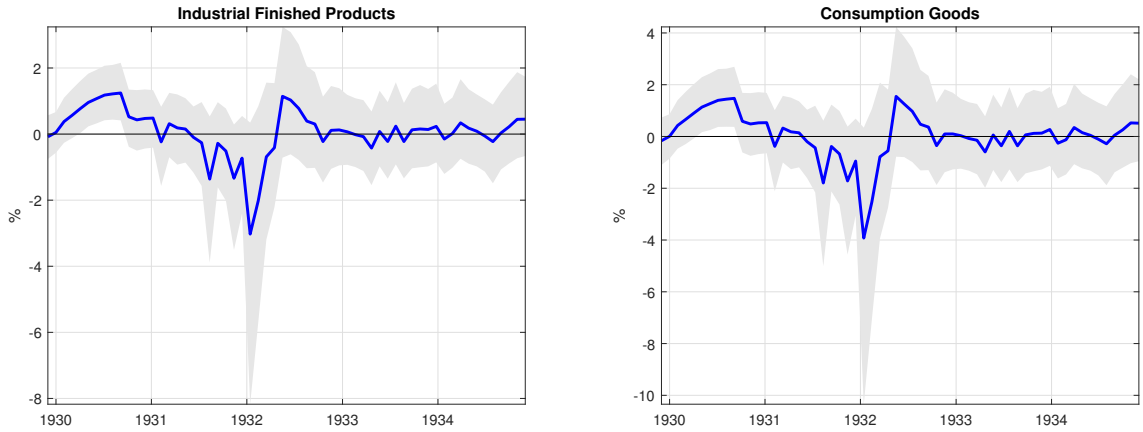
[12] We have also estimated forecasts for other price series in the dataset, with very similar results.

Figure 5: Six-months ahead forecasts



Notes: Medians of posterior distribution shown in blue, 95 % of the posterior probability mass in gray.

Figure 6: Twelve-months ahead forecasts



Notes: Medians of posterior distribution shown in blue, 95 % of the posterior probability mass in gray.

this figure, however, is the clear and quick convergence of expected inflation rates to zero toward the end of 1932. Essentially, there was nothing known to the public that would have indicated that positive inflation rates, if they were expected at all, would persist over time. Clearly, the opposite is the case during the early years of the decade, where

continued deflation impulses lead inflation expectations to be adjusted downward. This also suggests that the fact that inflation expectations are essentially zero towards the end of the sample period was to a large extent not driven by the stationarity assumption of the VAR model, which implies that over longer horizons the forecasts converge to the unconditional mean of the factors. If this were the case, we would also see zero expected inflation at the beginning of the sample.

Overall, the time series evidence shows little evidence of inflation expectations, with some occasional hint toward positive expected inflation at best. This is not surprising given that the slight increase in price levels once the economy had passed the economic trough paled in comparison to the preceding deflation episode.

4 Conclusion

Inflation expectations are regarded as a key factor in the recovery from the Great Depression in the United States. In Germany, no measures to increase inflation expectations were feasible given its experience with hyperinflation in 1923. However, Germans experienced a recovery as fast and as strong as in the U.S. Our article sheds light on the question of whether this remarkable recovery truly went along without inflation expectations. Or were there really inflation expectations in Germany?

To answer this question, we examined inflation expectations across two methods: We gathered new narrative evidence from the media account in Germany during the depression and then estimated inflation expectations using forecasts from an extensive dataset in a FAVAR model. Our finding is that there were no inflation expectations at the beginning of the recovery in Germany. Our quantitative forecasting results are inconclusive. The inflation forecasts show no indication for a clear shift to inflation expectations at any point between 1931 and 1933. However, we do observe an increase in

inflation expectations in 1932, a time of ongoing deflation. A detailed narrative study of media articles ruled out a regime change that was potentially undetected by our quantitative estimates. Newspaper article counts with respect to inflation reveal four spikes in the coverage, which could possibly point to inflationary news. Reading carefully, the narrative record reveals that whenever fears of inflation came up politicians denounced any price increasing policies and emphasized the unconditional (price) stability of the currency.

