

- 1.
2. Seasonal Patterns
 - a. After generating our seasonal dummy variable and computing the regression of g_{cem} on $L(0/10)$ we have the following results seen in Figure 1. Using this we can then calculate the average value for g_{cem} for every month to determine which has the largest and smallest average value seen in Figure 2. Using this we find that March has the largest average value with 0.2396536 and December has the smallest with a value of -0.3081064.
 - b. Performing the OLS of g_{cem} on $grres(x)$ and then with 1, 3, and 5 lags. The 3 regressions are seen in Figure 3. We can then find the three χ^2 for each of these regressions in Figure 4. Using these we can calculate the nR^2 for each of these regressions and compare them to the χ^2 to test for serial correlation which is seen in the following table.

	nR^2	χ^2	Asymptotic Distribution
1 Lag	69.0844	69.237	$\chi^2(1)$
3 Lags	101.9592	103.322	$\chi^2(3)$
5 Lags	114.8512	117.311	$\chi^2(5)$

Based on this we see that the Stata reported χ^2 is close to our nR^2 for all lags 1, 3, and 5.

- c. Comparing Newey-West standard errors to our regular standard errors we see how the two models differ in Figure 5. As we can see the Newey west SE for $grres$ is 0.408 and the normal regression SE is 0.376. Since there is serial correlation in the error terms the robust standard errors from our OLS regression are not consistent. This differs from our Newey-West SE which are consistent to order p since Newey-West standard errors account for the presence of serial correlation.
- d. Testing the null hypothesis that β_1 equals β_2 we find the T-test seen in Figure 6. Based on this we reject the null hypothesis in favour of the alternative hypothesis that β_1 does not equal β_2 with a 99% significance level.

Appendix:

Figure 1:

```
. reg gcem L(0/10).seasonal,robust
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Linear regression		Number of obs	=	300
		F(11, 288)	=	222.59
		Prob > F	=	0.0000
		R-squared	=	0.8579
		Root MSE	=	.07263

gcem	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
seasonal						
--.	.0615033	.0311696	1.97	0.049	.0001543	.1228524
L1.	.4572201	.0277411	16.48	0.000	.402619	.5118211
L2.	.54776	.0227141	24.12	0.000	.5030534	.5924667
L3.	.5216514	.0162686	32.06	0.000	.489631	.5536717
L4.	.3994491	.0145876	27.38	0.000	.3707372	.428161
L5.	.4189702	.0127077	32.97	0.000	.3939584	.443982
L6.	.2630278	.0138355	19.01	0.000	.2357962	.2902593
L7.	.3745389	.012687	29.52	0.000	.3495679	.3995098
L8.	.2636277	.0132052	19.96	0.000	.2376368	.2896186
L9.	.3240971	.0131053	24.73	0.000	.2983027	.3498914
L10.	.070113	.0160822	4.36	0.000	.0384595	.1017666
_cons	-.3081064	.0114932	-26.81	0.000	-.3307278	-.285485

Figure 2:

```
. reg gcem L(0/11).seasonal, nocons robust
```

Linear regression		Number of obs	=	299
		F(12, 287)	=	210.04
		Prob > F	=	0.0000
		R-squared	=	0.8572
		Root MSE	=	.0726

gcem	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
seasonal						
--.	-.2466031	.0289752	-8.51	0.000	-.303634	-.1895722
L1.	.1491136	.02525	5.91	0.000	.0994149	.1988124
L2.	.2396536	.0195931	12.23	0.000	.2010892	.278218
L3.	.2135449	.0115148	18.55	0.000	.1908808	.2362091
L4.	.0913427	.0089842	10.17	0.000	.0736594	.109026
L5.	.1108637	.0054218	20.45	0.000	.1001922	.1215353
L6.	-.0450786	.0077029	-5.85	0.000	-.0602401	-.0299172
L7.	.0664325	.005373	12.36	0.000	.055857	.0770079
L8.	-.0444787	.0065029	-6.84	0.000	-.0572782	-.0316792
L9.	.0159906	.0062976	2.54	0.012	.0035952	.028386
L10.	-.2346745	.011197	-20.96	0.000	-.2567131	-.2126358
L11.	-.3081064	.011494	-26.81	0.000	-.3307297	-.2854831

Figure 3:

```
. estout lag1 lag3 lag5, cells(b(star fmt(3)) se(par fmt(2))) ///
> legend label varlabels(_cons constant) ///
> stats(r2 df_r bic, fmt(3 0 1) label(R-sqr dfres BIC))
```

	1 Lag b/se	3 Lag b/se	5 Lag b/se
x	0.091 (0.32)	-0.049 (0.30)	0.060 (0.30)
L.Residuals	0.474*** (0.05)	0.495*** (0.05)	0.499*** (0.06)
L2.Residuals		0.003 (0.06)	-0.085 (0.06)
L3.Residuals		-0.335*** (0.05)	-0.344*** (0.06)
L4.Residuals			0.149* (0.06)
L5.Residuals			-0.264*** (0.06)
constant	-0.000 (0.01)	-0.001 (0.01)	-0.002 (0.01)
R-sqr	0.224	0.333	0.378
dfres	305	301	297
BIC	-219.6	-253.8	-261.5

* p<0.05, ** p<0.01, *** p<0.001

Figure 4:

lags(p)	chi2	df	Prob > chi2
1	69.237	1	0.0000
3	103.322	3	0.0000
5	117.311	5	0.0000

Figure 5:

	Newey SE b/se	Normal SE b/se
x	0.512 (0.408)	0.512 (0.376)
constant	0.003 (0.012)	0.003 (0.011)
R-sqr		0.007
dfres	307	307
BIC	.	-148.2

* p<0.05, ** p<0.01, *** p<0.001

Figure 6:

Two-sample t test with equal variances						
Group	Obs	Mean	Std. err.	Std. dev.	[95% conf. interval]	
1	25	-.2466031	.0289732	.1448661	-.3064009	-.1868053
2	26	.1477424	.0242965	.1238882	.0977028	.1977819
Combined	51	-.0455642	.0335445	.2395556	-.1129403	.0218119
diff		-.3943454	.037695		-.4700964	-.3185944
diff = mean(1) - mean(2)				t = -10.4615		
H0: diff = 0				Degrees of freedom = 49		
Ha: diff < 0		Ha: diff != 0		Ha: diff > 0		
Pr(T < t) = 0.0000		Pr(T > t) = 0.0000		Pr(T > t) = 1.0000		