Employment and GDP

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Abstract

In economics, there is a simple, empirical-observed relation which states that the increase in aggregate output will lead to the decline in unemployment rate. In this research, I take advantage of the statistics of employment and GDP in the state level to find out whether the rule exists or not. And the main finding is that only those state with high employment or GDP growth rate support this hypothesis.

1 Introduction

Okun's law or Okun's rule of thumb is an empirical conclusion rather than the theoretical results. In original statements by Arthur Melvin Oken in 1962, a 2% increase in output corresponds to 1 % decline in the rate of cyclical unemployment. And the intuition is straight-forward: the increase in output will need more labor force. Although the rule seems to be reasonable, it can not be observed everywhere, for example, China has different situation since the unemployment is only counted within city. In the following section, I will pick 4 states which the employment or GDP growth rate are either highest or lowest to see whether the rule exists or not. The 4 states are West Virginia, Utah, Louisiana and North Dakota. West Virginia has the lowest average employment growth rate while Utah has the highest from 1997 to 2021. In another aspect, Louisiana has the lowest average GDP growth rate while North Dakota has the highest from 1997 to 2021. The reason to check both the highest and lowest GDP and employment growth rate is that the Okun's rule seems to only exist in high GDP or employment growth rate which can be observed in the figure in the reference section.

VARIABLES	(1) lag_corr	(2) lag_corr	(3) lag_corr
emp_gr	0.148***		0.0889
	(0.0312)		(0.0581)
gdp_gr		0.104***	0.0556
		(0.0277)	(0.0491)
Constant	0.0650	0.00650	0.0135
	(0.0443)	(0.0616)	(0.0671)
Observations	60	60	60
R-squared	0.205	0.198	0.229

Robust standard errors in parentheses

After Perform simple linear regression and the samples are the states in U.S.A, we can observe that if a state's employment rate increase by 1% the correlation coefficient between employment growth rate and lag 1 period GDP growth rate will increase 0.148. Condition is much alike in terms of real GDP growth rate. Since the employment growth rate and real GDP growth rate is highly correlated, coefficients in regression are not significant. My interpretation of this phenomenon is that maybe the states with high GDP growth rate or employment growth rate are those in developed and thus the industries of the state are more labor-intensive. And it makes sense that the employment of a state where the industries are labor-intensive is highly correlated with its GDP.

2 Case Study

2.1 minimum average employment growth rate: West Virginia

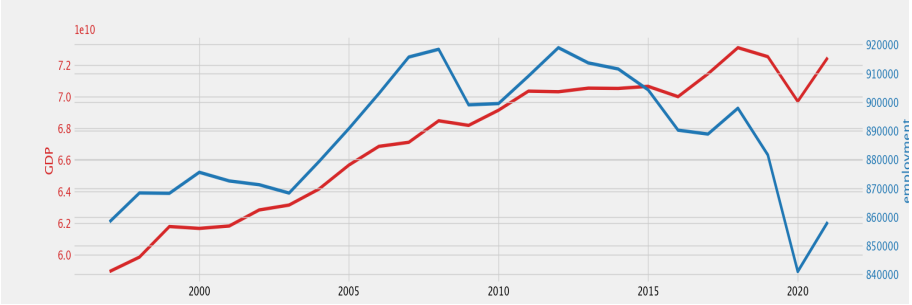

Figure 1: Real GDP and Employment of West Virginia

VARIABLES	(1) emp_gr	(2) emp_gr	(3) emp_gr	(4) emp_gr	(5) emp_gr
L.gdp_gr	0.0776				
	(0.212)				
L.emp_gr		0.0806	0.264		0.362
		(0.224)	(0.246)		(0.263)
L2.emp_gr			-0.584*	-0.433	-0.774**
			(0.333)	(0.303)	(0.365)
L3.emp_gr					0.313
					(0.360)
Constant	-0.0982	-0.0342	0.0684	0.0135	-0.0414
	(0.352)	(0.315)	(0.320)	(0.317)	(0.331)
Observations	23	23	22	22	21
R-squared	0.006	0.006	0.145	0.093	0.215

