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Sentiment and Uncertainty about Regulation

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Keywords

Regulation, text analysis, NLP, sentiment analysis, uncertainty

JEL Classification

E2, E3, K2, O4

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Sentiment and Uncertainty about Regulation*

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1 Introduction

The COVID-19 pandemic has disrupted daily lives and business operations. As part of the policy responses to the pandemic, the U.S. government has taken various regulatory actions. These regulatory responses include interstate and foreign quarantine, state and local “shelter-in-place” orders, the emergency use authorization of medical products, and temporary relaxations of certain regulatory requirements. While the primary objective of these regulations is to contain the spread of coronavirus and protect public health, they also affected many business activities and generated substantial economic impacts.

The U.S. government issues thousands of regulations a year. Some of these are in response to crises, such as the current pandemic, while others have evolved over time to address longer term goals. Regulations can address market failures to reduce or eliminate negative externalities and improve efficiency of resource allocation, creating significant economic and social benefits. However, poorly designed or excessive regulations may impose “regulatory burden” on the economy, which can potentially generate substantial adverse effects on aggregate economic outcomes. How regulation affects the economy is thus an important question for both researchers and policymakers and particularly relevant today.

While the existing research studying the economic effects of regulation has mostly focused on the quantity of regulation, subjective perceptions of regulation could also influence firms’ investment and hiring decisions and thus affect the aggregate economic activity. In this study, we construct news-based measures of sentiment and uncertainty about regulation in the U.S. over time and examine their relationships with macroeconomic performance. We construct the measures using computational text analysis of news data, which cover 493,418 news articles related to regulation from seven leading U.S. newspapers from January 1985 to August 2020. The overall trend of these articles suggests increasing news attention to regulatory policy over time, stressing the need to investigate the content of regulation-related news. We then use a lexicon-based sentiment analysis method to evaluate two dimensions of the news corpus: the general sentiment (i.e., positive and negative tone) and the degree of

uncertainty expressed in the news about regulation, which capture the subjective attitudes toward the overall regulatory environment. As a result, we build monthly indexes of regulatory sentiment and uncertainty from 1985 to 2020. In addition to the aggregate indexes, we also categorize relevant news articles into 14 regulatory policy areas and construct categorical indexes that measure sentiment and uncertainty around specific policy areas in the news.

Using our regulatory indexes, we estimate impulse responses of key macroeconomic variables to shocks in sentiment and uncertainty about regulation, following the vector autoregression (VAR) models in Baker et al. (2016). We have three key findings. First, the impulse response estimates suggest that a negative shock to sentiment about regulation is associated with large, persistent drops in future output and employment, while a regulatory uncertainty shock overall reduces output and employment temporarily. This indicates that news sentiment about regulation may be a more appropriate measure reflecting the connection between regulation and macroeconomic outcomes than uncertainty about regulation. Second, the impulse responses to regulatory sentiment shocks remain after controlling for news-based measures of general economic sentiment or economic policy uncertainty, implying that our regulatory sentiment measure contains some unique information that may be valuable for predicting future economic activity. Third, economic outcomes are particularly sensitive to sentiment and uncertainty around certain regulatory policy areas. Specifically, we find that negative sentiment shocks related to transportation regulation have negative, long-lasting effects on future output and employment, and sentiment shocks around finance and banking regulation have relatively transitory but measurable effects on employment. In addition, increased uncertainty about labor and workplace regulation leads to a persistent reduction in output.

Economic research has well documented that sentiment measuring subject attitudes toward current and future economic conditions has strong predictive power for many macroeconomic outcomes (Bram and Ludvigson, 1998; Carroll et al., 1994; Benhabib and Spiegel,

2019). Survey-based measures of economic sentiment are most widely used in empirical studies, including the Michigan Consumer Sentiment Index and the Conference Board’s Consumer Confidence Index. However, these measures are often subject to limitations due to small sample sizes covered in surveys and low data frequency. As a result, recent studies have begun to discover sentiment measures with high-frequency information in the news. News-based economic sentiment measures are found to be strongly correlated with survey-based measures and help explain aggregate economic fluctuations (Shapiro et al., 2020; Fraiberger, 2016).

The development of news-based measures is partially a result of the advance in computational text analysis during recent years. Research using text as data has introduced economists to advanced natural language processing (NLP) techniques (Gentzkow et al., 2019). As a popular field of NLP, sentiment analysis is used to extract, quantify, and analyze the semantic orientation of a document, such as customer reviews, social media, survey responses, and news articles. In addition to a mere polar view of sentiment (i.e., positive or negative), sentiment analysis methods can be applied to broader sentiment classifications to extract other subjective information in source material, such as emotional states (e.g., happiness, fear, and anger), subjectivity, confidence, and uncertainty.

Uncertainty has a long history in economic research, including a literature explicitly focused on policy uncertainty (for example, Rodrik (1991); Hassett and Metcalf (1999); Pastor and Veronesi (2012)). Similar to the sentiment literature, text-based measures of policy uncertainty have gained rapid development and increasing attention recently. A key contribution is made by the news-based economic policy uncertainty (EPU) index developed by Baker et al. (2016). Numerous studies have been published subsequently to develop similar measures for other countries (Arbatli et al., 2017; Cerda et al., 2016) and specific policy areas such as trade policy and monetary policy (Caldara et al., 2020; Husted et al., 2019). This research generally finds that increased policy uncertainty reduces business investment and employment growth, raises precautionary savings, and increases stock price volatility (Baker

et al., 2016; Bloom et al., 2018; Gulen and Ion, 2016; Caldara et al., 2020; Julio and Yook, 2016). Comparatively, uncertainty surrounding regulatory policy remains largely unexplored.

Just as measures of economic sentiment and uncertainty reveal information about current and future economic activity, our study suggests that news-based measures of sentiment and uncertainty about regulation may provide important information for understanding the effects of regulatory policy on aggregate economic outcomes. Therefore, our study also connects to the literature studying the aggregate economic effects of regulation. As detailed in the next section, this literature has mostly focused on the volume or restriction of regulation (Coffey et al., 2020; Dawson and Seater, 2013), so our study presents a new direction of considering the economic impact of regulation.

Our study has several practical implications. First, although it's hard to draw any conclusion on the causal effects of regulatory sentiment and uncertainty on macroeconomic activity based on the VARs, the dynamic relationships we show in this paper suggest that an improvement in the regulatory system that increases public confidence and reduces uncertainty in government interventions may help minimize unnecessary regulatory burden on the economy. Second, news sentiment and uncertainty around certain regulatory policy areas appear to have particularly strong links with macroeconomic performance. Policymakers in those areas should explicitly consider both incremental and cumulative economic effects of their regulations and increase transparency and clarity of the regulations. Third, up-to-date indexes of regulatory sentiment and uncertainty can provide forward-looking information about economic conditions. This information may help businesses better anticipate payoffs and make optimal hiring and investment decisions.

In the next section, we discuss the theoretical framework and empirical evidence in the existing literature for understanding the economic effects of regulation. In Section 3, we describe the data we use in this study, including text data of news articles and economic data used in the VAR analysis. In Section 4, we describe our approach to identifying the news content related to regulation and the evidence of increasing media attention to regulation

over time. Section 5 presents the regulatory sentiment and uncertainty indexes, including the sentiment analysis method we use to construct the indexes, some descriptive analysis of the indexes, and the impulse responses of macroeconomic variables to regulatory sentiment and uncertainty shocks. In Section 6, we describe the categorical indexes that measure news sentiment and uncertainty in 14 regulatory policy areas and their varied roles in the impulse responses of macroeconomic outcomes. Section 7 concludes the study.

2 Economic Effects of Regulation

Regulations, also called rules, are the primary tools that the government uses to implement laws and achieve policy goals. Regulations often involve “specific standards or instructions concerning what individuals, businesses, and other organizations can or cannot do” (Dudley and Brito, 2012, p.1). In this paper, we examine regulations in the U.S., with a focus on regulatory actions considered by the federal government. Federal agencies issue thousands of rules every year, covering a broad range of issues such as health, safety, transportation, and the environment. For example, the Food and Drug Administration (FDA) regulates the production, distribution, and packaging of certain foods and medical products to ensure consumer health and safety; the Environmental Protection Agency (EPA) issue regulations to control pollutants, manage waste and hazardous substances, restore wetlands, and ensure drinking water quality.

Given the broad scope of issues covered by regulatory policy, it can affect various industries and generate substantial impacts on the economy. These impacts are considered both incrementally and cumulatively. The incremental economic effects of regulations are partially reflected in agencies’ regulatory impact analyses. When issuing a new regulation that may have significant effects on the economy, executive branch agencies are required to estimate the costs and benefits of the intended regulation and adopt the regulation only if “the benefits...justify its costs” (Clinton, 1993, p.51736). However, such regulatory im-

impact analysis is an ex-ante assessment of the effects of a regulation, based on unverifiable assumptions and models of the counterfactual (Dudley, 2017). Agencies rarely conduct retrospective analyses to assess the realized impacts of the regulation after it is implemented (Dudley, 2017). Scholarly research comparing available ex-post assessments of the costs and benefits of individual regulations and their ex-ante estimates suggests that the costs of regulations tend to be overestimated in ex-ante analyses (Harrington et al., 2000). In addition, many independent agencies (e.g., Federal Communications Commission) are not subject to the requirement of conducting regulatory impact analyses for issuing rules.

Even if individual regulations are estimated to generate net benefits, regulations can create indirect and cumulative economic impacts that are not considered in analyses of individual regulations. Eads (1980) discusses four channels through which regulation can affect innovation, which also have important implications for considering the aggregate economic effects of regulation. First, regulation imposes restrictions on firm behavior and thus diverts resources that otherwise might be used for production and innovation (Eads, 1980). While the direct costs for compliance with regulatory requirements are typically considered in regulatory impact analyses, the indirect effects on innovation and productivity are often overlooked.

In academic research, theoretical models that incorporate the effects of regulation on innovation or productivity are also limited. Coffey et al. (2020) presents one way of considering the impact of regulatory constraints on productivity in an endogenous growth model. In their model, firm i in industry j produces goods with the following technology:

$$Y_{ij} = Z_{ij}^{\zeta_j(R_j)} [L_{Y_{ij}} - \phi_j(R_j)],$$

where $Z_{ij}^{\zeta_j(R_j)}$ is the total factor productivity, Z_{ij} is the labor-enhancing knowledge specific to the firm, ζ_j is the elasticity of the firm's output to knowledge, $L_{Y_{ij}}$ is the labor employed in producing Y_{ij} , ϕ_j is a fixed labor cost, and R_j is regulatory constraints (Coffey et al.,

2020). The firm accumulates knowledge according to:

$$\dot{Z}_{ij} = \kappa(R_j)K_jL_{Z_{ij}},$$

where $L_{Z_{ij}}$ is the labor invested in knowledge accumulation, K_j is the stock of public knowledge in the industry, and $\kappa(R_j)$ governs how much knowledge is generated by the firm’s investment given the regulatory restrictions R_j (Coffey et al., 2020). Therefore, their model captures the direct effect of regulation on the firm’s fixed labor costs (i.e., labor used for compliance) and the indirect effect on the firm’s productivity growth.

Second, regulation may change the firm’s ability to calculate the payoffs to investments (Eads, 1980). This connects to the broad literature studying uncertainty. Uncertainty hampers firms’ ability to form a probability distribution of payoffs, making firms more cautious about their investment and hiring decisions. This is often referred to as the “real options” or “wait-and-see” effect (Bloom, 2014; Bachmann and Bayer, 2013). Regulatory uncertainty acts in a similar way. For example, a pharmaceutical company may have the option to invest in the development of a new drug; however, if the company is uncertain about whether the drug would be approved to enter the market by FDA, it may prefer to wait until some certainty is achieved. Less examined is other types of subjective attitude, such as sentiment about regulation, and how they affect firm behavior. The firm’s anticipation of payoffs may depend on whether business executives hold a positive or negative view about the current and future regulatory environment, which captures the idea of “animal spirits” that influence household and business behavior (Keynes, 1936; Shiller, 2017).

While the first two channels suggested by Eads (1980) point to the adverse effects regulation may impose on the economy, the other two channels imply indirect positive impacts of regulation. Eads (1980) argues that regulation may change the nature and the optional institutional patterns of research the firm undertakes. Examples include environmental regulations that stimulate innovation in pollution control techniques or new products or processes

that bring less harm to the environment. This follows Michael Porter’s discussion on environmental regulation and industry competitiveness, also known as the “Porter hypothesis” (Porter and Van der Linde, 1995). Porter and Van der Linde (1995) argue that properly designed environmental regulations can stimulate innovation that may partially offset or even exceed their compliance costs.

While the theory suggests potential channels through which regulation may affect the economy, the aggregate effects of regulation need to be examined empirically. However, such efforts are often hindered by the difficulty of measuring regulation. Existing approaches to measuring regulation at an aggregate level primarily focus on the quantity of regulation, such as the number of rules published by federal agencies, and the number of pages, total words, and command words in the regulatory code (e.g., the *Code of Federal Regulations*) (Dawson and Seater, 2013; Mulligan and Shleifer, 2005; Coffey et al., 2020). Others use government spending and staffing devoted to regulatory activity as a proxy of regulation (Beard et al., 2011; Sinclair and Vesey, 2012). These studies generally find a negative or insignificant relationship between regulation and macroeconomic outcomes.

However, the existing empirical measures may not provide complete information about the aggregate effects of regulation. The quantity of regulation or regulators’ spending is far from a perfect measure of regulation itself.¹ Moreover, these measures typically track one aspect of regulation on a relatively low frequency (mostly annually) due to the prolonged rulemaking or budget process. In contrast, sentiment and uncertainty about regulation are more likely fluctuate on a much higher frequency, since they are driven by most recent regulatory events, which might include the promulgation of a new regulation, a company’s regulatory compliance or violation, a regulatory investigation, or a lawsuit challenging agency regulatory actions. An aggregate measure of sentiment or uncertainty about regulation therefore reflects high-frequency information about subjective attitudes toward the overall regulatory environment. As discussed above, these subjective variables can influence firms’

¹Many studies have discussed the limitations of the existing approaches of measuring regulation. See, for example, Calomiris et al. (2020) and Simkovic and Zhang (2019).

anticipation of payoffs and thus affect the aggregate economic activity.

While there is some existing research that examines different types of economic sentiment and policy uncertainty, little has been done specifically on regulation. The most closely related work to our regulatory uncertainty index is the categorical EPU index on regulation from Baker et al. (2016), which attempts to measure economic uncertainty around regulatory policy. Baker et al. (2016) use a pre-defined set of terms related to regulation, in addition to their economic, uncertainty, and policy terms, to identify news articles that reflect regulatory policy uncertainty and construct the index based on the volume of those articles. Our regulatory uncertainty index differs from theirs in at least three ways. First, we use a substantially broader set of regulatory terms to identify news content related to regulation. The set of terms is defined using computational text analysis of rule titles published by the federal government. Second, we assess regulatory uncertainty in articles using a lexicon-based sentiment analysis method, instead of based on whether the article contains any uncertainty terms. Third, we use regressions to construct the index following Shapiro et al. (2020) instead of using the volume of relevant articles. Neither Baker et al. (2016) nor other studies measure news sentiment about regulation.

3 Data

Our initial news corpus includes 822,737 news articles that contain the keywords starting with “regulat” or “deregulat” (e.g., “regulation”, “regulator”, “deregulation”) from seven U.S. newspapers published between January 1985 and August 2020.² The seven newspapers are Boston Globe, Chicago Tribune, Los Angeles Times, New York Times, USA Today, Wall Street Journal, and the Washington Post.³ We access to the full texts and metadata of the news articles through ProQuest’s TDM Studio, which provides a comprehensive collection of historical and current newspapers in a machine readable format. We remove articles with

²In a robustness check, we remove the articles containing the keywords “deregulat*”. The impulse response functions slightly change, but our main results remain unchanged. See Appendix L.

³Data for USA Today and the Washington Post are only available from January 1987.

identical full text to a previous article, leaving 788,516 articles in the corpus.

Since the keyword “regulation” and its variants can be used in many contexts other than referring to government regulatory policy,⁴ we conduct further analysis to refine the corpus by defining a dictionary of regulatory noun chunks (i.e., certain noun phrases extracted from the text) from the titles of all rules considered by federal agencies from 1995 to 2019. The data of rule titles are obtained from the federal government’s semiannual Unified Agenda of Regulatory and Deregulatory Actions reports. The reports provide uniform data on regulatory and deregulatory actions that agencies plan to issue in the near and long-term future. The Unified Agenda reports published over 190,000 actions between 1995 and 2019, which are associated with 38,868 unique rules (as identified by Regulation Identifier Numbers (RINs)). Section 4 details our approach to define the dictionary and identify the news content related to regulatory policy. As a result, our final news corpus includes relevant regulatory sections from 493,418 news articles. Table 1 shows the number of articles from each newspaper.

In the VARs, we use the same economic variables as those in Baker et al. (2016). Those include monthly data on employment from the U.S. Bureau of Labor Statistics, effective federal funds rate and industrial production from the Board of Governors of the Federal Reserve System, and monthly averages of the S&P 500 index from the S&P Dow Jones Indices LLC. In the VAR model examining impulse responses of investment, we use quarterly data on real gross domestic product and real gross private domestic investment from the U.S. Bureau of Economic Analysis, and quarterly averages of effective federal funds rate and S&P 500. In addition, we add the Michigan Consumer Sentiment Index from the University of Michigan, VIX from the Cboe Global Markets, Inc., the EPU index of Baker et al. (2016), and the economic sentiment index of Shapiro et al. (2020) into the monthly VARs for robustness checks. The monthly data cover the period from January 1985 to August 2020, and the

⁴For example, the term “regulation” and its variants are often used in the context of sports. A February 7, 2019 article in USA Today says: “As you watch the NFL or any baseball game and see every replay tortured and analyzed from every angle, have you ever asked yourself, ‘You know, we could really use more regulations in sports.’”

quarterly data are from the first quarter of 1985 to the second quarter of 2020.

4 News Attention to Regulation

In this section, we describe the approach we use to identify regulation-related news articles from the initial news corpus. Controlling for the total number of news articles published in each newspaper, we first show evidence that news attention to regulation has been increasing over time.

4.1 Identifying Regulation-Related News

Identifying regulation-related news is challenging for several reasons. While some newspaper databases label news articles by subject categories such as finance, politics, and health care, news articles are rarely labeled as regulatory policy. Also, regulation may be the main theme of an article, but it may also be mentioned only in certain sections of an article that mainly discusses economic or political issues. This makes a standard article-level analysis inappropriate to identify news content related to regulation. A simple search of a limited set of keywords like “regulation” or “regulator” would also return inaccurate results, because those words could be used in various contexts.

To identify the specific news content related to regulation, we define a dictionary of regulatory noun chunks to assess the context in which the keyword “regulation” or its variants are mentioned in an article. Specifically, we examine the sentence that mentions “regulat*” or “deregulat*” and its neighbor sentences (i.e., a sentence before and after the regulatory sentence). If any of the three sentences contain one or more regulatory noun chunks defined in our dictionary, then we consider these sentences as regulation-related news. An article can have multiple regulatory sentences, depending on the extent to which regulation is the focus of the article, and all these sentences and their neighbor sentences compose the regulatory section of the article. Specifically, we conduct this assessment in a three-step process.

First, we obtain noun chunks from the titles of all unique rules published in the Unified Agenda reports from 1985 to 2019. Noun chunks are “base noun phrases” identified using the NLP library spaCy. For example, the rule title “Test Procedures for the Analysis of Trace Metals Under the Clean Water Act” is associated with a list of four noun chunks: [“Test Procedures”, “the Analysis”, “Trace Metals”, “the Clean Water Act”]. We then clean the noun chunks by removing special characters, removing leading articles (i.e., “the”, “a”, and “an” at the beginning of a noun chunk), and lemmatizing the tokens of the noun chunks. The above example thus becomes [“test procedure”, “analysis”, “trace metal”, “clean water act”]. We only keep the cleaned noun chunks with two or more tokens, because a single-token noun chunk such as “analysis” has too broad meaning to suggest any relevance to regulation. We iterate this process over all unique rule titles and eventually generate a list of unique n -token noun chunks ($n \geq 2$). This list includes over 37,000 noun chunks and serves as the base for our dictionary.

Next, we preprocess the texts of all news articles in our initial data set. This includes segmenting sentences of an article, extracting the sentence that mentions “regulat*” or “deregulat*” (indexed i) and its neighbor sentences (indexed $i - 1$ and $i + 1$), and lemmatizing the tokens in the sentences. We then search each of the n -token noun chunks from the first step in the extracted sentences using regular expression operations. If the three consecutive sentences ($i - 1$ to $i + 1$) contain one or more of the noun chunks, then these sentences are included in the regulatory section of the article.

As the third step, we conduct human checking and correction of the noun chunks that occurred in the articles. Because the list of the n -token noun chunks automatically generated from the rule titles still includes some general terms that are mentioned frequently in the news articles but not necessarily related to regulatory policy (e.g., “same time”, “first quarter”, “other country”), we read through the noun chunks that occurred in all the news articles and manually filter out those general terms.⁵ After removing the general terms from the

⁵For filtering out the general terms, two coders went through the list of noun chunks and marked general terms independently, compared their results, and the discussed to solve the discrepancies.

results, there remains 10,645 unique noun chunks that occurred in 493,418 news articles, meaning that each of these articles contains a regulatory section. These noun chunks form our dictionary of regulatory noun chunks, which are also used for building our categorical indexes as discussed in Section 5. Appendix A lists 100 regulatory noun chunks with most occurrences in the news articles.

Our sentiment analyses in the remainder of the paper are based on the corpus of the regulatory sections in the 493,418 news articles.

4.2 Increasing News Attention to Regulation

Tracking the relative frequency of articles discussing regulation over time can suggest trends in news attention to regulation. We investigate that by building a monthly index of news attention to regulation using an approach similar to Baker et al. (2016)’s approach to building their EPU index. That is, we scale the monthly count of news articles that contain regulatory sections by dividing it by the total number of news articles published in the newspaper in the month, and then standardize the scaled monthly counts and normalize the time series to a mean of 100 from 1985 to 2009. Specifically, the monthly news attention index NA_t is calculated as:

$$NA_t = z_t \frac{100}{\frac{1}{\tilde{T}} \sum_{t=1}^{\tilde{T}} z_t},$$

where z_t is the mean of standardized monthly counts over newspapers:

$$z_t = \frac{1}{K} \sum_{i=1}^K \frac{x_{it}}{N_{it} \delta_{i,\tilde{T}}},$$

where $i = \{1, 2, \dots, K\}$ denotes the newspaper, $t = \{1, 2, \dots, T\}$ denotes the month, x_{it} is the raw count of articles related to regulation in newspaper i in month t , N_{it} is the total number of news articles published in newspaper i in month t , $\delta_{i,\tilde{T}}$ is the standard deviation of the scaled count $\frac{x_{it}}{N_{it}}$ over the time interval \tilde{T} for standardization and normalization (i.e., January 1985 – December 2009).

Figure 1 plots the monthly index of news attention to regulation. The overall trend suggests that regulation has been drawing increasing attention from the media since 1996. News attention to regulation raised during months of important regulatory developments and historical events that triggered massive regulatory responses. For example, the index shows spikes around the Lehman Brothers bankruptcy in 2008, the passage of Obamacare and the Dodd-Frank Act in 2010, and the 2016 presidential election, and a substantial drop during the month of the 9/11 attack in 2001. Beside the overall increasing trend, the 2016 election is accompanied by particularly elevated news attention to regulation compared to other elections, presumably because deregulation is one of Trump’s top political priorities (Dudley, 2020).

The trend in news focus on regulation not only suggests that regulatory policy has become an increasingly popular topic among journalists, but also implies that regulation has become more relevant to their readers, potentially including consumers, workers, and business leaders. This also motivated our study to investigate the news content and their implications for the macroeconomy.

5 Sentiment and Uncertainty about Regulation

This section starts with a description of the sentiment analysis method we use to estimate the sentiment and uncertainty scores of the regulation-related news articles in our sample. Using the estimated scores, we compute the monthly indexes of regulatory sentiment and uncertainty from 1985 to 2020. We then include the indexes in VAR models to examine how macroeconomic variables respond to regulatory sentiment and uncertainty shocks.

5.1 Sentiment Analysis

We use a lexicon-based approach for sentiment analysis. The lexicon-based approach assesses the semantic orientation of a document based on the frequency of words or phrases

with a particular semantic orientation that occur in the document. It relies on pre-defined dictionaries of opinionated words, such as a list of positive or negative words. There are many available sentiment dictionaries designed for general purposes and some for specific domains.

We use the 2018 Loughran and McDonald (LM) dictionary (originally developed in Loughran and McDonald (2011)) to assess the sentiment and uncertainty in the regulatory sections of the relevant news articles in our baseline analysis. The LM dictionary was constructed specifically for the domain of finance, using a corpus of corporate 10-K reports (Loughran and McDonald, 2011). Because of its domain relevance, the LM dictionary has been frequently used in economic research (for example, Fraiberger (2016); Calomiris et al. (2020); Ostapenko et al. (2020)). The 2018 version of the dictionary comprises sentiment word lists in several categories, including 2,355 words in the negative category, 354 words in the positive category, and 297 words in the uncertainty category.

