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Macroeconomic Modeling of Labor Union Activity in the 21st Century: A Vector Autoregression Analysis

By

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Abstract

After decades of decline in membership and related activities such as strikes and certification elections, the American labor movement has received renewed attention in the aftermath of the COVID-19 pandemic and its associated economic aftershocks. While there is substantial literature on the relationships between public policy, labor unions, and economic performance, little empirical research exists regarding how labor union activity is observed in a macroeconomic model. This project seeks to investigate the relationship between labor union activities and economic indicators, such as changes in GDP, labor market tightness, and CPI inflation using a vector autoregression model. While the estimated VAR coefficients and accompanying analyses provide nuanced results, changes in real GDP give evidence of having a statistically significant impact on strikes and union member employee compensation. Empirical results and data trends also suggest that labor union activities may be structurally affected by exogenous legal and public policy factors not captured by the model.

1 Introduction

The decline of labor union membership and bargaining power across developed economies, and especially the United States, has been well documented. Labor union density[1] in the United States currently sits at 10 percent, down over 50 percent since 1983 (Bureau of Labor Statistics, 2023). However, there has been a sudden and intense uptick in labor union coverage in national media in the years following the COVID-19 pandemic. While union density has remained stagnant, high-profile organizing efforts and strike campaigns have reinvigorated public awareness of labor unions.

This sudden and intense increase in labor union activities leads me to examine how dynamic macroeconomic conditions may influence organizing actions. For decades, labor unions have been weakened in the United States due to a shifting macroeconomic and political environment. Trade balance changes between the United States and emerging economies in addition to a decline in domestic manufacturing's share of income at the turn of the 21st century have been cited as reasons for the aggregate decline in union jobs (Ahlquist and Downey, 2023). However, the myriad of legal and political challenges that unions have faced since the second half of the 20th century have also had a stated impact on union organizing. After the passage of the Labor Management Relations Act of 1947, American unions were restricted from partaking in a variety of nonprimary work stoppages, such as secondary and sympathy strikes. The act also allowed for the passage of statewide "right-to-work" laws which ban closed union shops. This legal framework and the introduction of intense foreign import competition further incentivized employer resistance to the presence of labor unions (Farber, 1990). Mishel et al. (2020) report that these public policy changes and the accompanying intensification of employer resistance are the

[1] Labor union density is defined as the total number of union employees as a percentage of all workers.

primary drivers of labor union election decline and subsequent union density decline since the 1970's.

Despite this dramatic overall decline in American labor unions and the events that occurred with it, there have still been novel developments in union organizing trends. Ahlquist and Downey (2023) also note that while the manufacturing share of unionized jobs declined in past decades, economic conditions have also led to increased union activity in labor sectors with less historical connections to organized labor, such as healthcare and education. Furthermore, post-pandemic union activities have coincided with a historic rise in inflation and labor market tightness. 2023 saw the largest number of strikes and the highest union win percentage union certification elections[2] in the last two decades following the greatest spike in labor market tightness ever observed the prior year.

In the aftermath of the COVID-19 pandemic and the inauguration of President Joe Biden, there have been some public policy efforts to increase aggregate union bargaining power and organizing activities. A 2023 ruling from the National Labor Relations Board (NLRB) set up new guidelines concerning how union elections are scheduled, finding that once a simple majority of employees in a workplace had signed union cards, the employer must either voluntarily recognize the union or a union certification election must occur (2023). Further and more expansive policy measures have been proposed in Congress, namely the Protecting the Right to Organize Act. This bill would greatly increase unions' abilities to perform organizing activities, as it would remove limits on secondary work stoppages, remove employers from setting NLRB workplace elections

[2] Union certification elections are conducted by the National Labor Relations Board after 30 percent of employees at a workplace have signed a union card. Once this threshold is met, the workers file a certification petition with the NLRB, which oversees an election within the workplace to determine certification of the union. Certification is won if the union receives a simple majority of votes in the workplace election.

procedures, and allow employers and unions to enter fair share[3] agreements (McNicholas et al., 2021).

These congruent events, combined with the contemporary resurgence of high-profile organizing activities across industries, lead me to examine how macroeconomic conditions and shocks affect union activities in the United States. My primary goal is to fill a gap in the literature concerning how labor union activities fit into the larger dynamics of quantitative macroeconomic models. To do this, I begin by building a quarterly dataset of macroeconomic and union activity statistics from 2001 to 2023. Using this data, I construct a vector autoregression (VAR) model to examine the dynamic relationship between real gross domestic product, labor market tightness, consumer price index (CPI) inflation, union-related major work stoppages, total labor compensation for union members, and union certification election results. I estimate the variable coefficient matrices of this VAR model and calculate the corresponding impulse response functions (IRFs) and forecast error variance decompositions (FEVDs). Finally, I utilize the model to construct an eight quarter ahead forecast for each of the considered variables. Quantitative results from the VAR model provide evidence that shocks to real GDP have a statistically significant effect on the impulse response functions of major work stoppages and union compensation, with a maximum increase of 0.55 strikes over three quarters, and a -0.25 percent decrease in union employee total compensation.

The rest of Section 1 concerns related literature on labor unions and their response to macroeconomic conditions. Section 2 of the paper will describe the data used in the VAR model and summary statistics. Section 3 will discuss my empirical strategy and the validity of the model

[3] Fair share provisions are a type of union shop agreement that allows employers to hire workers that are not a part of a given labor union. However, all non-union employees pay a collective bargaining fee to the union. Statewide right-to-work laws ban this type of agreement in 26 states as of May 2024 (Table 1).

that I have chosen for this analysis. Section 4 reports my results from the model including the coefficient estimations, impulse responses, forecast error variance decompositions, and forecasts for the variables. Finally, Section 5 discusses these empirical results, and relates to how they may be limited due to data volatility and exogenous factors affecting labor organizing.

Related Literature

The literature surrounding labor unions and their relationship with economic indicators is abundant, however, little work has been done looking at how labor union activities themselves interact with metrics such as labor market tightness. Recent literature in response to tight labor markets in the aftermath of the COVID-19 pandemic has begun to discuss how union activities may change with these economic conditions. Naidu (2022) finds that support for labor unions has increased in recent years as labor markets have become tighter. Using survey data, Pezhold et al. (2023) report that while workers' willingness to engage in union activities increases with perceived tight labor markets, aggregate data suggests that there is no systematic relationship between labor market tightness and union activities. Further research has been done on recent trends in labor markets that may significantly affect union actions. Autor et al. (2023) find that while labor markets tightened in recent years, workers faced wage compression and separations rose as a result. Such separations may limit union activism given workers' preferences for exiting the labor market.

While these studies examine recent labor union activities, there is a larger gap in the literature surrounding how labor unions interact with further economic indicators in modern macroeconomic models. Kim (2005) uses a vector error correction model to examine the relationship between labor union membership numbers, GDP, and unemployment in Korea. The study finds that unionization is correlated with unemployment and negative economic growth,

though it does not focus on how these indicators conversely affect further union organizing activities.

2 Data

The dataset that I use for my analysis uses a variety of publicly available series that concern both macroeconomic conditions and labor union activities. All observations are quarterly and range from Q1 2001 to Q4 2023. Work stoppage data is from the Bureau of Labor Statistics' Major Work Stoppages database. This dataset contains the number of effective major work stoppages going on in a month and the number of employees involved. The Bureau of Labor Statistics only records what it considers to be "major work stoppages," or those that involve 1,000 workers in a single dispute. This data set documents the number of major work stoppages beginning with in each month. I convert this data so that it shows the number of strikes within the respective quarter. Due to variation observed in the data, and consistent with historical findings regarding strikes being more likely during periods with warmer weather[4], I seasonally adjust the data under the X-12 filter outlined by Findley et al. (1998).

To observe total employee compensation to union members over time, I use the Bureau of Labor Statistics' Employment Cost Index database. From this resource, I examine the total compensation index[5] of private industry union workers. The growth rate of this measure is utilized as a proxy of material incentives for workers to unionize after observing previous compensation gains from adjacent worker strike activity.

[4] Yoder (1938) and Kennan (1986) discuss the seasonality of strike activity. While strike behavior is volatile and conditional on employer-based labor disputes, strike data is seasonally adjusted to account for the increase in strikes observed in summer and autumn.

[5] The total compensation index is an index of the relative value of total wages, salaries, and benefits paid to labor by employers. The index publishes quarterly data from 2001 – 2023 with Q4 2005 = 100.

Finally, union certification election data is from monthly union election reports published by the National Labor Relations Board (NLRB), which detail the number of elections held and the percentage won by the union within a given month. Similar to major work stoppages, the total number of union certification elections and union election victories are usually volatile and depend on NLRB funding, legal challenges, and other factors. As such, I utilize the number of elections won by the union across periods. This data set is used as a metric to examine the further results of union strike activity and bargaining agreements, as union-related increases in compensation at adjacent workplaces would hypothetically spur other workers to unionize their own workplace. This mechanism can be seen as similar to what is suggested by the empirical results from Pezhold et al. (2023), as workers become more willing to engage in union organizing when beliefs about heightened aggregate organizing activity increase.

Finally, quarterly real GDP, labor market tightness, and CPI data are pulled from the Federal Reserve Economic Database (FRED) website. Using the methodology of Birinci and Ngân (2023), I utilize the ratio of job vacancies to unemployment as a metric for quarterly labor market tightness. The transformed values of these variables that are used in the following vector autoregression model can be found in Figure 1.

3 Model and Methodology

Real GDP is considered to be the most exogenous variable in the model, which theoretically has a causal relationship with labor market conditions and inflation in accordance with the modern Phillips curve. A positive increase in output would induce a negative response in unemployment and an increase in CPI inflation. This decrease in unemployment would lead to a rise in the labor market tightness ratio. An increase in labor market tightness and inflation would

in turn incentivize an increase in strike activity, as workers use their higher relative bargaining power to advocate for higher wages and benefits in response to rising costs, leading to an increase in union members' total employee compensation. This increase in compensation will incentivize further workplace organizing, leading to a rise in the growth of union victories in representation certification elections.

