Measuring Core Inflation in the UK

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Submitted in accordance with the requirements for the degree of
Degree of Doctor of Philosophy of Cardiff University

Department of Economics of Cardiff Business School,

Cardiff University

Month Year

Declaration

I hereby declare that the work presented in this thesis has not been submitted for any other degree or professional qualification, and that it is the result of my own independent work.

Yiyi Li(Candidate)

Date

Abstract

Abstract of about 300 words.

Publications associated with this research

List of publications goes here, formatted as a full citation.

Consider including publication in an appendix, too.

Acknowledgements

There are no formal rules here, but it is generally appropriate to acknowledge supervisors, funders, participants, and others in the academy who helped in the PhD process.

You can also acknowledge people from your personal life who supported your efforts.

Keep this to one page.

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Chapter 1: Modelling UK Inflation

1.1 Introduction

Since December 2019, the global outbreak of the COVID-19 pushed down global oil prices, the consumer price index (CPI) has floated sharply in many countries, and there is growing interest in how core inflation is measured. In other words, how we calculated the durable or persistent component of aggregate inflation.

UK CPI rose 1.8% in January 2020 from a year earlier, up again from 1.4% the previous month. The UK Office for National Statistics said that the "lockdown" measures taken to curb the neo-crown epidemic had dampened demand for some goods. Falling motor fuel and clothing prices are the main reasons for lower inflation levels. However, in January 2020, China's CPI rose 5.4 per cent year-on-year, the highest value in eight years. A closer look at China's January data shows different commodity prices rose differently - food prices led by 20.6%, pork again "first" rose sharply by 116%, and non-food prices rose only 1.6%. Food skyrocketed because people feared an outbreak might trap them in their homes, so there would be panic hoarding of essentials, which would raise prices for a short time. In other words, demand for groceries and meat skyrocketed without a corresponding increase in supply, hence the high food prices in January.

This chapter tries to model UK inflation in different ways. It first describes the data we use when modelling inflation, mainly introducing the structure of UK consumer price indices. We then construct an ordinary least square (OLS) framework with the monthly and quarterly datasets. Section 1.4 presents the stepwise regression to simplify the OLS model. I next test the OLS estimator efficiency by applying seemingly unrelated regressions. Section 1.6 illustrates the estimated results. Section 1.7 concludes.

1.2 Data

1.2.1 Data Description

The data set is monthly and quarterly CPI for the UK from January 1993 to December 2019 and considers frequency data for three different classification levels: the 12 COICOP divisions, the 38 COICOP groups and the 71 COICOP classes.

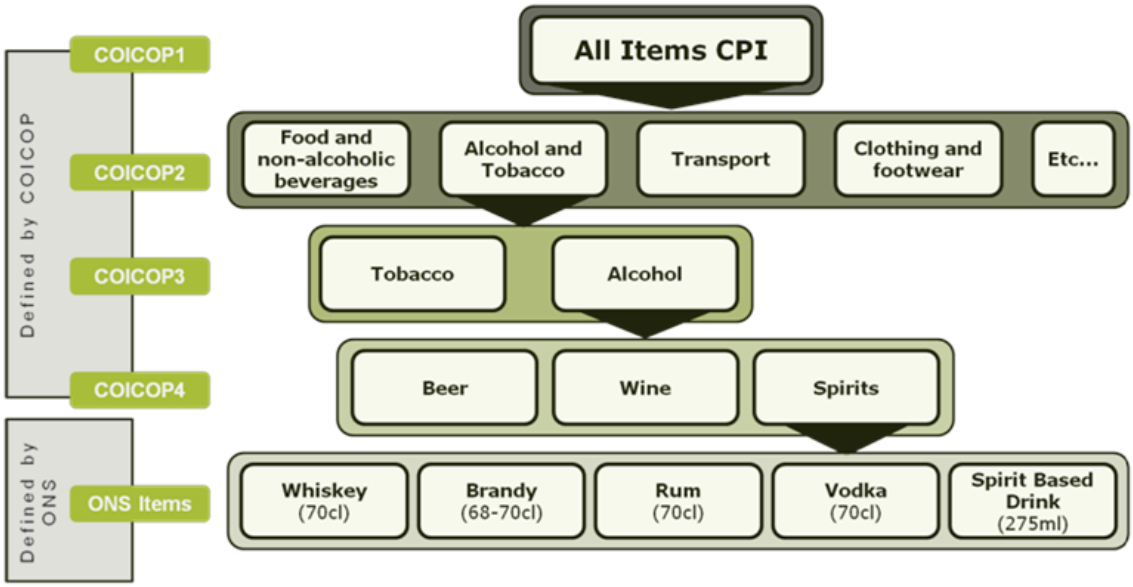
Inflation is calculated by subtracting the past date CPI from the current date CPI and dividing it by the past date CPI.

1.2.2 Structure of UK consumer price indices

Classification of Individual Consumption According to Purpose (COICOP) is an international classification system for household consumption expenditures. COICOP is a hierarchical classification system comprising: divisions (for example, 01 food and non-alcoholic beverages), groups (for example 01.1 food), classes (for example 01.1.1 bread and cereals) and subclasses (for example 01.1.1.1 rice).

In the empirical analysis, we estimate models first with the UK monthly CPI ALL ITEMS data and then at the different disaggregation levels, corresponding to 12 COICOP divisions, the 38 COICOP groups and the 71 COICOP classes. The time series dataset is from the Office for National Statistics (ONS) website.

Figure 1： Example of current COICOP structure in the CPI



Source: Office for National Statistics

1.3 Model Framework

Our model applies to not only UK monthly data but also quarterly data. The monthly or quarterly dummy variable and lag dependent variable are essential for the model. Hence when we change UK monthly data to quarterly data, the corresponding variables are changed. For example, D_{Jan}, D_{Mar}.. to D_{Dec}, they are eleven dummy

variables for each month, we will replace monthly dummies with Q_1, Q_3 and Q_4 in quarterly data. Similarly, the maximum lag-dependent period varies from 12 to 4.

1.3.1 Monthly data regression:

This model for monthly data assumes inflation depends on 12 lagged inflation, dummies variables of each month, three VAT change announcements, and the great recession $\mathrm{D}_{recession}$.

$$\begin{aligned}\pi_t = \pi + \ \mathrm{Trend}_t + \beta_1 D_{Jan} + ... + \beta_{11} D_{Dec} + \beta_{12} D_{\mathrm{recesion}} + \\ \beta_{13} D_{VAT_1} + \beta_{14} D_{VAT_2} + \beta_{15} D_{TAT_3} + \sum_{j=1}^{12} \alpha_j \pi_{t-j} + \sum_{i=1}^{12} \lambda_i CPI_{t-i} + \sigma_t\end{aligned} \quad (1)$$

Where π_t is the inflation, 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. $\mathrm{D}_{recession}$, 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. $\sum_{j=1}^{12} \alpha_j \pi_{t-j}$ is the sum of twelve months lagged inflation dependent variables. $\sum_{i=1}^{12} \lambda_i CPI_{t-i}$ represents the sum of twelve months lags of the inflation rate of CPI ALL ITEMS.

Besides modelling general inflation, I also specify measuring CPI ALL ITEMS inflation. The main difference is removing general inflation and keeping CPI ALL ITEMS inflation. The rest of the part will be the same as modelling general inflation. It represents CPI regression as:

$$\begin{aligned}CPI_t = CPI + \ \mathrm{Trend}_t + \beta_1 D_{Jan} + ... + \beta_{11} D_{Dec} \\ + \beta_{12} D_{\mathrm{recesion}} + \beta_{13} D_{VAT_1} + \beta_{14} D_{VAT_2} + \beta_{15} D_{VAT_3} \\ + \sum_{i=1}^{12} \lambda_i CPI_{t-i} + \sigma_t\end{aligned} \quad (2)$$

1.3.2 Quarterly data regression:

In addition to using monthly data, we also used quarterly data for regression. Since there is no official monthly CPI Quarterly Index available, the quarterly price indexes will be calculated by taking the average of the three-monthly price indexes. Therefore, the regression can be defined as,

$$\begin{aligned}\pi_t = \pi + \ & \mathrm{Trend}_t + \beta_1 Q_1 + \beta_2 Q_3 + \beta_3 Q_4 + \beta_4 D_{\mathrm{recession}} \\ & + \beta_5 D_{VAT_1} + \beta_6 D_{VAT_2} + \beta_7 D_{VAT_3} + \sum_{i=1}^{4} \alpha_j \pi_{t-j} + \sum_{i=1}^{4} \lambda_i CPI\pi_{t-i} + \sigma_t\end{aligned} \tag{3}$$

Where π_t is the quarterly inflation, Q_1, Q_3 and Q_4 are three dummy variables for each quarter, we define Q_2 as base category against which the others are assessed to avoid the dummy variable trap. $\mathrm{D}_{recession}$, D_{VAT_1}, D_{VAT_2} and D_{VAT_3} are the same as equation (1).

Quarterly frequency CPI regression formula:

$$\begin{aligned}CPI_t = CPI + \ & \mathrm{Trend}_t + \beta_1 Q_1 + \beta_2 Q_3 + \beta_3 Q_4 \\ & + \beta_4 D_{\mathrm{recesion}} + \beta_5 D_{VAT_1} + \beta_6 D_{VAT_2} + \beta_7 D_{VAT_3} \\ & + \sum_{i=1}^{4} \lambda_i CPI_{t-i} + \sigma_t\end{aligned} \tag{4}$$

1.4 Stepwise regression

To further discover the independent variables that have a more significant influence on inflation and remove less critical coefficients, we introduce stepwise regression. Stepwise regression is the step-by-step iterative construction of a regression model that involves the selection of independent variables. It usually takes the form of a series of F-tests or T-tests. Still, some researchers may also use other techniques, such as adjusting R square, Akaike information standard (AIC), Bayesian information standard, Mallow's C_P, PRESS, or false discovery rate.

Stepwise included three main approaches: forward selection, backward elimination, and bidirectional elimination.

Forward selection, i.e., no variables from the model start using the selected model fit to add a standard test case for each variable and add in the statistical fit to improve the most significant variable (if any) and repeat this process until no one can improve the model to a statistically significant degree.

Backward elimination method, starting from all potential variables, using the selected model fit criteria to test the deletion of each variable, deleting the variable (if any), the loss of which leads to the least statistically significant deterioration of the model fit. Repeat this process until no other variables can not be removed and there is no statistically insignificant fit loss.

The Bidirectional elimination checks the variables included or excluded at each step, combined with the above methods.

In our simplified process, we apply backward elimination selection based on P-value criteria. For each Division (CPI), 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 (VAT, monthly, crisis etc.) in regression, even if insignificant.

1.5 Seemingly unrelated regressions

So far, the model is estimated by equation-by-equation using standard ordinary least squares (OLS). The estimators are only efficient if we assume the equation errors are uncorrelated. Therefore, It is essential to test whether there is a common shock across the system equation.

In econometrics, the Seemingly Uncorrelated Regression (SUR) or Seemingly Uncorrelated Regression Equation (SURE) model proposed by Arnold Zellner (1962) is an extension of the linear regression model, which consists of multiple regression equations, each has its dependent variable and possibly different exogenous explanatory variable sets. It is assumed that the error of each equation is homogeneous and linearly independent in the basic SUR model. The error of each equation may have its variance. Each equation is correlated with the others in the same period.

There are two exceptional cases when SUR can be viewed as OLS: 1. if the error terms are uncorrelated between the equations, in this case, the system is genuinely unrelated but not seemingly unrelated. 2. when each equation includes the same set of regressors.

This thesis estimates twelve divisions using SUR and then compares them with OLS results. Moreover, the twelve equations error correlation table from SUR can verify whether the system equation error is correlated.

1.6 Results

1.6.1 The structure

Table 1 - Table 4 shows summary tables from OLS and stepwise estimates using monthly and quarterly data, respectively. Table 5 - Table 9 presents stepwise regression output using monthly data at divisions and group levels, while Table 10 - Table 14 in quarterly data. OLS and SUR estimation at the division level is shown in Table 15- Table 16. Table 17 shows the correlation between error measures from the SUR model.

We omit the monthly (quarterly) dummy variables, time trend, recession, and VAT changes in regression output for saving space.

1.6.2 Summary table

We produced four summary tables to make each period's lag variables' significance more straightforward. Tables rows are lagging CPIs and lower price indices. The first column gives the proportion of classes where the coefficient is significant at 1%, and the second column at 5%. The following two columns are the weighted proportion (each type is CPI weighted). The following four columns would be the same as the first four but are the simplified model (i.e., after the stepwise regression program). Tables 1 and 2 are based on monthly data, and Tables 3 and 4 quarterly data.

The whole calculation is class-based and does not contain division to avoid double-counting. If there is no class, the group is used instead—finally, we use 85 regressions to make these tables. For example, in Table 1, we have two out of eleven classes where the coefficient is significant at 1% in food and non-alcoholic beverages, multiplying the corresponding 2014 Food and non-alcoholic beverages weights. In the

same way, then calculate the remaining twelve divisions and add them up, we will get a proportion where the CPI lags by one period is significant at 1%, 4.95% in this case.

1.6.3 OLS Analysis

Take a close look at the OLS summary table details. The OLS estimates with monthly data are in Table 1. Whether weighted or not, at the 1% and 5% significant level, the significant proportion of most lag dependent variables is higher than the CPI lag dependent variable, which implies lag dependent variable may have a higher impact than the CPI lag dependent variable. CPI six-month lag dominates CPI lag dependent variable while lagging one-month and twelve-month have the highest proportion comparing the rest inflation lag dependent variable. From the unweighted to weighted proportion part, the number of each corresponding does not show much fluctuation. When we look at a significant level from 5% to 1%, all explanatory variables had a natural percentage decline. It is worth noting that CPI 11 month lag is not significant below 1% in any 85 class. Lag 1 and 12 still maintained a high significant proportion. More than half of the lag 1 P-value is less than 0.01.

Move to the OLS summary table using quarterly data. The lag dependent variable still dominates CPI lag dependent variables. In 85 OLS regressions, CPI one-quarter lag and inflation one-quarter and four-quarter period lag coefficients are essential in predicting inflation.

1.6.4 Stepwise Analysis

First, starting from the stepwise summary table using monthly data, the significant coefficients proportion does not show many changes compared to OLS estimates. CPI lag variables have little impact on inflation. The significant proportion of CP I six-month lag coefficient in 85 regressions is also the highest. In the unweighted columns, lags one month and twelve months account for a high proportion at a 5% significant level, with 54.12% and 62.35%, indicating more than half of 85 class regressions, the one and twelve-month lag have an essential effect on inflation. As seen from the third column of Table 2, the weighted proportion shows that one-month and 12-month lag significantly impact inflation at the 5% significant level.

Second, a summary table by applying stepwise regression using quarterly data is shown in Table 4. All significant percentage figures increased relative to OLS estimates.

There is little difference between weighted and unweighted. Although variable lagging one-quarter dependent coefficient still dominates the rest of the three-time lag variables, the significant percentage of the variables with four-quarter lag differs little from those with one-quarter lag.

Finally, from Table 1 - Table 4, we can conclude that CPI six-month lag, one and twelve-month lag dependent variables are essential for predicting inflation when using monthly data. In contrast, one and four-quarter lagged dependent variables are significant coefficients to explain inflation using quarterly data.

1.6.5 Seemingly Uncorrelated Regression Analysis

The SUR and OLS estimate comparison can be found in Table 15 and Table 16. These two tables focus on twelve division estimates. From these two tables, the SUR results are similar to OLS. In other words, if we allowed the twelve divisions only related through the error terms, there is little change in the coefficients and significance. Table 17 provides the correlation table between error measures from the SUR estimation. We can see the errors have little correlation.

