

Finance in Montana

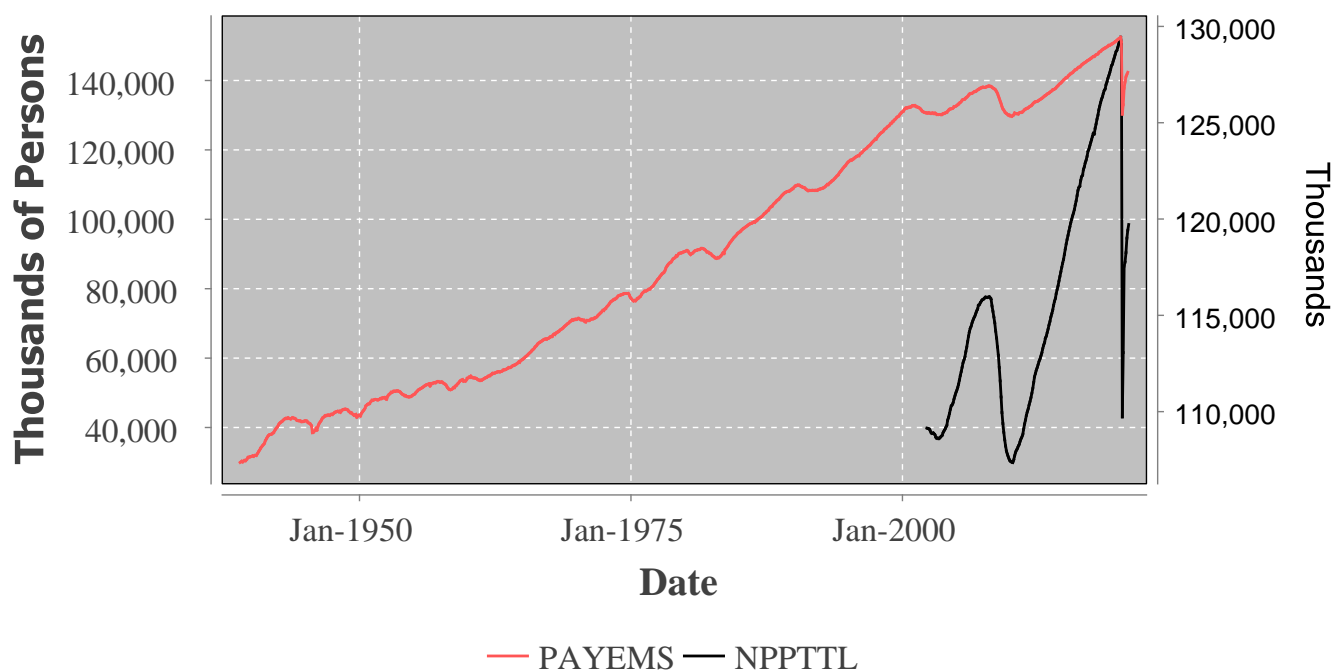
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This week's release of ADP's [Total Nonfarm Private Payroll Employment](#) and the last week's release of [Industrial Production: Total Index](#) allows us to easily forecast the [All Employees, Total Nonfarm](#) for this coming Friday. My forecast is 142,864 Or a net change of 491.089 thousand. The consensus estimate on the site, [Trading Economics](#), is 587k.

All Employees, Total Nonfarm vs. Total Nonfarm Private Payroll Employment



I arrived at the above estimate using a combination of arima models and a multivariate regression on the arima residuals. Arima models are good but we can do better when knowing the residual errors from recently released economic data.

First, we will use the 'forecast' package of R to auto generate [Arima Models](#) for our three data series. The number of observations for each series are dissimilar as we want to use as much data as possible. We will restrict the data to the same time period when doing the regression on Arima residuals.

Series: PAYEMS

ARIMA(0,1,0)