This project uses a vector autoregression model to examine the dynamic relationships between the observed macroeconomic variables and labor union activities metrics. As such, the model is represented by the following:

$$Y_{i,t} = C + \Phi_1 Y_{i,t-1} + \cdots + \Phi_p Y_{i,t-p} + \varepsilon_t \quad (1)$$

where $Y_{i,t}$ is a vector of AR-stationary economic indicators (changes in real GDP, labor market tightness, and inflation) and labor union activity metrics (strike activity, union total compensation changes, and union certification election result changes). $\Phi_1, \ldots, \Phi_p$ are the corresponding 6-by-6 lagged autoregressive coefficient matrices. Given the multivariate nature of the data, these coefficient matrices are estimated using maximum likelihood estimation (MLE). Using the Alkine Information Criterion, a maximum lag p is set to 2 quarters to allow for the effects of the macroeconomic shocks to transfer to labor union activities[6]. C is the 6-by-1 constant vector. ε_t is a 6-by-1 error vector of random Gaussian innovations with mean zero and covariance Σ. Σ is the 6-by-6 estimated innovations covariance matrix.

Each of the six variables are considered endogenously in the model. This is done in consideration of related literature and features observed in the data. Given the level of influence that labor unions have historically had in the United States, and the subsequent rapid decline that

[6] There is a large variation in the time required for a strike to be authorized or a union election to be carried out. Most union bargaining agreements are reached sometime between 6 months and a little over a year (McNicholas et al., 2023). Thus, a lag of 2 quarters is chosen to represent this time in between macroeconomic events and union organizing outcomes, as well as for model fit.

organized labor has experienced in recent decades, economic performance should be considered endogenously along with the labor union activities that may influence them. Vedder and Galloway (2002) find statistical evidence that labor union activities have had a considerable effect on economic output and labor market conditions in the United States throughout the second half of the 20th century. Furthermore, Ratner and Sim (2022) report that the decline of labor unions and associated worker bargaining power greatly impacted inflation volatility in preceding decades. Granger causality tests of the data provide further evidence of endogeneity within the model. Table 3 provides evidence that select union statistics appear to have some Granger causality with the considered macroeconomic variables.

Finally, the orthogonalized impulse response functions of the six variables are calculated using a Cholesky decomposition method as discussed in Uhlig (2005). This follows the standard procedure in which the estimated covariance matrix Σ is decomposed into lower triangular matrices L such that $\Sigma = LL^T$. This notation gives us the orthogonal impulse vector $u_t = L^{-1}\varepsilon_t$. The Cholesky decomposition also allows for a computation of orthogonalized forecast error variance decompositions for each variable in the model. As outlined in Lütkepohl (2007), this orthogonalized FEVD for h periods in the future can be written using the lower triangular matrix L as:

$$\omega_{hij} = \frac{\sum_{t=0}^{h-1}(e_j' \Omega L e_i)}{\mathrm{MSE}(Y_{j,t}(h))} \quad (2)$$

where e_j is a 6-by-1 selection vector of zeros except where $j = 1$, and $\Omega = \Phi^{-1}$ for the inverse coefficient matrix Φ for the VAR model in lag operator notation.

When discussing these shocks to the variables, it is important to consider how such shocks would relate to real world macroeconomic events. A shock to real GDP would be a productivity or output shock common in macroeconomic modeling literature, such as sudden changes in

technological efficiency. Shocks to labor market tightness would take the form of labor supply shocks that affect job vacancies or unemployment, especially those related to the COVID-19 pandemic and its aftermath similarly outlined by Kurozumi and Van Zandweghe (2022). Inflationary shocks can be similarly viewed this way, as rapid supply chain bottlenecks greatly contributed to inflation in the aftermath of the pandemic (Liu and Nguyen, 2023). Shocks associated with labor union activities can similarly be considered in the framework of how organizing results can cause sudden economic changes for workers and employers. For example, shocks to strikes could be the result of more aggressive union leadership cadres, such as the 2023 United Auto Workers strike after the election of union president Shawn Fain. Further shocks in total union employee compensation would arise from the implementation of new union negotiated contracts, like those that came as a result of the 2023 UAW strikes. Other shocks to union organizing capabilities could take the form of adjacent union election wins at other workplaces or increases in union organizing campaign budgets that would subsequently lead to sudden increases in union certification election victories.

Following the previously described theoretical mechanisms of the model, we would expect the impulse response functions of a given shock to similarly act in accordance with these mechanisms. A positive shock to productivity would induce a positive impulse response function from real GDP and all other variables with the associated increase in economic activity. Similarly, according to Philips curve mechanics, a positive labor supply shock would induce a positive response from CPI inflation and strikes particularly, as workers utilize employers' higher demand for labor to strike for better employee compensation. Intuitively, a positive shock to strikes would lead to a negative impulse response function from real GDP as production falls and associated macroeconomic variables respond accordingly. This response from economic activity to a shock

in strikes has also been empirically observed with the aforementioned 2023 UAW Strike (Rua and Tito, 2024). Shocks to increases in union member total employee compensation would induce a positive impulse response from CPI inflation as workers would have more disposable income to consume with, while we would observe a negative impulse response from dispute-caused major work stoppages. This shock would also create a positive impulse response from union certification election wins, as workers are incentivized to unionize for higher union-backed employment gains. Finally, a shock to union election wins would induce a negative response from real GDP and associated macroeconomic variables as workers' capabilities to enforce demands through work stoppages increase. A sudden rise in union election wins and associated unionized workplaces would consequently also induce positive shocks in all organizing activity as workers utilize their higher relative bargaining power to increase total employee compensation.

4 Results

Table 4 reports the coefficient estimates, standard errors, and significance levels of the vector autoregression model. While the causal relationships between all variables appear mixed, there are significant results that show some evidence of how labor union organizing activities interact with larger macroeconomic indicators. Figures 2-7 display the impulses response functions of each variable to a given shock. Additionally, Figures 8-12 show the forecast variance error decomposition of these same variables with regards to the given shocks.

The coefficient estimations of the macroeconomic variables and their relationship to each other appear to be statistically ambiguous. However, Figure 2 shows that the impulse response functions for labor market tightness and inflation both follow the Phillips curve mechanics outlined above, as a roughly 1 percent positive shock to real GDP leads to an increase in both variables'

IRFs by approximately 0.8 and 0.27 percent, respectively. Conversely, labor market tightness and inflation seem to show little evidence of having a statistically significant effect on real GDP. Figures 3 and 4 indicate that shocks of 0.4 to the labor market tightness ratio and roughly 0.5 percent to inflation create a slightly negative to neutral impulse response of -0.2 and 0.05 percent, respectively, to real GDP over two quarters.

Changes in real GDP and labor supply appear to have a statistically significant impact on strike activity. Figure 2 shows that a shock to real GDP increases the overall number of major work stoppages by a maximum of roughly 0.55 over three quarters. Consequentially, Figure 8 displays the relative importance that shocks to real GDP have in the forecast error variance of strikes, making up 5 to 20 percent of the decomposition over ten quarters. A labor supply shock affecting labor market tightness has a less significant effect on the impulse response of strikes, causing a slightly positive shock of 0.1 strikes that quickly dies off. An inflationary shock is also shown to have a positive effect of roughly 0.25 on strikes' IRF.

Union member total employee compensation appears to exhibit similar estimation dynamics that strikes do with regards to changes in real GDP and labor market tightness. Both appear to have somewhat statistically significant effects on union compensation, though the MLE regression results show no evidence of such a relationship with strike activity. Shocks to strikes similarly appear to also have a neutral effect on union compensation's impulse response function, and Figure 10 shows that strikes make up a small portion of compensation's forecast error variance. Interestingly, shocks to real GDP and inflation appear to have a somewhat negative effect on union compensation's IRF of -0.25 and -0.6 percent, respectively. This could potentially be caused by the compensation nature of long-term union-negotiated contracts for some union workers. Union workers are more likely to maintain long-term employment contracts that provide some form of

insurance or severance pay, which backload compensation during periods of economic downturn (Balke and Lamadon, 2020).

Union election victories are shown to only have a statistically significant relationship with lagged union elections. This suggests further evidence of the statistical results found in Pezhold et al. (2023), which reports that workers' willingness to organize a union are further motivated by adjacent workplace organizing. Shocks to all six variables appear to have a positive to neutral effect on the impulse response function for union election victories, notably shocks to real GDP which increase log victories by a measure of roughly 0.125. Interestingly, lagged union election wins are found to show evidence of a statistically significant relationship to real GDP and labor market tightness. This could potentially be caused by lagged unionizing efforts occurring at the end of the business cycle, or a higher number of unionized workers being correlated with decreased economic output as discussed by Kim (2005). Shocks to labor union election certification wins are also shown to create a somewhat negative impulse response function for real GDP, consistent with my described theoretical mechanisms.

Finally, I utilize the estimated coefficient matrices to construct a forecast for quarterly changes in each of the six variables and compare them to the observed data. Figure 13 shows the eight quarter forecasts for the six variables with 95 percent forecast intervals. Other than slight spikes in the post-COVID-19 observations, the forecast replicates the general trends of the series within the intervals. The three forecasted macroeconomic variables reproduce figures that are consistent with a Phillips curve-like relationship, as an increase in real GDP and labor market tightness are met with an increase in inflation. These dynamics also forecast a slight increase in major work stoppages and other labor union activity metrics with accompanying macroeconomic variables. This is consistent with the model mechanisms described above, as an upswing in

economic output and resulting labor market tightening will increase worker bargaining power and incentives for employees to organize.

5 Conclusions and Discussion

In this paper, I estimate a vector autoregression model using macroeconomic and labor union activity data to examine the effects that these two variable groups have on one another. First, I estimate the corresponding coefficient matrices and use those to compute the impulse response function and forecast error variance decompositions for each variable. Next, I forecast these six variables and compare them to observed data to further examine the validity and applications of the constructed model.

The coefficient estimates calculated show evidence of statistically significant relationships between the considered variables, particularly concerning the effect of macroeconomic conditions on strikes. The forecasts produced follow a Phillips curve relationship and therefore correspond to the predicted macroeconomic mechanisms as outlined in this paper. Impulse response functions and forecast error variance decompositions show further evidence of the directional mechanics that may affect labor union activity. Coefficient estimates and impulse response functions do provide robust evidence that shocks to real GDP have a statistically significant impact on strikes and union compensation. Further quantitative analysis does yield some results that follow the model mechanics outlined, however, the statistical evidence for such mechanics appears nuanced and at times ambiguous. This may in part be caused by the nature, availability, and reporting methods of labor organizing data.

