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This writing sample is an assignment from Tim Duy's January - March 2022 EC 522 Economic Forecasting class. The prompt was to imagine myself as an analyst at a Capital Fund who has been tasked by a lead partner to predict whether the Fed will raise interest rates this year (2022). The lead partner has also specifically asked for the interest rate prediction to be linked to a job growth prediction.

The assignment description is repeated in its entirety below for your information and the writing sample itself begins on the following page.

You are an analyst at BigTree Capital. The lead partner reads an article that claims "February 2022 job growth will be 300,000, high enough to put downward pressure on unemployment and force the Federal Reserve to raise interest rates faster than anticipated." The partner is very worried by this analysis; they have bet that the Fed will not raise interest rates this year and they will need to redesign their portfolio if they suspect the Fed will raise interest rates.

The partner turns to you for analysis. First, they want a forecast for job growth for the next 12 months. Second, they want you to explain your confidence around that forecast. Third, they want your estimate of the probability that February 2022 job growth exceeds 300,000. Fourth, they want to know the implications of your forecast for monetary policy.

What they expect is a memo with four sections: 1. Introduction/explanation/literature review (under what conditions would the Fed care about strong job growth). 2. Methodology (how you will look at the question) 3. Results 4. Conclusions (on the basis of your forecast, is the Fed likely to change policy in the next year).

Per usual, the partner is a busy person. They only read the first 5 pages of anything you give them, so that's the page limit of any of your work. Some guidelines: You will create on ARMA model to generate your forecast. The series name is PAYEMS. You are forecasting the first difference (not the log difference). 1 inch margins, Arial, 11 point, single spaced lines.

Use only the following articles for your introduction/explanation/lit review/background

Bidder, Rhys, Mahedy, Tim, and Valletta, Rob, "Trend Job Growth: Where's Normal?" Federal Reserve Bank of San Francisco Economic Letter, October 24, 2016, https://www.frbsf.org/economic-research/publications/economic-letter/2016/october/trend-job-growth-where-is-normal/

Cambon, Sarah Chaney, and Rubin Gabriel T., "U.S. Jobs Surged by 467,000 in January as Economy Weathered Omicron" Wall Street Journal, February 4, 2022

Press Conference – Federal Open Market Committee, January 26, 2022, https://www.federalreserve.gov/monetarypolicy/fomcpresconf20220126.htm

Introduction

The Federal Reserve has the legally mandated goals of maximum employment, stable prices, and moderate long-term interest rates (federalreserve.gov). However, the goals of maximum employment and stable prices are often perceived to be in tension. The simple model is that to lure workers into jobs, employers raise wages but to fund higher wages they also raise prices. The Fed has interpreted the stable prices mandate as inflation expectations equal to an average of 2%. The primary tool used by the Fed in service of these goals is adjusting the interest rate paid by the Fed on banks' reserve balances. By adjusting the interest rate, the Fed makes it more or less expensive for banks, and thus businesses, to borrow money i.e., fund increasing levels of capital and employment.

The Fed cares about the number of jobs added each month as one piece of an indicator for full employment. More important than the overall number of jobs is the relationship between the number jobs and the number of job-seekers. Loosely interpreted, the goal of maximum employment is for economic growth to be unconstrained by labor shortages and for there to be jobs for everyone who wants one. High numbers of jobs added each month is a concern only if there are not enough workers because unfilled positions will become a constraint on the economic recovery. As of now, the labor force participation rate is still much lower than it was before the pandemic, which suggests that there is the potential for people to reenter the labor force to continue to fill job vacancies. If the ratio of positions to workers stays too high for too long it could be a sign of the economy "overheating" which could cause of inflation.