1.7 Conclusion

Table 1 OLS Analysis: Summary table (Monthly data)

	p<0.01	p<0.05	p<0.01(Weight)	p<0.05(Weight)
CPI_lag1	5.88%	11.76%	4.95%	10.21%
CPI_lag2	3.53%	12.94%	3.51%	15.17%
CPI_lag3	2.35%	11.76%	2.63%	12.32%
CPI_lag4	7.06%	9.41%	9.54%	11.66%
CPI_lag5	1.18%	5.88%	1.38%	5.64%
CPI_lag6	9.41%	16.47%	11.72%	20.98%
CPI_lag7	3.53%	8.24%	2.87%	6.30%
CPI_lag8	1.18%	4.71%	0.99%	3.72%
CPI_lag9	3.53%	9.41%	3.22%	8.41%
CPI_lag10	2.35%	7.06%	2.33%	6.60%
CPI_lag11	0.00%	2.35%	0.00%	1.69%
CPI_lag12	1.18%	3.53%	0.95%	3.22%
Lag1	48.24%	60.00%	46.53%	57.11%
Lag2	25.88%	37.65%	22.37%	36.24%
Lag3	17.65%	29.41%	14.74%	26.90%
Lag4	10.59%	20.00%	8.84%	16.81%
Lag5	4.71%	12.94%	4.75%	11.65%
Lag6	14.12%	24.71%	16.53%	26.91%
Lag7	3.53%	12.94%	3.75%	11.23%
Lag8	4.71%	14.12%	4.64%	12.94%
Lag9	7.06%	21.18%	6.13%	18.74%
Lag10	5.88%	14.12%	5.33%	12.59%
Lag11	8.24%	14.12%	7.46%	13.01%
Lag12	34.12%	54.12%	34.39%	51.35%

Table 2 Stepwise Analysis: Summary Table (Monthly data)

	p<0.01	p<0.05	p<0.01(Weight)	p<0.05(Weight)
CPI_lag1	3.53%	11.76%	2.97%	10.71%
CPI_lag2	4.71%	11.76%	4.46%	14.22%
CPI_lag3	3.53%	12.94%	3.90%	12.71%
CPI_lag4	8.24%	10.59%	10.28%	12.55%
CPI_lag5	1.18%	8.24%	0.99%	8.34%
CPI_lag6	10.59%	16.47%	12.75%	21.28%
CPI_lag7	3.53%	10.59%	2.87%	8.63%
CPI_lag8	1.18%	5.88%	0.74%	5.29%
CPI_lag9	3.53%	12.94%	3.22%	11.07%
CPI_lag10	3.53%	8.24%	3.28%	8.08%
CPI_lag11	1.18%	8.24%	0.74%	10.22%
CPI_lag12	1.18%	7.06%	0.95%	6.87%
Lag1	48.24%	54.12%	46.02%	52.46%
Lag2	25.88%	35.29%	22.35%	33.88%
Lag3	16.47%	23.53%	14.18%	20.57%
Lag4	5.88%	15.29%	5.73%	13.08%
Lag5	5.88%	9.41%	5.70%	8.51%
Lag6	15.29%	23.53%	17.93%	25.95%
Lag7	8.24%	14.12%	7.43%	11.98%
Lag8	7.06%	12.94%	7.36%	12.67%
Lag9	10.59%	17.65%	9.41%	15.53%
Lag10	7.06%	12.94%	6.38%	10.89%
Lag11	7.06%	15.29%	7.74%	14.44%
Lag12	48.24%	62.35%	45.78%	61.38%

Table 3 OLS Analysis: Summary table (Quarterly data)

	p<0.01	p<0.05	p<0.01(Weight)	p<0.05(Weight)
CPI_lag1	8.24%	17.65%	10.93%	18.53%
CPI_lag2	4.71%	11.76%	3.62%	13.24%
CPI_lag3	3.53%	4.71%	2.93%	4.50%
CPI_lag4	4.71%	12.94%	4.31%	14.13%
Lag1	22.35%	35.29%	19.26%	35.03%
Lag2	11.76%	21.18%	14.65%	22.56%
Lag3	4.71%	11.76%	3.95%	9.73%
Lag4	18.82%	28.24%	18.07%	29.74%

Table 4 Stepwise Analysis: Summary Table (Quarterly data)

	p<0.01	p<0.05	p<0.01(Weight)	p<0.05(Weight)
CPI_lag1	9.41%	21.18%	11.68%	21.42%
CPI_lag2	9.41%	16.47%	7.88%	16.07%
CPI_lag3	5.88%	10.59%	6.17%	14.30%
CPI_lag4	7.06%	17.65%	6.05%	18.44%
Lag1	30.59%	38.82%	29.55%	38.00%
Lag2	15.29%	25.88%	17.95%	25.99%
Lag3	11.76%	14.12%	10.16%	12.06%
Lag4	27.06%	34.12%	24.74%	30.85%

Table 5 Stepwise Analysis: CPI and Divisions (Monthly data)

	Dependent variable:												
	CPI	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
lag1		0.15*	-0.15*	-0.19*	0.22*	-0.26*	-0.38*			-0.18*			
lag2				-0.13*		-0.22*	-0.39*						
lag3													
lag4				-0.13*			-0.24*						
lag5							-0.19*						
lag6				0.28*		0.21*	-0.22*			0.18*			
lag10						-0.15*							
lag11							-0.15*						
lag12	0.27*		0.27*	0.33*		0.35*		0.24*		0.22*	0.47*	0.19*	
CPI_lag1													
CPI_lag3				0.67*				-0.57*	0.50*				
CPI_lag4													
CPI_lag6			0.62*										
CPI_lag7			-0.48*			0.58*							
Observations	324	324	324	324	324	324	324	324	324	324	324	324	324
R^2	0.73	0.27	0.62	0.93	0.31	0.92	0.43	0.55	0.17	0.36	0.59	0.44	0.17
Adjusted R^2	0.72	0.22	0.60	0.93	0.26	0.92	0.39	0.52	0.12	0.31	0.57	0.41	0.12
Residual Std. Error	0.19	0.57	0.57	0.68	0.57	0.44	0.69	0.74	0.65	0.29	1.15	0.17	0.30
F Statistic	46.46*	5.85*	23.83*	181.85*	7.11*	154.10*	9.99*	19.44*	3.70*	7.62*	24.66*	14.10*	3.54*

Note: * p<0.01;

Table 6 Stepwise Analysis: Groups 1 (Monthly data)

	Dependent variable:									
	FOOD	NON-ALCOHOLIC BEVERAGES	ALCOHOLIC BEVERAGES	TOBACCO	CLOTHING	FOOTWEAR INCLUDING REPAIRS	ACTUAL RENTALS FOR HOUSING	REGULAR MAINTENANCE AND REPAIR OF THE DWELLING	WATER SUPPLY AND MISC. SERVICES FOR THE DWELLING	
lag1	0.15*	-0.30*	-0.44*		-0.22*					
lag2		-0.16*	-0.27*							
lag3			-0.16*							
lag4										
lag5										
lag6					0.34*	0.17*		0.19*		
lag7		0.15*								
lag9								0.14*		
lag11						0.17*				
lag12		0.19*	0.24*	0.27*	0.29*	0.27*	0.73*		0.27*	
CPI_lag1										
CPI_lag3			0.80*		0.60*					
CPI_lag4				0.58*						
CPI_lag5										
CPI_lag6			1.17*							
CPI_lag7										
CPI_lag9							-0.17*			
CPI_lag12										
Observations	324	324	324	324	324	324	324	324	324	
R^2	0.25	0.33	0.72	0.40	0.93	0.84	0.86	0.24	0.57	
Adjusted R^2	0.21	0.29	0.70	0.36	0.93	0.83	0.86	0.18	0.54	
Residual Std. Error	0.62	0.76	0.82	0.73	0.74	0.74	0.22	0.38	1.04	
F Statistic	5.74*	6.88*	35.49*	11.14*	168.42*	78.54*	96.40*	4.47*	23.57*	

Note: * p<0.01;

Table 7 Stepwise Analysis: Groups 2 (Monthly data)

	Dependent variable:								
	ELECTRICITY, GAS AND OTHER FUELS	FURNITURE, FURNISHINGS and CARPETS	HOUSEHOLD TEXTILES	HOUSEHOLD APPLIANCES, FITTING AND REPAIRS	GLASSWARE, TABLEWARE and HOUSEHOLD UTENSILS	TOOLS AND EQUIPMENT FOR HOUSE AND GARDEN	GOODS AND SERVICES FOR ROUTINE MAINTENANCE	MEDICAL PRODUCTS, APPLIANCES AND EQUIPMENT	OUT-PATIENT SERVICES
lag1	0.26*	-0.50*	-0.35*	-0.20*	-0.31*		-0.22*	-0.43*	
lag2		-0.37*	-0.16*					-0.35*	
lag3		-0.14*							
lag4							-0.17*	-0.16*	
lag5									
lag6		0.14*							
lag7		0.12*		0.15*					
lag8							-		
lag10		-0.19*							-0.20*
lag11		-0.22*							
lag12		0.26*	0.18*	0.24*	0.14*				
CPI_lag1									
CPI_lag2						0.62*			
CPI_lag3									
CPI_lag4						0.52*			
CPI_lag5									
CPI_lag6			0.66*						
CPI_lag7							0.84*		0.37*
CPI_lag8						0.63*			
CPI_lag9									
CPI_lag11					0.62*				
CPI_lag12									
Observations	324	324	324	324	324	324	324	324	230
R^2	0.13	0.91	0.88	0.40	0.68	0.25	0.26	0.39	0.29
Adjusted R^2	0.08	0.90	0.87	0.36	0.65	0.20	0.21	0.34	0.22
Residual Std. Error	1.59	0.90	0.80	0.99	0.85	0.65	0.56	0.76	0.40
F Statistic	2.63*	106.00*	103.43*	10.65*	27.66*	4.76*	5.00*	7.91*	4.44*

Note: * p<0.01;

Table 8 Stepwise Analysis: Groups 3 (Monthly data)

	Dependent variable:									
	HOSPITAL SERVICES	PURCHASE OF VEHICLES	OPERATION OF PERSONAL TRANSPORT EQUIPMENT	TRANSPORT SERVICES	POSTAL SERVICES	TELEPHONE AND TELEFAX EQUIPMENT AND SERVICES	AUDIO-VISUAL EQUIPMENT AND RELATED PRODUCTS	OTHER MAJOR DURABLES FOR RECREATION AND CULTURE	OTHER ITEMS, PETS	RECREATIONAL GARDENS and
lag1		0.39*	0.31*	-0.49*					-0.42*	
lag2				-0.34*						
lag3	-0.25*			-0.40*			0.17*		-0.15*	
lag4				-0.27*						
lag5		-		-0.24*						
lag6	-0.21*			-0.31*			0.16*			
lag7				-0.30*					-0.15*	
lag8				-0.18*			0.19*			
lag9				-0.39*						
lag10		0.15*		-0.32*						
lag11			0.18*	-0.20*						
lag12	0.47*			0.26*			0.17*		0.26*	
CPI_lag2			-1.00*	1.85*						
CPI_lag3										
CPI_lag5										
CPI_lag7		-0.42*								
CPI_lag9				1.60*						
Observations	216	324	324	324	324	324	324	228	324	
R^2	0.67	0.41	0.33	0.80	0.21	0.17	0.35	0.36	0.38	
Adjusted R^2	0.64	0.37	0.29	0.78	0.17	0.12	0.31	0.30	0.33	
Residual Std. Error	0.47	0.51	0.95	1.89	1.63	0.70	0.86	0.43	0.75	
F Statistic	20.81*	10.02*	7.58*	37.07*	4.63*	3.48*	8.31*	6.53*	8.68*	

Note: * p<0.01;

Table 9 Stepwise Analysis: Groups 4 (Monthly data)

	Dependent variable:										
	RECREATIONAL AND CULTURAL SERVICES	BOOKS, NEWSPAPERS AND STATIONERY	PACKAGE HOLIDAY	CATERING SERVICES	ACCOMMODATION SERVICES	PERSONAL CARE	PERSONAL EFFECTS (NEC)	SOCIAL PROTECTION	INSURANCE	FINANCIAL SERVICES (NEC)	OTHER SERVICES (NEC)
lag1	-0.17*	-0.21*	0.43*		-0.21*	-0.21*	-0.16*				
lag2			0.24*								
lag3									0.25*		
lag6					-0.19*		0.18*		0.15*		
lag8											
lag9										0.18*	0.17*
lag12	0.22*	0.26*		0.20*		0.16*	0.18*	0.36*	0.14*		0.21*
CPI_lag1							0.55*				
CPI_lag2											
CPI_lag3											
CPI_lag4				0.11*							
CPI_lag6					-0.56*		0.44*				
CPI_lag7											
CPI_lag9	0.34*										
CPI_lag10											
CPI_lag11											
CPI_lag12											
Observations	324	324	311	324	281	324	324	228	324	324	324
R^2	0.62	0.34	0.47	0.53	0.34	0.23	0.74	0.61	0.25	0.08	0.28
Adjusted R^2	0.60	0.30	0.43	0.50	0.30	0.18	0.72	0.57	0.20	0.02	0.23
Residual Std. Error	0.45	0.70	0.29	0.12	0.69	0.46	0.53	0.15	1.01	1.74	0.51
F Statistic	23.95*	7.19*	12.66*	16.34*	7.21*	4.67*	41.44*	14.41*	5.06*	1.43	5.87*

Note: * p<0.01;

Table 10 Stepwise Analysis: CPI and Divisions (Quarterly data)

	Dependent variable:											
	CPI	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	12MS
lag1	0.31*							0.26*		0.36*		0.29*
lag2				0.30*		0.30*						
lag3												
lag4	0.26*		0.38*	0.31*						0.29*	0.42*	
CPI_lag1		0.80*	0.65*		0.89*							
CPI_lag2												
Observations	108	108	108	108	108	108	108	108	108	108	108	108
R^2	0.71	0.28	0.65	0.95	0.27	0.81	0.23	0.68	0.29	0.49	0.63	0.25
Adjusted R^2	0.68	0.21	0.61	0.94	0.21	0.79	0.15	0.65	0.23	0.44	0.60	0.18
Residual Std. Error	0.003	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.004	0.02	0.004
F Statistic	23.54*	4.25*	17.64*	156.35*	4.11*	34.39*	2.84*	20.97*	4.51*	9.41*	18.56*	3.54*
Note:												* p<0.01;

Table 11 Stepwise Analysis: Groups 1 (Quarterly data)

	Dependent variable:							
	FOOD	NON-ALCOHOLIC BEVERAGES	ALCOHOLIC BEVERAGES	TOBACCO	CLOTHING	FOOTWEAR INCLUDING REPAIRS	ACTUAL RENTALS FOR HOUSING	REGULAR MAINTENANCE AND REPAIR OF THE DWELLING
lag1			-0.47*					
lag2					0.32*			0.39*
lag4			0.22*	0.42*	0.28*	0.33*	0.73*	
CPI_lag1	0.82*		1.28*					
CPI_lag2		0.64*	0.72*					
CPI_lag4		0.62*						
Observations	108	108	108	108	108	108	108	108
R^2	0.26	0.55	0.77	0.46	0.95	0.86	0.84	0.36
Adjusted R^2	0.19	0.50	0.75	0.42	0.94	0.85	0.83	0.30
Residual Std. Error	0.01	0.01	0.01	0.01	0.01	0.01	0.004	0.01
F Statistic	3.84*	10.75*	27.18*	9.44*	154.23*	67.80*	59.27*	6.01*

Note: * p<0.01;

Table 12 Stepwise Analysis: Groups 2 (Quarterly data)

	Dependent variable:							
	WATER SUPPLY AND MISC. SERVICES FOR THE DWELLING	ELECTRICITY, GAS AND OTHER FUELS	FURNITURE, FURNISHINGS and CARPETS	HOUSEHOLD TEXTILES	HOUSEHOLD APPLIANCES, FITTING AND REPAIRS	GLASSWARE, TABLEWARE and HOUSEHOLD UTENSILS	TOOLS AND EQUIPMENT FOR HOUSE AND GARDEN	GOODS AND SERVICES FOR ROUTINE MAINTENANCE
lag1		0.31*	-0.33*					
lag2							0.24*	
lag3			-0.29*					
lag4	0.25*				0.31*			
CPI_lag1							1.02*	
CPI_lag2			0.72*				0.80*	0.57*
CPI_lag4								
Observations	108	108	108	108	108	108	108	108
R^2	0.53	0.18	0.78	0.76	0.37	0.57	0.42	0.26
Adjusted R^2	0.48	0.10	0.75	0.73	0.31	0.52	0.35	0.19
Residual Std. Error	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.01
F Statistic	12.04*	2.38	30.64*	30.62*	6.29*	12.78*	6.31*	3.45*

Note: * p<0.01;

Table 13 Stepwise Analysis: Groups 3 (Quarterly data)

	Dependent variable:							
	HOSPITAL SERVICES	PURCHASE OF VEHICLES	OPERATION OF PERSONAL TRANSPORT EQUIPMENT	TRANSPORT SERVICES	POSTAL SERVICES	AUDIO-VISUAL EQUIPMENT AND RELATED PRODUCTS	OTHER MAJOR DURABLES FOR RECREATION AND CULTURE	OTHER RECREATIONAL ITEMS, GARDENS and PETS
lag1	-0.63*	0.37*		-0.42*		0.44*		
lag2	-0.66*			-0.46*				
lag3	-0.55*			-0.41*		0.25*		
lag4				0.31*	0.57*			0.44*
CPI_lag1								
CPI_lag2								
CPI_lag3								
CPI_lag4		1.11*						0.53*
Observations	73	108	108	108	108	108	77	108
R^2	0.66	0.45	0.46	0.85	0.57	0.49	0.33	0.44
Adjusted R^2	0.59	0.38	0.41	0.82	0.53	0.44	0.24	0.39
Residual Std. Error	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01
F Statistic	9.79*	6.44*	9.13*	36.81*	14.23*	9.41*	3.73*	7.75*

Note: * p<0.01;

Table 14 Stepwise Analysis: Groups 4 (Quarterly data)

	Dependent variable:									
	RECREATIONAL AND CULTURAL SERVICES	BOOKS, NEWSPAPERS AND STATIONERY	PACKAGE HOLIDAY	CATERING SERVICES	ACCOMMODATION SERVICES	PERSONAL CARE	PERSONAL EFFECTS (NEC)	SOCIAL PROTECTION	INSURANCE	OTHER SERVICES (NEC)
lag1			0.82*				0.26*		0.58*	
lag2					-0.35*					
lag3										0.28*
lag4	0.24*							0.29*		
CPI_lag1				0.25*						
CPI_lag2							0.71*			-0.64*
CPI_lag3	0.45*									
CPI_lag4							0.58*	-0.26*		
Observations	108	108	105	108	93	108	108	76	108	108
R^2	0.70	0.17	0.56	0.69	0.53	0.28	0.60	0.70	0.38	0.41
Adjusted R^2	0.67	0.09	0.52	0.66	0.47	0.21	0.55	0.63	0.32	0.34
Residual Std. Error	0.01	0.01	0.01	0.002	0.01	0.01	0.01	0.002	0.02	0.01
F Statistic	22.81*	2.25	12.18*	19.71*	9.24*	4.20*	11.89*	10.97*	6.57*	6.01*

Note: * p<0.01;

Table 15 OLS estimation: The twelve divisions (monthly data)