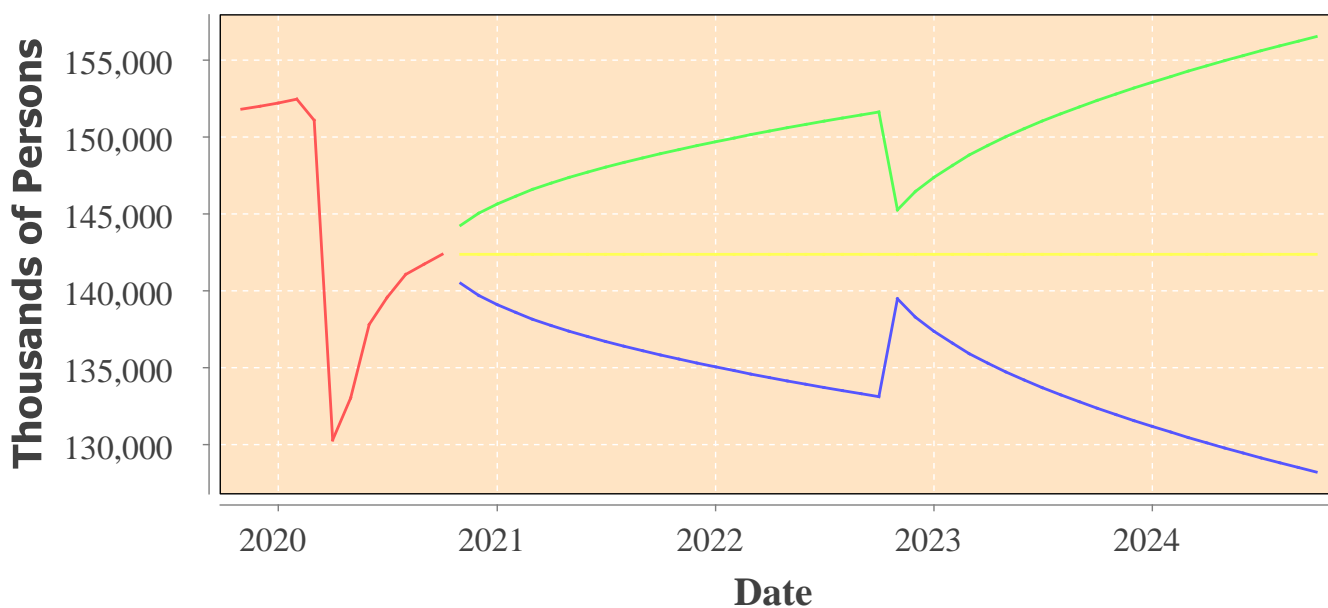
sigma^2 estimated as 2173535.056: log likelihood=-1934.7

AIC=3871.39 AICc=3871.41 BIC=3874.8

Training set error measures:

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	53.2763360299937	1470.982073875809	340.406380873043	0.03330454434769	0.25079601736596	0.13317637201149
		0.13317637201149	0.01361183875812			

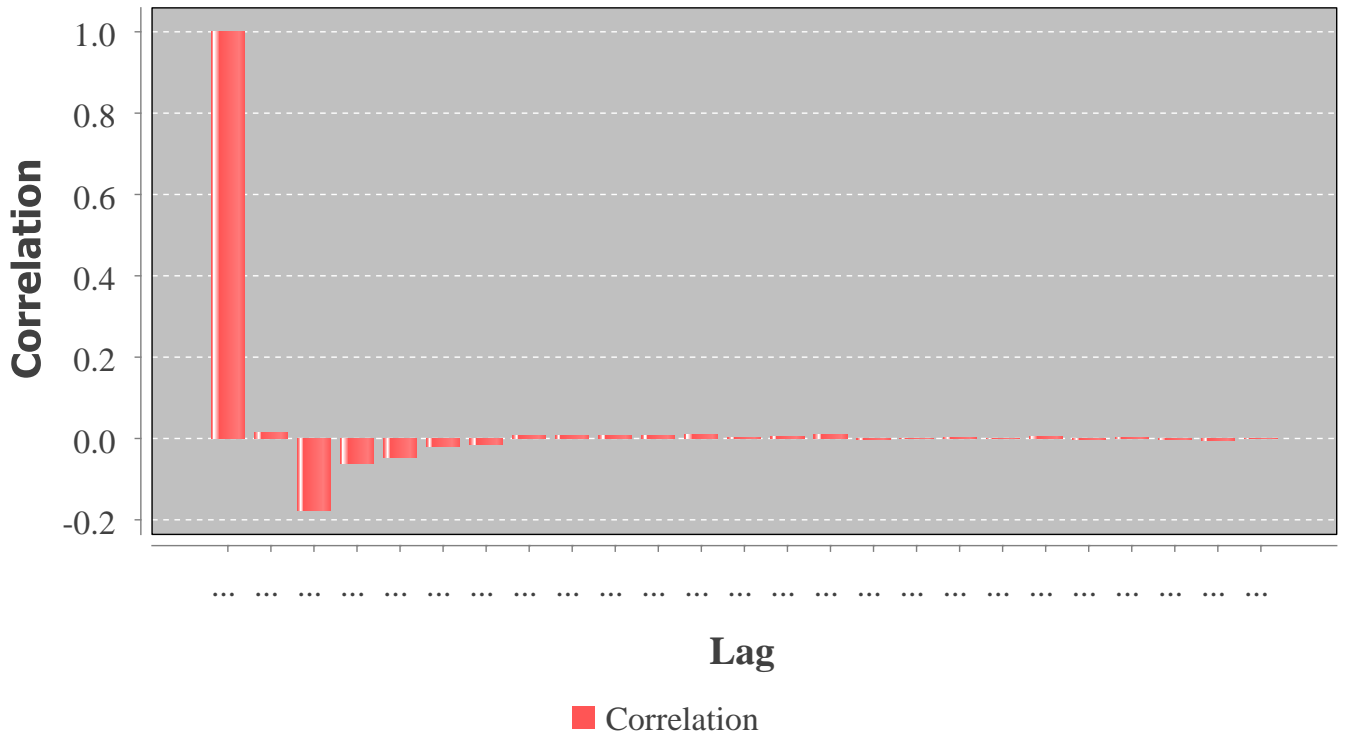
All Employees, Total Nonfarm



— PAYEMS — PAYEMS_Forecast_Lower — PAYEMS_Forecast_Upper
 — PAYEMS_Forecast_Mean_LU

