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## **Forecasting the US and Wisconsin Economies in 2018**

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**January 8, 2018**

### **Abstract**

This paper provides forecasts for the United States and Wisconsin economies in 2018. We use versions of mixed-frequency vector autoregression (MF-VAR) models that have been previously applied to forecast the national economy, which we extend to also consider the state of Wisconsin. Our median forecasts suggest that the national economy will grow by about 2.4% in 2018, and the unemployment rate will continue to decrease, to about 3.6% by the end of 2018. For the Wisconsin economy, we forecast that real GDP will grow by about 1.6% in 2018. The labor market in Wisconsin will continue to tighten, with the forecast unemployment rate dropping below 3% to a new historic low. Thus our forecasts suggest a continuation of the economic expansion which began in late 2009, with a slight increase in the rate of growth in 2018. While we forecast faster growth, the uncertainty in our forecasts. For both the national and Wisconsin economies there is a significant chance that growth will slow, but relatively little chance of a substantial economic downturn. We forecast a 10.7% chance that national GDP will decline for two consecutive quarters, and an 18% chance that by the end of 2018 the Wisconsin unemployment rate will be above its current level. We also show that national growth which is faster or slower than our median forecast will have a similar impact in Wisconsin.

# 1 Overview

This paper provides forecasts for the United States and Wisconsin economies in 2018. For the national economy, we use a mixed-frequency vector autoregression (MF-VAR) model developed recently by Schorfheide and Song (2015). For the Wisconsin economy, we extend the MF-VAR model to allow national variables to enter the model as exogenous variables. Our model for the national economy includes 18 variables, while the model for the Wisconsin economy includes 13 state-level variables as well as the 18 national variables. We estimate the model for each economy using data available by January 5, 2018. With the estimated model, we forecast each variable forward to the end of 2018.

Our forecasts are based on recent trends and relationships between economic variables at the national and state levels, and thus assume that these relationships will continue. Changes in federal and state policy going forward thus only enter our forecasts to the extent that expectations of these changes are reflected in current variables. For example, expectations of future monetary policy are priced into current financial indicators and expectations of the tax reform which was recently enacted may have already been built into stock prices and investment.

Our median forecasts suggest that the national economy will grow by about 2.4% in 2018. The overall price level for personal consumption goods will increase by about 1.71%, while the core inflation measuring the price increase of consumption goods other than food and energy will be about 1.48%. For the labor market, we forecast that the unemployment rate will continue to decrease, dropping from 4.1% in December 2017 to about 3.6% by the end of 2018, a level which has not been seen since 1969. We also forecast that the economy will add about 2.6 million nonfarm jobs in 2018, slightly more than in the past two years and on par with 2015. We also project that the effective federal funds rate, which has risen recently with Federal Reserve monetary tightening, will only rise slightly further, to about 1.76%, while longer term interest rates remain low.

Thus our forecasts are consistent with a continuation of the steady economic expansion which began in mid-2009, with a slight increase in the rate of growth. However, there is a risk that the economy may slow down, with our forecasts suggesting a reasonable likelihood that the growth rate of real GDP would drop below 1% and the unemployment rate rise above its current level. In particular, we forecast that there is a 10.7% chance that the real GDP will drop in two consecutive quarters in 2018, a common definition of a recession.

For the Wisconsin economy, the median forecasts suggest that real GDP will grow by about 1.64% in 2018, and personal income will increase by about 4.67%. Both of these are roughly equal to the average growth rates of these variables in Wisconsin since 2010. Our forecasts suggest that the labor market in Wisconsin will continue to tighten. The unemployment rate will remain low and may drop below 3%. With unemployment already at or near historic lows in Wisconsin, this suggests even further labor market tightening to levels not previously seen.

However, as with the national economy, there is also a risk that the Wisconsin economy will

slow down: the real GDP may drop by about 2%, and there is a 18% chance that the unemployment rate will rise above its current level.

Since the manufacturing is the largest sector in Wisconsin, accounting for roughly 18% of output, we also forecast manufacturing employment and output. Since the recession, manufacturing employment both nationally and in Wisconsin has risen, reversing its long-term downward trend. We forecast that manufacturing output and employment nationally will slow in 2018. In Wisconsin, manufacturing employment has continued to increase in recent years, even as manufacturing output has been stagnant or declined. We forecast that these trends will continue in 2018: real output in the manufacturing sector is likely to decline even as employment continues to increase.

Not surprisingly, we find that the Wisconsin economy is positively related to the national economy. If the national economy grows by over 3% instead of our median forecast of 2.4%, the Wisconsin economy will grow by 1.76% as opposed to 1.64%. On the other hand, if national GDP were to decline in the first two quarters or the national unemployment rate would rise above 4.5% by the end of 2018, the Wisconsin economy will only grow by 1.25%.

Overall, for both economies, our median forecasts for 2018 are within the range of values observed in the past few years, suggesting that, in the absence of any significant shocks, both economies will continue on their trends in 2018.

## 2 Model and Data

We use a mixed-frequency vector autoregression (MF-VAR) model developed recently by Schorfheide and Song (2015). As other VAR models used for forecasting, the MF-VAR model assumes that a variable in a given period depends on its lagged values as well as the lagged values of other variables. This dependence is estimated using historical data. The estimated model is then used to forecast each variable forward.

Specifically, let  $x_t$  be a vector of macroeconomic variables at time  $t$ , a VAR model can be expressed as

$$x_t = \sum_{i=1}^p A_i x_{t-i} + C + \varepsilon_t$$

where  $p$  is the number of lags,  $A_i$  and  $C$  are matrices of coefficients, and  $\varepsilon_t$  is the forecast error.

