Total Expenditure into monthly data and Model Consumption and CPI

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1 Process

According to your suggestion, I made quarterly into smoothed monthly data. The idea is I give Jan, April, July and Oct 1/3 weight of the previous quarter and 2/3 current quarter, sum up and divided by 2. Feb, May, August, Nov keep their quarter figures and divide by 2. March, June, Sept and Dec have given 1/3 of the previous quarter and 2/3 current quarter, sum up and divided by 2.

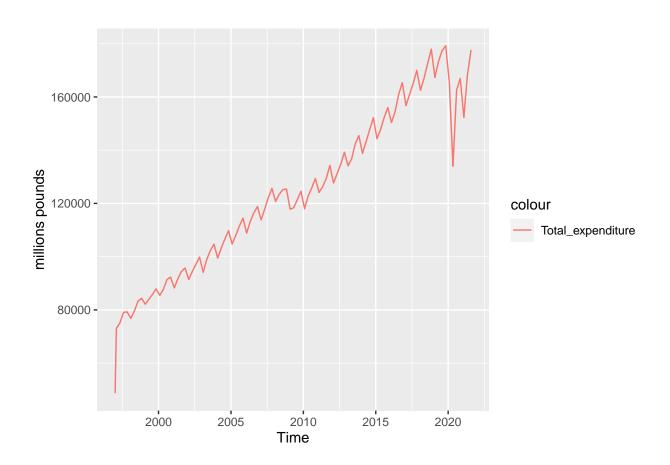


Figure 1: Total expenditure

```
##
## Augmented Dickey-Fuller Test
##
## data: df.ts
## Dickey-Fuller = -3.0187, Lag order = 6, p-value = 0.1469
## alternative hypothesis: stationary
```

2 Augmented Dickey-Fuller Test

One way to test whether a time series is stationary is to perform an augmented Dickey-Fuller test, which uses the following null and alternative hypotheses:

H0: The time series is non-stationary. In other words, it has some time-dependent structure and does not have constant variance over time.

HA: The time series is stationary.

P-value: 0.1469

Since the p-value is 0.1469 not less than .05, we fail to reject the null hypothesis.

This means the time series is non-stationary. In other words, it has some time-dependent structure and does not have constant variance over time.

3 Growh rate

Since total expenditure monthly data is not stationary, I try to convert to a percentage growth rate.

```
##
## Augmented Dickey-Fuller Test
##
## data: df.ts
## Dickey-Fuller = -8.332, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

We examine the growth rate stationary by applying the ADF test. The p-value is 0.01; we reject the null hypothesis. This means the time series is stationary now.

After we perform an augmented Dickey-Fuller test on the data, we can create a quick plot to visualize the data: There was a very clear fluctuation between March and August 2020.

4 CPI all items level

4.1 Model and data

The data set is monthly CPI all items and total expenditure for the UK from March 1997 to November 2019. We ignore the data after December 2019 since it is impacted by the Covid effect in 2020 Q1.

One of the significant differences between this model and the previous one is that we use total consumption as the demand variable for the overall CPI rate. This model for monthly data not only assumes inflation depends on 12 lagged inflation, dummies variables of each month, three VAT change announcements, and the great $D_{recession}$, but also Consumption C.

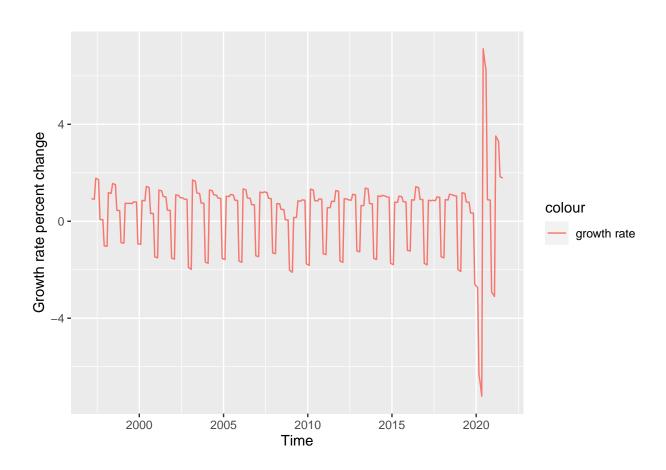


Figure 2: Growth rate

$$CPI_{t} = Constant + \text{Trend}_{t} + \beta_{1}D_{Jan} + \dots + \beta_{11}D_{Dec} + \beta_{12}D_{\text{recesion}} + \beta_{13}D_{VAT_{1}} + \beta_{14}D_{VAT_{2}} + \beta_{15}D_{TAT_{3}} + \sum_{j=1}^{12} \alpha_{j}C_{t-j} + \sum_{i=1}^{12} \lambda_{i}CPI_{t-i} + \sigma_{t}$$

Where CPI is the inflation for CPI all itmes, D_{JAN} to D_{Dec} are eleven dummy variables for each month. We define February as the base category against which the others are assessed to avoid the dummy variable trap. $D_{recession}$, the great recession that officially began in April 2008 and ended in June 2009, D_{VAT_1} , D_{VAT_2} and D_{VAT_3} are three Value-add ed tax change in the United Kingdom, which were December 2008, January 2010 and January 2011. $\sum_{j=1}^{12} \alpha_j C_{t-j}$ is the sum of 12 monthly lags consumption growth rate. $\sum_{i=1}^{12} \lambda_i CPI_{t-i}$ represents the sum of twelve months lags of the inflation rate of CPI ALL ITEMS.

4.2 Stepwise function

To further discover the independent variables that have a more significant influence on inflation and remove less critical coefficients, we introduce stepwise regression. In our simplified process, we apply backward elimination selection based on P-value criteria. For CPI all items, we go through a systematic procedure to simplify the lag structure: Omit the least significant independent variable and rerun until all variables are significant at 5% or 1%. In this process, we always leave the dummy variables in (VAT, monthly, crisis etc.) in regression, even if insignificant.

4.3 Results

4.3.1 The original results

=======================================	
	Dependent variable:
	CPI ALL ITEMS
Constant	0.52**
lag1	0.11
lag2	-0.01
lag3	0.10
lag4	0.02
lag5	-0.01
lag6	0.06
lag7	0.04
lag8	0.04
lag9	0.02
lag10	-0.001
lag11	0.02
lag12	0.17**
time_Aug	-0.56
time_Dec	-0.61*
time_Apr	-0.44
time_Jan	-1.07**
time_Jul	-0.96**
time_Jun	-0.66**
time_Mar	-0.37
time_May	-0.36
	Constant lag1 lag2 lag3 lag4 lag5 lag6 lag7 lag8 lag9 lag10 lag11 lag12 time_Aug time_Dec time_Apr time_Jan time_Jun time_Jun time_Mar