Simply put, labor union activity data is volatile, and it would appear that there are variations in the data that cannot only be explained in a rigid macroeconomic model such as the vector

autoregression considered. For example, between 2018 and 2019, there was a sizable increase in major work stoppages almost solely caused by strikes associated with the American Federation of Teachers. These strikes were in response to public sector events such as budget cuts, school choice policies, and right-to-work legislation. This sudden surge of organizing was almost entirely contained in the education sector, though the strike action led to sizable increases in compensation to public school teachers in many states. While certainly related to labor union organizing, such motivating factors are difficult to capture within the endogenous variables considered in the VAR model.

Despite this, there is still evidence that labor union activity is experiencing a novel, significant increase when considering data from the last two decades. Figure 13 shows the Hodrick-Prescott filtered[7] trend in quarterly major strike activity, for which there is a sizable increase post-COVID-19 pandemic, even when removing the business cycle component of the data series. Further studies could possibly examine exogenous political and public policy factors that may be affecting labor union activity volatility and trends. For example, Bayesian or other vector autoregression models with vectors for exogenous variables such as executive branch National Labor Relations Board funding could be utilized to examine how fiscal budgetary changes affect labor unions' organizing capabilities. Time-varying parameter vector autoregression models may also be utilized to examine the pre- and post-COVID-19 dynamics of the data and how they affect time-specific model coefficient estimates. Furthermore, dummy variables could be introduced to examine the state-specific effects of right-to-work laws or the political party of the incumbent president determining the priorities of the NLRB's union

[7] This trend is calculated using the quarterly smoothing parameters suggested by Ravn and Uhlig (2002). Additional notes can be found under Figure 16.

organizing oversight. An important next step is to further investigate the causes for the volatility found in the data, and how it can be better interpreted by a macroeconomic model.

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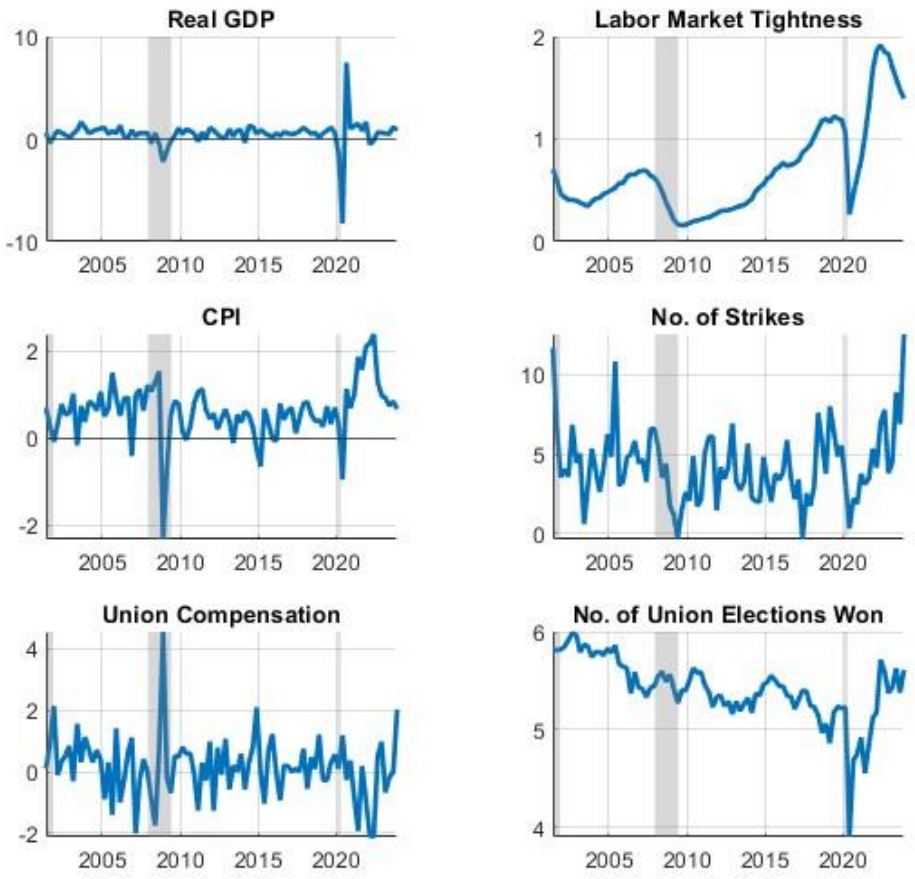
Figures

Figure 1: Transformed Data for Vector Autoregression Model Analysis



Note: Transformations and sources for data are listed in Table 1. Recession periods are shaded gray. All observations quarterly from Q1 2001 to Q4 2023.