Different from typical VAR models which require all variables in  $x_t$  to be measured at the same frequency, a noteworthy feature of the MF-VAR model is that it combines data measured at different frequencies (e.g. monthly unemployment rate and quarterly GDP), allowing the use of more timely high frequency data (e.g. monthly unemployment rate) to help forecast low frequency variables (e.g. quarterly GDP).

MF-VAR models have seen recent applications in forecasting for policy analysis. Brave, Butters, and Justiniano (2016) evaluate the performance of the MF-VAR model and finds it provides an attractive alternative to surveys of professional forecasters. The MF-VAR model has also been

used by the Federal Reserve Bank of Minneapolis to forecast the national economy.<sup>1</sup> Our model for the national economy is similar to the Minneapolis Fed model, but includes three additional variables for the manufacturing sector. The complete list of national variables used in this paper is reported in the upper panel of Table 1.

We start the model from 1987, the starting date of the current series of manufacturing output (outms), and use all data available by January 5, 2018. By this date, the monthly variables are observed until either November 2017 (2017M11) or December 2017 (2017M12), while the quarterly variables are only observed until the third quarter of 2017 (2017Q3). As mentioned above, the MF-VAR model allows us to use the more timely monthly observations to help forecast the quarterly variables.

As in Schorfheide and Song (2015), we set  $p = 6$  and use the marginal data density (MDD) to select the hyper-parameters that govern the prior for the VAR coefficients  $A_i$  and  $C$ . The model is estimated using a Markov chain Monte Carlo (MCMC) algorithm. We generate 15,000 draws from the posterior distribution of the VAR parameters. The first 10,000 draws are discarded, and the remaining 5,000 draws are used to calculate posterior moments. With the estimated model parameters, we forecast each variable forward to the end of 2018.

The federal funds rate increased from 1.16% in early December 2017 to its current level of 1.42% after the Federal Reserve raised the target rate on December 13, 2017. To account for this recent policy change, we assume that the effective federal funds rate is 1.42% in January 2018. Forecasts for other variables are conditional on this assumption.

## 2.1 State Model and Data

To forecast the Wisconsin economy, we extend the MF-VAR model to include measures of the national economy as exogenous variables. Thus our VAR model becomes a VARX, as has been commonly used in small open economy frameworks following Cushman and Zha (1997), and similar to the forecasting model for the Euro area studied by Burlon et al (2015). In particular, we extend the MF-VAR model above as follows:

$$x_t = \sum_{i=1}^p A_i x_{t-i} + \sum_{j=0}^l B_j w_{t-j} + C + \varepsilon_t$$

where  $x_t$  is a vector of state-level variables measured at different frequencies,  $w_t$  is a vector of national variables, all of which are measured at the model frequency,  $\varepsilon_t$  is the forecast error at time  $t$ , and  $A_i$ ,  $B_j$  and  $C$  are matrices of the VAR coefficients. In this framework,  $B_j$  represents the response of state variables  $x_t$  to national variables  $w_{t-j}$ . The original MF-VAR model in Schorfheide and Song (2015) can be obtained by setting  $B_j = 0$  for all  $j$ .

In empirical implementation, each model period is taken to be a month. We first run the

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<sup>1</sup>See <https://www.minneapolisfed.org/economy/mf-var-forecast> and Beauchemin (2013).

Table 1: Summary of Variables

Variable (short name)	End	Source
U.S.		
Real gross domestic product (gdp)	2017Q3	FRED (GDPC1)
Fixed private investment (fpi)	2017Q3	FRED (FPI)
Real government expenditures (gce)	2017Q3	FRED (GCEC1)
Manufacturing real output index (outms)	2017Q3	FRED (OUTMS)
Civilian unemployment rate (ur)	2017M12	FRED (UNRATE)
Total nonfarm payroll employment (emp)	2017M12	FRED (PAYEMS)
Manufacturing employment (manemp)	2017M12	FRED (MANEMP)
Aggregate weekly hours index (hrs)	2017M12	FRED (AWHI)
Average hourly earnings in private sector (wage)	2017M12	FRED (AHETPI)
Average hourly earnings in manufacturing (manwage)	2017M12	FRED (CES3000000008)
Personal consumption expenditures (pce)	2017M11	FRED (PCE)
PCE price index (pcepi)	2017M11	FRED (PCEPI)
Price index of PCE excluding food and energy (pcepilfe)	2017M11	FRED (PCEPILFE)
Industrial production index (indpro)	2017M11	FRED (INDPRO)
Effective federal funds rate (fedfunds)	2017M12	FRED (FEDFUNDS)
10-year treasury bond yield (gs10)	2017M12	FRED (GS10)
Moody's seasoned Baa corporate bond yield (baa)	2017M12	FRED (BAA)
S&P 500 index (sp500)	2017M12	FRED (SP500)
Wisconsin		
Real GDP (wigdp)	2017Q2	FRED (WIRQGSP)
Manufacturing GDP (wimangdp)	2017Q2	FRED (WIMANRQGSP)
Personal income (wipinc)	2017Q3	FRED (WIOTOT)
All-transactions house price index (wihpi)	2017Q3	FRED (WISTHPI)
Return on average assets for banks (wiroa)	2017Q3	FRED (WIROA)
Tax collections (witax)	2017Q3	Census Bureau
Unemployment rate (wiur)	2017M11	FRED (WIUR)
Civilian labor force (wilf)	2017M11	FRED (WILF)
Nonfarm employment (wiemp)	2017M11	FRED (WINA)
Manufacturing employment (wimanemp)	2017M11	FRED (WIMFG)
New private building permits (wipermits)	2017M11	FRED (WIBPPRIVSA)
Initial unemployment insurance claims (wiiclaims)	2017M12	FRED (WIICLAIMS)
Average hourly earnings: manufacturing (wimanwage)	2017M10	FRED (SMU55000003000000008SA)

For the source column, FRED stands for the Federal Reserve Economic Data available at <https://fred.stlouisfed.org/>, and the values in the parentheses are the names of the original data series.

model for the national economy. In addition to forecasts of the national economy, we can obtain an estimated monthly series for each variable originally available at a quarterly frequency. For example, we can obtain a monthly series of real GDP which is observed only quarterly in data. These estimated monthly series, together with other national variables observed monthly in data, are included in the vector of exogenous variables  $w_{t-j}$  in the model for the state economy.