```
## time_Nov
                             -0.65*
                             -0.40
## time_Oct
## time_Sep
                             -0.31
## VAT1
                             -0.94**
## VAT2
                             0.51*
## VAT3
                             0.48*
## Recession
                             0.17*
## Trend
                             0.0002
## growth lag1
                             0.18*
## growth lag2
                             -0.12
## growth lag3
                             0.01
## growth lag4
                             0.08
## growth lag5
                             -0.01
## growth lag6
                             -0.05
## growth lag7
                             0.03
## growth lag8
                             -0.05
## growth lag9
                             0.14
## growth lag10
                             0.02
## growth lag11
                             -0.14
## growth lag12
                             0.06
## -----
## Observations
                             273
## R2
                             0.76
## Adjusted R2
                             0.72
## Residual Std. Error
                            0.19
## F Statistic
                           18.37**
## Note:
                 *p<0.05; **p<0.01; ***p<[0.***]
```

4.3.2 The simplified result

##		
##	=======================================	
##		Dependent variable:
##		
##		COPY[, 1]
##		CPI ALL ITEMS
##		
##	Constant	0.39**
##	lag3	0.12*
##	lag12	0.19**
##	time_Aug	-0.26*
##	time_Dec	-0.44**
##	time_Apr	-0.15
##	time_Jan	-1.06**
##	time_Jul	-0.75**
##	time_Jun	-0.52**
##	time_Mar	-0.13*
##	time_May	-0.36**
##	time_Nov	-0.39**
##	time_Oct	-0.17
##	time_Sep	-0.11
##	VAT1	-0.92**