	Dependent variable:											
	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
lag1	.13	-.18*	-.24*	.21*	-.30*	-.41*	-.07	0.00	-.17*	-.06	-.14	-.12
lag2	-.01	-.09	-.11	.05	-.24*	-.39*	.05	.08	.02	.02	-.01	0.00
lag3	-.03	.03	-.15*	-.11	-.10	.12	.04	.07	.01	-.05	-.05	.12
lag4	-.15	-.05	-.14	.01	-.06	-.23*	.06	-.09	.14	.01	-.01	.04
lag5	.03	-.04	.11	-.01	-.04	-.23*	-.10	-.06	.16*	.02	0.00	.06
lag6	-.03	-.06	.32*	.03	.21*	-.25*	-0.00	-.03	.17*	-0.00	-.09	.05
lag7	-.02	-.05	.08	.06	.09	-.10	.02	.01	-.05	-.02	-.03	-.01
lag8	-.05	-.08	-.01	-.11	0.00	-.02	.07	-.03	.03	-.01	-.03	-.08
lag9	-.04	-.06	.10	.04	.05	-.01	-.12	.12	.08	.02	-.14	.07
lag10	.05	.05	.01	-.04	-.16*	.02	-0.00	.09	-.01	-.03	-.01	.01
lag11	-.10	-.01	-.01	-.08	-.13	-.17*	.06	-.06	.02	-.06	-.02	-.01
lag12	.11	.28*	.32*	.17*	.34*	-.09	.19*	-.03	.18*	.45*	.17*	.12
CPI_lag1	.13	0.00	.36	.05	-.06	-.18	.70	-.16	-.03	-.12	.08	.20
CPI_lag2	.07	-.04	-.28	.13	.15	-.09	-.11	-.06	-.06	-.31	.04	-.09
CPI_lag3	.03	.33	.68*	.41	.13	-.11	-.69	.49	.05	.84	.02	-.02
CPI_lag4	.53*	.31	.28	.19	.06	-0.00	-.22	-.23	-.12	-.19	.09	-0.00
CPI_lag5	-.09	.02	-.32	.16	.07	-.20	.31	.38	-.11	-.62	0.00	-.02
CPI_lag6	.16	.69*	-.01	-.38	.16	.12	-.32	-.16	-.14	.44	.02	-.01
CPI_lag7	.04	-.46*	.01	.09	.46*	.29	.01	-.06	-.03	-.32	.05	.09
CPI_lag8	.41	.10	.26	.04	-.01	.35	-.34	.26	.04	.05	-.02	-.08
CPI_lag9	-.02	.14	.08	.03	-.14	-.20	.38	-.13	.02	-.05	.08	-.05
CPI_lag10	-.13	.18	.19	.15	.22	-.16	.20	-.02	-.02	.43	-.02	-.03
CPI_lag11	.23	.15	.12	.19	.12	.01	-.10	.19	.13	.12	-0.00	.07
CPI_lag12	.09	-.05	-.18	-.09	-.06	.36	.07	.04	.06	-.02	-.05	-.08
Observations	324	324	324	324	324	324	324	324	324	324	324	324

Note: * p<0.01;

Table 16 SUR estimation: The twelve divisions (monthly data)

	Dependent variable:											
	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
lag1	.10	-.21*	-.25*	.18*	-.33*	-.38*	-.07	0	-.16*	-.07	-.12*	-.13*
lag2	-.04	-.09	-.11	.06	-.25*	-.37*	.05	.09	.03	.01	-.02	0
lag3	-.05	.03	-.13*	-.13*	-.1	.15*	.05	.09	.05	-.04	-.05	.10
lag4	-.17*	-.05	-.11	.02	-.07	-.23*	.05	-.07	.13*	.02	-.06	.03
lag5	.04	-.02	.12*	-.02	-.06	-.23*	-.07	-.04	.18*	.02	-.03	.06
lag6	-.05	-.07	.32*	.02	.17*	-.25*	.01	-.02	.17*	-.01	-.11	.07
lag7	-.03	-.04	.09	.05	.09	-.11	.02	.01	-.07	-.01	-.02	0
lag8	-.09	-.07	-.01	-.09	0	-.01	.07	-.01	-.01	-.02	-.09	-.07
lag9	-.02	-.07	.08	.03	.06	.01	-.13	.13*	.09	.01	-.12*	.07
lag10	.03	.03	0	-.02	-.15*	.05	0	.09	.01	-.02	-.05	-.01
lag11	-.09	0	-.03	-.08	-.13*	-.15*	.08	-.06	.03	-.05	-.03	.01
lag12	.12	.28*	.32*	.17*	.35*	-.09	.22*	-.02	.17*	.44*	.14*	.12*
CPI_lag1	.17	.02	.36	.08	-.02	-.17	.71*	-.14	-.04	-.10	.08	.20*
CPI_lag2	.11	-.06	-.28	.14	.15	-.11	-.11	-.06	-.06	-.33	.04	-.09
CPI_lag3	.07	.33	.65*	.43*	.12	-.10	-.71*	.48*	.04	.82*	.03	-.01
CPI_lag4	.56*	.32	.24	.19	.05	0	-.22	-.23	-.10	-.17	.10	0
CPI_lag5	-.07	.01	-.33	.19	.09	-.22	.25	.37	-.12	-.61	.02	-.02
CPI_lag6	.20	.69*	-.01	-.36*	.19	.13	-.36	-.17	-.14	.42	.02	-.01
CPI_lag7	.07	-.44*	-.01	.1	.47*	.29	.02	-.07	-.02	-.34	.06	.09
CPI_lag8	.46*	.08	.24	.03	.01	.34	-.31	.24	.05	.06	-.01	-.08
CPI_lag9	-.05	.14	.09	.04	-.17	-.21	.41	-.13	.01	-.03	.09	-.05
CPI_lag10	-.10	.20	.18	.14	.2	-.17	.19	-.02	-.03	.40	-.01	-.02
CPI_lag11	.21	.14	.12	.18	.14	.01	-.15	.19	.13	.14	0	.07
CPI_lag12	.10	-.04	-.17	-.1	-.03	.37	.02	.03	.07	.01	-.04	-.08
Observations	324	324	324	324	324	324	324	324	324	324	324	324

Note: * p<0.01;

Table 17 The correlation between the Errors from the SUR estimates

	01FB	02AT	03CF	04HW	05FH	06HL	07TR	08CM	09RC	10ED	11RH	12MS
01FB	1.00											
02AT	0.00	1.00										
03CF	-0.06	0.07	1.00									
04HW	0.03	-0.15	-0.10	1.00								
05FH	0.14	0.14	0.13	-0.07	1.00							
06HL	0.00	-0.09	-0.05	0.11	0.05	1.00						
07TR	0.05	-0.01	0.02	0.02	0.04	-0.12	1.00					
08CM	0.10	-0.06	-0.03	-0.06	-0.01	0.10	-0.00	1.00				
09RC	0.07	0.05	-0.08	-0.00	-0.01	-0.04	0.01	0.02	1.00			
10ED	0.15	0.02	0.02	0.01	-0.04	0.09	0.03	0.02	-0.02	1.00		
11RH	0.10	0.12	0.05	0.11	-0.03	-0.16	-0.06	0.02	0.22	0.01	1.00	
12MS	0.09	0.03	0.15	0.07	0.01	0.07	-0.07	-0.03	-0.03	0.02	0.07	1.00

Chapter 2: Different meanings of core inflation

2.1 Introduction

Current and future inflation matters to monetary policy makers and market participants. The most important measure of inflation identified in most economies is the year-on-year increase in the consumer price index (CPI) or Personal Consumption Expenditures (PCE) index published by national statistics authorities. Still, there are at least three problems with these official inflation indicators:

Although researchers and central banks widely use core inflation, there are no clear and accepted definitions. It may find a different message from the various measures of core inflation.

There are two very different uses of the term core inflation. First, its meaning is a statistically robust measure of actual inflation. These measures try to exclude extreme prices or unstable changes from the sample of price changes to obtain more effective and less biased inflation estimates. The second concept is very different from the first. It refers to the part of actual inflation that reflects the underlying pressure in the economy.

No consensus on the definition of core inflation reflects the underlying economic pressure. Still, all these measures are based on the observation that inflation indicators may be "noisy", making it challenging to interpret underlying inflation developments. For example, Bryan and Cecchetti (1993) proposed that core inflation is related to the growth rate of the money supply. Blinder (1997) defines core inflation as the "persistent" part of the inflation, while Quah and Vahey (1995) define core inflation as the part of inflation that has no medium - and long-term impact on actual output.

This chapter is organised in the following way:

2.2 The Concept of Core Inflation

The current mainstream view on core inflation is fundamentally different from changes in the cost of living. The cost of living index theory is the most complete and coherent inflation measurement framework currently in existence: the fundamental idea takes a representative household's expenditure or cost function at a given point in time as its starting point. The change in the minimum cost u to reach the reference utility level

between the two periods is the change in the cost of living between the base period 0 and the subsequent comparison period 1. Proper elaboration of this theory forms the design framework of the US Consumer Price Index (CPI). However, the cost-of-living index theory is not the theoretical framework of the harmonised Consumer Price Index (HICP) used to assess inflation in the euro area. Although there is a relatively well-defined price concept, namely "final household monetary consumption", HICP lacks a complete theoretical framework. By avoiding the idea of the cost of living, the Statistical Office of the European Communities (Statistics of the European Communities) can reasonably promote excluding specific categories of prices from HICP. The most concerning type is the missing cost of owner-occupied housing. For example, in the US CPI, owner-occupied housing costs are measured based on rent equivalent, which is appropriate considering the cost of the living concept behind the US CPI. The service flow cost of consumption can better replace the cost of purchasing owner-occupied housing. Since the equivalent rental cost of monthly consumer housing services is not part of household monetary consumption, it is not priced as part of HICP. However, the net purchase cost of new housing can be part of this consumption, and Eurostat is currently studying ways to include this cost in HICP.

A standard measure of core inflation excludes the impact of indirect tax changes from the overall inflation rate. Donkers et al. (1983) discussed how many European countries do this. From the perspective of monetary policy, such measures may arouse people's interest because it can be said that the acceleration of overall inflation caused to some extent by the increase in indirect taxes should not cause the central bank to worry about it. As reviewed by Donkers et al., the current practice is to use ad hoc methods to estimate the inflation rate after deducting indirect taxes. The specific method used varies from country to country. One approach is to (i) assume that all observed price changes reflect taxes and (ii) calculate a substitute CPI based on this assumption. However, Mark (2008) states that this approach assumption about supply elasticities (perfectly elastic) is not very close to reality for many products. In addition, some methods consider the impact of changes in indirect tax rates on the structure of production prices. However, a variant of the Diewert and Bossons (1987) analysis still requires the restrictive assumption that the input-output system of the economy is invariant to changes in indirect tax rates.

The different calculations are because there is no consensus on what core inflation statistics measure. If we pursue an actual cost of living index, it is unclear whether we should eliminate the impact of tax increases from our price measurement. Moreover, the above reasoning is only partially equilibrium. To correctly handle the effects of indirect taxes on measuring price levels, a detailed general equilibrium analysis of the impact of tax increases is needed, which will go far beyond current practices. Diewert and Fox (1998) proposed a method to deal with tax changes, and the purpose is to use inflation to compare welfare. The substantial price changes of the relevant products reflect changes in indirect taxes that apply to particular products but not others. The biased impact estimates of core inflation proposed by Bryan and Pike (1991) and Bryan and Cecchetti (1994) will ignore these observations when calculating inflation. However, the considerable changes in relative prices caused by changes in indirect taxes can differ from those caused by other factors, such as developing supply and demand in the market for specific goods or services. These other factors may be more challenging to determine than changes in indirect taxes, so it may be harder to filter out their impact on the headline inflation rate.

The typical starting point for almost all analyses of core inflation is that monetary policymakers should focus on a well-defined concept of monetary inflation. This type of inflation is conceptually different from the cost of living and not adequately captured by standard price statistics. Therefore, some people believe that the central bank should target a price index whose growth rate corresponds to the cost of inflation. The central bank is trying to avoid this cost by focusing on inflation control objectives. Inflation undermines the coordination of economic activities and impedes the use of fiat money in market transactions. While changes in the cost of living may reflect some of the inflation costs, some may require broader market-traded measures. From the above discussion, we can conclude that we need a macroeconomic theory of the cost of inflation rather than a microeconomic theory of the cost of living from a monetary policy perspective. Therefore, essentially all measures of core inflation aim to measure inflation from a monetary policy perspective. (Wynne, 2008)

2.3 Measures of core inflation

To measure core inflation and remove temporary relative price changes from headline inflation indicators (mainly CPI), official statistical agencies and researchers have proposed some measures that can be broadly classified into two categories: statistical and modelling approaches.

Statistical approaches generally distinguish between headline inflation's temporary and persistent components through the statistical processing and analysis of price data, including exclusion methods, limited impact estimation methods, variance weighting methods, and trend estimation methods.

The modelling approach is mainly based on economic theory through modelling to examine core inflation, multivariate analysis of the relationship between headline inflation and the determinants in the past, and thus isolate core inflation

2.3.1 Exclusion—Based Methods

The exclusion method fixes the removal of specific components of the CPI that are highly volatile. The main idea is that some parts of the CPI reflect supply-side movements rather than changes in aggregate demand. The impact of these price changes would fade away with no change in monetary policy so that their exclusion better reflects existing inflationary pressures.

The exclusion method is simple to calculate, easy to interpret, produces timely results, and is transparent in its approach. The economic logic of the exclusion approach is that some components of the CPI reflect changes in supply rather than aggregate demand. This is done by removing certain specific commodities, reallocating the weights of the remaining basket of items and calculating the price index on a weighted average. Frequently excluded items include: (1) Food and energy, as their prices are more volatile and determined mainly by supply. (2) Indirect taxes and regulated prices because they are exogenous variables to monetary policy. (3) Mortgage interest payments because it affects the CPI in the opposite direction to what monetary policy is trying to do. Using this standard elimination method will make it less likely for the public suspects that the authorities are manipulating the inflation target. It will also make the elimination method of CPI comparable internationally.

The criteria for exclusion should be transparent. In the case of Canada, for example, the eight most volatile components excluded were selected based on historical data, and their month-on-month distance from the mean exceeded 1.5 times the standard deviation more than 25% of the time in the last 15 years. In addition, the credibility of the exclusion is also important in deciding what to exclude. For example, food and energy may be important components of consumer spending, especially in developing countries. Their elimination may create credibility problems for measures of core inflation for poorer members of society (Lehohla and Myburgh, 2002).

The elimination of all indirect taxes and subsidies removes exogenous factors that influence prices. One of the assumptions on which they are based is that: tax changes are passed through immediately. They have a one-to-one effect on consumer prices reasonable but unrealistic since taxes can affect wages and the prices of other goods and services, creating second-round effects. And it's necessary to exclude interest rates from core inflation. If interest rates are included, a rise in interest rates in an attempt to reduce inflation would instead increase inflation.

The disadvantage of the exclusion method is mainly that the determination of the excluded items, although relatively well-founded objectively, is still somewhat subjective.

2.3.2 Trimmed Mean

It is also argued that CPI is influenced not only by monetary factors but also by relative price changes caused by nominal price rigidity. According to menu-cost theory, in the face of a specific impact, some micro-enterprises with relatively high menu costs do not adjust immediately but adjust only when the impact exceeds the critical value. Therefore, price changes in real life tend to show skewness distribution. To calculate the trend of price changes, the end values of those abnormal fluctuations need to be eliminated. This is Bryan and Cecchetti's (1994) trimmed mean method, which works as follows: significant changes in relative prices do not contain information about underlying inflation trends because these price changes are quickly reversed.

The trimmed mean method requires first sorting the indices of the CPI index, trimming the tails of the sample distribution where the indices are too volatile, and then averaging the remainder.

Specifically, the data will first be sorted and obtained $\{x_1.....x_n\}$. Their corresponding weights in the same order are $\{w_1...,w_n\}$, then, defined as the cumulative weights as the weight of W_i, i.e. $W_i \equiv \sum_{j=1}^{i} W_j$, $\alpha/100 \ < \ W_i \ < (1-\alpha/100)$, which reflects the range of observations that will be used to calculate the mean of the observed data range I_α. The formula for the α% trimmed mean $\bar{x}_\alpha$ is:

$$\bar{x}_\alpha = \frac{1}{1-2\alpha/100} \sum_{i \in I_\alpha} w_i x_i \tag{5}$$

There are two exceptional cases for trimming mean: if the value α is taken to be 50, then the weighted median is obtained; if the value α is taken to be 0, then the weighted mean is obtained. Trimmed mean values can be calculated for different trim ratios for comparison. There is a trade-off between removing extreme values and loss of information when determining the trimming ratio.

In contrast to the exclusion method, the CPI components excluded by the trimmed mean depend on the magnitude of their relative price change rather than being arbitrary. However, there are some problems with the trimmed mean value. First, the nature of the shock or the reason for the extreme values needs to be identified. For example, Mankikar and Paisley (2004) show that the sharp increase in beef prices caused by the supply shock of the 2001 foot-and-mouth disease outbreak was rightly trimmed, but the smaller readjustment in subsequent months was not. Central banks do not want to react to price fluctuations that may reverse quickly, which means that first and second-round effects should be removed from the calculation of core inflation. In addition, some product groups have persistent price trends that differ from other product groups. For example, the price of electronics can fall quickly when general inflation rises. The trimming mean method may erroneously remove this trend as a persistent shock, resulting in an overestimation of the overall inflation trend.

Secondly, the trimmed mean value varies depending on the trim level. There is no ideal trim ratio, and the level of subdivision of the base data also affects its value. Generally speaking, when the sample size is sufficiently large, the finer the basic data, the better.

Again, the trimmed means are systematically lower than the CPI, suggesting that they cut information other than random shocks (Kearns, 1998; Cutler, 2001). Roger (2000) points out that the lower value of the trimmed mean is due to empirical studies showing a positive skewness of price changes and suggests trimming more of the right-hand tail than the left. The skewness of a given country-specific price change should be determined prior to the calculation of the trimmed mean value.

The trimmed mean is also timely, transparent and easy to compile. It requires access to structural and weighting data for the CPI but has no requirement for the time series length. Once the data has been adjusted, it is unnecessary to correct the historical data, and the public quickly understands it. Trimmed mean is accepted by many countries, announced and updated online. The National Institute of Economic and Social Research (NIESR) published the UK trimmed mean inflation per month.

2.3.3 Sticky-price measures

The underlying factors that influence traditional inflation forecasts do not affect all prices equally. For example, some prices are "sticky," meaning they may not respond as quickly to market changes as other commodities with more "flexible" prices. Moreover, because sticky prices change slowly, it seems reasonable to assume that they better reflect expectations of future inflation when these prices are specific than frequently changing prices.

There are many explanations for prices being sticky. The prevailing view is that price changes can entail high costs in some markets. These costs can significantly reduce the incentive for firms to change their prices. Since price-makers understand that varying prices are costly, they will want their price decisions to take into account inflation in the period between price changes.

