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The Role of Sentiment in the Economy: 1920 to 1934

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Abstract

This paper investigates the role of sentiment in the US macro economy from 1920 to 1934. We use 2.4 million digitized articles from the Wall St Journal to algorithmically derive a monthly sentiment index. A ten variable vector error correction model is then used to identify shocks to sentiment that are orthogonal to the fundamentals of the economy. We show that the identified "pure" sentiment shocks have economically significant effects on Industrial Production, the S&P500 stock index, money supply (M2), credit spreads, terms spreads, interest rates and prices. We are further able to delineate both the timing and strength of the shocks and their subsequent effects on the economy using historical decompositions. These suggest impacts of up to 9%.

JEL: D89, E32, E70, N1, N3

Keywords: Great Depression, General Theory, Algorithmic Text Analysis, Behavioural Economics

†An earlier version of this paper used different sentiment data. This version uses updated sentiment data. The authors would like to thank Charles Goodhart for valuable advice and suggestions and Jacob Turton for research assistance. Any errors are our own.

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1 Introduction

Did sentiment play a role in the 1920s boom and the 1930s depression, and if so, how did these sentiments behave? The US economy was dynamic but highly turbulent at the beginning of the twentieth century.[1] Dramatic growth expansions were accompanied by credit expansion and stock price surges, but also recurrent recessions. The 1920s economic and stock market boom and the Depression of the early 1930s, gave rise to a need for new ideas in economics to explain the events that had befallen the US and Global economy. In the US, numerous economists such as Benjamin Graham and David Dodd (Graham and Dodd, 1934) lamented the exuberance of the 1920s and the undervaluation of the US stock market in the market trough in 1932. Irving Fisher, in his insightful 1932 book 'Booms and Depressions' (Fisher, 1932), cited pessimism as one of the factors prolonging the slump. These new ideas about the role of human psychology in the economy were given greater credence following the publication of the 'General Theory of Employment, Interest and Money' (Keynes, 1936). The role of expectations that Keynes' new theory set out has been widely accepted. The role he attached to "animal spirits" (i.e. the role of human emotion in human cognition) has remained more controversial.[2]

The 1930s were thus a nascent period for new economic theories. They were set against the vivid backdrop of a US stock market that had fallen by 90% from 1929-1932 and a real economic depression that was comparable in size to the worst in prior US history dating as far back as the Articles of Association.

We hypothesise that newspaper articles of the time contain information related to the state of emotions or confidence of economic agents as well as factual information about the actual fundamentals of the economy.[3] The emotion or sentiment component may have independent effects on the economy that are unrelated to the fundamentals that they describe.[4] We call this sentiment. The large boom and bust cycle provides the ideal setting to test for the role of sentiment especially because this period is often cited as being influenced heavily by some form of optimism or exuberance related to the US economy and the Stock Market (see e.g. Galbraith, 1955) . De Long and Shleifer (1991), find evidence of potential deviations from rational behaviour in the pricing of financial assets by examining closed-end fund premia. White (1990) and Rappoport and White

[1]The NBER measures ten recessions from 1899-1933.

[2]We interpret Keynes (1936) reference to"animal spirits" not as irrational changes in expectations of future economic conditions but rather "human psychology...states of mind...emotions unrelated to fundamentals".

[3]We are motivated by a number of new empirically backed theories developing in sociology, economics, anthropology, psychology and neuroscience, which suggest that narrative and emotion can be conceived to combine with cognitive and calculative skills to facilitate economic action (For example, Bruner, 1990; Damasio, 1999; Berezin, 2005; Lane and Maxfield, 2005; Mar and Oatley, 2008; Akerlof and Shiller, 2009; Bandelj, 2009; Berezin, 2009; Pixley, 2009; Beckert, 2011; Tuckett, 2011; Barbalet, 2014).

[4]We hypothesize that fundamentals (i.e. data about economic fundamentals) are known via frames or narratives (Tuckett and Nikolic, 2017).

(1993) suggest that an overvaluation of stocks of a significant size occurred from 1927-9. Other studies find a potentially overvalued and then undervalued stock market, for this period (Shiller, 1981, 2000).[5] While the focus of attention has been on the stock market, we investigate the major components of the macro economy.

To investigate our hypothesis, we utilize a computer algorithm to conduct large-scale text analysis of digitized newspaper articles that measure the emotional word content in economic and financial narratives from over 2.4 million articles in The Wall St. Journal (WSJ) from 1889-1934. We construct a sentiment metric following Nyman et al. (2018) and apply it to our databases of news articles. We use our algorithm, which counts sentiment-indicating or, 'emotionally laden' words to produce an index for the WSJ from 1889-1934. The results are illustrated in Figure 1 from 1905-1934.[6] Our index measures the balance between two emotion groups that are broadly analogous to excitement (approach) and anxiety (avoidance) in text data, using a lexicon of approximately 150 words for each category utilizing ordinary English words[7] associated with these two major groups. Having carefully treated the articles to remove all adverts, legal notices and theatre reviews, we calculate the difference between word counts from each word group normalized by the total word count per month to derive our index at a monthly frequency. We additionally produce a sentiment index using digitized articles from the New York Times (NYT) in the same way as the WSJ.

Some notable points in US economic history are clearly visible in Figure 1 and consistent with accounts of these periods. For example, the 1907/8 trough around the time of the financial crisis, the sharp drop around the recession of 1913 and the outbreak of the First World War in 1914. A major slide from 1929 through to 1934, at the deepest point of the Great Depression and encompassing the Bank Holiday and revaluation of the Dollar can also be seen.

Having derived our indexes, we then carefully construct a database of the macro economy of the period from 1920-1934 at a monthly frequency. To perform the empirical investigation, we first utilize a 10 variable vector error correction (VEC) model to recover the orthogonalized effects of our sentiment index on the real economy and financial markets. This model includes variables to control for inflation expectations and credit distress and uses a NYT based sentiment index to filter out general news shocks.

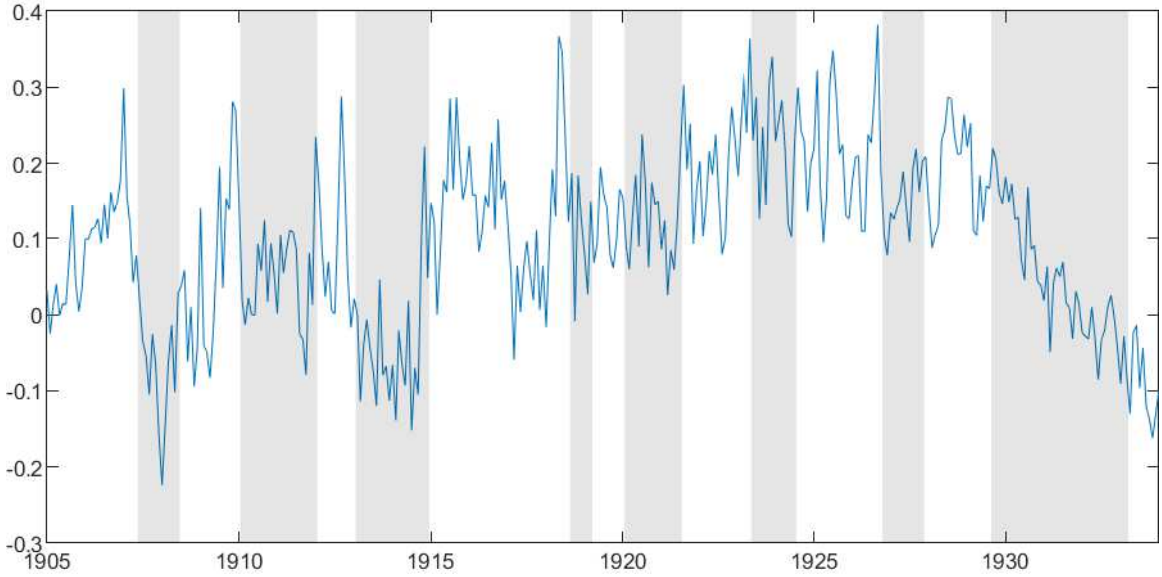
We are subsequently able to analyse and interpret episodes where structural shocks to our VEC model are at their most intense and refer back to the actual news articles driving

[5]Quantitative studies of the US stock market of the period point to non-fundamental factors as playing a significant role. Shiller (1981, 2000) uses a backward looking dividend discount model to identify large over and underpricing of the US Stock market in the 1920s and 30s, given the highly stable and growing collective dividend stream of US stocks.

[6]We use data starting from 1905 as the data are more sparse in the early periods. The Wall St Journal consisted of only four pages of text in its first edition in 1889, which marks the start of the database.

[7]Using a British English lexicon.

Figure 1: Index of Sentiment for the Wall Street Journal (1905 – 1934)



Shaded regions are NBER recessions

these effects. We do this by scoring each article individually for its net level of positive or negative sentiment words. We then perform historical decompositions utilising this model to illustrate clearly the impact of these structural shocks on all of the macroeconomic and financial variables. This method allows us to compare the counterfactual path of the economy with and without the impact of sentiment shocks.

We then conduct a series of robustness tests using different sentiment dictionaries on the WSJ and NYT data, namely Loughran and McDonald (2011)[8] and Harvard IV-4 (2020)[9]. These alternative sentiment indexes are added into our VEC models in addition to our index and separately, to ensure that our lexicon of words are not replicating these effects.

The results show our sentiment index has robust and economically meaningful independent effects on the real economy. We illustrate the timing and intensity of these effects for the money supply (M2), the S&P 500 stock market index, industrial production, prices, interest rates, credit spreads and term spreads. The impacts are large, reaching up to 9% for industrial production and the S&P 500 in specific time periods. Analysis of the sentiment levels in the news articles that create the structural shocks and their subsequent impacts on the economy, illustrate the potential sources of the shocks. As our extensive method isolates sentiment from the news, we interpret the results as demonstrating that sentiment changes are independent drivers of the macro economy and financial markets in this period.

[8]Loughran and McDonald (2011) use an unbalanced series of 2355 positive and 354 negative words in their sentiment lexicon.

[9]Harvard IV-4 (2020) has 2291 negative and 1915 positive words in its sentiment lexicon.

We proceed as follows; Section 2 reviews the literature. Section 3 describes the WSJ article data and macroeconomic data, and the method for constructing the sentiment index. Section 4 sets out the econometric method and the results of the empirical investigation of the effect of sentiment on the economy. In Section 5 we use historical decompositions of sub-periods to investigate the impact of sentiment on the economy while in Section 6 we report our summary and conclusions.

2 Literature Review

In both the finance and economics literature, research analysing text using a dictionary approach to search for words with positive and negative emotional content[10] has emerged (see, for example Tetlock, 2007). Dominguez and Shapiro (2013) analyse newspaper and media sources to detect narrative shifts that could account for the slowness of the economic recovery. Soo (2016) quantifies the positive and negative tone of housing news in local newspaper articles about the US housing market, to isolate the roles of sentiment and fundamentals. Other research uses the analysis of news media or other digital sources to derive information about future expectations and behaviour (Ramey and Shapiro, 1999; Romer and Romer, 2010; Choi and Varian, 2012; Dominguez and Shapiro, 2013; Haddow et al., 2013).

Recent work focused specifically on the period in question have also borne fruit. Jalil and Rua (2016) use the historical narrative record from newspapers to determine whether inflation expectations shifted during the second quarter of 1933 as the recovery from the Great Depression took hold. Their results indicate that the shift in inflation expectations played a causal role in stimulating the recovery. Mathy and Ziebarth (2017) measure the effect of political uncertainty on economic outcomes using the case of Huey Long's tenure as governor and senator of Louisiana during the Great Depression. Based on primary sources they construct stock volatility indexes and newspaper mentions of terms related to "uncertainty" and the economy. Combined with employment data from the Census of Manufactures they suggest the effects of political uncertainty in Louisiana did not have a marked effect on the economy.

Manela and Moreira (2017) use the title and abstract of front-page news articles from The Wall St Journal from 1896 to 2009 and an algorithm trained on words associated with a modern indicator of stock market volatility (VIX). They reconstruct a News Implied Volatility or 'NVIX' time series back to 1896. They show that NVIX predicts future stock returns and conclude that NVIX captures time-varying risk premia. Garcia (2013) measures the balance of positive and negative sentiment words in two daily financial news columns of The New York Times over the 20th Century, finding generally small but

[10]The technical term in the Psychology literature is 'valence'.

heightened predictive effects on stock returns during recessions. Baker, Bloom and Davis (2016) focus on the macro economy and describe a method to construct an 'Economic Policy Uncertainty' (EPU) index, based on analysing the frequency of the words related to government policy and 'uncertainty' in numerous digitized newspaper articles from several different sources. Using a VAR model, they show that their index of uncertainty has an independent effect on the macro-economy from 1920-84.

The literature described above has made headway towards explaining the influence of news-based sentiment and expectations data. We contribute to the literature in a number of ways. Firstly, this period is often cited as being influenced heavily by some form of non-fundamental optimism or exuberance related to the US economy and the Stock Market. While the focus of attention in prior studies has been the stock market, we investigate the major components of the macro economy including the financial side, simultaneously. We find that there are definite impacts on the macro economy and financial markets and therefore highlight the role of sentiment across the economy.

Secondly, our method employs digitized data for historical time periods using very large databases of news and establishing further their use in historical finance and macroeconomics. We further show that our novel sentiment index contains different information to existing state of the art sentiment lexicons and provide a method that can be applied to other historical databases.

Thirdly, our approach complements the work of Baker, Bloom and Davis (2016) as we are able to investigate factors specifically related to emotion or confidence orthogonal to uncertainty around economic policy effects. In the same way, we also complement the work of Bernanke (1983) to show how such effects occur distinct from credit frictions.

Fourth, by using data at the monthly frequency, we are able to provide clearer understanding of the nature and timing of sentiment shocks and the intensity and timing of the reactions of major subcomponents of the economy. Furthermore, we can isolate the actual news articles that were responsible for the shocks, a method which can help refine future analyses. We are, to our knowledge, the first to attempt such an exercise for the period.

Most importantly, we are able to address the question of the underlying nature of sentiment shocks themselves. We show that some cases of sentiment shocks can be plausibly seen as being fundamentals based, either based on fundamentals from outside the system (news from Europe, for example) or based on sentiment about future expectations (worries about the effect of paying out the Soldiers' Bonus, for example). At other times we can identify shocks that do not have a clear attachment to specific fundamentals.

In other words, incorporating sentiment information from news articles allows us to incorporate information on variables that 1) may not be available or 2) may not be measurable, into our econometric model to better explain historically important events.

What is important in our approach is the extensive method used to measure sentiment shocks and their effects, which are not capturing the news itself but rather the sentiment changes of economic agents.

These innovations enhance the current literature on the role of sentiment in business cycles generally and specifically for this period.

3 Construction of Sentiment Index

The analysis is based on the ProQuest digital archive of The Wall St. Journal (WSJ). The WSJ ProQuest archives consist of individual articles published between 1889 and 1934, which have been digitized and converted to an XML format that is machine-readable. This format allows them to be 'read' by a computer algorithm. In total we analyse 2.4 million articles to give a rich dataset of words for our algorithm to read. We also use the ProQuest digital archive of the NYT from 1888 to 1936 with some 8.4 million articles. We focus on the period 1920-1933.[11]

We filter both databases by removing non-relevant articles. These articles deal with subjects such as theatre reviews, legal notices, classified advertisements and display advertisements. The identification method is common to both databases as they are formatted in the same way.

We measure sentiment as a summary statistic of words in news articles related to the two emotion groups. For each of the two groups, we use a word list or, lexicon that consists of about 150 words.[12] We use a 'bag of words' technique and tokenize the articles to be able to match the words in each word list with the words in each article.

For the summary statistic of a collection of texts, we count the frequency of excitement/ approach words ($Approach_t$) and anxiety/avoidance words ($Avoidance_t$) and then scale these numbers by the total number of words per period (N_t). To arrive at a single statistic, we subtract the avoidance statistic from the approach statistic as in equation (1). Data are collected at daily frequency but collated at the monthly frequency to ensure a higher signal to noise ratio.[13] The sentiment index is calculated using

$$Sent_t = \frac{|Approach_t| - |Avoidance_t|}{N_t}. \tag{1}$$

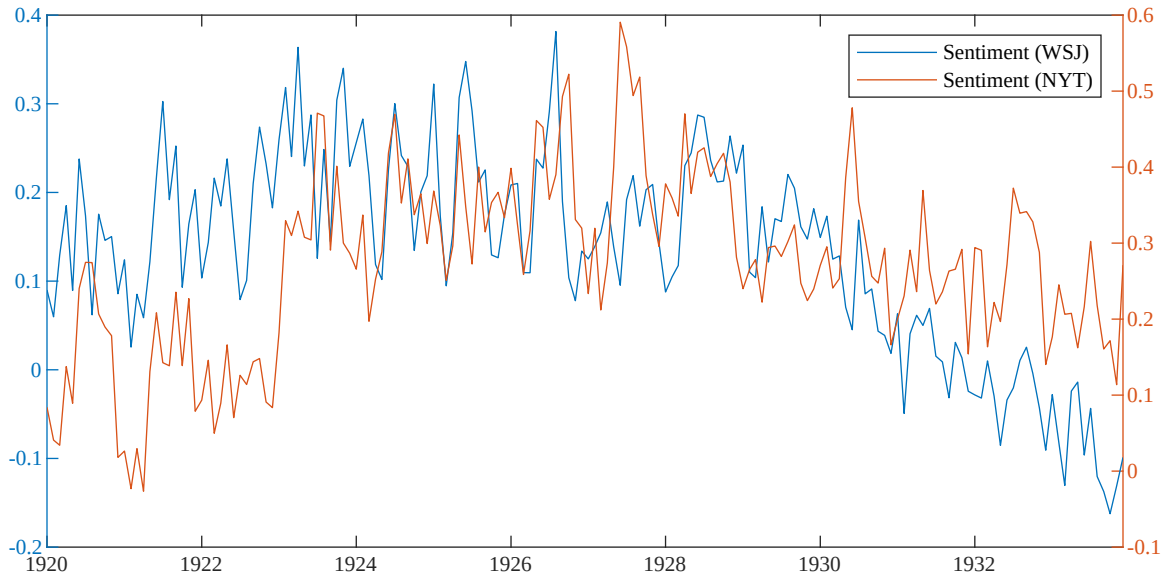
Of the average 2.5 million words per month in the WSJ in the period we investigate from 1920 -1933, there are an average of 22,030 emotion words, or just 0.86 % that display

[11] Over the sample we use for 1920-1933 this equates to 2.5 million words per month for the WSJ and 10 million words per month for the NYT.

[12] **Approach/excitement** words include 'attract', 'encouraging', 'excels', 'excited', 'ideal', 'impress', 'impressively', 'incredible'and **Anxiety/avoidance** words include 'jitters', 'terrors', 'worries', 'threatening', 'distrusted', 'panics', 'jeopardized' and 'eroding'.

[13] We use code written in *Python*

Figure 2: Comparison of Sentiment constructed from Wall Street Journal and New York Times.



the emotional words in our lexicon.[14] [15]

The WSJ is one source of financial information that agents used during this period.[16] An alternative source of information that agents read during this period was the NYT. The NYT, however, reports on events other than business and the financial markets, whereas the WSJ is a more specialized publication. Using equation (1), we construct a sentiment series based on articles from the NYT in addition to the sentiment series constructed from the WSJ. A priori, there is no expectation that the two sentiment series would contain the same information and in our analyses, reported below, we include both series. The sentiment series constructed from both the WSJ and the NYT are reported in Figure 2. It is clear from inspection of the figure that the information obtained from the WSJ is different from the information obtained from the NYT . In particular, the sentiment obtained from the WSJ declines at a faster rate than the NYT from 1928 to 1932.