Figure 2: Impulse Response Functions of Shock to Real GDP

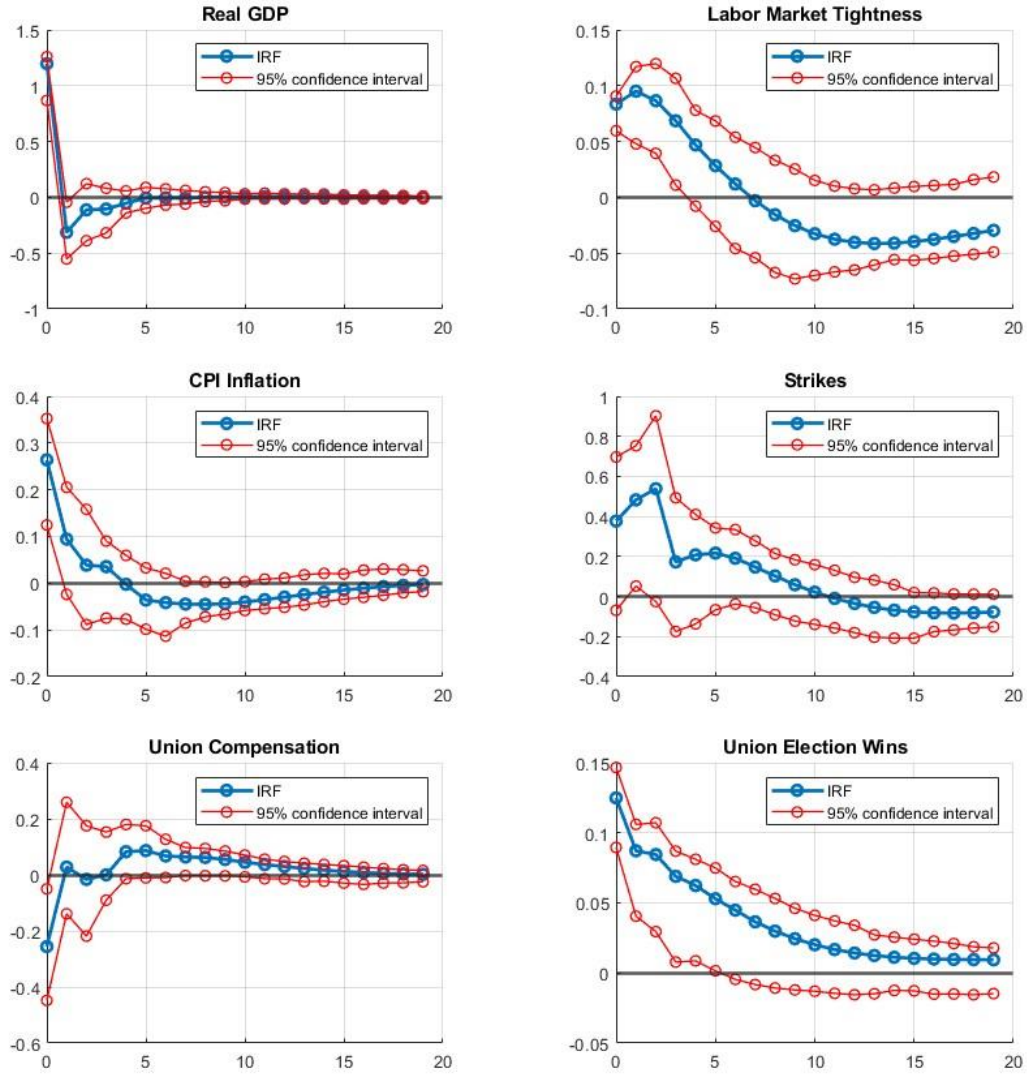


Figure 3: Impulse Response Functions of Labor Supply Shock

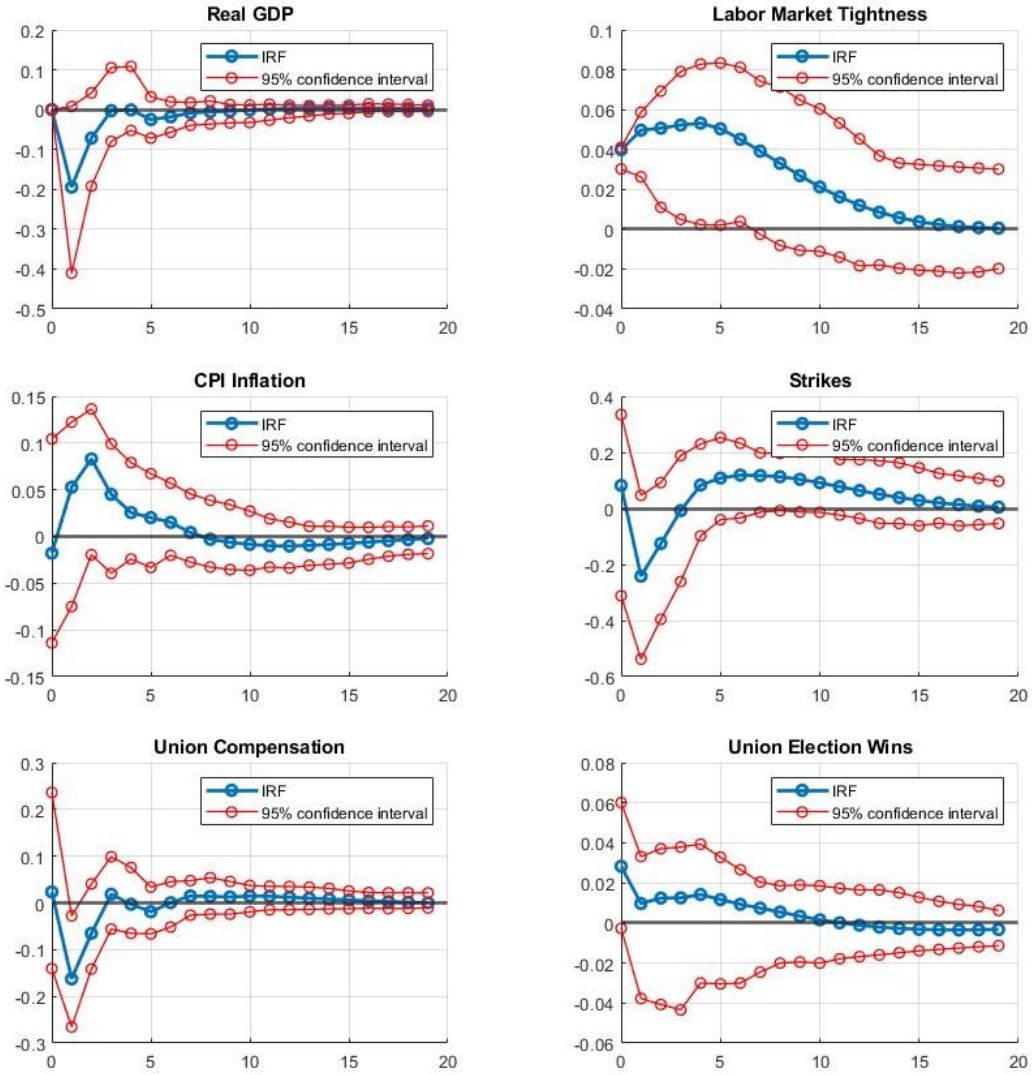


Figure 4: Impulse Response Functions of Inflationary Shock

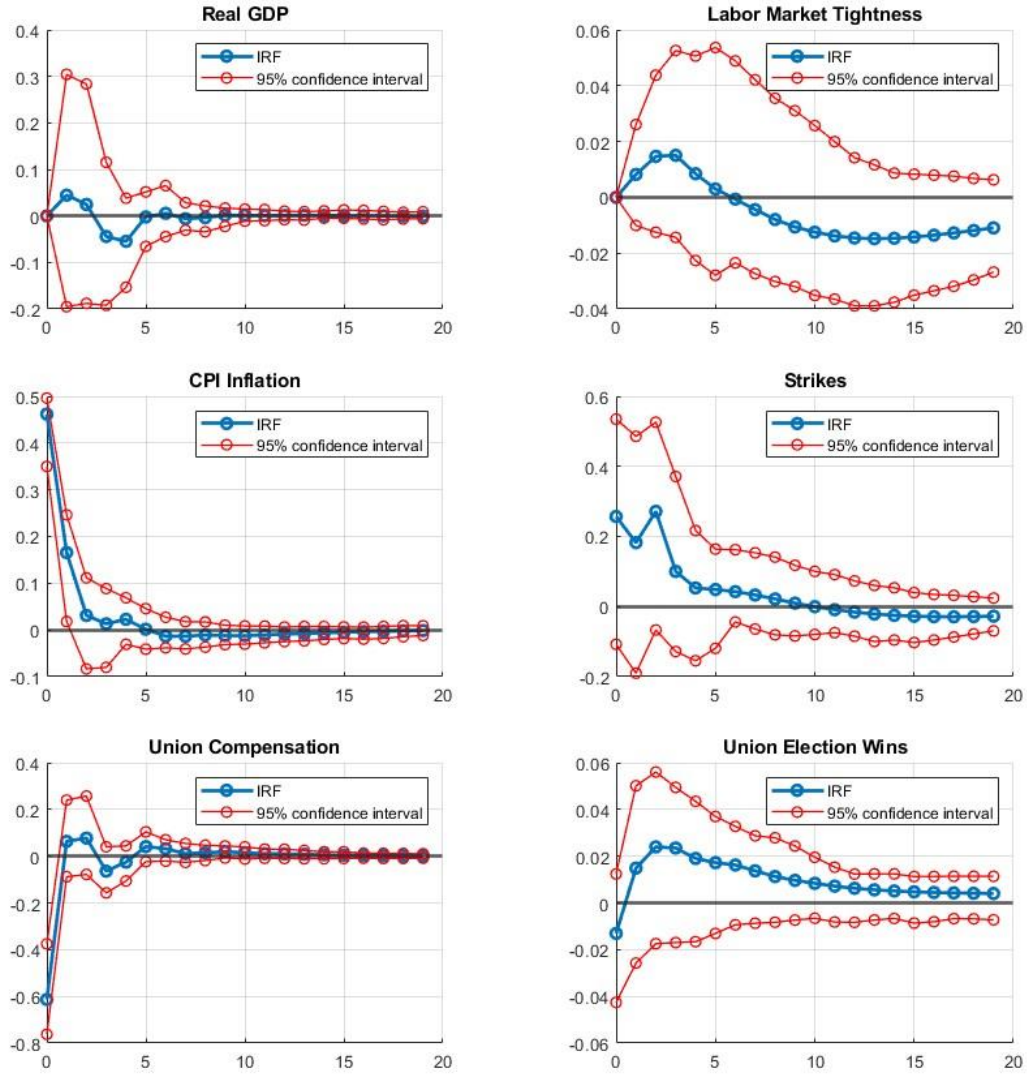