However, we also notice that the LM positive and negative word lists are strongly unbalanced, with substantially more negative words than positive words. One reason is that Loughran and McDonald (2011) has a clear focus on the proportion of negative words in 10-Ks for detecting the association between tone and excess returns. They note that finance and accounting research generally finds little incremental information in positive words, and the LM positive word list was created more for completeness than “discerning an impact on tone identification” (Loughran and McDonald, 2011, p.45). While an unbalanced dictionary may not affect our interpretation of changes in sentiment over time, it will bias our sentiment assessment toward a disproportionately negative tone. For this reason, we also use two other dictionaries to construct the sentiment measure for comparison: the Harvard General Inquirer (GI) dictionary and the Lexicoder Sentiment Dictionary (LSD). The GI dictionary is a general-purpose lexicon originally developed in the 1960s and has been widely used in various disciplines. It covers several broad valence categories, including lists of 2,005 negative words and 1,637 positive words. The LSD is a comprehensive sentiment lexicon combining

three pre-existing dictionaries and tailored primarily to political news (Young and Soroka, 2012).⁶ The LSD comprises 2,857 negative words and 1,709 positive words.

Similar to our search of regulatory noun chunks, we use regular expression to count occurrences of each sentiment word in the preprocessed regulatory section of an article. We incorporate a negation rule to take into account negated positive and negative words. That is, if an English negation word, such as “not”, “don’t”, or “cannot”, occurs within three tokens before the opinionated word, then the opinionated word would be considered as the opposite orientation. For example, the following regulatory section contains two occurrences of negative words as defined by the LM dictionary: “hazard” and “violation”, and three occurrences of positive words: “boost”, “fear” (with the negation word “without”), and “boost”.

So, the department’s Occupational Safety and Health Administration in recent years has **boosted** spending on its consultation program, which allows little companies to ask for an OSHA visit to look for workplace **hazards without fear** of being cited for **violations** as a result of that visit. The idea is to **boost** voluntary compliance with safety regulations. The program’s funding rose 50% between fiscal 1996 and fiscal 2001, to \$48.8 million, equal to about 11% of OSHA’s total budget.⁷

We use a standard formula to calculate sentiment scores. The regulatory sentiment score of an article is the difference between the proportion of positive words and the proportion of negative words in the regulatory section of the article. Therefore, a positive sentiment score indicates an overall positive tone in the news about regulation, and a negative score means an overall negative tone.

⁶The three pre-existing dictionaries combined in the LSD are the GI, the Regressive Imagery Dictionary (Martindale, 1975), and the Roget’s Thesaurus (Roget, 1911).

⁷The quote is from “GAO Criticizes OSHA’s Program for Small Businesses—Report Questions Effectiveness of Consultations as Visits and Hazards Decline” published by the Wall Street Journal on October 30, 2001.

We use a similar approach to assess uncertainty in regulation-related news content. The uncertainty category of the LM dictionary covers a broad range of terms in addition to “uncertainty” and “uncertain”, such as “ambiguity”, “confusion”, “doubt”, and “vague”. The regulatory uncertainty score of an article is the proportion of uncertainty words in the regulatory section of the article. A higher uncertainty score suggests a higher level of uncertainty expressed in the regulation-related news.

5.2 Regulatory Sentiment and Uncertainty Indexes

Table 2 shows the descriptive statistics of the sentiment scores estimated using the LM, GI, and LSD dictionaries and the uncertainty scores using the LM dictionary. The absolute sentiment score that measures the polarity of a document is clearly dependent on the scope of opiniated words defined in the dictionary. Unsurprisingly, the sentiment measured using the LM dictionary is generally more negative compared with the GI and LSD. The LSD generated the most balanced result, with an approximately same number of articles estimated negative and positive. To illustrate how the three dictionaries assess a document differently, Appendix B shows examples of regulatory sections with negative and positive words identified from each dictionary. As shown in Table 2, the uncertainty scores indicate that approximately half of the articles expressed a degree of uncertainty in the sections that discuss regulation. Appendix B also includes the uncertainty words and estimated uncertainty scores for the examples.

To construct the monthly sentiment and uncertainty indexes, we use fixed effects regressions following Shapiro et al. (2020). The specification is:

$$s_j = u_{t(j)} + v_{i(j)} + \epsilon_j,$$

where s_j is the estimated sentiment or uncertainty score for article j , $u_{t(j)}$ is a year-month fixed effect, and $v_{i(j)}$ is a newspaper fixed effect. The estimated coefficients on the year-

month fixed effects u_t from this regression are the monthly sentiment or uncertainty index, depending on the dependent variable. One advantage of this approach is that the newspaper fixed effects control for time-invariant heterogeneities across newspapers, which can potentially address the concern of ideological differences among news sources. This is particularly important for our study, because the news sentiment toward government regulation could be largely affected by the political stance of the newspaper.

Figure 2 plots the regulatory sentiment indexes estimated using different dictionaries between January 1985 and August 2020. To focus on changes over time rather than relative polarity between indexes, we normalize the indexes by their means and standard deviations. The three time series demonstrate similar patterns over time and are strongly correlated with each other. The correlation between the LM and LSD indexes is 0.8; the correlation between the LM and GI indexes is 0.56; and the correlation between the LSD and GI indexes is 0.71. We also show the first principal component of the three standardized sentiment indexes in Figure 2, which explains 80 percent of the variance. All the three indexes and the principal component suggest that news sentiment about regulation has changed over time. For example, the newspapers in the period of late 1980s and early 1990s appear to express a relatively negative tone when discussing regulation, while the sentiment largely improved around the mid-1990s and maintained at a stable and higher level until the early 2000s. In the following VAR analyses, we present the results using the LM sentiment index, but include the results using the GI and LSD indexes and the principal component in Appendix C to show robustness.

Figure 3 plots the regulatory uncertainty index. In particular, we see more spikes in regulatory uncertainty during recent years. Regulatory uncertainty reached a historical peak in 2010, a year that marks many important events in the regulatory history, including the enactment of Obamacare (March 2010), the Deepwater Horizon oil spill (April 2010), and the passage of the Dodd-Frank Act (July 2010). Other large spikes occurred around the Lehman Brothers bankruptcy in September 2008, the Trump election in November 2016,

and the coronavirus outbreak in the U.S. in April 2020.

Appendix D compares our regulatory sentiment index with the economic sentiment index of Shapiro et al. (2020) and our regulatory uncertainty index with the EPU index of Baker et al. (2016). The correlation between the regulatory sentiment index and economic sentiment index is 0.38 and statistically significant. While the two time series comove in some time periods, they do not always coincide with each other. Similarly, the regulatory uncertainty index has a statistically significant correlation of 0.28 with the EPU index, but the two indexes demonstrate clear variations. These comparisons suggest that regulatory sentiment or uncertainty is distinct from aggregate economic sentiment or policy uncertainty, and possibly contains unique information about the economy. We further investigate this issue in the next section.

5.3 Impulse Responses

We then examine how our measures of sentiment and uncertainty about regulation affect future economic activity. We use the monthly VAR model of Baker et al. (2016), through which we estimate how measures of economic activity respond to a regulatory sentiment or uncertainty shock. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: our regulatory sentiment or uncertainty index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production.⁸ The VAR includes three lags of all variables. We show impulse responses up to 60 months after the shock.

Figure 4 plots the impulse responses of industrial production and employment to a one-standard-deviation negative shock to the regulatory sentiment index, with point estimates and 90 percent confidence bands. The estimates show that a negative sentiment shock reduces industrial production and employment. The effects on industrial production are

⁸We tested for stationarity of our regulatory sentiment and uncertainty indexes. The Phillips-Perron test rejects unit root for all the indexes, while the ADF and KPSS tests suggest more mixed results. See test statistics in Appendix E.

statistically significant between 6 and 15 months after the shock and reach the maximum of a 0.35 percent drop at 13 months post the shock. The shock leads to a statistically significant reduction in employment for a longer time period, lasting up to 24 months after the shock, and the maximum estimated drop is 0.2 percent.

Figure 5 shows the impulse responses to a regulatory uncertainty shock. The effects of a one-standard-deviation shock that increases regulatory uncertainty are relatively short-lived, compared to the sentiment shock. Industrial production and employment drop by 0.13 percent and 0.16 percent, respectively, in the next month after the shock, but the effects start waning and are not statistically significant at the 10 percent level after that.

Similar to Baker et al. (2016), we make several modifications to the VAR specification to test the robustness of the results. Those include the VAR with reverse ordering, a bivariate VAR, a bivariate VAR with reverse ordering, dropping the S&P index, including the VIX, including time trends, and including the Michigan Consumer Sentiment Index. Figures 6 and 7 show the results on the regulatory sentiment and uncertainty indexes, respectively, suggesting that the estimates of impulse responses to regulatory sentiment shocks are robust to the modifications, while the estimates to regulatory uncertainty shocks present some variations. In particular, the effects of sentiment shocks on industrial production and employment are nearly unaffected after controlling for the Michigan Consumer Sentiment Index, regardless of the ordering of the Michigan index and our regulatory sentiment index (see the bottom two subplots of Figure 6). The Michigan index reflects consumers' confidence in current and future economic conditions. The robust impulse response functions suggest that our measure of news sentiment about regulation reflect at least some unique information about economic activity that is not captured by the general consumer sentiment or other sources of first-moment information.

To investigate this issue further, we also add the news-based economic sentiment index of Shapiro et al. (2020) and the EPU index of Baker et al. (2016) to the VARs. As shown in Figures 8 and 9, most of the impulse response estimates remain after controlling for

general economic sentiment or economic policy uncertainty. When the general economic sentiment index is placed after our regulatory sentiment index in the causal ordering, the estimated effects of a regulatory sentiment shock on output and employment are nearly unchanged. When economic sentiment is placed first in the ordering, the magnitude of the effects diminishes but still remains sizable.

In addition, we implement VARs using quarterly data to examine how gross investment responds to regulatory sentiment and uncertainty shocks. The identification of the quarterly VAR is based on three lags and Cholesky decomposition with the following order: our regulatory sentiment or uncertainty index, the log of S&P 500 index, the federal funds rate, log investment, and log gross domestic product. Appendix F plots the impulse response functions over 20 quarters after a shock. The estimates of investment responses to regulatory sentiment and uncertainty shocks are not statistically significant at the 10 percent level, regardless of which dictionary we use to measure sentiment.

It is possible that the effects of regulatory sentiment and uncertainty shocks are conditional on each other. Using the approach from Caggiano et al. (2017), we estimate an Interacted-VAR and compute state-dependent generalized impulse response functions (GIRFs) to see: (1) whether the impact of regulatory uncertainty shocks is different when regulatory sentiment is particularly low, and (2) whether the impact of regulatory sentiment shocks is different when regulatory uncertainty is particularly high. The results suggest no clear evidence that the impulse responses to regulatory sentiment shocks under high and low regulatory uncertainty are different: while the estimated negative effects of a regulatory sentiment shock are generally larger when regulatory uncertainty is high, the GIRFs under high and low uncertainty generally follow similar trajectories, and their differences are not statistically significant at the 10 percent level. Similar results are observed for GIRFs to regulatory uncertainty shocks under high and low regulatory sentiment. The details are discussed in Appendix G.

In sum, the impulse response estimates indicate that news sentiment about regulation

has a larger and more robust link with aggregate economic activity than uncertainty about regulation. A drop in regulatory sentiment has a significant, persistent effect on future output and employment. The robustness of this effect after controlling for news-based measures of economic sentiment and policy uncertainty implies that our measure of sentiment about regulation contains some unique information that may be valuable for predicting future economic outcomes. An increase in regulatory uncertainty may reduce output and employment temporarily, but this effect is smaller in terms of magnitude and presents some variations in robustness checks.

While the application of our sentiment and uncertainty indexes has some interesting implications, these indexes measure information in the news about regulatory policy in general. However, regulation is diverse, involving various policy areas and segments of the economy. In the next section, we discuss disaggregated measures of sentiment and uncertainty by regulatory area.

6 Sentiment and Uncertainty by Regulatory Policy Area

To discover how news sentiment and uncertainty about regulation differ by policy area and how they connect to economic activity, we build categorical indexes of sentiment and uncertainty for 14 regulatory policy areas. We present the indexes and impulse response estimates in this section.

6.1 Categorizing News Articles

To categorize relevant news content by regulatory area, we rely on the dictionary of regulatory noun chunks described in Section 4.1. Specifically, we use the fact that the regulatory noun chunks are extracted from rule titles and that rules are issued by agencies with specific regulatory authorities. For example, EPA generally issues environmental regulations, FDA issues regulations to protect food safety and health, and the Commodity Futures Trading

Commission regulates part of the financial market. Therefore, we categorize agencies by regulatory area according to their authorities and assume that the noun chunks extracted from the rules issued by a given agency are associated with the regulatory area of the agency.

As a result, we specify 14 regulatory areas for the agencies in our sample, including consumer safety and health, national and homeland security, transportation, labor and workplace, environment and natural resources, energy, finance and banking, general business and trade, agriculture and rural development, education and culture, communications, criminal justice, society, and international relations. Appendix H lists examples of the agencies, their designated areas, and rule titles. After linking regulatory noun chunks back to agencies, the vast majority of the noun chunks (8,919 out of 10,645) in our dictionary are designated with one regulatory area, while a small proportion of the noun chunks appear in multiple rules issued by multiple agencies and thus are associated with multiple regulatory areas (e.g., “final rule”, “administrative requirement”, and “technical amendment”). We use only the area-specific noun chunks (i.e., the regulatory noun chunks associated with only one area) for categorizing the news articles.

Since the regulatory section of a news article in our sample contains one or more of the noun chunks, the article can potentially be classified into regulatory areas based on the noun chunks mentioned. The following is an example of regulatory section:

Automobile manufacturers are financing a multimillion dollar lobbying campaign aimed at persuading state legislatures to require motorists to buckle up their **seat belts**, a move designed to kill a **federal regulation** requiring the industry to equip vehicles with more expensive **air bags** by 1989. Last year, legislatures in New York, New Jersey and Illinois adopted mandatory **seat belt** laws and legislation already has been filed on Beacon Hill to bring about the same end.⁹

⁹The quote is from “Automakers’ Millions Back Seat-Belt Laws” published by Boston Globe on January 30, 1985.

This regulatory section contains four regulatory noun chunks: “seat belt”, “federal regulation”, “air bag”, and “seat belt” (with “seat belt” occurring twice). Among these terms, “federal regulation” is a common term used in rule titles and thus are associated with seven regulatory areas, whereas “seat belt” and “air bag” are noun chunks unique to the area of transportation in our dictionary. Therefore, we classify this article into the transportation category, based on the area associated with “seat belt” and “air bag”.

In longer regulatory sections, it is common that there are many regulatory noun chunks that are linked to multiple unique areas. In that case, we define the dominant area of an article as the most common area across all the regulatory noun chunks with unique areas in the regulatory section. This approach intends to capture the primary regulatory areas discussed in the relevant text of a news article. Mathematically, suppose there are n noun chunks with unique areas in the regulatory section (duplicated noun chunks are counted multiple times), $\mathbf{a}_{m \times 1}^p$ denotes a $m \times 1$ vector for the p th noun chunk, where the q th element of the vector $a_q^p = 1$ if the p th noun chunk is associated with the q th area ($q = \{1, 2, \dots, m\}$), and otherwise $a_q^p = 0$. We add the vectors for all noun chunks:

$$\sum_{p=1}^n \mathbf{a}_{m \times 1}^p = \mathbf{b}_{m \times 1}.$$

Then the dominant area is q_{max} such that $b_{q_{max}} = \max_{1 \leq q \leq m} b_q$. In some instances, there are multiple dominant areas for an article. Appendix I plots article counts by dominant area, showing that finance and banking is the regulatory area that has drawn the most news attention, followed by environment and natural resources regulation.

Appendix J shows the top 30 area-specific regulatory noun chunks with most occurrences in the regulatory sections of news articles in each area. For example, “food and drug administration”, “public health”, and “child care” occur frequently in the articles classified into the consumer safety and health category. For robustness checks, we conduct human checking of the most common area-specific noun chunks in each area. Specifically, we manually filter

out certain general or irrelevant terms from the top 100 regulatory noun chunks in each area and then reclassify news articles. When filtering out general or irrelevant terms, we take two alternative approaches: one is a relatively conservative approach that removes a small set of terms that are unlikely associated with the corresponding area or very likely associated with multiple areas, and the other is a relatively aggressive approach that keeps only the terms that are more likely associated with the corresponding area than any other areas (see Appendix K). These alternative approaches result in slightly different classifications of news articles, and we discuss how they change the impulse response functions in Section 6.3.

6.2 Categorical Indexes

We use the same approach to construct the categorical indexes as we did for the aggregate sentiment and uncertainty indexes. Namely, for a given regulatory area, we create the indexes by fitting the fixed effects regression to the estimated sentiment or uncertainty scores of the articles classified into the area. The specification is:

$$s_{j,q} = u_{t(j,q)} + v_{i(j,q)} + \epsilon_{j,q},$$

where $s_{j,q}$ is the estimated sentiment or uncertainty score for article j in area q , $u_{t(j,q)}$ is a year-month fixed effect, and $v_{i(j,q)}$ is a newspaper fixed effect. The estimated coefficients on the year-month fixed effects $u_{t(j,q)}$ from the regression compose the monthly sentiment or uncertainty index for regulatory area q .

Figures 10 and 11 plot the categorical sentiment and uncertainty indexes over time. There are substantial variations in the measured sentiment and uncertainty about different regulatory areas. For example, the sentiment about environmental and natural resources regulation largely improved in the 1990s, a decade beginning with the passage of the 1990 Clean Air Act amendments. The sentiments around finance and banking regulation and general business and trade regulation comoved closely over time, with large drops around

recessions. In contrast, regulatory uncertainty around those two areas raised substantially during and post recessions.

6.3 Impulse Responses

We conduct VAR analyses using the categorical indexes and the same economic variables as described in Section 5.3 and compute impulse response functions. Our baseline analysis suggests particularly strong linkage between our sentiment and uncertainty measures in some regulatory areas and future economic outcomes. Some of the impulse response patterns change in terms of significance or magnitude when we use filtered regulatory noun chunks to reclassify news articles into regulatory areas (see Appendices K.1-K.8). Therefore, we put more weight on the regulatory areas that are robust to the alternative classifications when interpreting the results.

Figure 12 shows the impulse responses of industrial production to a negative sentiment shock for each regulatory area. Sentiment shocks about regulation concerning transportation, general business and trade, or agriculture and rural development are associated with statistically significant drops in future output. The point estimates of the reductions in industrial production are generally between 0.2 percent and 0.4 percent. However, the effects of sentiment shocks about general business and trade regulation or agriculture and rural development regulation are not statistically significant at the 10 percent level in at least one robustness check in which we filter the regulatory noun chunks in each area. The impulse response functions related to transportation regulation are robust to the alternative classifications, regardless of whether we use a conservative or aggressive approach for filtering the regulatory noun chunks, and the effects are relatively large and persistent.

Figure 13 shows that a regulatory sentiment shock related to consumer safety and health, transportation, finance and banking, general business and trade, or agriculture and rural development reduces future employment. The point estimates range from 0.1 percent to 0.2 percent. The impulse responses for transportation regulation and finance and banking

regulation remain statistically significant in both robustness checks, and a sentiment shock around transportation regulation has more persistent employment effects.

While we do not observe statistically significant effects of an aggregate regulatory uncertainty shock (as discussed in Section 5.3), there are variations in the responses of economic activity to uncertainty shocks in different regulatory areas. Our baseline analysis indicates that a one-standard-deviation shock that increases uncertainty around transportation regulation or labor and workplace regulation leads to relatively large and persistent drops in future output (Figure 14). However, only the effects of uncertainty shocks around labor and workplace regulation remain statistically significant in the robustness checks.

An uncertainty shock to transportation regulation is also associated with statistically significant reductions in future employment in our baseline analysis (Figure 15), but it is still not robust to alternative approaches for article classification. Although the responses of employment to uncertainty shocks around labor and workplace regulation and energy regulation are not significant at the 10 percent level in the baseline analysis, both robustness checks indicate statistically significant impulse responses, implying possible negative effects of regulatory uncertainty shocks in those areas on employment.

In sum, our analyses suggest that economic outcomes are particularly sensitive to sentiment and uncertainty around certain regulatory policy areas. Negative sentiment shocks related to transportation regulation have persistent, large negative effects on future output and employment. Sentiment shocks to finance and banking regulation are associated with relatively transitory but measurable drops in future employment. Increased uncertainty about labor and workplace regulation leads to persistent reductions in future output. These impulse response patterns are also robust to alternative approaches for article classification.

7 Conclusion

In this study, we examine how the sentiment and uncertainty about regulation expressed in the news changed over time and affected aggregate economic activity. We identify an original corpus of regulation-related news from seven leading U.S. newspaper, which shows that news attention to regulation has been increasing since 1996. We then use lexicon-based sentiment analysis of the relevant news text to construct monthly indexes of sentiment and uncertainty about regulation from January 1985 to August 2020.

Using monthly VARs, we estimate how aggregate economic indicators respond to regulatory sentiment and uncertainty shocks. The impulse response functions suggest that a negative sentiment shock about regulation is associated with persistent drops in future output and employment, while a regulatory uncertainty shock overall only has transitory effects. Notably, the responses to sentiment shocks largely remain after controlling for existing news-based measures of general economic sentiment and policy uncertainty, which suggests that our measure of regulatory sentiment captures some unique information about the economy.

To further explore what types of regulatory policy drive the connection between regulation and macroeconomic outcomes, we construct categorical indexes of sentiment and uncertainty for 14 regulatory policy areas. Our estimates of impulse responses using the categorical indexes suggest that sentiment shocks related to transportation regulation have persistent, large negative effects on future output and employment, and negative sentiment around finance and banking regulation has a transitory effect on employment. Regardless of the lack of findings on persistent effects of aggregate regulatory uncertainty shocks in our analysis, we find that increased uncertainty around labor and workplace regulation has long-lasting adverse effects on output.

As our analysis suggests, sentiment about regulation plays a more important role in the aggregate economy than uncertainty about regulation. Future research could further explore the mechanisms through which regulatory sentiment affects macroeconomic outcomes. The text-based approaches used in our study could also be applied to constructing industry-

specific or topic-specific regulatory sentiment and uncertainty measures to examine their economic effects.