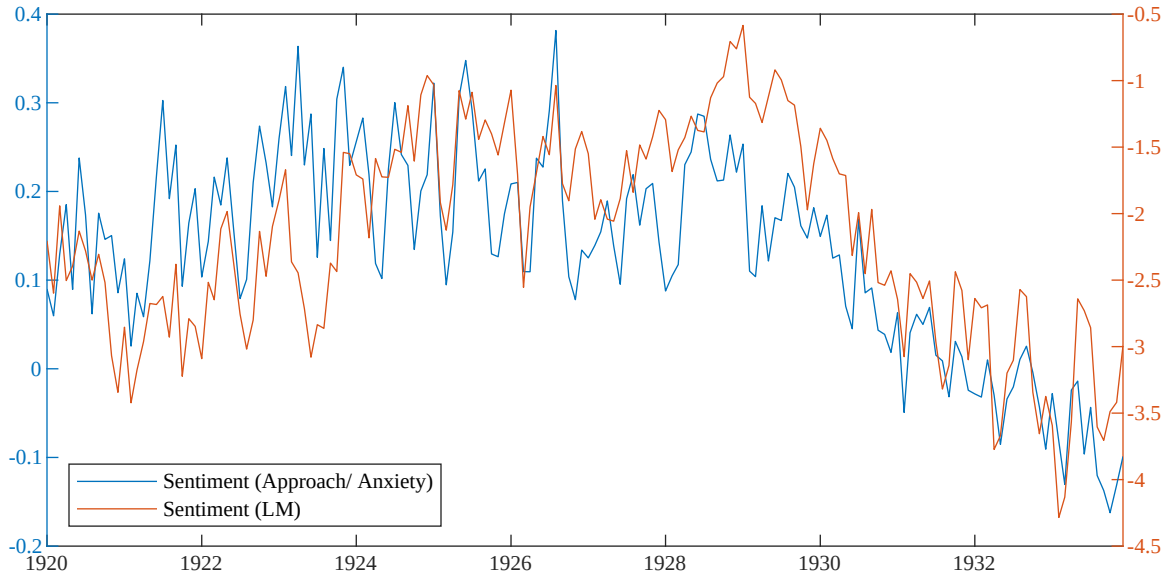
It should be noted that there are other approaches to measure sentiment. A notable

[14] One issue that may lessen the accuracy of our algorithm is that the modern lexicon we use may not match the historical lexicon. Although this effect should be negated by the fact that we use two counterbalancing sub-indices which would be equally affected and hence net out this effect, (Manela and Moreira, 2017) also illustrate that modern lexicons can be used to accurately measure 'news implied volatility- NVIX' back to before 1889.

[15] As a robustness check of the WSJ data, we utilize the data available from the Federal Reserve Bank of St Louis - FRED database, which contains digitized articles for the Commercial and Financial Chronicle - a popular weekly financial news source based in New York. The correlation between the CFC and WSJ from 1907-1934 is 0.74 indicating that we are using a sentiment index that captures consistent information on the economy and financial markets that is not specific to the WSJ.

[16] The WSJ had an estimated 7,000 readers in 1902 climbing to 50,000 by the end of the 1920s and can be seen as a good source of information for financial market and business professionals, rather than a general readership (Rosenberg, 1982).

Figure 3: Comparison of Sentiment from WSJ with Alternative Loughran and McDonald (2011) Series



approach is that of Loughran and McDonald (2011). This index has been used widely as a benchmark and as a way of measuring sentiment in financial news text analysis, most recently in Calomiris and Mamayasky (2019). This index uses a very broad range of words in its lexicon of positive and negative words and comprises 2355 negative and 354 positive words. This lexicon, although tailored to financial text, does not have a balanced number of words and may unwittingly amplify negative sentiment. Further, it does not have any particular theory of deeper meaning behind the words.

As a robustness check we also construct a sentiment series using the dictionary of words from Loughran and McDonald (2011) (LM). Figure 3 depicts the sentiment series that is constructed using the approach/avoidance lexicon and the sentiment series constructed using the dictionary of words from (LM). While the two series depicted show similar patterns, there are some noticeable differences. Once noticeable difference is that the underlying trend in the sentiment that we construct turns negative earlier in 1928 than the underlying trend in the sentiment series constructed using the dictionary of words from LM.

4 Identification of the Impact of Sentiment on the Economy

In order to determine the impact of sentiment on the real economy a vector error correction model is estimated that contains the following variables: the (natural) logarithm of industrial production (IP), the logarithm of the Standard and Poor's 500 stock market

index (SP), the logarithm of the money supply ($M2$), the logarithm of the price level (CPI), the nominal interest rate (R) , the term spread (R^S) (a measure of inflation expectations), the quality spread (QS) (a measure of the strength of preferences for safe assets), a measure of economic policy uncertainty (EPU), and our measures of sentiment (S^{NYT} and S^{WSJ}). The variables are ordered as above so that we can determine the impact that sentiment has on the economy after controlling for a large number of economic variables.

Our macro economic data are; the Industrial production (IP)- Federal Reserve Bank of St. Louis -FRED Database[17], Standard and Poors' 500 stock market index(SP)(Shiller, 2000)[18], Money supply ($M2$) (Friedman and Schwartz, 1971), the consumer price index (CPI), the nominal interest rate (R) (the 3-month interest rate (Cecchetti, 1992), the term spread (R^S) (the spread between the 10 year rate and the 3 month rate), the quality spread (QS) (Bernanke, 1983)[19] and a measure of economic policy uncertainty (EPU) – (Baker, Bloom and Davis, 2016). Time series for these data are depicted in Figure 4 together with the constructed sentiment data from the WSJ and the NYT.

There are two sources of news that we use. The WSJ is a more focused business and finance news source, while the NYT is a much broader new source. Our main aim is to investigate the information content of news from the WSJ as this news is focused on business, finance, and the economy. We include the information gathered from the New York Times as well to control for general news, as this paper had a larger circulation during this time. Circulation from Dec 1928 was 429,537.[20]

An orthogonalized decomposition is used to identify orthogonal shocks as follows: the first shock is a shock to industrial production (IP). The second identified shock is a shock to the S&P 500 stock market index that is orthogonal to the shock to industrial production. The third shock is a shock to the money supply (M2) that is orthogonal to both the industrial production shock and the S&P 500 stock market index shock. Next is a shock to nominal prices that is orthogonal to the industrial production, S&P 500 stock market index, and money supply shocks. The fifth shock is a shock to short-term interest rates, again orthogonal to all previous shocks in the system. The next three variables deal with measures of uncertainty. These variables are the term spread, reflecting inflation expectations, the quality spread, used by Bernanke (1983), economic policy uncertainty from Baker, Bloom and Davis (2016). We have not utilized any structural restrictions in

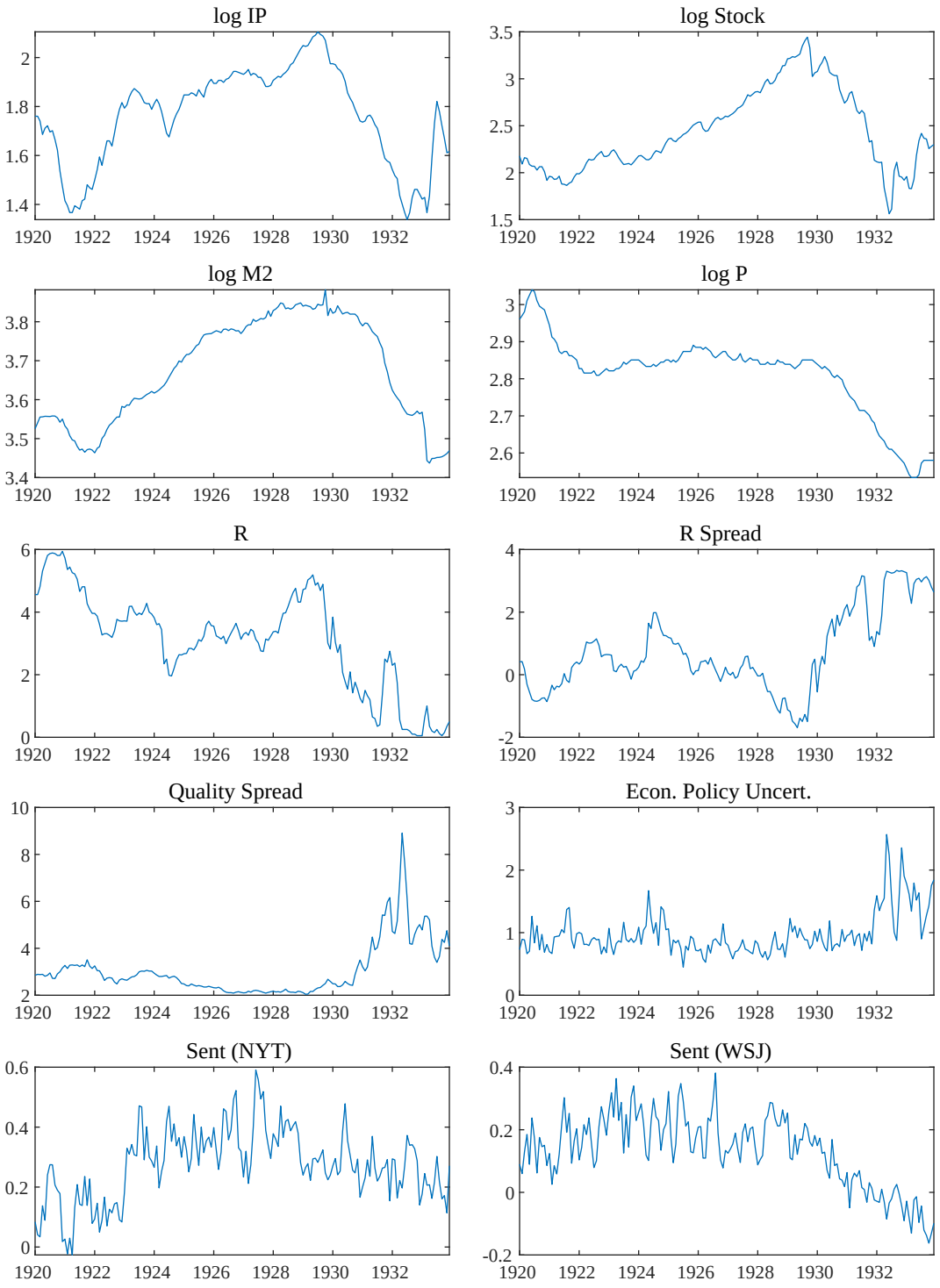
[17] https://fred.stlouisfed.org/series/INDPRO

[18] http://www.econ.yale.edu/ shiller/data.htm - These data are based on Cowles (1938) indexes of US stock prices for 59 industrial groups. The data was first accessed in 2017.

[19] The Quality Spread is the spread between Moody's seasoned Baa corporate bond yield less the long-term (over 10 years) Treasury composite yield. This quality spread is "an indicator of he strength of lender preferences for safe, liquid assets (and hence of the difficulty of risky borrowers in obtaining funds) ..." (Bernanke, 1983, p. 266)

[20] "Circulation. Gains in December," New York Times. Jan 24, 1929: 21

Figure 4: Data Used in Analysis (1919 – 1934)



this model so we cannot interpret the identified shocks as, for example, aggregate supply an demand shocks, money supply and money demand shocks, but the shocks that we identify certainly contain aspects of these shocks.

Finally, we have the two sentiment measures. We order the sentiment variable obtained from the NYT before the sentiment variable obtained from the WSJ. This means that the identified shock to sentiment that comes from the WSJ, is orthogonal to all other variables. It is the shock to sentiment after taking into account all the other variables including general news contained in the NYT . It is interpreted as the shock to sentiment controlling for shocks to industrial production, the S&P 500 stock market index, the money supply (M2), the price level, the nominal interest rate, the quality spread, and economic policy uncertainty. In this sense we interpret the shock to sentiment as a "pure" business sentiment shock that is orthogonal to the other shocks in the system.

The identified business-sentiment shock potentially encompasses many factors. It would include information on variables that are not included in the VECM system. For example, factual news and related sentiment about economic conditions in Europe or Canada would be captured by this shock. The business-sentiment shock would also include information about expectations of future events that were not fully captured (or priced) by the stock market. More importantly, it would reflect economic agents changing perceptions (or sentiment) about news.

The identified business-sentiment shock is ordered last in our system. In this approach we make it as hard as possible for our sentiment variable to have an impact of the system. We will see that this sentiment shock from the WSJ has a sizeable impact on the variables in the model. Our interpretation is that the sentiment obtained from the WSJ reflects perceptions decision makers have about current news and as such reflects business-sentiment that is not contained in the other variables of our model.[21]

In what follows we summarize the econometric tests we perform on the data to build the model that will be used to perform our analysis. We first test each series for the presence of a unit root. In Table 1 the unit root tests are reported using the standard augmented Dickey-Fuller (ADF) tests. [22]

All time series contain unit roots and so we first check for cointegration using the Johansen cointegration test. A vector auto regression in levels was estimated and information criteria were calculated for lags of 1 through 8. The optimal number of lags in the level vector autoregression was found to be equal to 2 when using the Schwarz Bayesian information criterion (BIC) and when using Akaike's information criterion (AIC). The number of lags chosen by AIC was chosen in order to be conservative. This led to 1 lag of first differences being chosen for the Johansen cointegrating regression.

Table 2 contains the results of the cointegration test with 1 lag (Johansen, 1988). There is evidence at the 5% level of four cointegrating relationships. That is, we will

[21]Our sentiment index can be seen as a measure of the psychology or states of mind of agents and we do not make any inferences about the rationality or irrationality of these sentiments.

[22]The modified ADF tests of Elliot, Rothenberg and Stock (1996) (ADF-GLS) also yield the same results.

Table 1: Unit Root Tests for Full Sample (1919 – 1934)

Variable	Deterministic Term	Test Statistic	5% Critical Val.	Result
$\log IP(ip)$	Trend + constant	-1.85	-3.44	Unit Root
$\log SP(sp)$	Trend + constant	-1.24	-3.44	Unit Root
$\log M2(m2)$	Trend + constant	0.05	-3.44	Unit Root
$\log P(p)$	Constant	-0.03	-2.88	Unit Root
R	Constant	-0.99	-2.88	Unit Root
R^S	Constant	-1.28	-2.88	Unit Root
QS	Constant	-1.14	-2.88	Unit Root
EPU	Constant	-2.15	-2.88	Unit Root
S^{NYT}	Constant	-1.79	-2.88	Unit Root
S^{WSJ}	Constant	-0.52	-2.88	Unit Root

Table 2: Cointegration Test Results: Rank Test

No. of Coint. relationships in Null	Eigenvalue	Test Statistic	5% Critical Value	p-value
None	0.431	93.53	64.50	0.00
At most 1	0.301	59.47	58.43	0.04
At most 2	0.265	51.20	52.36	0.066
At most 3	0.259	49.80	46.23	0.02
At most 4	0.200	37.02	40.08	0.11
At most 5	0.129	22.89	33.88	0.54
At most 6	0.111	19.46	27.58	0.38
At most 7	0.069	11.95	21.13	0.55
At most 8	0.029	4.94	14.26	0.75
At most 9	0.000	0.07	3.84	0.79

estimate a vector error correction model (VECM) with four cointegrating relationships.

Table 3 reports the information criteria (BIC and AIC) for a VEC model with four cointegrating relationships included. Both information criteria suggest that one lag of the first differences is appropriate to include in the VEC model. Thus, a VEC model with four cointegrating relationships and one lag is estimated.

Table 3: Lag Length Determination for VEC model with 4 CI Relationships

Lags	BIC	AIC
1	-26.97*	-30.53*
2	-24.54	-29.99
3	-22.59	-29.96
4	-20.89	-30.19

4.1 Estimation of VEC Model for the period of March 1920 to December 1933

In this section, the VEC model is estimated for the sample period of March 1920 to December 1933. The time series that are included in the model are industrial production (IP), the S&P 500 stock market index (SP), money supply ($M2$), the price level (P), the three-month short-term nominal interest rate (R), the term spread (R^S), the quality spread (QS), economic policy uncertainty (EPU), and our measures of sentiment (S^{NYT} and S^{WSJ}). The time series are ordered as listed above so that the identified (orthogonalized) sentiment shock, obtained from the WSJ, is interpreted as the "pure" "business" sentiment shock after controlling for shocks to industrial production, the S&P 500 stock market index, money supply (M2), price level, interest rate, the term spread, the quality spread, economic policy uncertainty, and general news. The interpretation of the sentiment shock is that it is the residual shock to business sentiment that is not due to the previous "fundamental" shocks from the economy.

All cointegrating relationships include a constant to allow for trends in the level of the data and a non-zero constant in the cointegrating relationship. The estimated cointegrating relationships are

$$\begin{aligned}\log(IP_t) = 35.72 &- \underset{(0.06)}{0.48}\log(R_t) - \underset{(0.07)}{0.51}\log\left(R_t^S\right) + \underset{(0.04)}{0.07}QS_t - \underset{(0.12)}{0.24}EPU_t \\ &- \underset{(0.28)}{1.30}S_t^{NYT} + \underset{(0.35)}{2.08}S_t^{WSJ} + Z_t^{IP},\end{aligned} \tag{2}$$

$$\log(SP_t) = 10.82 - 1.81\log(R_t) - 1.40\log\left(R_t^S\right) - 0.57QS_t + 0.91EPU_t$$
$$\qquad\qquad (0.37) \qquad\quad (0.44) \qquad\quad (0.73) \qquad (0.73)$$
$$- 10.25S_t^{NYT} + 13.83S_t^{WSJ} + Z_t^{SP}, \tag{3}$$
$$(1.72) \qquad (2.19)$$

$$\log(M2_t) = 5.52 - 0.41\log(R_t) - 0.28\log\left(R_t^S\right) - 0.11QS_t - 0.03EPU_t$$
$$\qquad\qquad (0.09) \qquad\quad (0.11) \qquad\quad (0.06) \qquad (0.18)$$
$$- 1.74S_t^{NYT} + 3.42S_t^{WSJ} + Z_t^{IP}, \tag{4}$$
$$(0.43) \qquad (0.54)$$

and

$$\log(P_t) = 2.77 + 0.09\log(R_t) + 0.12\log\left(R_t^S\right) - 0.08QS_t - 0.03EPU_t$$
$$\qquad\qquad (0.03) \qquad\quad (0.03) \qquad\quad (0.02) \qquad (0.05)$$
$$- 0.05S_t^{NYT} + 0.42S_t^{WSJ} + Z_t^{IP}. \tag{5}$$
$$(0.12) \qquad (0.16)$$

The cointegrating relationships given in equations (2) – (5) are long-run equilibrium relationships. The sentiment series obtained from the WSJ enters into all relationships in a statistically significant and positive way on industrial production, the S&P 500 stock market index, money supply (M2), and prices. Table 5 of the Appendix reports the estimation results for the VEC with one lag and four cointegrating vectors.