Item	Value	2020-11-01	2020-12-01	2021-01-01	2021-02-01	2021-03-01	2021-04-01
Std Error	1,473.32						
R2	0.95						
Method	ARIMA(0,1,0)						
All Employees, Total Nonfarm_Forecast_Upper		144,262	145,045	145,646	146,152	146,598	147,001
All Employees, Total Nonfarm_Forecast_Mean_LU		142,373	142,373	142,373	142,373	142,373	142,373
All Employees, Total Nonfarm_Forecast_Lower		140,484	139,701	139,100	138,594	138,148	137,745

Residual Autocorrelation



Series: INDPRO

ARIMA(0,1,2)

Coefficients:

ma1 ma2

0.3638 -0.0528

s.e. 0.0739 0.072

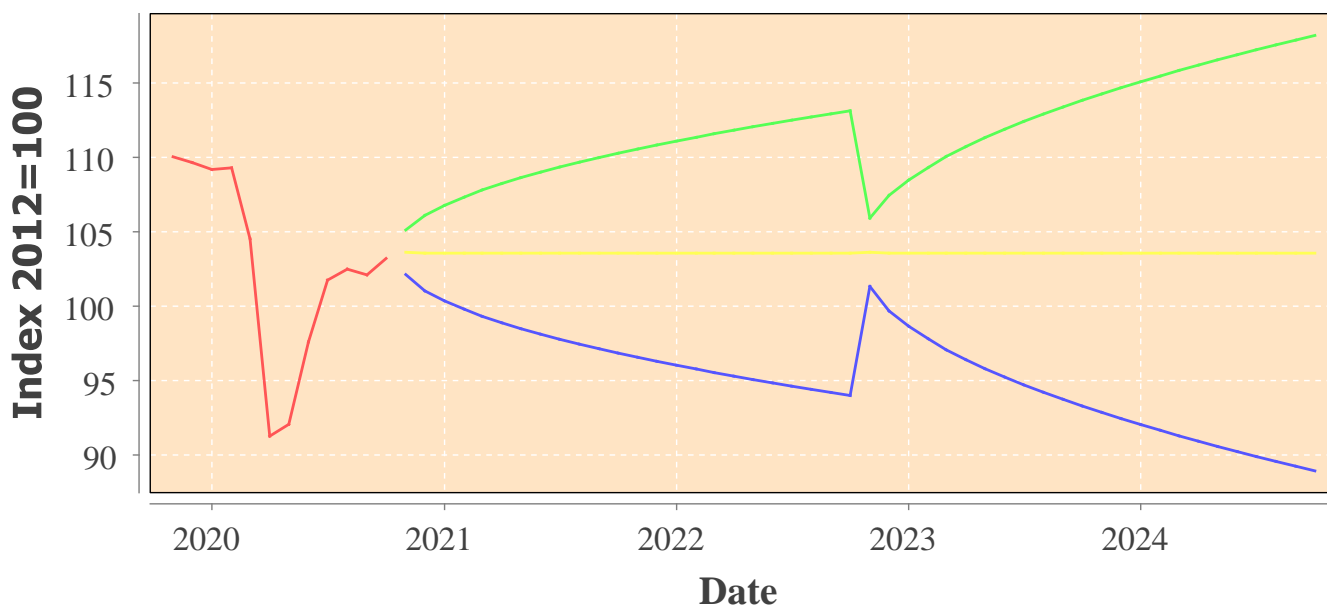
sigma^2 estimated as 1.37: log likelihood=-349.03

AIC=704.05 AICc=704.16 BIC=714.26

Training set error measures:

ME RMSE MAE MPE MAPE MASE ACF1
Training set 0.03930837923219 1.1625796292515 0.60788250210752 0.03529310388048
0.61534570420277 0.17303954304549 0.00861373895658