In his January 26 press conference, Chair Powell made clear that he and the board felt that the goal of maximum employment was being met and that they were turning their attention towards reducing inflation. The Fed has explicitly stated that they expect to begin raising interest rates "soon" although the exact timing and magnitude of the increase has not been decided. Chair Powell repeatedly referred to the speed of this recovery compared to past recoveries and pointed out the tighter labor market, higher inflation, and general strength of the economy. I take this to mean that we should not be surprised if interest rate hikes are higher, faster, or both compared to the recovery from the Great Recession.

Methodology

Job growth is measured as the month-to-month difference in seasonally adjusted nonfarm personnel. Figure 1 shows job growth between January 1984 and February 2020; Figure 2 shows job growth between February 2020 and January 2022. Growth was broken into two figures because the large drop in employment due to the pandemic expanded the y-axis to the point that the pre-pandemic structure was impossible to see. Recessions are shown as shaded grey bars.

Data prior to 1984 are excluded because the data generating process changed; macroeconomic data prior to the mid-1980's tends to be much more volatile than data after. The more volatile data is not relevant to our forecast and will only add uncertainty without adding predictive power. For this analysis we will assume that the fundamental mechanics of the economy remain consistent with the period between 1984 and the start of the pandemic.

When attempting to build the forecasting model it was found that the pandemic spike effectively "washed out" evidence of time dependence in that data. The spike was so large that the program was unable to detect any other structure in the data. To get around this problem, the model was trained excluding data from March 2020 to August 2020. These dates were identified by the automated outlier search contained within RATS. After excluding the outliers, an ARMA

{1,1} model was found to provide a reasonable model of the actual data since 1984. Figure 3 shows the time series of the residuals along with the autocorrelation and partial autocorrelation results, confirming that there is no further evidence of time dependence using this model. This ARMA {1,1} model was used as the forecast model.