As Jalil and Rua (2016) have thoroughly traced the causes of the regime shift in the United States to inflation expectations in spring 1933, our study provides considerable narrative evidence that no such event occurred in Germany. The story of Temin and Wigmore (1990) and Eggertsson (2008) may hold for the U.S. For the German recovery, inflation expectations played no major role.

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A Appendix

A.1 Estimating inflation expectations using the Mishkin-method

Mishkin (1981) estimates inflation expectations from real rate forecasts. Here, we replicate Voth (1999), who applied the method to German data during the interwar period. Our specification is Voth's model 2 with the monthly money rate as interest rate, because this approach uses a dataset that comes close to our own data incorporated in the FAVAR forecasts.

Following Mishkin (1981), the expected real interest rate between periods $t-1$ and t is determined by the Fisher equation

$$r_t = i_t - \pi_t^e \tag{7}$$

That is, expected real interest rates are determined as the difference between the nominal interest rate between the periods i_t and expected inflation π_t^e. A similar relationship holds for realized real interest rates:

$$eprr_t = i_t - \pi_t \tag{8}$$

Mishkin's approach now supposes that a subset X_{t-1} of the available past information set available to agents at the time provides a good prediction of ex-ante real interest rates, so that we can write

$$r_t = \beta X_{t-1} + u_t \tag{9}$$

If we combine Equations (7) to (9) we arrive at the final regression equation

$$eprr_t = \beta X_{t-1} + u_t - \epsilon_t \tag{10}$$

where $\epsilon_t = \pi_t - \pi_t^e$. Rational expectations imply that this equation can be estimated by OLS. As in Voth's paper, we specify the independent variables as yearly changes: $\Delta x_t = Ln(\frac{x_t}{x_{t-12}})$, although we do not apply this transformation to the nominal rate. To make the series comparable to the interest rates, we multiply the yearly changes by 100. In the estimation, we employ lags of different length of the nominal monthly money rate, money supply and inflation.[13]

Table 2: Our replication of Voth's model 2 for the period until December 1930

	Dependent variable: monthly money		
Variable	Coefficient	std. Error	t
$i(-1)$	0.820	0.085	9.69
$\pi(-1)$	-1.193	0.038	-31.25
$\pi(-4)$	0.271	0.037	7.22
$m(-1)$	-0.017	0.044	-0.38
$m(-8)$	-.024	0.049	-0.51
C	1.654	0.681	2.43
Sample	1926/5-1930/12		
Observations	51		
R^2	0.986		

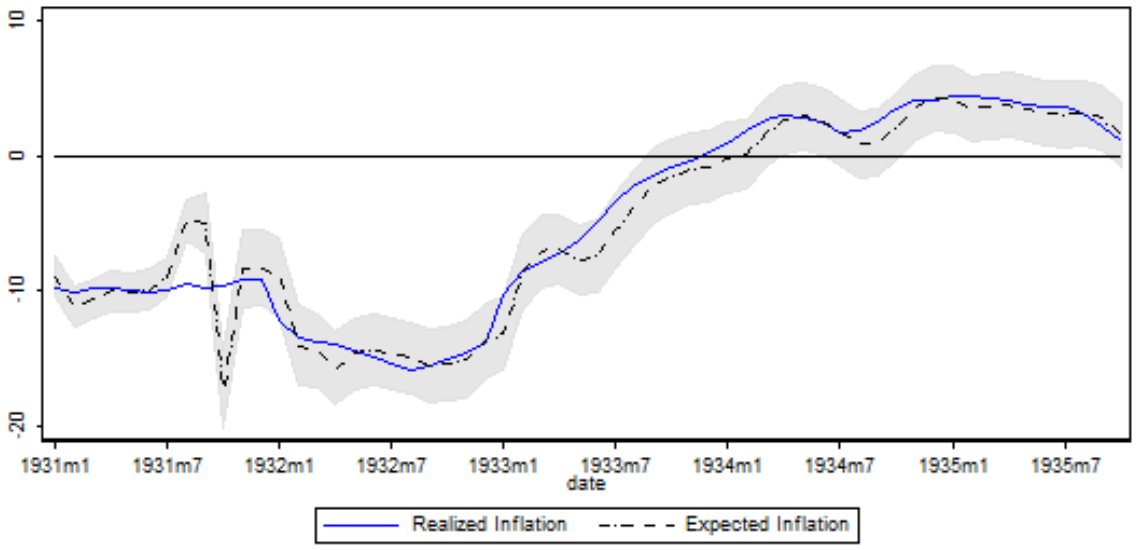
[13] We chose the following series as stated in Wagemann (1935): Monthly money rate: p.112 '15. Monatsgeld'. Money supply: p.130, '1. Geldumlauf insgesamt, Stand Monatsende'. Inflation (of industrial finished products): p.114 , '23. Industrielle Fertigwaren insgesamt'.