The inclusion of exogenous variables  $w_{t-j}$  requires us to specify the prior for  $B_j$ . In the spirit of the Minnesota prior, we assume a prior where  $E(B_j) = 0$  and the variance of each element in  $B_j$  declines exponentially with  $j$ . This is implemented by adding relevant dummy observations for  $B_j$  into the set of dummy observations for  $A_i$  and  $C$  detailed in Schorfheide and Song (2015). The dummy observations for the Minnesota prior are controlled by a small set of hyper-parameters. We expand this set of hyper-parameters to include one more element that controls for the tightness of the prior for  $B_j$ . All hyper-parameters are selected by maximizing the marginal data density (MDD).

Based on some preliminary exploration of the MDD, we set  $p = 6$  and  $l = 0$ . That is, we allow six lags for endogenous variables but only use the contemporaneous values of national variables to help forecast the state variables.

Clearly, our forecasts for the state variables depend on relevant forecasts of the national variables. To account for the random errors in the national forecasts, for each draw from the estimated posterior distribution of the state model parameters, we also draw a path of all national variables from the national model estimated above. In this way, the state forecasts account for both the estimation error of the state model and the forecast error of the national variables. As in the national model, we generate 15,000 draws, discard the first 10,000 draws, and use the remaining 5,000 draws to calculate posterior moments.

As reported in the lower panel of table 1, we use 13 state-level variables, 7 of which are observed monthly, while others are observed quarterly.<sup>2</sup> Our state-level variables include many counterparts of the national output and employment variables as well as state level indicators, such as initial unemployment insurance claims and new building permits which forecast future activity. Many of the same variables are included in the Coincident and Leading Indexes produced by the Federal Reserve Bank of Philadelphia as well as the Midwest Economy Index produced by the Federal Reserve Bank of Chicago (which has more sectoral disaggregation). But rather than combining all the indicators into a single activity index, we use them directly to forecast the state-level economic variables of interest.

As quarterly GDP at the state level is not available until 2005, we can only start the full state model from 2005. We can, however, estimate a smaller model with fewer variables starting from a much earlier date. The longer history of data used in the smaller model will allow us to

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<sup>2</sup>Some variables, like the initial unemployment insurance claims, are originally available at a higher than monthly frequency. We average these variables to a monthly frequency. We also adjust for the seasonality of two variables: the initial unemployment insurance claims (wiiclaims) and the quarterly tax collections (witax).

obtain better forecasts of key variables like the unemployment rate. With these considerations in mind, we estimate two state models, one starting from 1990 with 9 state-level variables (the excluded variables are real GDP (wigdp), manufacturing GDP (wimangdp), tax collections (witax) and manufacturing wage (wimanwage)), and another one starting from 2005 with all 13 state-level variables. We use the smaller state model to forecast the 9 variables. Conditional on these forecasts, we use the full model to forecast the remaining 4 variables.

### 3 Forecast for the National Economy

Overall, the model forecasts that the national economy will grow by about 2.4% in 2018. The overall price level for personal consumption goods will increase by about 1.71%, while the core inflation measuring the price increase of consumption goods other than food and energy will be about 1.48%. In terms of the labor market, we forecast that the unemployment rate will continue to decrease, dropping from 4.1% in December 2017 to about 3.6% by the end of 2018, and the economy will add about 2.6 million nonfarm jobs in 2018. The effective federal funds rate will rise to about 1.76%, and the manufacturing sector is likely to shrink. However, there is a risk that the economy may slow down, with the growth rate of real GDP dropping below 1% and the unemployment rate rising above its current level. In particular, we forecast that there is a 10.7% chance that the real GDP will drop in two consecutive quarters. The rest of this section discusses our forecasts in detail.

#### 3.1 Output, Investment and Expenditure

Table 2 reports our median forecasts of the year-over-year growth rates of real GDP (gdp), fixed private investment (fpi), real government consumption expenditures and gross investment (gce), and personal consumption expenditures (pce). Relative to 2016Q4, we forecast that the real GDP in 2017Q4 will grow by about 2.65%, and growth will accelerate in early 2018 before slowing slightly later in the year. Overall, we forecast that the economy will grow by about 2.4% in 2018.

Table 2: Growth Rates of Output, Investment and Expenditures for the U.S.: Median Forecasts

	gdp	fpi	gce	pce
2017Q4	2.65	6.73	-0.03	4.36
2018Q1	3.09	6.39	0.08	4.74
2018Q2	3.00	6.52	0.47	5.07
2018Q3	2.74	6.51	0.72	5.27
2018Q4	2.40	5.47	1.09	4.85

For fixed private investment, we forecast that it will grow by about 6.73% between 2016Q4 and 2017Q4. The growth rate may slow down a bit in 2018 but will remain above 5.4%. Government expenditures will drop slightly in 2017Q4 relative to 2016Q4, and it will start to grow slowly in

2018. Personal consumption expenditures, on the other hand, will continue to grow by about 5% a year.

While the median forecasts are useful, they are not informative of the potential risks that the economy may face. For this, we plot the 67% forecast intervals as the shaded areas in figure 1. The black curve shows the historical values and our median forecasts. The red vertical line indicates January 2018. According to the model, the economy does face some risks: real GDP growth rate may drop below 1% by the end of 2018, and fixed private investment (fpi) may experience a similar slowdown. One common definition of a recession is that real GDP declines in two consecutive quarters. According to this definition, the model forecasts that the probability of a recession in 2018 is 10.7%.