Figure 1: Monthly Total Nonfarm Seasonally Adjusted Job Growth Pre-Pandemic

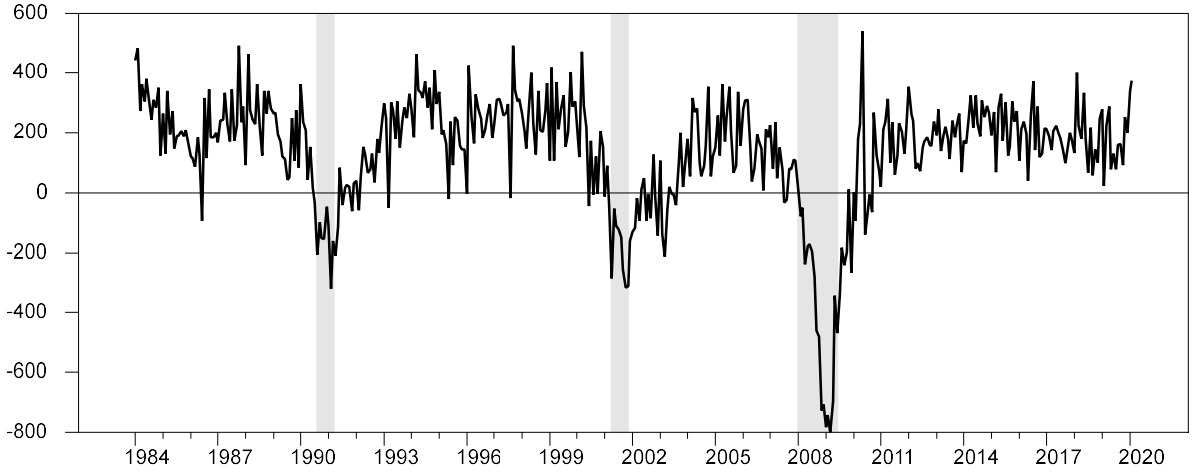


Figure 2: Monthly Total Nonfarm Seasonally Adjusted Job Growth Pandemic

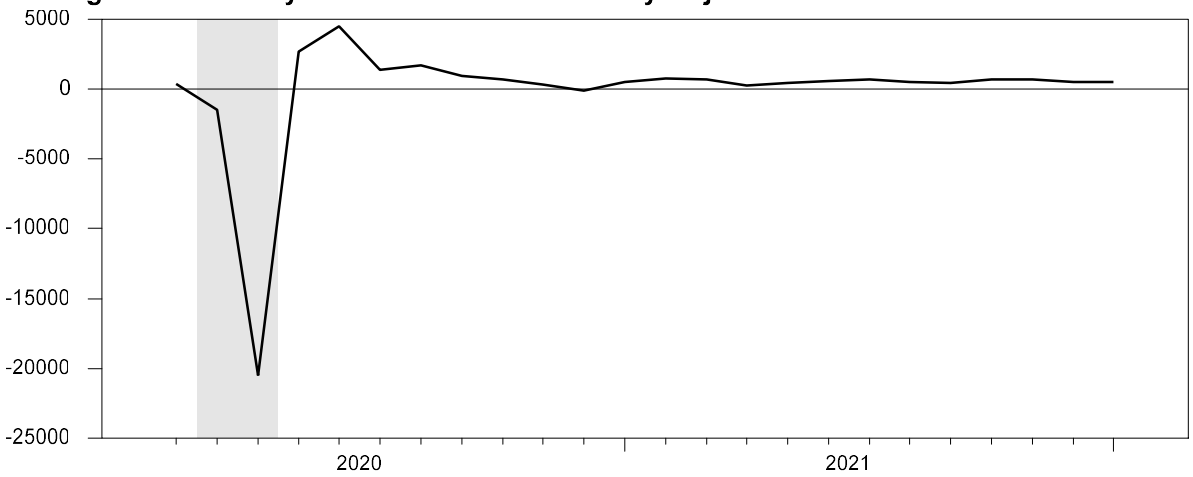
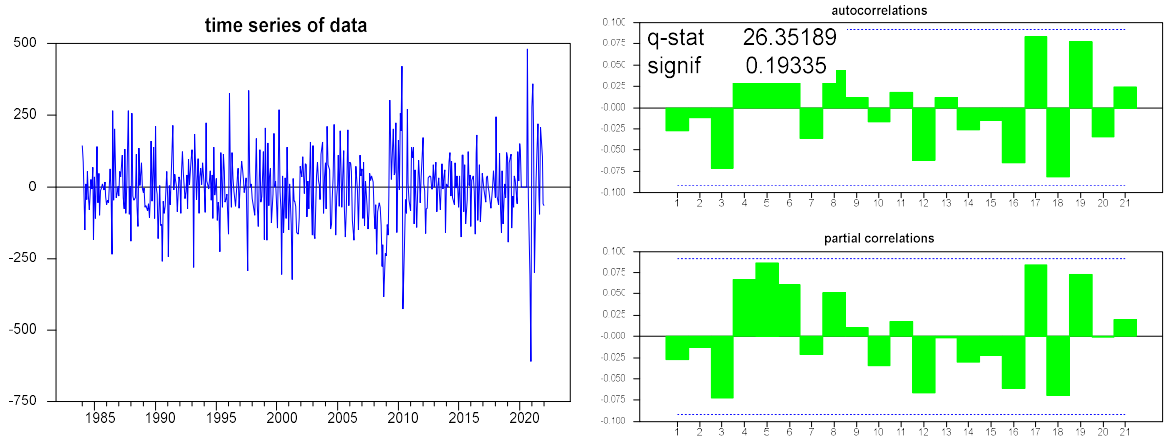