Figure 5: Impulse Response Functions of Shock to Strikes

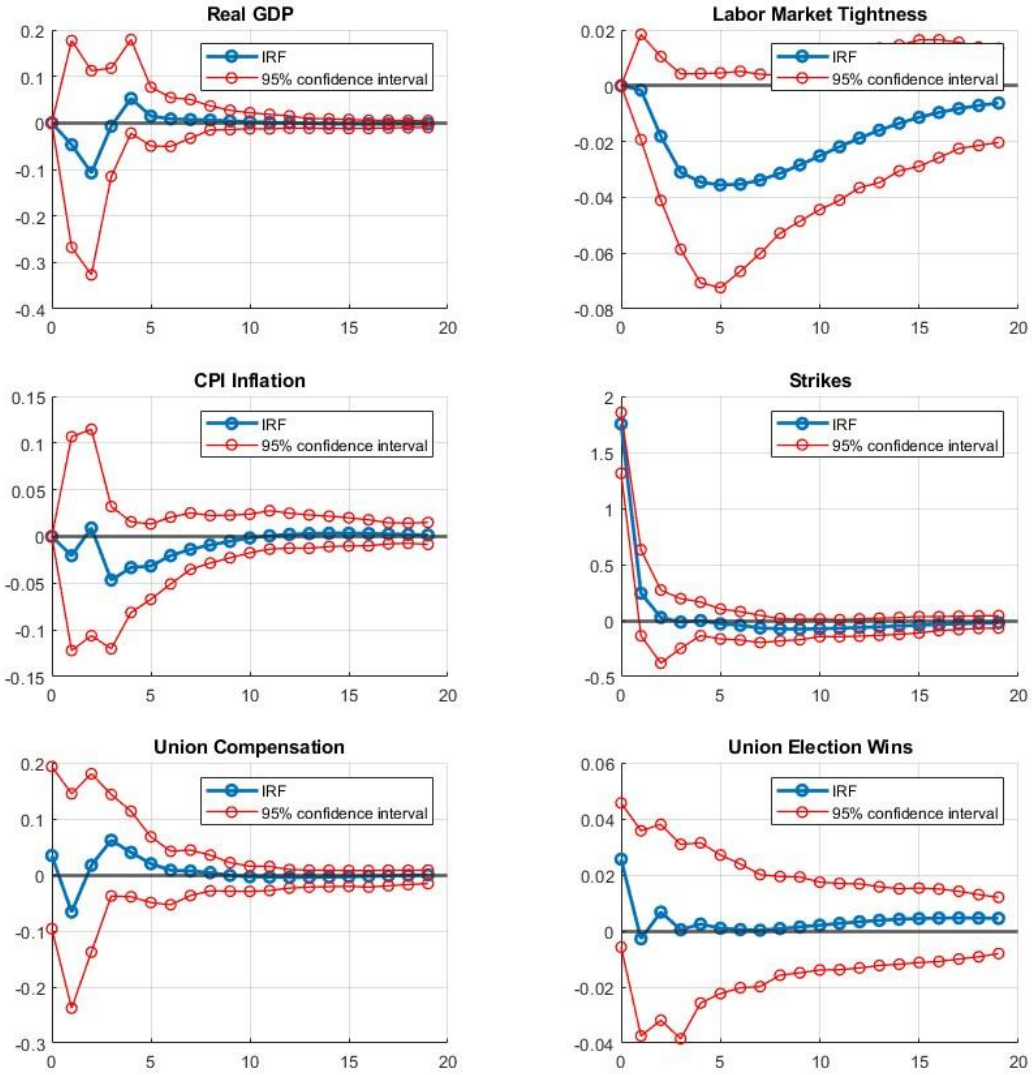


Figure 6: Impulse Response Functions of Shock to Union Member Compensation

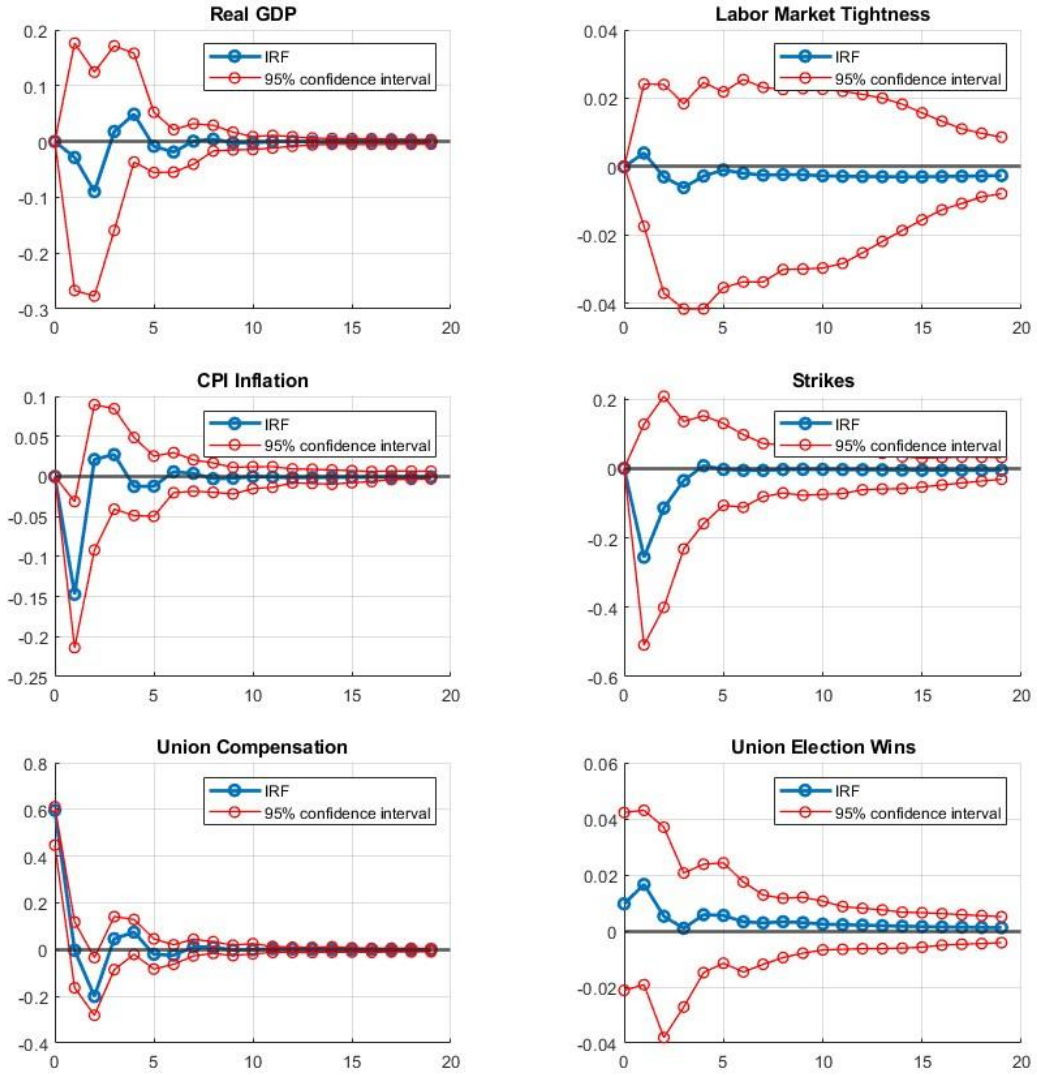


Figure 7: Impulse Response Functions of Shock to Union Certification Election Wins