The coefficients on the other variables in the cointegrating equations, for the most part, make sense. For example, an increase in the short term interest rate has a significant and negative effect on industrial production, the S&P 500 stock market index, and money supply (M2). One interesting set of results pertains to the signs of the coefficients on the sentiment series obtained from the NYT. In the cointegrating relationships reported in (2) – (5) the coefficient on S^{NYT} is negative and significant. However, this result only occurs when both sentiment obtained from the WSJ and sentiment obtained from the NYT are included together. When sentiment from the WSJ is included by itself (in a 9 variable VECM) the coefficient on S^{WSJ} is significant and positive. When sentiment from the NYT is included by itself (in a 9 variable VECM) the coefficient on S^{NYT} is also significant

and positive. When S^{WSJ} is included by itself the overall results are very similar to the results we report here for the 10 variable VECM with both S^{NYT} and S^{WSJ} included. The contribution the sentiment shock makes to each forecast error variance decomposition is slightly higher in the 9 variable VECM and the impulse response functions are almost identical. However, when S^{NYT} is included by itself, the sentiment shock has almost no impact on the forecast error variance decompositions and the impulse response functions for the sentiment shock are all insignificant. It is clear that the sentiment series obtained from the WSJ contains different information from the sentiment series obtained from the NYT. It is also clear that the sentiment shock coming from the WSJ has statistically and economically significant impacts on the variables in our model. This is not the case for the sentiment shock obtained from the NYT. Including the sentiment series from the NYT into the VECM has a small mitigating effect on the impact that the WSJ sentiment shock has on the system in terms of the forecast error variance decompositions. We included the sentiment series from the NYT in order to control for "general" news. Given that the two series are correlated (the contemporaneous correlation between S^{WSJ} and S^{NYT} is approximately 0.3) the negative coefficient on in the cointegrating relationships suggests that there is a mitigating effect of including sentiment from the NYT in the long-run relationship as well.[23] Our conjecture for why S^{WSJ} impacts the variables of our model while S^{NYT} does not is that forward-looking articles, that is articles that discuss future events or future ramifications of current events appear to be more frequent in the WSJ compared to the NYT. The sentiment series constructed from the WSJ is not correlated with past values of the sentiment series constructed from the NYT but is correlated with future values of the sentiment series constructed from the NYT.[24]

Orthogonalized shocks are identified by taking the Cholesky factor of the residual covariance matrix. In order to determine the impact each identified shock has on the eight time series in the model we report the forecast error variance decomposition. These are reported in Table and Table 6 of the Appendix. The WSJ sentiment shock, is the shock to business news sentiment that is orthogonal to the shocks to industrial production, the S&P 500 stock market index, money supply (M2), the price level, the nominal short-term interest rate, the term spread, the quality spread, economic policy uncertainty, and the general news shock.

The business sentiment shock contributes as much as 10% towards the forecast error variance of industrial production with the peak occurring at a lag of ten periods. This is in contrast to the general news shock which has a lower impact of around 7% occurring at a much longer lag. Other variables that business sentiment impacts are the money

[23]Note that the coefficients on S^{NYT} are always smaller in magnitude than the coefficients on in the cointegrating relationships.

[24]The correlation between S^{WSJ} and S^{NYT}_{t-k} is less than 0.1 for $k \geq 4$ while the correlation between S^{WSJ} and S^{NYT}_{t+k} is greater than 0.2 for $k = 1, ..., 12$.

Table 4: The Contribution of Sentiment from WSJ on Forecast Error Variance Decompositions of all Variables

Period	*ip*	*sp*	*m2*	*p*	R	R^S	Q^S	EPU	S^{NYT}	S^{WSJ}
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.76
2	1.54	0.12	1.03	0.12	0.12	0.13	0.32	0.87	0.07	74.38
3	3.56	0.39	2.36	0.56	0.31	0.29	2.08	0.76	1.22	68.16
4	5.60	1.07	4.08	1.26	0.53	0.49	4.71	0.84	2.98	63.03
5	7.30	1.82	5.70	2.16	0.80	0.72	6.80	0.97	4.41	59.14
10	10.12	2.62	10.72	6.02	2.72	2.38	7.42	0.78	7.41	48.68
20	8.65	2.14	12.46	8.07	6.23	5.40	5.04	0.51	9.01	38.22
30	7.53	1.78	12.19	8.20	7.83	6.71	3.79	0.37	9.43	33.33
40	6.90	1.57	11.90	8.13	8.58	7.30	3.07	0.28	9.70	30.75
50	6.51	1.44	11.72	8.08	8.99	7.63	2.59	0.23	9.89	29.18

Note: Variables in lower case are in natural logarithms.

supply (M2), the price level, the interest rate, and the quality spread. Business sentiment does not appear to impact the S&P 500 stock market index to any great extent, given that the maximum contribution towards the forecast error variance of the stock market index is at most 2.6%.

Impulse response functions for each shock are reported in Figure 16 through Figure 25 in the Appendix. Figure 25 reports the response of each variable to the "pure" business-sentiment shock. The confidence intervals are constructed using the method of Hall (1992) with 1000 bootstrap replications. The "pure" business-sentiment shock has a positive and significant impact on industrial production, on money supply (M2), on prices, and on the general sentiment obtained from the NYT. The "pure" business sentiment shock also has a significant negative impact on the quality spread.

There are a number of potential interpretations of the business sentiment shock that we have identified. One interpretation is that it includes shocks to expectations of future values of the variables in the system. Another is that it incorporates shocks to variables that are not included in the model, such as shocks to foreign economic variables. A third interpretation is that the business sentiment shock includes shocks to how agents perceive current news. Note that our approach is not set up to test whether the stock market boom of the late 1920's was due to the presence of non-fundamental shocks as we have ordered the stock market index before the sentiment shock in our system. Any non-fundamental shock impacting the S&P 500 stock market index that is contemporaneously correlated with the business-sentiment shock would appear in the S&P 500 stock market index shock. The fact that the residual business-sentiment shock does not contribute much to the forecast error variance of the S&P 500 stock market index is not evidence against the presence of a stock market bubble in the late 1920's.

4.2 Robustness Analysis

Before analyzing our results for some important periods of our sample, it should be noted that we performed a number of robustness tests of our specification. The first robustness check was to switch the order of the sentiment series in the model. In the alternative model, the sentiment series obtained from the WSJ was ordered before the sentiment series obtained from the NYT. In this alternative ordering, the sentiment shock for the WSJ is still orthogonal to all the shocks to industrial production, the S&P 500 stock market index, money supply (M2), prices, interest rates and their spreads, and economic policy uncertainty. The NYT sentiment shock is now orthogonal additionally to the business-sentiment shock identified from the WSJ. The results of this change in ordering was minimal. The contribution to the forecast error variance of all the variables were only minimally affected by the change in order of the sentiment variables. This suggests that the information content of the sentiment series from the two sources are different from each other. We report the results for the WSJ sentiment series ordered last as we believe that the identified "pure" business-sentiment shock will be orthogonal to general news shocks coming from the NYT.

Another robustness check is to check whether the sentiment series obtained using the approach/avoidance lexicon is different from the sentiment series obtained using the lexicon of Loughran and McDonald (2011) (LM). To do this, we replaced the sentiment series obtained from the NYT with the sentiment series obtained from the WSJ using the lexicon of LM. By ordering the LM sentiment series before the sentiment series used in our analysis we are allowing LM series the chance to dominate any comparison. We found that the sentiment series obtained from using the approach/avoidance lexicon dominated the LM sentiment series when explaining industrial production, the S&P 500 stock market index, the quality spread, and economic policy uncertainty. The LM sentiment series dominated our sentiment series for money supply (M2) and prices. What is clear is that the two approaches contain different information as the shock to the LM sentiment series explains only 20% of the forecast error variance of our sentiment series.

A third approach is to use the Harvard IV-4 lexicon of sentiment words. As with LM, ordering the sentiment series constructed from the WSJ using the Harvard IV-4 lexicon of sentiment words has little impact on the effect that the our sentiment series using the approach/avoidance lexicon has on industrial production and the S&P 500 stock market index. There are some impacts on the overall impact of our series on money supply (M2) and prices but no effect of our business-sentiment series' impact on industrial production and the S&P 500 stock market index.

5 Historical Decompositions of Important Periods in our Sample

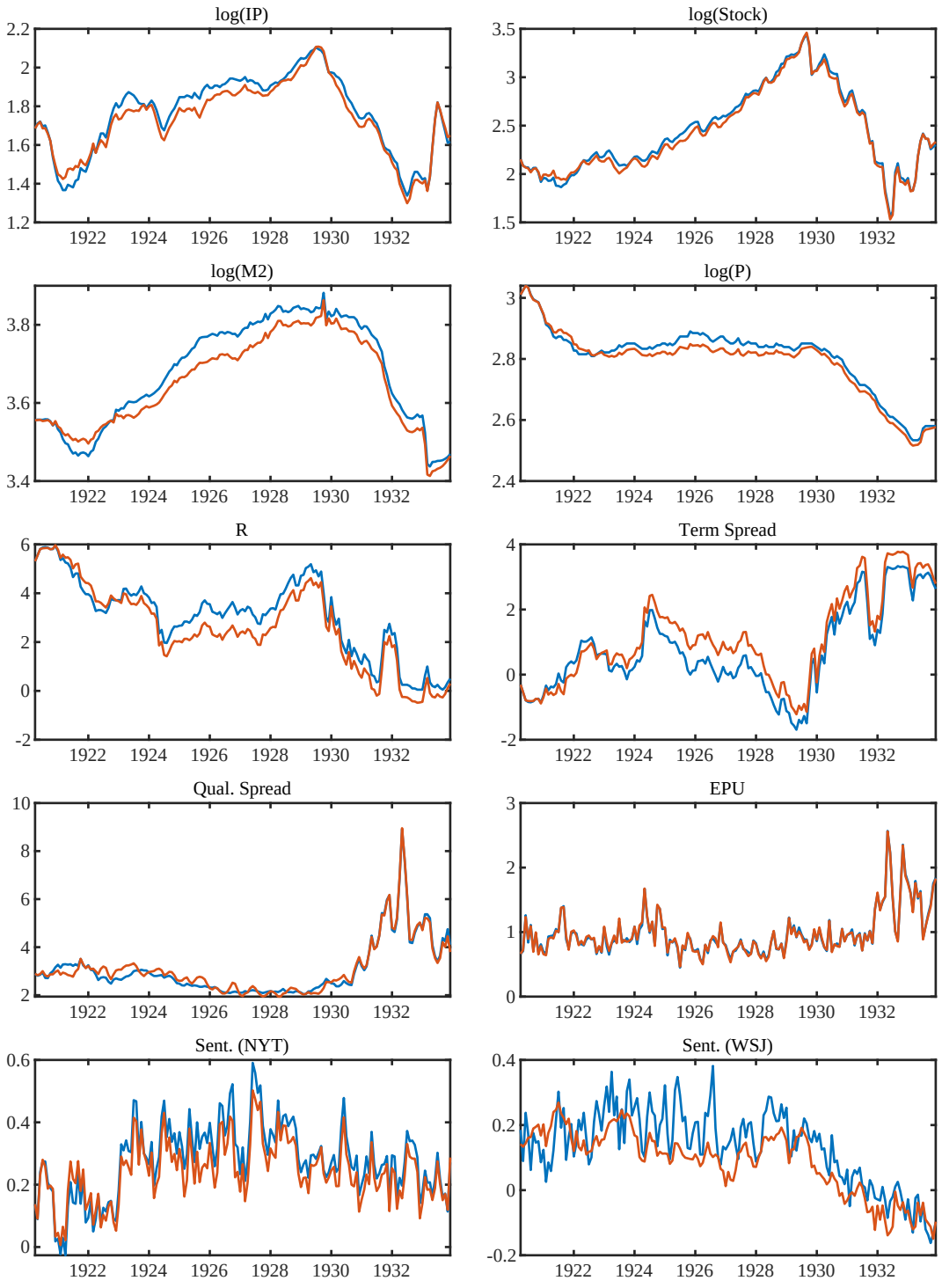
The forecast error variance decomposition, given in Table 4, reports the average impact of a "pure" business-sentiment shock on each series in the model. The fact that the "pure" business-sentiment shock has a modest overall impact on industrial production and the S&P 500 stock market index does not mean that the "pure" business-sentiment shock does not impact these series more significantly for some short periods of the sample. In order to see this, we construct historical decompositions. Figure 5 depicts the historical decompositions for each series in the model for the counterfactual experiment where the "pure" business-sentiment shock is set to 0. That is, counterfactual residuals are calculated from a set of counterfactual structural shocks with the "pure" business-sentiment shock set to 0 and all other structural shocks set to their estimated values. This counterfactual set of residuals are then fed back into the model yielding counterfactual series.

In Figure 5, the actual series is depicted in blue while the counterfactual series is depicted in red. When the counterfactual series departs from the actual series the interpretation is that a "pure" sentiment shock influenced that series. Inspecting Figure 5, we see that there was a great diversion during the mid-1920s in money supply (M2) and price level from their counterfactual paths. We also observe that there is a diversion in industrial production during the early and mid-1920s as well, even though, on average, the forecast error variance decomposition suggests the "pure" sentiment shock has a small overall impact on industrial production.

The counterfactual series in Figure 5 is depicted as the red line. It shows the cumulative impact of omitting the business-sentiment shock. Comparing actual industrial production to the counterfactual series we see some large divergences between the actual series and the counterfactual series. This is noticeable in the early 1920's where, if not for the business-sentiment shock, industrial production would have been higher. It appears that business-sentiment did exacerbated the recession. After the recession ended in 1921 we see the actual line rise more steeply then the counterfactual output series. This implies that the business-sentiment shocks after the end of the 1921 recession had a positive impact on growth. The same can be said for money supply (M2) growth.

In the next subsections we look in more detail at some periods in our sample and comment on what might have driven the major shocks to sentiment. In particular, how much optimism, and how much worry, were generated by observations of domestic developments, and how far did articles reflect a concern that foreign developments, financial instability, worries about government debt levels, but also labor militancy, might spill over into the US?

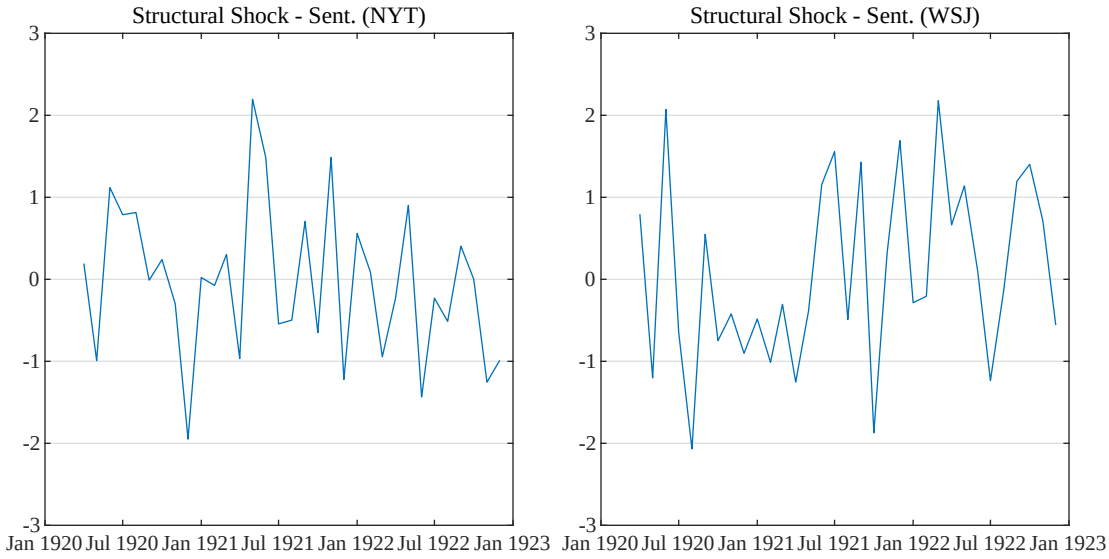
Figure 5: Historical Decomposition for All Series with Business-Sentiment Shock Omitted



Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

The theory of foreign contagion is a frequent feature of analysis of bubbles and busts. Jevons (1884, p. 243) commented on the emergence of euphorias that: "The impulse from

Figure 6: Structural Sentiment Shocks (1920 – 23)



abroad is like the match which fires the inflammable spirits of the speculative classes. The history of many bubbles shows that there is no proportion between the stimulating cause and the height of folly to which the inflation of credit and prices may be carried. A mania is, in short, a kind of explosion of commercial folly followed by the natural collapse." The experience of the interwar period is more about the contagion of worry.

5.1 The Impact of Sentiment during the Early 1920s

Inspection of Figure 5 shows in the early 1920s actual sentiment was lower than what was predicted by fundamentals. Figure 6 depicts the structural sentiment shocks for 1920 to 1923 and Figure 7 depicts the historical decompositions for period from 1920 to 1923 with the business-sentiment shock omitted.

In Figure 6 the structural (orthogonalized) shocks for the two sentiment series are shown. For the structural shock obtained from the Wall Street Journal sentiment series (the "pure" business shock) there are predominantly negative sentiment shocks during the period from 1920 to 1923. There are two large negative shocks that occur in August, 1920 and October, 1921. Between these two periods there are predominantly moderate sized negative business-sentiment shocks until May, 1921. After May, 1921 there are mainly positive business-sentiment shocks, with the exception of October, 1921. The pattern of shock obtained from the New York Times is quite different.

The impact of the identified shocks on the variables of the model can be seen in Figure 7. In this figure, the blue lines are the actual values of the series, while the red lines are the counterfactual values if the business-sentiment shock, the second tile of Figure 6, was set to 0. The business-sentiment shock has quite a sizeable impact on

many of the variables in the model. The trough of the recession in output would have been shallower if not for the negative business-sentiment that accumulated through late 1920 and early 1921. The gap between the red line and the blue line was largest in July 1921 and was equal to 0.09 log points which equates to approximately a 9% difference in industrial output. A similar pattern occurs with the stock market index with the accumulated negative business-sentiment leading to a lower level of the index in early 1921. The largest difference between the actual series and the counterfactual series occurs in August, 1921 with a difference of 0.08 log points or an 8% difference in the actual stock market index compared to the counterfactual stock market index.

The negative business sentiment also affects money supply (M2), prices and interest rates. Without the negative business-sentiment, the level of money supply (M2) would have been approximately 3% higher and the nominal interest rate would have been approximately 50 basis point higher. Note that the decline in the nominal interest rate or the rise in the term spread during this period was not due to business-sentiment as the counterfactual series has a similar shape as the actual series. There is also a large impact on the quality spread, the measure of the strength of preference for safe assets . At its largest the gap is 46 basis points, with the impact of the negative business-sentiment shock being that the quality spread is higher than what would have been the case had there not been any business-sentiment shocks.

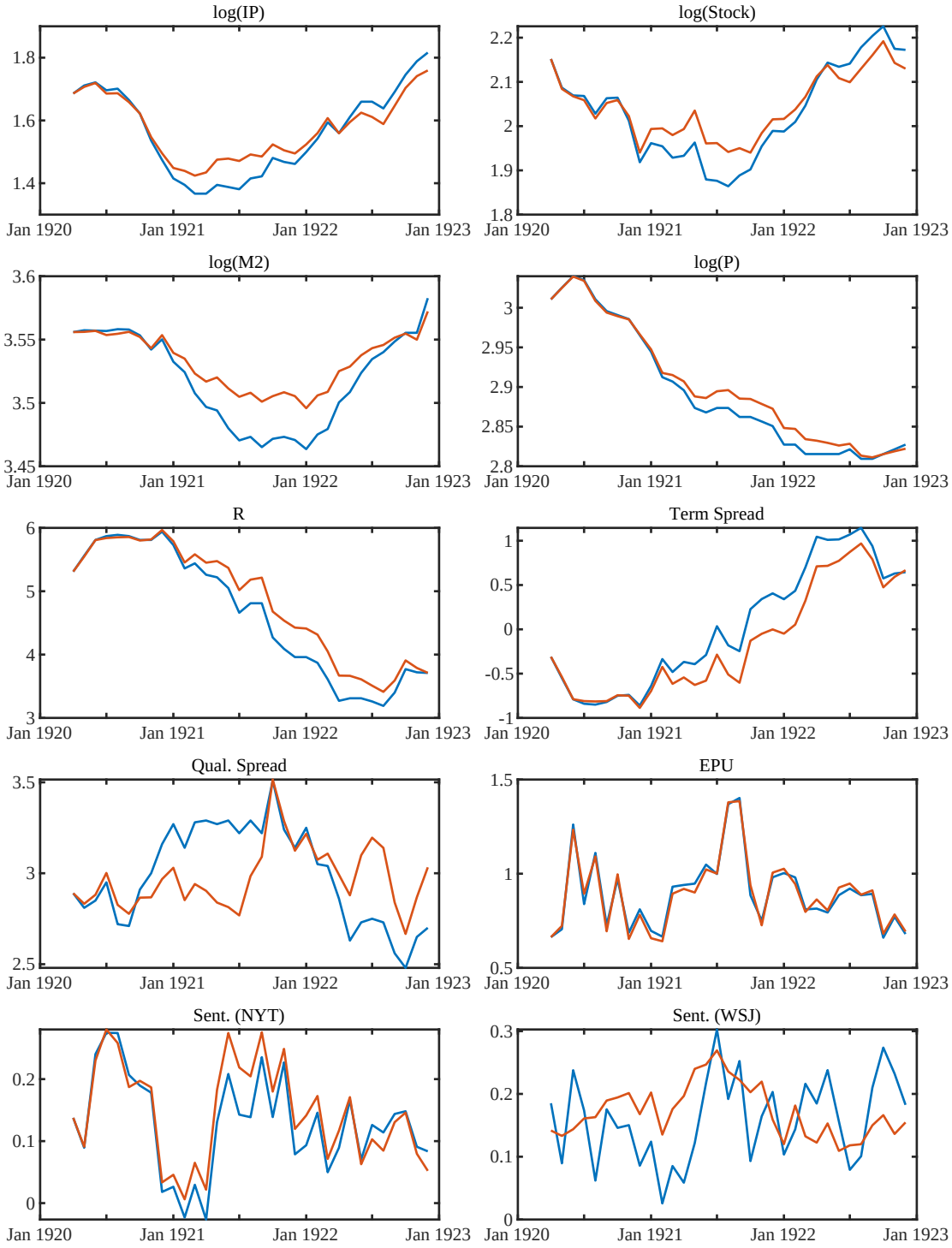
After the middle of 1921, when there are predominantly positive business-sentiment shocks, we see the actual industrial production and stock market series climbing faster than the counterfactual series. The same occurs for money supply (M2) and we see a lower quality spread than what the counterfactual series predicted.