In addition to studying the question of what makes prices sticky, other researchers have studied the speed of recording price adjustments.

Mark Bills and Peter Klenow, using unpublished data from the US Bureau of Labor Statistics (BLS) from 1995 to 1997, examine the frequency of monthly price changes for 350 consumer goods and services, accounting for about 70% of consumer spending. They find that many prices rarely change. Prices for newspapers, men's haircuts and

cabs change less than 5% per month. In contrast, many prices change very frequently. The prices of gasoline, tomatoes and airline tickets vary by 70% each month.

2.4 Comparison of various core inflation measures

It is not easy to compare and evaluate various measures of core inflation. Mark A. Wynne (1999) proposes suitable criteria for assessing core inflation: 1. Timeliness (can be calculated in real-time) 2. Foresight (has the function of predicting future inflation trends from the calculation method) 3. Consistency of trend (can accurately capture the underlying movement trend of the target inflation series 4. Intelligibility (can be understood by the public) 5. Stability (historical values remain unchanged) 6. Theoreticality (does it rely on economic theory).

The exclusion method has the advantage of being easy to understand and calculate and does not require a long time series but requires a pre-determination of those items that should be deducted.

The trimmed mean does not require a pre-determination of which items should be deducted. It has the advantage of being easy to calculate and does not require a long time series, but requires detailed information on the composition of the price index and requires a practical choice of trimming ranges.

The sticky-price measure requires the frequency of price change data, which is a tedious task. However, it does not require a long time series but should draw the line between a sticky-price and a flexible price.

Table 18 Criteria for selecting a measure of core inflation

	Exclusion method	Trimmed mean	Sticky-price
Computable in real-time	Yes	Yes	Yes
Forward-looking	No	No	No
Track record	Yes	Yes	Yes
Understandable by public	Yes	Yes	Yes
History does not change	Yes	Yes	Yes
Theoretical basis	No	No	No

2.5 Estimates of UK core CPI

We measured the core CPI using the Consumer Price Index (CPI) compiled by The Office for National Statistics in the UK as the benchmark indicator, using the exclusion method, trimmed mean and sticky-price, respectively.

2.5.1 Excluding food and energy

The items excluded from core inflation by central banks are not consistent across countries. Still, they can all be grouped into the following three categories: (1) the most excluded items are unprocessed foodstuffs, which have seasonal solid price fluctuations and are often supply-driven even when there are non-seasonal movements; (2) most countries also exclude energy items as energy price fluctuations usually come from international markets; (3) some countries also exclude goods that are affected by changes in indirect taxes; or prices that are regulated by the government, such as household fuels, public transport, postal services, telephone services and tobacco.

We considered several exclusion types of metrics and ultimately excluded food and energy measures(FE). These measures have been calculated for a long time and have received regular coverage in the media, so they are relatively easy to understand.

This type is constructed by excluding food and energy from the inflation measure. We get rid of the food (division 01) and energy parts of division (04) and transport (07). We then rescale the weights to add up to 1 and have the core inflation excluding food and energy. The data is from January 2005 to December 2019.

Figure 2 CPI excluding food and energy

Figure 2 plots annual CPI all items and CPI excluding food and energy. The two

series trends are similar, but the fluctuations of FE are more stable. CPI all items diverged from this measure of underlying inflation on three prominent occasions: 2007, 2013 and 2015-2016. In 2007 both energy and food price inflation rose sharply, but this proved temporary and was unwound in 2008. Similarly, in 2013, food and energy positively contributed to CPI all items, but this was short-lived and was unwound in 2014. By the beginning of 2015, CPI all items were just lower than towards the end of 2014. It was between 0 and 1.9 during this period. By contrast, CPI excluding food and energy was much smoother, around 1.2 over this period. In both cases, changes in food and energy prices proved to be temporary, and there may be reasons to ignore these items in policy formulation.

2.5.2 Trimmed Mean approach

The historical trimmed mean data is collected from the National Institute of Economic and Social Research (NIESR). NIESR start by collecting micro-data on the prices of individual goods in the UK Consumer Price Index (CPI) for all goods. The data set contains prices for as many as 135,000 goods and services per month, adding up to about 30 million price quotes since the 1990s. These data will also enable us to monitor the variance, skewness, kurtosis and frequency of price changes at regional and country resolutions.

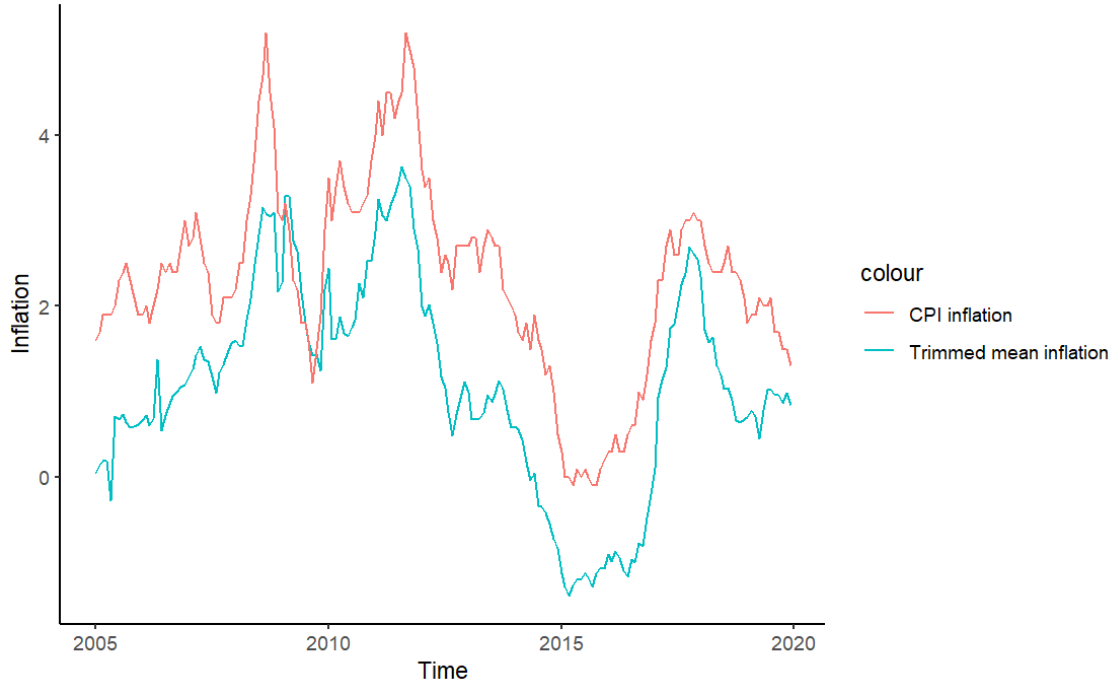
The first step is to calculate the month-to-month inflation rate for the item $i = 1, 2..., N$ at the time t: $\Delta p_{i,t} = \frac{p_{i,t}}{p_{i+1}} - 1$ to calculate the trimmed mean. The next step is to choose a 5 per cent trimmed mean for each month $\Pi_{j,t}^{m}$. The reason determines 5 per cent is that it outperforms the CPI and CPI-ex for future inflation, not only on a 12-month horizon but also on a 24-month and 36-month horizon. Finally, calculate the annualised trimmed mean for the jth percentage of each month:

$$\prod_{j,t}^{y} = \left(\left(I + \prod_{j,t}^{m}\right) \times \left(I + \prod_{j,t-l}^{m}\right) \times ... \times \left(I + \prod_{j,t-1|}^{m}\right) - I\right).$$

Figure 3 is the UK CPI and trimmed mean year-on-year inflation. The highest value for the UK trimmed mean of 3.6 in August 2011, and the lowest point was -1.4 in March 2015. Headline consumer inflation fell significantly, from 5.2 per cent in September 2008 to 3.1 per cent in September 2009. As measured by the trimmed mean, the

measure of underlying inflation, which excludes 5 per cent changes in top and bottom prices, decreased to 3.3 per cent in February 2009 from 1.7 per cent recorded in September. The gap becomes much closer during this period.

Figure 3 CPI and trimmed mean inflation



These measures appear to meet the (minimum) criteria of policy usefulness. These figures are based on the same data as the CPI, so they are as timely as the CPI and are not subject to revision. They are also easy to understand and transparent. These measures differ in their coverage.

However, all of the above measures have an essential conceptual shortcoming in that they do not explicitly consider the persistence of individual price changes in their construction. As Blinder and Johnson suggested, persistent price changes contain more information about future inflation, we would like to give these high weights in core inflation. In the trimmed mean approach, more significant persistent price shocks may be outliers in the inflation distribution for some successive periods, in which case these would be excluded, and the measure would ignore potentially helpful information about future inflation.

2.5.3 Sticky price CPI

We examine the frequency of price changes for 570 categories of goods and services covering about 66.4% of consumer spending based on "Dixon and Tian items frequency data". Then, I looked up the monthly CPI index and weights data for these 570 items based on their ID one by one for the years 2005 to 2021. This is used to construct CORE inflation measures of sticky and flexible CPI. Dixon and Tian items frequency data

provide the frequency (expressed as a %) of prices changing per month for 570 items contained in the VML data set for the whole period from January 1996 to December 2007. In Table 19, Column A is the COICOP item name. The frequency is in Column B. The rebase weight in column C adds up to 1000 (their total share in CPI is 664).

Let λ = the monthly frequency of price changes. Mo = the mean duration between price changes implied by [= .1/ ln(1.λ)]. If prices can change at any moment, not just at the monthly interval, the instantaneous probability of a price change is .ln(1.λ) and the mean time between price changes .1/ ln(1 . λ) months. We used this formula to calculate the Mo. column from the Freq. Column in Table 1. If prices instead change at most once per month, then the mean duration is simply 1/λ, about half a month longer. In Table 19, we list, for each of the 570 categories, the 1996-2007 average monthly frequency of price changes. Table 1 also provides the weight and the mean duration between price changes. The monthly frequency of price changes averages 21.9%. The weighted median is 17.9%. The time between 1 price change averages five months for the median category. Thus, prices change less frequently than every five months for one-half of consumption items. We break down the monthly CPI's published components into "sticky price" and "flexible price" aggregates using this information. If price changes for a particular CPI component occur less often, on average, than every five months, we call that component a "sticky-price" good. We labelled " flexible price " goods as goods that change prices more frequently than this. Next, I looked up the monthly CPI index and weight for sticky price items based on their ID one by one for the years 2005 to 2021. Since the monthly CPI data is calculated year-on-year, the CPI trend started in February 2006.

Table 19 The Frequency of Price Changes by Category

item_des	Freq	Weight	Mo
Automatic car wash, drive through basic charge	3.7	2.17	26.5
Contact lens, Soft pair (state type/condition)	4.1	1.63	23.9
BOTTLE OF CHAMPAGNE	4.5	1.55	21.7
PRINT OFF UPTO 50 DIGITAL PHOTOS	4.5	0	21.7
Car Park Charges	5.1	1.54	19.1
TEA -TAKE-AWAY	5.2	1.55	18.7
Daily film rental, new release (specify DVD/Video)	5.2	0.6	18.7
Prescription lenses (point focal, 70mm diameter)	5.5	1.63	17.7
Develop & print (135/24 colour film)	5.5	1.2	17.7
COFFEE -TAKE-AWAY	5.6	1.55	17.4
Daily disposable contact lenses	5.7	1.54	17.0
POTATO CRISPS-INDIVIDUAL PACK	5.8	1.55	16.7
CHINESE TAKEAWAY	5.9	3.1	16.4
KEBAB- TAKEAWAY	5.9	3.1	16.4
FLORIST - DELIVERY COST	5.9	2.15	16.4
TV repair (state hour/min/complete)	6	0.75	16.2
STAFF RESTAURANT FIZZY DRINK	6.1	3.52	15.9
Eyesight Test charge	6.1	0.6	15.9
BURGER IN BUN- TAKEAWAY	6.2	3.1	15.6
CHILD MINDER - HOURLY RATE	6.2	1.81	15.6
Restaurant - Main Course 1st	6.3	4.65	15.4
RESTAURANT CUP OF COFFEE	6.3	3.1	15.4
PASTY/SAVOURY PIE - TAKEAWAY	6.4	3.1	15.1
Woodscrew's - Steel/zinc plated specify length	6.4	1.32	15.1
INDIAN TAKEAWAY	6.5	3.1	14.9
Washing machine repair (state hour/min/complete)	6.5	0.75	14.9
Non-NHS Medicine (Physiotherapy per session)	6.6	1.2	14.6
Window cleaning, 3 bed semi (outside only)	6.7	0.09	14.4
Minicab fare for journey of 2 miles	6.7	3.61	14.4
Basic Manicure	6.8	1.57	14.2
RESTAURANT - SWEET COURSE	7	4.65	13.8
PIZZA TAKEAWAY OR DELIVERED	7	3.1	13.8
WATCH REPAIR-CLEAN AND SERVICE	7	1.05	13.8
Night-club entry, no flyer, (Saturday 11.30pm)	7.1	1.2	13.6
BASIC WILL FOR A SINGLE PERSON	7.2	2.35	13.4
PC repair (state hour/min/complete)	7.3	0.75	13.2
Man's Haircut	7.3	2.89	13.2
Full leg wax (both legs)	7.4	1.93	13.0
Spectacle frames (basic without lenses)	7.5	1.63	12.8
Self Drive Van Hire transit type (24 hr charge inc. VAT)	7.5	1.99	12.8
Chewing Gum/Bubble Gum, single pack	7.6	0.5	12.7
Plumber (Daytime, hourly rate inc. call out & VAT)	7.7	2.29	12.5
BOTTLE OF WINE 70-75CL	7.8	4.65	12.3
Driving school, 1 hour lesson (after 5pm)	7.8	0.27	12.3
Non NHS Chiropractor	7.8	1.2	12.3

TAKEAWAY COFFEE LATTE	7.9	1.55	12.2
Gas service charge (state hourly or complete)	8	0.96	12.0
Basic private dental examination (no X-rays)	8	1.32	12.0
Car repairs - labour per hour - local garage	8	7.23	12.0
Decorator-daily rate (specify number of hours)	8.1	2.17	11.8
Dry Cleaning (Man's Suit)	8.1	1.51	11.8
Home office desk	8.3	1.51	11.5
Knitting wool, double knit, (acrylic/wool or mix), 100g	8.3	1.67	11.5
Dog kennel fees, boarding (daily charge)	8.4	1.58	11.4
Hourly rate for Domestic Help (paid by customer)	8.4	3.88	11.4
Catering 50 people, set menu, cost per head	8.4	1.55	11.4
Liquid Foundation specify size	8.4	1.45	11.4
Women's Hairdressing (Cut & Blow Dry)	8.4	3.73	11.4
Electrician (Daytime, hourly rate inc. call out & VAT)	8.5	2.17	11.3
Annual booster injection (medium size dog)	8.5	1.37	11.3
Women's highlighting	8.5	1.93	11.3
Windscreen wiper blade (state length/type)	8.5	1.17	11.3
Oil filter (specify car)	8.6	1.26	11.1
RESTAURANT MAIN COURSE 1	8.7	4.65	11.0
Vet fees, spay kitten 6 months (not Pedigree)	8.7	1.48	11.0
Ball Point (individual), disposable, (eg Bic)	8.8	0.98	10.9
Private health club/gym annual member (exc. Joining fee)	8.9	1.08	10.7
STAFF RESTAURANT PUDDING	9	3.52	10.6
Home Removal - 1 Van	9	3.16	10.6
MOT test fees, VAT EXEMPT	9	1.45	10.6
Pub, cold filled roll/sandwich, state filling	9.1	4.65	10.5
Bookcase, flatpack, self assembly (no drawers)	9.1	1.13	10.5
Spectacle frames, designer (without lenses)	9.2	1.54	10.4
Car repairs - labour per hour - main dealer	9.2	7.23	10.4
Power Point (double socket)	9.3	2.35	10.2
Greetings card (state code)	9.3	1.35	10.2
HOURLY RATE FOR SOLICITOR	9.4	2.15	10.1
Car Service - Local Garage	9.4	4.34	10.1
Paint Brush (2inch/5cm width)	9.5	0.83	10.0
Hire domestic steam wallpaper stripper	9.5	0.36	10.0
Leisure centre, charge for exercise class upto 1hr	9.5	0.6	10.0
BOTTLED MINERAL WATER	9.6	3.1	9.9
STAFF RESTAURNT HOT SNACK ITEM	9.6	3.72	9.9
Bottle of mixer, 113-180ml size (eg tonic water)	9.7	1.55	9.8
Weekly Nanny Fees	9.7	2.35	9.8
Pub, Hot meal (please specify)	9.8	6.2	9.7
LEMONADE/COLA DRAUGHT	9.8	3.1	9.7
PRIMARY SCHOOL- FIXED CHARGE	9.8	0.39	9.7
FRUIT JUICE	9.9	3.1	9.6
NURSERY FEES: CHILD 0-4	9.9	1.81	9.6
Brake pads, two pairs (state car make/model)	9.9	1.26	9.6
RESTAURANT MAIN COURSE 2	10	4.65	9.5