Figure 1: Year-on-Year Growth Rates of Output, Investment and Expenditures for the U.S.

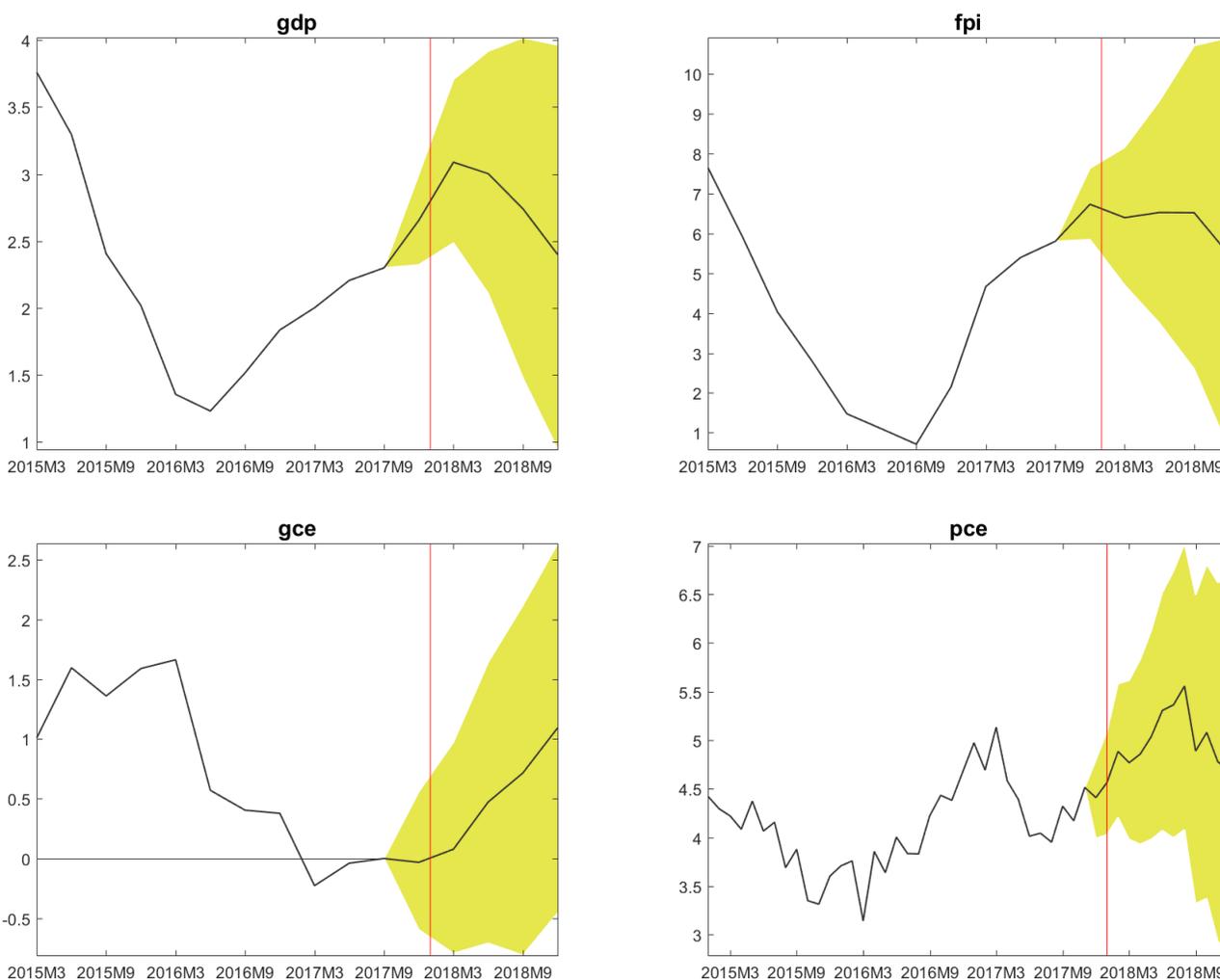
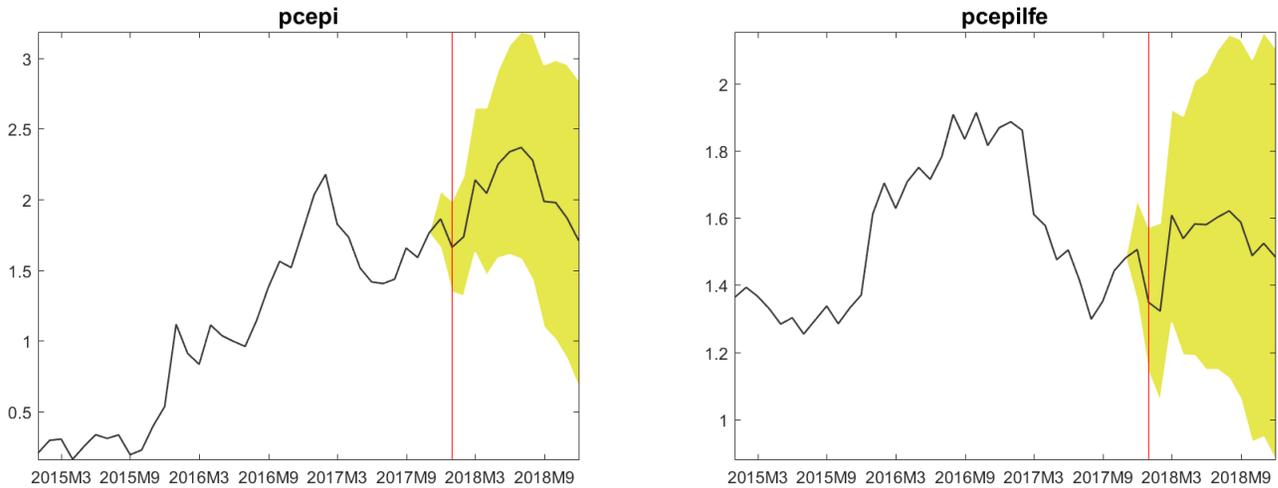


Figure 1 also shows that our median forecasts for 2017Q4 and 2018 are within the range of values observed in the past few years, suggesting that, in the absence of any significant shocks, the economy is likely to continue on its trend in 2018.