```
## VAT2
                                    0.57**
## VAT3
                                    0.56**
## Recession
                                    0.18 **
## Trend
                                    0.0002
  growth lag2
                                     0.09*
## growth lag10
                                    0.11**
  growth lag12
                                    -0.07*
##
  Observations
                                      273
##
  R2
                                     0.75
## Adjusted R2
                                     0.73
## Residual Std. Error
                                     0.18
## F Statistic
                                    35.24**
## ==========
                       *p<0.05; **p<0.01; ***p<[0.***]
## Note:
```

4.3.2.1 Conclusions Comparing the results before and after simplification, we can see that after simplification, 2, 10 and 12 monthly lags consumption growth variables are significant. However, before stepwise, the results show that only one monthly lag consumption out of 12 is significant.

5 Divisions level

Besides modelling CPI for all items and Consumption, we also try with the divisions level.

5.1 Model

$$\begin{split} \pi_t = & \pi + \text{ Trend}_t + \beta_1 D_{Jan} + + \beta_{11} D_{Dec} + \beta_{12} D_{\text{recesion}} + \\ \beta_{13} D_{VAT_1} + \beta_{14} D_{VAT_2} + \beta_{15} D_{TAT_3} + \sum_{j=1}^{12} \alpha_j \pi_{t-j} + \sum_{i=1}^{12} \lambda_i CPI_{t-i} + \sum_{k=1}^{12} \theta_k C_{t-k} + \sigma_t \end{split}$$

Where π is the inflation for each divisions, D_{JAN} to D_{Dec} are eleven dummy variables for each month. We define February as the base category against which the others are assessed to avoid the dummy variable trap. $D_{recession}$, the great recession that officially began in April 2008 and ended in June 2009, D_{VAT_1} , D_{VAT_2} and D_{VAT_3} are three Value-add ed tax change in the United Kingdom, which were December 2008, January 2010 and January 2011. $\sum_{k=1}^{12} \theta_k C_{t-k}$ is the sum of 12 monthly lags consumption growth rate. $\sum_{i=1}^{12} \lambda_i CPI_{t-i}$ represents the sum of twelve months lags of the inflation rate of CPI ALL ITEMS and $\sum_{j=1}^{12} \alpha_j \pi_{t-j}$ is the sum of twelve months lagged inflation dependent variables.

5.2 Output

Please see Table 3.

							Dependent						
		01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
lag1 lag7		0.15*	-0.19**	-0.22**	0.23**	-0.25**	-0.32** -0.18**			-0.18**		-0.23**	-0.13*
CPI_lag4		0.36*			0.46**					-0.22*		0.10*	
lag8							-0.12*						
lag2				-0.17**		-0.23**	-0.25**						
lag3				-0.17**					0.14*				
lag4				-0.18**						0.16*			
lag5										0.14*			
lag6				0.26**		0.22**				0.14*		-0.15**	
CPI_lag8		0.44**		0.44*									
lag10			0.14*			-0.13**			0.14*				
Tag12			0.23**	0.31**		0.38**	0.19**			0.21**	0.38**	0.12*	
CPI_lag3			0.50**	0.67**									
CPI_lag5					0.34*								
CPI_lag1								0.66**				0.13**	0.24**
CPI_lag6			0.66**		-0.35*			-0.48*					
CPI_lag7			-0.45*			0.64**	0.27**						
CPI_lag12								0.55*					
time_Aug		-0.56**	0.03	0.73**	-0.78*	-0.003	0.50**	-0.31	0.06	-0.01	-0.02	-0.02	-0.10
time_Dec		-0.24	-0.33	0.71	0.23	0.88**	-0.30*	-1.51*	-0.12	0.08	-0.28	-0.27**	-0.37**
time_Apr		-0.76**	1.64**	0.82	-0.11	-0.29	0.30**	-1.33*	0.22	0.18	0.10	0.11	-0.23
time_Jan		-0.86**	1.41**	-1.50**	-0.53**	-1.23**	0.05	-0.63	-0.13	-0.36**	1.62*	-0.40**	-0.39**
time_Jul		-0.86**	1.40**	-0.87	-1.13**	-0.40	-0.42	-0.26	-0.09	-0.03	-0.20	0.17	-0.38**
time_Jun		-0.69**	-0.14	0.95*	-0.66	-0.42	-0.73**	-0.58	-0.07	0.05	0.01	0.11	-0.42**
time_Mar		-0.56**	0.12	0.11	-0.16	-0.21	-0.05	-0.79*	-0.15	0.01	-0.01	-0.05	-0.32*
time_May		0.15	0.52*	0.24	-0.81*	-0.14	-0.50**	-1.08*	-0.06	-0.06	0.01	0.39**	-0.36**
time_Nov		-0.09	-0.57*	0.59	0.12	-0.60**	-0.69**	-1.44*	-0.13	0.02	-0.27	-0.14*	-0.29**
time_Oct		-0.54**	-0.39	1.19*	0.11	0.04	-0.72**	-1.23*	0.12	0.20	0.82	0.03	-0.21
time_Sep		-0.26	0.74	2.95**	-0.54	-0.21	-0.21	-1.56*	-0.11	0.18	1.63**	0.03	-0.27*
VAT1		-0.69	-0.41	-3.56**	-0.76	-2.92**	-1.04**	-0.08	-1.98**	-1.14**	0.12	-0.40*	-0.51
VAT2		-0.22	1.80**	-1.78*	0.93	0.44	0.15	0.79	1.22	0.63*	-0.18	0.36*	0.38
VAT3		0.01	2.41**	-0.50	0.27	1.52**	0.11	0.94	1.21	0.19	0.55	1.21**	-0.45