The pattern of behaviour during this period is consistent with business-sentiment impacting investment decisions. Fears about both the current and future state of the economy would have affected, at the margin, investment decisions which would have impacted industrial production with a lag and affect money supply (M2) through a lower demand for bank credit.

The articles dealt with domestic conditions in the US, but also with the impact of foreign political uncertainties, especially the western military push of the Soviet armies, and the uncertainty about Germany and reparations. In July 1920, the highest rating article in "avoidance" terms reported on the complaint of Comptroller of the Currency John Skelton Williams about the "excessive and burdensome interest rates, running up to 10, 12 and 15 percent and higher" charged by New York banks.[25]Other articles dealt with transportation difficulties, and coal shortages, with discussions that the wartime control of coal might be required to combat bottlenecks in the supply of bituminous coal

[25] "Comptroller Williams Criticises Money Rates," Wall Street Journal, 31 July 1920: 1.

Figure 7: Historical Decomposition with Business-Sentiment Shock Omitted (1920 – 1923)

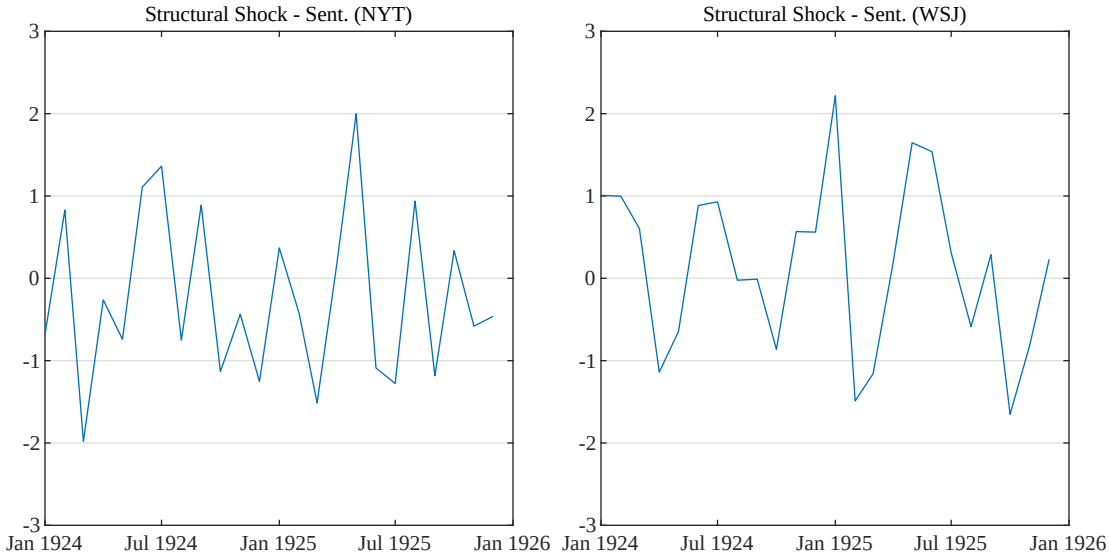


Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

and anthracite.[26] In August 1920, a substantial number of articles were concerned with

[26] "Coal May Go Back To Government Control," Wall Street Journal 12 July 1920: 9 (number 3 in

Figure 8: Structural Sentiment Shocks (1924 – 25)



the slow pace of downward wage adjustments and consequent threats to profitability.[27] While consumer prices were falling during this period, railway wages were not. There was deep concern that the Interstate Commerce Commission was not allowing railroads to increase their shipping prices which was affecting profits. This meant that railroads were not investing in increased capacity leading to problems with capacity constraints within the system.

In August 1921, some of the "avoidance" pieces examined the financial links between Europe and the US, with presentations on how the large number of German Mark banknotes physically exported to the US constituted a "gigantic fraud" on American investors.[28] These articles reflect an uncertain time during the early 1920s which had the effect of exacerbating the recession. The pattern of the historical decompositions is consistent with the nervous sentiment impacting investment decisions at the margin.

5.2 The Impact of Sentiment in 1924

The middle of the 1920's is another interesting period. With respect to business-sentiment, there are both positive and negative shocks as seen in Figure 8. There are a majority of positive business-sentiment shocks after July, 1924 which was the end of a short sharp recession. The largest positive business sentiment shock occurred in January of 1925.

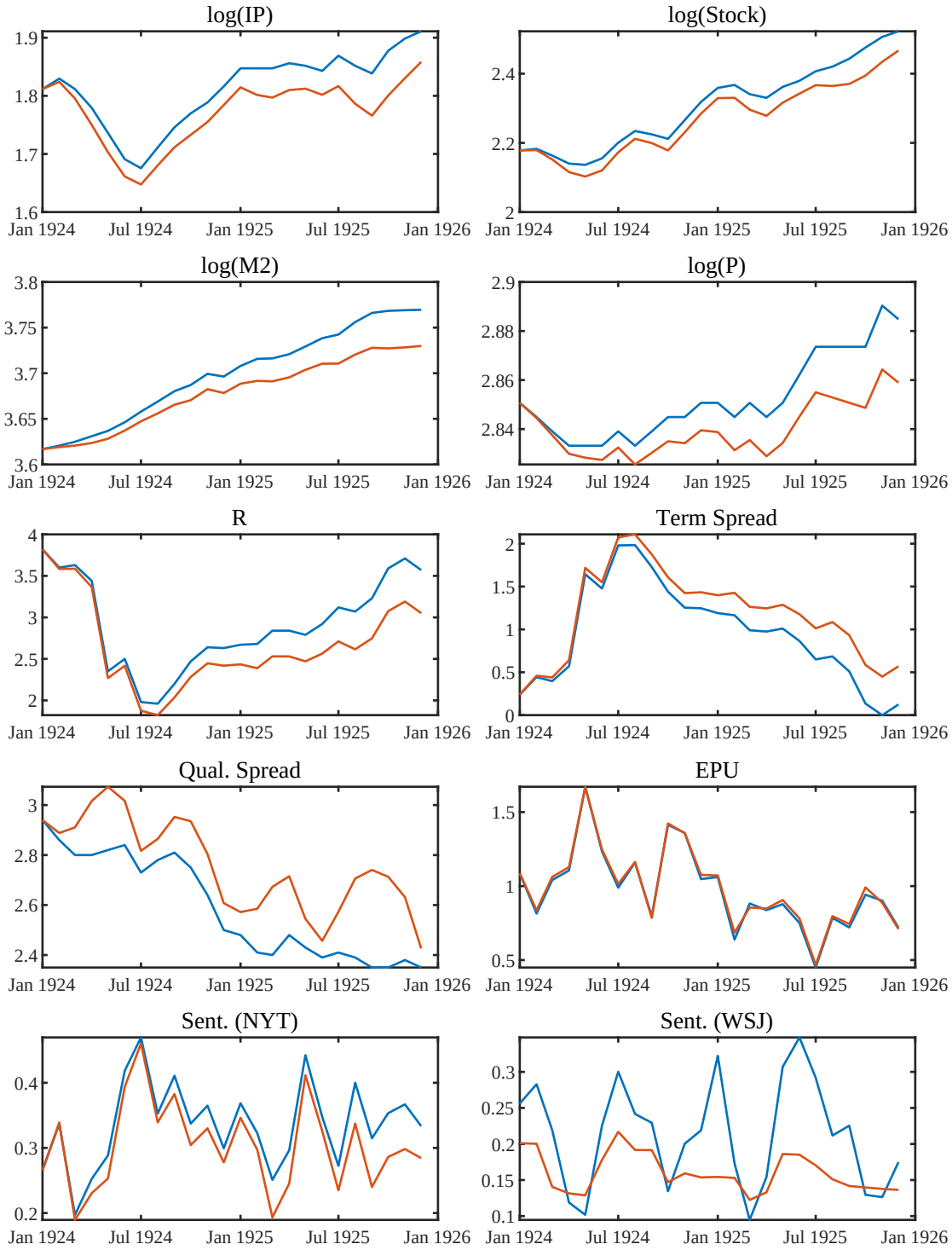
Figure 9 shows the historical decomposition for this period. The blue lines depicts the actual series and the red lines depicts the counterfactual series with the business-

avoidance terms in July 1920).

[27] "Western Bank Doubts If Prices Decline Much Wall Street Journal," Aug 13, 1920: 10 (number 1 in avoidance in August 1920).

[28] "Mark Inflation Seen As Gigantic Fraud," Wall Street Journal; Oct 6, 1921: 1

Figure 9: Historical Decomposition with Business-Sentiment Shock Omitted (1924 – 1925)



Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

sentiment shocks set to 0. The accumulated impact of the business-sentiment series was

to increase output, the stock market index, money supply (M2) and prices over this expansionary period. Interest rates rose more than would have been predicted and the term spread and quality spread were lower than what would have been predicted. At its largest the gap between actual industrial production and counterfactual industrial production was 0.072 log points or approximately 7.2%. For the stock market index the gap was 0.08 log points or approximately 8%. The impact on money supply (M2) and prices was approximately 4% and 3% respectively. The impact on interest rates also point to business-sentiment during this period having a positive effect on economic conditions. The nominal interest rate was approximately 51 basis points higher than what would have been predicted while the term spread and quality spread were approximately 44 and 39 basis points lower than what would have been predicted had there not been any business-sentiment shocks.

This is a period where there are surges of positive sentiment as we see in the historical decomposition for business-sentiment. In July 1924, the highest ranking article in "approach" terms concerned optimistic forecasts for railroads with large grain and ore transports.[29] Another big theme was the favorable state of public sector finances, with the US having the lowest debt in relationship to public wealth, and paying less in interest rates.[30] There was also good news about Europe, and the chances of a stable solution to the reparations problem, with reports about how Germany seemed likely to embrace the Dawes Plan.[31] Some articles explicitly addressed the new investing environment in terms of "optimism" and a "cheerful atmosphere," with relief over the stabilization of the European political situation.[32] In January 1925, there was extended discussion about German companies going to the American capital markets;[33] and generally boosterish articles. Thus Edward V. Decker, president of the Northwestern National Bank Minneapolis was quoted as opining on how "we are learning more to work together, farmers, bankers, businessmen, railroad men, and we propose to march forward with a united front, believing and expecting that we will have our share of the world's prosperity during the next few years."[34]

[29] "Northerns' Stock Prices Justified: Advance of Gt. Northern and No. Pacific Reflects Restored Confidence in Northwest," Wall Street Journal; 18 July 1924: 4

[30] "Decrease In Federal Interest Payments: United States, of Four Leading Nations, Has Smallest Debt in Proportion to Public Wealth," Wall Street Journal; 11 July 1924: 8.

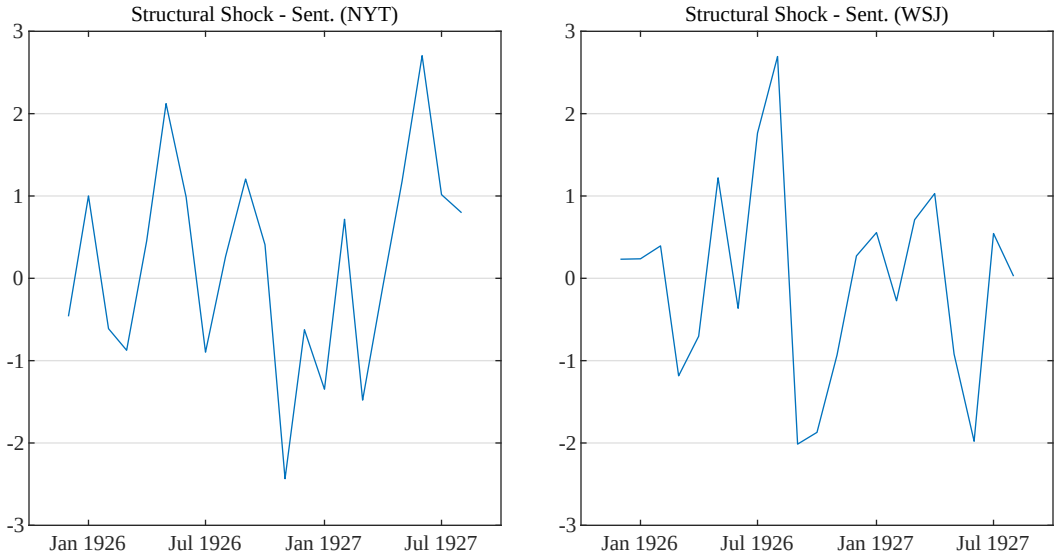
[31] "Germans Favor Dawes: Would Sign Report as Best Expedient, D.L. Breed Thinks Alternative Serious for New Currency," Wall Street Journal; 29 July 1924: 5.

[32] "Optimism Rules In Financial World: Buoyant Grain and Security Markets Creates Cheerful Atmosphere in Wall Street Circles," Wall Street Journal; 21 July 1924: 10

[33] "German Industries Seek Foreign Loans: Numerous Concerns Participate in Active Campaign for Outside Credit Accommodations," Wall Street Journal; 22 Jan 1925: 10.

[34] "Banking Opinion Shows Confidence: Northwest, Clear to the Pacific Coast, Cheered by Fine Crops, Feels Sure of Good Times," Wall Street Journal; 10 Jan 1925: 8.

Figure 10: Structural Sentiment Shocks (1926)



5.3 The Impact of Sentiment during 1926

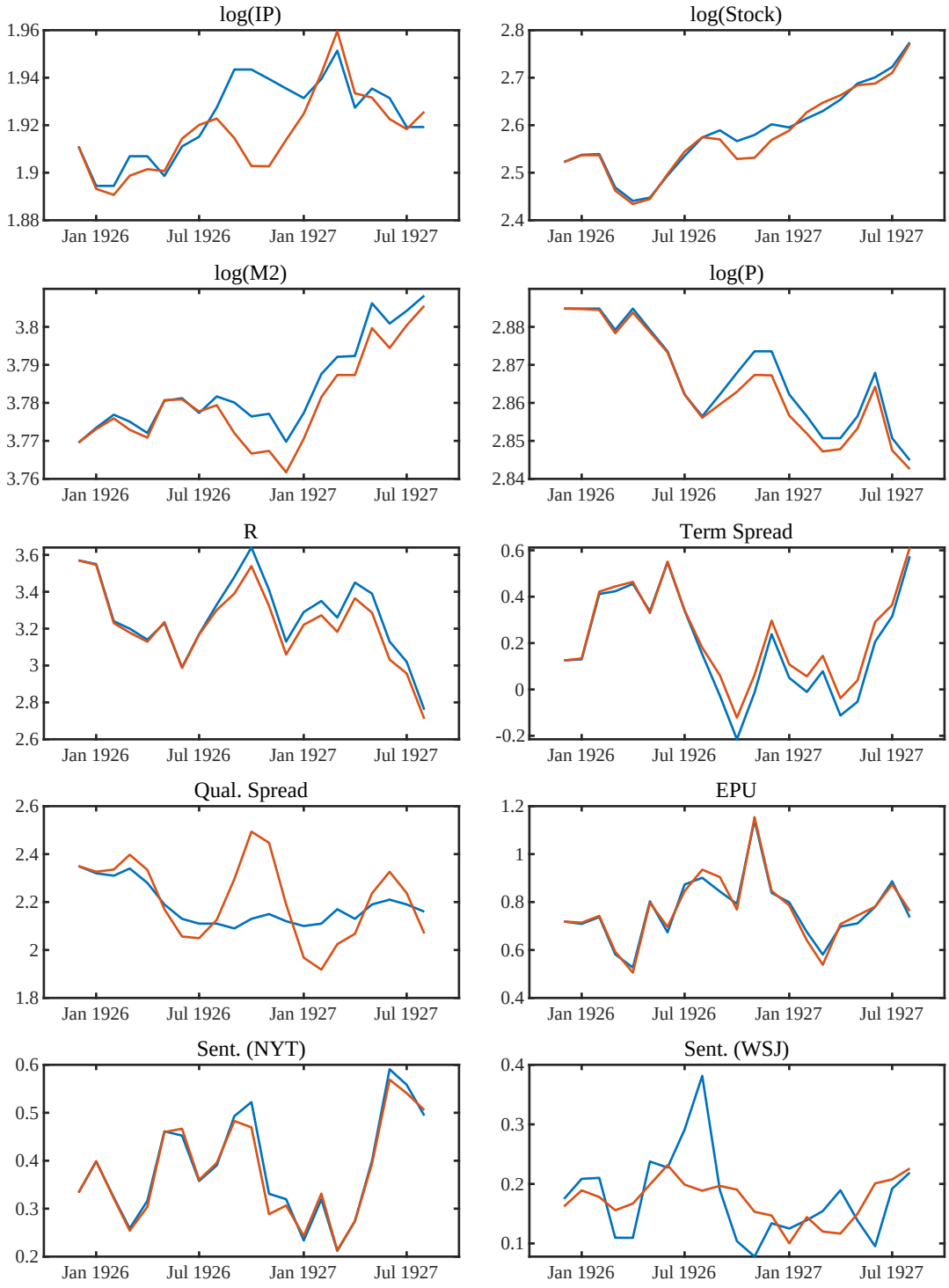
The year 1926, in which growth was generally, sustained and resilient, provides some interesting examples of how sentiment shocks affect economic outcomes. Starting in April, 1926 and ending in August, 1926, there is a surge in our sentiment index, culminating in a large positive sentiment shock in both July and August of 1926. However, in September, 1926 there is an almost equally as large negative sentiment shock that lasts for two periods, as can be seen in Figure 10.

The impact of the large swings in sentiment can be seen in the historical decompositions depicted in Figure 11. The blue line in the subfigures of Figure 11 show the actual series while the red lines show the counterfactual series had there not been the business-sentiment shock shown in Figure 10.

The impact of the positive business-sentiment shock in July and August is profound. The actual industrial production series continues its upward trend from August to September, whereas the red counterfactual series shows industrial production declining during this period. Had it not been for the positive business-sentiment shock in August it appears that industrial output should have fallen. The gap between the actual output and the counterfactual output is maximized in October and is equal to 0.0408 log points or 4.08%. At the same time the stock market index is 3.8% higher than the counterfactual series and the money supply (M2) series is about 1% higher than the counterfactual value. The quality spread is also impacted by the business-sentiment shock in August. The actual quality spread is flat throughout the latter part of 1926 whereas the counterfactual quality spread series is 36 basis points higher than the actual spread.