### 3.2 Inflation

Figure 2 reports our inflation forecasts. The overall inflation (pcepi) will fluctuate around 2%, while the core inflation measuring the price increase of consumption goods other than food and energy (pcepilfe) will be around 1.5%. In particular, we forecast that the overall price level will increase by about 1.71% between 2017M12 and 2018M12, while the core inflation during this period will be about 1.48%.

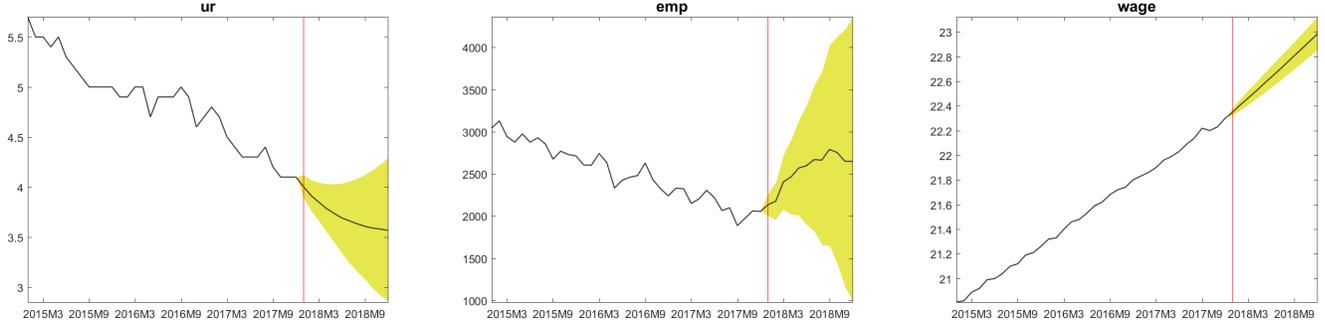
Figure 2: Inflation in the U.S.



### 3.3 Labor Market

Figure 3 reports our forecasts for the labor market. The first panel (ur) shows that, according to the median forecasts given by the black curve, the unemployment rate will remain low and may continue to decrease, dropping from 4.1% in 2017M12 to about 3.6% in 2018M12. The second panel (emp) reports the year-on-year change in the size of non-farm payroll employment. The economy added about 2-3 million non-farm jobs in each of the past few years. The model forecasts that this trend will continue in 2018, with the economy adding about 2.6 million nonfarm jobs. Finally, the last panel (wage) shows that the average hourly earnings in the private sector will continue to increase, rising from \$22.3 in 2017M12 to about \$23 in 2018M12. This is a slight increase in wage growth to about 3.1% rather than the 2.2% growth seen in recent years. The 67% forecast intervals shown by the yellow-shaded areas suggest that the labor market may face some risks: the unemployment rate may rise above its current level, and the economy may only add about 1 million nonfarm jobs.

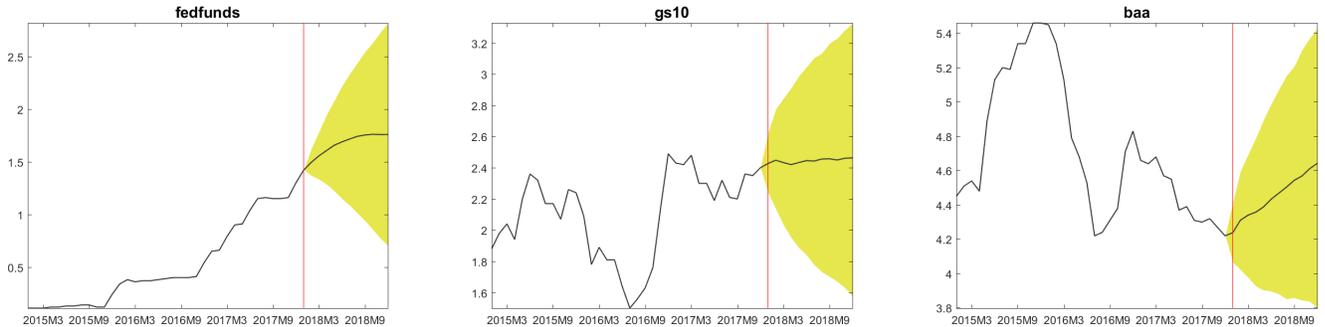
Figure 3: Labor Market Indicators in the U.S.



### 3.4 Financial Market

Figure 4 plots our forecasts for the financial market. Recall that we assume the federal funds rate is 1.42% in 2018M1. The model forecasts that the federal funds rate (fedfunds) will rise to 1.76% by 2018M12. Thus our forecast is more dovish than the current Federal Reserve projections, which suggest further rate increases. However in recent years the Fed has consistently had fewer rate increases than they initially expected, and our model suggests that this trend will continue. With the increase in short-term rates, the Moody’s BAA corporate bond yield will rise from 4.22% to 4.64% during the same period. The 10-year treasury bond yield (gs10) is predicted to remain flat at its current level, although there is a substantial chance that it could go either up or down. Thus our forecasts suggest that the yield curve will continue to flatten, as it has over most of the past few years.

Figure 4: Financial Market Indicators in the U.S.