Tables

Table 1: Article Counts by Newspaper

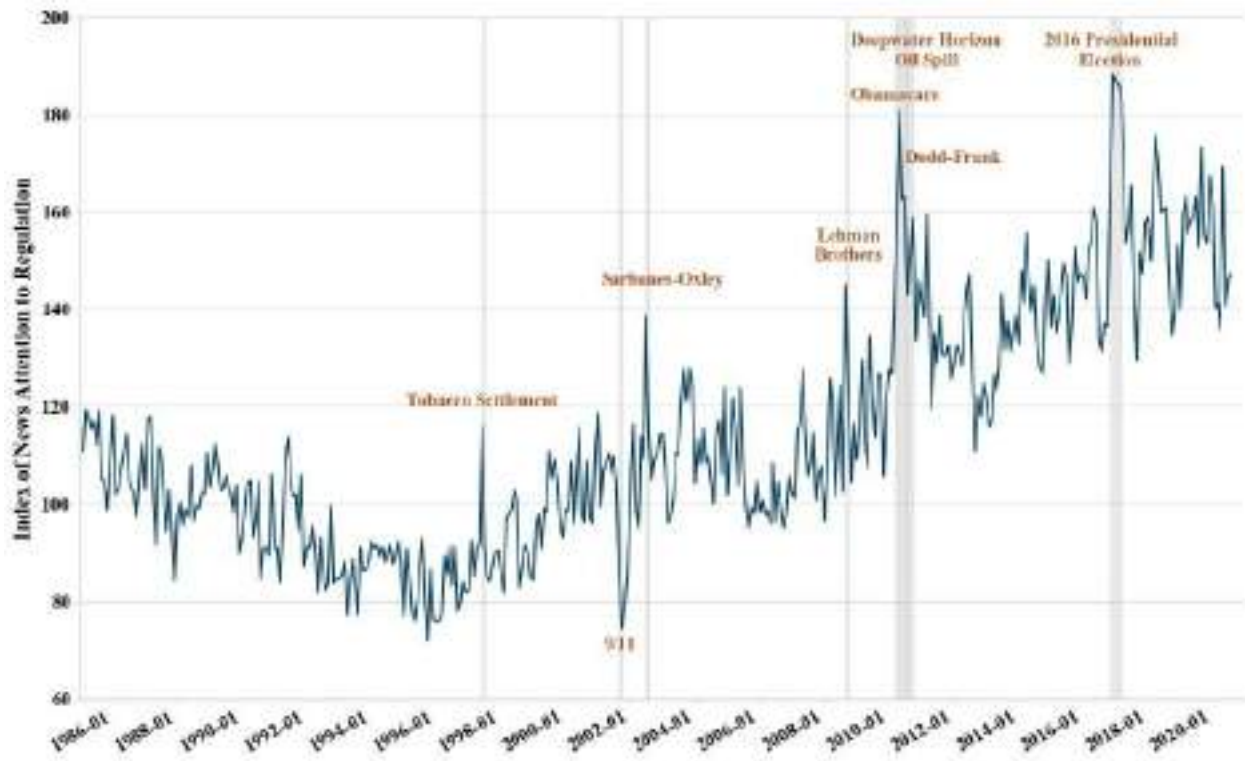
	All articles	Unique articles	Regulatory articles	First regulatory article	Last regulatory article
Wall Street Journal	251,983	242,084	163,788	1985-01-02	2020-08-31
New York Times	125,270	117,441	72,852	1985-01-01	2020-08-31
Los Angeles Times	121,406	120,802	73,568	1985-01-01	2020-08-31
The Washington Post	116,772	109,216	67,448	1987-01-01	2020-08-31
Chicago Tribune	90,023	89,600	51,740	1985-01-01	2020-08-31
Boston Globe	78,922	72,456	43,445	1985-01-01	2020-08-30
USA Today	38,361	36,917	20,577	1987-04-01	2020-08-31
Total	822,737	788,516	493,418	-	-

Table 2: Descriptive Statistics of Estimated Sentiment and Uncertainty Scores

	Sentiment Score			Uncertainty Score
	LM	GI	LSD	LM
Mean	-2.07	1.04	-0.08	0.74
Std. Dev.	2.58	4.00	3.43	0.95
Minimum	-37.50	-30.77	-35.71	0
Maximum	13.33	30.77	26.32	20.45
Articles with negative scores	359,302	168,220	219,216	N/A
Articles with positive scores	58,973	277,573	214,473	267,701
N	493,418	493,418	493,418	493,418

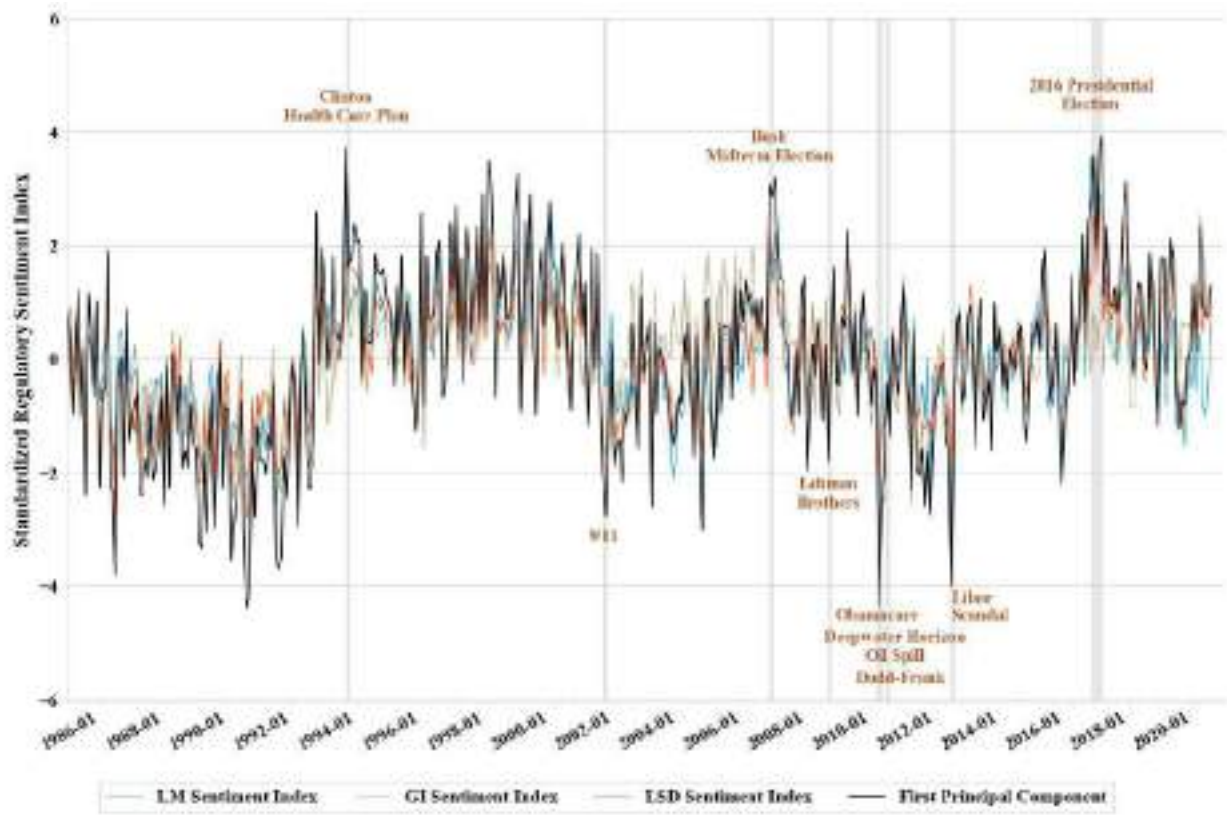
Figures

Figure 1: Monthly Index of News Attention to Regulation
(January 1985 – August 2020)



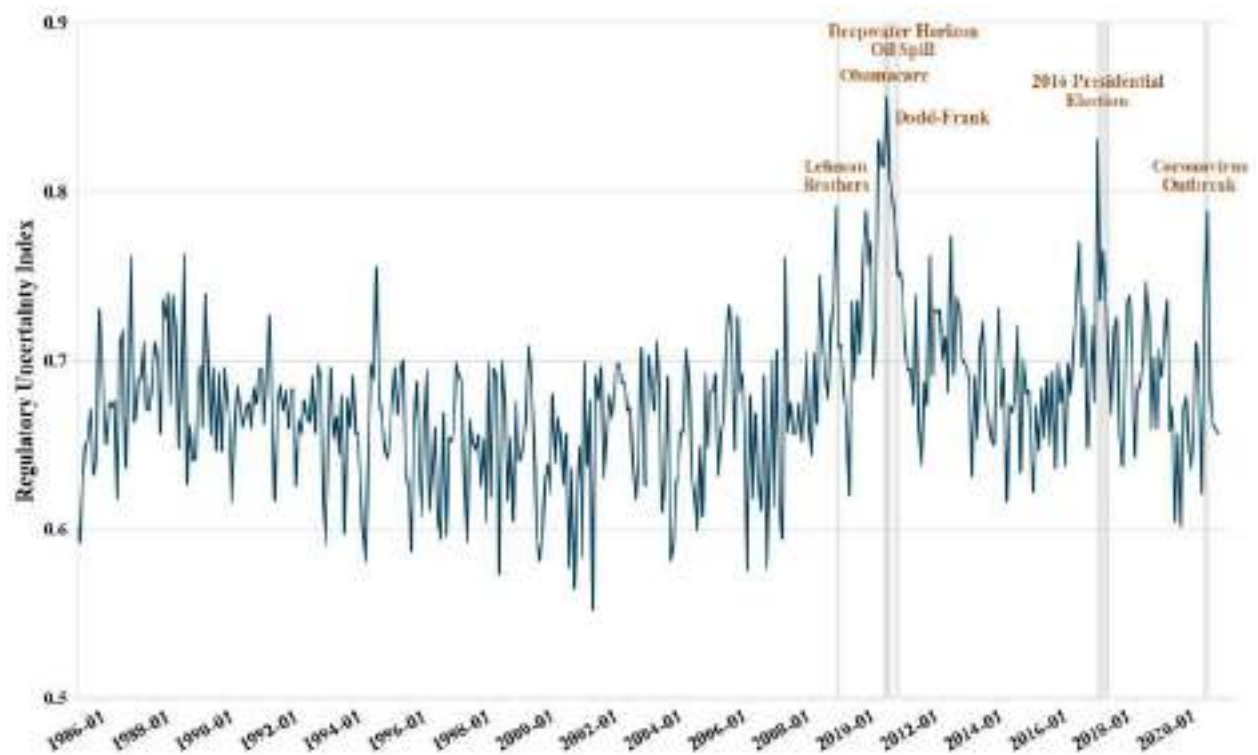
Notes: The index is constructed by standardizing the monthly counts of regulation-related news articles scaled by the monthly counts of all news articles in each newspaper and normalizing the time series to a mean of 100 from January 1985 to December 2009. The index is calculated using data from seven U.S. newspapers including Boston Globe, Chicago Tribune, Los Angeles Times, New York Times, USA Today, Wall Street Journal, and the Washington Post. Data for the Washington Post are available from January 1987, and data for USA Today are available from April 1987.

Figure 2: Monthly Indexes of News Sentiment about Regulation
(January 1985 – August 2020)



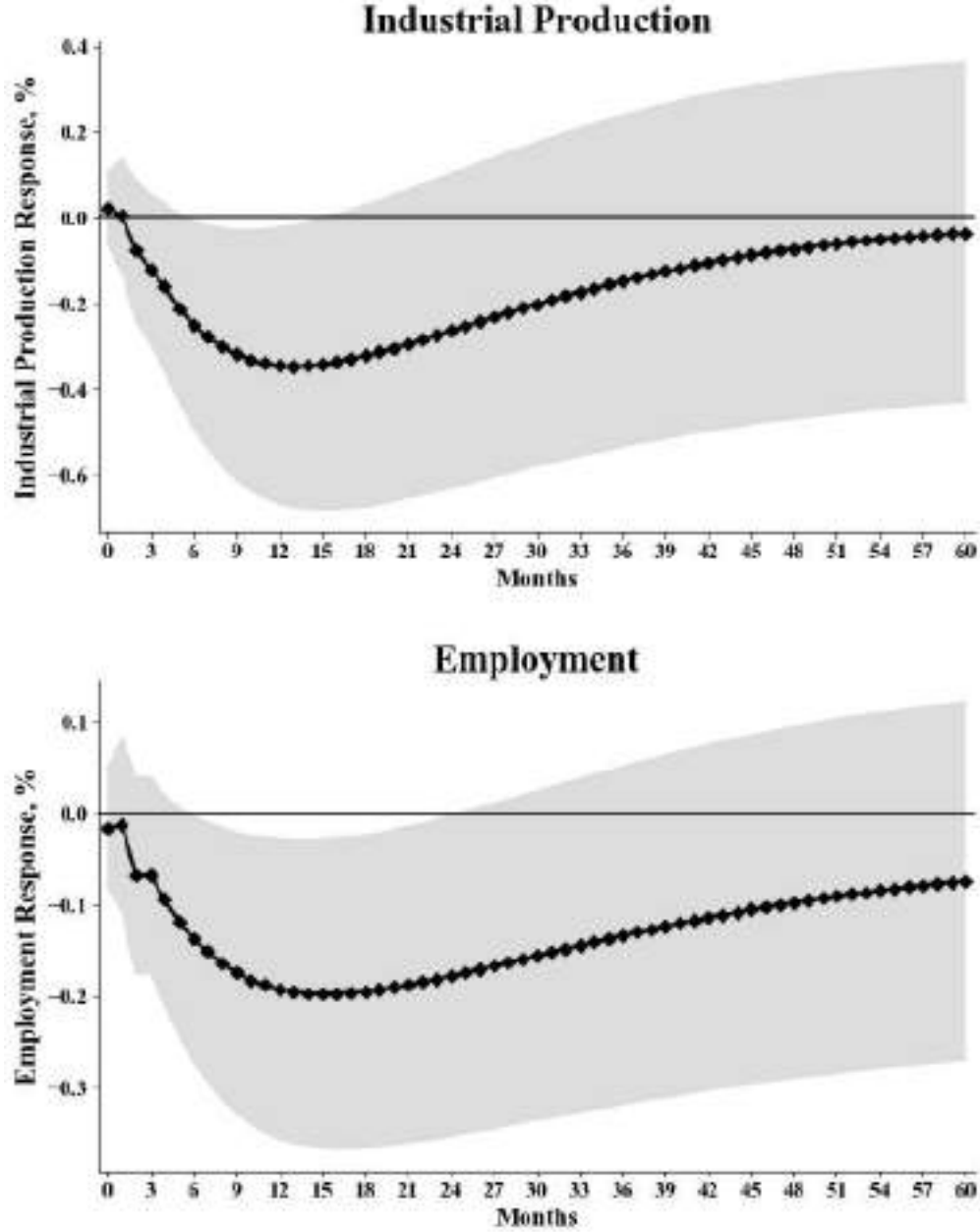
Notes: The figure plots three regulatory sentiment indexes estimated using the Loughran and McDonald (LM) dictionary, the General Inquirer (GI) dictionary, and the Lexicoder Sentiment Dictionary (LSD), respectively, and the first principal component of the three indexes. All indexes are normalized to have mean equal to zero and standard deviation equal to one.

Figure 3: Monthly Index of Regulatory Uncertainty
(January 1985 – August 2020)



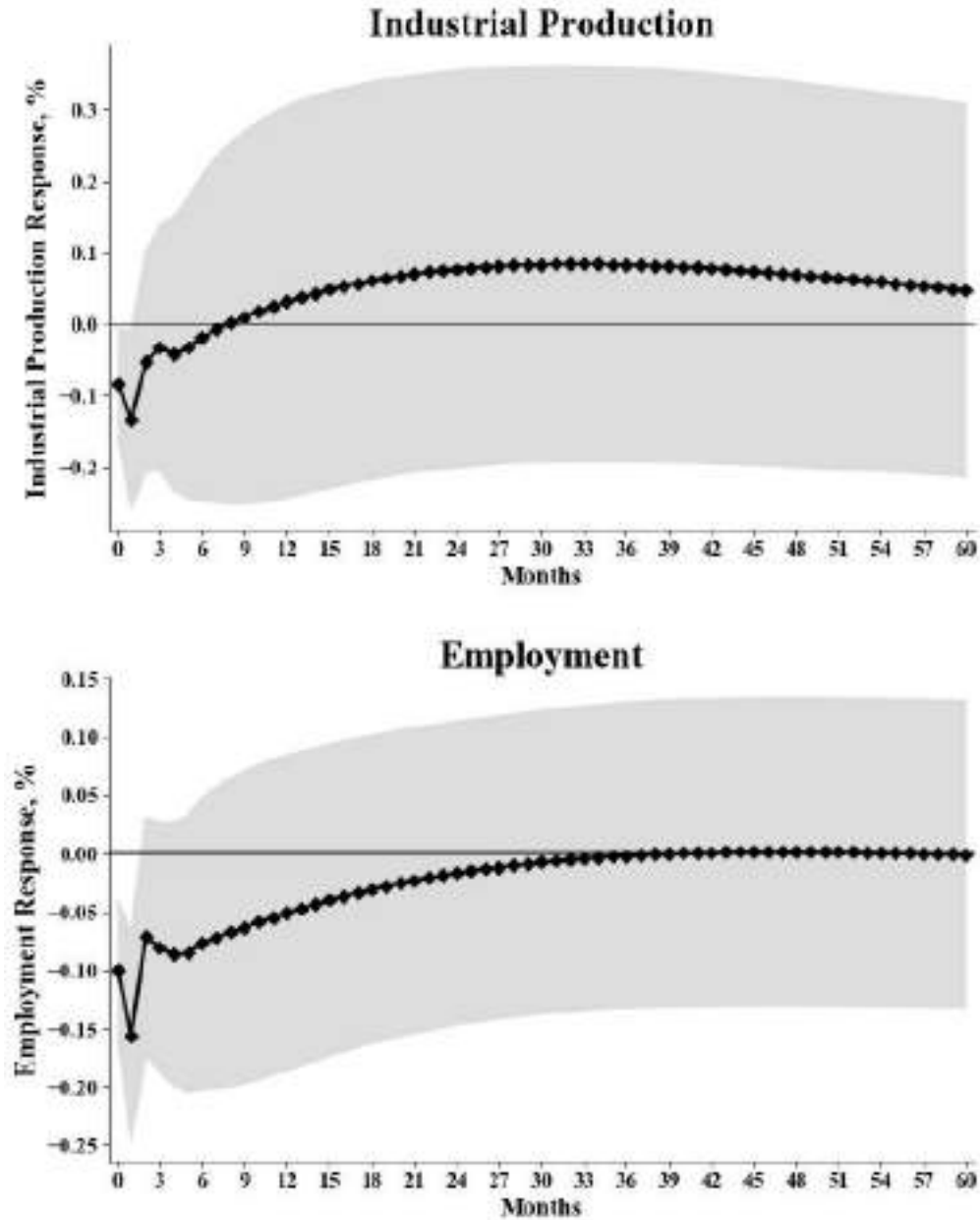
Notes: The figure plots the regulatory uncertainty index estimated using the uncertainty category of the Loughran and McDonald (LM) dictionary.

Figure 4: Impulse Responses to a Negative Sentiment Shock about Regulation
(Monthly VAR)



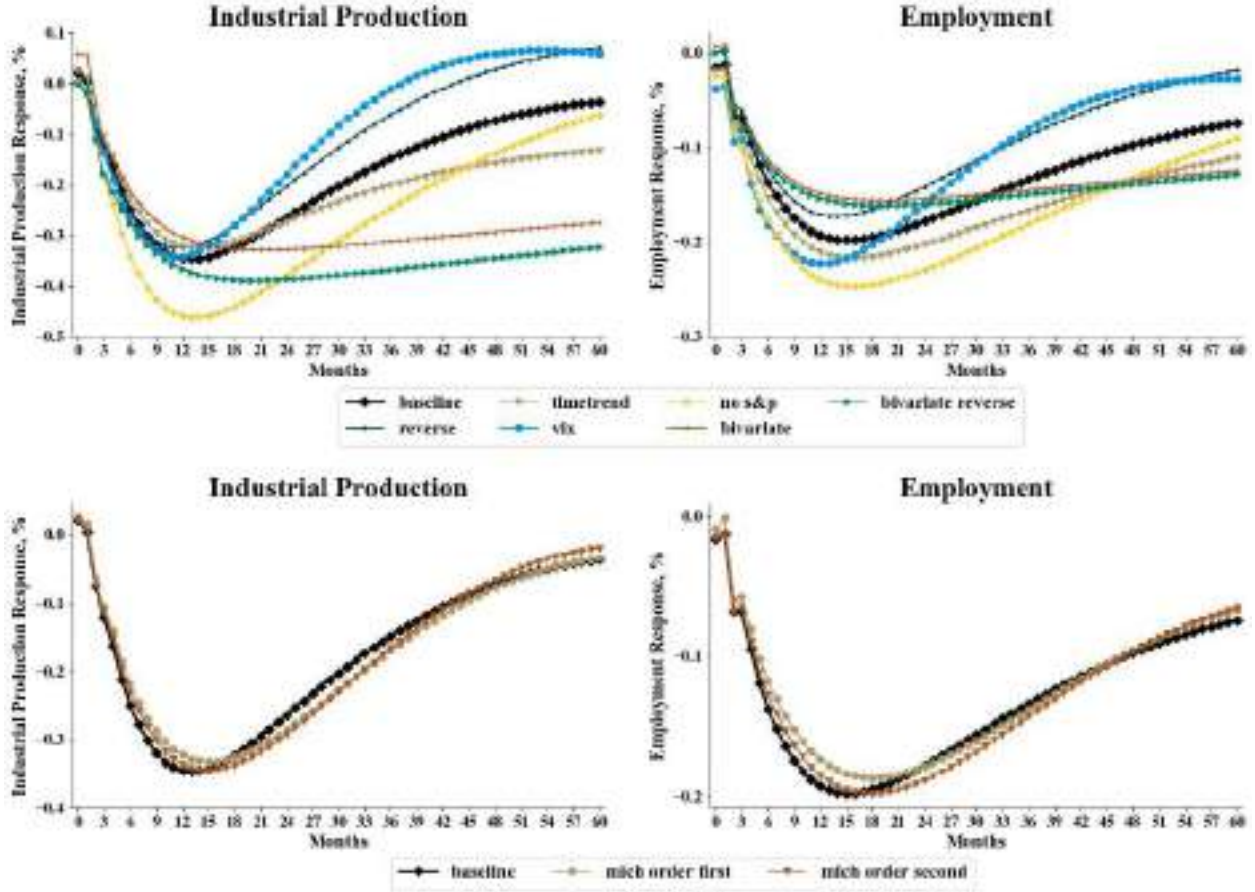
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation negative shock to sentiment about regulation. The sentiment index is estimated using the Loughran and McDonald (LM) dictionary. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory sentiment index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

Figure 5: Impulse Responses to an Uncertainty Shock about Regulation
(Monthly VAR)



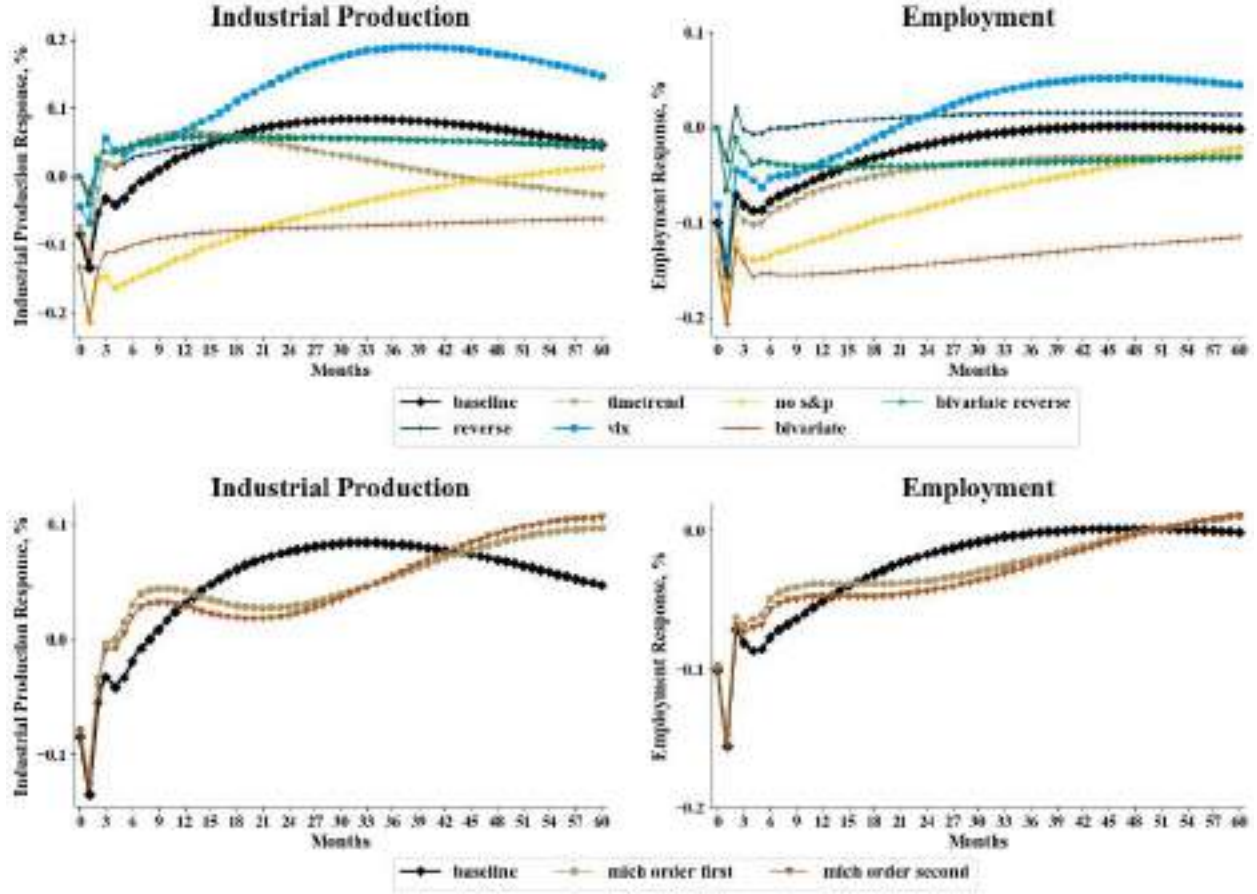
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation upward shock to uncertainty about regulation. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory uncertainty index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

Figure 6: Impulse Responses to a Negative Sentiment Shock about Regulation
(Monthly VAR, Robustness Checks)



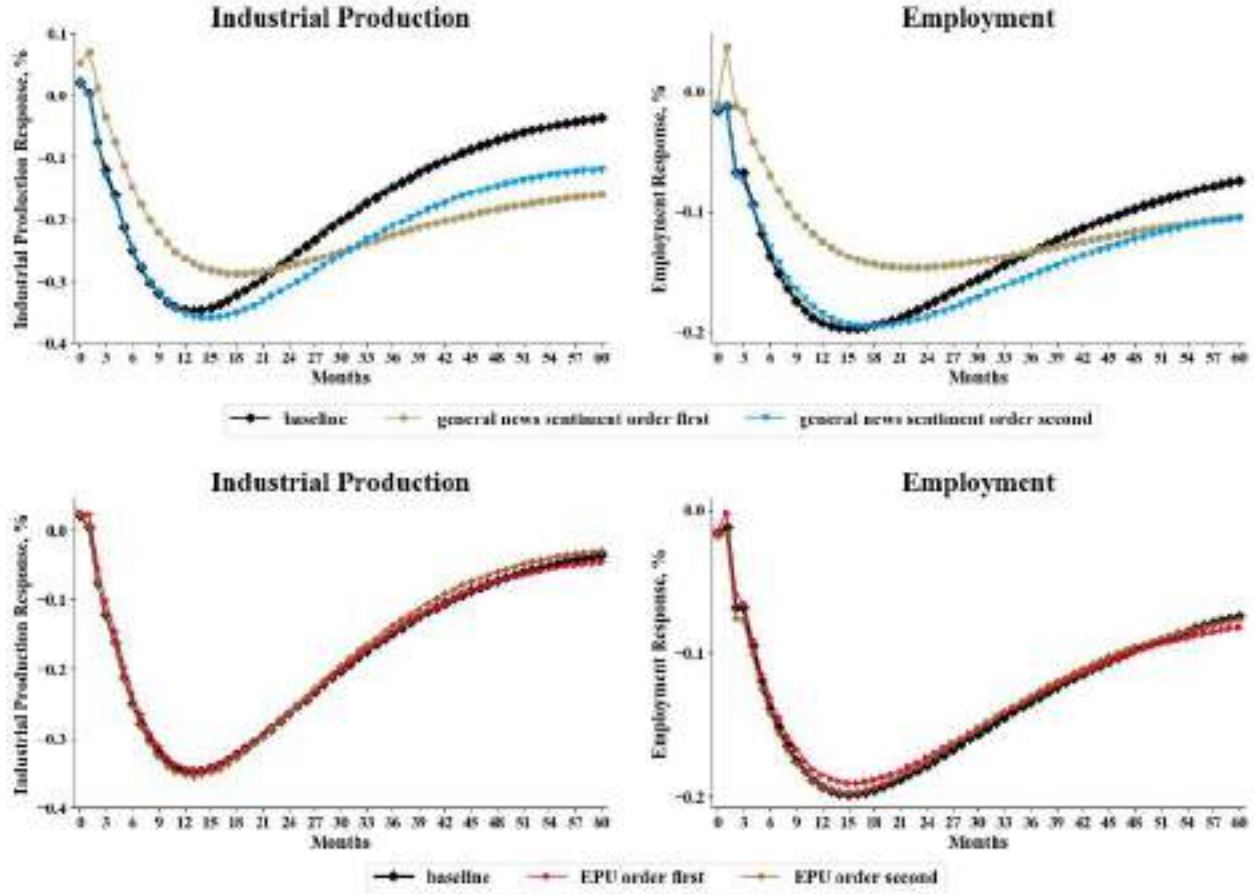
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation negative shock to sentiment about regulation, with several modifications to the baseline specification. The sentiment index is estimated using the Loughran and McDonald (LM) dictionary. The modifications include reverse ordering, a bivariate VAR, a bivariate VAR with reverse ordering, dropping the S&P index, including the VIX, including time trends, and including the Michigan Consumer Sentiment Index.