IN STORE CAFETERIA MEAL	10.1	4.65	9.4
TAKEAWAY SOFT DRINK	10.1	1.55	9.4
Door Handle, (pack for one door)	10.1	2.35	9.4
Gardener Hourly Rate	10.1	2.71	9.4
SECONDARY SCHOOL- CAFETERIA	10.3	0.59	9.2
Liqueur per nip (see help screen) specify ml	10.3	1.55	9.2
Private Rented Furnished property (see note)	10.3	15.56	9.2
Sheet Of Wrapping Paper	10.3	1.43	9.2
Private Rented Unfurnished property (see note)	10.4	14.86	9.1
Swim Pool Admission, standard adult (off-peak)	10.4	0.6	9.1
Ten-pin bowling, eve. session (per game)	10.4	0.6	9.1
STAFF RESTAURANT SANDWICH	10.6	3.91	8.9
WHISKY (PER NIP) SPECIFY ML	10.6	3.1	8.9
VODKA (PER NIP) SPECIFY ML	10.6	4.65	8.9
Hardboard, specify sheet size, (e.g. 2440x1220mm/8x4ft)	10.6	1.32	8.9
Car battery	10.8	1.26	8.7
Self Drive Car Hire (24 hour basic charge inc. VAT)	10.8	2.08	8.7
FISH & CHIPS TAKEAWAY	10.9	3.1	8.7
WINE (175ML GLASS)	10.9	4.65	8.7
Light Bulb, each (specify wattage)	10.9	0.9	8.7
Lipstick	10.9	1.45	8.7
Coarse Fishing Rod	10.9	0.96	8.7
NEWSPAPER AD NON TRADE 20 WORD	11	2.35	8.6
BOTTLE OF LAGER IN NIGHTCLUB	11.1	4.65	8.5
Chicken Kiew 2 Pack 250g (chilled not frozen)	11.2	0.63	8.4
SPIRIT BASED DRINK 275ML	11.3	1.55	8.3
Squash court, evening session (specify length)	11.3	0.6	8.3
Pair of basin taps (not mixer)	11.4	4.14	8.3
Sink, single drainer (specify material)	11.4	3.39	8.3
Lady's Umbrella (Folding)	11.5	0.6	8.2
Original Polo Mints	11.6	0.5	8.1
Mascara	11.6	1.81	8.1
Child's swing	11.6	0.69	8.1
Canned Sweetcorn, (198g-340g)	11.7	0.84	8.0
Carpenter Hourly Rate	11.7	2.17	8.0
Screwdriver (specify size and type)	11.7	0.45	8.0
Drycell Battery, pack of 4, state size (eg AA)	11.8	0.9	8.0
IN CARE HOME ASSISTANT RATE	11.8	2.89	8.0
Potting compost (specify size)	11.8	0.98	8.0
Residential Home	11.9	5.78	7.9
Potato Crisps, 25g/40g	12	1.26	7.8
MONTHLY SELF STORAGE FEE	12	2.15	7.8
Annual leisure centre membership (not private)	12	1.08	7.8
Envelopes (specify size and number in packet)	12.1	0.98	7.8
Softwood, 1.6m-2.4m length	12.2	1.49	7.7
Women's Tights	12.3	1.57	7.6
Bar of Toilet Soap (100-125G)	12.3	0.72	7.6

CIDER-1/2PT OR 275-340ML BOT	12.4	3.1	7.6
35mm colour film (24 exposures)	12.4	0.45	7.6
Clear sticky tape, eg cellotape (specify size)	12.5	0.98	7.5
Nursing Home	12.5	5.55	7.5
Oil Per Litre (multigrade)	12.5	0.53	7.5
CINEMA POPCORN	12.7	1.55	7.4
Multi-vitamins capsules/tablets (eg Sanatogen)	12.7	1.51	7.4
Child's Wellington Boots	12.8	0.27	7.3
Peanuts, 100g (roasted or salted) specify	12.9	1.08	7.2
DRAUGHT STOUT PER PINT	12.9	3.1	7.2
Wallpaper Paste, specify coverage (5-20 rolls)	12.9	0.83	7.2
Metal Model Toy, Diecast car (eg Matchbox)	12.9	2.42	7.2
Mars Bar (approx 62.5g)	13	2.48	7.2
BOTTLED PREMIUM LAGER 4.3-7.5%	13	3.1	7.2
Ceramic tile plain 15x15 - 25x20cm, (box of 6-44)	13	0.83	7.2
Ready mixed Filler, interior use (430gm-1.8kg)	13.1	0.83	7.1
STAFF RESTAURANT MAIN COURSE	13.2	3.91	7.1
PLAYGROUP FEES - PER SESSION	13.2	2.53	7.1
Solid gold ring, no stones, 9ct	13.2	1.48	7.1
Beginner's Acoustic Guitar	13.3	0.54	7.0
Golf Balls	13.3	0.96	7.0
SANDWICH-TAKE-AWAY	13.4	4.65	7.0
Men's Socks	13.4	0.78	7.0
Indigestion Tablets, pack of 24, (eg Rennies)	13.4	1.51	7.0
Chocolate covered Ice Cream bar (e.g. Magnum)	13.5	0.83	6.9
PREMIUM LAGER - PINT 4.3-7.5%	13.5	9.3	6.9
18 ct Gold Gemstone Ring	13.5	2.63	6.9
Sterling silver earrings, plain (per pair)	13.6	0.84	6.8
Condoms (pack of 3 to 5)	13.6	0.54	6.8
Garden Spade	13.6	0.72	6.8
DRAUGHT BITTER (PER PINT)	13.7	15.5	6.8
Brake fitting in fast fit centre for Ford Focus	13.8	4.34	6.7
Small Caged Mammal	13.9	0.53	6.7
Rowntrees Fruit Pastilles- tube	14	1.49	6.6
Dustbin Liners (pack of 10)	14	0.68	6.6
LAGER - PINT 3.4-4.2%	14.1	9.3	6.6
Dog food, can (390-400gm)	14.2	1.16	6.5
Men's Tie	14.3	1.22	6.5
Disposable camera with flash (24-27 exp)	14.3	0.6	6.5
Gloss paint, white (750ml - 2.5 litres)	14.4	1.32	6.4
Animal cage (e.g for gerbil/mouse)	14.4	0.63	6.4
Tomato Ketchup (340-345g) bottle	14.5	0.36	6.4
Steering lock device	14.5	1.54	6.4
Seeds, packet of vegetable (specify variety)	14.5	0.68	6.4
Scissors (Kitchen)	14.6	1.26	6.3
Doughnut, each	14.7	0.68	6.3
Gent's Watch - Analogue Face	14.7	2.11	6.3
Bag of sweets, boiled/jellies, not choc (200-250g)	14.8	1.82	6.2

Car Service - Main Dealer	14.9	4.34	6.2
Varnish, clear gloss, 750ml - 1 litre	15	0.83	6.2
Wallpaper Per Roll	15	1.32	6.2
Book, illustrated for under 5's	15	1.28	6.2
Dry Spaghetti or pasta 500g	15.1	0.23	6.1
Car tyre, Tubeless Radial (state size)	15.2	1.26	6.1
Individual meat pie (eg steak and kidney)	15.3	1.9	6.0
Smarties, small tube	15.3	0.83	6.0
Cadburys dairy milk (49g bar)	15.3	3.64	6.0
Paint, Emulsion, white (2.5 to 5 litres)	15.3	1.49	6.0
Cat food, can (390-400gm)	15.3	1.9	6.0
9ct Gold Chain (16-18"/ 40-46cm)	15.3	1.48	6.0
Pain Killer Tablets (pack of 16 or 24)	15.3	1.51	6.0
Plain Biscuits (e.g. Digestive Biscuits) 200-300g	15.4	1.81	6.0
Shop Milk, pasteurised, 4pt or 2ltr carton (specify)	15.4	2.54	6.0
Shop milk, semi-skimmed, per 2 pints/1.136 litres	15.4	4.31	6.0
Baby Food Can/Jar (state main meal/dessert, size)	15.4	0.12	6.0
Gas fire (state make & model)	15.4	1.69	6.0
Men's Pants/Boxer shorts	15.4	0.78	6.0
Tampons, pack of 10-16 (specify pack size)	15.4	1.81	6.0
Aluminium cooking Foil, 300mm wide, state length	15.5	0.45	5.9
Toothpaste (specify size)	15.6	2.53	5.9
Women's Pants	15.7	1.57	5.9
Canned Fruit, 400-450g, (specify type)	15.9	0.84	5.8
Fabric roller blind	15.9	2.29	5.8
Basmati rice (500g)	16	0.68	5.7
Cheese Edam, per kg	16	0.59	5.7
Perfume/eau de toilette (men or women)	16	1.81	5.7
CD Single (Top 40)	16	0.3	5.7
FUNERAL-CREMATION	16.3	2.54	5.6
Girl's Knickers (one pair)	16.3	0.78	5.6
Book, Reference, specify title/type (eg Atlas/Dictionary)	16.4	0.23	5.6
Decorative plant pot not plastic (10-20" diameter)	16.4	0.3	5.6
Child's Socks	16.5	0.78	5.5
Cooking Oil - Vegetable 1 Litre	16.6	0.78	5.5
Aluminium step ladder (specify number of steps)	16.6	0.45	5.5
Pack of Plasters (20-24 assorted)	16.6	0.54	5.5
Sleeping Bag	16.6	0.96	5.5
Crunchie	16.7	0.66	5.5
Pork Pie, individual, (not buffet)	16.8	1.58	5.4
Football, stitched, size 5 (specify material)	17	0.96	5.4
Kitkat (4 Finger Bar)	17.1	0.9	5.3
Jar of jam, 340-454g, specify flavour	17.1	0.5	5.3
Squash/tennis racquet	17.2	0.96	5.3
Cooked ham, loose, spec type (per 100g)	17.3	1.9	5.3
Sugar - Granulated, white, per kg	17.3	0.33	5.3
Black Inkjet Cartridge (single pack)	17.3	0.9	5.3
Adults Bicycle	17.4	1.4	5.2

Canned Tomatoes, approx. 390-400g	17.5	0.42	5.2
Men's Shoe, Leather uppers (1)	17.5	0.54	5.2
Baked Beans, (415-420g tin)	17.6	0.84	5.2
HAIR DRYER	17.6	1.45	5.2
Brassiere	17.6	1.57	5.2
Floor rug, state size and material	17.7	1.79	5.1
Men's Shoe	17.7	0.68	5.1
Camera 35mm, Compact (not disposable)	17.7	0.6	5.1
Rosebush Floribunda/Hybrid Tea not full/half stnd	17.8	1.2	5.1
Canned Meat Stewed Steak approx. 400-425g	18	0.95	5.0
Apple Juice, 1 litre carton	18	0.95	5.0
Vending Machine Cigarettes	18	1.96	5.0
Plain Glass Tumbler	18	0.84	5.0
Babygro or sleepsuit (each)	18	0.78	5.0
Child's trike for under 5's	18	2.42	5.0
Frozen chicken breasts 500g-1.5kg	18.1	0.32	5.0
Household Cleaner Cream/Liquid (450-500ml)	18.1	1.58	5.0
Cream Crackers, packed, 200g	18.2	0.45	5.0
Cold/flu drink powder packet of 10 sachets	18.2	1.51	5.0
Blank Video Cassette (VHS/E180)	18.2	0.15	5.0
Mineral water, still, 2 litre bottle	18.3	1.08	4.9
Women's swimwear	18.3	0.78	4.9
Stainless steel cutlery set specify no of settings	18.4	0.53	4.9
Washing Up Liquid (400-600ml)	18.4	0.68	4.9
AFTER SCHOOL CLUB CHARGES	18.4	1.63	4.9
Outdoor adventure boot (eg Timberland)	18.4	0.95	4.9
Childs Bicycle	18.4	1.35	4.9
Energy drink, 250-500ml (eg Red Bull, Lucozade)	18.5	1.08	4.9
Sausages-pork-per kg	18.7	2.53	4.8
Butter, Home produced, 250g	18.7	0.24	4.8
Vegetable Pickle, 280-310g (e.g. Branston)	18.7	0.21	4.8
Large Loaf, White unsliced, 800g	18.8	0.68	4.8
Flour, self raising 1.5kg	18.8	0.23	4.8
Boy's Shoes	19	0.54	4.7
Exhaust fitting in fast fit centre for Ford Focus	19	4.34	4.7
6 Bread Rolls White/Brown	19.2	0.9	4.7
Fizzy Canned Drink 330ml	19.2	1.63	4.7
MENS JEANS	19.2	2.35	4.7
Yoghurt/fromage frais (small individual)	19.3	1.76	4.7
Fresh single cream 284ml	19.3	0.39	4.7
Electric Convector Heater	19.4	1.32	4.6
Single plastic food storage container with lid	19.6	1.26	4.6
Fabric Conditioner (1 Litre)	19.6	0.68	4.6
Men's Leather Boot	19.6	0.27	4.6
Picture/Photo Frame (silver plated)	19.6	1.99	4.6
Shampoo (250-400ml)	19.6	1.08	4.6
Laminate flooring (eg tongue & groove) per sq.m	19.7	1.37	4.6
Saucepan (milk - non-stick)	19.7	1.37	4.6

Pure Orange Juice, 1 litre carton	19.9	1.49	4.5
Home Killed beef, Braising steak per kg	20	0.63	4.5
Cook-in sauce jar/can, 350-520g (eg bolognese)	20	0.45	4.5
Child's soft toy/teddy bear	20	1.38	4.5
Mens training shoe-footwear	20.1	1.08	4.5
Red Wine - European	20.2	3.39	4.4
Washable Carpet, (e.g. Kitchen/Bathroom) per sq. metre	20.2	1.79	4.4
Fruit drink carton with straw, 3 pack (200-290ml)	20.3	0.81	4.4
Potted shrub	20.3	1.2	4.4
Power Drill, Hammer Action	20.4	0.36	4.4
Margarine/Low Fat Spread, 500g	20.5	1.45	4.4
Girl's Shoes (School)	20.5	0.54	4.4
Womens' Shoes - Flat	20.5	1.63	4.4
Cereal snack eg. Wotsits, Skips, single packet	20.7	1.35	4.3
Cider, (1-2 litre bottle)	20.7	0.68	4.3
Earrings, fashion, not solid gold or silver (state type)	20.7	0.95	4.3
Chilled pot dessert (non yoghurt) 50-200g	20.8	1.37	4.3
MEN'S FORMAL SHIRT-LONG SLEEVE	20.8	2.35	4.3
Boxed board game, not travel type (specify)	20.8	2.42	4.3
Spirit based drink 275ml (see help screen)	20.9	0.68	4.3
Table lamp, with shade	20.9	1.13	4.3
Trousers, suitable for school (5-15 years)	20.9	1.57	4.3
Child's trainers-footwear	20.9	0.54	4.3
Plastic Doll, child's (eg Barbie/Action Man)	20.9	2.42	4.3
Fizzy Bottled Drink 500ml	21	1.35	4.2
Canned Soup (390-425g)	21	0.27	4.2
Butter, Imported, 250g	21.1	0.54	4.2
MEN'S FORMAL RDY-MADE TROUSERS	21.1	0.78	4.2
Construction toy, specify kit no. (eg Lego)	21.1	4.15	4.2
Tissues (large size box)	21.2	2.53	4.2
Cooked meat, turkey sliced (100-113g)	21.3	0.95	4.2
Lemonade, 2 litre bottle	21.3	0.41	4.2
Flower vase	21.3	2.42	4.2
Pitta bread (state type, number in pack and weight)	21.5	0.9	4.1
Chilled Ready-meal, serve one, (specify weight)	21.5	1.05	4.1
Mayonnaise (400g-500g)	21.5	0.3	4.1
Hair gel (150-200ml)	21.6	1.08	4.1
Smokeless Fuel, boiler/heater 50kg (specify brand)	21.7	0.27	4.1
Deodorant, specify eg spray/roll-on (50-150ml)	21.7	1.45	4.1
Breakfast cereal 1 sweetened/chocolate coated	21.8	2.26	4.1
Frozen Beefburgers, Pack of 4, specify weight	21.9	0.63	4.0
Frozen Garden Peas (900-910g bag)	21.9	1.05	4.0
White Wine - European	21.9	2.57	4.0
Frozen vegetarian ready meal	22	0.21	4.0
Coal - Household best quality (Group A) 50kg	22	1.23	4.0
Dishwasher Tablets	22	0.68	4.0
Complete dry dog food (2-2.5kg)	22	1.9	4.0

MEN'S TRACKSUIT/JOGGIN BOTTOMS	22	0.78	4.0
Wall hanging mirror	22	1.51	4.0
20 Berkeley mentholated cigarettes	22.1	1.57	4.0
Moisturising (100-150ml)	22.2	1.45	4.0
Concentrated fruit drink eg orange (1 litre)	22.3	1.35	4.0
Wine box - 3 litres min abv 11%	22.3	0.81	4.0
Glass Ovenware Casserole dish	22.3	0.84	4.0
Disposable Nappies (specify type/pack size)	22.3	3.61	4.0
Hard Regional Cheese	22.4	0.59	3.9
Men's training shoe-sportswear	22.4	1.35	3.9
Womens' Shoes High - Sensible	22.4	0.81	3.9
Box/carton of chocolates, 450-500gm	22.5	1.99	3.9
Shower gel (150-250ml)	22.5	0.72	3.9
Potato Crisps, Multi-pack	22.6	1.69	3.9
Coffee, Instant (100g jar)	22.7	2.26	3.9
Recordable CD	22.7	0.6	3.9
Cheese spread, tub, 200g	22.8	0.98	3.9
Frying Pan 20-24cm	22.9	1.16	3.8
Car CD/radio autochanger (exclude fitting cost)	23.1	0.18	3.8
Canned Fish, Tuna, specify oil/brine/water (180-200g)	23.2	0.72	3.8
Tea bags 1, packet of 80 (250g)	23.2	1.4	3.8
Washing powder, automatic, 1 to 2kg (specify size)	23.2	0.68	3.8
Frozen ready-cooked meal, to serve one	23.3	0.45	3.8
Hand Rolling Tobacco 25g	23.3	1.57	3.8
Women's Jeans - Own Brand	23.3	1.57	3.8
Cheese Cheddar, Imported, per kg	23.6	0.78	3.7
Whole sponge cake, not frozen, eg Victoria sponge (specify)	23.7	1.13	3.7
Women's permanent hair colourant (60-120ml)	23.7	1.08	3.7
Cut flowers, carnations (price per stem)	23.7	1.28	3.7
Cooked Ham Prepacked Sliced (100-125g)	23.9	3.48	3.7
Eggs, Large, per dozen or 2 x 6	23.9	0.78	3.7
Womens shorts	24	0.78	3.6
Bath sheet	24.1	2.29	3.6
Women's Training Shoe	24.1	1.49	3.6
Frozen Prawns	24.2	0.54	3.6
Frozen Veg Burger/grills, pack of 4, (200-400g)	24.2	0.63	3.6
Electric Shower Unit	24.2	1.32	3.6
Coffee, ground, filter fine (227-250g)	24.3	0.41	3.6
Preschool Activity Toy	24.3	3.81	3.6
ADULT OFFICIAL FOOTBALL SHIRT	24.4	0.78	3.6
MEN'S BRANDED SPORT SWEATSHIRT	24.4	0.78	3.6
Fresh Veg-mushrooms-per kg	24.5	1.05	3.6
Bacon, Back, per kg	24.7	3.79	3.5
Pre-packed salad	24.7	0.21	3.5
Girl's skirt, suitable for school (5-15 years)	24.8	0.78	3.5
Frozen Fish Fingers	25	1.08	3.5
Carpet, Axenminster or traditional Wilton (eg per sq. m)	25	1.79	3.5