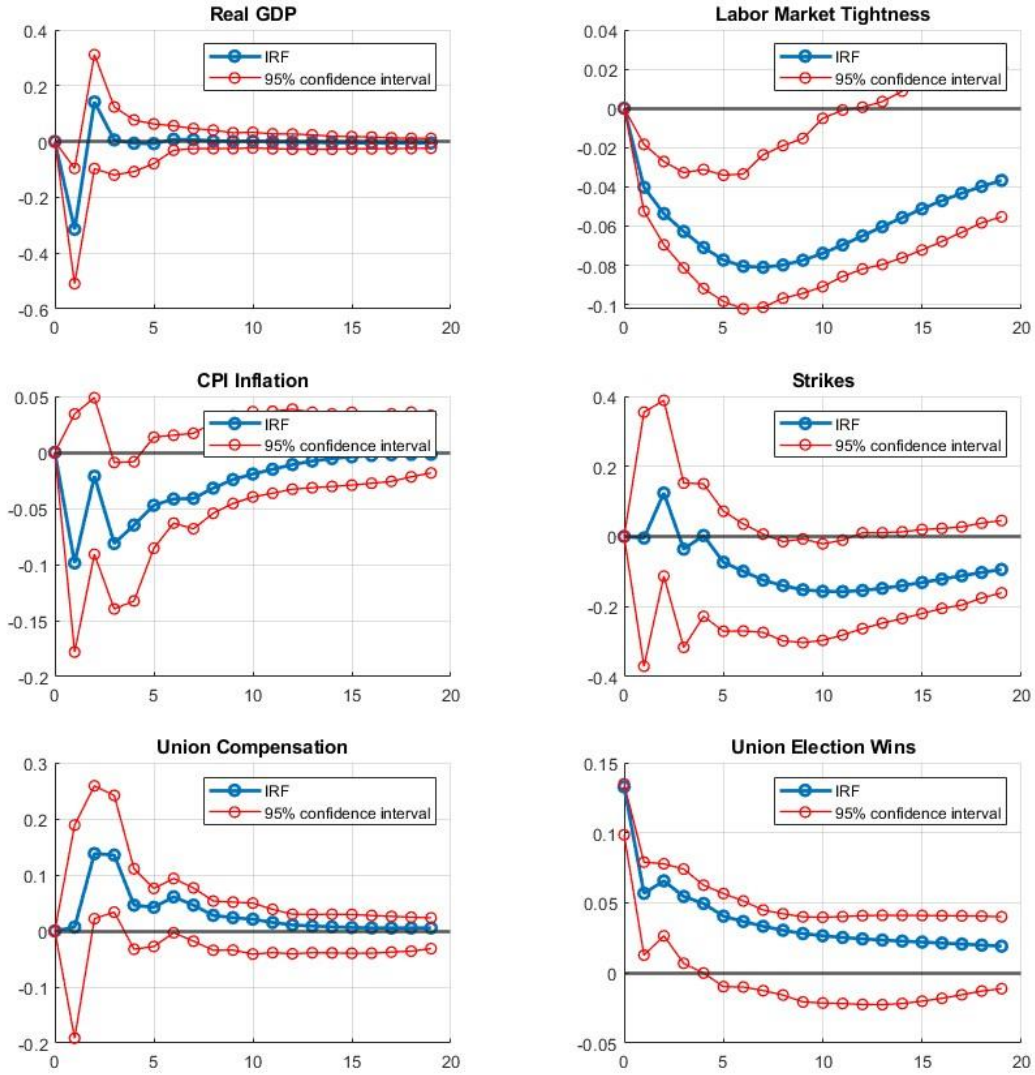


Figure 8: Forecast Error Variance Decomposition of Shock to Real GDP

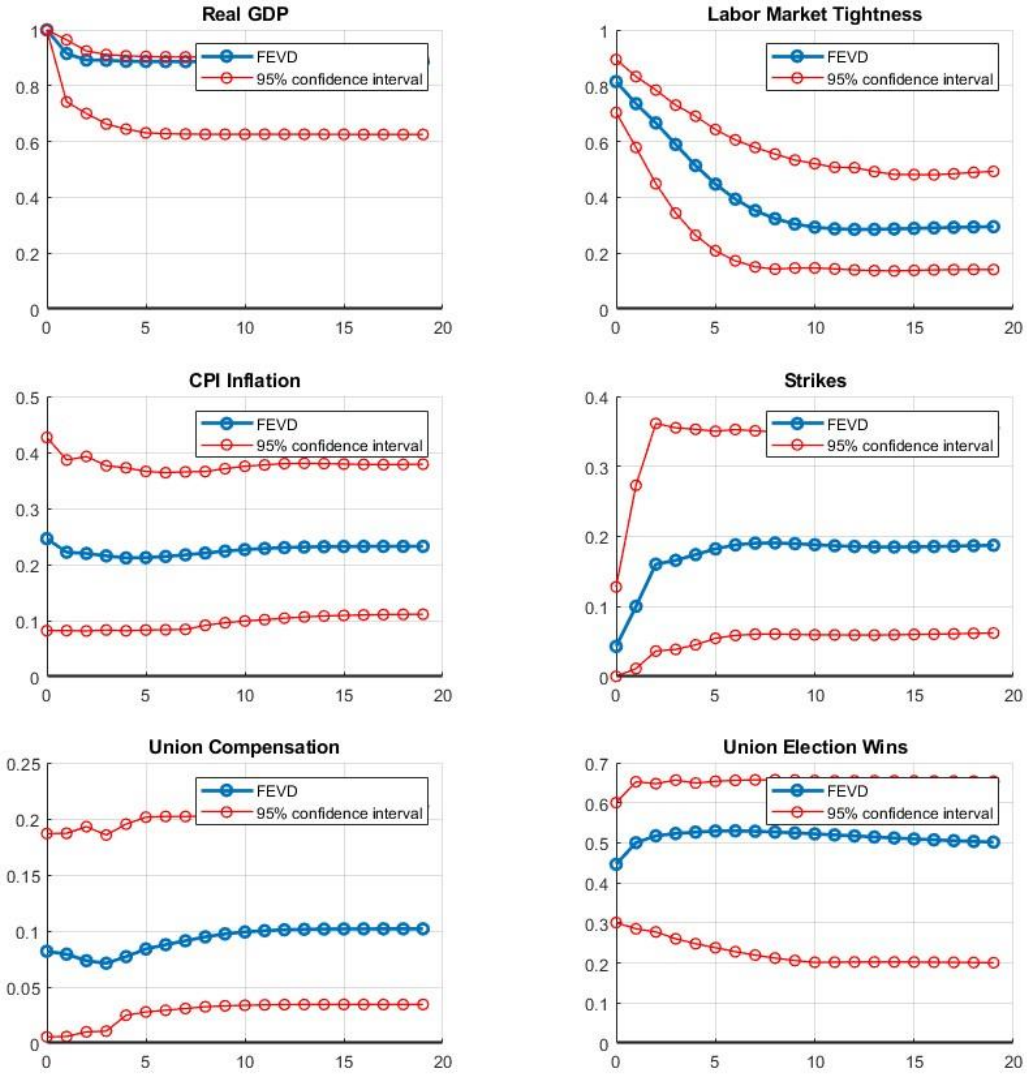


Figure 9: Forecast Error Variance Decomposition of Labor Demand Shock

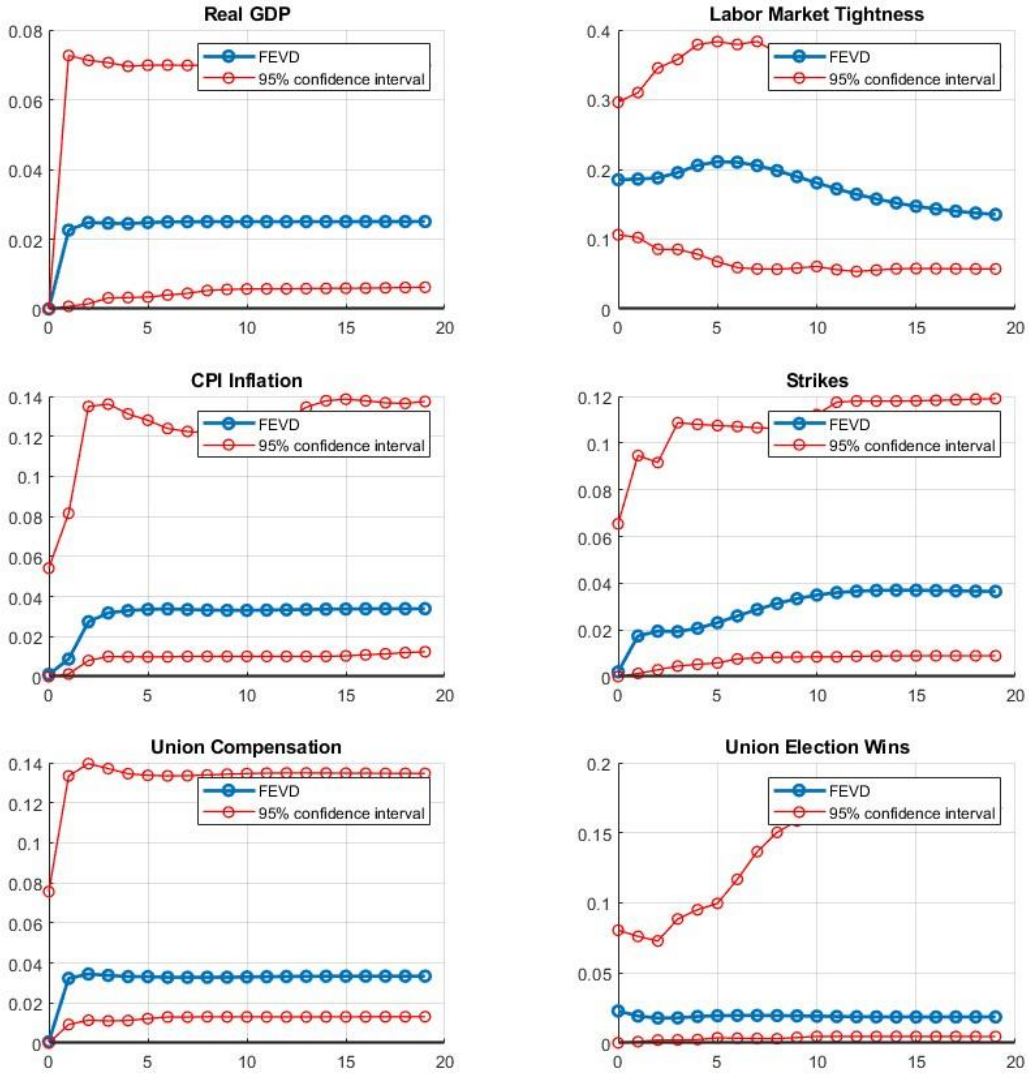


Figure 9: Forecast Error Variance Decomposition of Inflationary Shock

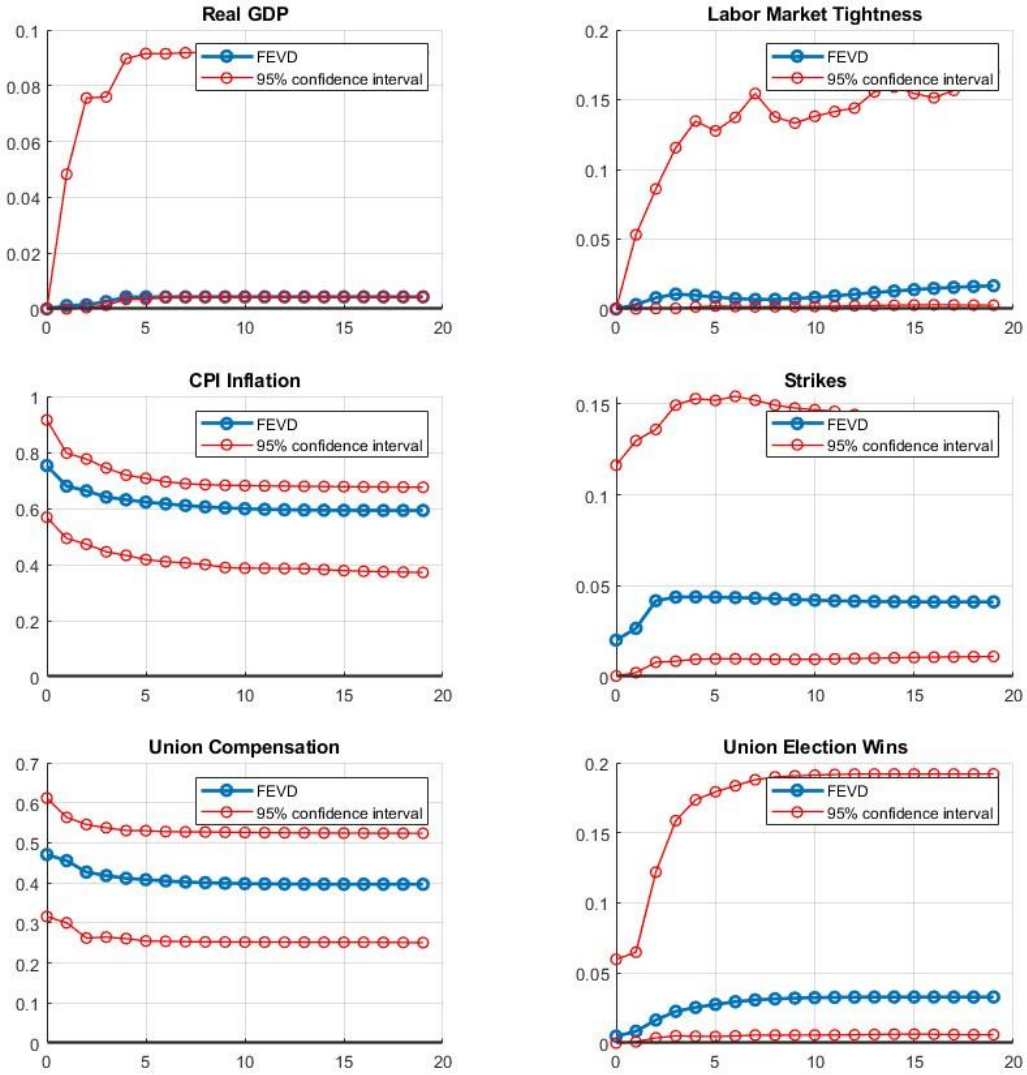


Figure 10: Forecast Error Variance Decomposition of Shock to Strikes

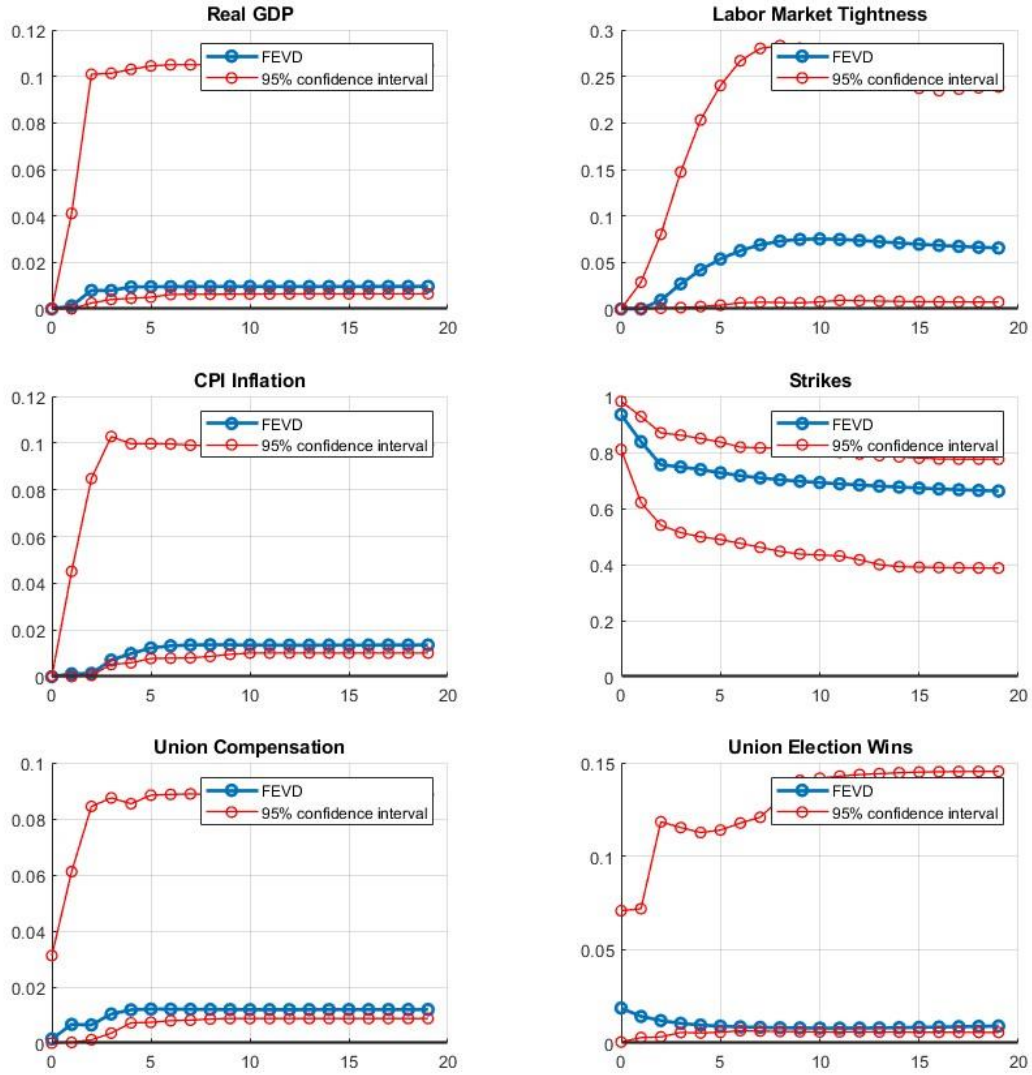


Figure 11: Forecast Error Variance Decomposition of Shock to Union Member Compensation