The model predicts that, had it not been for the large positive business-sentiment

Figure 11: Historical Decomposition with Business-Sentiment Shock Omitted (1926)



Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

shock in August, the economy would have had a sharp negative correction. In September there is a sharp negative business-sentiment shock and this shock as the opposite effect on

the variables of the model. Actual industrial production falls whereas the counterfactual series would have risen. By the end of 1926 the impact of the two opposing business-sentiment shocks have cancelled each other out.

This is an interesting period as the impact of the business-sentiment shock appears to be sharp but short-lived. In the summer (June through August) there was a general level of anxiousness about events in Europe, especially the currency problems in Belgium and France, but this is more than made up by positive news. The positive news is dominated by stories about railroads and crops, ie about the events driving the US domestic economy. During this period, there are many articles containing a high number of approach words that refer to record crop yields in the upper plains and high profits for railroads, especially the Great-Northern railroad. Also during this time there are articles extolling the soundness and competitiveness of the US economy. There is a high degree of triumphalism during this period.

An ecstatic article on the way foreign countries perceived the 150th anniversary of the Declaration of Independence, for instance, commented: "Articles are appearing in the British press describing the money glut in the United States-the vast hoard of more than half the gold of the world. The American government has a surplus of $350,000,000, says the daily press, while the British government has a deficit of at least $100,000,000."[35] The story with the highest approach rating starts with a celebration of United States Steel's "brilliant performance."[36] However, there is no one unifying theme in this triumphalism suggesting that the run up of business-sentiment during the middle of 1926 reflects a surge in sentiment rather than being the result of any specific news.

In September, 1926 there followed an equally sizeable negative business sentiment shock, with worries about US trade performance and competitiveness, as exports to Canada and Germany produced gold outflows from the US.[37] Interestingly, the article that is top in avoidance terms concerned allegations of market manipulation through the press – the Wall Street Journal and the Dow Jones ticker. C. W. Barron, the president of Dow Jones, assured the readers of his newspaper that he had never had occasion to sack any reporter for "faithlessness."[38] There is also discussion of bad weather in Texas and disease and pestilence in the cotton crop. This period provides an example of a short sharp bout of enthusiasm followed by what appears to be an overreaction the other way. The impact on industrial production is short and sharp as well. The overall impact

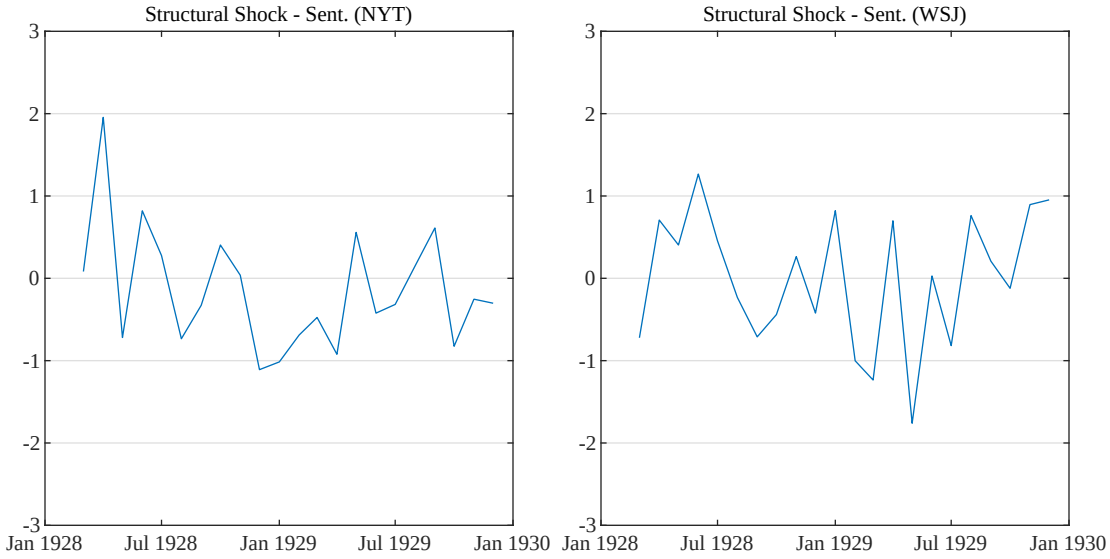
[35] "Herbert N. Casson, America's Progress Astounds Britain: Publication of Facts on Wealth of United States Amaze People of Older Nation," Wall Street Journal, 19 July 1926: 10

[36] "Market Comment: Buying Grows in Volume Big Investment Demand," Wall Street Journal; Jul 1, 1926. 16

[37] "Gold Flowing In Both Ways: Exports Going to Canada and Germany," Wall Street, 09 Sep 1926: 8.

[38] "U.S. Steel–General Motors: B.C. Forbes Tells 'Inside Story' of Now Famous Articles by Dow, Jones & Co." Wall Street Journal, 01 Sep 1926: 11

Figure 12: Structural Sentiment Shocks (1928 –29)



is about 4% of IP with a short increase in IP when the counterfactual series suggest industrial production should have gone the other way. Then there is a negative sentiment shock at the same time fundamentals would suggest an increase in industrial production was likely. These two corrections cancel each other out and industrial production and counterfactual industrial production re-join each other by the end of the year.

These articles undermine the exuberance apparent earlier in the year as the articles caution the reader that not all is as it appears. Finally, there are some articles in September and October defending the use of installment selling, but these articles use a lot of avoidance words. Fears are rising that investors are becoming too leveraged.

This period appears to be a period where general positive business-sentiment is not being driven by specific news articles. The surge in positive business-sentiment is halted, not by any one specific event but rather by articles that suggest all the positive news may be not all be backed by the fundamentals of the economy.

5.4 The Impact of Sentiment during 1928 and 1929

The period leading up to the October 1929 crash is of particular interest. Figure 12 depicts the structural sentiment shocks with the second frame of Figure 12 showing the business-sentiment shocks. Starting in August 1928 there are predominantly negative business-sentiment shocks with the largest negative sentiment-shock occurring in May 1929. The general sentiment shocks coming from the NYT is also negative during this period but the magnitude of the shocks are not as great.

The impact of the business-sentiment shocks can be seen in Figure 13. The blue line in this figure depicts the actual value of the series whilst the red lines depict the

counterfactual series if the business-sentiment shocks were set to 0. During the middle of 1928 there were positive business-sentiment shocks which is seen when we look at the sentiment series obtained from the Wall Street Journal. This led to industrial production, the stock market index, and money supply (M2) being higher than what would have been predicted without the business-sentiment shocks. During the middle of 1928, industrial production is higher by approximately 0.032 log points or 3.2% than what would have been predicted, while the stock market index is higher by 0.035 log points or 3.5% than what would have been predicted without business-sentiment.

Had it not been for positive business-sentiment in 1928, the quality spread would have been 25 basis points higher. Starting in February 1929 the quality spread started to increase. The counterfactual quality spread series would have continued to decline until September 1929 suggesting that the initial rise in the quality spread during this period was due to negative business-sentiment.

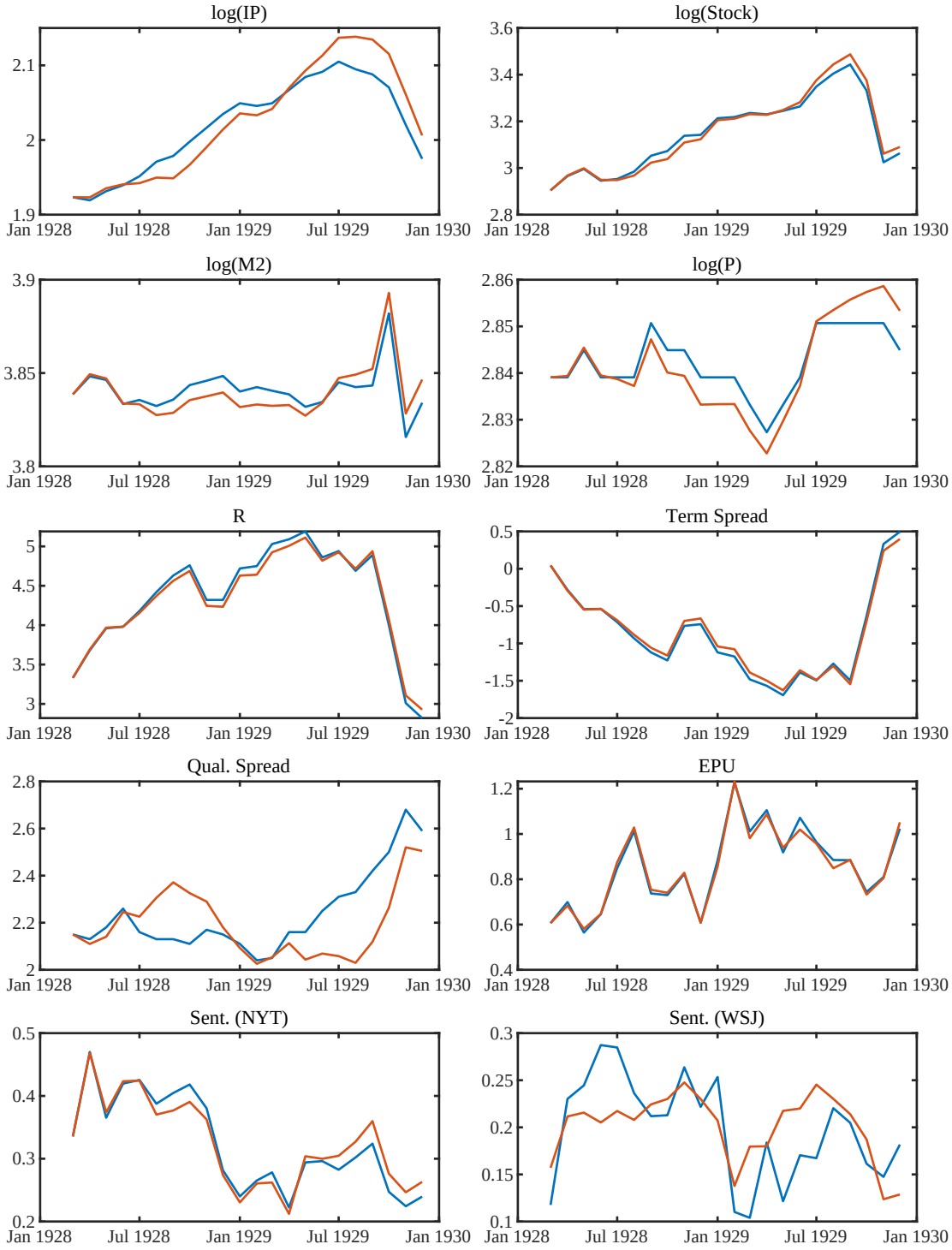
With one exception, in February 1929, the lead-up to the dramatic stock market events is punctuated less by worries about bad or dangerous developments than by a cooling of enthusiasm, a diminution of the grounds for any euphoria. There was a shortage of any general optimistic vision. In February 1929, there was a surge of avoidance terms, mostly associated with the Federal Reserve's restriction of broker loans. The daily "Abreast of the Market" market gossip and news column of February 11 explained that: "Sentiment generally continues pessimistic. There is a feeling that the latest warning of the Federal Reserve Board has attracted more attention than those of the past month and as a result a general tendency to clean house is noted, particularly among those outsiders who have been outspokenly optimistic right along. Conservative observers plan to continue to favor taking profits whenever opportunities are presented, because they feel that before the market reaches a level where good buying will be encountered stocks can be repurchased at more reasonable figures."[39] Writers were highly critical of the Federal Reserve's crack down on broker's loans and there was commentary during this period that this would affect business' access to credit as money would be diverted to the stock market from commercial loans.

The newspaper reported on a National City Bank report's "alarm" at the "extraordinary growth of unregulated non-bank loans being made for speculative purposes, not because the size of brokers· loans is of itself dangerous, but because non-bank lenders feels little responsibility towards the money market, may withdraw their funds at a moment's notice, and thus place upon banks the responsibility of maintaining the money market on an even keel."[40] There were complaints about the "smug silence" of the New York

[39] "Abreast of the Market: A Daily Column of Comment," Wall Street Journal; Feb 11, 1929: 16

[40] "'Others' Loans Create Alarm: City Bank Stresses Danger of Potential ...," Wall Street Journal; Feb 4, 1929: 15

Figure 13: Historical Decomposition with Business-Sentiment Shock Omitted (1928 – 29)

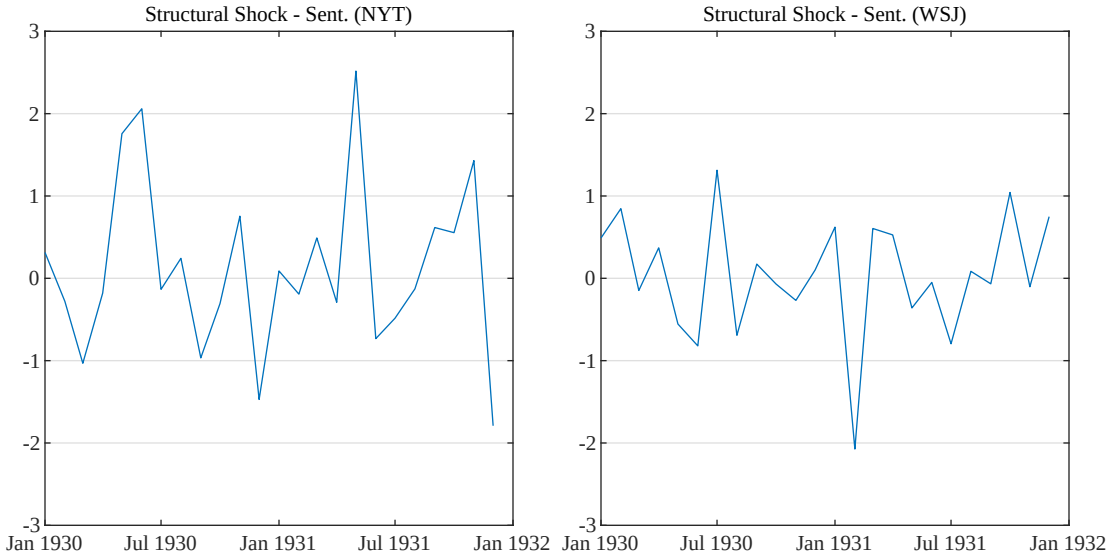


Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

Fed.[41] Other worries included difficulties for railroad mergers, such as objections to a

[41] "No Place for Mysteries," Wall Street Journal; Feb 19, 1929: 1

Figure 14: Structural Sentiment Shocks (1930 –31)



merger of the Chesapeake & Ohio with the Baltimore & Ohio.[42]

For the rest of the year leading up to the October crash, however, there is not so much of a surge in avoidance terms, as an absence of approach terms, a lack of reasons to be enthusiastic about the economy or stock market. After October 1929, there is a long period of prevalence of avoid terms, unsurprisingly given the worsening state of economic news.

5.5 The Impact of Sentiment during 1930 and 1931

The developments of 1931 really made the Great Depression a Great Depression. Signs of an economic recovery in the spring faded, and were replaced by a new pessimism, much of which had its origin in foreign developments. Some episodes in 1931 deserve attention in pushing a new level of avoidance, with two distinct waves, one in February largely concerned with domestic fiscal issues, when conservatively oriented investors were worried about the effects of larger government spending in a measure to counter the depression; and another in the summer, in June and July when foreign news – which also played a prominent role in the New York Times coverage and in that paper's surge of avoidance – dominated the pessimistic turn. Figure 14 shows the sentiment shocks for this period.

Figure 15 depicts the historical decomposition for this period where the business-sentiment shock is omitted. The impact of this positive sentiment on industrial production and the stock market was small. For industrial production, the impact was

[42] "Merger Plans of Trunk Lines: C. & O. and B. & O. Unification ... ,from the Wall Street Journal Washington Bureau," Wall Street Journal; Feb 21, 1929: 1

approximately 0.023 log points or approximately 2.3% while for the stock market index, the impact was also approximately 0.023 log points or approximately 2.3%. This is smaller than the impact that business-sentiment had on output and the stock market earlier.

During the first half of 1931 we observe a large negative spike in business-sentiment in February 1931 and a series of negative shocks to sentiment in June and July of 1931 as seen in Figure 14. In February 1931, most of the sudden spike in avoidance came from worries that a proposed early payment of the war veterans' bonus that was being debated by Congress would place strain on the bond market. A long article listed the details of the "unanimous opposition against the proposal to cash veterans insurance adjustment certificates expressed by Industrial and financial leaders throughout the country." [43] There were also concerns about the congressional investigations, by a committee under Carter Glass, of the brokers' loans ("loans for others") that had driven the surge in speculation in 1928 and 1929.[44]

The "avoidance" terms were heavily dominated in the summer of 1931 by news from Europe, where in July the contagion effects from the May failure of the largest Austrian bank, the Creditanstalt, spilled over to Germany. Already on May 25, an article freighted with avoid terms surveyed Europe's debt. Of the top 6 articles in the WSJ in July ranked by relative frequency of avoid words, five were about the European crisis. The top article immediately followed the failure of the Danat bank on July 13 and the declaration of a banking holiday: it erroneously claimed that German central bank was discussing the issue a new emergency currency, the Rentenmark, which had briefly been issued in 1923 as part of the attempt to stabilize in the wake of hyper-inflation.[45] The only non-European crisis article in the top 6 dealt with the pricing of U.S. utilities on the basis of reproduction costs and attacked the idea that objections to pricing abuse could apply to companies whose capital is widely distributed.[46]

This pattern repeats an oddity from June, when the most frequent sentiment articles were domestic U.S. rather than focused on the actually emerging European crisis, and where the highest "avoid" article was a gushing piece on how President Hoover was at last tackling the depression. The article began by noting that stocks were advancing on the announcement of President Hoover's reparations moratorium, "one of the most effective measures that could be taken to relieve international uncertainty and world depression." It goes on to make the point that it was likely that pessimistic and deflationary