Figure 7: Impulse Responses to an Uncertainty Shock about Regulation
(Monthly VAR, Robustness Checks)



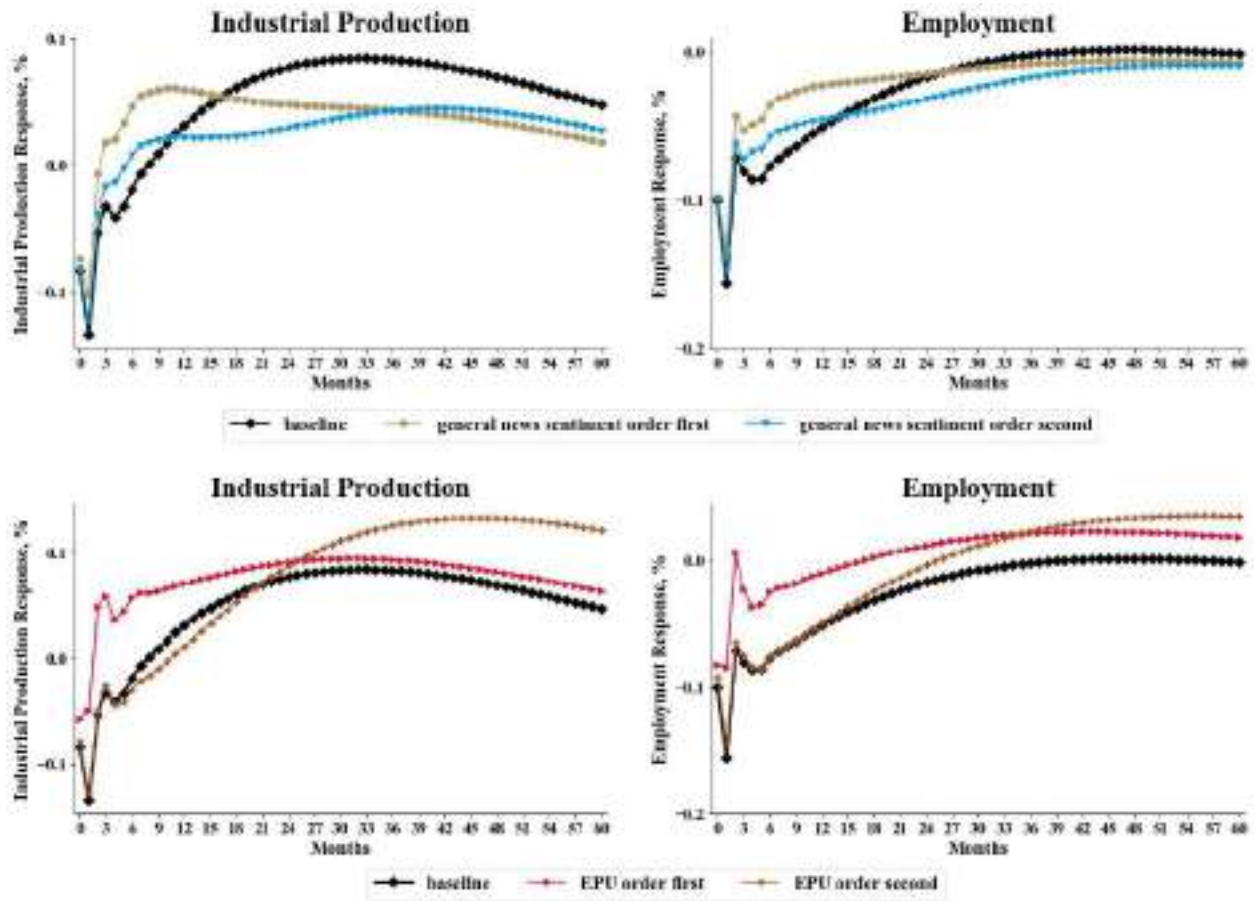
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation upward shock to uncertainty about regulation, with several modifications to the baseline specification. The modifications include reverse ordering, a bivariate VAR, a bivariate VAR with reverse ordering, dropping the S&P index, including the VIX, including time trends, and including the Michigan Consumer Sentiment Index.

Figure 8: Impulse Responses to a Negative Sentiment Shock about Regulation
(Monthly VAR, Adding General News Sentiment or EPU)



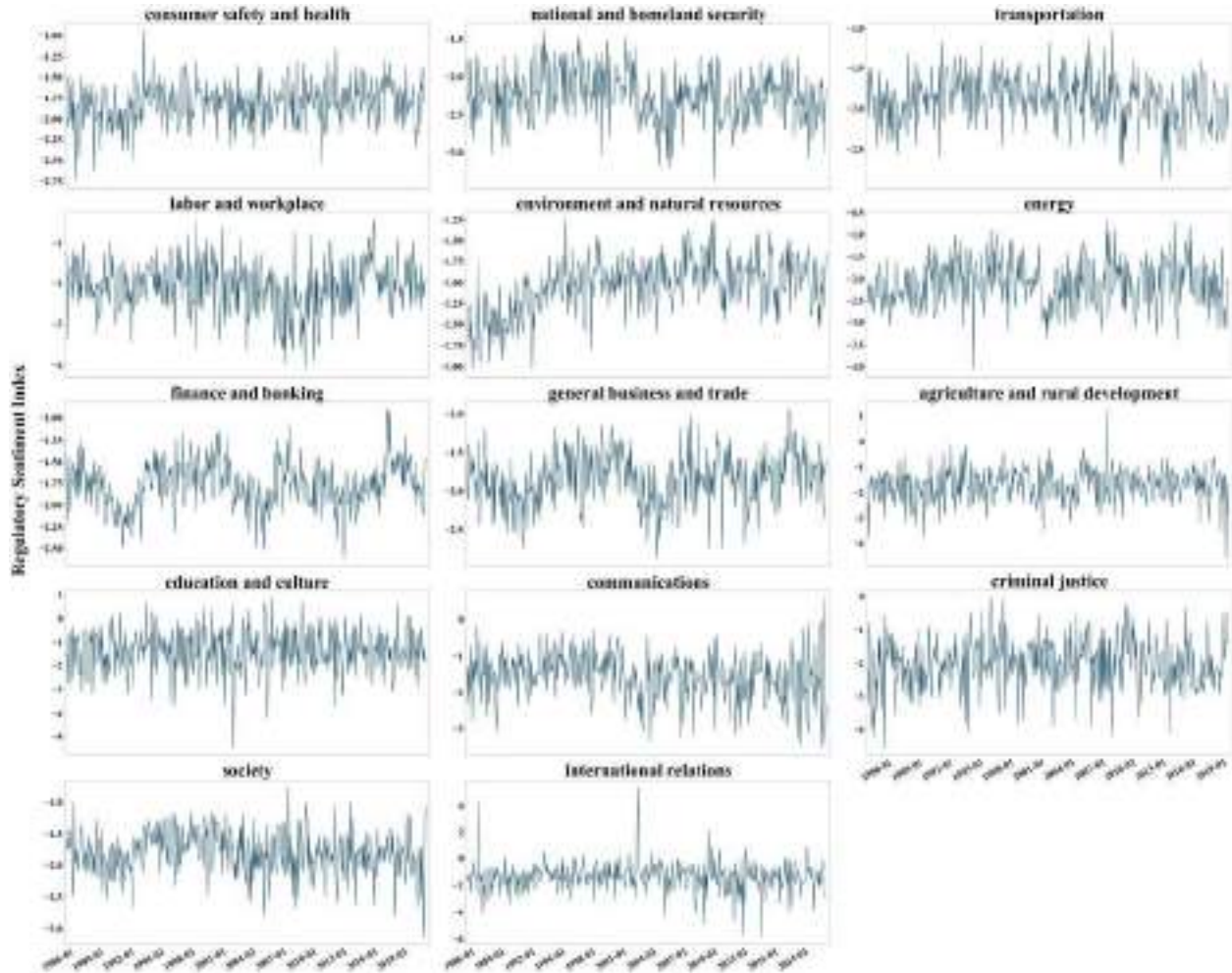
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation negative shock to sentiment about regulation, after adding the news sentiment index of Shapiro et al. (2020) or the EPU index of Baker et al. (2016). The sentiment index is estimated using the Loughran and McDonald (LM) dictionary.

Figure 9: Impulse Responses to an Uncertainty Shock about Regulation
(Monthly VAR, Adding General News Sentiment or EPU)



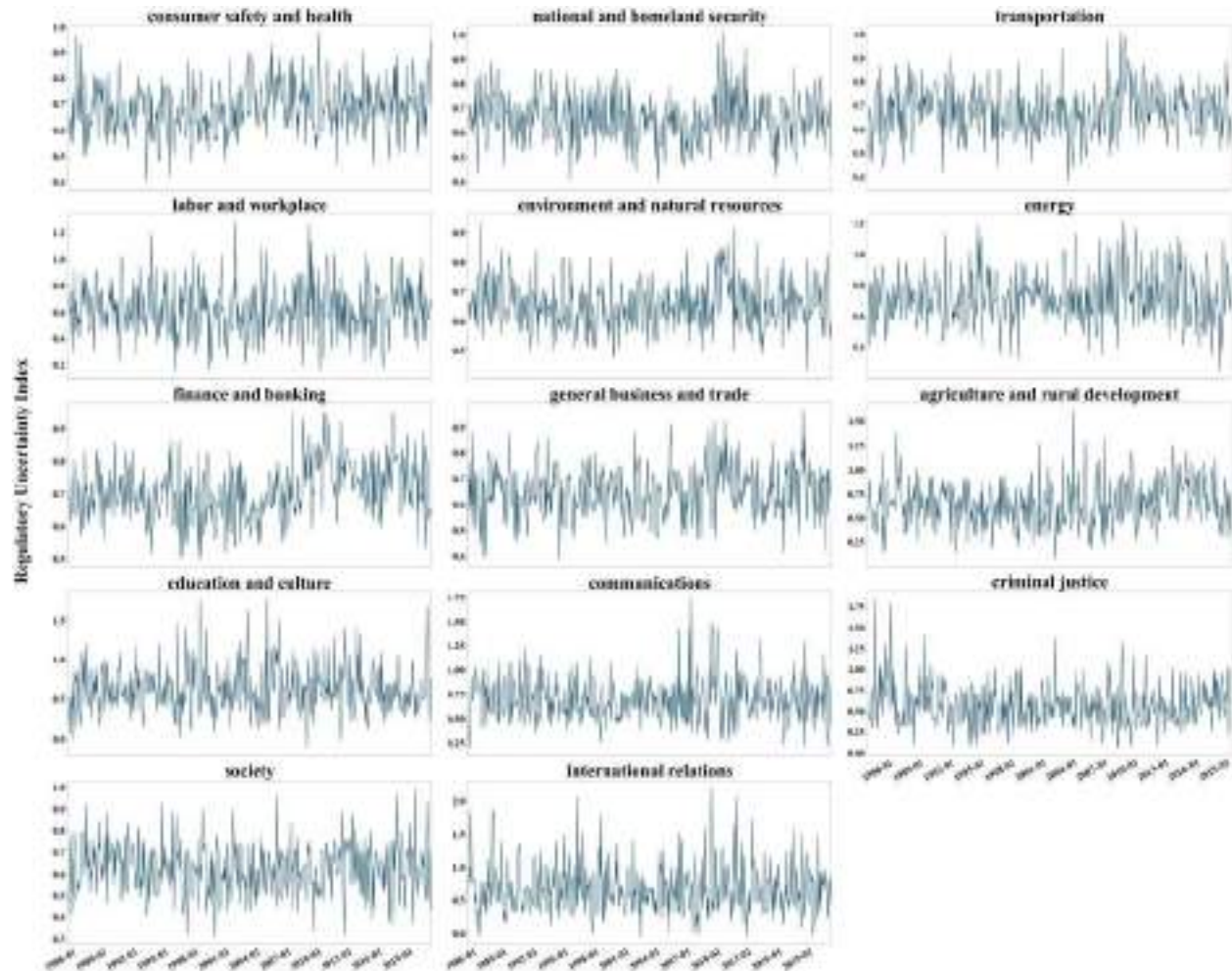
Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation upward shock to uncertainty about regulation, after adding the news sentiment index of Shapiro et al. (2020) or the EPU index of Baker et al. (2016).

Figure 10: Monthly Sentiment Index By Regulatory Policy Area
(January 1985 – August 2020)



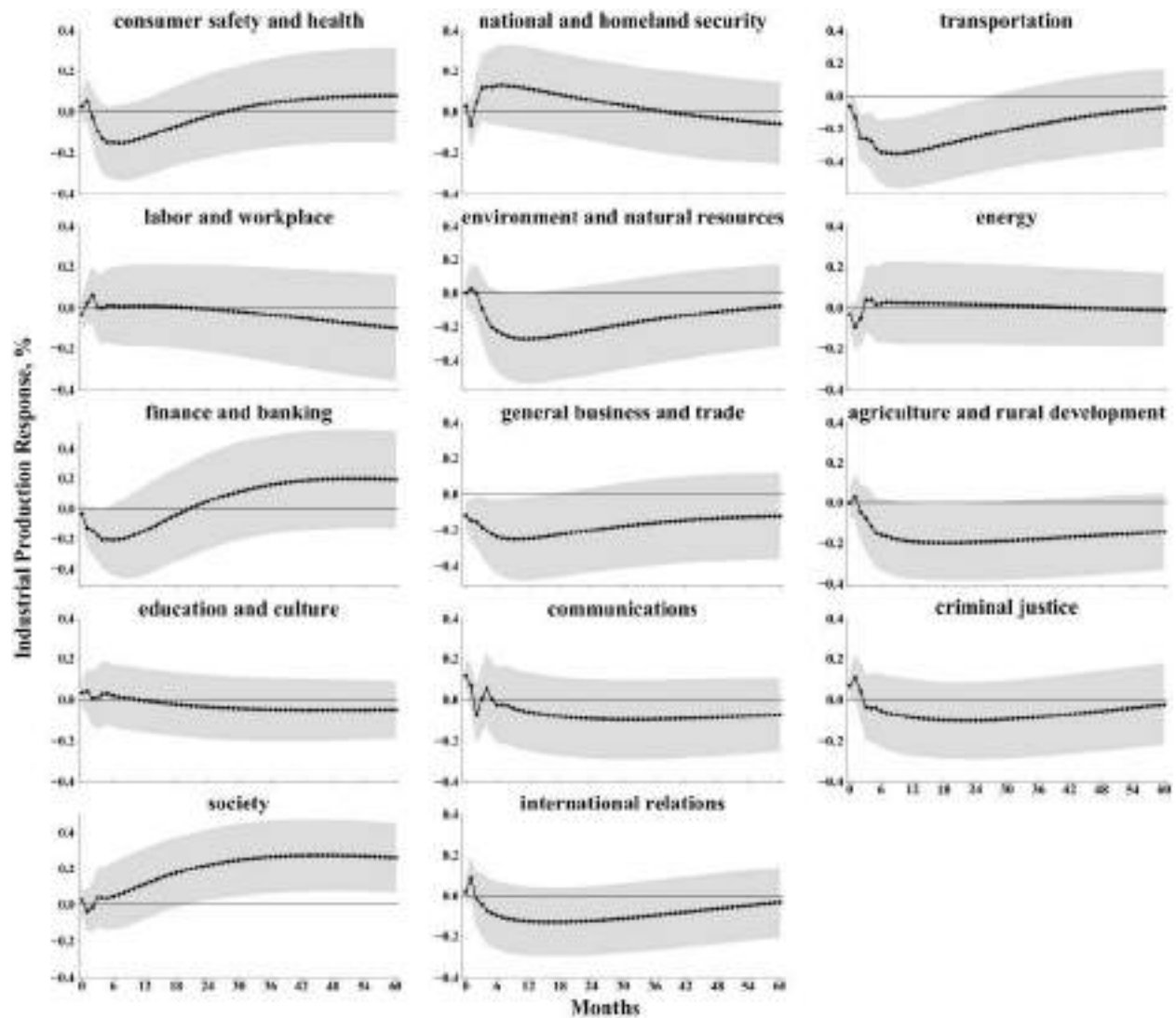
Notes: The figures plot the sentiment indexes estimated using the Loughran and McDonald (LM) dictionary for each regulatory policy area.

Figure 11: Monthly Uncertainty Index By Regulatory Policy Area
(January 1985 – August 2020)



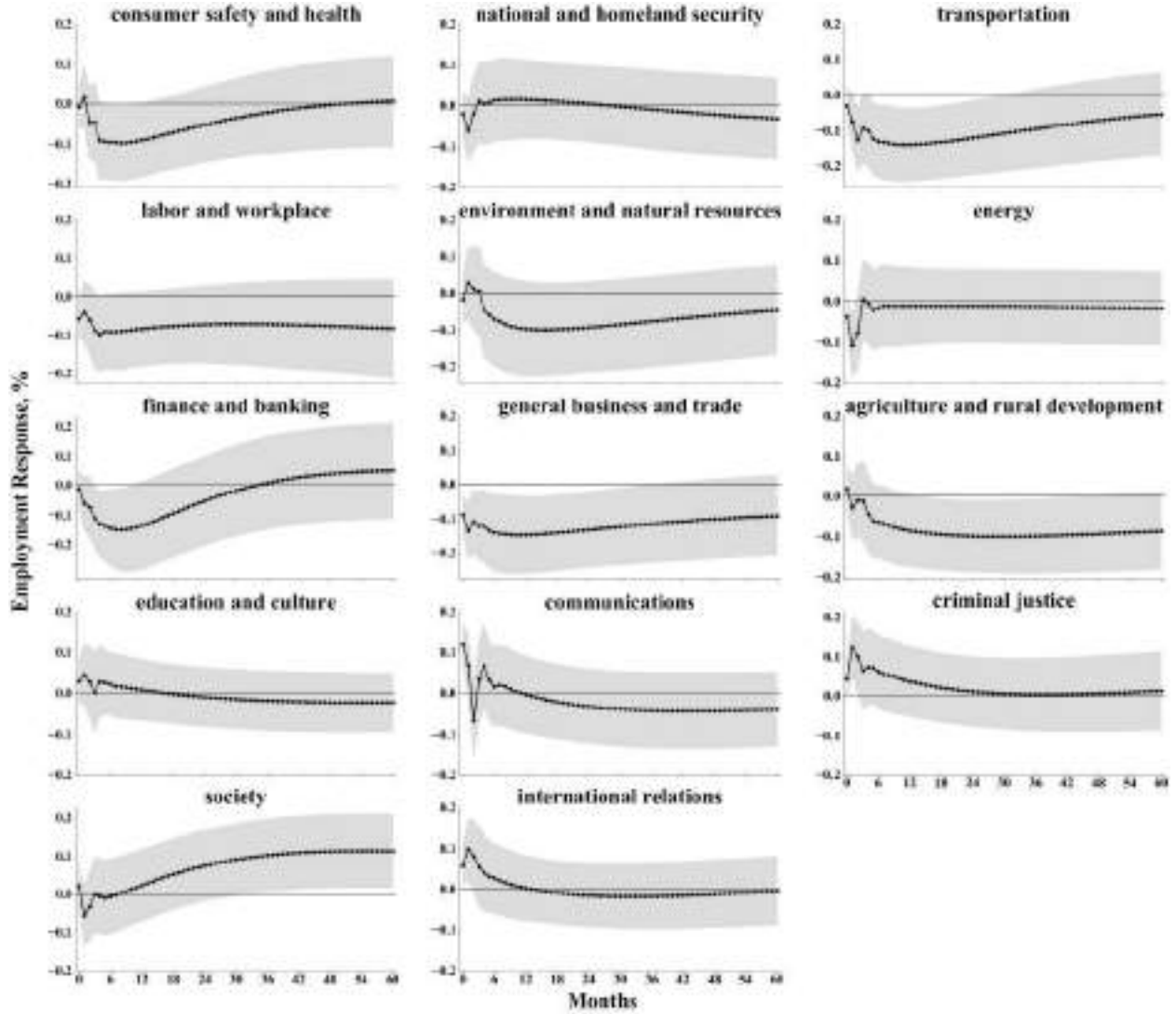
Notes: The figures plot the uncertainty indexes estimated using the Loughran and McDonald (LM) dictionary for each regulatory policy area.