Crockery set (specify contents/no place settings)	25.1	0.84	3.5
Home Killed Beef, Best Mince, per kg	25.2	0.95	3.4
Mattress, 3ft/90cm (interior sprung)	25.2	1.51	3.4
House plant (eg African Violet)	25.2	0.6	3.4
5 cigars, specify brand (eg Hamlet, Café Crème)	25.3	2.35	3.4
Bleach (750ml bottle)	25.3	1.58	3.4
Cordless phone (specify digital/analogue)	25.4	1.81	3.4
Razor Cartridge Blades	25.4	2.53	3.4
Portable CD radio cassette	25.4	0.54	3.4
Kitchen Base Unit, self assembly, width 1000mm	25.7	3.39	3.4
Frozen Chicken Nuggets (250-500g)	25.9	0.63	3.3
Frozen Chips (908g approx.)	25.9	1.26	3.3
DRIED POTTED SNACK 50-120G	25.9	0.68	3.3
Womens' Shoes - High - Stiletto	25.9	0.95	3.3
Push Chair	26	0.48	3.3
20 Lambert & Butler kingsize	26.1	8.22	3.3
Fitted bed sheet, specify size	26.2	1.69	3.3
Bacon, Gammon, per kg	26.3	1.26	3.3
Cheese Cheddar, Home produced, per kg	26.3	1.76	3.3
Individual Fruit Pies, 6 Pack	26.4	1.13	3.3
Eggs, Medium, per dozen or 2 x 6	26.4	0.78	3.3
Apples, cooking (per kg)	26.4	0.48	3.3
Breakfast Cereal 1 unsweetened	26.5	3.61	3.2
Fortified wine eg Sherry/Port (70-75cl)	26.5	0.41	3.2
Lady's leather handbag/ shoulder bag	26.5	1.38	3.2
HIFI - 2006	26.5	1.08	3.2
Carpet, Tufted, per square metre	26.6	1.79	3.2
Women's Jeans - Branded	26.6	1.57	3.2
Fresh boneless chicken breast per kg	26.7	1.9	3.2
MEN'S CASUAL TROUSERS	26.7	2.35	3.2
Womens short sleeve sports top	26.7	0.78	3.2
Cola flavoured drink, 2 litre bottle	26.8	2.17	3.2
Childs trainers-sportswear	26.8	0.54	3.2
Duvet cover, specify size and if pillow cases incl.	26.9	1.69	3.2
Cheese Brie, per kg	27	0.39	3.2
Carpet, Tufted - 2 (per sq.metre)	27	2	3.2
Men's Football Boots	27	0.9	3.2
20 Superkings	27.2	5.48	3.2
Brandy (68-70cl bottle)	27.3	0.68	3.1
POTATOES- BAKING PR KG	27.4	0.21	3.1
Lager 4 Cans - Premium	27.4	1.2	3.1
Lager 4 Bottles - Premium	27.4	1.69	3.1
20 Benson & Hedges King Size	27.4	4.31	3.1
Women's nightdress/pyjamas (specify)	27.4	1.57	3.1
Lady's Scarf (State material and type)	27.4	1.63	3.1
Premium Potato Crisps/Chips	27.5	0.84	3.1
Bananas, (per kg)	27.5	2.17	3.1
Frozen imp lamb loin chops with bone (per kg)	27.6	0.32	3.1

Gas cookers (specify make & model)	27.6	0.48	3.1
Curtains, Ready Made, approx. 66x72inch/168x183cm	27.8	2.41	3.1
Vodka, (70cl bottle)	28	2.56	3.0
MENS BRANDED T-SHIRT	28	0.78	3.0
MENS SUIT-READY MADE	28.1	2.35	3.0
Women's Sandals (1)	28.1	0.68	3.0
WOMEN'S TROUSERS-FORMAL	28.2	2.35	3.0
Ice cream specify flavour (500ml - 1 litre)	28.5	0.99	3.0
Boy's branded sports top (5-15 years)	28.5	1.57	3.0
20 Silk Cut, Ultra Low Tar	28.6	2.74	3.0
MEN'S CASUAL S/SLEEVE SHIRT	28.6	0.78	3.0
Mower electric (flymo, cylinder)	28.6	0.54	3.0
Pack of 5-6 individually wrapped cakes	28.7	0.9	3.0
Television, Colour (14inch/34cm Portable)	28.7	1.08	3.0
Boy's jeans (5-15 years)	28.8	1.57	2.9
Duvet, double, polyester filled TOG 10-13.5	28.9	1.69	2.9
TOILET ROLLS	28.9	3.61	2.9
Tea bags 2, packet of 240 (approx 750g)	29	0.45	2.9
Home Killed Pork, Loin Chops with bone, per kg	29.1	0.95	2.9
Yoghurt/fromage frais, 4pk (50-125g each)	29.1	1.37	2.9
Fresh Veg-onions-per kg	29.6	1.26	2.8
20 King size filter, other Brand (eg Marlboro Lights)	29.6	5.09	2.8
Electric Kettle (jug-type) 3 pint/ 1.5-1.7 litre	29.6	0.6	2.8
FROZEN PIZZA-MED SIZE-300-450G	29.7	1.58	2.8
Kitchen Roll	29.7	0.53	2.8
Hotel 1 Night Price	30.1	9.48	2.8
Sunglasses, non-designer, UV lenses	30.2	0.18	2.8
Compact Disc Album (top 40)	30.4	5.42	2.8
Pre-Packed Veg Eg Baby Corn	30.5	0.21	2.7
Red Wine - New World	30.5	2.3	2.7
MEN'S JUMPER OR SWEATSHIRT	30.5	1.57	2.7
Fresh/chilled orange juice eg: tropicana (1l)	30.7	0.81	2.7
WOMEN'S T-SHIRT	30.7	0.78	2.7
MEN'S CASUAL SHIRT-LONG SLEEVE	30.8	0.78	2.7
Book, non-fiction, paperback (top 10 best seller)	30.8	1.35	2.7
Microwave oven (state if combined)	30.9	0.12	2.7
Child's Pyjamas	31	0.78	2.7
Child's Baby Doll	31.1	2.42	2.7
Electric iron	31.2	0.36	2.7
Fresh Veg-cabbage-whole-per kg	31.3	0.63	2.7
Electric Cooker, 4 rings, grill and oven	31.3	1.2	2.7
Kiwi Fruit, (each)	31.6	0.6	2.6
Lager Stubbies 4.3-7.5(ABV) [24 L	31.6	0.78	2.6
Sunscreen cream/lotion (specify size/SPF)	31.6	2.17	2.6
Fresh fish -salmon fillets (per kg)	31.7	1.26	2.6
Whisky (70cl bottle)	31.7	3.61	2.6
MEN'S JUMPER-KNITTED	31.7	1.57	2.6
Women's casual trousers 2	31.7	1.57	2.6

Home Killed Pork, boneless shoulder, per kg	31.8	0.95	2.6
Single bed (width approx. 3ft/90cm)	31.8	2.26	2.6
Large Wholemeal Sliced Loaf	31.9	0.9	2.6
Chest of Drawers	31.9	2.26	2.6
Coffee Table	32	1.88	2.6
White Wine - New World	32.1	2.03	2.6
White Sliced Loaf	32.2	1.58	2.6
Home Killed Beef, Rump Steak/Popes eye steak, per kg	32.5	1.26	2.5
WOMEN'S SKIRT: WORK/FORMAL	32.6	2.35	2.5
Draught flow bitter, 4 cans (440-500ml)	32.8	1.08	2.5
Double Wardrobe	32.8	2.26	2.5
Book, Fiction, paperback, top 10 best seller)	33	2.63	2.5
Childs Trousers eg Jeans	33.1	0.78	2.5
Girl's trousers not denim (5-15 years)	33.1	0.78	2.5
Fresh/Chilled Chicken, per kg, state size (eg small)	33.5	0.63	2.5
MEN'S CASUAL JACKET/FLEECE	33.6	2.35	2.4
WOMEN'S TROUSERS-CASUAL	33.6	1.57	2.4
VHS Video Recorder	33.8	0.72	2.4
Double Bed (width approx. 4ft 6inch/135cm)	33.9	2.26	2.4
Luggage Trolley Case	33.9	1.38	2.4
Sofa Bed	34.5	1.88	2.4
Fresh white fish fillets, per kg (eg cod)	34.7	2.41	2.3
Apples-dessert-(per kg)	35	1.2	2.3
WOMEN'S FORMAL JACKET	35	1.57	2.3
Home Killed, Beef Topside, 1st Quality, no bone, per kg	35.1	0.95	2.3
Bottle of champagne 70-75cl	35.2	1.35	2.3
Cola flav/other fizzy drink 330ml, pack of 6/8	35.3	0.41	2.3
Armchair (upholstered)	35.3	2.26	2.3
Fresh Turkey Steaks	35.4	0.63	2.3
Dining room table & 4-6 chairs (specify no. chairs)	35.5	1.13	2.3
WOMEN'S CARDIGAN	35.9	0.78	2.2
ELECTRIC RAZOR	36	1.81	2.2
POTATOES- OLD WHITE PER KG	36.2	1.48	2.2
Women's vest/strappy top	36.4	0.78	2.2
DVD player	36.5	1.08	2.2
Dishwasher (12 Place Setting)- 2005	36.6	0.72	2.2
Fresh veg, lettuce, round (each)	36.9	0.42	2.2
WOMEN'S BLOUSE LONG/SHORT SLV	36.9	2.35	2.2
MP3 Player	37.2	0.72	2.1
Women's premium branded dress	37.3	0.78	2.1
WOMEN'S JUMPER	37.4	0.78	2.1
Home Killed Lamb, Loin Chops with bone, per kg	37.8	0.63	2.1
Vaccum cleaner - 2006	38	0.84	2.1
Girls's summer jacket (5-15 years)	38.3	0.78	2.1
Women's Ankle Boot	38.4	0.68	2.1
Oranges, class 1, (each)	38.5	0.84	2.1
Fridge/freezer - 2006	38.5	1.32	2.1
Women's showerproof Jacket	38.6	0.78	2.1

Frozen imported lamb, leg (per kg)	38.7	0.63	2.0
Grapefruit, (each)	38.7	1.2	2.0
Lager - Pack of 12 Cans	39	1.26	2.0
WOMEN'S CASUAL OUTER JACKET	39.4	1.57	2.0
MEN'S 3/4 LENGTH CASUAL COAT	39.7	1.57	2.0
WOMEN'S SKIRT: CASUAL	40.1	2.35	2.0
WOMEN'S CAS OUTER JKT-FLEECE	40.3	1.57	1.9
DVD RECORDER	40.3	0	1.9
MEN'S SHORTS	40.4	0.78	1.9
Fresh Veg-carrots-per kg	40.6	0.63	1.9
Bag of organic dessert apples (state number)	40.7	0.6	1.9
Home Killed Lamb, Shoulder with bone, per kg	40.8	0.63	1.9
Widescreen TV - 2006	40.9	1.9	1.9
3 Piece Non-Leather Suite	41	2.26	1.9
Girl's winter jacket (5-15 years)	41.1	0.78	1.9
Leather Settee	41.2	4.89	1.9
Girl's Fashion Top (12-15Y)	41.4	0.78	1.9
WOMEN'S LONG SLV TOP-NT BLOUSE	41.8	0.78	1.8
Cut Flowers Lillies	41.9	1.28	1.8
Pre-Recorded Video	42.7	0.6	1.8
Potatoes-new-loose-per kg	42.9	0.63	1.8
Women's 3/4 length casual coat	43.3	0.78	1.8
Fresh Veg-organic carrots,kg	43.4	0.21	1.8
Gas BBQ	43.5	0.3	1.8
Washing Machine - 2006	44.1	2.05	1.7
Avocado pear, (each)	44.7	0.96	1.7
20 Richmond King Size	44.7	5.87	1.7
Wooden Patio Set	45.2	0.75	1.7
Womens dress (casual/formal)	45.6	3.13	1.6
Child's jumper (18 months - 4 years)	46.6	0.78	1.6
Pears, dessert (per kg)	47.1	0.6	1.6
Book, non-fiction, hard cover (top 10 best seller)	47.2	1.35	1.6
WOMENS SHORT SLEEVE TOP	48.6	2.35	1.5
Flat panel TV	50.5	1.72	1.4
Pre-Recorded DVD	51.4	4.06	1.4
Theatre Admission Eves, Front Stalls (adult)	55.4	2.11	1.2
Fresh Veg-tomatoes-per kg	59	1.9	1.1
Fresh Veg, Cucumber (whole)	61.5	0.63	1.0
Fresh Veg-sprouts-per kg	62.5	0.21	1.0
Digital Camcorders	62.9	2.56	1.0
Ultra low sulphur diesel (per 10 litres)	63.5	8.96	1.0
Ultra low sulphur/unleaded petrol (per 10 litres)	67.7	43.2	0.9
Peaches, (each)	68.4	0	0.9
Grapes, (per kg)	69.6	1.45	0.8
Fresh Veg, Lettuce - Iceberg	71.6	0.63	0.8
Fresh Veg, Cauliflower, each	76.1	1.48	0.7
Strawberries, (per kg)	81.2	0	0.6
Kerosene per litre (1000 litres local bulk delivery)	93.8	3.01	0.4

Notes:

Mo = the mean duration between price changes implied by $\lambda = -1/\ln(1 - \lambda)]$.

Weight = Share of the Level Item in the VML data set for the whole period January 1996 to December 2007

(these sum to 1000).

Freq = the estimated average monthly frequency of price changes (λ in the text).

2.5.4 Autoregressive Integrated Moving Average (ARIMA) process

Besides the core inflation measures, we also include a stochastic model in our comparison. The first focuses on an autoregressive analysis. The primary purpose of modelling time series using stochastic processes is to explain how the phenomenon evolves and make predictions based on the estimated model. The main idea of this method is to predict the future through historical inflation data, which is used as the baseline in comparison.

2.5.4.1 Literature review

Thus we estimate an ARIMA model.

The data used are represented by the monthly data series from January 1993 to December 2019 for the inflation rate in the UK.

A stationary series ${\pi_t}^{CPI}$ follows a process AR(p) if the condition is fulfilled:

$$\pi_t{}^{CPI} = \beta_0 + \beta_1 \pi_{t-1}{}^{CPI} + \ldots + \beta_p \pi_{t-p}{}^{CPI} + \varepsilon_t \qquad (6)$$

Where $\varepsilon_t \sim \mathrm{N}(0, \sigma_\varepsilon^2)$ stationary time series, $\mathrm{E}(\varepsilon_t) = 0, \mathrm{E}(\varepsilon_t^2) = \sigma^2, \mathrm{E}(\varepsilon_{t,}\varepsilon_s) = 0,$ if $t \neq s$;

2.6 EVALUATING CORE INFLATION MEASURES

2.6.1 Criteria for evaluation: forecasting future inflation

This work uses Cogley's model to test the forecasting ability of the core inflation rate, and it also compares the forecasting ability of various core inflation measures, including Excluding food and energy and Trimmed mean. Cogley's model has based on Bryan and Cecchetti's definition of core inflation: "Core inflation changes in the price level that are expected to persist over a long period of time." According to Bryan and Cecchetti's definition, proper core inflation is one that is "pure" after removing temporary factors from measured real inflation. On this basis, Cogley developed the following model to evaluate the predictive power of core inflation:

$$\pi_{t+h} - \pi_t = \alpha_h + \beta_h(\pi_t - \pi_t^c) + u_{t+h} \quad (7)$$

Here π represents the headline inflation rate, and core π^c means some core inflation indicator, both year-on-year data. Parameter h is N (month) ahead. For sufficiently large H, the core deviation $(\pi_t - \pi_t^c)$ should be inversely related to subsequent changes in inflation ($(\pi_{t+h} - \pi_t)$. Moreover, in order for the candidate to satisfy the equation (7), the coefficients in the regression should meet $\alpha = 0$ and $\beta = -1$.

The estimated coefficient β of importance to the forecasting model indicates whether core inflation has sufficiently purified the transitory component. Suppose the absolute value of the estimated coefficient is equal to 1. In that case, it suggests that the model is a random walk process. The components removed from the core inflation do not contain any information that predicts overall future inflation. Suppose $\beta = -1$, the forecasting capacity for core inflation is the best. It proves that core inflation has fully captured the trend components of general inflation and has a complete forecasting ability for future inflation.

1. 1. If the $|\beta| < 1$, it indicates that subsequent changes in inflation are overestimated;

2. If the $|\beta| > 1$, it shows an underestimation of the current temporary movement in headline inflation.

Therefore, the closer the absolute value of the estimated regression coefficient is to 1, the better the predictive power of core inflation is. In addition, the root mean square error $\mathrm{RMSE} = \sqrt{\frac{1}{\mathrm{T}} \sum_{\mathrm{t}=1}^{\mathrm{T}} (\pi_{\mathrm{t}} - \hat{\pi}_{\mathrm{t}})^{2}}$ obtained by Cogley regression represents the deviation between the predicted value and the actual value. $\hat{\pi}_{\mathrm{t}}$ is the forecast value of the inflation rate. The smaller the RMSE, the more accurate the forecast and the better the estimates of core inflation.

From the above discussion, I used my own data to re-simulate the values of the parameters. For the results please see Table 2,3 and Figure 2.