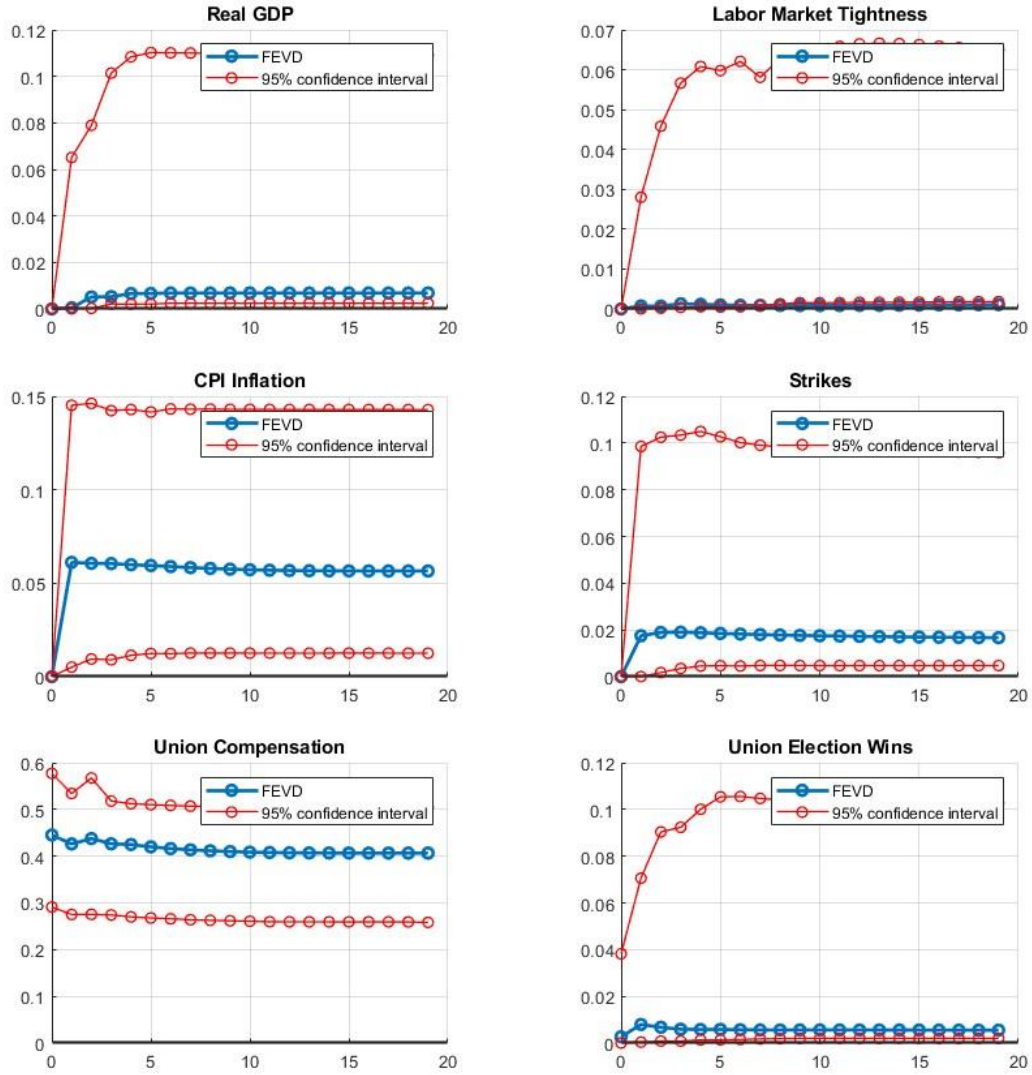


Figure 12: Forecast Error Variance Decomposition of Shock to Union Certification Election Wins

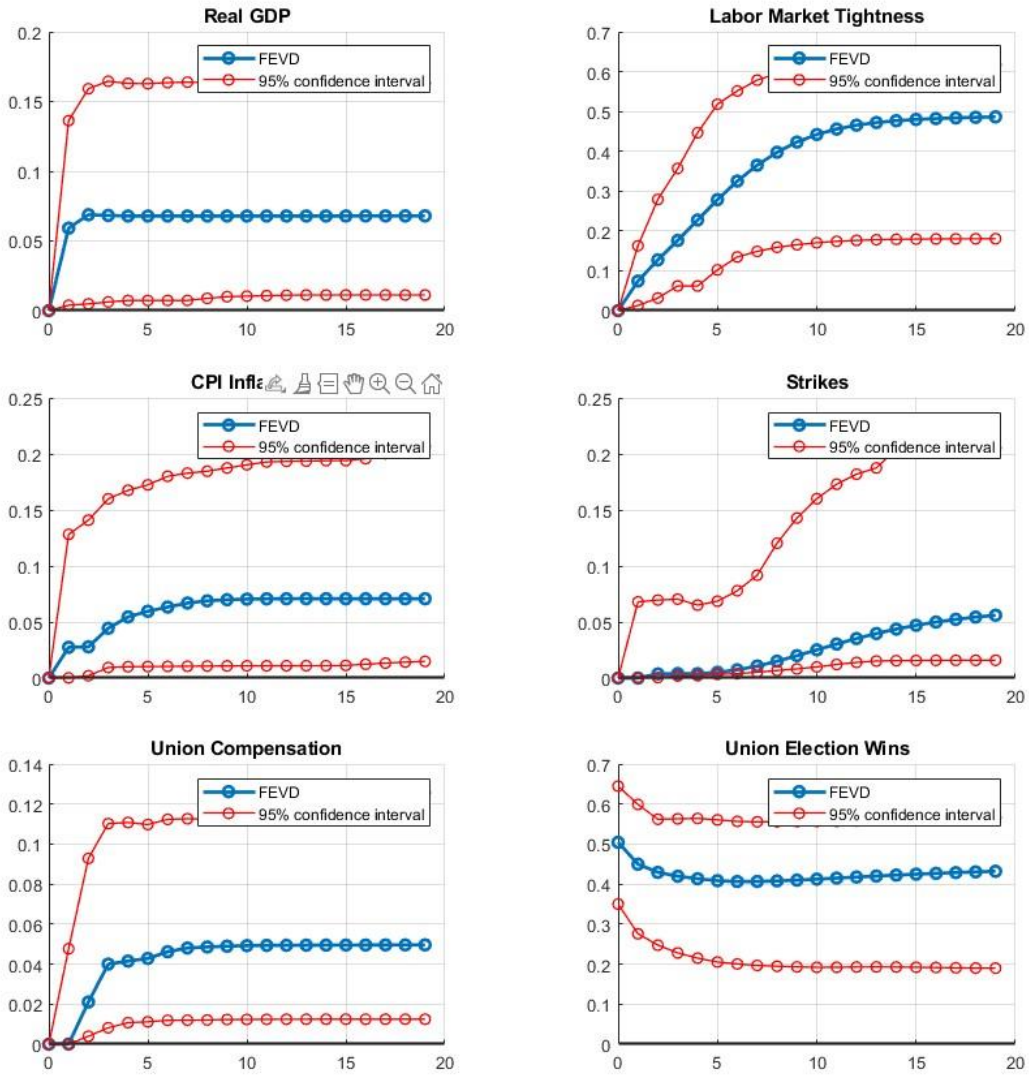
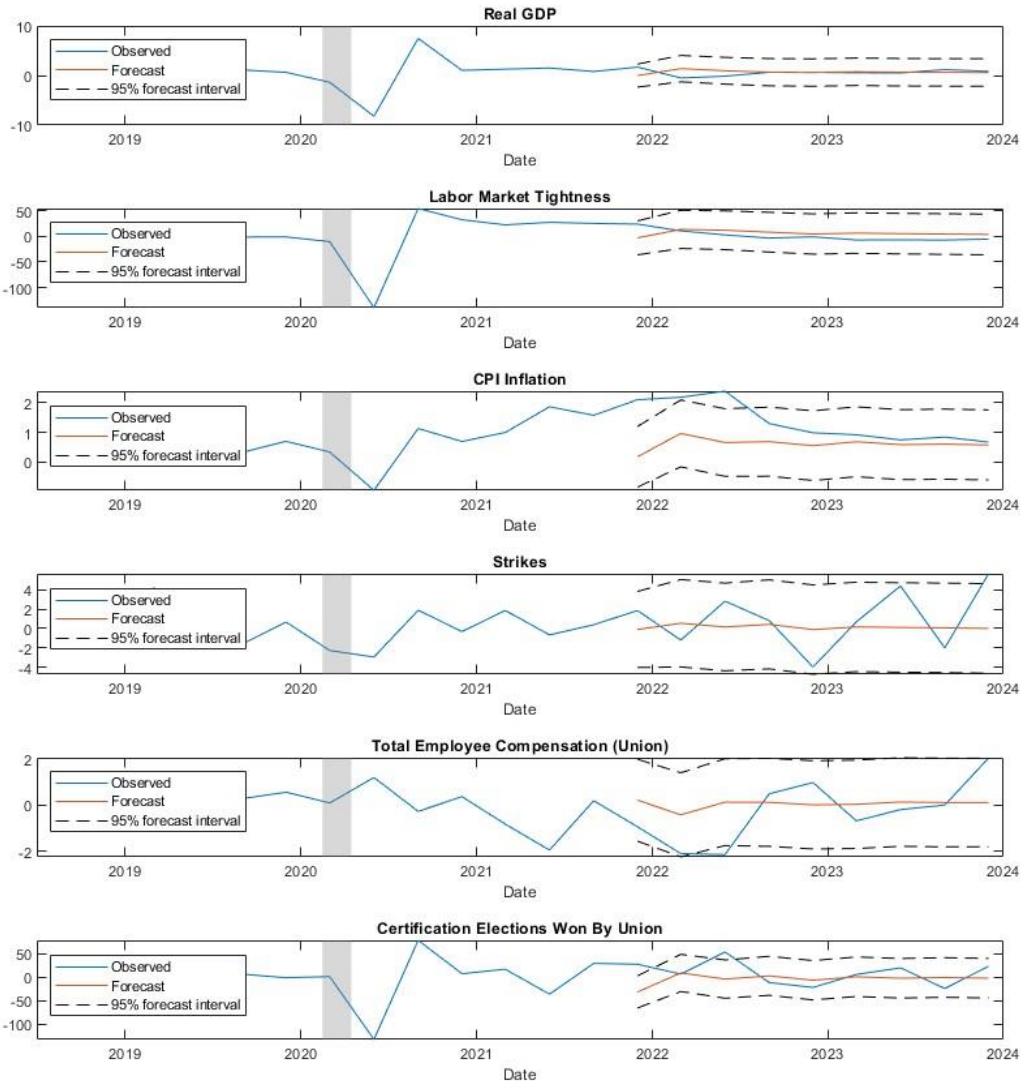
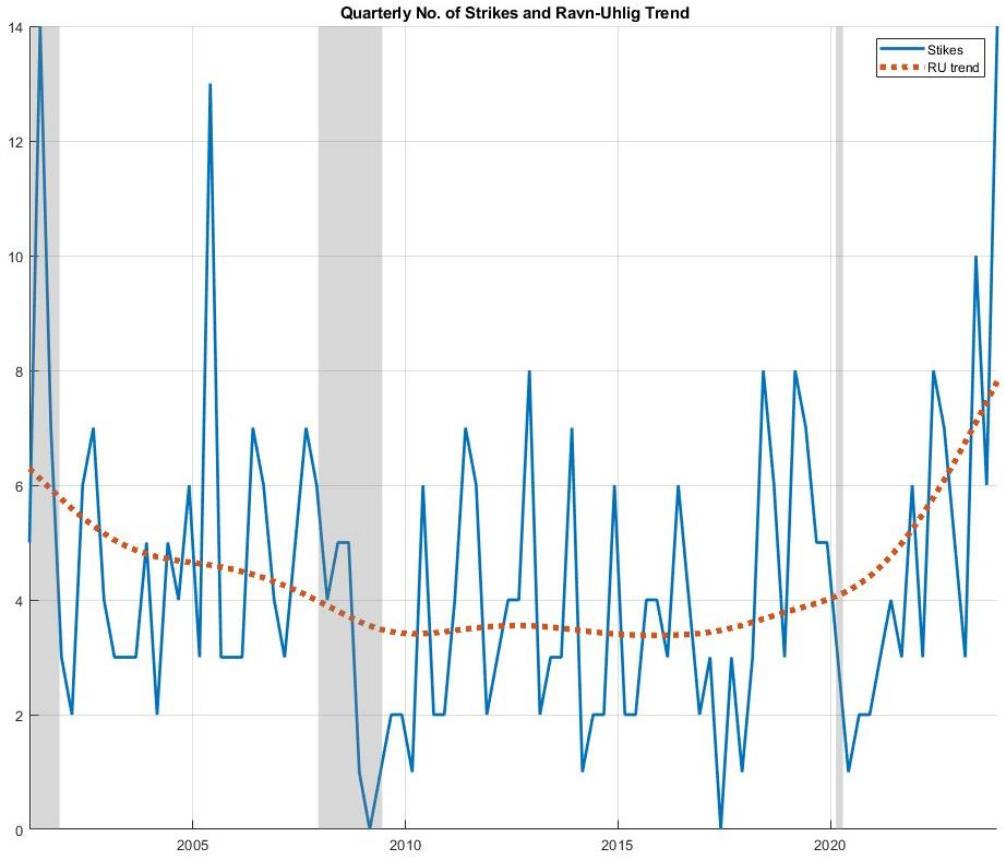