Figure 12: Industrial Production Responses to a Negative Sentiment Shock By Regulatory Area
(Monthly VAR)



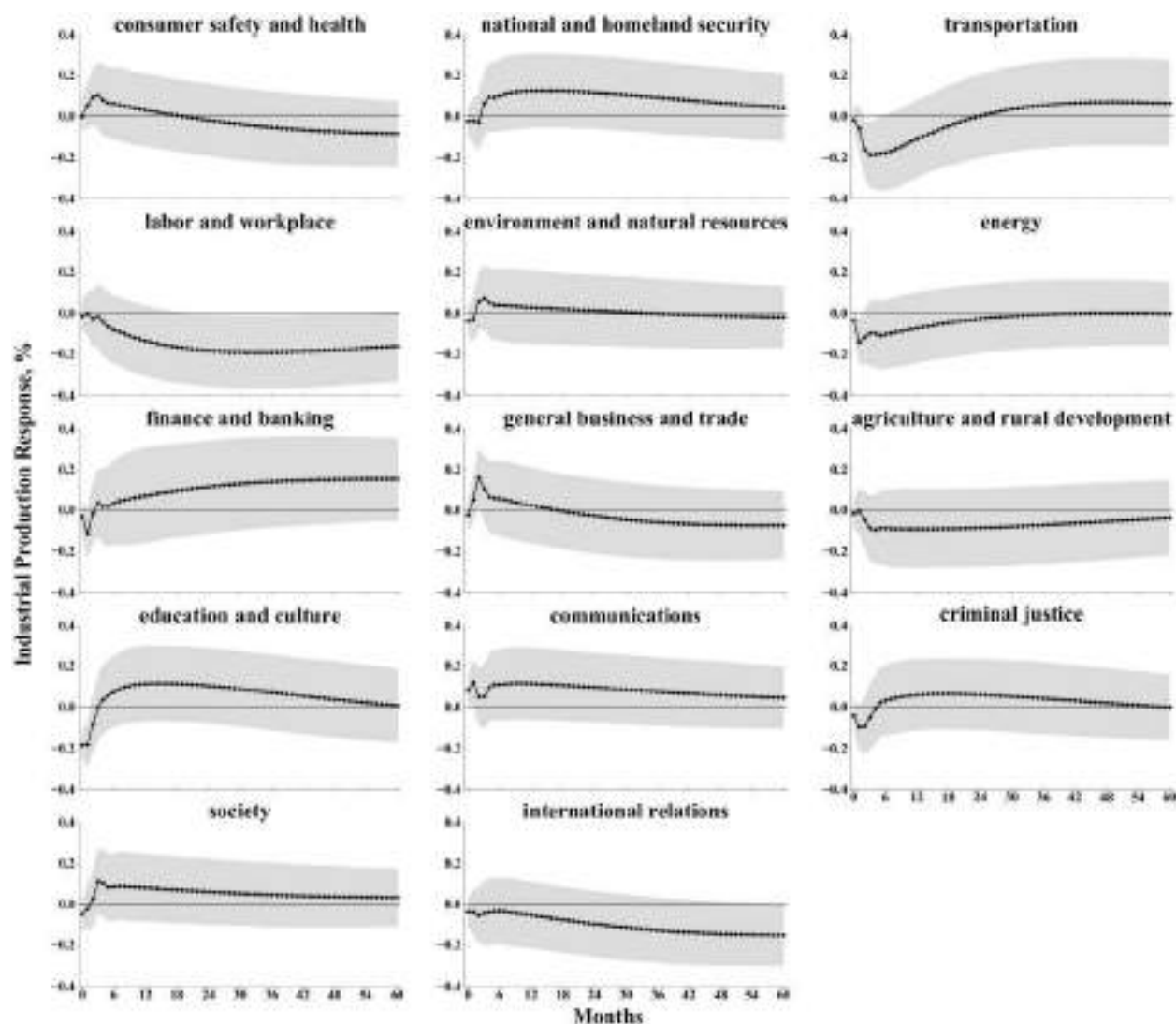
Notes: The figures plot VAR-estimated impulse responses of industrial production to a one-standard-deviation negative sentiment shock for each regulatory policy area. The sentiment indexes are estimated using the Loughran and McDonald (LM) dictionary. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory sentiment index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

Figure 13: Employment Responses to a Negative Sentiment Shock By Regulatory Area
(Monthly VAR)



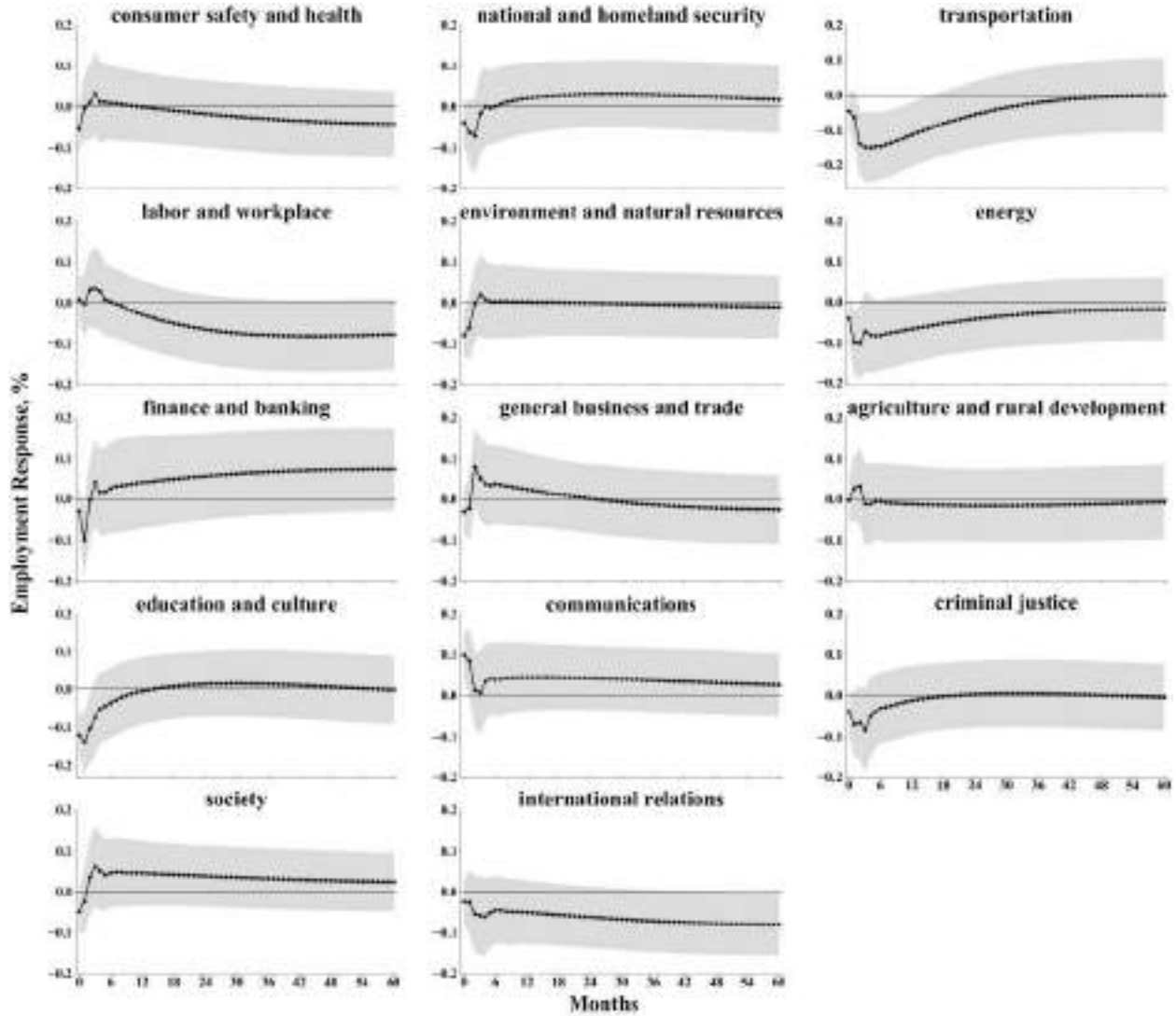
Notes: The figures plot VAR-estimated impulse responses of employment to a one-standard-deviation negative sentiment shock for each regulatory policy area. The sentiment indexes are estimated using the Loughran and McDonald (LM) dictionary. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory sentiment index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

Figure 14: Industrial Production Responses to an Uncertainty Shock By Regulatory Area (Monthly VAR)



Notes: The figures plot VAR-estimated impulse responses of industrial production to a one-standard-deviation upward uncertainty shock for each regulatory policy area. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory uncertainty index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

Figure 15: Employment Responses to an Uncertainty Shock By Regulatory Area
(Monthly VAR)



Notes: The figures plot VAR-estimated impulse responses of employment to a one-standard-deviation upward uncertainty shock for each regulatory policy area. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory uncertainty index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.

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Appendices

A The Most Common Regulatory Noun Chunks in News Articles

{new regulation: 29880, federal regulation: 22168, health care: 17897, real estate: 17401, federal reserve: 16590, new rule: 15906, federal government: 15414, attorney general: 14667, government regulation: 13776, interest rate: 12065, food and drug administration: 11989, hedge fund: 11942, natural gas: 11356, state regulation: 11207, nuclear regulatory commission: 10891, mutual fund: 10498, financial institution: 10215, environmental protection agency: 9921, small business: 9664, public health: 8746, federal law: 8718, state law: 8612, insurance company: 8002, financial service: 7969, executive director: 7604, federal agency: 7103, propose regulation: 7096, federal deposit: 6719, federal energy regulatory commission: 6630, state department: 6477, clean air: 6472, fannie mae: 6350, state official: 6084, credit card: 5674, task force: 5490, greenhouse gas: 5460, freddie mac: 5327, hold company: 5054, brokerage firm: 5038, safety regulation: 4970, law enforcement: 4846, health insurance: 4832, regulatory change: 4677, life insurance: 4446, air quality: 4402, rate increase: 4380, consumer protection: 4336, regulatory body: 4322, nuclear power plant: 4267, economic growth: 4245, nursing home: 4212, propose rule: 4170, local government: 4105, general counsel: 4077, national bank: 4050, air pollution: 3973, public hearing: 3965, regulatory system: 3855, regulatory requirement: 3834, public comment: 3801, joint venture: 3762, insider trading: 3542, government agency: 3503, credit union: 3485, commodity futures trading commission: 3425, capital requirement: 3350, air bag: 3269, high speed: 3206, carbon dioxide: 3191, federal home loan bank: 3155, enforcement action: 3129, security firm: 3126, executive officer: 3107, tax cut: 3101, market share: 3081, health plan: 3053, state agency: 3033, u.s government: 2979, regulatory reform: 2955, commercial bank: 2940, initial public offering: 2864, electric utility: 2828, land use: 2821, executive order: 2797, regulatory review: 2794, inspector general: 2785, self regulation: 2753, court decision: 2741, public utility: 2740, drinking water: 2685, high cost: 2624, u.s department: 2599, fuel economy: 2592, money laundering: 2583, accounting firm: 2558, national security: 2522, start up: 2504, medical device: 2486, bank hold company: 2481, regulatory burden: 2473}

Notes: The above shows 100 most common regulatory noun chunks that occurred in all the non-duplicated news articles in our initial corpus (N=788,516). The number indicates the number of occurrences of the noun chunk across all news articles. The noun chunks are lemmatized, so, for example, “hold company” is a lemmatized version of “holding company.”

B Examples of Regulatory Sections

Example 1 (Wall Street Journal, 1993-06-22):

Property and casualty insurers would have to meet stringent capital requirements under a proposal likely to be adopted by insurance regulators. The standards, similar to those now in place for life and health insurers, would require property and casualty insurers to have sufficient capital to meet the riskiness of their investments and operations. Failure to meet the requirements would mean regulators could either seize a troubled insurer or order operational changes. The property and casualty market, alone, involves annual premiums totaling \$500 billion. Under the proposal, each insurer must report to what extent it exceeds or falls below its minimum-capital threshold. Insurance regulators released a draft of the rules at a conference for state insurance commissioners here. “We are entering the home stretch of one of the most important improvements in insurance regulation,” said Virginia Insurance Commissioner Stephen Foster, chairman of the National Association of Insurance Commissioners. Regulators will vote on whether to adopt the proposal in December. The rules, if passed, would go into effect next year and the results would be available to the public in the spring of 1995. Insurance experts say it’s unlikely that regulators will make major changes in the proposal before voting on it. The effort comes at a time when Congress is concerned about whether states are up to the job of overseeing insurance companies. The company wants to prove that the idea is administratively possible, said Roger Joslin, State Farm’s treasurer. Under the plan, State Farm can still trade securities but cannot withdraw from the account or convert safe assets into riskier ones without approval of the trustee and state insurance regulators.

Regulatory noun chunks: [capital requirement, minimum capital, insurance regulation, major change, insurance company]

Sentiment:

LM negative words: [stringent, concerned, risky, seize, troubled]

LM positive words: [improvement]

LM sentiment score: -1.4085

GI negative words: [casualty, capital, pass, casualty, stringent, capital, fall, capital, casualty, involve, make, risky, approval (with negation), mean, seize, order]

GI positive words: [health, sufficient, meet, pass, meet, home, important, improvement, company, premium, expert, make, major, company, security, safe, asset, credit, meet, order]

GI sentiment score: 1.4085

LSD negative words: [casualty, riskiness, casualty, casualty, unlikely, concerned, riskier, approval (with negation), failure, seize, troubled]

LSD positive words: [sufficient, adopted, improvements, foster, adopt, experts, effort, safe, assets, credit]

LSD sentiment score: -0.3521

Uncertainty:

LM uncertainty words: [riskiness, possible, risky, could]

LM uncertainty score: 1.4085

Example 2 (Wall Street Journal, 2010-06-22):

House and Senate Democrats are under pressure to complete their overhaul of financial regulations before President Barack Obama meets with world leaders this weekend, setting up a scramble to iron out differences on a range of complicated provisions. The discussions cover issues from bank regulation to consumer protection. They seek to find a balance that may appease the few centrist Republicans willing to support the bill, while also keeping liberal Democrats happy. Lawmakers are also close to a deal that would place a new consumer-financial protection bureau within the Federal Reserve, scrapping an original White House proposal to create a standalone agency. The change, which closely follows language adopted by the Senate in May, would likely not appease business groups, which oppose the creation of any new consumer-protection regulator with broad powers. Lawmakers are divided over whether it would have power over auto dealerships. Lawmakers on Monday did reach a deal that would limit the amount of fees banks are allowed to charge retailers for processing debit cards. The conference committee of congressional negotiators seeking to resolve differences between the House and Senate versions of the bill plans to work through the consumer-protection issues on Tuesday, the Volcker Rule on Wednesday, and derivatives regulation on Thursday. The timing could slip if lawmakers need more time to resolve disputes.

Regulatory noun chunks: [consumer protection, consumer protection, volcker rule, consumer protection, debit card, consumer financial protection bureau, federal reserve]

Sentiment:

LM negative words: [oppose, dispute, complicated, close]

LM positive words: [happy, resolve, resolve]

LM sentiment score: -0.4444

GI negative words: [divide, appease (with negation), oppose, deal, limit, charge, need, dispute, iron, close, deal]

GI positive words: [protection, appease, willing, support, liberal, happy, resolve, protection, protection, deal, allow, resolve, complete, meet, deal, protection, create]

GI sentiment score: 2.6667

LSD negative words: [divided, appease (with negation), oppose, limit, charge, disputes, complicated, scrapping]

LSD positive words: [protection, balance, appease, support, keeping, happy, resolve, protection, adopted, creation, protection, allowed, resolve, protection, create]

LSD sentiment score: 3.1111

Uncertainty:

LM uncertainty words: [may, could]

LM uncertainty score: 0.8889

Example 3 (New York Times, 2016-11-10):

Republican control of Washington sets the stage for a sweeping shift in economic policy. Mr. Trump has proposed a fairly standard set of conservative prescriptions, such as lower taxes and less regulation, with one notable departure: a promise to reduce trade with other nations. The centerpiece of Mr. Trump's plans is a major overhaul of the federal tax code. An analysis by the nonpartisan Committee for a Responsible Federal Budget estimated that Mr. Trump's plans would increase the federal debt by \$5.3 trillion over the next decade, and raise the ratio of debt to gross domestic product to 105 percent. Mr. Trump also has

promised to reduce federal regulation. Business groups argue that the Obama administration has impeded economic growth by significantly expanding regulation in areas including environmental and worker protections. He has specifically promised to reverse some new environmental rules, such as the climate change regulations on power plants. Earlier this year, he also proposed the “dismantling” of the Dodd-Frank Act, which overhauled federal regulation of the financial industry in the aftermath of the 2008 financial crisis. The act created the Consumer Financial Protection Bureau, a likely target for Republican legislators. He also has threatened a variety of sanctions against American companies that move manufacturing jobs overseas, although the legality of such measures is unclear. Republicans who broadly agree with Mr. Trump on taxes and regulation may have greater reservations about his views on trade. The party has long supported increased trade among nations.

Regulatory noun chunks: [economic growth, consumer financial protection bureau, change regulation, federal regulation, dodd frank act, federal regulation]

Sentiment:

LM negative words: [argue, impede, threaten, against, aftermath, crisis]

LM positive words: [great]

LM sentiment score: -2

GI negative words: [argue, impede, threaten, against, unclear, crisis, tax, low, raise]

GI positive words: [protection, support, create, company, promise, great, promise, major, notable, promise]

GI sentiment score: 0.4

LSD negative words: [argue, impeded, threatened, against, unclear, crisis, debt, debt, gross]

LSD positive words: [protections, supported, created, protection, agree, frank, notable, responsible]

LSD sentiment score: -0.4

Uncertainty:

LM uncertainty words: [unclear, may]

LM uncertainty score: 0.8

Example 4 (Boston Globe, 1998-10-25):

“We don’t know whether it will be feasible to lower emissions 75 percent by 2005, but we will participate in the effort.” On sludge, or the muck left over when wastewater is drained, Shaheen’s plan builds on the ongoing efforts at the Department of Environmental Services to more tightly regulate mercury in the waste, some 18,600 tons of which are spread on farmland annually as fertilizer. The department is moving to adopt a new standard for how much mercury may be in the sludge, and is considering – as per Shaheen’s plan – an even tighter standard.

Regulatory noun chunks: [environmental service, new standard]

Sentiment:

LM negative words: [waste]

LM positive words: []
LM sentiment score: -1.0204
GI negative words: [know (with negation), lower, waste, even]
GI positive words: [feasible, consider, even]
GI sentiment score: -1.0204
LSD negative words: [wastewater, drained, waste]
LSD positive words: [feasible, effort, efforts, adopt]
LSD sentiment score: 1.0204

Uncertainty:

LM uncertainty words: [may]
LM uncertainty score: 1.0204

Example 5 (The Washington Post, 2001-04-05):

All recreational boats will be limited to one bushel of hard crabs and three dozen soft or peeler crabs per day. The new limits were implemented after the Chesapeake Bay Commission’s Bi-State Blue Crab Advisory Committee decided last year that fishing regulators should reduce crab harvests by 15 percent over three years to increase spawning stock. In recent years, crab harvests have dipped near all-time lows throughout the region. They pointed out that other factors – including recreational crabbers, environmental damage and predatory fish – also contribute to diminishing crab populations. Those factors, the watermen said, should also be addressed when local regulators devised new limits. The commercial crabbers’ reaction to the new limits varied from disappointment to relief. He suggested that the panel’s new limits are too tough on the commercial crab industry. “These regulations are just getting piled on us one after the other,” said Conway, of Crisfield. “If society wants to eliminate the waterman, then these regulations are a very efficient way of doing it.” The shortening of the crabbing season drew more complaints from watermen than did the lowering of pot limits.

Regulatory noun chunks: [recreational boat, chesapeake bay, advisory committee, environmental damage]

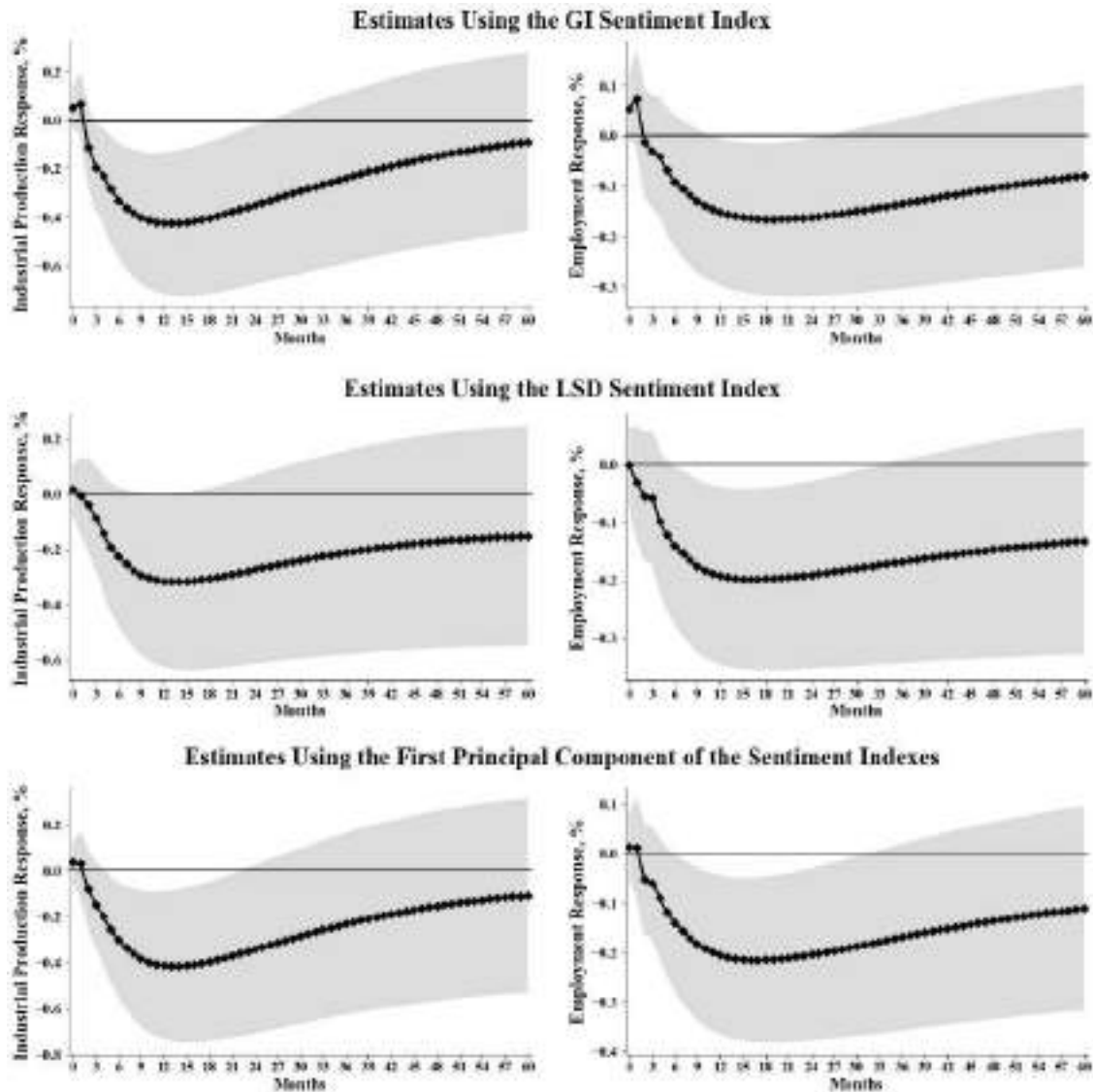
Sentiment:

LM negative words: [complaint, disappointment, damage, predatory, diminish]
LM positive words: [efficient]
LM sentiment score: -2.1277
GI negative words: [eliminate, limit, hard, limit, low, limit, get, limit, too, complaint, limit, limit, disappointment, point, damage]
GI positive words: [efficient, just, relief, contribute]
GI sentiment score: -5.8511
LSD negative words: [eliminate, limited, hard, limits, limits, limits, too, tough, complaints, limits, limits, disappointment, damage, predatory]
LSD positive words: [efficient, recreational, relief, recreational]
LSD sentiment score: -5.3191

Uncertainty:

LM uncertainty words: [suggest, vary]
LM uncertainty score: 1.0638

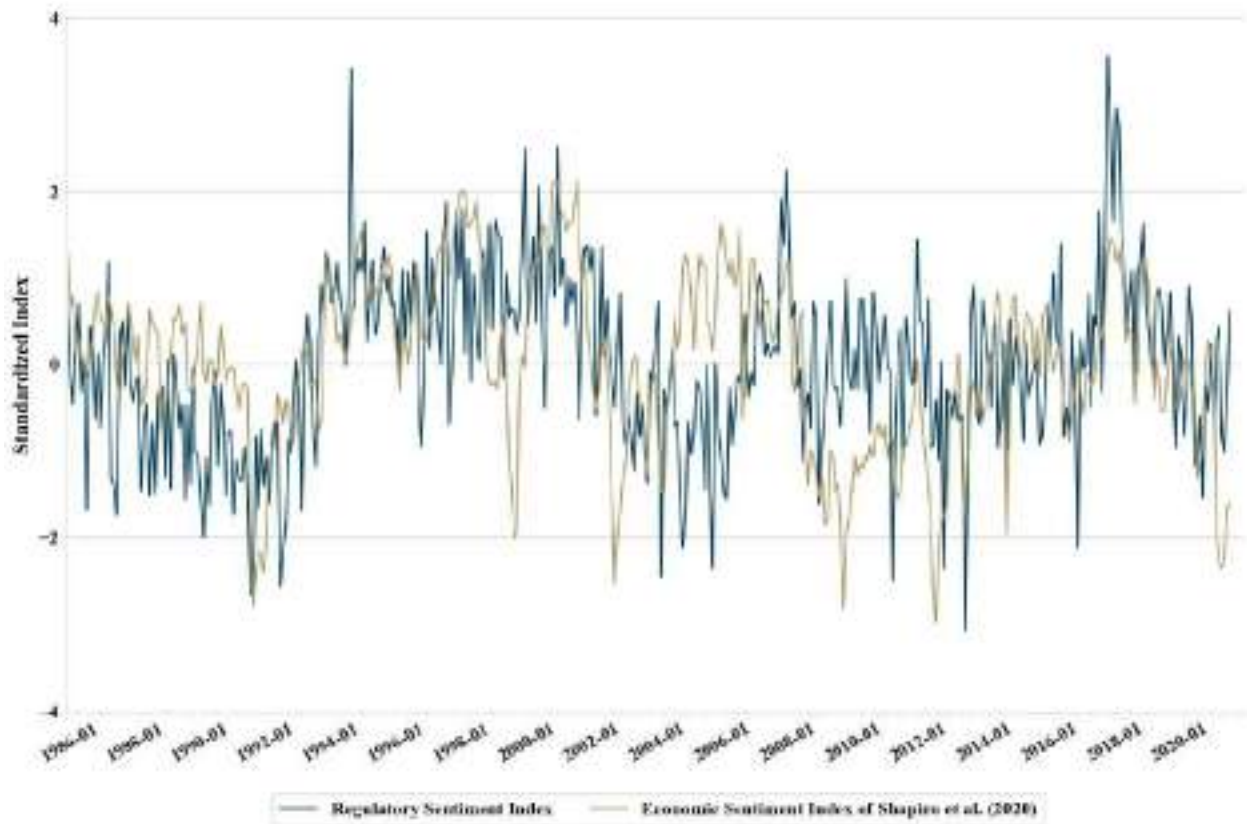
C Impulse Responses Using Alternative Regulatory Sentiment Indexes (Monthly VAR)



Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation negative shock to sentiment about regulation, using the sentiment indexes estimated from the General Inquirer (GI) dictionary and the Lexicoder Sentiment Dictionary (LSD) as well as the first principal component of the GI, LSD, and Loughran and McDonald (LM) sentiment indexes. Gray areas show 90 percent confidence bands.