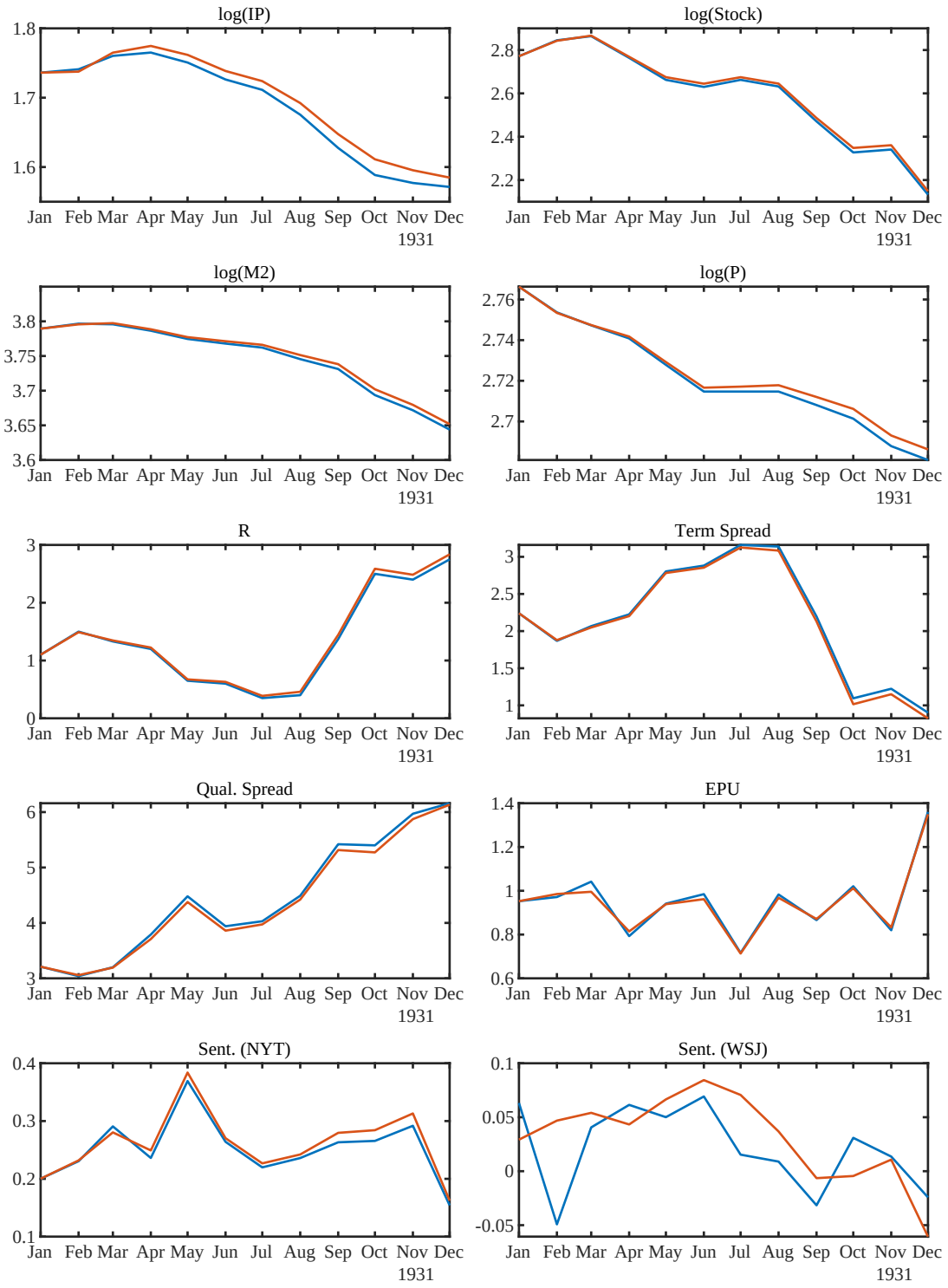
[43] "Leaders Oppose Soldiers Bonus: Business Men Throughout the Country," Wall Street Journal; Feb 10, 1931: 16

[44] "Seeks Curb On 'Others Loans': Glass Committee Likely to Recommend" by W.H. Grimes, Staff Correspondent of The Wall Street Journal, Wall Street Journal; Feb 7, 1931: 1

[45] "German Reserve now at Minimum: Industrialists Urge Rentenmark", by Charles R. Hargrove, Wall Street Journal; July 15, 1931: 1

[46] "Rate Bases," Wall Street Journal, July 24, 1931: 1

Figure 15: Historical Decomposition with Business-Sentiment Shock Omitted (1930 – 31)



Line in blue is actual series. Line in red is counterfactual series with WSJ sentiment shock set to 0.

expectations had become deeply entrenched. This development in the view of the WSJ

emphasized the danger of assuming extensive bear contracts after a period of deflation such as the main body of stocks had passed through over the last 22 months. It also demonstrated that *constructive* news is likely to appear when pessimism is rampant, and the speculative community has resigned itself to a spirit of hopelessness."[47] The *New York Times* in July 1931 also focused heavily on European events. Its top "avoid" article dealt with the French response to the German banking crisis, noting that "there was a significant lack of anything bordering on excitement." [48] The worry about a foreign blow to confidence thus emerged quickly even in a newspaper not primarily focused on the financial community.

The business-sentiment shocks that were identified appear to be expectation shocks (worries about what would happen if the soldiers' bonus happened) and shocks about economic conditions in Europe. Again this appears to be shock to future expectations that the European problems would eventually impact US financial and business conditions. The impact of the large negative shock to business-sentiment in 1931 , is small relative to some other periods, most notably in 1926. The historical decomposition is shown in Figure 15. One explanation for this lack of impact is that, during the 1930's, the frame of reference for decision makers is quite different from 1926 and even 1920 – where there was also a recession. It was quite clear to all in 1930 that the economy was bad. Shocks to business-sentiment might be expected to change investment decisions at the margin but in 1931 it is possible that changes in business-sentiment, no matter how large, would do little to change the mind of decision makers that now is not the time to invest.

The difference in the magnitude of the effect of business-sentiment on industrial production across the different sub-periods is likely an example of a non-linear response of investment decisions to sentiment shocks. There are likely threshold effects at play. In 1931, the state of the world might be such that there are very few investment projects that have an expected profit close to zero. Thus shocks to sentiment which induce small changes to expected profitability of an investment opportunity does not change the decision to hold off investing for that many a project. Whereas, in 1926, since the state of the economy is perceived to be good, there may be many more projects that are close to the margin in terms of expected profit. In this case, small changes in expected profitability of investment opportunities might lead to more projects being initiated (or killed) as there are more projects close to having an expected profit.

[47] "Abreast of the Market," by Richard E. Edmondson, Wall Street Journal; Jun 22, 1931: 8

[48] "Paris Press Lays Deceit To Germany: Asserts Advantage Is Being Taken Special Cable To The New York Times." New York Times , Jul 14, 1931: 19

6 Summary and Conclusions

Did sentiment play a role in the 1920s boom and the 1930s depression, and if so, how did these sentiments behave?

We hypothesise that newspaper articles of the time contain information related to the state of emotions or confidence of economic agents as well as information about the fundamentals of the economy. The emotion component is constructed to be orthogonal to the fundamental component contained in the variables of our model. We use over 2.4 million digitized articles from the Wall St Journal to algorithmically derive a monthly sentiment index based on emotion related words. A ten variable vector error correction model is then used to identify structural shocks to sentiment that are orthogonal to the fundamentals of the economy.

As we introduce several layers of controls in to our VECM, which includes forward looking financial market variables, the business-sentiment shocks we identify are unlikely to be caused by factual, news based fundamentals that our algorithm detects ahead of time. The model is also set up in a way that controls for general news sentiment in the New York Times and includes variables to control for EPU (Baker, Bloom and Davis, 2016) , financial distress (Bernanke, 1983) and inflation expectations. We interpret the sentiment shock derived from the Wall St Journal as a business-sentiment shock orthogonal to general news and orthogonal to the fundamentals of the economy.

Using historical decompositions, we show the timing and intensity of the identified "pure" business-sentiment shocks have economically significant effects on Industrial production, the S&P 500 stock market index, money supply (M2), credit spreads, terms spreads, interest rates and prices during this period. In some cases, these effects are as high as 9% for industrial production and the Stock market with these effects typically taking 4 months to reach their peak.

The broad impacts across the economic system suggest a common factor. These results are robust to various other sentiment formulae used to construct the indexes such as the dictionaries in Loughran and McDonald (2011) and Harvard IV-4 (2020).

We investigate the individual news articles, and their net sentiment levels to identify which news were moving the economy at key moments. The nature of these shocks and the reaction of the main components of the macro economy to them, suggests that sentiment was playing a highly significant and intermittent role in the dynamics of the economy on both the real and financial side. Some of these cases, such as 1931, have a specific news-based driver which can be identified as a potential cause from the news. There appear to be others , such as in 1926, where such an interpretation is much harder to reconcile with a specific event in the news driving sentiment. Our method is designed to capture the sentiment of economic agents and we interpret the sentiment shocks as

capturing how economic agents' perceptions changed.

We contribute to the literature in a number of ways. Firstly, this period is often cited as being influenced heavily by some form of non-fundamental optimism or exuberance related to the US economy and the Stock Market. While the focus of attention in prior studies has been the stock market, we investigate the major components of the macro economy including the financial side, simultaneously. We find that there are definite impacts on the macro economy and financial markets and therefore highlight the role of sentiment across the economy.

Secondly, our method employs digitized data for historical time periods using very large databases of news and establishing further their use in historical finance and macroeconomics. We further show that our novel sentiment index contains different information to existing state of the art sentiment dictionaries and provide a method that can be applied to other historical databases.

Thirdly, our approach complements the work of Baker, Bloom and Davis (2016) as we are able to investigate factors specifically related to emotion or confidence orthogonal to uncertainty around economic policy effects. In the same way, we also complement the work of Bernanke (1983) to show how such effects occur distinct from credit frictions.

Fourth, by using data at the monthly frequency, we are able to provide clearer understanding of the nature and timing of sentiment shocks and the intensity and timing of the reactions of major subcomponents of the economy. Furthermore, we can isolate the actual news articles that were responsible for the shocks, a method which can help refine future analyses. We are, to our knowledge, the first to attempt such an exercise for the period.

Most importantly, we are able to address the question of the underlying nature of sentiment shocks themselves. We show that some cases of sentiment shocks can be plausibly seen as being fundamentals based, either based on fundamentals from outside the system (news from Europe, for example) or based on sentiment about future expectations (worries about the effect of paying out the Soldiers' Bonus, for example). In other words, incorporating sentiment information from news articles allows us to incorporate information on variables that 1) may not be available or 2) may not be measurable, into our econometric model to better explain historically important events. What is important in our approach is that the extensive methods used to isolate and measure sentiment shocks and their effects are not capturing the news itself but rather the sentiment changes of economic agents.

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A Estimation Results

Table 5: Estimation Result for VEC Model: March 1920 – December 1933

Eqn	ip	sp	m	p	R	R^S	QS	EPU	S^{NYT}	S^{WSJ}
Z_{1t-1}	-0.038	0.090	0.031	0.014	0.157	-0.151	-0.298	-0.632	-0.015	0.057
	(0.016)	(0.041)	(0.008)	(0.005)	(0.219)	(0.219)	(0.217)	(0.139)	(0.048)	(0.043)
Z_{2t-1}	-0.002	-0.008	0.006	0.001	-0.005	0.013	-0.317	0.106	-0.095	-0.049
	(0.009)	(0.022)	(0.004)	(0.003)	(0.115)	(0.115)	(0.114)	(0.073)	(0.025)	(0.022)
Z_{3t-1}	-0.003	-0.077	-0.061	-0.018	-0.214	0.164	2.433	0.130	0.334	0.339
	(0.046)	(0.116)	(0.021)	(0.014)	(0.617)	(0.616)	(0.609)	(0.389)	(0.134)	(0.120)
Z_{4t-1}	0.011	0.263	0.047	0.016	0.267	-0.202	-5.252	-1.869	0.007	-0.355
	(0.060)	(0.151)	(0.027)	(0.019)	(0.803)	(0.802)	(0.793)	(0.507)	(0.175)	(0.156)
Δip_{t-1}	0.377	0.183	-0.001	0.049	-0.769	0.834	-1.826	-0.507	0.104	0.088
	(0.070)	(0.176)	(0.032)	(0.022)	(0.939)	(0.938)	(0.928)	(0.593)	(0.204)	(0.183)
Δsp_{t-1}	0.141	0.101	0.026	0.005	0.373	-0.389	0.028	-0.680	0.075	-0.025
	(0.036)	(0.092)	(0.017)	(0.011)	(0.489)	(0.489)	(0.483)	(0.309)	(0.106)	(0.095)
Δm_{t-1}	-0.311	-0.958	-0.154	0.001	1.299	-1.178	0.627	0.968	-0.533	0.068
	(0.185)	(0.467)	(0.085)	(0.057)	(2.487)	(2.484)	(2.457)	(1.570)	(0.541)	(0.483)
Δp_{t-1}	0.174	-0.327	0.088	0.242	0.226	-0.392	5.002	3.526	1.024	0.162
	(0.263)	(0.666)	(0.121)	(0.082)	(3.543)	(3.539)	(3.501)	(2.237)	(0.771)	(0.689)
ΔR_{t-1}	-0.059	-0.004	-0.011	-0.005	2.261	-1.374	-0.930	-0.839	0.318	-0.227
	(0.085)	(0.215)	(0.039)	(0.026)	(1.144)	(1.142)	(1.130)	(0.722)	(0.249)	(0.222)
ΔR^S_{t-1}	-0.066	-0.026	-0.009	-0.009	2.139	-1.259	-0.753	-0.779	0.311	-0.228
	(0.086)	(0.217)	(0.039)	(0.027)	(1.155)	(1.154)	(1.141)	(0.729)	(0.251)	(0.224)
ΔQS_{t-1}	-0.011	-0.093	-0.003	0.000	0.031	-0.027	0.460	0.183	0.005	-0.001
	(0.006)	(0.016)	(0.003)	(0.002)	(0.086)	(0.086)	(0.085)	(0.054)	(0.019)	(0.017)
ΔEPU_{t-1}	0.015	-0.001	0.006	-0.002	0.010	-0.016	0.035	-0.109	-0.018	0.007
	(0.009)	(0.023)	(0.004)	(0.003)	(0.123)	(0.123)	(0.122)	(0.078)	(0.027)	(0.024)
ΔS^{NYT}_{t-1}	0.039	0.013	-0.006	-0.002	0.069	-0.076	-0.148	-0.265	-0.025	-0.025
	(0.028)	(0.072)	(0.013)	(0.009)	(0.382)	(0.382)	(0.378)	(0.241)	(0.083)	(0.074)
ΔS^{WSJ}_{t-1}	-0.006	-0.014	-0.008	-0.001	-0.065	0.046	0.616	-0.578	-0.232	-0.047
	(0.033)	(0.084)	(0.015)	(0.010)	(0.447)	(0.447)	(0.442)	(0.283)	(0.097)	(0.087)
$Const.$	-0.001	0.002	0.000	-0.002	0.002	-0.003	0.000	0.002	0.007	-0.003
	(0.002)	(0.006)	(0.001)	(0.001)	(0.029)	(0.029)	(0.029)	(0.019)	(0.006)	(0.006)
R^2	0.505	0.346	0.320	0.344	0.071	0.054	0.355	0.411	0.237	0.230
$\overline{R}^2$	0.459	0.286	0.257	0.284	-0.015	-0.034	0.295	0.356	0.166	0.158
$LogLik.$	388.7	234.9	517.8	583.2	-42.7	-42.5	-40.7	33.6	210.4	229.2
AIC	-4.503	-2.649	-6.058	-6.845	0.695	0.693	0.671	-0.224	-2.355	-2.581
SIC	-4.222	-2.368	-5.777	-6.564	0.977	0.974	0.953	0.057	-2.073	-2.300

Notes: Numbers in parentheses are standard errors. Lowercase variables are in natural logs.
Upper case variables are in levels.

Table 6: Forecast Error Variance Decomposition.

					$\log IP$					
Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	92.55	4.53	0.50	0.12	0.26	0.02	0.43	0.03	0.01	1.54
3	85.33	7.42	0.90	0.12	0.76	0.13	1.48	0.02	0.29	3.56
4	80.17	8.90	1.03	0.10	1.18	0.30	2.06	0.01	0.65	5.60
5	76.77	9.57	1.09	0.09	1.46	0.54	2.17	0.02	1.00	7.30
10	68.79	10.04	1.23	0.06	2.41	2.96	1.83	0.27	2.29	10.12
20	61.36	9.34	1.24	0.19	4.65	7.34	1.60	1.04	4.58	8.65
30	58.01	8.78	1.20	0.36	6.35	8.76	1.37	1.67	5.98	7.53
40	56.35	8.47	1.17	0.45	7.42	9.19	1.21	2.07	6.76	6.90
50	55.36	8.28	1.16	0.51	8.11	9.40	1.10	2.33	7.24	6.51
					$\log SP$					
Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	12.01	87.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	15.64	76.46	0.92	0.01	0.31	0.21	5.19	1.00	0.14	0.12
3	18.95	69.65	1.13	0.00	0.60	0.36	6.10	2.47	0.35	0.39
4	20.94	66.14	1.23	0.10	0.60	0.46	5.10	3.84	0.52	1.07
5	21.81	64.15	1.31	0.35	0.52	0.62	4.10	4.71	0.61	1.82
10	21.13	61.27	1.63	1.22	0.28	2.93	2.22	6.05	0.65	2.62
20	18.36	59.27	1.76	1.27	0.17	7.64	1.58	6.84	0.97	2.14
30	16.69	58.65	1.78	1.20	0.15	10.10	1.39	7.07	1.20	1.78
40	15.78	58.43	1.79	1.15	0.15	11.34	1.28	7.17	1.34	1.57
50	15.23	58.33	1.80	1.12	0.15	12.07	1.21	7.24	1.42	1.44
					$\log M$					
Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	3.97	7.21	88.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	7.28	13.40	74.11	0.34	1.49	0.03	0.68	1.63	0.01	1.03
3	10.94	15.41	63.51	0.72	2.66	0.10	1.96	2.17	0.17	2.36
4	14.61	16.71	53.32	1.12	3.68	0.21	2.88	2.93	0.45	4.08
5	17.66	17.37	44.93	1.54	4.56	0.39	3.55	3.61	0.69	5.70
10	24.47	17.56	23.28	2.74	6.90	2.25	5.47	5.41	1.20	10.72
20	24.45	16.44	13.08	2.92	8.13	7.58	7.54	6.32	1.07	12.46
30	22.88	15.78	10.74	2.75	8.45	11.27	8.50	6.55	0.90	12.19
40	21.91	15.44	9.86	2.63	8.58	13.27	8.98	6.64	0.81	11.90
50	21.36	15.25	9.41	2.56	8.65	14.38	9.24	6.69	0.75	11.72

Table 6 continued.

$\log P$

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	0.27	0.10	0.13	99.50	0.00	0.00	0.00	0.00	0.00	0.00
2	3.71	0.50	0.23	95.04	0.21	0.01	0.06	0.12	0.00	0.12
3	7.98	1.42	0.32	88.51	0.19	0.03	0.35	0.62	0.01	0.56
4	11.87	2.34	0.40	81.91	0.13	0.09	0.83	1.17	0.01	1.26
5	15.04	3.13	0.46	75.93	0.10	0.17	1.33	1.68	0.01	2.16
10	22.21	5.28	0.65	58.10	0.37	1.25	3.00	3.08	0.04	6.02
20	23.48	6.31	0.79	46.59	0.94	4.92	4.85	4.00	0.04	8.07
30	22.65	6.44	0.83	43.09	1.15	7.63	5.71	4.29	0.03	8.20
40	22.04	6.44	0.83	41.63	1.22	9.13	6.13	4.41	0.02	8.13
50	21.69	6.44	0.84	40.85	1.26	9.98	6.37	4.48	0.02	8.08

R

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	1.08	0.13	4.76	0.41	93.61	0.00	0.00	0.00	0.00	0.00
2	1.12	0.74	3.74	0.52	93.44	0.23	0.01	0.07	0.01	0.12
3	1.31	0.97	3.34	0.58	92.68	0.65	0.01	0.14	0.03	0.31
4	1.67	1.11	3.07	0.63	91.52	1.21	0.01	0.22	0.03	0.53
5	2.21	1.26	2.90	0.70	89.94	1.85	0.02	0.30	0.02	0.80
10	6.41	2.38	2.64	1.19	79.05	4.59	0.15	0.76	0.11	2.72
20	12.82	4.13	2.71	2.06	64.00	5.75	0.46	1.48	0.36	6.23
30	15.46	4.94	2.81	2.43	58.17	5.32	0.72	1.87	0.45	7.83
40	16.65	5.34	2.87	2.60	55.61	4.94	0.87	2.07	0.48	8.58
50	17.31	5.57	2.90	2.69	54.20	4.70	0.96	2.19	0.50	8.99

R^S

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	1.02	0.12	4.85	0.39	93.51	0.10	0.00	0.00	0.00	0.00
2	1.00	0.75	3.90	0.50	93.57	0.05	0.00	0.08	0.01	0.13
3	1.11	1.00	3.54	0.55	93.19	0.09	0.02	0.17	0.04	0.29
4	1.38	1.15	3.30	0.59	92.55	0.19	0.04	0.27	0.04	0.49
5	1.79	1.31	3.16	0.64	91.57	0.32	0.08	0.37	0.03	0.72
10	5.16	2.45	3.02	1.05	83.59	0.93	0.42	0.95	0.06	2.38
20	10.38	4.18	3.18	1.75	71.12	0.94	1.07	1.81	0.17	5.40
30	12.42	4.94	3.30	2.03	65.95	0.68	1.51	2.25	0.21	6.71

Table 6 continued.