Industrial Production: Total Index

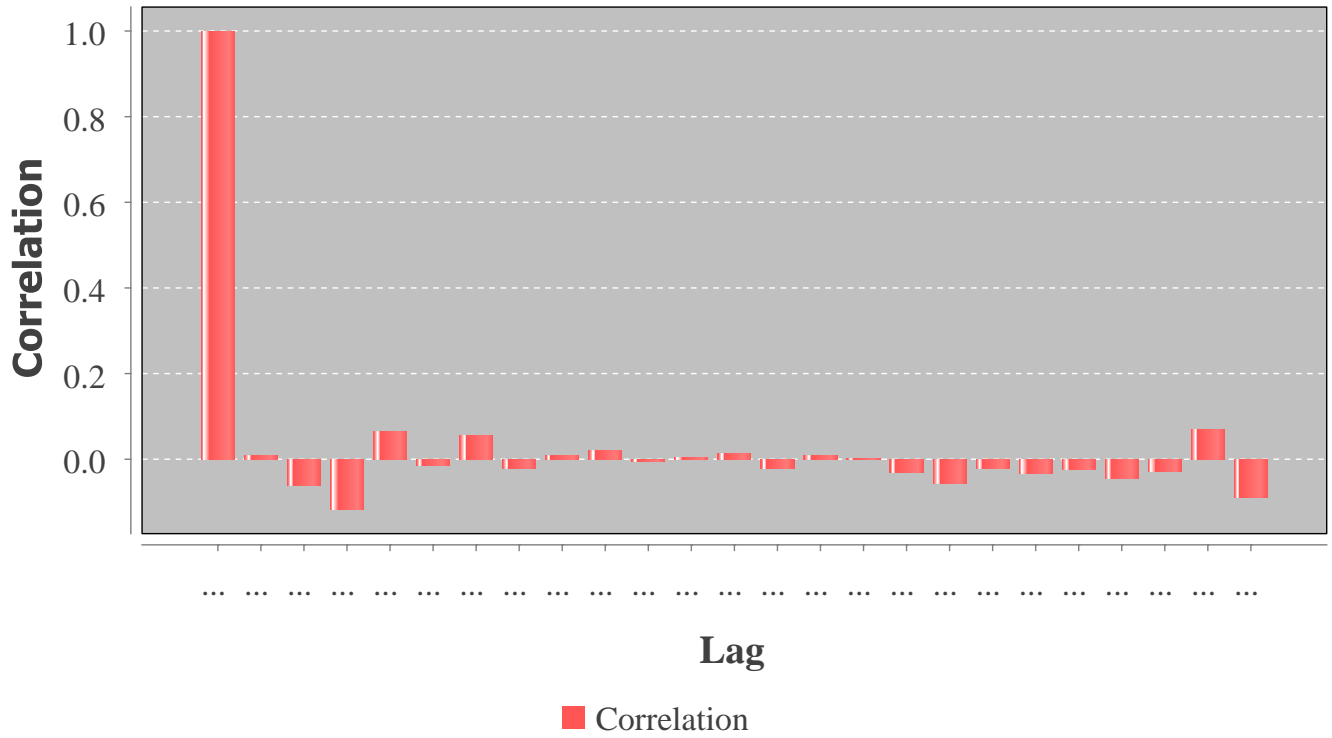


— INDPRO — INDPRO_Forecast_Lower — INDPRO_Forecast_Upper
— INDPRO_Forecast_Mean_LU

Item	Value	2020-11-01	2020-12-01	2021-01-01	2021-02-01	2021-03-01	2021-04-01
Std Error	1.165						
R2	0.955						
Method	ARIMA(0,1,2)						
Industrial Production: Total Index_Forecast_Upper		105.123	106.1	106.773	107.327	107.81	108.243
Industrial Production: Total Index_Forecast_Mean_LU		103.623	103.563	103.563	103.563	103.563	103.563

Item	Value	2020-11-01	2020-12-01	2021-01-01	2021-02-01	2021-03-01	2021-04-01
Industrial Production: Total Index_Forecast_Lower		102.123	101.026	100.353	99.799	99.316	98.883

Residual Autocorrelation



Series: NPPTTL

ARIMA(0,1,0)

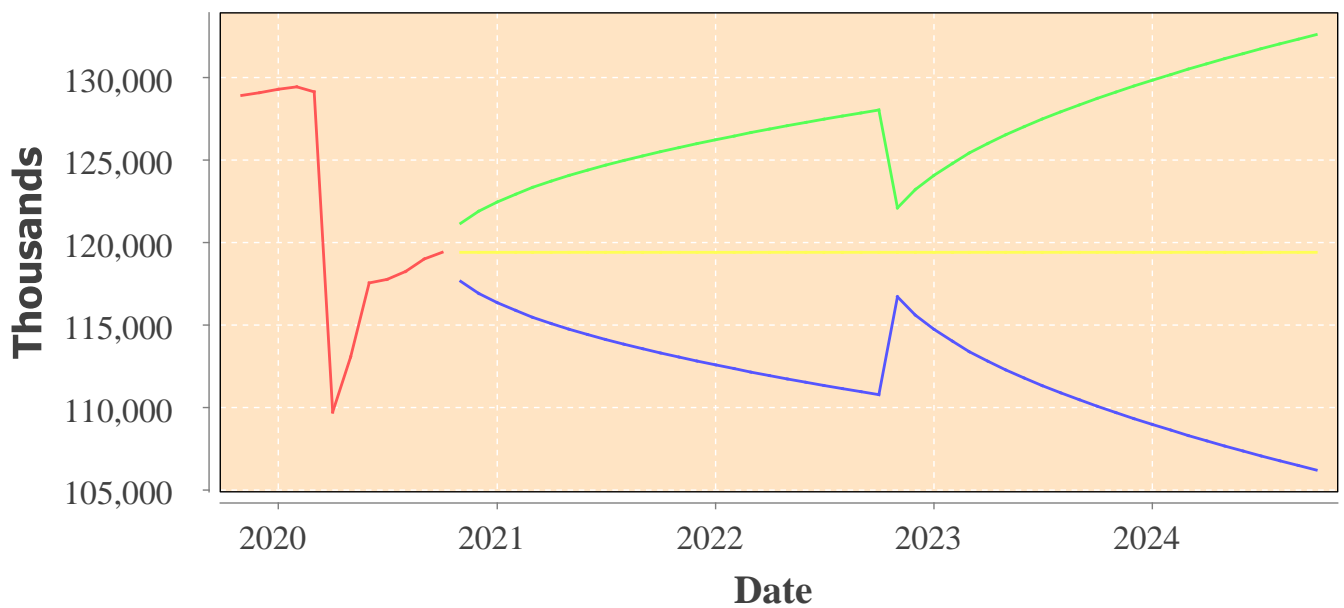
sigma^2 estimated as 1888314.013: log likelihood=-1919.08