2.7 Forecasting

2.7.1 Introduction

The forecast of inflation is crucial to the conduct of monetary policy. Since monetary policy transmission has a significant lag, central banks aiming to achieve price stability also need to be forward-looking in their decisions, emphasising the importance of inflation forecasting. Thus, the formation of expectations is at the heart of what drives (and helps predict) inflation and is at the heart of policymaking. The New Zealand statistician Phillips first proposed the famous Phillips curve (Phillips, 1958) around the issue of inflation. The curve has since been further extended to an "output-inflation" Phillips curve, which describes the deviation of inflation and the actual output level from the potential output level. The "output-inflation" Phillips curve describes the stable relationship between inflation and the deviation of the actual output level from the potential output level, i.e. the "output gap". This provides an important theoretical basis for policymakers to weigh the relationship between inflation and economic growth. Although other methods that can be used to describe and predict the inflation rate have been proposed in the existing literature, the Phillips curve still plays a critical

role in the prediction of the inflation rate due to its superior prediction effect (Stock and Watson, 2008). It has been widely concerned in academic articles.

The Phillips curve shows that the economy is exposed to inflationary pressures when aggregate demand exceeds potential output, and inflation should be expected to grow. In these conditions, authorities seeking to slow price increases can consider enacting policies that limit aggregate demand. In contrast, inflation should decline when aggregate demand falls short of potential supply, prompting policymakers to consider expanding policies. When using the Phillips curve to predict inflation, policymakers need to estimate the output gap based on the data available at the time because the output gap is not observable. However, real-time and final estimates of the output gap vary widely due to factors such as the data correction effect and post-event information effect (Orphanides and Van Norden, 2002). This could lead to different inflation forecasts based on final output gap estimates from those based on real-time estimates. At the same time, as policymakers gain more data, they will update their estimates of model parameters, which may further lead to differences between real-time and final inflation forecasts. Therefore, although the Phillips curve based on the output gap is more accurate in forecasting inflation when the final data is used, and the introduction of the output gap improves the forecasting accuracy of the model, in practice, the reliability of real-time forecasting of inflation using the Phillips curve and the value of the output gap in forecasting remains questionable.

Given the large difference between the real-time forecast of the inflation rate and the analysis result based on the final data, as well as the doubt about the role of the output gap in the real-time forecast of the inflation rate, researchers have conducted extensive research on the reliability of the real-time forecast of output-inflation Phillips curve. Robinson et al. (2003), for example, found that introducing the output gap did not increase the accuracy of inflation rate forecasting, and that the role and utility of the production gap in inflation rate forecasting were relatively restricted.

Orphanides & Van Norden (2005) discovered that, while final output gap estimates are useful for inflation forecasting, real-time production gap estimates do not increase forecasting accuracy, and inflation projections based on real-time output gaps are erroneous; Clausen & Clausen (2010) concluded that analysing the production gap

based on the final estimate will overestimate the Phillips curve's value in the inflation projection for Germany, the United Kingdom, and the United States. When real-time data is used for analysis, the function of the output gap in inflation forecasting is reduced, according to the literature. The result of an inflation forecast based on real-time data and the conclusion based on final data differ significantly, and the applicability of the Phillips curve in real-time inflation forecasting is controversial.

This section discusses seasonal ARIMA inflation forecasting models, as well as our method's outcomes, strengths, and limits.

2.7.2 Why we need forecast inflation

Forecasting inflation generally improves financial planning for businesses and the private sector. Inflation affects the actual cost of expenses and stock valuations at the business level. Therefore, anticipating changes can help investors understand risks and hedge investments. Forecasting inflation also helps in the formulation and evaluation of monetary policy.

Private banks need to forecast inflation to keep their investments profitable. Inflation can reduce banks' returns on fixed-rate loans, sometimes making them unprofitable. Thus, forecasting inflation can help banks meet their working capital requirements.

Forecasting corporate inflation can help companies prepare for accurate accounting of expenses. Preparing for an inflationary shift allows firms to stock up on raw materials more cheaply, avoiding price rises during periods of inflation. Forecasting inflation will also enable firms to prepare for demand for wage shifts, heralding necessary adjustments in human resources.

Forecasting corporate inflation can help companies prepare for accurate accounting of expenses. Preparing for an inflationary shift allows firms to stock up on raw materials more cheaply, avoiding price rises during periods of inflation. Forecasting inflation will also enable firms to prepare for demand for wage shifts, heralding necessary adjustments in human resources.

Companies that fail to account for predicted inflation fluctuations experience strategic growth shifts and stock price declines. Higher raw material prices often cause lower demand due to higher prices. This reduction in available cash, combined with higher

borrowing costs in times of inflation, tends to slow growth strategies. The combination of reduced cash flow and growth processes can harm stock prices.

Choosing the best time to refinance and making appropriate mortgage rate decisions are two benefits to individuals of anticipating inflation. Predicting inflation can give investors information about whether to invest in the bond market since fixed-rate bonds lose value in times of inflation. Portfolio diversification can also help offset inflation.

If individuals do not consider the underlying inflation, there will be a decline in purchasing power. People living on retirement or savings accounts, for example, rely on their balances and current interest rates. Inflation pushes up prices, making today's money less valuable in the future and making their fixed income even less helpful.

Monetary policy decisions also depend on forecasts of inflation. Understanding the potential of inflation can help policymakers estimate the economic effects of their policies. For example, high inflation can affect the value of domestic products on the international market. If such inflation did not occur worldwide, price increases would reduce the competitiveness of the above-mentioned domestic products.

We first developed the forecast under ARIMA analysis. This approach assumes that the history of the CPI index contains the necessary information to explain the future behaviour of the index under normal conditions.

2.7.3 Seasonal Autoregressive Integrated Moving Average (SARIMA)

SARIMA is one of the time series predictive analysis methods that evolved from the ARMA model. ARMA model is a primary method for time series research, composed of the autoregressive model (AR) and moving average model (MA). The form of the ARMA model is as follows:

$$\begin{aligned} Y_t - \beta_1 Y_{t-1} - \beta_2 Y_{t-2} - \cdots - \beta_p Y_{t-p} = \\ c + \varepsilon_t - \alpha_1 \varepsilon_{t-1} - \alpha_2 \varepsilon_{t-2} - \cdots - \alpha_q \varepsilon_{t-q} \end{aligned} \tag{8}$$

Where $\{Y_t, Y_{t-1}, \cdots, Y_{t-p}\}$ is time-series data, c is constant; $\{\varepsilon_t, \varepsilon_{t-1}, \cdots, \varepsilon_{t-q}\}$ is random interference sequence; Subscript t is time;

$Y_t - \beta_1 Y_{t-1} - \beta_2 Y_{t-2} - \cdots - \beta_p Y_{t-p}$ is the autoregressive part of the model;

$\beta_1, \beta_2, \cdots, \beta_p$ is autoregressive coefficient; $\varepsilon_t - \alpha_1 \varepsilon_{t-1} - \alpha_2 \varepsilon_{t-2} - \cdots - \alpha_q \varepsilon_{t-q}$ is the moving average part of the model; $\alpha_1, \alpha_2, \cdots, \alpha_q$ is the moving average coefficient; p and q are autoregressive order and moving average order respectively.

The backward shift operator B can be introduced, where $B^j Y_t = Y_{t-j}$, and denote the ARMA (p,q) model as:

$$\left.\begin{array}{l} \phi(B) Y_t = c + \theta(B)\varepsilon_t \\ \phi(B) = 1 - \beta_1 B - \beta_2 B^2 - \cdots - \beta_p B^p \\ \theta(B) = 1 - \alpha_1 B - \alpha_2 B^2 - \cdots - \alpha_q B^q \end{array}\right\} \quad (9)$$

Where $\phi(B)$ Is polynomial of p order autoregressive coefficient; $\theta(B)$ is polynomial of moving average coefficient of order q; ε_t is white noise, and follows a normal distribution with a mean of 0 and a constant variance.

A smooth time series is a prerequisite for the ARMA model, and the determination of the smoothness of the time series is the first step in forecasting. When the time series shows a specific trend, the series can be smoothed by differencing. The ARMA(p,q) study is based on the d-order differenced series, called ARIMA(p,d,q) model, expressed as

$$\phi(B)(1-B)^d Y_t = c + \theta(B)\varepsilon_t \quad (10)$$

Seasonal time series are time series that have both a trend and a cycle, with the cycle being driven by seasonal variation or other underlying variables. The SARIMA model is an ARIMA analysis based on the sequence following seasonal differences. It is expressed as equation (11) and is denoted as $\mathrm{SARIMA}(p,d,q)(P,D,Q)_S$.

$$\left.\begin{array}{l} \phi(B)\Phi(B^S)(1-B)^d(1-B^S)^D Y_t = c + \theta(B)\Theta(B^S)\varepsilon_t \\ \Phi(B^S) = 1 - \beta_1 B^S - \beta_2 (B^S)^2 - \cdots - \beta_P (B^S)^P \\ \Theta(B^S) = 1 - \alpha_1 B^S - \alpha_2 (B^S)^2 - \cdots - \alpha_Q (B^S)^Q \end{array}\right\} \quad (11)$$

Where B^S is the seasonal backward shift operator; S is the seasonal cycle; $\Phi(B^S)$ is the regression coefficient polynomial; $\Theta(B^S)$ is the moving average coefficient polynomial; with p = non-seasonal AR order, d = non-seasonal differencing, q = non-

seasonal MA order, P = seasonal AR order, D = seasonal differencing, Q = seasonal MA order, and S = time span of repeating seasonal pattern.

Monthly CPI data (not seasonally adjusted) for the UK economy from January 1989 to December 2019 (2015 index = 100) is used in this application to discover the best model for monthly inflation rates. The Office for National Statistics provided the data.

This programme was created using the "forecast" and "uroot" packages in R Project for Statistical Computing version 4.2.0. To create a SARIMA model, the auto.arima() function in R utilises a variant of the Hyndman-Khandakar approach (Hyndman & Khandakar, 2008), including unit root tests, AICc minimization, and Maximum likelihood estimation(MLE). The inputs to auto.arima() allow for a wide range of algorithm changes.

Using repeated KPSS tests, the number of differences $0 \leq d \leq 2$ is determined. After differencing the data d times, the values of p and q are chosen by minimising the AICc. Instead of considering every conceivable combination of p and q, the algorithm traverses the model space via a stepwise search. The most parsimonious model was an ARIMA(1,1,1)(0,0,2)[12] after assessing the information criterion.

We forecasted the UK CPI using this model. We started with an in-sample forecast, estimating the model until December 2016, and then one-step-ahead forecasts until December 2019. Figure 4 shows the observed values of the differences of the index. Figure 5 compares the forecast and actual value in the 3-year forecast horizon. The capacity to appropriately catch trends is critical in cpi research. As the forecast horizons increase, the accuracy of prediction gradually decreases. Until January 2019, the forecast appears to underestimate the observed values using this method. After that, the estimates fail to reflect cpi fluctuations appropriately. Figure 6 includes a residuals time series plot and graphs of the autocorrelation function (ACF) and residuals histogram. There is some significant lag, but not so much. The residuals show no cyclical pattern suggesting no autocorrelation. Figure 7 shows the recursive predictions method's pseudo out-of-sample forecasts; A pseudo out-of-sample forecasting exercise simulates standing at a particular date t and performing the model specification and parameter estimates using only the data available at that time, then computing the h-period forward forecast for date t+h. In this case, we investigate

forecasts of UK inflation at the 12-month horizon from 2019:12. In order to provide projections for periods ahead, each anticipated value is replaced in the estimated model. The model predicts that inflation will fall until June 2020 and then rise slowly, inflation over the next 12 months will be lower than at the end of 2019.

Figure 4

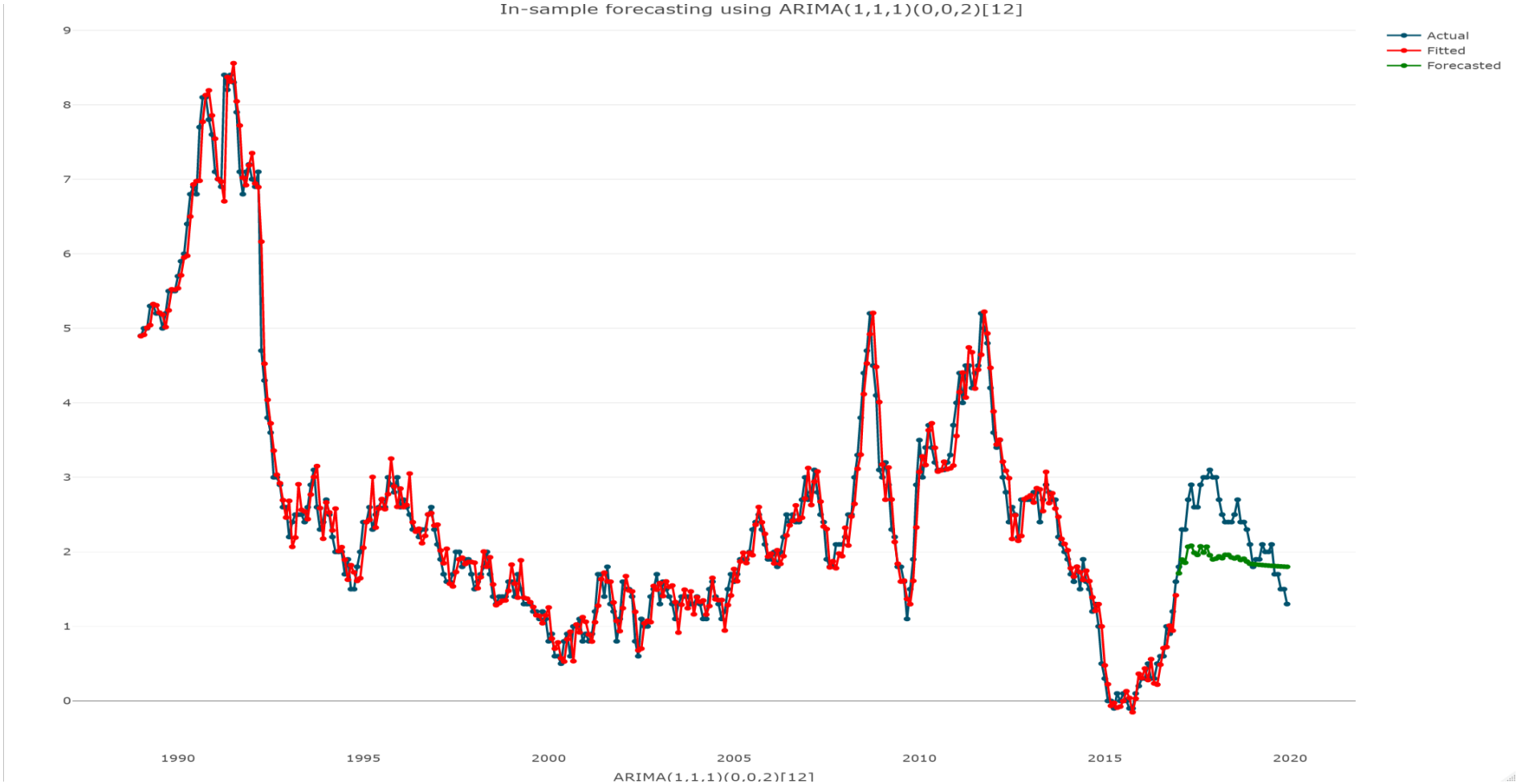

In-sample forecasting using ARIMA(1,1,1)(0,0,2)[12]
Actual
Fitted
Forecasted
9
8
7
6
5
4
3
2
1
0
1990
1995
2000
2005
2010
2015
2020
ARIMA(1,1,1)(0,0,2)[12]

Figure 5

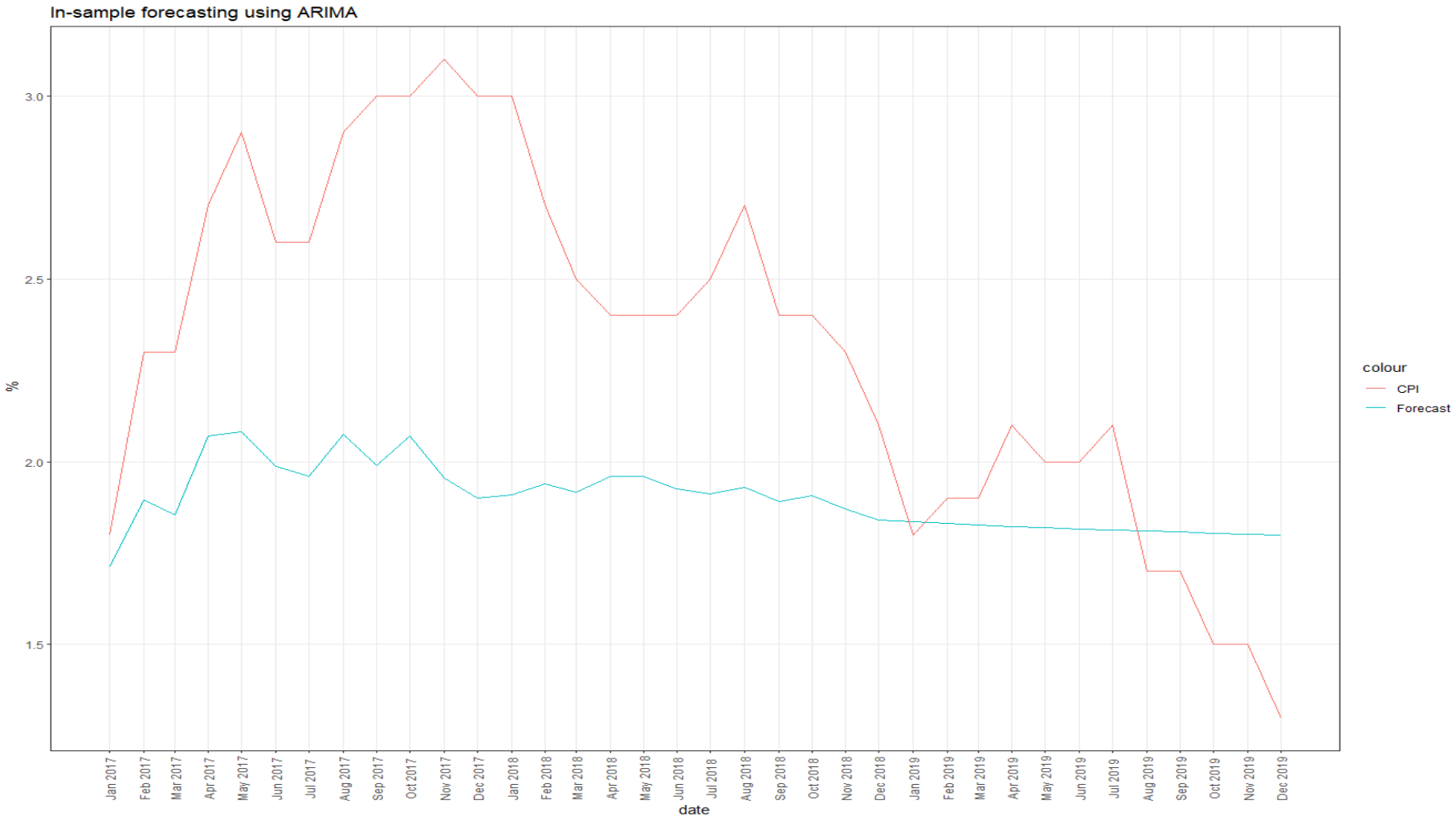

In-sample forecasting using ARIMA
3.0
2.5
2.0
1.5
%
Jan 2017
Feb 2017
Mar 2017
Apr 2017
May 2017
Jun 2017
Jul 2017
Aug 2017
Sep 2017
Oct 2017
Nov 2017
Dec 2017
Jan 2018
Feb 2018
Mar 2018
Apr 2018
May 2018
Jun 2018
Jul 2018
Aug 2018
Sep 2018
Oct 2018
Nov 2018
Dec 2018
Jan 2019
Feb 2019
Mar 2019
Apr 2019
May 2019
Jun 2019
Jul 2019
Aug 2019
Sep 2019
Oct 2019
Nov 2019
Dec 2019
date
colour
CPI
Forecast