Standard errors in parentheses

2.2 minimum average GDP growth rate: Louisiana

VARIABLES	(1) emp_gr	(2) emp_gr	(3) emp_gr	(4) emp_gr	(5) emp_gr
L.gdp_gr	-0.110				
	(0.0955)				
L.emp_gr		0.0491		0.168	0.272
		(0.217)		(0.215)	(0.240)
L2.emp_gr			-0.605*	-0.667**	-0.849**
			(0.292)	(0.305)	(0.326)
L3.emp_gr					0.291
					(0.340)
Constant	0.598*	0.515	1.012**	0.979**	0.733
	(0.322)	(0.350)	(0.388)	(0.394)	(0.474)
Observations	23	23	22	22	21
R-squared	0.060	0.002	0.177	0.202	0.287

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the above two states, West Virginia and Louisiana the lag 1 GDP explanatory variable is not significant and the most explanatory variable is the lag 2 employment. However, In the next two states, Utah and North Dakota the lag 1 GDP explanatory variable is the most explanatory and also significant. Notice that the Utah has the highest average employment growth rate and North Dakota has the highest average GDP growth rate.So I conclude that the Oken's rule of thumb only holds within those states with high average employment or GDP growth rate. For more information(stationary, q test) check the reference.

2.3 maximum average employment growth rate: Utah

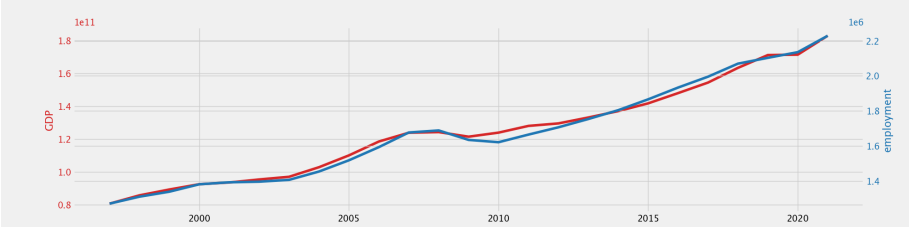

Figure 2: Real GDP and Employment of Utah

	(1)	(2)	(3)	(4)	(5)
VARIABLES	emp_gr	emp_gr	emp_gr	emp_gr	emp_gr
L.gdp_gr	0.439***	0.576***	0.579***	0.451***	0.392*
	(0.151)	(0.155)	(0.181)	(0.144)	(0.194)
L2.emp_gr		-0.371*			
		(0.187)			
L2.gdp_gr			-0.206		0.115
			(0.182)		(0.244)
L3.gdp_gr				-0.358**	-0.425*
				(0.146)	(0.206)
Constant	0.885	1.377**	1.221	2.125**	2.156**
	(0.620)	(0.646)	(0.711)	(0.781)	(0.801)
Observations	23	22	22	21	21
R-squared	0.286	0.431	0.357	0.483	0.489

Standard errors in parentheses

2.4 maximum average employment growth rate: North Dakota

	(1)	(2)	(3)	(4)	(5)
VARIABLES	emp_gr	emp_gr	emp_gr	emp_gr	emp_gr
L.gdp_gr	0.213**	0.231**	0.199**	0.230**	0.212**
	(0.0814)	(0.0927)	(0.0870)	(0.0891)	(0.0927)
L2.emp_gr		-0.0895			
		(0.239)			
L2.gdp_gr			0.0673		0.0781
			(0.0902)		(0.0962)
L3.gdp_gr				-0.0498	-0.0651
				(0.0925)	(0.0953)
Constant	0.311	0.429	0.134	0.498	0.305
	(0.559)	(0.613)	(0.653)	(0.708)	(0.753)
Observations	23	22	22	21	21
R-squared	0.246	0.260	0.276	0.270	0.298