AIC=3840.17 AICc=3840.19 BIC=3843.57

Training set error measures:

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	46.52060095707824	1371.0748472135256	305.9640359346574			
	0.03374663968678	0.26878537349576	0.1232764492577	-0.0793710877463		

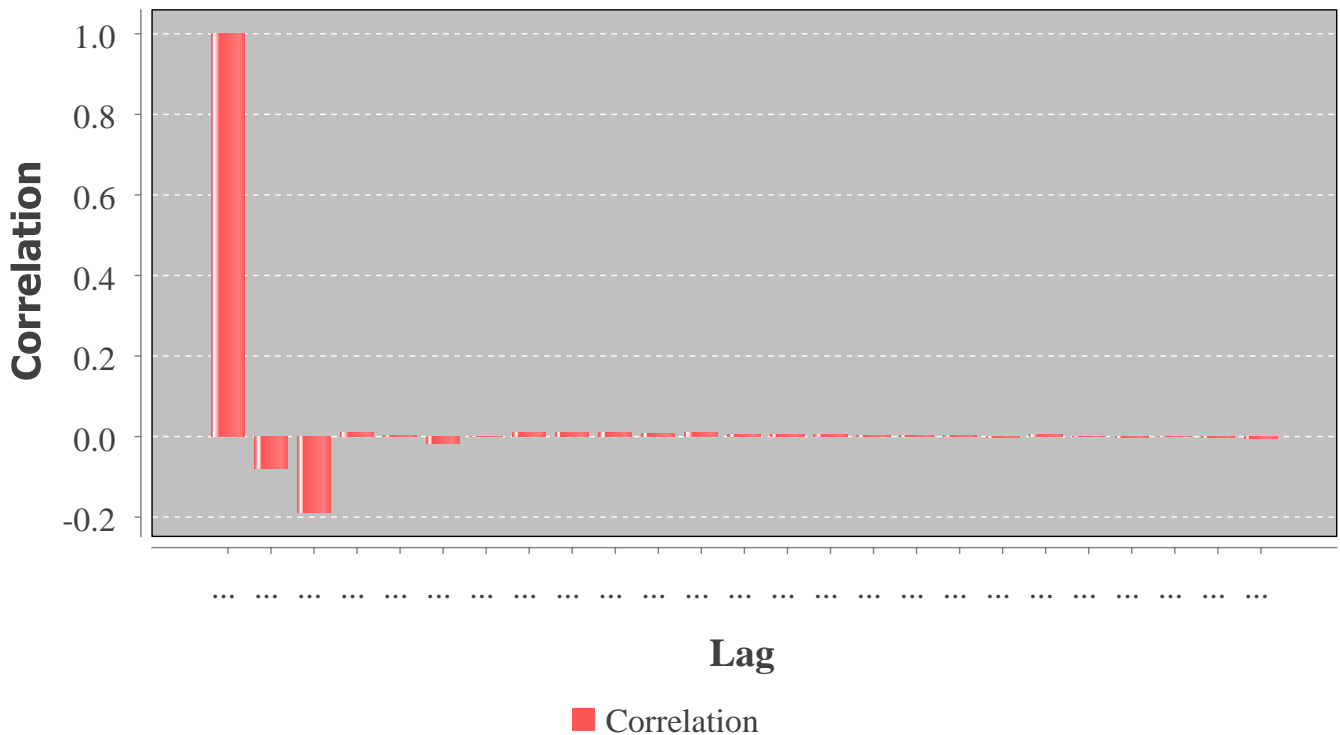
Total Nonfarm Private Payroll Employment