We estimate the following equation over the period 05/1926 to 12/1930 and then add recursively month by month until September 1935.

$$eprr_t = \beta_0 C + \beta_1 i_{t-1} + \beta_2 \pi_{t-1} + \beta_3 \pi_{t-4} + \beta_4 m_{t-1} + \beta_4 m_{t-8} + \epsilon_t \tag{11}$$

Our estimates, which we depict in Table 2, comes close to Voth's own estimation results for the first estimation period until December 1930.

Figure 7: *Expected and actual inflation*



Notes: Actual inflation on an annual basis from prices for industrial finished products. Expected inflation computed from plugging our real rate forecasts into the Fisher equation.

In Figure 7, we plot annual inflation and the series of inflation expectations computed from plugging our real rate forecasts into the Fisher equation. Our estimated inflation series moves closely with the realized inflation with the exception of the period between July and September 1931 during the German banking crisis. As in our FAVAR forecasts, we find no shift to inflation expectations at the start of the recovery around mid-1932. Inflation expectations start increasing in the second half of 1932 but only turn positive by late 1933. Voth's application of the Mishkin approach to German data therefore

seems to underscore our own results. There were no inflation expectations at the start of the recovery from the Great Depression. Further, Voth (1999) provides a possible explanation for the increasing inflation expectations indicated by our FAVAR forecasts in 1932. The inflation forecasts, particularly over a long time horizon, of close to zero percent could reflect the high uncertainty about future price developments during this period.

A.2 Price cuts under the presidential decree of December, 1931

The source for the drastic fall of prices in January 1932 indicated by our own time series evidence was due to one policy measure: the concerted and official reductions of prices, rents, wages and interest rates by the presidential decree of December 8, 1931. Since the timing and the expectations of the measure are important for our reasoning, we provide a detailed description leaning on news articles and the official legislative texts stated in the law gazette of the Reich (*'Reichsgesetzblatt'* = RGB).

The decree (*'Vierte Verordnung des Reichspräsidenten zur Sicherung von Wirtschaft und Finanzen und zum Schutze des inneren Friedens'*) stated that fixed prices had to be reduced by at least ten percent by January 1, 1932 compared to the prices on June 30, 1931. As fixed prices, the law defined prices of products for which prices where set by contractual agreements such as cartels or syndicates. The industries for which this was the case were iron and metal, construction, chemicals, paper, glassware, ceramics and textiles, as well as coal (RGB 1931, Nr. 79, 1. Teil, Kap. 1.1 §1(2) and §3).

The reductions were complemented by a commissioner for price control for which a second decree was issued on December 8. His task was to enforce the consumer price reductions and punish violations (see *'Verordnung über die Befugnisse des Reichskommissars für Preisüberwachung'*, RGB 1931, Nr. 80).

The price reductions were accompanied by reductions of rents by ten percent and

of wages by up to fifteen percent. The presidential decree also contained a section on interest rates. The nominal rates on a large number of bonds, obligations and debt instruments were reduced by a proportionate share between zero and up to 50 percent (see RGB 1931, Nr. 79, parts 1-3). To support the intended effects of the presidential decrees, the Reichsbank reduced the discount and Lombard rates on December 10, 1931.