Figure 13: Vector Autoregression Variable Growth Forecasts



Note: All series are first differenced to examine growth of each variable. Real GDP, labor market tightness, CPI inflation, and union member compensation are shown in changes to percentage growth rates. Recession periods shaded in gray.

Figure 14: Quarterly Number of Strikes and Hodrick-Prescott Filter



Note: The number of strikes observed is not seasonally adjusted. The Hodrick-Prescott filter applied is using the smooth parameters for quarterly data as suggested by Ravn and Uhlig (2002), where smoothing parameter $\lambda = 1600$. Recession period shaded in gray.

Tables

Table 1: U.S. States with Right-to-Work Laws and Year Enacted

	Year
Alabama	1953
Arizona	1947
Arkansas	1947
Florida	1943
Georgia	1947
Idaho	1985
Indiana	2012
Iowa	1947
Kansas	1958
Kentucky	2017
Louisiana	1976
Mississippi	1954
Nebraska	1947
Nevada	1952
North Carolina	1947
North Dakota	1947
Oklahoma	2001
South Carolina	1954
Tennessee	1947
Texas	1993
Utah	1955
Virginia	1947
Wisconsin	2015
West Virginia	2016
Wyoming	1963

Source: National Conference of State Legislatures

Table 2: Description of Data

Data Series	Source	Units	Transformation
Real Gross Domestic Product	FRED	SAAR, Bil.Chn.2017	100 × log
CPI Inflation	FRED	NSA, Percent	100 × log
Labor Market Tightness Ratio (Job Vacancies / Unemployment)	FRED	SA, Level	Raw
Major Work Stoppages	BLS	SA, Level	Raw
Total Employee Compensation (Union Member)	BLS	NSA, Level	100 × log
Union Certification Election Wins	NLRB	NSA, Percent	Log

Table 3: Granger Causality P-Values

Lagged Variables	**Real GDP**	**Tightness**	**Inflation**	**Strikes**	**Union Comp.**	**Election Wins**	**Block-Wise**
Real GDP (-1)	X	0.6089	0.6888	0.0246**	0.1675	0.7448	0.0903*
Tightness (-1)	0.3440	X	0.1174	0.0053	0.0706*	0.8220	0.0001***
Inflation (-1)	0.8983	0.6224	X	0.5455	0.7039	0.3568	0.7564
Strikes (-1)	0.5074	0.1145	0.8993	X	0.8009	0.8064	0.2885
Union Comp. (-1)	0.9403	0.7559	0.0352**	0.4350	X	0.8287	0.1979
Election Wins (-1)	0.0290**	0.0001***	0.2385	0.7051	0.2932	X	0.0000***

Notes: Granger causality tests are conducted using a “leave-one-out” test. Final block-wise tests show effects of lagged variable on all other variables. ***p<0.01, **p<0.05, *p<0.1.

Table 4: Vector Autoregression Estimates

Variables	**Real GDP**	**Tightness**	**Inflation**	**Strikes**	**Union Comp.**	**Election Wins**
Real GDP (-1)	0.2009	0.0057	-0.0394	0.7589***	0.2717**	0.0198
	(0.1817)	(0.0140)	(0.0808)	(0.2753)	(0.1357)	(0.0284)
Real GDP (-2)	-0.0106	-0.0077	-0.0502	0.3569*	0.0262	-0.0036
	(0.1233)	(0.0095)	(0.0549)	(0.1868)	(0.0921)	(0.0193)
Tightness (-1)	-3.2034	1.4585***	1.9929**	-6.2098*	-3.9652**	-0.0215
	(2.1324)	(0.1649)	(0.9484)	(3.2306)	(1.5929)	(0.3330)
Tightness (-2)	2.9080	-0.5154***	-1.7943*	7.6768**	3.7973**	-0.0191
	(2.0940)	(0.1619)	(0.9313)	(3.1724)	(1.5642)	(0.3270)
Inflation (-1)	0.0127	0.0228	0.0239	-0.2570	0.1529	0.0766
	(0.3815)	(0.0295)	(0.1696)	(0.5779)	(0.2849)	(0.0596)
Inflation (-2)	0.1569	0.0134	0.1577	0.5812	-0.2024	0.0291
	(0.3263)	(0.0252)	(0.1451)	(0.4944)	(0.2438)	(0.0510)
Strikes (-1)	0.0080	0.0033	0.0037	0.1480	-0.0384	-0.0082
	(0.0744)	(0.0058)	(0.0331)	(0.1127)	(0.0556)	(0.0116)
Strikes (-2)	-0.0858	-0.0119**	-0.0152	-0.0169	0.0177	0.0018
	(0.0686)	(0.0053)	(0.0305)	(0.1039)	(0.0513)	(0.0107)
Union Comp. (-1)	-0.0095	0.0116	-0.2346***	-0.4283	-0.0056	0.0209
	(0.2031)	(0.0157)	(0.0903)	(0.3077)	(0.1517)	(0.0317)
Union Comp. (-2)	-0.0727	-0.0022	0.0358	-0.1254	-0.2856**	0.0068
	(0.1926)	(0.0149)	(0.0857)	(0.2918)	(0.1439)	(0.0301)
Election Wins (-1)	-2.3702***	-0.3030***	-0.7425*	-0.0335	0.0513	0.4282***
	(0.9113)	(0.0705)	(0.4053)	(1.3807)	(0.6808)	(0.1423)
Election Wins (-2)	1.5976	0.1975***	0.6983	0.7021	0.5718	0.4075***
	(0.9787)	(0.0757)	(0.4353)	(1.4828)	(0.7311)	(0.1529)
Constant	5.0510*	0.6257***	0.7122	-1.6180	-3.0810	0.8604**
	(2.5946)	(0.2006)	(1.1539)	(3.9308)	(1.9381)	(0.4052)
Observations	89	89	89	89	89	89
R^2	0.1851	0.9570	0.3136	0.3199	0.2023	0.6722
P-Value	0.0631	0.0000	0.0001	0.0000	0.0316	0.0000

Notes: All coefficients estimated using maximum likelihood estimation (MLE). Standard errors are in parentheses. ***p<0.01, **p<0.05, *p<0.1.