— NPPTTL — NPPTTL_Forecast_Lower — NPPTTL_Forecast_Upper
 — NPPTTL_Forecast_Mean_LU

Item	Value	2020-11-01	2020-12-01	2021-01-01	2021-02-01	2021-03-01	2021-04-01
Std Error	1,373.37						
R2	0.953						
Method	ARIMA(0,1,0)						
Total Nonfarm Private Payroll Employment_Forecast_Upper		121,169	121,899	122,458	122,930	123,346	123,722
Total Nonfarm Private Payroll Employment_Forecast_Mean_LU		119,408	119,408	119,408	119,408	119,408	119,408
Total Nonfarm Private Payroll Employment_Forecast_Lower		117,647	116,918	116,358	115,886	115,470	115,094

Residual Autocorrelation

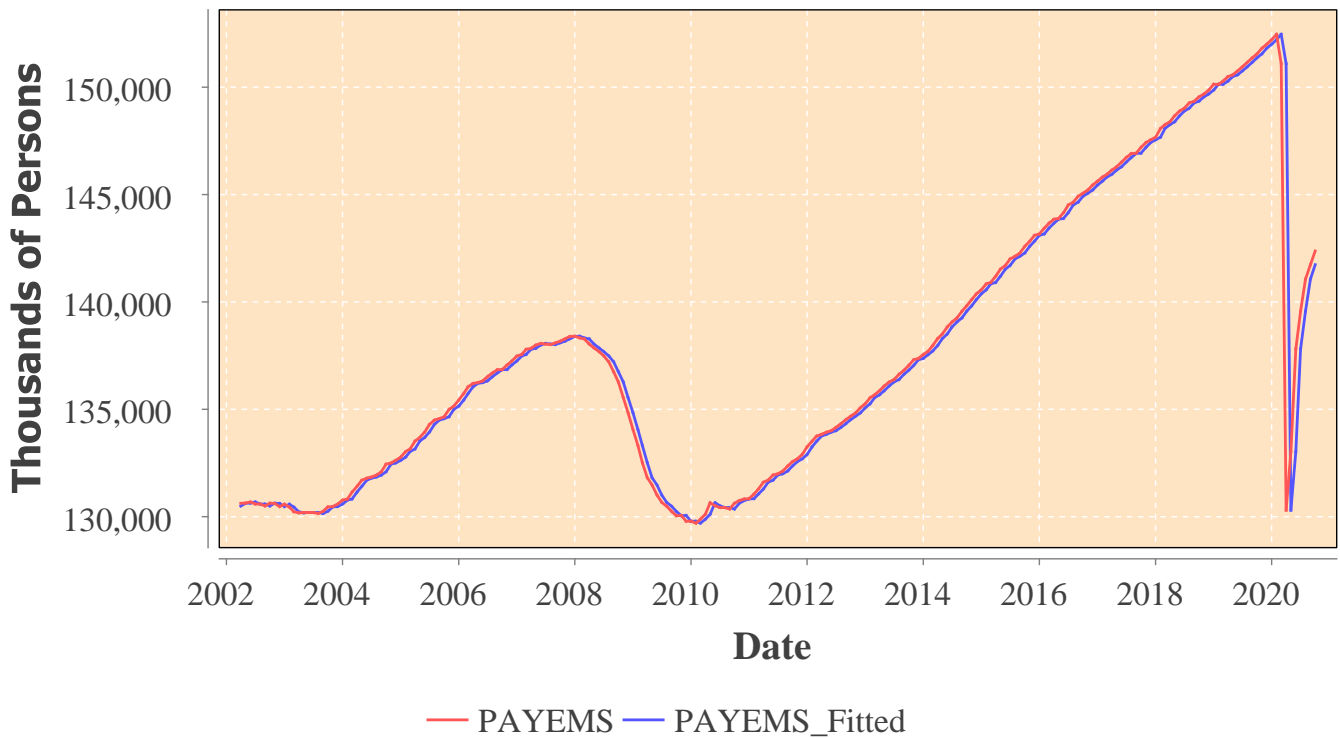


Now let's create a simple linear regression of the errors from each Arima model. Arima residual's are somewhat stationary after Arima filtering so we can be confident of our beta estimates. In fact, our beta coefficients are quite significant -- and should be for obvious reasons.