The news media covered the presidential decree and its consequences in detail after the decree became published. Before its passage, exact measures were unknown. First mention of possible future price and wage cuts appeared on December 3. Nevertheless, on December 8, VZ reported of an 'emergency decree with surprises', as the decree had become the subject of last minute changes. After December 8, the measures were discussed in-depth and should thus be regarded as common knowledge in December 1932 and to take effect on January 1, 1932. The first price reductions in response to the decree were mentioned on December 18 (see VZ, LA and other newspapers 01.11.31-31.01.32).

A.3 Prior distribution

We specify the following prior for the parameters in each equation $i = 1, \ldots, N$ of (1):

$$\lambda_i \sim \mathcal{N}(\underline{M}, \underline{V})$$

$$\underline{M} = 0_{K \times 1}$$

$$\underline{V} = I_K$$

Next, the idiosyncratic variances follow

$$\sigma_i^2 \sim \mathcal{IG}\left(\frac{\alpha}{2}, \frac{\delta}{2}\right)$$

$$\alpha = 6$$

$$\delta = 0.001$$

These values are taken from Ritschl and Sarferaz (2014). For the VAR block of the model we set the natural conjugate Normal-Inverse Wishart prior as in Kadiyala and Karlsson (1997)

$$\Sigma \sim \mathcal{IW}\left(\underline{S}, K+2\right)$$

$$vec(B)|\Sigma \sim \mathcal{N}(vec(\underline{B}), \Sigma \otimes \underline{G})$$

The matrix $\underline{S}$ is the K-dimensional identity matrix. The diagonal elements of $\underline{G}$ are chosen such that the prior variance on the parameter of variable j in equation k at lag l is $p\frac{\sigma_k^2}{l\sigma_j^2}$, where $p = 0.05$. The prior covariance matrix of the VAR parameters is given by $\underline{S} \otimes \underline{G}$. The posterior distributions are shown in Appendix A.4. $\underline{B}$ is the $KL \times K$ matrix of prior VAR parameters, which has all zeros.

A.4 Estimation of the FAVAR model

We perform estimation using the following steps. First, we start with a sample that ends in December of 1929 and estimate the factor model on standardized data up to that point in time. After an initial burn-in period, we then estimate our forecasts for one, six, and twelve months according to Equations (5) and (6). We then expand the sample by one month and perform the sampler and regressions again. This is done until December of 1934. One could in principle estimate the factor model over the entire

sample once, but this creates the problem that when we sample the common factors the algorithm moves backwards through the sample and draws the factors based on their conditional distributions. This means that for each time period we use information that economic agents would not have known yet. Our procedure, instead, makes use only of available information when estimating the model.

For each run, we performed 50,000 iterations of the sampler, each time resetting the prior covariances in the VAR to account for the changing information available. We then discard the initial 30,000 draws and base the inference on the remaining draws. Our point estimates are then the medians of the posterior distributions at each point in time together with 95 % bands of the posterior probability mass. We use $L = 12$ in the estimation and $K = 3$ common factors for each run.

We start by drawing the idiosyncratic variances conditional on the data, factors, and loadings from the following distribution

$$\sigma_i^2 \sim \mathcal{IG}\left(\frac{T+\alpha}{2}, \frac{\epsilon_i'\epsilon_i + \delta}{2}\right)$$

where ϵ_i is the $T \times 1$ vector of residuals in equation i. Next, based on the drawn variances we sample the factor loadings from

$$\begin{aligned}
\lambda_i &\sim \mathcal{N}(\overline{M}, \overline{V}) \\
\overline{V} &= \left(\underline{V}^{-1} + \frac{1}{\sigma_i^2} f'f\right)^{-1} \\
\overline{M} &= \overline{V}\left(\underline{V}^{-1}\underline{M} + \frac{1}{\sigma_i^2} f'Y_i\right)
\end{aligned}$$

where f is $T \times K$ and Y_i is $T \times 1$. To sample the VAR block, we write the VAR as