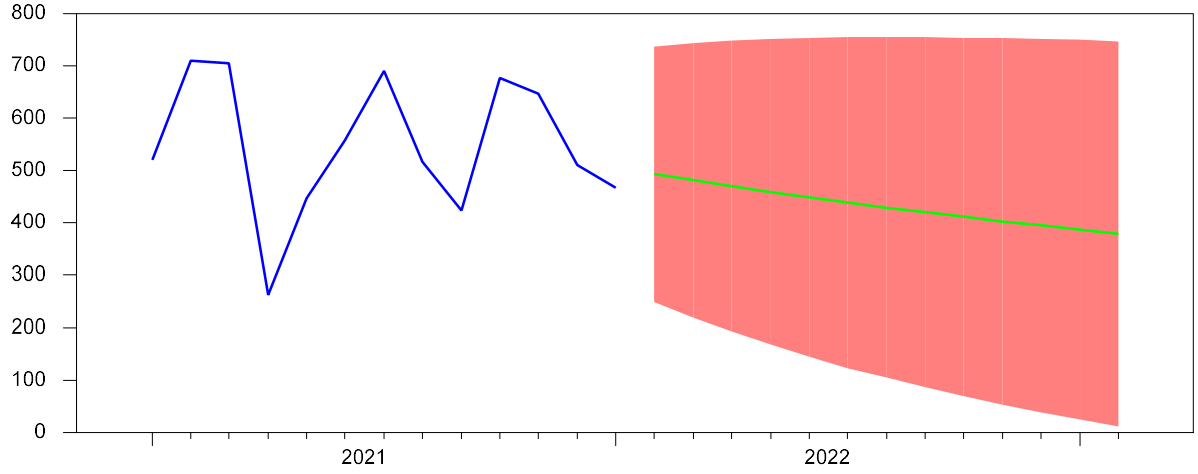
Figure 3: ARMA{1,1} Residuals



Results

Figure 4 shows the job growth forecast using the ARMA {1,1} model described in the Methods section. The blue line is actual data since January 2021, the green line is the forecast through February 2023, and the red shading represents the 95% confidence interval for the forecast.

Figure 4: ARMA{1,1} Forecast of Job Growth



The specific forecast for February 2022 is 492,839 +/- 124,189 jobs added. Given this model, the probability of the February 2022 jobs number being equal to or greater than 300k is ~94%.

We should be reasonably confident in the prediction of next month's job numbers. We should place much less confidence in the prediction going forward. This prediction makes the implicit assumption that everything keeps going essentially the way it has been going. However, the Fed has signaled that they are more concerned about inflation than the labor market so they are likely to respond with actions that may slow job growth below the rate predicted here. Therefore, I would treat this forecast more like an upper bound of expectations.

Conclusions

It is highly likely that job growth will be above 300,000 next month and likely that job growth will remain above average for a while going forward. However, high job growth numbers alone are not enough to cause the Fed to raise rates. The Fed is actively tracking labor market indicators and inflation, among other economic indicators to determine monetary policy. The strong job growth will only be concerning if the labor force participation rate does not recover causing unemployment to continue to fall.

The Fed has clearly signaled they are currently more concerned about inflation than about employment and that the Fed expects to begin raising rates soon. I believe the Fed will begin to raise rates later this year and I would not be surprised if rates are raised faster, higher, or both compared to the recovery from the Great Recession. However, Chair Powell did note that "monetary policy works on expectations" so nothing the Fed does should be a surprise. We will continue tracking the same economic indicators the Fed is tracking and we can expect the Fed to continue signaling its intentions.

References

Bidder, Rhys, Mahedy, Tim, and Valletta, Rob, "Trend Job Growth: Where's Normal?" Federal Reserve Bank of San Francisco Economic Letter, October 24, 2016, https://www.frbsf.org/economic-research/publications/economic-letter/2016/october/trend-job-growth-where-is-normal/

Cambon, Sarah Chaney, and Rubin Gabriel T., "U.S. Jobs Surged by 467,000 in January as Economy Weathered Omicron" Wall Street Journal, February 4, 2022

Press Conference – Federal Open Market Committee, January 26, 2022, https://www.federalreserve.gov/monetarypolicy/fomcpresconf20220126.htm