40	13.29	5.31	3.36	2.15	63.62	0.53	1.75	2.47	0.22	7.30
50	13.77	5.51	3.40	2.22	62.32	0.43	1.90	2.60	0.22	7.63

QS

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	4.67	17.64	0.06	0.00	0.45	1.47	75.70	0.00	0.00	0.00
2	9.81	17.49	0.48	0.01	1.69	1.42	67.13	1.64	0.01	0.32
3	13.34	17.64	0.89	0.58	2.01	1.39	58.11	3.95	0.02	2.08
4	14.84	17.22	1.27	2.37	1.93	1.54	50.40	5.72	0.01	4.71
5	14.90	16.53	1.63	4.96	1.77	1.97	44.65	6.74	0.05	6.80
10	11.55	14.05	3.00	13.24	1.53	8.90	31.59	8.43	0.31	7.42
20	7.22	10.92	3.76	16.78	2.01	21.82	22.83	9.41	0.21	5.04
30	5.37	9.27	4.03	18.05	2.58	28.09	19.08	9.61	0.15	3.79
40	4.32	8.34	4.20	18.92	2.99	31.42	16.90	9.73	0.12	3.07
50	3.63	7.73	4.32	19.54	3.26	33.54	15.45	9.83	0.10	2.59

EPU

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	0.41	0.37	3.34	0.00	0.01	0.77	1.95	93.16	0.00	0.00
2	4.09	6.55	3.55	0.21	0.23	0.75	6.84	76.89	0.02	0.87
3	8.53	7.14	4.04	0.18	0.32	0.68	7.53	69.42	1.41	0.76
4	12.03	6.83	4.22	0.52	0.30	0.65	6.93	64.72	2.96	0.84
5	13.88	6.30	4.26	1.44	0.51	0.60	7.27	60.62	4.15	0.97
10	18.75	4.72	4.47	4.68	2.20	1.94	6.83	48.42	7.20	0.78
20	24.10	3.32	4.57	6.34	4.44	8.68	4.22	33.04	10.79	0.51
30	24.76	2.60	4.52	6.70	5.47	14.32	3.00	25.66	12.61	0.37
40	24.73	2.18	4.48	6.81	5.99	17.78	2.34	21.67	13.75	0.28
50	24.68	1.91	4.45	6.88	6.31	19.96	1.92	19.18	14.49	0.23

LM^{WSJ}

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	0.69	0.01	0.10	2.34	0.08	0.28	1.09	3.03	92.38	0.00
2	0.48	0.05	0.08	4.37	0.36	0.30	1.05	8.96	84.28	0.07
3	0.43	0.22	0.66	5.30	0.60	0.42	1.02	12.87	77.26	1.22
4	0.37	0.50	1.76	5.51	0.68	0.47	0.99	15.23	71.51	2.98
5	0.40	0.76	2.95	5.36	0.72	0.45	1.17	16.33	67.45	4.41
10	0.84	1.12	7.36	3.73	1.28	0.31	5.50	17.67	54.78	7.41

Table 6 continued.

20	2.07	1.73	11.64	2.27	2.27	0.22	8.96	17.85	43.95	9.01
30	2.80	2.12	13.69	1.64	2.86	0.27	10.13	17.70	39.36	9.43
40	3.17	2.33	14.83	1.28	3.21	0.34	10.73	17.60	36.81	9.70
50	3.38	2.46	15.56	1.06	3.43	0.39	11.12	17.54	35.19	9.89

S^{WSJ}

Period	u_{ip}	u_{sp}	u_m	u_p	u_R	u_{R^S}	u_{QS}	u_{EPU}	$u_{S^{NYT}}$	$u_{S^{WSJ}}$
1	1.91	5.37	0.64	0.47	0.00	1.67	2.53	0.50	6.16	80.76
2	2.85	4.91	1.41	0.43	0.32	1.27	4.52	0.86	9.05	74.38
3	3.65	4.74	1.84	0.40	0.91	1.08	6.30	1.82	11.10	68.16
4	4.39	4.58	2.21	0.37	1.67	0.96	7.72	3.00	12.06	63.03
5	4.97	4.37	2.61	0.34	2.45	0.92	8.56	4.16	12.48	59.14
10	5.85	3.36	4.57	0.26	5.47	1.74	9.23	7.24	13.60	48.68
20	6.38	2.32	6.46	0.17	8.94	5.75	8.44	8.68	14.63	38.22
30	6.99	1.86	7.04	0.15	10.19	8.82	7.59	9.01	15.02	33.33
40	7.44	1.63	7.28	0.15	10.73	10.53	7.10	9.18	15.21	30.75
50	7.74	1.49	7.42	0.15	11.05	11.56	6.81	9.28	15.33	29.18