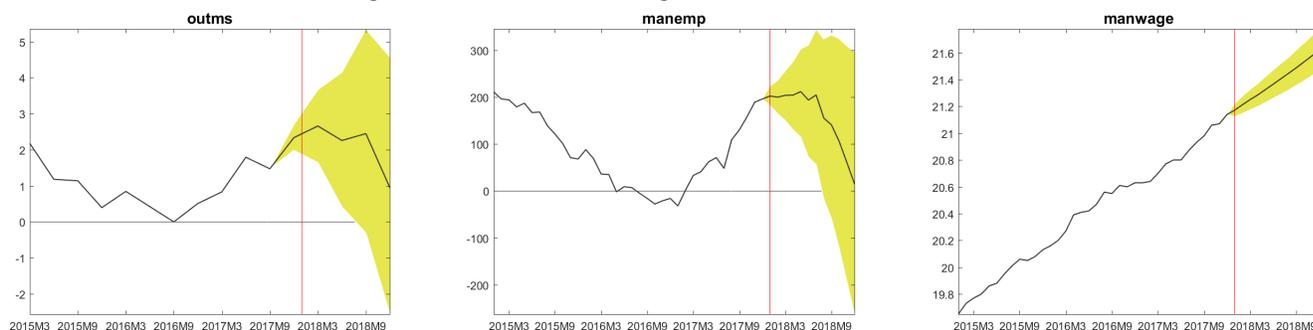


### 3.5 Manufacturing Sector

Figure 5 plots our forecasts for the manufacturing sector. The first panel (outms) shows the year-on-year growth rate of manufacturing output. We forecast that manufacturing output will increase by 2.34% between 2016Q4 and 2017Q4. This growth rate, however, is likely to decrease by the end of 2018. As the growth rate of manufacturing output is lower than that of real GDP, we

forecast that the manufacturing sector will continue to shrink. The second panel (manemp) shows the year-on-year change in the size of manufacturing employment. The economy added about 196 thousand manufacturing jobs between 2016M12 and 2017M12. Consistent with our forecasts for manufacturing output, we forecast that the growth in manufacturing employment will slow down and may drop to 15 thousand in 2018. The average hourly earnings of production and nonsupervisory employees in manufacturing (manwage) will rise slightly from \$21.14 in 2017M12 to about \$21.62 in 2018M12. For the year we are forecasting 2.3% increase in manufacturing wages, below the 3.1% overall forecast wage growth. Overall, the model forecasts that the manufacturing sector will shrink in 2018, and the wide forecast intervals suggest that this decline may be more dramatic than implied by the median forecasts.

Figure 5: Manufacturing Sector in the U.S.



## 4 Forecast for the Wisconsin Economy

Overall, the model forecasts that the real GDP will grow by about 1.64% in 2018, and personal income will increase by about 4.67%. The unemployment rate will remain low and may drop below 3%. On the other hand, the manufacturing sector will continue to shrink, with the real output decreasing by about 2.2% in 2018. However, as with the national economy, there is also a risk that the Wisconsin economy will slow down: the real GDP may decline by 2%, and there is a 18% chance that the unemployment rate will rise above its current level.

Our forecasts of the Wisconsin economy depend positively on forecasts of the national economy. If the national economy grows by over 3% instead of our median forecast of 2.4%, the Wisconsin economy will grow by 1.76% as opposed to 1.64%. On the other hand, if national GDP were to decline in the first two quarters or the national unemployment rate would rise above 4.5% by the end of 2018, the Wisconsin economy will only grow by 1.25%.

The rest of this section discusses the forecasts in detail.

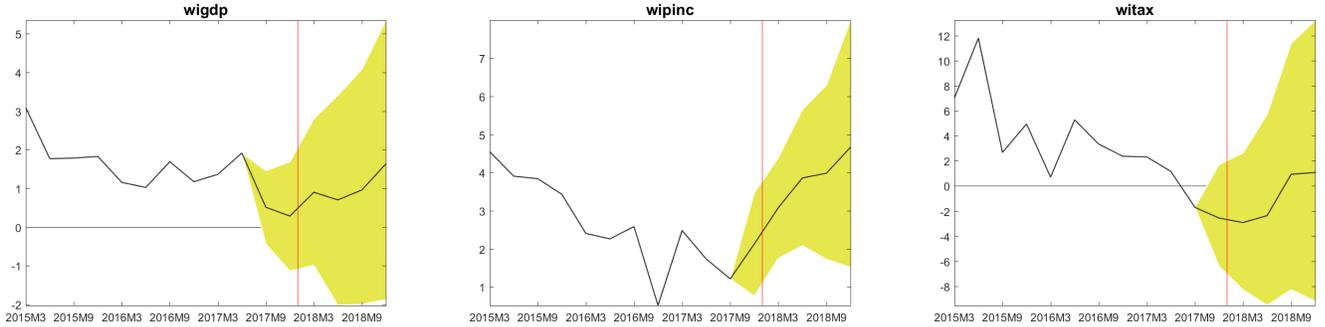
## 4.1 Output, Income and Tax

Table 3 and figure 6 report our forecasts of the year-on-year growth rates of real GDP (wigdp), personal income (wipinc) and tax collections (witax) in Wisconsin. Because data on real GDP ended in 2017Q2, our forecasts start from 2017Q3.

Table 3: Growth Rates of Output, Income and Tax in Wisconsin: Median Forecasts

	wigdp	wipinc	witax
2017Q3	0.51	1.22	-1.70
2017Q4	0.29	2.13	-2.56
2018Q1	0.90	3.08	-2.92
2018Q2	0.70	3.86	-2.36
2018Q3	0.96	3.99	0.93
2018Q4	1.64	4.67	1.08

Figure 6: Year-on-Year Growth Rates of Output, Income and Tax in Wisconsin



Relative to 2016Q3, we forecast that the real GDP in 2017Q3 will grow by 0.51%. A slower growth is likely to occur in 2017Q4, but growth will then accelerate slightly over the next year so that the economy will grow by about 1.64% in 2018. We also forecast that personal income in Wisconsin will increase by about 4.67% in 2018, while the growth rate of (seasonally adjusted) tax collections will fluctuate around zero.