Recession		0.38*	0.13	-0.58**	0.29	0.40**	-0.10	-0.06	0.25	0.25**	-0.10	0.06	0.06
Trend		-0.0003	-0.0001	0.003**	-0.0001	0.0004	-0.001**	0.0000	0.001**	0.0004	-0.0004	-0.0004**	-0.001*
growth6							-0.24**					0.11**	
growth8			0.41**				0.13*						
growth9			-0.26*									0.08**	
growth12				-0.28*							0.67*		
growth2					0.26*			0.51**					
growth3								-0.41*					
growth11					0.29**			-0.59**			-0.78**		
growth10							-0.19**	0.66**					
Constant		0.48**	-0.27	-1.17**	0.27	0.13	0.78**	0.94*	-0.16	-0.02	0.16	0.28**	0.58**
Observations		273	273	273	273	273	273	273	273	273	273	273	273
R2		0.28	0.64	0.93	0.33	0.92	0.49	0.63	0.20	0.37	0.60	0.56	0.18
Adjusted R2		0.23	0.64	0.93	0.33	0.92	0.49	0.59	0.14	0.37	0.57	0.50	0.18
Residual Std.	Error		0.51	0.70	0.28	0.46	0.44	0.39	0.62	0.32	1.21	0.32	0.12
F Statistic	21101	5.21**		134.95**		133.10**		18.12**		6.77**	19.72**	13.76**	3.02**
=========													

*p<0.05; **p<0.01; ***p<[0.***]

Figure 3: consumption-division output

5.3 Conclusions

From divisions stepwise results, we can see that all consumption lags of output in $01\mathrm{FB},\,05\mathrm{FH},\,08\mathrm{CM},\,09\mathrm{RC}$ and $12\mathrm{MS}$ is insignificant.

6 Unemployment

6.1 Data and methods

The data will be obtained from the ONS website of "Unemployment rate (aged 16 and over, seasonally adjusted)" in the Labor market statistics. To better examine how the unemployment rate affects monthly inflation, we turn the raw monthly unemployment data into monthly unemployment growth rates.

Then we add the unemployment rate to the equation, and we repeat the process.

$$\pi_t = \pi + \text{ Trend}_t + \beta_1 D_{Jan} + \dots + \beta_{11} D_{Dec} + \beta_{12} D_{\text{recesion}} + \\ \beta_{13} D_{VAT_1} + \beta_{14} D_{VAT_2} + \beta_{15} D_{TAT_3} + \beta_{16} U_t + \sum_{j=1}^{12} \alpha_j \pi_{t-j} + \sum_{i=1}^{12} \lambda_i CPI_{t-i} + \sum_{k=1}^{12} \theta_k C_{t-k} + \sigma_t$$

The values of unemployment and inflation are entered into figure 4, which shows their development in the period from 01.03.1997 to 01.11.2019.

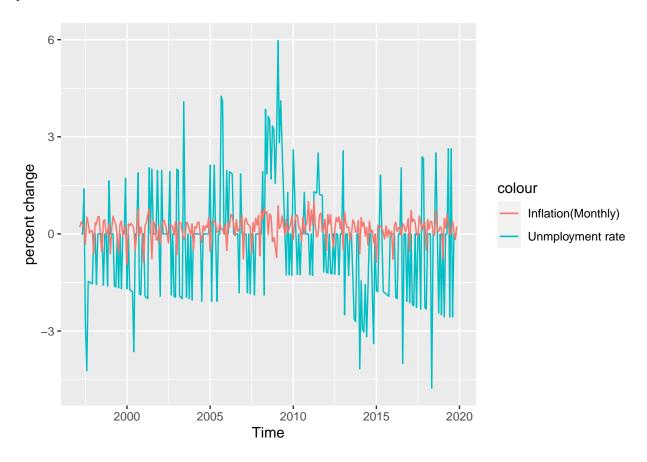


Figure 4: Unemployment and inflation

6.2 Regression output

The results are in Table 5. As we can see, The unemployment change rate is not significant for the 12 divisions and aggregate CPI.

							Depen	dent var	iable:					
	_	CPI	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
Constant	0).52**	1.55**	0.01	-1.26	-0.20	-0.37	0.77*	0.94	-1.21	-0.03	-0.15	0.54**	0.62*
lag1		0.10	0.09	-0.23**	-0.28**			-0.31**	-0.05	0.02	-0.20**	-0.04	-0.27**	-0.11
lag2		-0.01	-0.05	-0.10	-0.15*	0.08	-0.26**	-0.24**	0.06	0.07	0.03	0.01	-0.09	0.02
lag3		0.09	-0.04	0.05	-0.18**	-0.10	-0.14*	-0.05	0.08	0.12	0.01	-0.01	-0.06	0.06
ag4		0.02	-0.14	-0.03	-0.15*	0.03	-0.12	-0.01	-0.04	-0.10	0.15*	0.001	-0.04	0.03
ag5		-0.01	0.05	-0.06	0.08	-0.02	-0.13	-0.14*	-0.02	-0.03	0.17*	0.02	-0.01	0.02
ag6		0.06	0.02	-0.03	0.29**	0.01	0.17*	-0.09	0.04	-0.03	0.18*	-0.02	-0.18**	0.02
ag7		0.04	0.03	-0.04	0.08	0.17*	0.01	-0.24**	0.05	-0.04	-0.05	-0.02	-0.02	-0.07
ag8		0.03	-0.01	-0.07	-0.01	-0.13	-0.05	-0.21**	0.05	-0.06	0.01	-0.01	-0.02	-0.09
ag9		0.01	-0.02	-0.03	0.15*	0.01	0.03	0.01	-0.11	0.08	0.08	0.02	-0.09	0.10
ag10		0.003	0.09	0.11	0.01	-0.04	-0.16*	-0.11	-0.01	0.18**	-0.02	-0.03	-0.01	0.001
ag11		0.02	-0.07	0.06	0.01	-0.03	-0.11	0.05	0.10	-0.04	0.02	-0.05	-0.09	-0.05
ag12	C).17**	0.11	0.22**	0.31**	0.11	0.33**	0.12*	0.04	-0.003		0.34**	0.10	0.06
PI_lag1			0.24	-0.02	0.43	0.004	-0.10	-0.06	0.81*	-0.19	0.03	0.05	0.14*	0.23*
PI_lag2			0.12	-0.02	-0.26	0.09	0.08	0.21	0.05	0.02	-0.10	-0.37	0.05	-0.12
PI_lag3			-0.02	0.40	0.79**	0.33	0.25	-0.11	-0.52	0.27	0.01	0.83	0.03	0.05
PI_lag4			0.45*	0.28	0.21	0.43*	0.14	0.01	-0.10	-0.22	-0.17	-0.40	0.12*	0.01
PI_lag5			-0.07	0.05	-0.44	0.30	0.15	-0.01	-0.07	0.34	-0.13	-0.70	-0.01	-0.06
PI_lag6			0.36	0.65**	-0.002	-0.40*	0.14	0.13	-0.43	-0.01	-0.10	0.72	-0.01	-0.02
PI_lag7			0.05	-0.34	-0.06	-0.14	0.54**	0.21	-0.03	-0.10	-0.06	-0.15	0.04	0.15
PI_lag8			0.53*	0.06	0.50	0.17	0.14	0.15	-0.47	0.31	0.03	0.15	0.05	0.04
PI_lag9			-0.11	0.08	-0.08	0.06	-0.14	-0.01	0.37	-0.11	0.01	0.19	0.02	-0.07
PI_lag10			-0.08	0.11	0.24	0.17	0.28	-0.11	0.11	-0.06	-0.02	0.41	-0.004	-0.05