Figure 6

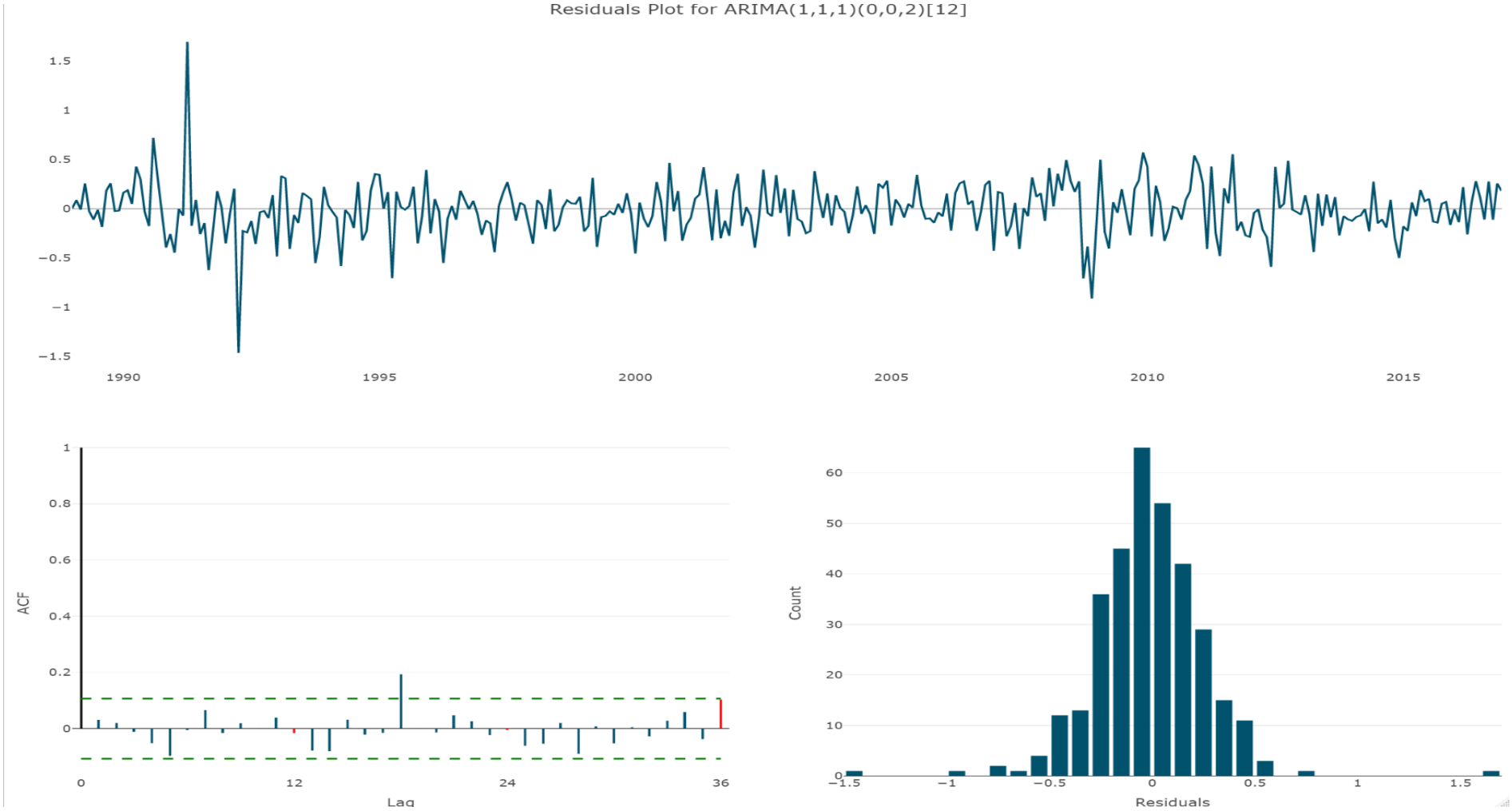

Residuals Plot for ARIMA(1,1,1)(0,0,2)[12]
1.5
1
0.5
0
−0.5
−1
−1.5
1990
1995
2000
2005
2010
2015
ACF
1
0.8
0.6
0.4
0.2
0
0
12
24
36
Lag
Count
60
50
40
30
20
10
0
−1.5
−1
−0.5
0
0.5
1
1.5
Residuals

Figure 7 Out-sample Forecasting using ARIMA(1,1,1)(0,0,2)[12]

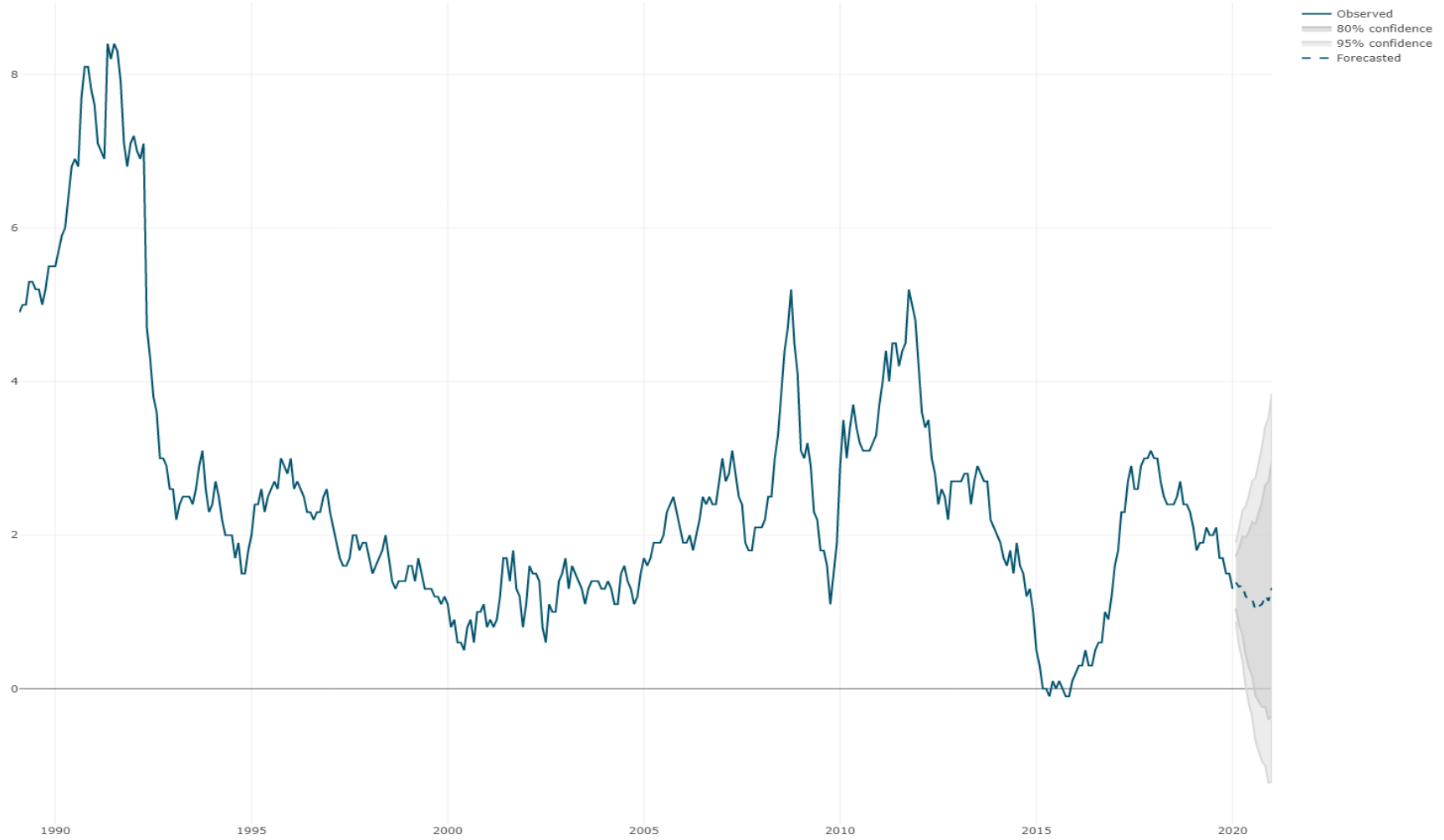


Figure 8

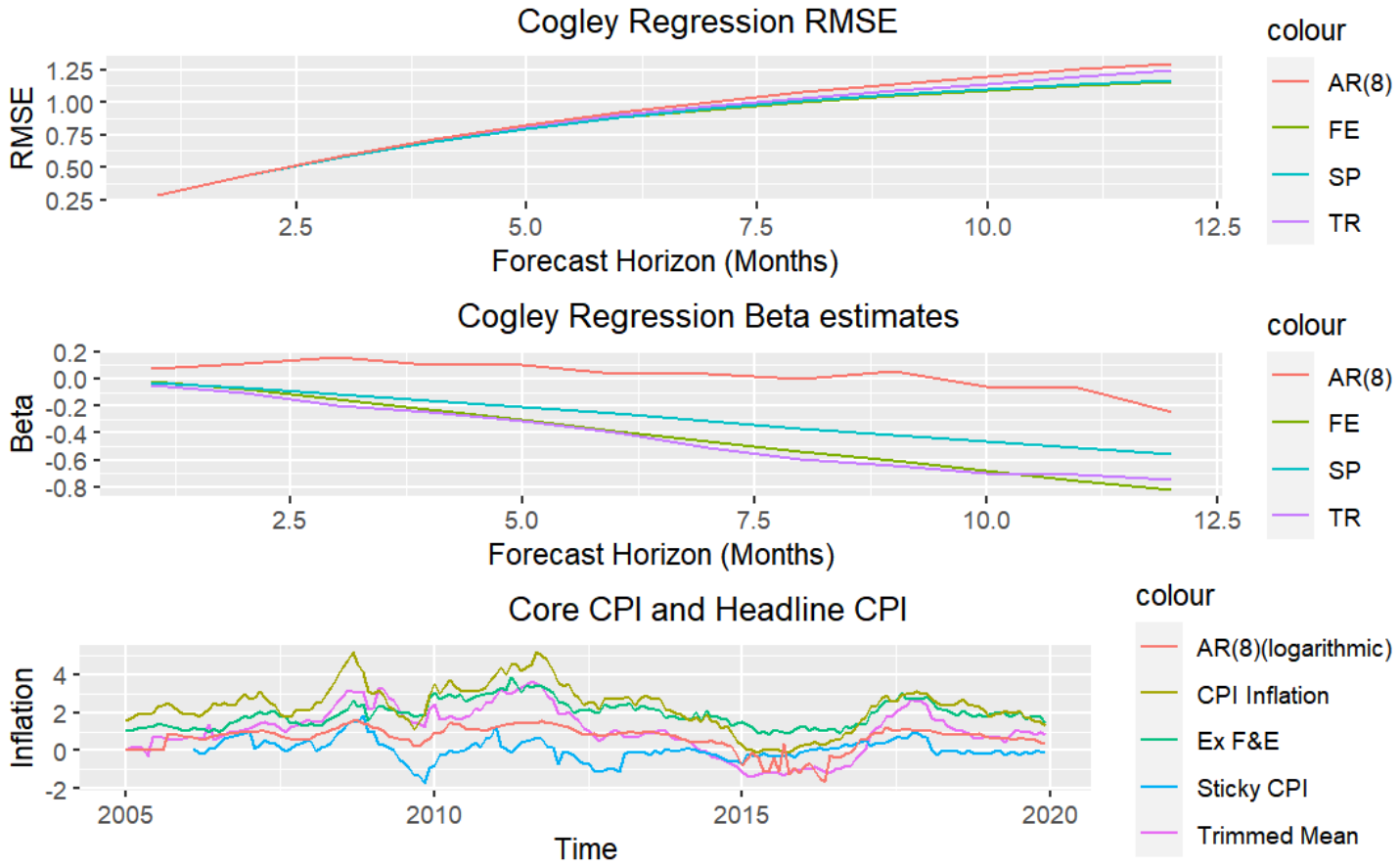

Cogley Regression RMSE
RMSE
1.25
1.00
0.75
0.50
0.25
2.5
5.0
7.5
10.0
12.5
Forecast Horizon (Months)
colour
AR(8)
FE
SP
TR
Cogley Regression Beta estimates
Beta
0.2
0.0
-0.2
-0.4
-0.6
-0.8
2.5
5.0
7.5
10.0
12.5
Forecast Horizon (Months)
colour
AR(8)
FE
SP
TR
Core CPI and Headline CPI
Inflation
4
2
0
-2
2005
2010
2015
2020
Time
colour
AR(8)(logarithmic)
CPI Inflation
Ex F&E
Sticky CPI
Trimmed Mean

Table 20 Headline CPI Forecast Accuracy: Coefficients

Core Inflation								
	FE		TR		SP		AR(8)	
	α	β	α	β	α	β	α	β
1 months ahead	0.01	-0.02	0.06	-0.05	0.07	-0.03	0.001	0.08
2 months ahead	0.03	-0.07	0.13	-0.11	0.14	-0.06	0.001	0.11
3 months ahead	0.06	-0.15	0.24	-0.20	0.26	-0.12	-0.002	0.16
4 months ahead	0.08	-0.23	0.30	-0.24	0.35	-0.16	-0.01	0.11
5 months ahead	0.10	-0.30	0.37	-0.31	0.44	-0.20	-0.02	0.11
6 months ahead	0.12	-0.38	0.47	-0.40	0.55	-0.25	-0.02	0.04
7 months ahead	0.14	-0.46	0.61	-0.51	0.67	-0.31	-0.03	0.04
8 months ahead	0.16	-0.54	0.69	-0.59	0.78	-0.36	-0.04	0.001
9 months ahead	0.17	-0.61	0.75	-0.64	0.88	-0.41	-0.05	0.06
10 months ahead	0.19	-0.68	0.80	-0.70	0.98	-0.46	-0.06	-0.06
11 months ahead	0.21	-0.76	0.81	-0.71	1.07	-0.50	-0.07	-0.07
12 months ahead	0.23	-0.82	0.85	-0.74	1.17	-0.55	-0.08	-0.25

Table 21 Headline CPI Forecast Accuracy: Root Mean Squared Errors

Core Inflation				
	FE	TR	SP	AR(8)
1 months ahead	0.29	0.29	0.29	0.29
2 months ahead	0.44	0.44	0.44	0.45
3 months ahead	0.58	0.58	0.58	0.59
4 months ahead	0.69	0.70	0.69	0.71
5 months ahead	0.79	0.81	0.80	0.82
6 months ahead	0.88	0.90	0.89	0.92
7 months ahead	0.95	0.97	0.95	1.00
8 months ahead	1.00	1.03	1.01	1.08
9 months ahead	1.05	1.09	1.06	1.14
10 months ahead	1.09	1.14	1.10	1.20
11 months ahead	1.12	1.20	1.14	1.25
12 months ahead	1.16	1.24	1.17	1.30

Chapter 3: Different measures of core inflation and how useful they are for the UK.

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List of Abbreviations

01FB Food and Non-Alcoholic Beverages

02AT Alcoholic Beverages, Tobacco and Narcotics

03CF Clothing and Footwear

04HW Housing, Water, Electricity, Gas and Other Fuels

05FH Furnishings, Household Equipment and Routine Household Maintenance

06HL Health

07TR Transport

08CM Communication

09RC Recreation and Culture

10ED Education

11RH Restaurants and Hotels

12MS Miscellaneous Goods and Services

Appendix A: CPI Weights: 2008

Table 22 CPI Weights: 2008

	2008
CPI (overall index)	1000
01 Food and non-alcoholic beverages	109
02 Alcoholic beverages and tobacco	42
03 Clothing and footwear	63
04 Housing, water, electricity, gas and other fuels	115
05 Furniture, household equipment and maintenance	67
06 Health	22
07 Transport	152
08 Communication	23
09 Recreation and culture	152
10 Education	19
11 Restaurants and hotels	137
12 Miscellaneous goods and services	99

Appendix B: Title here

Appendix C: Title here