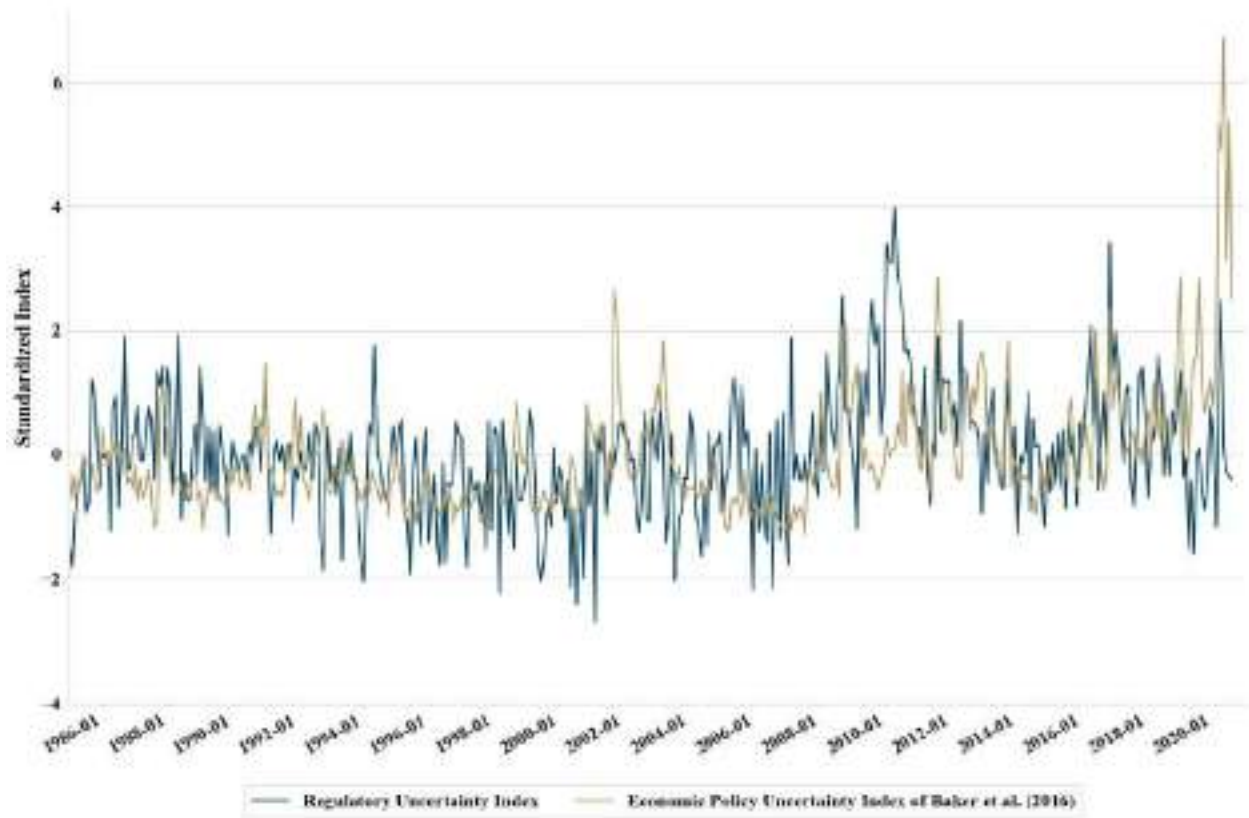
D Compare Sentiment and Uncertainty Indexes

D.1 Compare Regulatory Sentiment Index and Economic Sentiment Index



Notes: The figure plots the regulatory sentiment indexes estimated using the Loughran and McDonald (LM) dictionary and the economic sentiment index of Shapiro et al. (2020). Both indexes are normalized to have mean equal to zero and standard deviation equal to one.

D.2 Compare Regulatory Uncertainty Index and Economic Policy Uncertainty Index



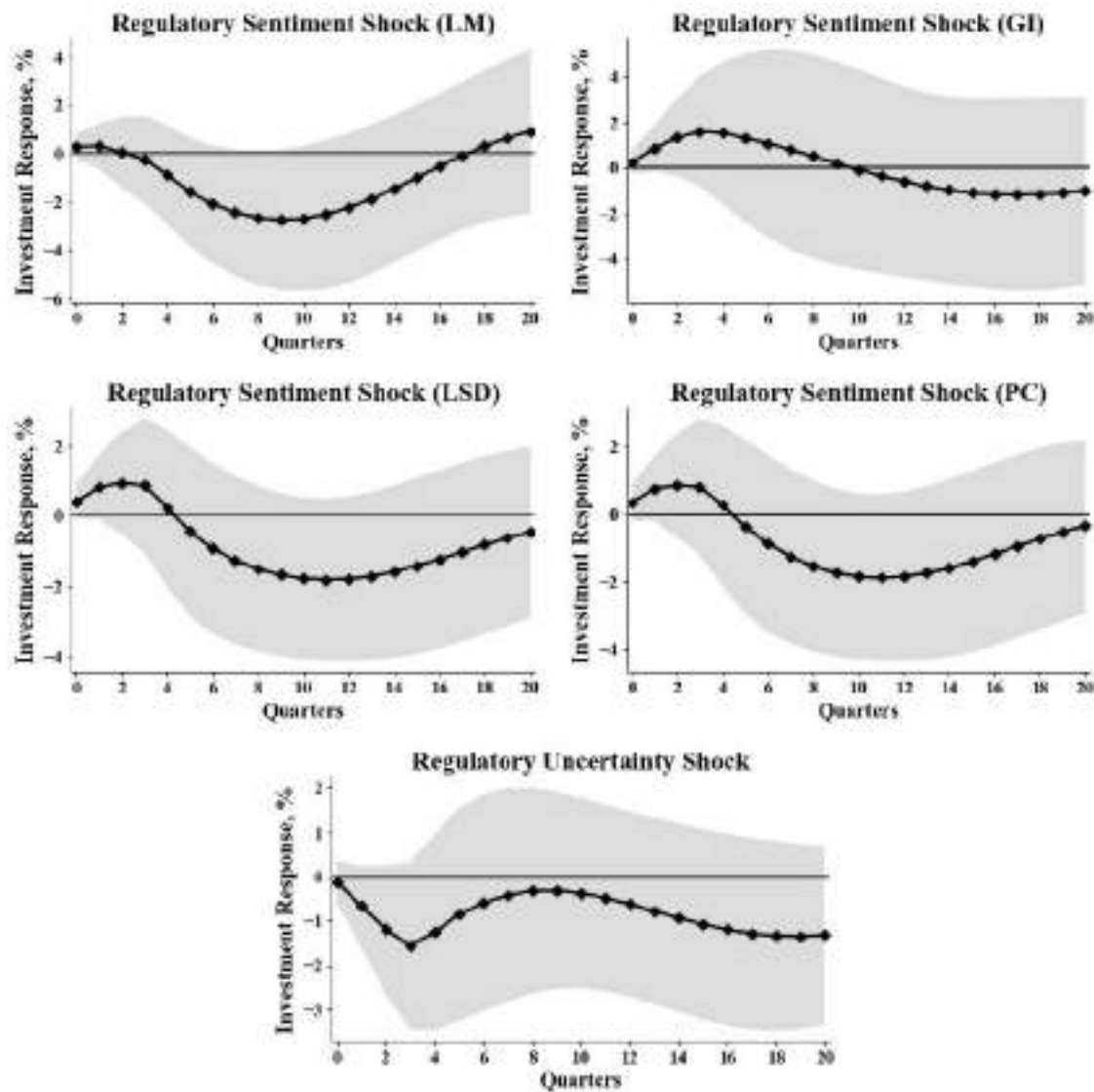
Notes: The figure plots the regulatory uncertainty indexes estimated using the Loughran and McDonald (LM) dictionary and the economic policy uncertainty index of Baker et al. (2016). Both indexes are normalized to have mean equal to zero and standard deviation equal to one.

E Stationarity Tests for the Regulatory Sentiment and Uncertainty Indexes

Index	ADF test statistic	Phillips-Perron test statistic	KPSS test statistic
LM sentiment index	-3.4107 (p=0.0106)	-15.2300 (p<0.0001)	0.2542 (p=0.1833)
GI sentiment index	-2.0719 (p=0.2560)	-16.6369 (p<0.0001)	0.6249 (p=0.0195)
LSD sentiment index	-4.1658 (p=0.0008)	-14.5903 (p<0.0001)	0.8013 (p=0.0072)
Sentiment PC	-2.3863 (p=0.1456)	-15.1323 (p<0.0001)	0.6713 (0.0149)
Uncertainty index	-3.7472 (p=0.0035)	-17.0986 (p<0.0001)	0.8722 (p=0.0049)

Notes: The sentiment PC represents the first principal component of the LM, GI, and LSD sentiment indexes.

F Investment Responses to Regulatory Sentiment and Uncertainty Shocks (Quarterly VAR)



Notes: The figures plot VAR-estimated investment responses to a one-standard-deviation negative shock to sentiment about regulation or a one-standard-deviation upward shock to regulatory uncertainty. Sentiment measures are indexes estimated from the Loughran and McDonald (LM) dictionary, the General Inquirer (GI) dictionary, the Lexicoder Sentiment Dictionary (LSD), and the first principal component (PC) of the three sentiment indexes. Gray areas show 90 percent confidence bands.

G Interaction between Regulatory Sentiment and Uncertainty

Following the approach of Caggiano et al. (2017), we estimate an Interacted-VAR with an interaction term of regulatory sentiment and uncertainty. The Interacted-VAR is as follows:

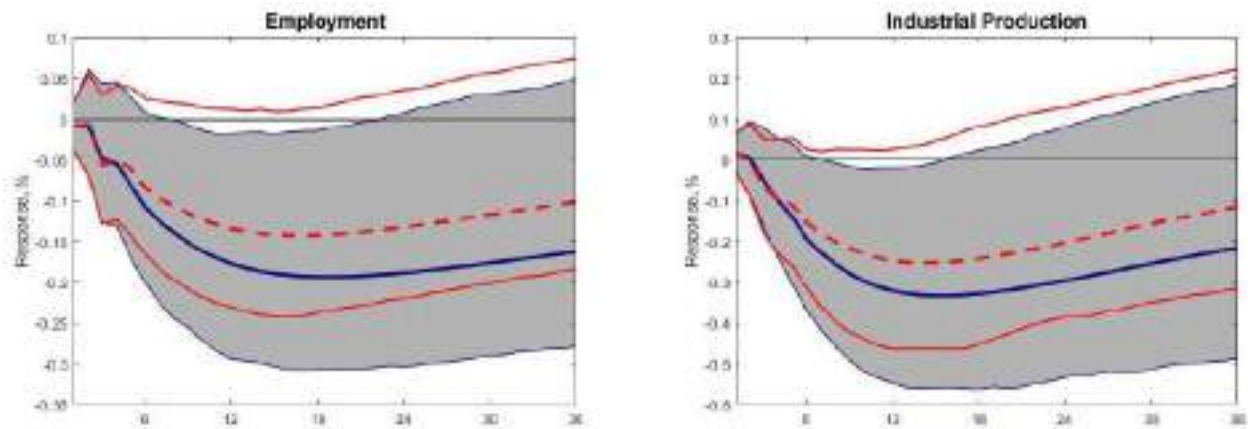
$$y_t = \alpha + \sum_{j=1}^k A_j y_{t-j} + \left[\sum_{j=1}^k c_j (sent_{t-j} \times unc_{t-j}) \right] + u_t$$

where $y_t = [sent_t, lsp_t, ffr_t, lemp_t, lip_t, unc_t]'$ is the $(n \times 1)$ vector of endogenous variables including the regulatory sentiment index, log S&P 500, federal funds rate, log employment, log industrial production, and the regulatory uncertainty index, $(sent_{t-j} \times unc_{t-j})$ is an interaction term of regulatory sentiment and uncertainty, A_j are $(n \times n)$ matrices of coefficients, c_j are $n \times 1$ vectors of coefficients, and u_t is the $(n \times 1)$ vector of error terms. Same as our baseline VAR, we include three lags of all variables.

We then compute generalized impulse response functions to examine: (1) whether the effects of regulatory sentiment shocks are different under the state of particularly high regulatory uncertainty, and (2) whether the effects of regulatory uncertainty shocks are different under the state of particularly low regulatory sentiment. The settings and results are shown in Appendices G.1 and G.2.

G.1 Generalized Impulse Response Functions to Regulatory Sentiment Shocks under High and Low Regulatory Uncertainty

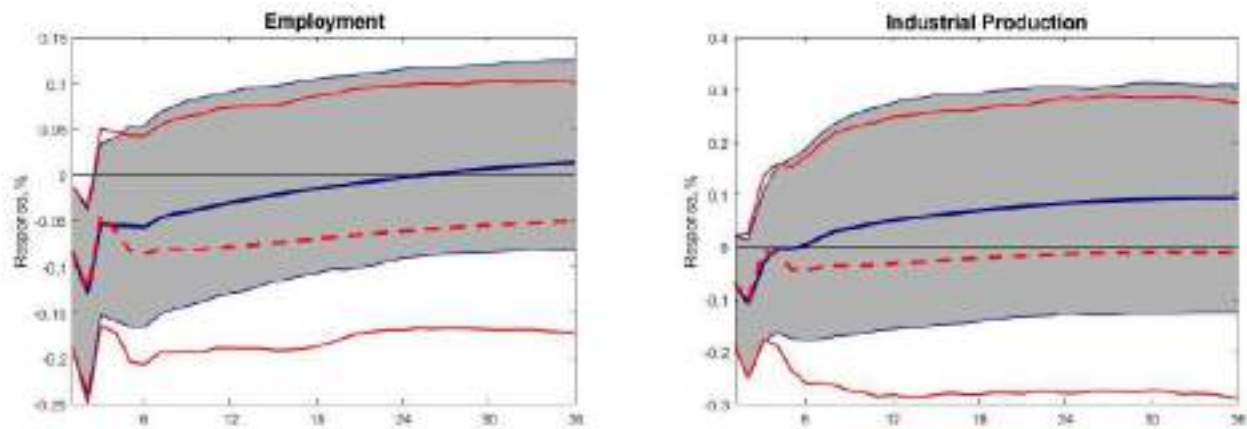
The high regulatory uncertainty state is defined as the months above the 75th percentile of the regulatory uncertainty index, and the low regulatory uncertainty state is the months below that. To identify regulatory sentiment shocks, we use the Cholesky decomposition with the following ordering: regulatory sentiment (the LM-based index), log S&P 500, federal funds rate, log employment, log industrial production, and regulatory uncertainty. The following figure plots the generalized impulse response functions for industrial production and employment to a one-standard-deviation negative regulatory sentiment shock.



Notes: Dashed-red line: low regulatory uncertainty state. Solid-blue line: high regulatory uncertainty state. Solid-red lines and gray areas: 90 percent confidence bands.

G.2 Generalized Impulse Response Functions to Regulatory Uncertainty Shocks under High and Low Regulatory Sentiment

The low regulatory sentiment state is defined as the months below the 25th percentile of the regulatory sentiment index, and the high regulatory sentiment state is the months above that. To identify regulatory uncertainty shocks, we use the Cholesky decomposition with the following ordering: regulatory uncertainty, log S&P 500, federal funds rate, log employment, log industrial production, and regulatory sentiment (the LM-based index). The following figure plots the generalized impulse response functions for industrial production and employment to a one-standard-deviation upward regulatory uncertainty shock.

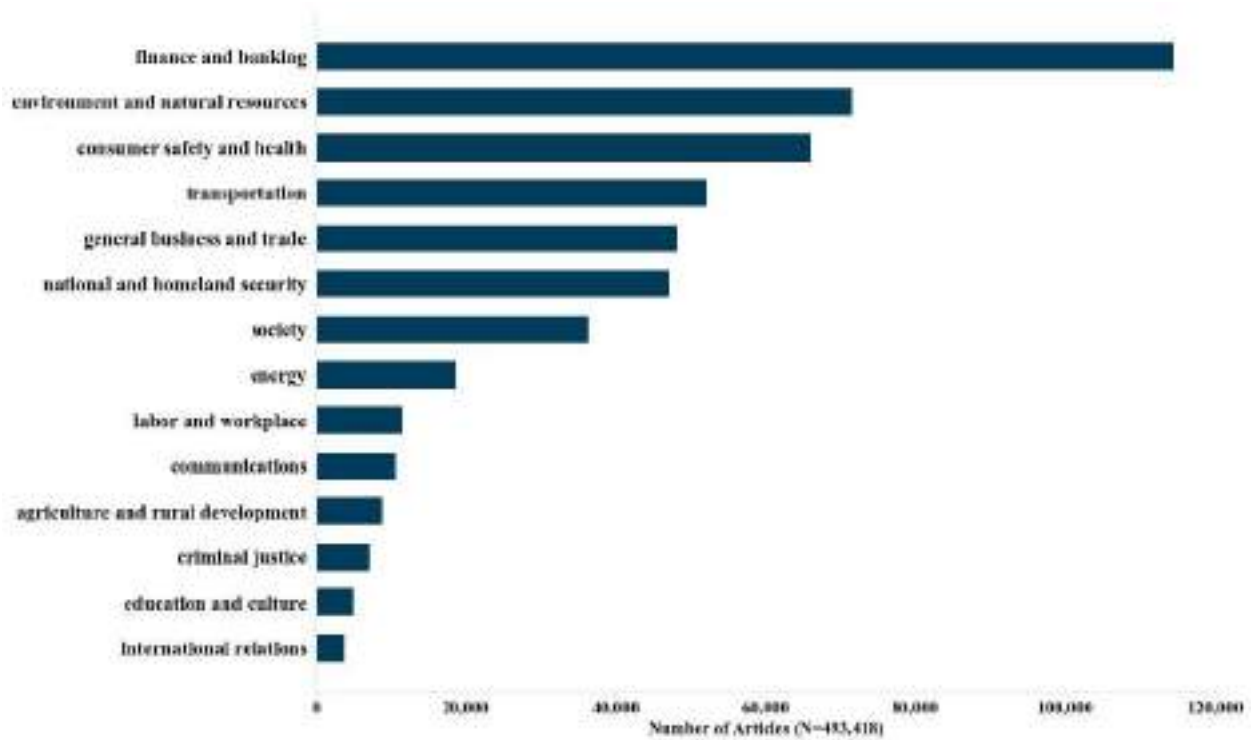


Notes: Dashed-red line: low regulatory sentiment state. Solid-blue line: high regulatory sentiment state. Solid-red lines and gray areas: 90 percent confidence bands.

H Examples of Agencies, Regulatory Areas, and Rule Titles

Regulatory Area	Agency	Department	Rule Title
agriculture and rural development	Agricultural Marketing Service	Department of Agriculture	National Organic Program
communications	Federal Communications Commission	N/A	Streamlining the Commission's Rules and Regulations for Satellite Application and Licensing Procedures (IB Docket No. 95-117)
consumer safety and health	Centers for Medicare & Medicaid Services	Department of Health and Human Services	Deduction of Incurred Medical Expenses (Spenddown) (HCFA-2020-F)
criminal justice	Bureau of Prisons	Department of Justice	Volunteer Community Service Projects
education and culture	Office of Elementary and Secondary Education	Department of Education	Improving Basic Programs Operated by Local Educational Agencies
energy	Energy Efficiency and Renewable Energy	Department of Energy	Energy Efficiency Standards for Room Air Conditioners
environment and natural resources	Office of Air and Radiation	Environmental Protection Agency	National Volatile Organic Compounds (VOC) Emission Standards for Consumer Products; Amendments
finance and banking	Commodity Futures Trading Commission	N/A	Review of Commission Disclosure Requirements Concerning Commodity Pool Operators
general business and trade	Small Business Administration	N/A	Certificate of Competency
international relations	Agency for International Development	N/A	Administration of Grants and Cooperative Agreements
labor and workplace	Employment and Training Administration	Department of Labor	Airline Deregulation: Employee Benefit Program
national and homeland security	Bureau of Citizenship and Immigration Services	Department of Homeland Security	Employment Verification by Employers That Are Members of a Multi-Employer Association
society	Office of Fair Housing and Equal Opportunity	Department of Housing and Urban Development	Economic Opportunities for Low- and Very-Low-Income Persons (FR-2898)
transportation	Federal Aviation Administration	Department of Transportation	Objects Affecting Navigable Airspace

I Frequencies of Articles By Regulatory Area



Notes: The figure plots the number of news articles classified into each regulatory policy area in our sample.

J The Most Common Regulatory Noun Chunks by Regulatory Area

Area Name: consumer safety and health

Unique Regulatory Noun Chunks: 1397

Top 30 Regulatory Noun Chunks and Occurrences:

{food and drug administration: 11452, public health: 7352, federal law: 6825, public hearing: 3146, government agency: 2628, child care: 2170, human service: 1934, federal rule: 1706, new drug: 1636, manage care: 1630, dietary supplement: 1256, new standard: 1119, federal fund: 905, disease control: 857, u.s nuclear regulatory commission: 851, major change: 744, health claim: 697, long term care: 675, sexual harassment: 675, pregnant woman: 659, european community: 643, federal funding: 618, policy change: 612, good faith: 606, social service: 601, bottled water: 582, toxic substance: 580, gene therapy: 554, fda approval: 524, food product: 488}

Area Name: national and homeland security

Unique Regulatory Noun Chunks: 802

Top 30 Regulatory Noun Chunks and Occurrences:

{attorney general: 11975, clean air: 3750, regulatory body: 3352, market share: 2647, accounting firm: 2163, chinese company: 1854, low price: 1769, oil spill: 1061, pollution control: 957, school board: 942, quality control: 857, insurance rate: 794, information technology: 784, internal investigation: 667, whistle blower: 588, foreign ownership: 580, u.s firm: 547, army regulation: 546, false statement: 524, trade agreement: 517, international regulation: 512, increase cost: 493, speed limit: 491, defense contractor: 412, surface transportation: 407, water pollution: 386, construction project: 384, criminal justice: 369, commercial use: 362, collective bargaining: 357}

Area Name: transportation

Unique Regulatory Noun Chunks: 784

Top 30 Regulatory Noun Chunks and Occurrences:

{new regulation: 23098, brokerage firm: 3839, air bag: 3212, high speed: 2912, interstate commerce: 1760, federal safety: 1508, telephone service: 1381, federal election: 1281, air travel: 1050, seat belt: 938, regulatory barrier: 865, electric vehicle: 848, safety violation: 628, drug use: 576, metropolitan area: 574, tank car: 543, air transport: 529, pickup truck: 526, gas pipeline: 519, cellular phone: 462, fuel tank: 429, federal railroad administration: 424, air carrier: 421, passenger car: 399, joint statement: 397, warning label: 397, pilot training: 371, special permit: 367, pipeline safety: 352, drug test: 334}

Area Name: labor and workplace

Unique Regulatory Noun Chunks: 244

Top 30 Regulatory Noun Chunks and Occurrences:

{stock option: 1555, minimum wage: 1467, airline deregulation: 1290, labor regulation: 588, fire safety: 519, other drug: 411, drug testing: 405, voting right: 364, union official: 311, investment advice: 270, large employer: 268, legal requirement: 233, foreign worker: 209, civil action: 202, construction industry: 200, soft dollar: 195, construction

worker: 193, shareholder right: 173, individual retirement: 158, reproductive health: 157, emergency evacuation: 146, safety program: 146, federal contractor: 146, welfare benefit: 135, register nurse: 135, fair labor standards act: 130, religious liberty: 128, government contractor: 126, labor standard: 125, interest rule: 122}

Area Name: environment and natural resources

Unique Regulatory Noun Chunks: 1656

Top 30 Regulatory Noun Chunks and Occurrences:

{nuclear regulatory commission: 9571, environmental protection agency: 8881, executive director: 6022, air pollution: 3724, carbon dioxide: 3059, land use: 2645, regulatory system: 2627, hazardous waste: 2314, emergency regulation: 1713, traffic safety: 1691, regulatory framework: 1567, fossil fuel: 1381, clean water act: 1253, federal authority: 1188, national park: 1112, nitrogen oxide: 1046, toxic chemical: 940, emission regulation: 925, pesticide regulation: 874, epa regulation: 867, public land: 862, regulatory investigation: 810, power line: 762, develop country: 756, solid waste: 748, diesel engine: 712, down payment: 709, cape cod: 655, state authority: 655, human health: 638}

Area Name: energy

Unique Regulatory Noun Chunks: 383

Top 30 Regulatory Noun Chunks and Occurrences:

{federal energy regulatory commission: 5958, nuclear power plant: 3638, energy policy: 792, new service: 617, nuclear waste: 617, competitive market: 595, radioactive material: 546, wholesale power: 534, strand cost: 417, non profit: 394, spend fuel: 385, radioactive waste: 375, worker safety: 366, antitrust review: 364, transmission system: 341, independent system operator: 327, criminal penalty: 318, commission staff: 299, license renewal: 264, oil pipeline: 241, medical license: 235, licensing process: 216, chief accountant: 189, medical use: 184, wind energy: 180, television set: 173, set top box: 173, radiation exposure: 161, energy board: 161, federal inspector: 152}