PI_lag11			-0.05	0.03	0.04	0.07	0.14	-0.10	-0.05	0.21	0.13	-0.04	0.01	0.02
PI_lag12			0.04	0.03	-0.23	-0.35	-0.08	0.09	0.33	-0.09	0.06	-0.05	-0.02	0.06
ime_Aug		-0.55	-2.87**	-0.59	1.12	0.08	0.84	0.61	-0.17	1.30	-0.06	-0.25	-0.18	-0.32
ime_Dec		0.61*	-2.23**	-0.40	1.74	0.66	1.51*	0.28	-1.45	1.66*	0.13	-1.92	-0.40	-0.48
ime_Apr		-0.43												
ime_Feb			-2.19**	1.66	1.37	0.38	0.86	0.46	-1.21	1.69*	0.35	-0.16	-0.08	-0.54
ime_Jan		1.06**		0.90	-2.30*	0.01	-0.99	-0.29	-1.16	0.54	0.20	3.35	-0.51*	-0.82*
ime_Jul			-2.08**	0.71	-0.03	-1.43	0.04	0.16	0.26	1.12	-0.49	-0.55	-0.03	-0.25
ime_Jun		0.67**		-0.66	0.93	-0.26	-0.51	-0.93*	-0.75	1.12	0.10	-0.55	-0.13	-0.60
ime_Mar			-1.71*	-0.51	0.17	-0.33	0.37	-0.13	0.62	1.18	-0.12	-0.11	-0.17	-0.43
ime_May		-0.34	-1.11	0.65	1.33	-0.16	0.14	-0.39	-0.27	1.33	0.21	-0.04	0.10	-0.47
ime_Nov		0.65*	-2.17**	-0.77	1.68	0.30	0.73	-0.82	-0.97	0.87	-0.12	-0.56	-0.41	-0.34
ime_Oct		-0.39	-2.30**	-1.00	3.55**	0.87	0.46	-0.70	-0.57	0.74	0.03	1.84	-0.25	-0.09
ime_Sep		-0.34	-1.84*	0.83	3.06**	0.98	0.40	0.31	-2.80**		0.26	2.42	-0.15	-0.53
/AT1		0.92**	-0.68	-0.46	-3.72**	-0.24		-1.21**	0.62	-2.20**		-0.43	-0.37*	-0.53
/AT2		0.50*	-0.14	1.81**	-1.64*	0.72	0.49	0.11	0.88	0.40	0.56	0.38	0.28	0.45
/AT3 .		0.48*	-0.24	2.47**	-1.08	0.16	1.61**	0.20	0.78	0.84	0.37	0.09	1.26**	-0.50
Recession		0.16*	0.70**	0.06	-0.63*	0.22	0.35*	-0.13	-0.12	0.14	0.21	0.37	0.07 -0.001**	0.03
rend		0.0002		-0.0003		-0.0001			-0.0000		0.0004			
rowth lag1).18**	0.39	-0.18	-0.42	0.49*	-0.24	-0.08	0.30	0.21	0.13	0.77	0.03	-0.01
rowth lag2		-0.12	-0.07	0.03	0.04	-0.33	0.21	0.06	-0.47	-0.49	-0.20	-0.66	0.06	-0.10
rowth lag3		0.04	-0.09	0.05	0.19	-0.22	-0.09	-0.13	0.73	0.23	0.04	0.28	-0.05	0.20
rowth lag4		0.06	0.39	0.22	-0.54	0.52	-0.01	0.17	-0.85*	0.27	0.23	0.13	0.02	-0.15
rowth lag5		-0.01	-0.02	-0.18	0.32	-0.24	-0.18	-0.24	0.20	-0.38	-0.19	-0.17	0.13	-0.02
rowth lag6		-0.03	-0.02	-0.15	0.09	-0.26	-0.07	-0.27	0.67	-0.11	-0.02	0.32	-0.03	0.17
rowth lag7		0.02	0.17	0.70*	-0.56	0.28	0.11	0.50**	-0.83*	0.56	0.06	-0.30	0.05	-0.02
rowth lag8		-0.05	-0.30	-0.47	0.20	0.17	-0.05	-0.05	-0.12	-0.43	-0.03	0.09	0.09	-0.20
rowth lag9		0.14	0.24	0.06	-0.08	-0.13	-0.15	-0.47**	1.07**	-0.26	-0.02	0.61	-0.05	0.20
rowth lag10		0.02	0.23	0.05	0.15	0.33	0.08	0.38**	-0.72*	0.47	-0.10	-1.13*	0.03	0.15
rowth lag11			-0.59**	-0.14	-0.39	0.03	0.19	-0.18	-0.29	-0.22	0.07	0.53	0.02	-0.26
rowth lag12 nemployment		0.05 0.01	0.34* -0.01	0.32 -0.02	-0.04 -0.04	-0.08 0.03	-0.25 -0.02	0.01 0.01	0.16 -0.01	-0.21 0.01	0.05 0.01	0.18 -0.05	0.01 0.01	0.16 0.01
bservations		272	272	272	 272	 272	272	272	272	 272	272	272	272	272
12		0.76	0.36	0.67	0.94	0.39	0.93	0.55	0.66	0.28	0.43	0.63	0.59	0.26
djusted R2		0.72	0.21	0.59	0.92	0.25	0.91	0.44	0.57	0.11	0.29	0.54	0.49	0.08
esidual Std.			0.55	0.59	0.70	0.54	0.46	0.32	0.73	0.63	0.31	1.25	0.16	0.30
esiduai stu. Statistic		U. 19 L7. 87**		8.35**	63.22**		55.60**		7.90**	1.62**		7.08**	5.98**	1.44*
=========	_										5.05	,	5.50	

 $Figure \ 5: \ Consumption-Unemployment \ output \\$

6.3 The simplified result

Stepwise regression results (Table 6) confirm the previous conclusion that unemployment rate in the same period has no significant effect on CPI, no matter division or aggregate CPI level.

							Depe	ndent var	iable:					
	-	CPI	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
lag1		0.10	0.15*		-0.22**		-0.25**	-0.32**			-0.18**		-0.23**	-0.13*
lag2		-0.01			-0.17**		-0.23**	-0.25**						
lag3		0.10			-0.17**					0.14*				
lag4		0.03			-0.18**						0.16*			
lag5		-0.01									0.14*			
lag6		0.05			0.26**		0.22**				0.14*		-0.15**	
lag7		0.03				0.14*		-0.18**						
lag8		0.04						-0.12*						
lag9		0.03												
lag10		-0.01		0.14*			-0.13**			0.14*				
lag11		0.02												
lag12	(0.17**		0.23**	0.31**		0.38**	0.19**			0.21**	0.38**	0.12*	
CPI_lag1									0.66**				0.13**	0.24**
CPI_lag2														
CPI_lag3				0.50**	0.67**									
CPI_lag4			0.36*			0.46**					-0.22*		0.10*	
CPI_lag5				0 000		0.34*			0 404					
CPI_lag6				0.66**		-0.35*	0.04**	0 27**	-0.48*					
CPI_lag7			0 4400	-0.45*	0 44*		0.64**	0.27**						
CPI_lag8			0.44**		0.44*									
CPI_lag9														
CPI_lag10														