Appendix A: RATS Input

```
cal(m) 1900:1
all 2025:12
data(format=fred) * * PAYEMS USREC
* PAYEMS: All Employees, total nonfarm, monthly, seasonally adjusted

compute startdate = 1984:1
compute shockstart = 2020:3
compute shockend  = 2020:8
compute enddate   = 2022:1
compute forstart  = enddate+1
compute forend    = 2023:2

** calculate first difference
set DIFF = PAYEMS - PAYEMS{1}

** Look for time dependence
@autocorr(header="Monthly Nonfarm Job Growth") DIFF startdate enddate
** no time dependence because the pandemic spike is too large, it washes everything else out

**** graphs looking at various time windows
graph(header="Figure 1: Monthly Total Nonfarm Seasonally Adjusted Job Growth Pre-
Pandemic",shading=usrec) 1
#DIFF startdate shockstart-1

graph(header="Figure 2: Monthly Total Nonfarm Seasonally Adjusted Job Growth
Pandemic",shading=usrec) 1
#DIFF shockstart-1 enddate

**** Create indicator which only zeros out Pandemic shock
set PANDEMIC startdate forend = 1.0
set PANDEMIC shockstart shockend = 0.0

********** PRE PANDEMIC MODELS
** Look for time dependence Pre Pandemic
@autocorr(header="Monthly Nonfarm Job Growth Pre-Pandemic") DIFF startdate shockstart-1
*** evidence of time dependecy present
*** partial corr suggest no more than AR(3)
*** choppyness of decay in autocorr suggests some level of MA

@bjautofit(pmax=5, qmax=5, crit=sbc) DIFF startdate shockstart-1
@bjautofit(pmax=5, qmax=5, crit=aic) DIFF startdate shockstart-1
*** SIC results suggest 1,1, AIC results suggest 5, 2

* evaluate pre-pandemic models
boxjenk(constant,ar=2,ma=1,define=prepanmod) DIFF startdate shockstart-1 resids
@armaroots(equation=prepanmod) DIFF
@regactfit
@autocorr(header="ARMA{2,1} Pre-Pandemic Residuals") resids startdate shockstart-1
@histogram2(stats,counts) resids startdate shockstart-1
```

* (5,2) doesn't converge
* (1,1) converges but continues to show evidence of time dependence p~4%, non-normal resids, high value for AR root
* (2,1) converges, no evidence of time dependence, non-normal resids, high value for AR(2) root
* additional terms show no advantages over (2,1), just add unecessary complexity
* tried (2,2) (3,1) (3,2)
* (2,1) is the best Pre PANDEMIC model

********** Full date range models with pandemic dummyed out
boxjenk(constant,ar=1,ma=1,define=dummod,smpl=PANDEMIC,maxl) DIFF startdate enddate resids
@armaroots(equation=dummod) DIFF
@regactfit
@autocorr(header="Figure 3: ARMA{1,1} Residuals") resids startdate enddate
@histogram2(stats,counts) resids startdate enddate

* (1,1) converges, no evidence of time dependence, non-normal resids, high value for AR(2) root * will use a 1,1 model

********** forecast model from dummied model
uforecast(equation=dummod,from=forstart,to=forend,stderrs=sterr2) fore2
set upper2 forstart forend = fore2 + 1.96*(sterr2)
set lower2 forstart forend = fore2 - 1.96*(sterr2)

graph(header="Figure 4: ARMA{1,1} Forecast of Job Growth",$
style=line,overlay=fan,ovcount=2,ovsame) 4
# DIFF 2021:1 * 2
# fore2 * forend 3
# upper2 * forend 4
# lower2 * forend 4

*** Feb 2022 forecast
display "forecast for 2022:2" fore2(2022:2) "+/-" sterr2(2022:2)

***probability the actual exceeds a particular value
compute probrmore = (1 - %cdf((300-fore2(2022:2))/sterr2(2022:2)))
display "probability that actual outcome is equal to or more than 300k" probrmore