Area Name: finance and banking

Unique Regulatory Noun Chunks: 1218

Top 30 Regulatory Noun Chunks and Occurrences:

{federal reserve: 16023, government regulation: 12094, financial service: 7587, insurance company: 7370, federal deposit: 6572, state official: 4548, life insurance: 4258, national bank: 3955, commodity futures trading commission: 3176, federal home loan bank: 3070, tax cut: 2989, security firm: 2915, commercial bank: 2866, executive officer: 2723, money laundering: 2511, banking regulation: 2337, start up: 2259, foreign investment: 2254, volcker rule: 2117, foreign bank: 2089, deposit insurance: 1828, internal revenue service: 1787, natural resource: 1482, regulatory capital: 1368, market participant: 1345, u.s treasury: 1340, regulatory structure: 1331, tax credit: 1321, sale practice: 1301, financial company: 1156}

Area Name: general business and trade

Unique Regulatory Noun Chunks: 621

Top 30 Regulatory Noun Chunks and Occurrences:

{state regulation: 8875, task force: 4355, initial public offering: 2508, self regulation: 2405, future trading: 1746, crude oil: 1238, mobile phone: 1198, money market fund: 1171, cross border: 1127, tender offer: 1099, shareholder approval: 1049, investment company: 1016, saving bank: 993, market timing: 982, intellectual property: 976, short selling: 923, internal control: 846, market manipulation: 754, portfolio manager: 653, dodd frank act: 639, administration regulation: 617, independent director: 602, exchange trade fund: 589, political contribution: 583, foreign policy: 579, other service: 570, legal authority: 562, other asset: 554, political activity: 543, public offering: 537}

Area Name: agriculture and rural development

Unique Regulatory Noun Chunks: 254

Top 30 Regulatory Noun Chunks and Occurrences:

{asset management: 1605, insurance regulation: 988, emerge market: 974, change regulation: 686, water system: 495, domestic market: 417, reorganization plan: 350, environmental policy: 348, spot market: 246, insurance program: 221, annual fee: 212, dairy product: 160, charitable organization: 137, designate area: 135, rural community: 124, property management: 91, federal bankruptcy code: 90, marketing agreement: 86, price support: 86, fresh fruit: 85, marketing order: 82, non compliance: 81, qualified mortgage: 77, debt settlement: 65, u.s producer: 63, loan document: 60, insurance provider: 59, loan rate: 56, write agreement: 55, seismic safety: 54}

Area Name: education and culture

Unique Regulatory Noun Chunks: 161

Top 30 Regulatory Noun Chunks and Occurrences:

{high quality: 826, due diligence: 640, high standard: 612, special education: 442, public space: 271, advisory council: 242, agency report: 222, all child: 99, price change: 87, national science: 86, national aeronautics and space administration: 81, foreign language: 80, vocational education: 80, international study: 77, electronic mail: 77, national endowment: 72, special program: 63, cash management: 61, college tuition: 61, special project: 61, borrower defense: 59, nixon administration: 53, accrediting agency: 53, space flight: 49, education act: 48, pell grant: 46, spinal cord injury: 44, commercial firm: 40, outside employment: 36, propose system: 36}

Area Name: communications

Unique Regulatory Noun Chunks: 227

Top 30 Regulatory Noun Chunks and Occurrences:

{middle class: 1152, sbc communications: 715, accounting practice: 653, aviation safety: 591, commission rule: 526, common carrier: 444, fcc rule: 410, rate reduction: 397, full power: 395, open internet: 361, video service: 336, tv channel: 264, cable act: 245, formal complaint: 238, caller id: 209, competitive bidding: 201, unfair competition: 192, broadcast license: 179, regulatory fee: 178, television channel: 170, communication network: 166, satellite service: 166, telephone network: 165, regulatory treatment: 158, infrastructure investment: 147, digital television: 143, television programming: 138, mobile service: 136, comprehensive review: 131, communication act: 130}

Area Name: criminal justice

Unique Regulatory Noun Chunks: 101

Top 30 Regulatory Noun Chunks and Occurrences:

{public safety: 1738, private company: 1381, special counsel: 892, former employee: 834, birth control: 560, federal bureau: 558, housing unit: 326, other information: 244, security measure: 243, religious belief: 201, certification process: 133, reporting regulation: 100, write comment: 92, medical reason: 83, telephone regulation: 75, incentive regulation: 67, chapter 11 case: 62, juvenile justice: 56, magistrate judge: 45, civil investigative demand: 40, usa patriot act: 34, minimum safety: 32, u.s trustee: 31, crack cocaine: 30, state agent: 24, civil matter: 21, maximum capacity: 21, return address: 21, psychiatric evaluation: 19, megan 's law: 18}

Area Name: society

Unique Regulatory Noun Chunks: 660

Top 30 Regulatory Noun Chunks and Occurrences:

{rate increase: 3818, joint venture: 3305, social medium: 1967, high cost: 1965, social security: 1860, rent control: 1584, police department: 1456, urban development: 1142, u.s court: 1010, phase out: 886, single family: 876, oversight board: 815, federal housing enterprise oversight: 746, mortgage lending: 734, home mortgage: 714, health benefit: 564, criminal case: 514, mortgage broker: 506, next generation: 499, new construction: 468, weight loss: 453, home rule: 444, restructuring plan: 425, heart disease: 419, earning report: 409, civil liberty: 408, other source: 388, public fund: 339, old law: 335, minimum capital: 328}

Area Name: international relations

Unique Regulatory Noun Chunks: 84

Top 30 Regulatory Noun Chunks and Occurrences:

{economic development: 1435, agency regulation: 245, u.s agency: 240, u.s national: 213, parental consent: 208, export license: 153, international development: 138, statutory authority: 123, criminal history: 99, communication technology: 98, risk analysis: 95, public charge: 76, university student: 71, internal policy: 67, public domain: 61, arm regulation: 58, registration process: 56, medical leave: 52, contracting officer: 43, aid regulation: 42, global medium: 41, u.s institution: 30, visa application: 30, other assistance: 29, passport regulation: 27, foreign diplomat: 27, international will: 26, foreign service officer: 25, food use: 22, charitable activity: 22}

K Filtering Regulatory Noun Chunks for Article Classification

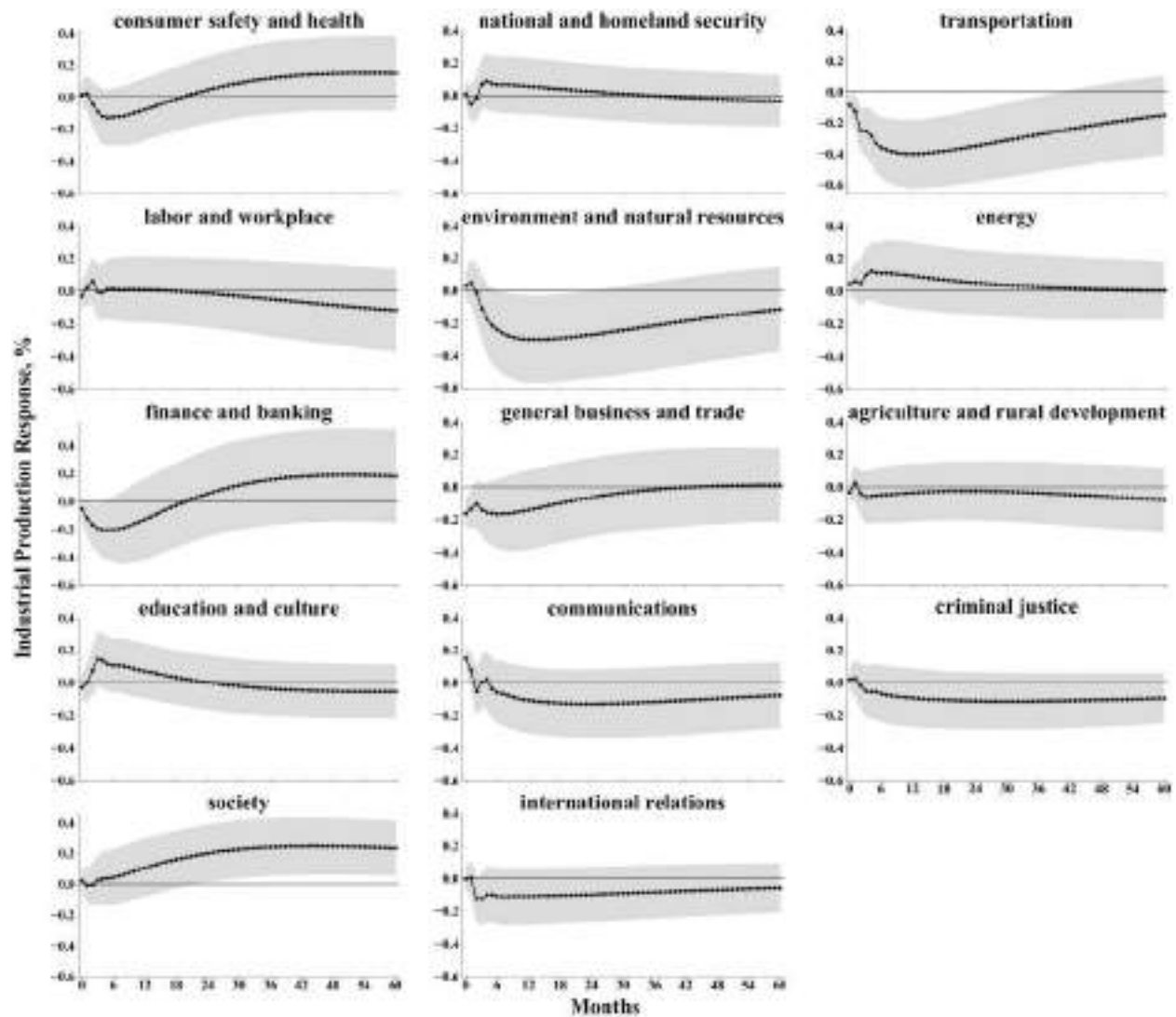
We conduct human checking of the most common regulatory noun chunks that occur in the news articles classified into each area. Specifically, we manually filter out certain general or irrelevant terms from the top 100 regulatory noun chunks in each area and then reclassify news articles. When filtering out general or irrelevant terms, we take two alternative approaches: one is a relatively conservative approach that removes a small set of terms that are unlikely associated with the corresponding area or very likely associated with multiple areas, and the other is a relatively aggressive approach that keeps only the terms that are more likely associated with the corresponding area than any other areas.

As a result, 258 terms were removed using the conservative approach, and 449 terms were removed using the aggressive approach. See the top 15 regulatory noun chunks for the labor and workplace category as an example (the strikethrough terms are the regulatory noun chunks filtered out through each approach):

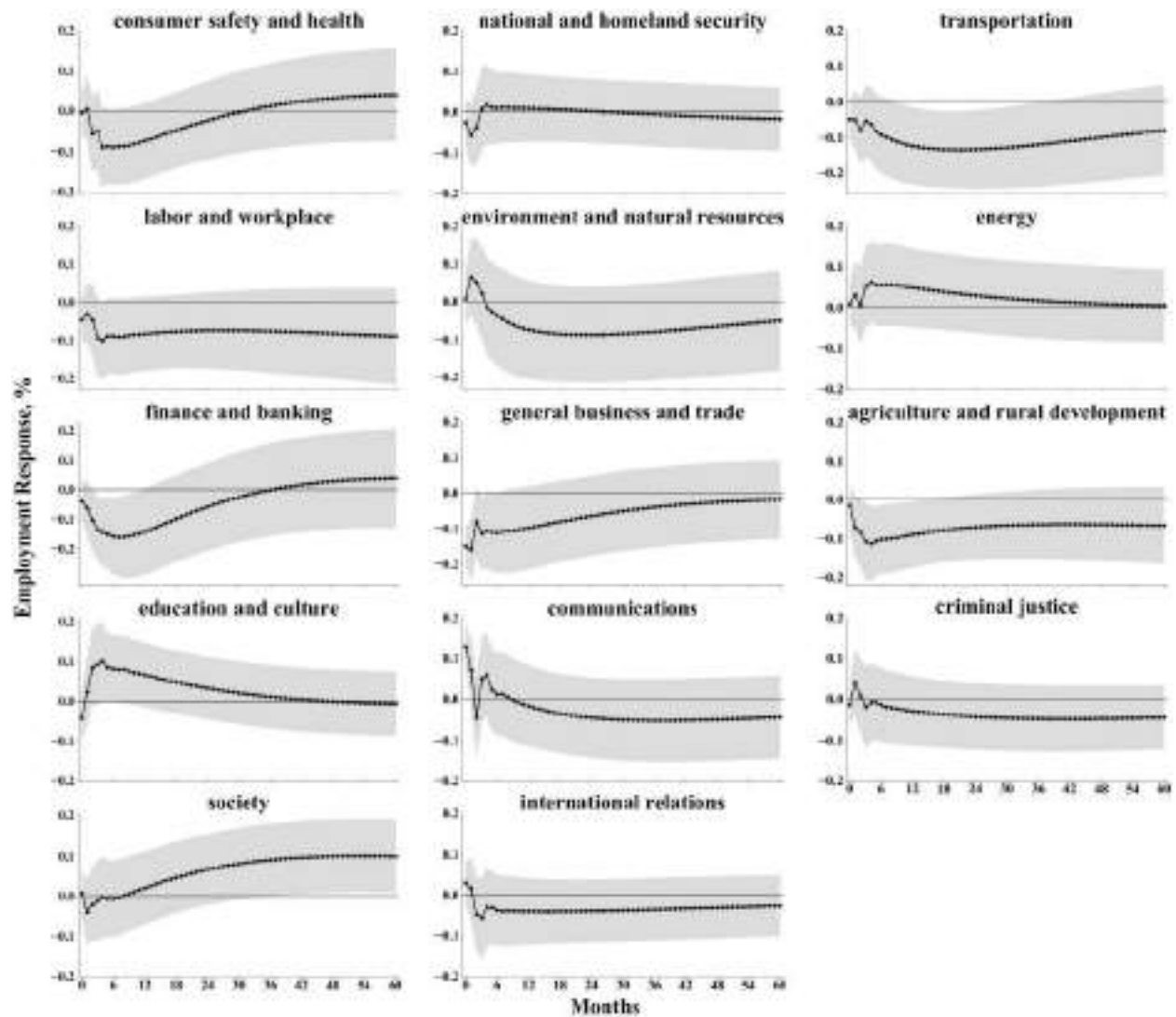
Conservative Approach	Aggressive Approach
stock option, minimum wage, airline deregulation, labor regulation, fire safety, other drug , drug testing, voting right, union official, investment advice, large employer, legal requirement , foreign worker, civil action, construction industry	stock option, minimum wage, airline deregulation , labor regulation, fire safety, other drug , drug testing, voting right , union official, investment advice , large employer, legal requirement , foreign worker, civil action , construction industry

Appendices K.1-K.4 plot VAR-estimated impulse responses to regulatory sentiment or uncertainty shocks by regulatory area using the conservative approach to reclassify news articles and create categorical indexes. Appendices K.5-K.8 plot impulse responses to regulatory sentiment or uncertainty shocks by regulatory area using the aggressive approach to reclassify news articles and create categorical indexes. The VAR specification is the same as the baseline VAR discussed in the paper.

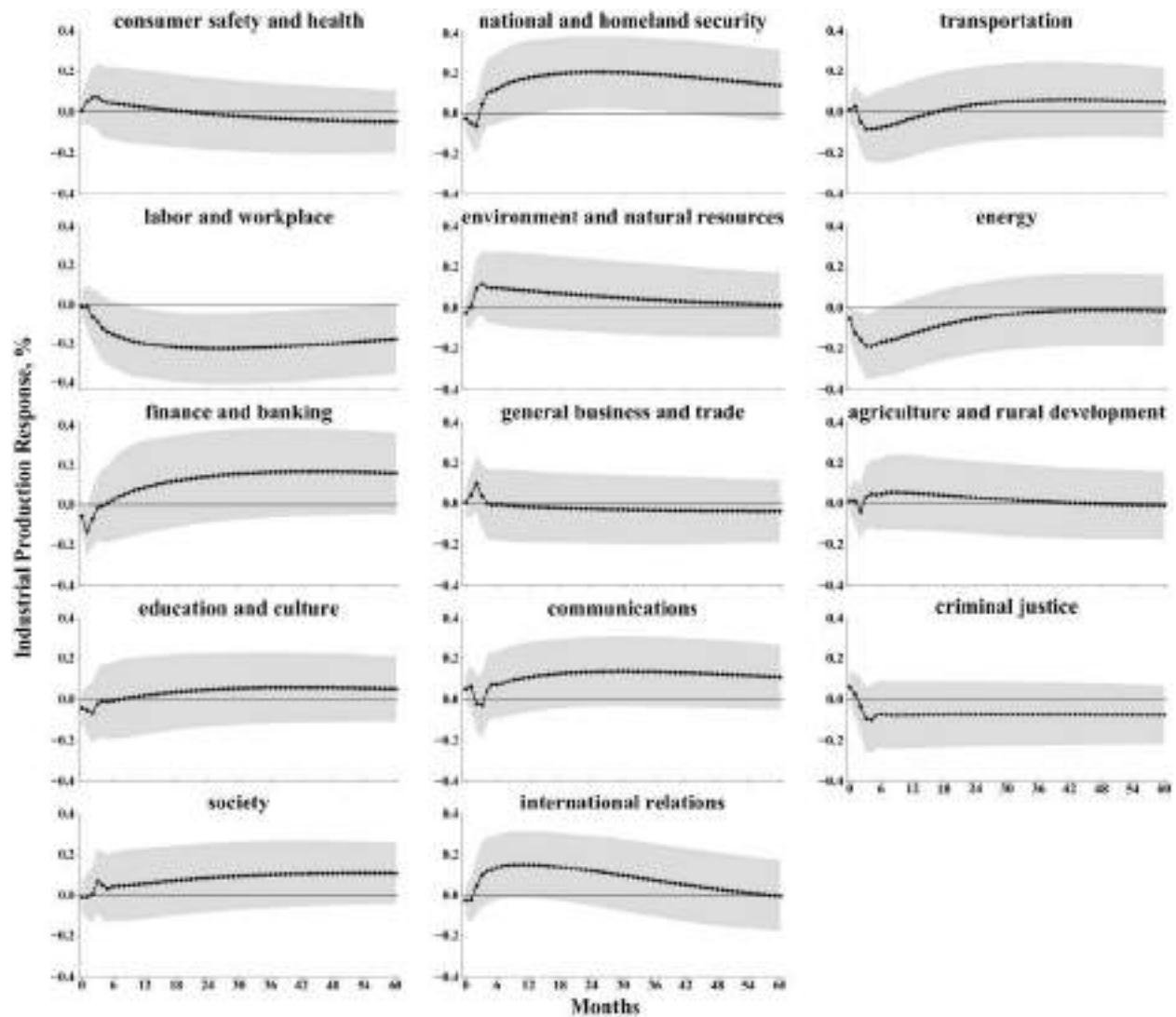
K.1 Industrial Production Responses to a Negative Sentiment Shock By Regulatory Area (Conservative Approach)



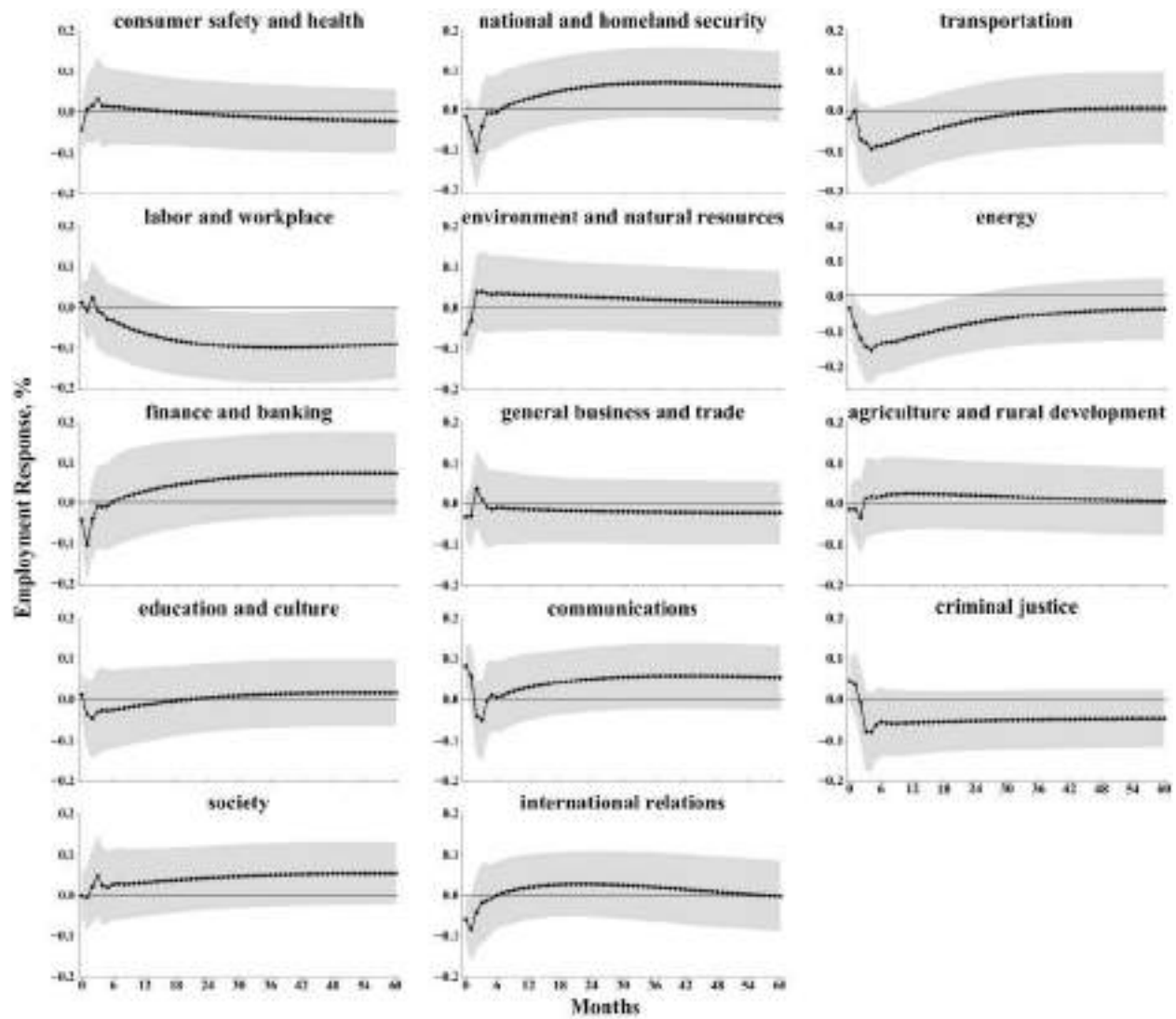
K.2 Employment Responses to a Negative Sentiment Shock By Regulatory Area (Conservative Approach)



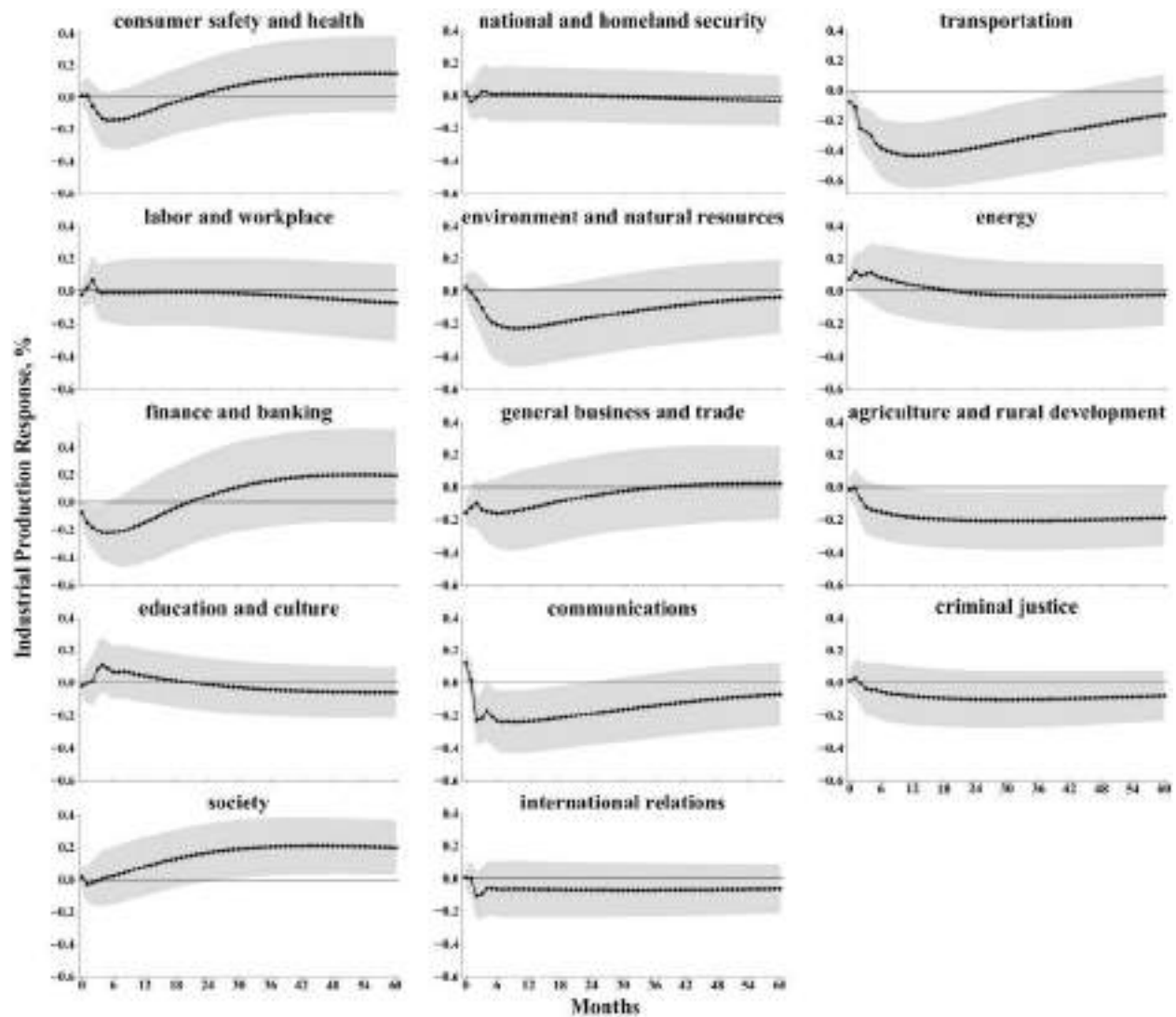
K.3 Industrial Production Responses to an Uncertainty Shock By Regulatory Area (Conservative Approach)