CPI_lag11									0.55*					
CPI_lag12		0 00*				0.26*			0.55*					
growth lag1		0.09*				0.26			-0.41*					
growth lag2								-0.24**	-0.41"				0.11**	
growth lag5				0.41**				0.13*					0.11	
growth lag7 growth lag8				-0.26*				0.15					0.08**	
growth lag9	(0.10**		-0.20				-0.19**	0.66**				0.08	
growth lag10	,	J. 10				0.29**		-0.15	-0.59**			-0.78**		
growth lag11		-0.07*			-0.28*	0.23			0.33			0.67*		
time_Aug			-0.56**	0.03	0.73**	-0.78*	-0.003	0.50**	-0.31	0.06	-0.01	-0.02	-0.02	-0.10
time_Dec			-0.24	-0.33	0.71	0.73	0.88**	-0.30*	-1.51*	-0.12	0.08	-0.28	-0.27**	-0.37**
time_Apr			-0.76**		0.82	-0.11	-0.29	0.30**		0.22	0.18	0.10	0.11	-0.23
time_Jan			-0.86**			-0.53**		0.05	-0.63	-0.13	-0.36**		-0.40**	-0.39**
time_Jul			-0.86**		-0.87	-1.13**		-0.42	-0.26	-0.09	-0.03	-0.20	0.17	-0.38**
time_Jun			-0.69**		0.95*	-0.66	-0.42	-0.73**	-0.58	-0.07	0.05	0.01	0.11	-0.42**
time_Mar			-0.56**		0.11	-0.16	-0.21	-0.05	-0.79*	-0.15	0.01	-0.01	-0.05	-0.32*
time_May		-0.46**		0.52*	0.24	-0.81*	-0.14	-0.50**		-0.06	-0.06	0.01	0.39**	-0.36**
time_Nov	-	-0.52**	-0.09	-0.57*	0.59	0.12	-0.60**	-0.69**	-1.44*	-0.13	0.02	-0.27	-0.14*	-0.29**
time_Oct		-0.31	-0.54**	-0.39	1.19*	0.11	0.04	-0.72**	-1.23*	0.12	0.20	0.82	0.03	-0.21
time_Sep		-0.24	-0.26	0.74	2.95**	-0.54	-0.21	-0.21	-1.56*	-0.11	0.18	1.63**	0.03	-0.27*
VAT1			-0.69		-3.56**		-2.92**		-0.08		-1.14**		-0.40*	-0.51
VAT2		0.51*		1.80**	-1.78*	0.93	0.44	0.15	0.79	1.22	0.63*	-0.18	0.36*	0.38
VAT3		0.51*	0.01	2.41**	-0.50	0.27	1.52**	0.11	0.94	1.21	0.19	0.55	1.21**	-0.45
Recession		0.15*	0.38*	0.13	-0.58**	0.29	0.40**	-0.10	-0.06	0.25	0.25**	-0.10	0.06	0.06
Trend	(0.0002	-0.0003	-0.0001	0.003**	-0.0001	0.0004	-0.001**	0.0000	0.001**	0.0004	-0.0004	-0.0004**	-0.001*
Constant	(0.46**	0.48**	-0.27	-1.17**	0.27	0.13	0.78**	0.94*	-0.16	-0.02	0.16	0.28**	0.58**
Observations		273	273	273	273	273	273	273	273	273	273	273	273	273
R2		0.75	0.28	0.64	0.93	0.33	0.92	0.49	0.63	0.20	0.37	0.60	0.56	0.18
Adiusted R2		0.73	0.23	0.64	0.93	0.33	0.92	0.49	0.59	0.20	0.37	0.57	0.50	0.18
Residual Std.			0.55	0.57	0.70	0.53	0.46	0.44	0.72	0.62	0.32	1.21	0.32	0.12
F Statistic													13.76**	
								=======						

Figure 6: Consumption-Unemployment stepwise output

6.4 Some more lags of unemployment

6.4.1 Model and data

Since unemployment is not significant for division and aggreagte CPI, we try 12 more lags of unemployment. I'm still using the rate of change of the unemployment rate instead of the level.

$$\begin{split} \pi_t = & \pi + \ \text{Trend}_t + \beta_1 D_{Jan} + + \beta_{11} D_{Dec} + \beta_{12} D_{\text{recesion}} + \\ \beta_{13} D_{VAT_1} + \beta_{14} D_{VAT_2} + \beta_{15} D_{TAT_3} + \sum_{h=1}^{12} \psi_i U_{t-h} + \sum_{j=1}^{12} \alpha_j \pi_{t-j} + \sum_{i=1}^{12} \lambda_i CPI_{t-i} + \sum_{k=1}^{12} \theta_k C_{t-k} + \sigma_t \end{split}$$

6.4.2 Regression output

The results are in Table 7. Some of unemployment lag variables are significant, especially for 06HL.

			Dependent variable:											
	CP:	. 0	1FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
onstant	0.5		09**	-0.38	-1.69	-0.25	-0.41	0.69*	1.07	-1.64*	-0.05	-0.76	0.57**	0.64
ag1	0.1).12		-0.28**		-0.32**	-0.16*	-0.10	-0.003	-0.23**		-0.28**	-0.11
ag2	-0.0)2 -	0.08	-0.11	-0.15*	0.04	-0.26**	-0.11	0.02	0.06	0.02	-0.01	-0.09	0.03
ag3	0.10) -	0.04	0.001	-0.21**	-0.13	-0.16*	-0.07	0.04	0.11	0.01	-0.03	-0.07	0.08
ag4	0.0		0.15	-0.07	-0.20**	0.01	-0.14	-0.01	-0.03	-0.13	0.14*	-0.02	-0.04	0.02
ag5	-0.0		0.04	-0.08	0.03	0.001	-0.14	-0.18**	-0.004	-0.05	0.17*	-0.01	-0.0004	-0.00
ag6	0.00		0.06	-0.01	0.27**	0.02	0.16*	-0.11	0.04	-0.06	0.18*	-0.04	-0.18*	-0.001
ag7	0.0		0.004	-0.08	0.04	0.16*	-0.01	-0.20**	0.09	-0.05	-0.06	-0.03	-0.04	-0.07
ag8	0.0		0.005	-0.11	-0.07	-0.13	-0.06	-0.17**	0.09	-0.09	-0.01	-0.02	-0.05	-0.06
ag9	0.0		-0.03	-0.03	0.12 0.005	0.01	0.02	-0.04	-0.07 -0.04	0.07	0.08	0.001	-0.10	0.13
ag10 ag11	-0.00 0.00		0.09 -0.05	0.09	0.003	-0.03	-0.16* -0.12	-0.05 0.04	0.07	0.17* -0.03	-0.002 0.02	-0.05 -0.06	0.01 -0.08	0.004 -0.07
lag12	0.10		0.03	0.20**	0.29**	0.10	0.33**	0.04	0.07	-0.03	0.02	0.34**	0.09	0.07
PI_lag1	0.1).26	-0.07	0.37	0.06	-0.13	-0.11	0.89**	-0.21	0.03	0.04	0.14*	0.25
CPI_lag1).17	-0.08	-0.29	0.17	0.08	0.23*	0.11	-0.06	-0.12	-0.37	0.06	-0.12