Name	Beta	Std.Error	T-Stat
Constant	3.071	11.321	0.271
INDPRO_Residuals	66.078	14.596	4.527
NPPTTL_Residuals	1.023	0.012	82.686
RSq	0.987		
AdjRSq	0.987		
DW Stat	1.55		

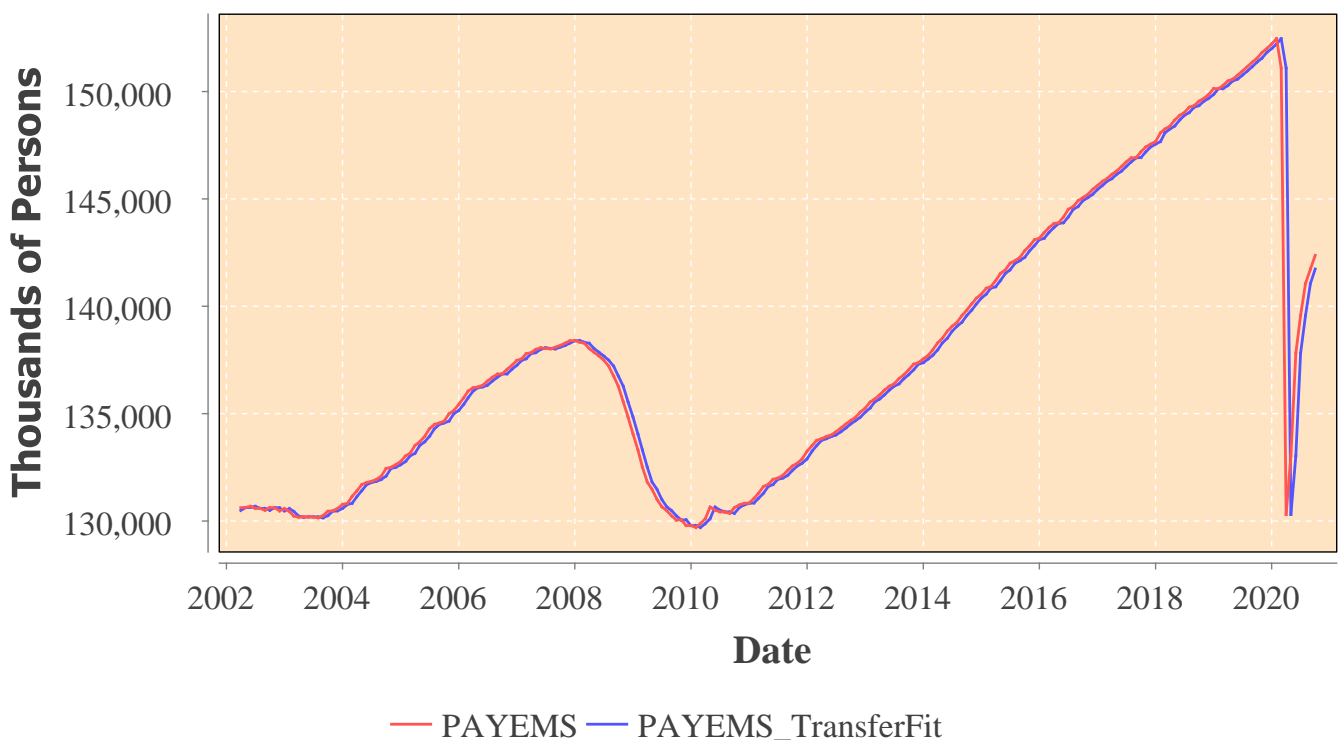
Below is the Arima fit for PAYEMS.

All Employees, Total Nonfarm



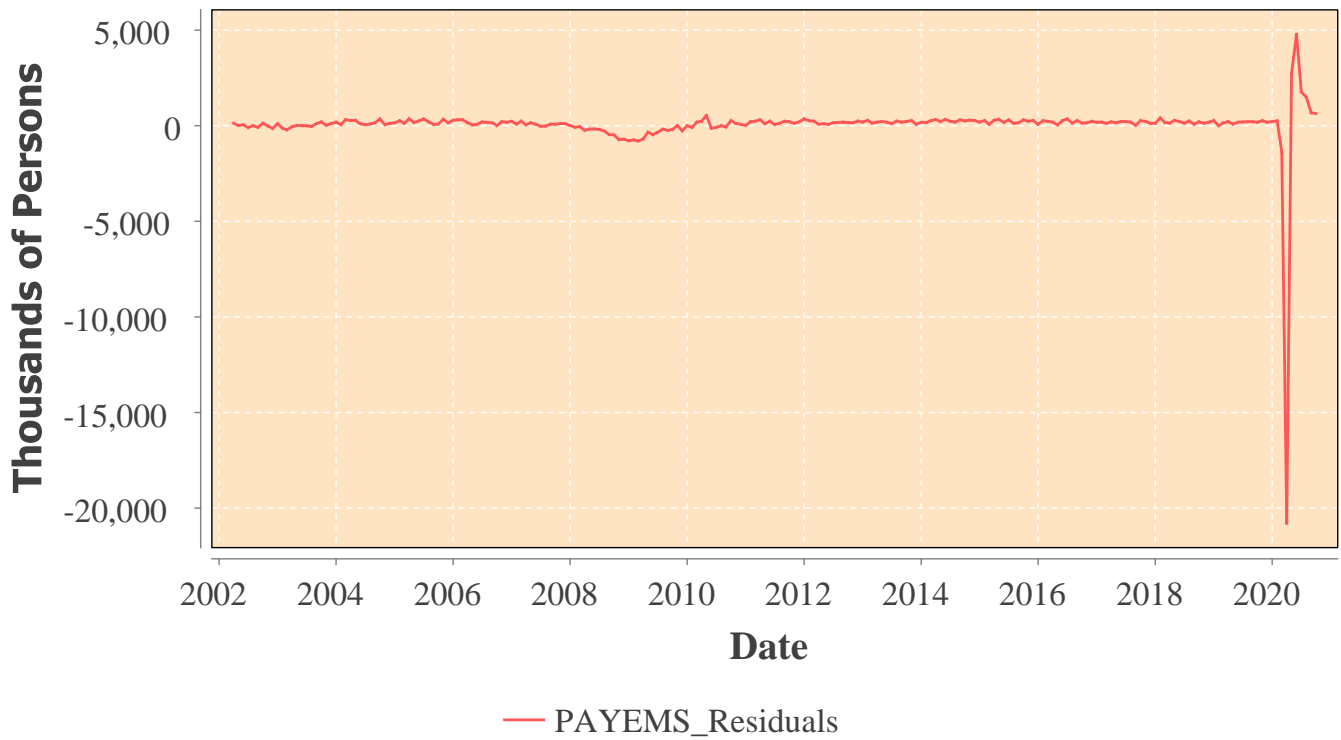
Below is the regression adjusted fit for PAYEMS.