$$F = XB + U$$

where F is the $(T-L)\times K$ matrix of common factors, X is the $(T-L)\times KL$ matrix of the lagged common factors that has the first lags of all factors in the first K columns, the second lags in the next K columns, and so on, and B is the $KL\times K$ matrix of coefficients. We then draw the VAR covariance matrix and the coefficients from

$$\Sigma \sim \mathcal{IW}(\overline{S}, T-L+K+2)$$
$$vec(B) \sim \mathcal{N}(vec(\overline{B}), \Sigma \otimes \overline{G})$$

where the matrices in these distributions are defined as

$$\overline{G} = \left(\underline{G}^{-1} + X'X\right)^{-1}$$
$$\overline{B} = \overline{G}\left(\underline{G}^{-1}\underline{B} + X'X\hat{B}\right)$$
$$\overline{S} = \underline{S} + \hat{B}'X'X\hat{B} + \underline{B}'\underline{G}^{-1}\underline{B} + \hat{U}'\hat{U} - \overline{B}'\left(\underline{G}^{-1} + X'X\right)\overline{B}$$

and variables with a hat denote OLS quantities.

Sampling the latent factors is based on the state space representation of the model. We write this as

$$Y_t = C + HF_t + \epsilon_t$$
$$F_t = \tilde{B}F_{t-1} + \tilde{v}_t$$
$$H = \begin{bmatrix}\Lambda & 0_{N\times K(L-1)}\end{bmatrix}$$

$\tilde{B}$ denotes the companion form matrix of the VAR, and $\tilde{v}_t$ are the original errors in the VAR, appended with zeros. To sample the common factors, we employ the Carter-Kohn algorithm. We first use the Kalman-Filter to produce estimates of the state vectors and then go backward in the sample; at each point we draw the common factors from the

corresponding normal distribution. The exact procedure is nicely explained in Kim and Nelson (1999).

A.5 Variables used to estimate the common factors

The following table lists all variables used to extract the common factors, together with transformations performed prior to estimation.

Variable	Code	SA	Transformation
Production and Employment			
Number of Uneymployed	II.B.20	1	1
Number of Recipients of Unemployment Benefits	II.B.21	1	1
Industrial Production	III.B.11	1	1
Productiongoods	III.B.12	1	1
Investmentgoods	III.B.13	1	1
Consumptiongoods, elastic demand	III.B.16	1	1
Consumptiongoods, inelastic demand	III.B.17	1	1
Fuels	III.B.18	1	1
Basic materials	III.B.19	1	1
Constructions	III.B.20	1	1
Iron	III.B.22	1	1
Construction Industry total	III.B.26	1	1
Coal	III.B.31	1	1
Gas	III.B.32	1	1
Electricity	III.B.33	1	1
Oil	III.B.35	1	1
Paper	III.B.36	1	1
Potassium	III.B.37	1	1
Textiles	III.B.39	1	1
Shoes	III.B.40	1	1
Household Porcelain	III.B.42	1	1
Orders of machinery within Germany	IV.4	1	1
Sales			
Foods	VI.A.2	1	1
Textiles and Clothing	VI.A.3	1	1
Furniture and Household Appliances	VI.A.4	1	1
Grocery stores	VI.A.7	1	1
Rural grocery stores	VI.A.8	1	1
Drugstores	VI.A.12	1	1
Men clothing	VI.A.14	1	1
Women clothing	VI.A.15	1	1
Shoes	VI.A.16	1	1
Furniture specialist shops	VI.A.19	1	1
Colonial products, central retailer cooperative	VI.B.25	1	1
Colonial products, local retailer cooperative	VI.B.26	1	1
Drugs, retailer cooperative	VI.B.27	1	1
Furniture, retailer cooperative	VI.B.28	1	1
Clocks, retailer cooperative	VI.B.29	1	1
Innkeeping, retailer cooperative	VI.B.30	1	1
Bakeries, central retailer cooperative	VI.B.31	1	1
Bakeries, local retailer cooperative	VI.B.32	1	1
Butchers, retailer cooperative	VI.B.33	1	1
Cutters, retailer cooperative	VI.B.34	1	1
Shoemakers, retailer cooperative	VI.B.35	1	1
Saddlers, retailer cooperative	VI.B.36	1	1
Painter, retailer cooperative	VI.B.37	1	1
Woodworking, retailer cooperative	VI.B.38	1	1
Metalworking, retailer cooperative	VI.B.39	1	1