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3 Reference

3.1 more plots

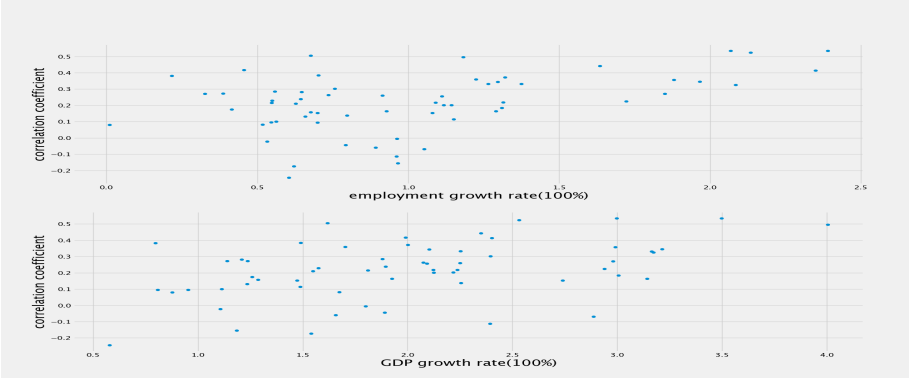

Figure 3: Correlation coefficient between employment growth rate and lag 1 period GDP growth rate versus employment and real GDP growth rate

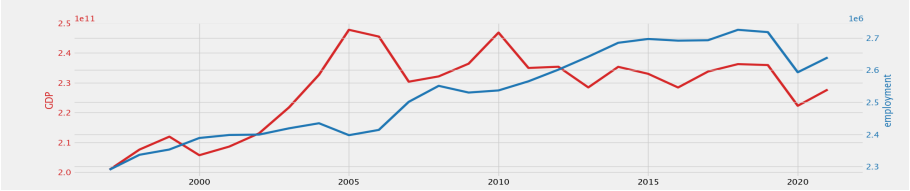

Figure 4: Real GDP and Employment of Louisiana

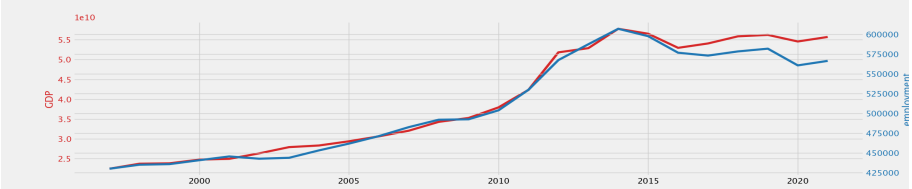

Figure 5: Real GDP and Employment of North Dakota

3.2 Stationary Test

3.2.1 West Virginia

ADF test for employment growth rate:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-4.096	-3.750	-3.0	-2.63

DF-GLS test for employment growth rate with no trend, max lag=3:

[lags]	mu Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
3	-1.268	-2.660	-2.396	-2.055
2	-1.773	-2.660	-2.462	-2.121
1	-3.739	-2.660	-2.528	-2.183

ADF test for employment growth rate with lag 1 period:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-4.125	-3.750	-3.0	-2.63

3.2.2 Louisiana

ADF test for employment growth rate:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-4.391	-3.750	-3.0	-2.63

DF-GLS test for employment growth rate with no trend, max lag=5:

[lags]	mu Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
3	-1.744	-2.660	-2.396	-2.055
2	-1.843	-2.660	-2.462	-2.121
1	-4.113	-2.660	-2.528	-2.183

ADF test for employment growth rate with lag 1 period:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-4.613	-3.750	-3.0	-2.63

3.2.3 Utah

ADF test for employment growth rate:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-2.535	-3.750	-3.0	-2.63

DF-GLS test for employment growth rate with no trend, max lag=5:

[lags]	mu Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
5	-1.976	-3.770	-2.947	-2.555
4	-2.580	-3.770	-3.052	-2.678
3	-3.319	-3.770	-3.194	-2.824
3	-2.629	-3.770	-3.347	-2.972
1	-4.180	-3.770	-3.485	-3.10

ADF test for employment growth rate with lag 3 period:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-2.964	-3.750	-3.0	-2.63

3.2.4 North Dakota

ADF test for employment growth rate:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-2.528	-3.750	-3.0	-2.63

DF-GLS test for employment growth rate with no trend, max lag=5:

[lags]	mu Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
3	-1.843	-2.660	-2.396	-2.055
2	-2.213	-2.660	-2.462	-2.121
1	-2.632	-2.660	-2.528	-2.183

ADF test for employment growth rate with lag 1 period:

Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
-2.721	-3.750	-3.0	-2.63

3.3 White noise test

Portmanteau (Q) test for white noise
null hypothesis: the residual is white noise
note: all the models are chosen from the last result, ex: select AR(3) for Louisiana

state	p-value
West Virginia	0.9944
Louisiana	0.9987
Utah	0.6861
North Dakota	0.3735