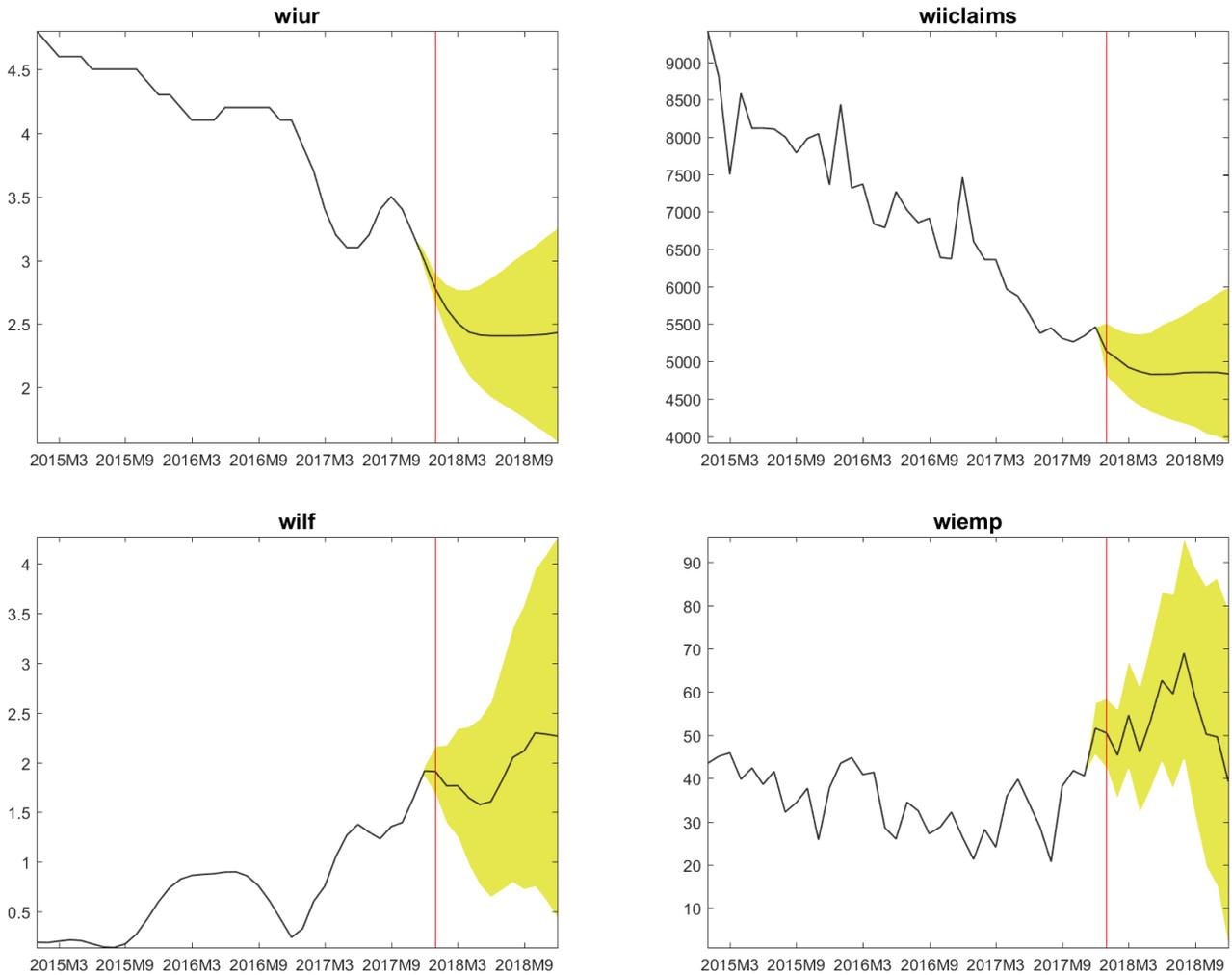
Overall, our forecasts suggest that the Wisconsin economy will continue its slow growth observed in the past few years into 2018. However, there is a risk that the economy will slow down, and the real GDP may decline by about 2%.

## 4.2 Labor Market

Figure 7 plots our forecasts for the Wisconsin labor market. The model forecasts that the unemployment rate (wiur) will remain low and may drop below 3% in 2018. Similarly, the (seasonally adjusted) number of initial unemployment insurance claims (wiiclaims) will decline from its current level of about 5,400 a month to about 4,800 a month. After having been basically flat for several years, the labor force in Wisconsin (wilf) has grown by roughly 2% over the past year, and

we project this growth to continue. This will support the continued growth in employment in the state, and we forecast that nonfarm payrolls (wiemp) will add 39,300 jobs in 2018.