CPI_lag3			0.004	0.42*	0.67**	0.48*	0.25	-0.06	-0.45	0.25	0.03	0.71	0.05	0.06
CPI_lag4).45*	0.26	0.19	0.46*	0.17	-0.03	-0.15	-0.23	-0.16	-0.52	0.14*	-0.003
PI_lag5		-	0.07	0.01	-0.47	0.31	0.14	0.02	-0.10	0.33	-0.13	-0.77	-0.01	-0.06
CPI_lag6		0).35	0.60**	-0.05	-0.36	0.15	0.19*	-0.50	0.0001	-0.10	0.62	-0.01	0.01
CPI_lag7		0	0.05	-0.31	-0.13	-0.13	0.59**	0.22*	-0.15	-0.09	-0.08	-0.23	0.03	0.17
CPI_lag8		0.	55**	0.04	0.41	0.19	0.10	-0.001	-0.54	0.28	0.03	-0.09	0.10	0.02
CPI_lag9			0.17	-0.03	-0.06	0.09	-0.18	0.11	0.17	-0.18	0.02	0.08	0.06	-0.09
CPI_lag10			0.01	0.19	0.15	0.09	0.27	-0.04	0.19	-0.02	-0.05	0.27	-0.004	-0.05
CPI_lag11			0.09	-0.02	-0.11	0.12	0.11	-0.08	0.03	0.18	0.10	-0.23	0.04	0.05
CPI_lag12	0.7		0.08	-0.11	-0.33	-0.26	-0.11	0.14	0.32	-0.18	0.05	-0.11	-0.001	0.10
time_Aug	-0.70		3.76**	-0.86	0.05	0.38	0.80	0.33	-0.68	1.04	-0.21	-0.36	-0.07	-0.30
ime_Dec		_	2.55**	-0.25 2.58*	0.76	0.93	1.62*	-0.26	-1.57	2.07*	0.26	-2.72	-0.25	-0.37
:ime_Feb :ime_Jan	-0. -1.2		2.89**	0.08	0.41 -2.71*	0.07 0.43	1.07 -0.77	0.59 -0.13	-0.97 -1.25	2.21* 0.45	0.40 0.34	-1.14 3.57	0.05 -0.58*	-0.78 -0.78
rime_Jul)** -2		0.88	-0.69	-1.23	-0.77	0.82	-0.16	1.29	-0.78	-0.67	0.02	0.13
ime_Jun			2.68**	-1.16	0.44	-0.57	-0.23	-0.29	-0.40	1.01	-0.03	-0.54	-0.15	-0.59
ime_Mar	-0.4		2.48**	-0.25	0.16	0.05	0.57	0.56	-0.42	1.19	-0.20	0.01	-0.15	-0.48
time_May	-0.4		1.82	0.57	0.96	-0.17	-0.01	-0.37	0.03	1.66	0.20	-0.86	0.26	-0.44
time_Nov	-0.69		2.42*	-0.21	1.08	0.46	0.84	-0.15	-1.50	1.36	0.02	-0.54	-0.48	-0.29
time_Oct	-0.4	18 -2	2.91**	-1.83	3.62**	1.46	0.18	-0.19	-1.38	0.34	0.15	1.92	-0.07	-0.12
time_Sep	-0.	33 -1	L.91*	0.83	2.09	1.37	0.19	-0.18	-2.57*	1.23	0.34	1.81	0.05	-0.48
/AT1	-0.9	·* -	0.87	-0.47	-3.20**	-0.17	-3.50**	-0.94**	0.29	-2.32**	-1.05**	0.06	-0.42*	-0.59
/AT2	0.5		0.09	1.36*	-1.49	1.04	0.35	0.30	0.54	0.18	0.66	0.41	0.32	0.49
/AT3	0.40			2.40**	-1.10	0.14	1.67**	0.26	0.90	0.81	0.38	-0.20	1.26**	-0.52
Recession	0.10		65**	0.11	-0.86**	0.27	0.30	-0.11	-0.08	0.16	0.20	0.42	0.09	0.05
Frend	0.00			0.0001	0.003**		0.001	-0.001**		0.002**	0.001		-0.001**	
growth lag1	0.1		0.43	-0.10	-0.55	0.47*	-0.21	-0.13	0.38	0.29	0.10	0.78	0.01	0.04
growth lag2	-0.		0.16	-0.15	0.19	-0.29	0.18	0.05	-0.50	-0.69*	-0.21	-0.62	0.10	-0.14
growth lag3 growth lag4	0.04		·0.14).45	0.33 0.49	0.48 -1.04*	-0.13 0.20	0.003 0.02	0.15 -0.22	0.34 -0.27	0.34 0.52	0.06 0.24	0.50	-0.10 0.04	0.17 -0.19
growth lag5	-0.0		0.11	-0.74	0.70	-0.04	-0.35	-0.22	0.13	-0.66	-0.21	-0.26	0.19	0.05
growth lag6	-0.		0.11	0.01	0.70	-0.30	-0.01	0.24	0.23	-0.15	-0.06	0.84	-0.15	0.13
rowth lag7	0.0).55	1.29**	-1.18**	0.12	0.15	0.02	-0.38	0.93*	0.01	-0.79	0.10	0.13
growth lag8	-0.).73*	-1.34**	0.47	0.45	-0.16	-0.28	-0.24	-0.91*	-0.001	0.21	0.19	-0.26
growth lag9	0.1		0.43	0.36	0.32	-0.16	-0.13	0.07	0.86	-0.20	0.02	1.09	-0.17	0.17
rowth lag10	0.0	7 0	.49	0.46	-0.14	0.23	0.09	0.13	-0.59	0.74*	-0.14	-1.47*	0.08	0.21
rowth lag11	-0.2	L* -0).99**	-0.62*	-0.39	0.21	0.23	-0.27	-0.34	-0.41	0.12	0.62	0.04	-0.28
growth lag12	0.1	L 0.	57**	0.47*	0.24	-0.14	-0.24	0.06	0.17	-0.15	0.09	0.36	-0.04	0.14
ınemployment lag			0.06	-0.15	0.27	0.13	-0.09	-0.04	-0.11	-0.08	-0.002	0.30	-0.01	0.07
ınemployment lag			0.03	0.29	-0.18	-0.14	0.17	0.08	-0.002	0.10	0.01	-0.02	-0.04	-0.0
ınemployment lag			0.07	0.02	-0.05	0.12	-0.01	-0.27**	0.04	0.08	0.05	-0.28	0.07	-0.02
nemployment lag		06 -0		-0.29	0.20	-0.10	0.01	0.12	0.09	-0.18	0.06	0.16	-0.03	-0.13
ınemployment lag			0.37*	0.38*	0.06	-0.12	-0.03	0.31**	0.07	0.29	-0.05	0.02	-0.06	0.14
ınemployment lag			-0.27	-0.23	-0.13	-0.13		-0.21**	0.04	-0.05	-0.08	-0.05	0.01	-0.02
nemployment lag			0.11	0.07	-0.22	0.19	0.03	-0.23**	0.01	-0.06	0.04	-0.01	0.01	0.05
ınemployment laç			0.07	-0.11	0.22	-0.04 -0.03	-0.02 -0.04	0.20** 0.21**	-0.02 -0.06	-0.15	-0.04	0.03	0.05	-0.02
ınemployment laq ınemployment laq			0.005 0.11	0.13 0.18	0.10 -0.26	0.02	-0.04 -0.01	-0.39**	0.08	0.13 0.07	0.01 0.05	0.11	-0.04 0.07	-0.06 0.002
unemployment lag unemployment lag			0.23	-0.21	0.08	0.02	0.01	0.36**	-0.05	-0.03	-0.01	0.15	-0.03	0.12
inemployment lac).18*	-0.21	0.02	0.01		-0.17**	-0.03	-0.03	-0.01	0.10	-0.03	-0.09
Observations	27		273	273	273	273	273	273	273	273	273	273	273	273