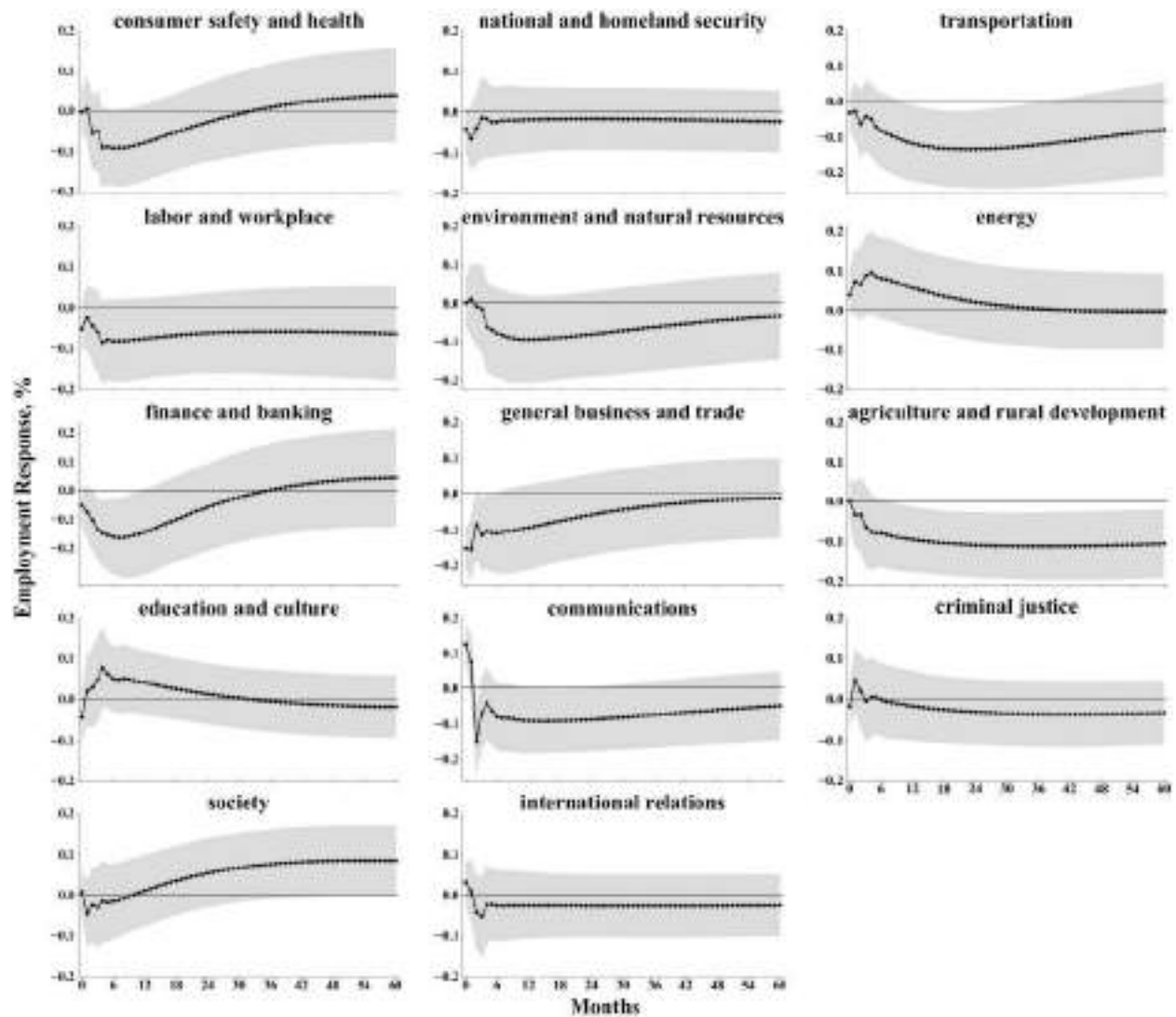
K.4 Employment Responses to an Uncertainty Shock By Regulatory Area (Conservative Approach)



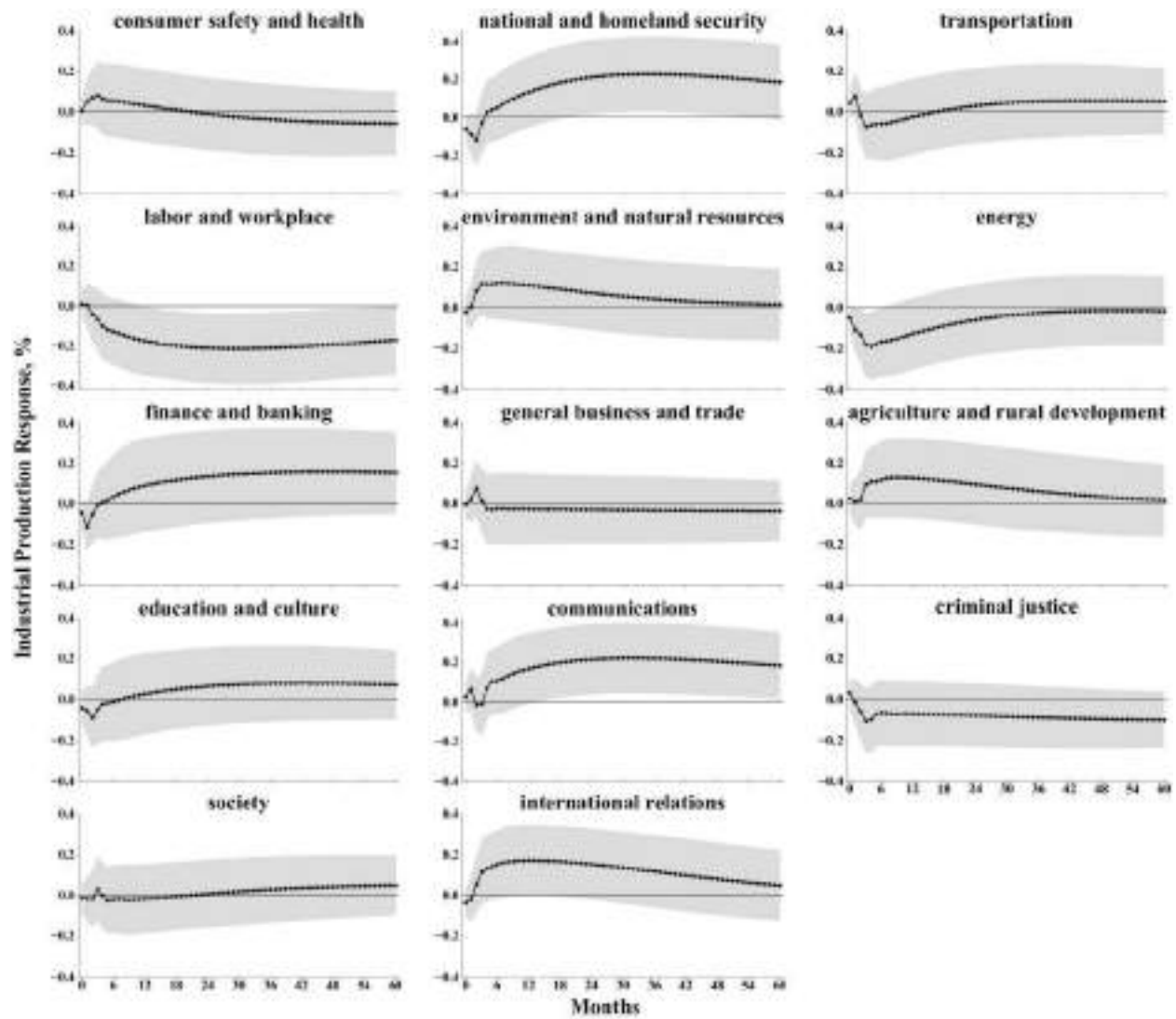
K.5 Industrial Production Responses to a Negative Sentiment Shock By Regulatory Area (Aggressive Approach)



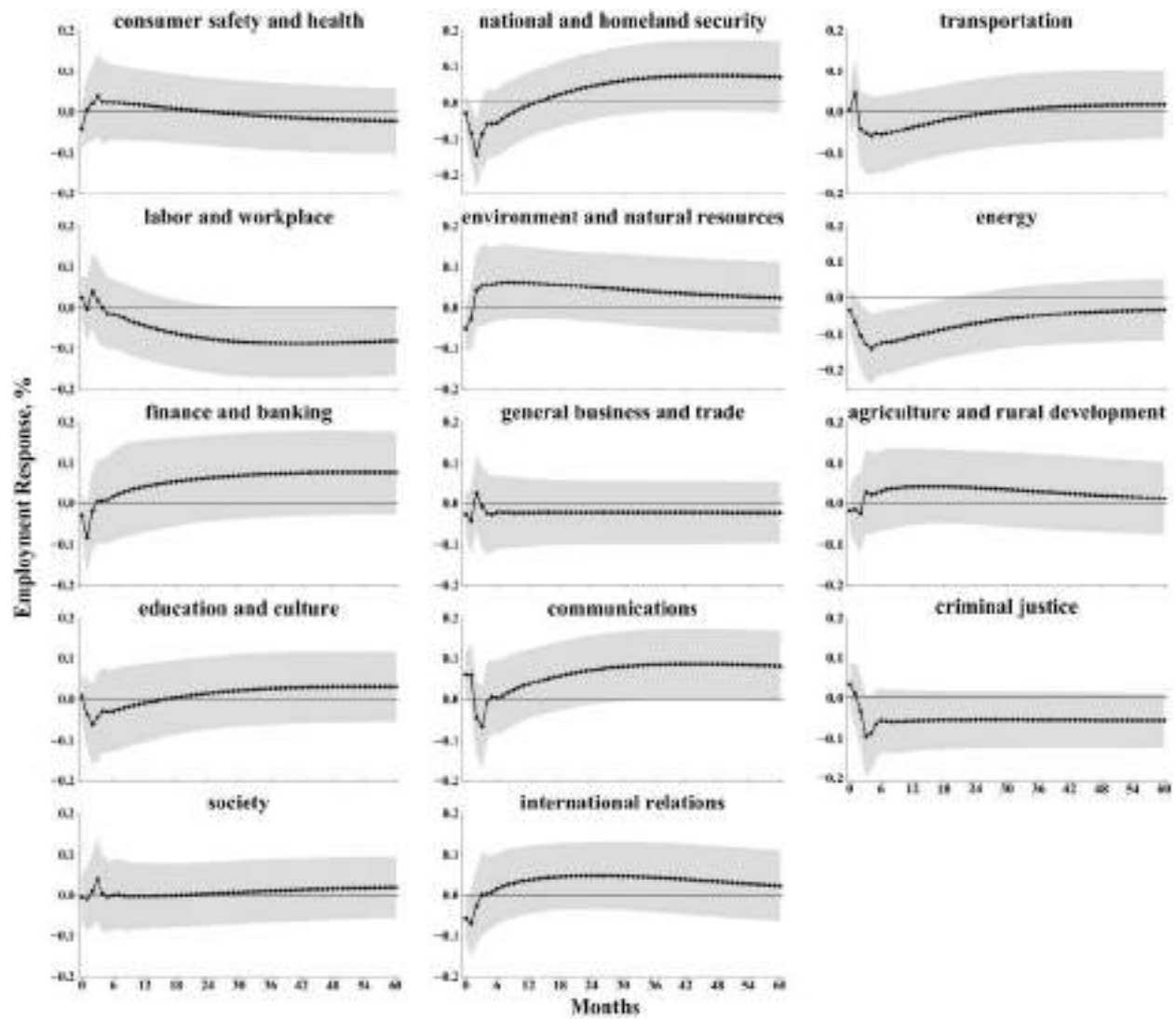
K.6 Employment Responses to a Negative Sentiment Shock By Regulatory Area (Aggressive Approach)



K.7 Industrial Production Responses to an Uncertainty Shock By Regulatory Area (Aggressive Approach)

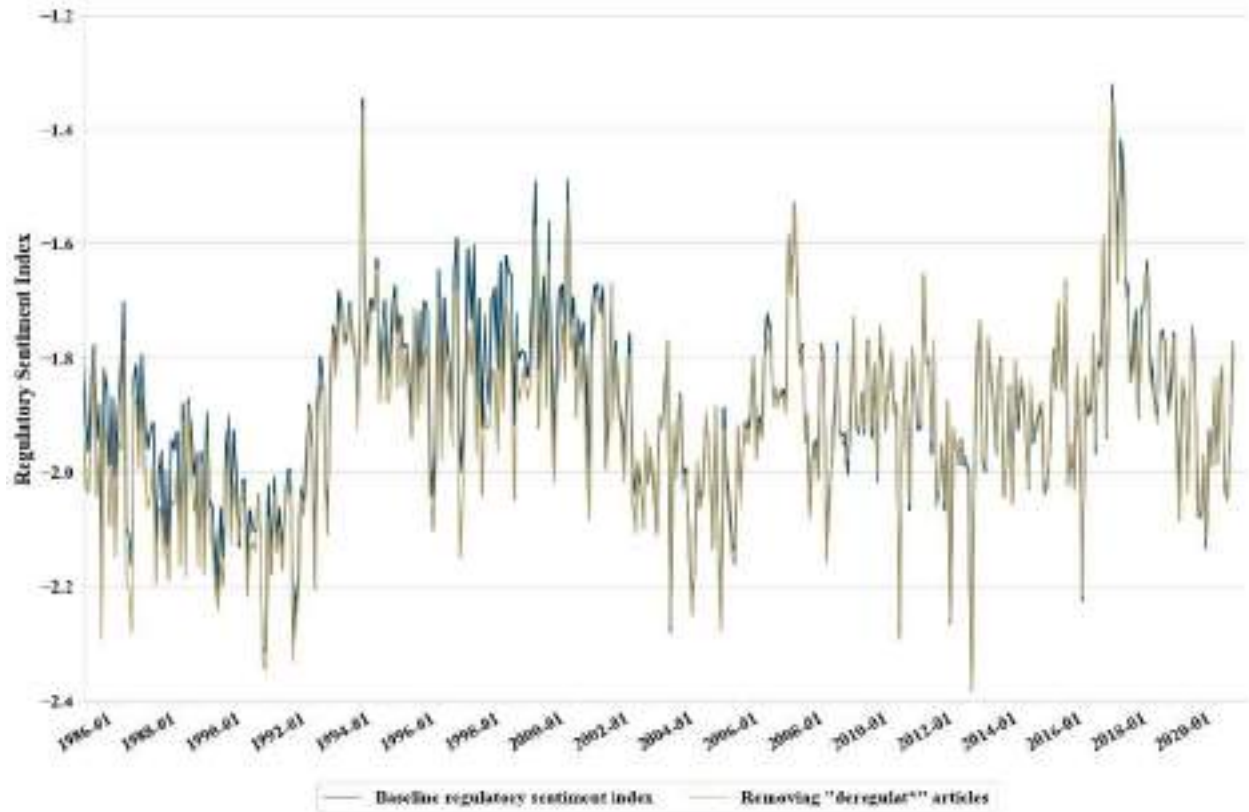


K.8 Employment Responses to an Uncertainty Shock By Regulatory Area (Aggressive Approach)



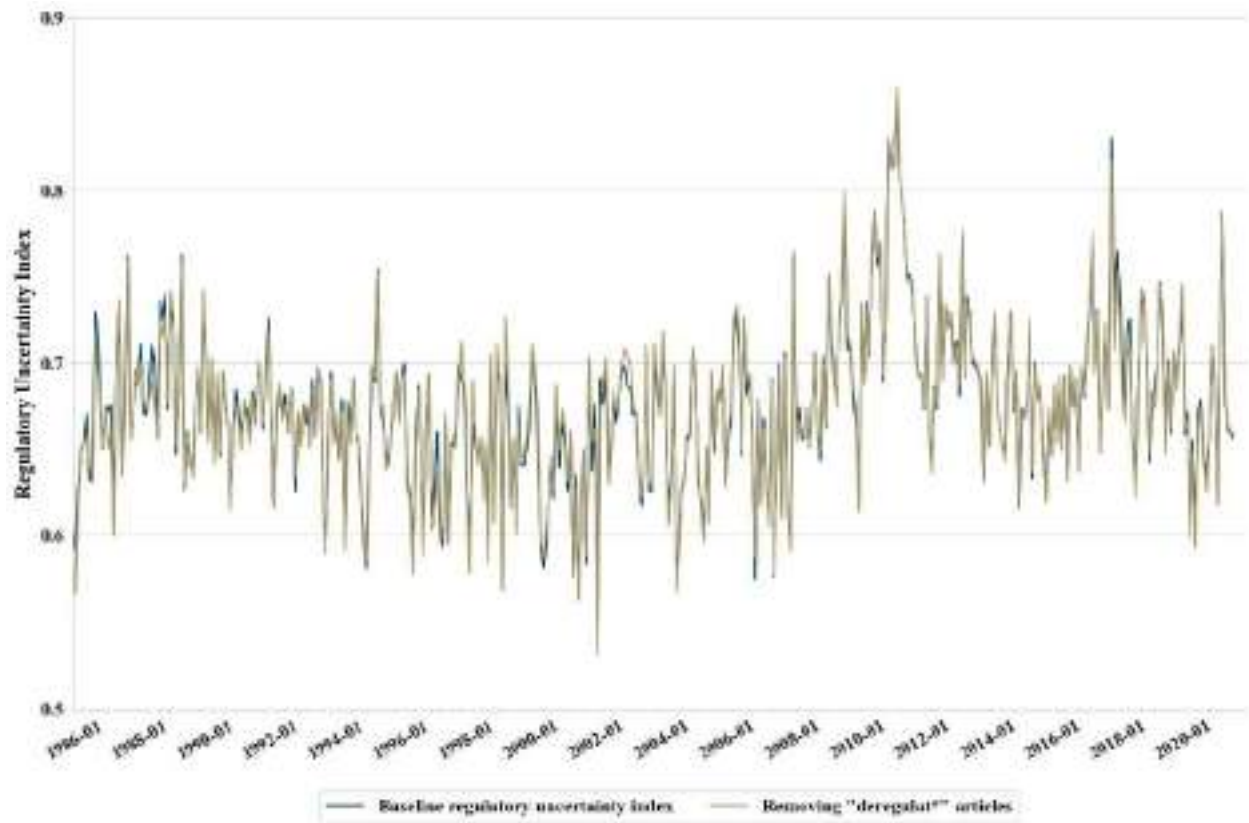
L Sentiment and Uncertainty about Regulation and Deregulation

L.1 Regulatory Sentiment Index Removing Articles about Deregulation



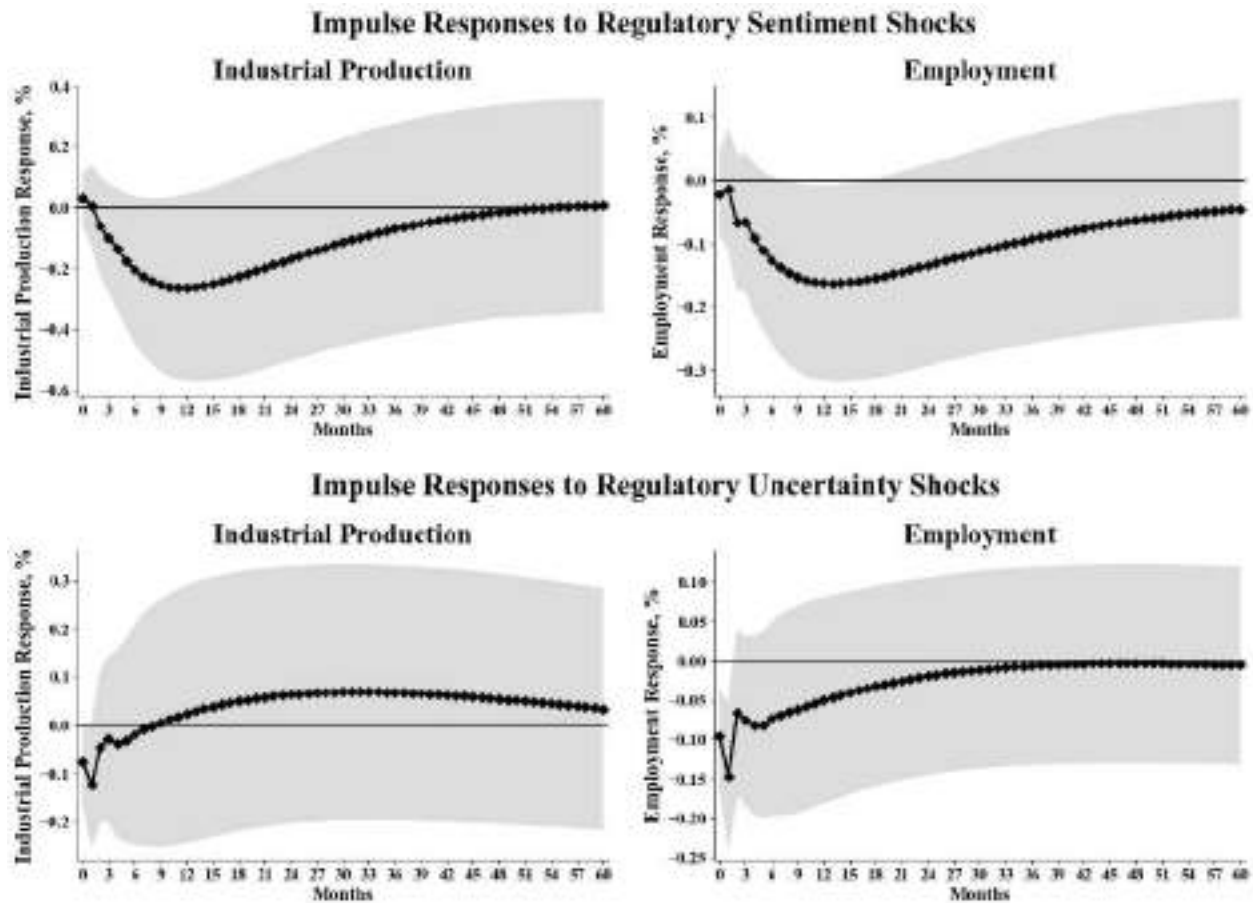
Notes: The figure plots the regulatory sentiment index estimated using the Loughran and McDonald (LM) dictionary. The baseline index is used in the main analysis in the paper. The revised index is estimated after removing news articles that contain words starting with “deregulat”.

L.2 Regulatory Uncertainty Index Removing Articles about Deregulation



Notes: The figure plots the regulatory uncertainty index estimated using the uncertainty category of the Loughran and McDonald (LM) dictionary. The baseline index is used in the main analysis in the paper. The revised index is estimated after removing news articles that contain words starting with “deregulat”.

L.3 Impulse Responses to a Regulatory Sentiment or Uncertainty Shock



Notes: The figures plot VAR-estimated impulse response functions for industrial production and employment to a one-standard-deviation negative regulatory sentiment shock or a one-standard-deviation upward regulatory uncertainty shock. The sentiment and uncertainty indexes are estimated using the Loughran and McDonald (LM) dictionary, after removing news articles that contain words starting with “deregulat”. The shock is orthogonalized by using the Cholesky decomposition with the following ordering of variables: the regulatory sentiment or uncertainty index, the log of S&P 500 index, the federal funds rate, log employment, and log industrial production. VARs are fit to monthly data from January 1985 to August 2020. Gray areas show 90 percent confidence bands.