Variable	Code	SA	Transformation
Imports			
Foods and Drinks	VII.B.a.5	1	2
Raw materials and semi-finished products	VII.B.a.6	1	2
Finished products	VII.B.a.7	1	2
Exports			
Foods and Drinks	VII.C.a.13	1	2
Raw materials and semi-finished products	VII.C.a.14	1	2
Finished products	VII.C.a.15	1	2
Prices			
Agricultural products	IX.B.3	1	1
Herbal foods	IX.B.4	1	1
Animals for slaughter	IX.B.5	1	1
Cattel products	IX.B.6	1	1
Animal feed	IX.B.7	1	1
Colonial products	IX.B.8	1	1
Industrial raw materials and semi-finished products	IX.B.9	1	1
Coal	IX.B.10	1	1
Iron	IX.B.11	1	1
Metal	IX.B.12	1	1
Textiles	IX.B.13	1	1
Leather	IX.B.14	1	1
Chemicals	IX.B.15	1	1
Artifical fertilizers	IX.B.16	1	1
Power oils and lubricants	IX.B.17	1	1
Rubber	IX.B.18	1	1
Paper	IX.B.19	1	1
Building materials	IX.B.20	1	1
Basic materials	IX.B.21	1	1
Industrial raw materials for exports	IX.B.22	1	1
Industrial finished goods	IX.B.23	1	1
Means of production	IX.B.24	1	1
Agricultural dead inventory	IX.B.25	1	1
Agricultural machinery	IX.B.26	1	1
Commercial facilities	IX.B.27	1	1
Commercial machinery	IX.B.28	1	1
Crafting materials	IX.B.29	1	1
Consumptiongoods	IX.B.30	1	1
Furniture	IX.B.31	1	1
Clothing and Shoes	IX.B.33	1	1
Nutrition	IX.C.36	1	1
Heating and Lighting	IX.C.38	1	1
Clothing for households	IX.C.39	1	1
Other	IX.C.40	1	1

Variable	Code	SA	Transformation
Nominal Interest Rates			
Reichsbank discount rate	X.A.a.1	0	0
Reichsbank lombard rate	X.A.a.2	0	0
Creditcosts	X.A.b.5	0	0
Daily due money	X.A.b.8	0	0
Daily money	X.A.c.14	0	0
Monthly deposits	X.A.c.15	0	0
Private discount rate	X.A.c.16	0	0
Goods of Exchange	X.A.c.17	0	0
Money and Banking			
Circulation of money	XIII.b.5	1	2
Circulation of notes (Reichsbank and private)	XIII.b.6	1	2
Circulation of Rentenbank notes	XIII.b.7	1	2
Circulation of coins	XIII.b.8	1	2
Billing traffic by the Reichsbank	XIII.c.9	1	2
Giro traffic by the Reichsbank	XIII.c.10	1	2
Post check traffic	XIII.c.12	1	2
Credit on post check accounts	XIII.c.13	1	2
Drawings of bills	XIII.c.16	1	2
Circulation of bills of exchange	XIV.A.3	1	2
Stock of gold and currency, Reichsbank	XIV.B.5	1	2
Investments, Reichsbank	XIV.B.6	1	2
Exchange loans, Reichsbank	XIV.B.7	1	2
Deposits, Reichsbank	XIV.B.8	1	2

Table 3: Variables used to estimate the common factors. 'Code' refers to the numeric codes from Wagemann (1935). 'SA' denotes whether series was seasonally adjusted (1) or not (0). 'Transformation' denotes whether a series entered in levels (0), transformed into 100 times first differences of logs (1), or converted into real terms using the cost of living index and then transformed into 100 times first differences of logs (2).