B Impulse Response Functions

Figure 16: Response to Industrial Production Shocks

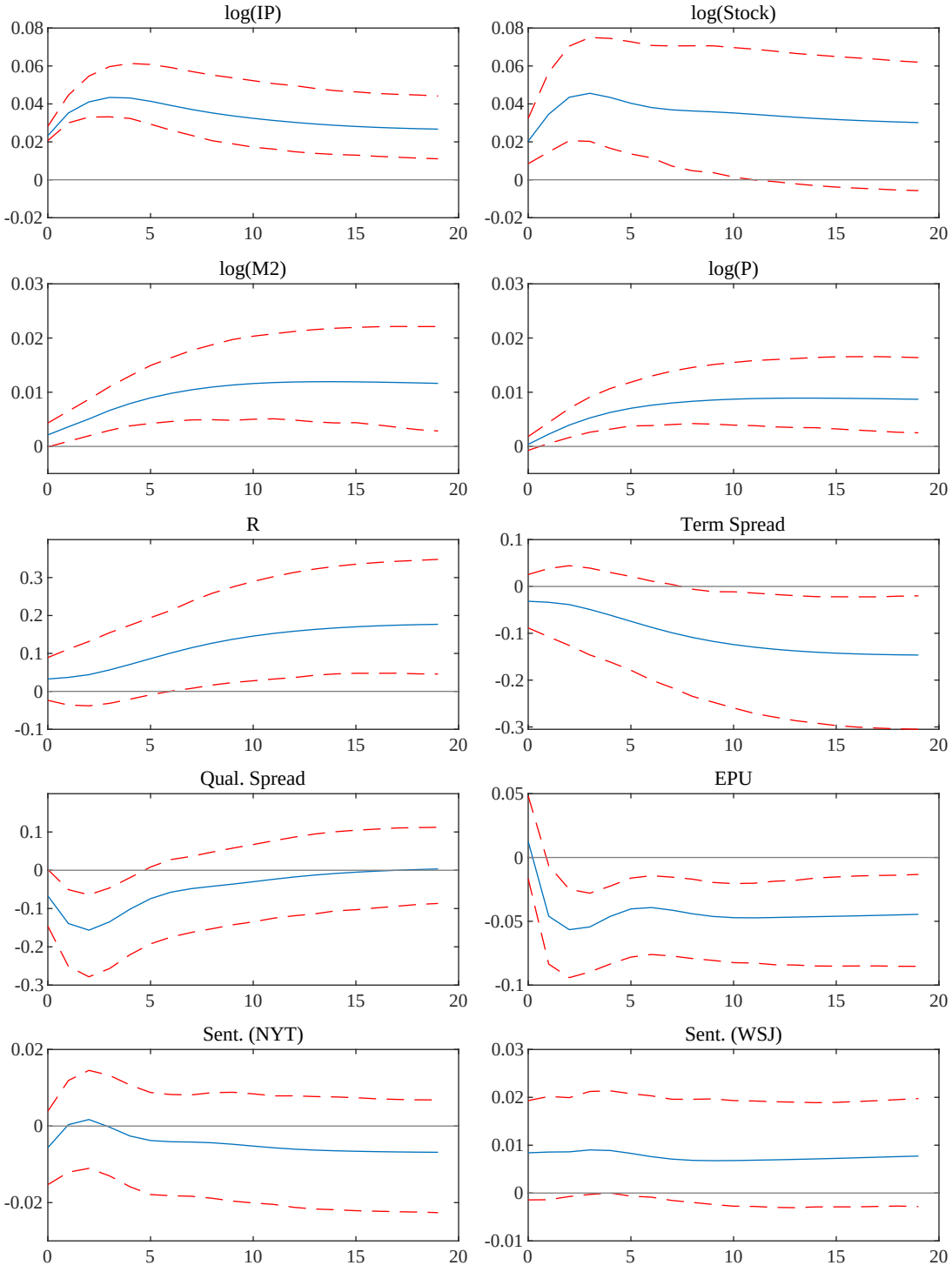

Figure 17: Response to Stock Market Shocks

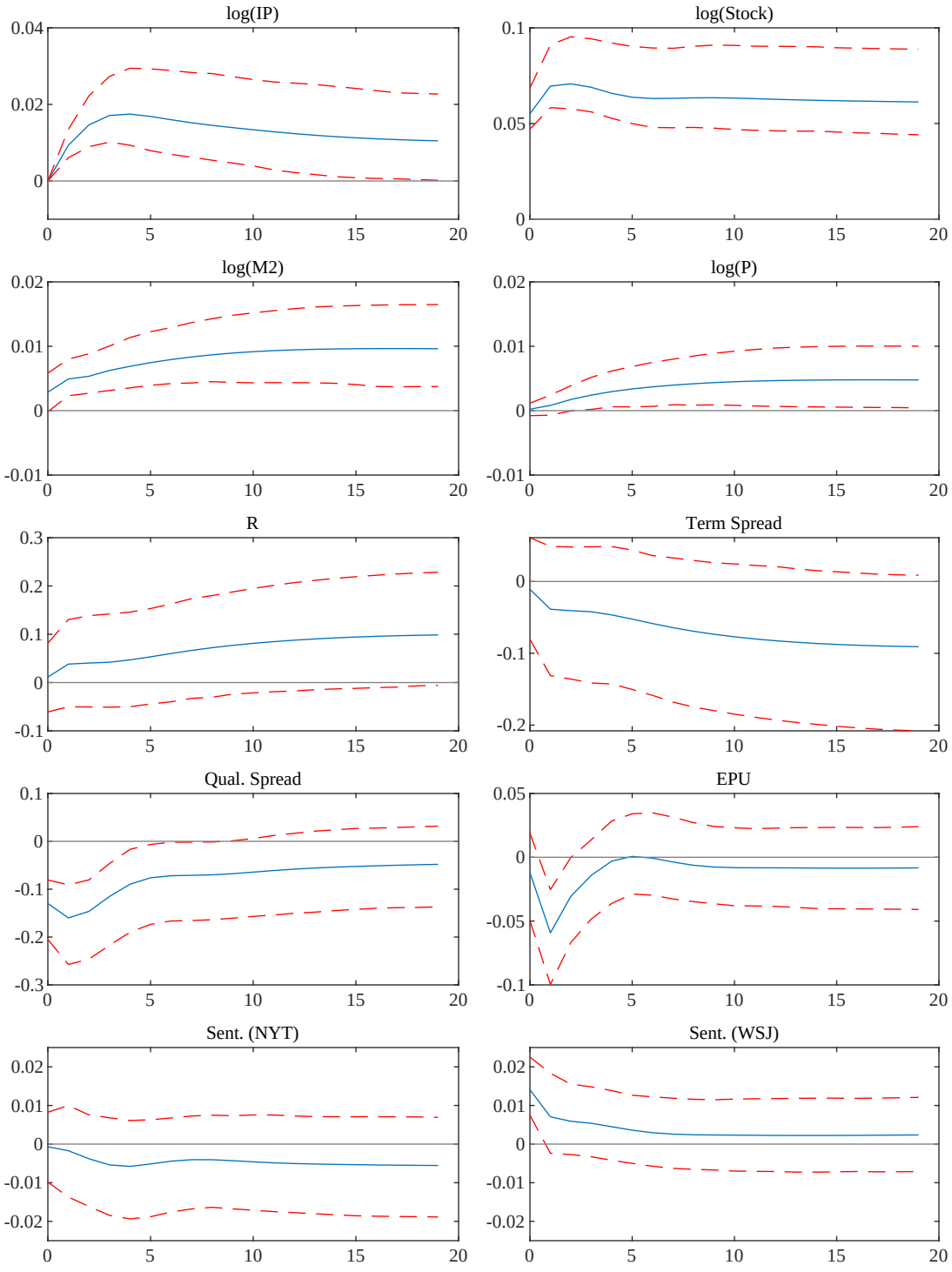

Figure 18: Response to Money Supply Level Shocks

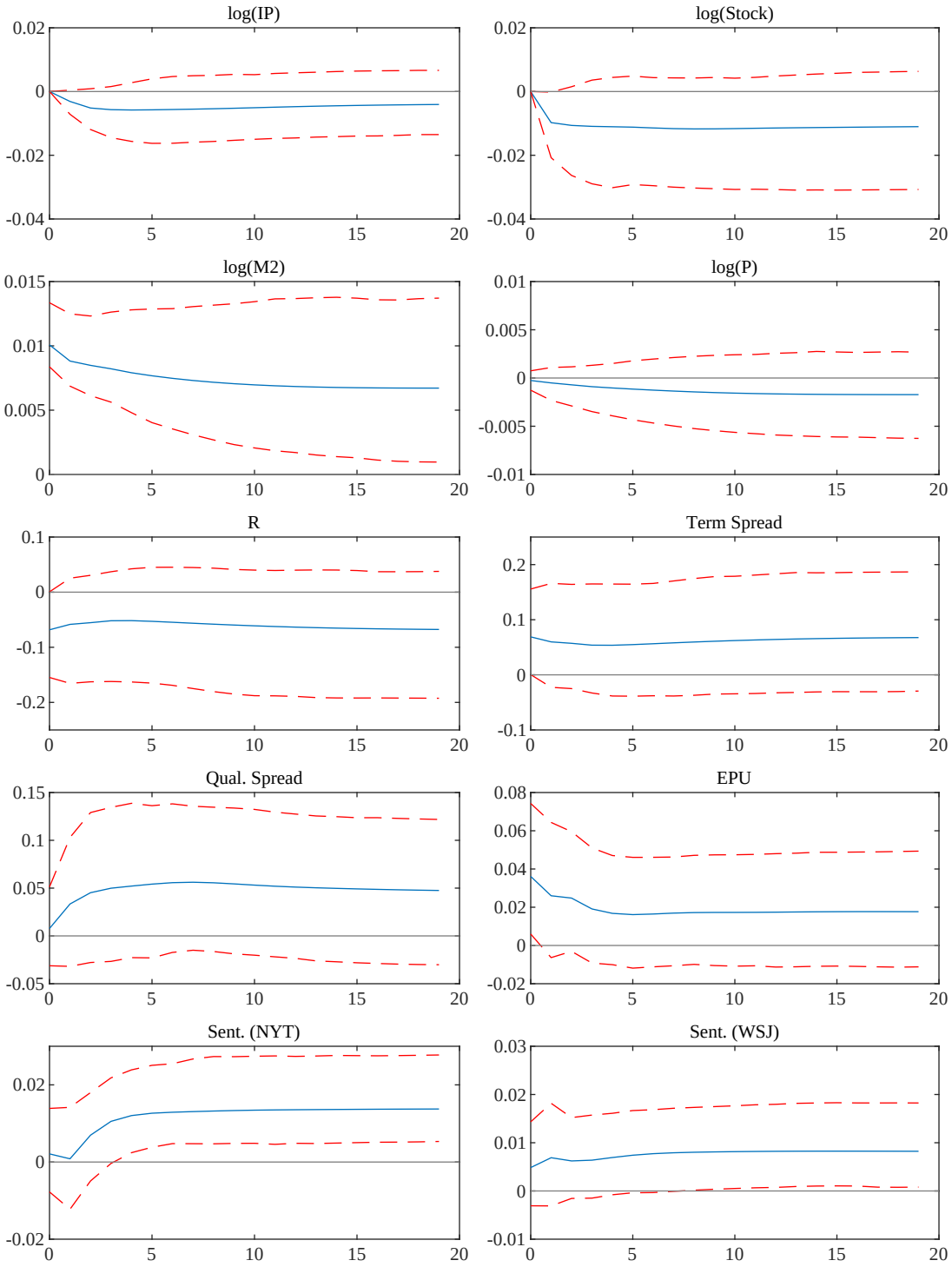

Figure 19: Response to Price Level Shocks

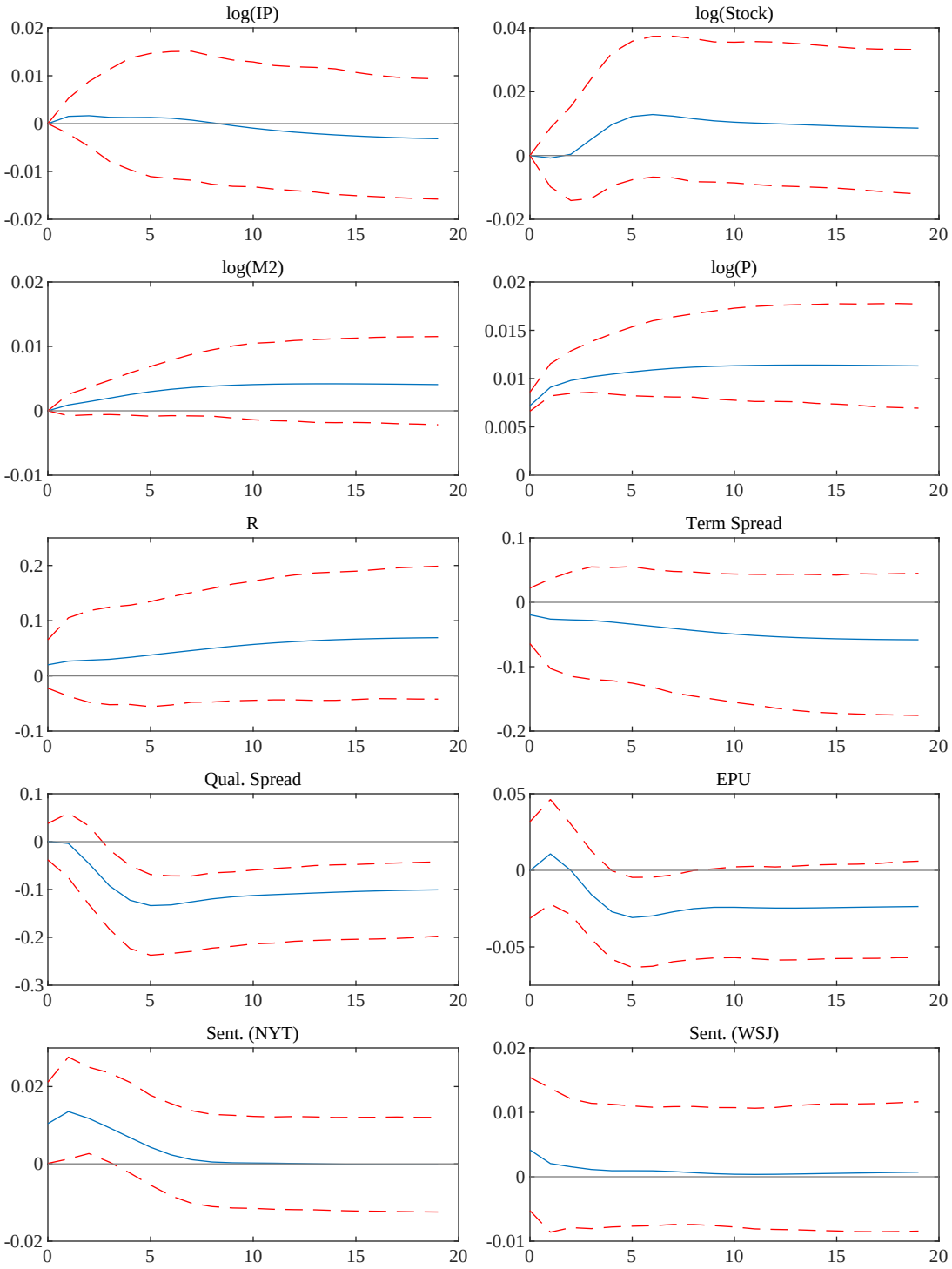

Figure 20: Response to Nominal Interest Rate Shocks

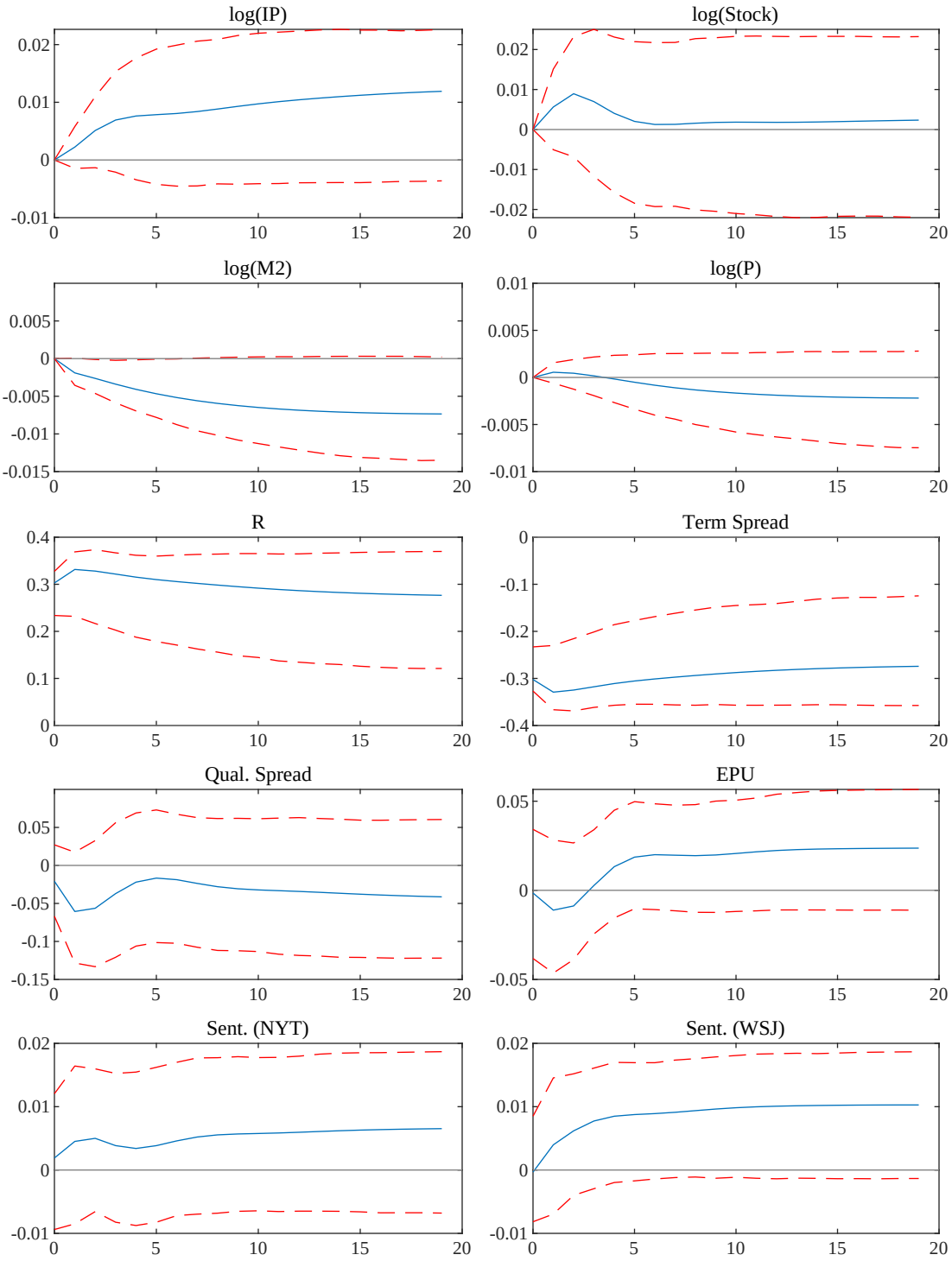

Figure 21: Response to Term Spread Shocks

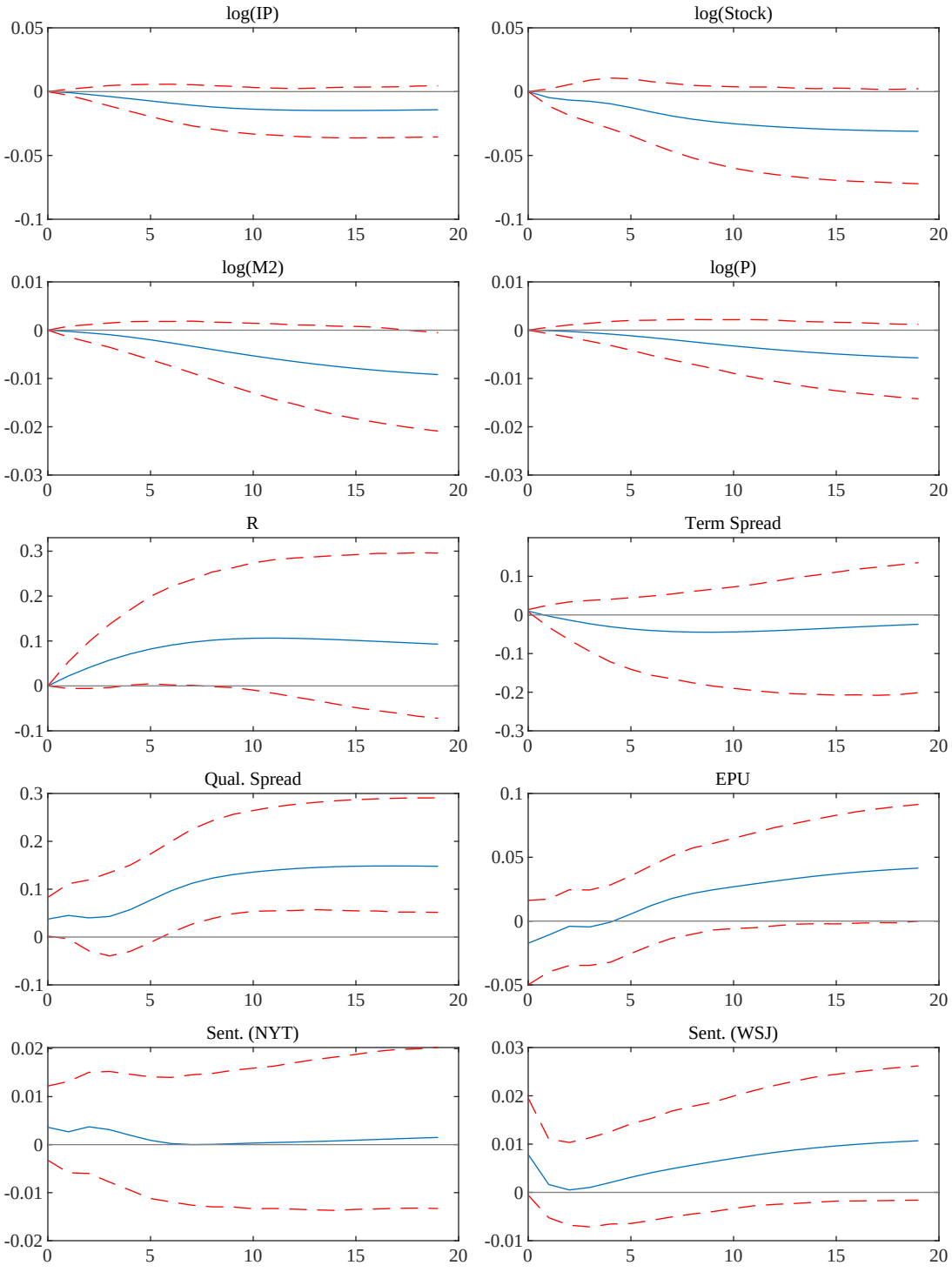

Figure 22: Response to Quality Spread Shocks

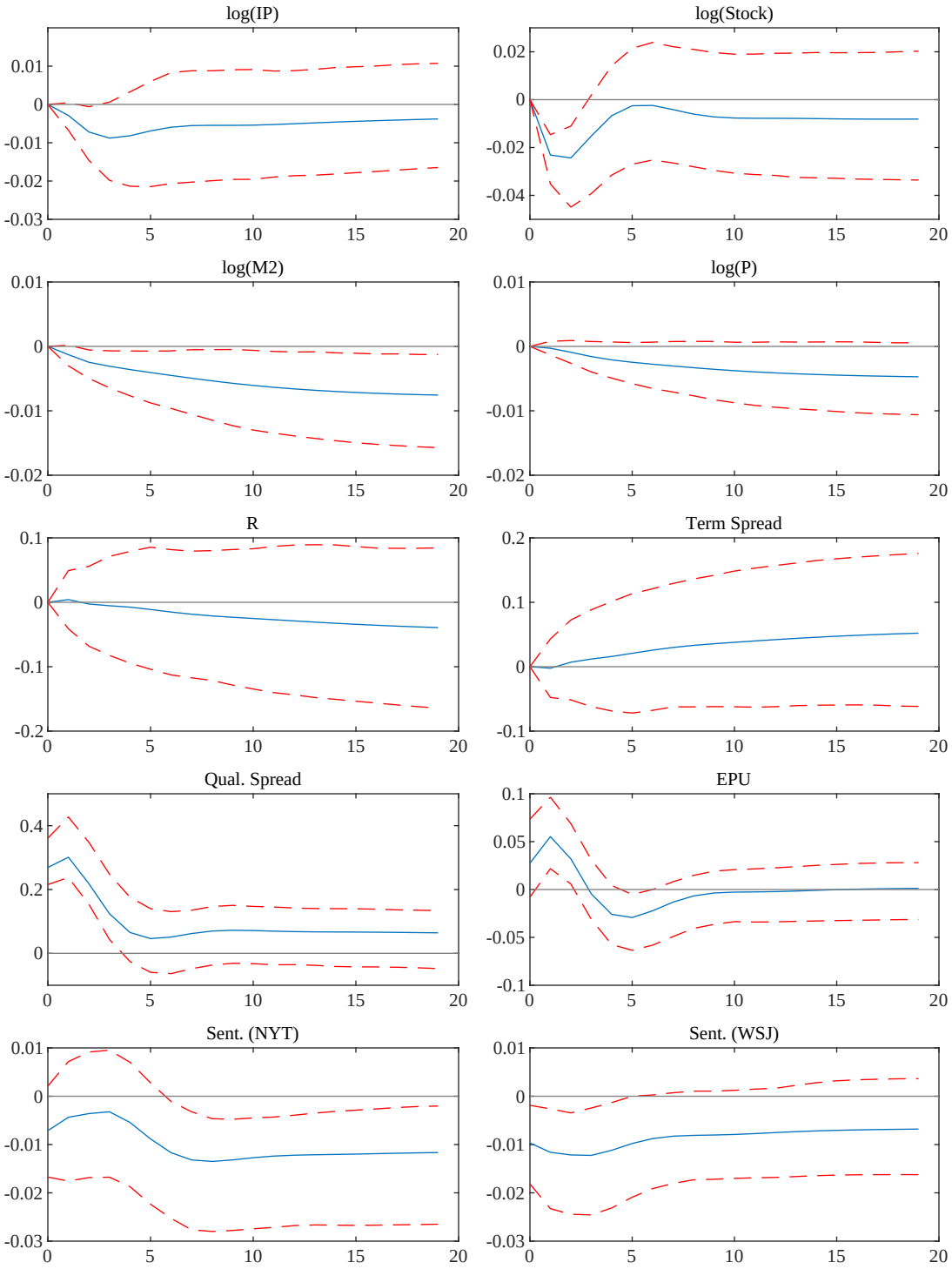

Figure 23: Response to Economic Policy Uncertainty Shocks

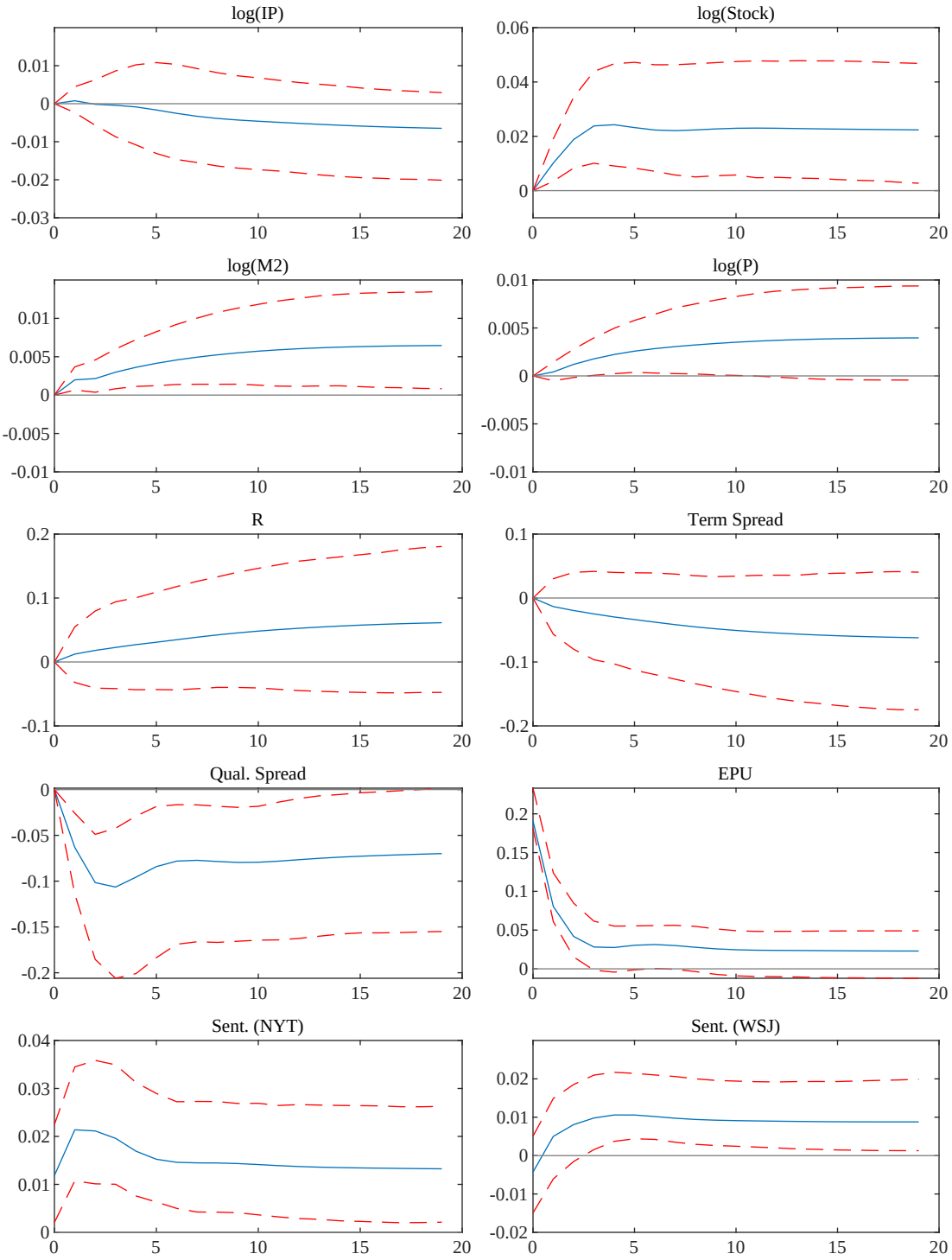

Figure 24: Response to Sentiment (NYT) Shocks

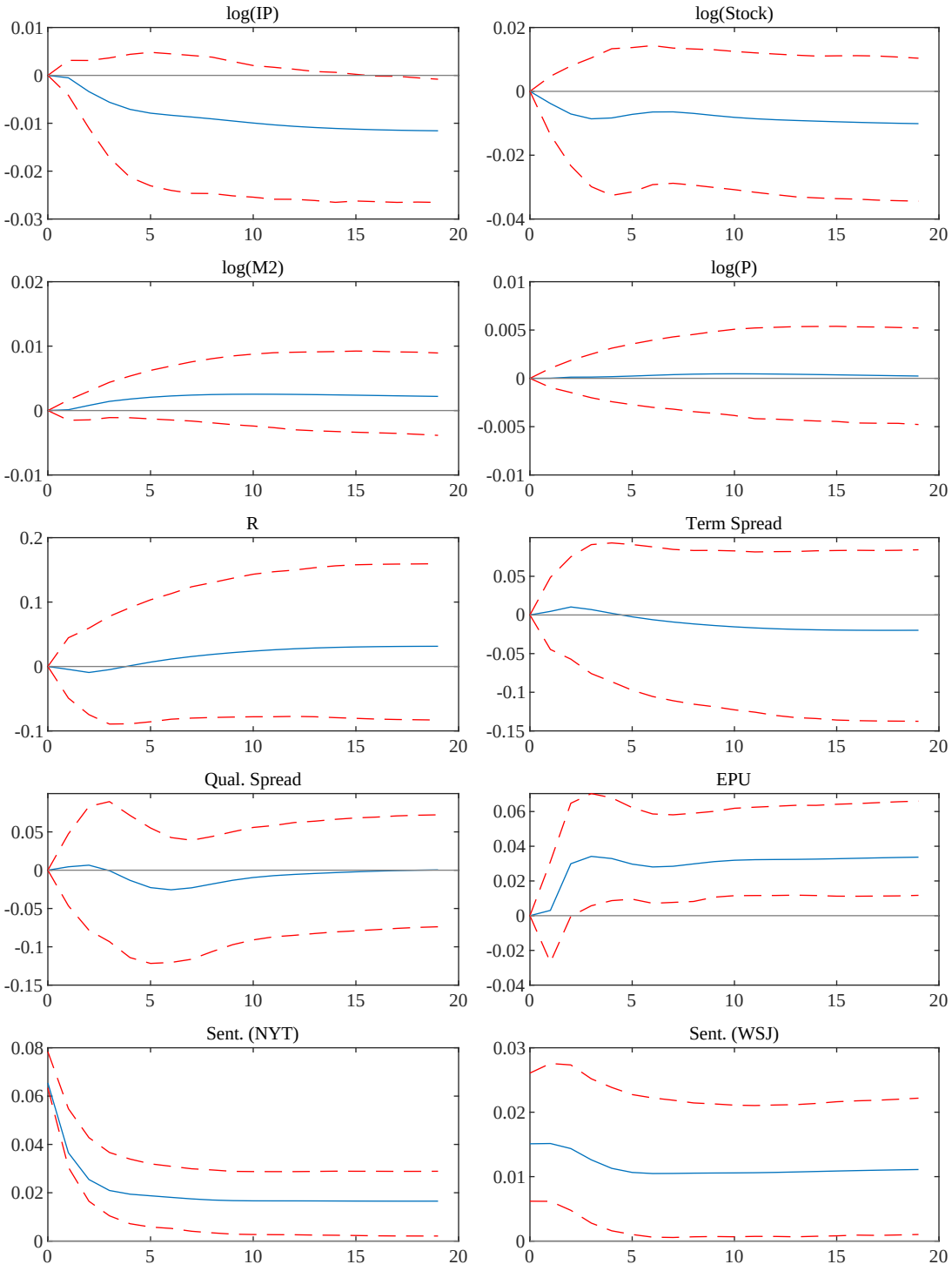

Figure 25: Response to Sentiment (WSJ) Shocks