R2	0.7		.41	0.70	0.94	0.43	0.93	0.71	0.66	0.32	0.45	0.64	0.62	0.31
Adjusted R2	0.7		23	0.61	0.93	0.25	0.91	0.62	0.56	0.11	0.28	0.53	0.50	0.10
Residual Std. Er).55	0.57	0.70	0.53	0.47	0.27	0.75	0.63	0.31	1.26	0.16	0.29
Statistic		5** 2.		7.63**			44.96**						5.31**	1.45
=========													=======	

Figure 7: Consumption-12 lag Unemployment output

6.4.3 The simplified result

The results are in Table 8. The unemployment lag variables for 02AT, 03CF, 06HL, 09RC, 11RH and 12MS are significant. It is worth noting that except for period lag of 1 and 2, which is not significant to 06HL, the other unemployment time lag variables are significant.

The most interesting things is that 2 period lag unemployment is insignificant for all divisions and aggregate CPI.

						Depe	ndent var	iable:					
	CPI	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
 ag1	0.10					-0.25**				-0.21**		-0.23**	
ag2	-0.01			-0.21**		-0.23**							
ag3	0.10			-0.20**					0.14*				
ag4	0.03			-0.20**						0.16**			
ag5	-0.01						-0.18**			0.15*			
ag6	0.05			0.23**		0.22**	-0.12*			0.16*		-0.16**	
ag7	0.03				0.13*		-0.22**						
ag8	0.04						-0.14**						
ag9	0.03												
ag10	-0.01		0.11*			-0.13**			0.14*				
ag11	0.02												
ag12	0.17**		0.22**	0.31**		0.38**				0.20**	0.38**	0.14*	
:PI_lag1								0.66**				0.15**	0.24*
PI_lag2							0.22*						
PI_lag3			0.46**	0.60**									
PI_lag4		0.36*			0.51**					-0.21*		0.10*	
PI_lag5													
PI_lag6			0.64**				0.21*	-0.48*					
PI_lag7			-0.43*			0.64**	0.20*						
PI_lag8		0.44**											
PI_lag9													
PI_lag10													
PI_lag11								0 554					
PI_lag12	0 00:				0 07:			0.55*					
rowth lag1	0.09*				0.27*			0.51**					
rowth lag2							0 114	-0.41*					
rowth lag4							-0.11*					0 1044	
rowth lag5										0.15%		0.10**	
rowth lag6			0 42**							-0.15*			
rowth lag7			0.43**									0.00**	
rowth lag8	0.10**		-0.30*					0.66**				0.09**	
rowth lag9	0.10**				0.20**						-0.78**		
rowth lag10	-0.07*				0.29**		-0.14**	-0.59**					
rowth lag11	-0.0/^						-0.14			0 14*	0.67*		
rowth lag12				0 13**						0.14*			
nemployment lag 1				0.12**			-0.23**			0.08**			
nemployment lag 3										0.08**			
nemployment lag 4			0.06*				0.13* 0.27**					-0.03*	
nemployment lag 5			0.06"				-0.21**			-0.09**		-0.03	
nemployment lag 6							-0.21**			-0.09**			
nemployment lag 7							0.19**						
nemployment lag 8							0.19**						
nemployment lag 9 nemployment lag 10							-0.39**					0.07**	
nemployment lag 11							0.41**					-0.05*	0.09*
nemployment lag 12							-0.21**					-0.03	-0.09
ime_Aug		-0.56**	-0 04	0.93**	-0.78*	-0.003	0.24*	-0.31	0.06	-0.77**	-0.02	0.03	-0.03
ime_Dec	-0.52**		-0.41	1.90**	0.18	0.88**		-1.51*	-0.12	0.10	-0.28	-0.27**	-0.35*
ime_Apr		-0.76**		1.01*	-0.07	-0.29	0.17	-1.33*	0.22	-0.19	0.10	0.09	-0.21
ime_Jan		-0.86**		-0.59	-0.27	-1.23**	0.09	-0.63		-0.36**		-0.42**	-0.37
ime_Jul		-0.86**		-0.81	-0.73*	-0.40	0.30*	-0.26	-0.09	-0.77**	-0.20	0.16	-0.35
ime_Jun		-0.69**		1.20**	-0.93**		-0.38*	-0.58	-0.07	-0.69**		0.09	-0.39
ime_Mar		-0.56**		0.11	-0.16	-0.21	0.21	-0.79*	-0.15	-0.37*	-0.01	-0.07	-0.30
ime_May	-0.46**		0.56*	0.51	-0.65	-0.14	-0.27	-1.08*	-0.06	-0.42*	0.01	0.38**	-0.34
ime_Nov		-0.09		1.71**	0.11	-0.60**	-0.48**	-1.44*	-0.13	-0.28	-0.27	-0.14*	-0.27
ime_Oct		-0.54**		1.63**	0.11	0.04	-0.19	-1.23*	0.12	-0.11	0.82	0.14	-0.18
ime_Sep	-0.24	-0.26	0.66	2.83**	-0.45	-0.21	0.15	-1.56*	-0.11	-0.13	1.63**	0.07	-0.24
AT1	-0.93**		-0.44	-3.53**	-0.92	-2.92**	-0.88**	-0.08		-1.22**	0.12	-0.40*	-0.5
AT2	0.51*		1.64**	-1.72*	0.89	0.44	0.31	0.79	1.22	0.70*	-0.18	0.40*	0.34
AT3	0.51*	0.01	2.33**	-0.64	0.33	1.52**	0.24	0.94	1.21	0.23	0.55	1.23**	-0.4
ecession				-0.65**		0.40**		-0.06		0.17	-0.10	0.06	0.00
rend									0.001**	0.0004		-0.0004**	
Constant				-2.38**		0.13						0.31**	
												-	
bservations	273	273	273	273	273	273	273	273	273	273	273	273	273
2	0.75	0.28	0.65	0.93	0.31	0.92	0.68	0.63	0.20		0.60	0.58	0.19
djusted R2	0.72	0.23	0.62	0.93	0.25	0.91	0.63	0.59	0.14	0.34	0.57	0.53	0.1
esidual Std. Error		0.55	0.57	0.69	0.53	0.46	0.27	0.72	0.62	0.30	1.21	0.15	0.29
Statistic												12.95**	
Statistic													

Figure 8: Consumption-12 lag Unemployment simplified output