All Employees, Total Nonfarm

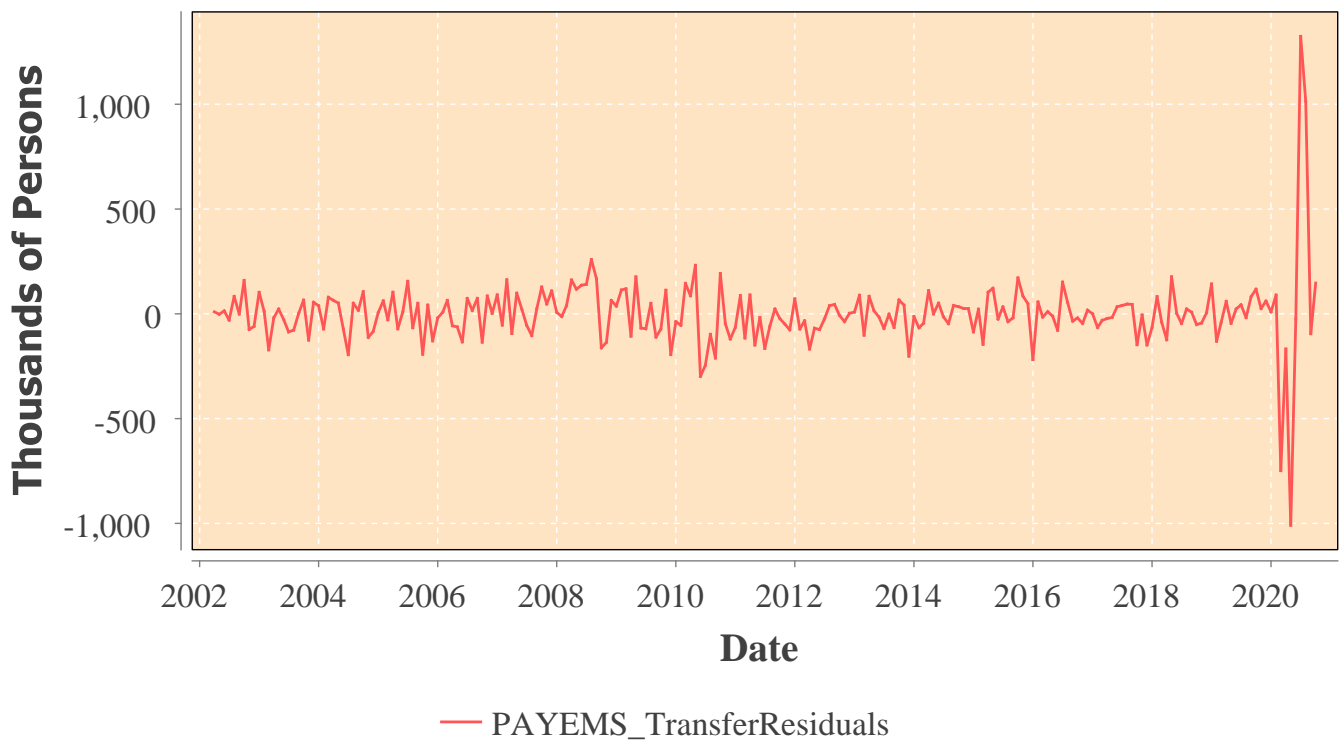


Note how including the information from our two regressors substantially reduces the outliers of a pure arima analysis. The reduction is illustrated in the two charts below.

All Employees, Total Nonfarm_Residuals



All Employees, Total Nonfarm_TransferResiduals



Cheers and stay healthy this Holiday Season.