Figure 7: Labor Market in Wisconsin

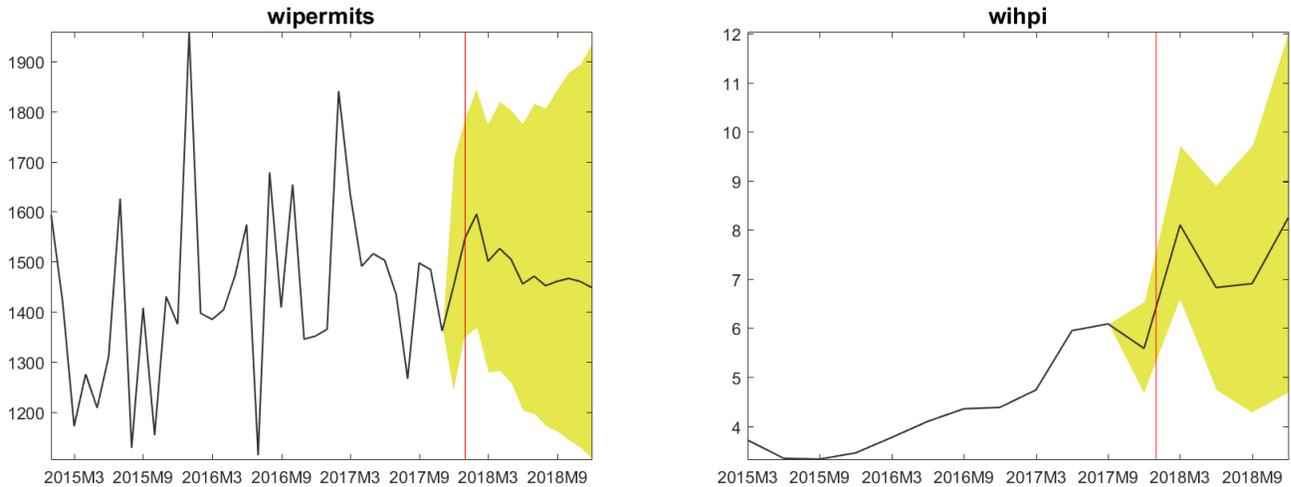


Despite these median forecasts, the model predicts that the Wisconsin labor market faces some substantial risks. In particular, the economy may only add about 10 thousand nonfarm jobs, and the chance that the unemployment rate will rise above its current level is over 18%.

### 4.3 Housing Market

Figure 8 reports our forecasts for the Wisconsin housing market. We forecast that the number of new private housing units authorized by building permits (wipermits) will remain around 1500, and the all-transactions housing price index (wihpi) will rise by about 8%.

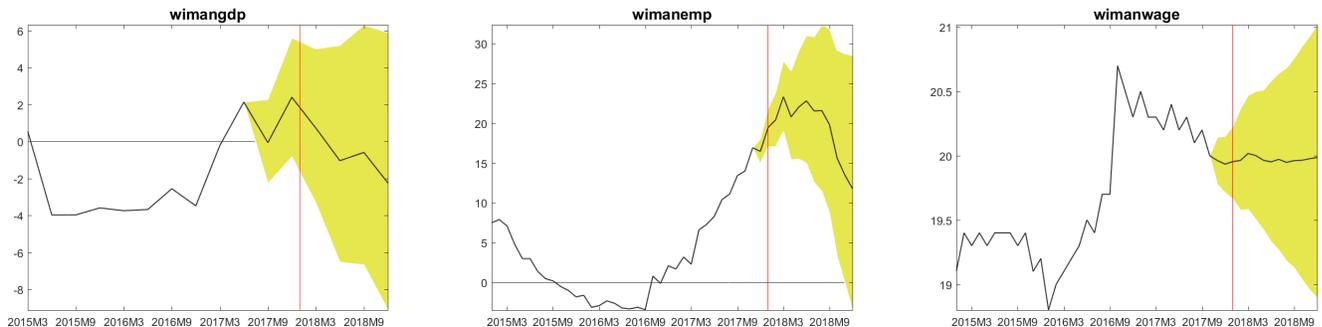
Figure 8: Housing Market in Wisconsin



#### 4.4 Manufacturing Sector

Figure 9 reports our forecasts for the Wisconsin manufacturing sector. While the manufacturing sector will continue to add about 11,800 jobs (*wimanemp*) in 2018, and the average hourly earnings of production employees will remain flat round \$20, we forecast that the manufacturing GDP will decline by about 2.2% in 2018, resulting in a smaller weight of manufacturing in the state economy. These forecasts continue recent trend in the manufacturing sector in the state: a rebound and continued growth in employment following the recession, coupled with relative stagnation or slight declines in output.

Figure 9: Manufacturing Sector in the Wisconsin



#### 4.5 Sensitivity

By including national variables into the state model, we can study the sensitivity of our state-level forecasts to the national economy. As an example, we generate forecasts of the growth rate of real GDP in Wisconsin under three different scenarios for the national economy, and compare them to our baseline forecasts.

As mentioned earlier in the paper, our forecasts for the state economy are calculated from 5,000 draws from the posterior distribution of the model parameters, where each draw is fed with a different path of national forecasts. Our baseline forecasts use all of the 5,000 draws. In each of the three scenarios, we use a different subset of draws to calculate the year-on-year growth rate of real GDP in Wisconsin. In the first scenario, we use only the draws where the national GDP grows by over 3% in 2018. In the second scenario, we use only the draws where the national GDP declines in both 2018Q1 and 2018Q2. Finally, in the third scenario, we use only the draws where the national unemployment rate rises above 4.5% by the end of 2018.

Table 4: Effect of National Economy on Forecasts of the Real GDP Growth Rate in Wisconsin  
Growth Rate of the Wisconsin GDP in 2018

Baseline	1.64
National GDP grows by over 3% in 2018	1.76
National GDP declines in the first two quarters of 2018	1.22
National unemployment rate rises above 4.5% in 2018	1.25

As reported in table 4, forecasts for the Wisconsin economy depend positively on our forecasts for the national economy: when the national economy grows by over 3% in 2018, real GDP in Wisconsin will grow by 1.76%, higher than the baseline forecast of 1.64%. On the other hand, when either the national economy declines in the first two quarters of 2018 or the national unemployment rate rises above 4.5%, the growth rate of real GDP in Wisconsin will decline to about 1.25%.

## 5 Conclusion

Overall, for both the US and Wisconsin economies, our median forecasts for 2018 are within the range of values observed in the past few years, suggesting that, in the absence of any significant shocks, both economies will continue on their trends in 2018. Although our forecasts do show that there is significant uncertainty and chance of a downside in 2018, we find relatively little chance of a substantial economic downturn either nationally or in Wisconsin.

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