Does Consumer Confidence Forecast Household Spending? The Euro Area Case (Appendix to the main text)

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23. November 2006

Appendix I: Correlation coefficients and graphs

Table 1: Correlation coefficient
(the one-quarter lag tests the leading property of the CCI)

Correlation matrix between consumption and confidence (1985q1-1999q4)

	Consumption (y-on-y growth rates)
CCI OLD	**0.782**
1 quarter lag	0.779
CCI NEW	0.605
1 quarter lag	**0.629**

According to the sample used, the results of the correlation coefficients may change. We have also tested for shorter samples. For instance, on a sample measured over the last decade (1991q1-2000q4), the results for the new CCI are higher and close to the ones for the Old CCI and still display a lead.

Correlation matrix between disposable income, GDP and confidence (1985q1-1999q4)

	Disposable income (y-on-y)	**GDP (y-on-y)**
Disposable income	1	0.674
GDP	0.674	1
CCI OLD	0.764	**0.753**
1 quarter lag	0.830	0.671
2 quarters lag	**0.845**	0.551
CCI NEW	0.619	**0.731**
1 quarter lag	0.720	0.644
2 quarters lag	**0.755**	0.498

It appears that consumer confidence has strong leading features with disposable income whereas it mostly appears coincident with GDP. In both cases, the Old and the New CCI show higher correlation coefficients with disposable income for the 2-quarters lead (respectively 0.83 and 0.755). This confirms the strong leading features of the CCI with

disposable income as stated in numerous analyses of the relationship between CCI and consumption through disposable income. In the following section, we perform a factor analysis to see whether other combinations of the index could not perform better than the current CCI.

Factor analysis to select the components of the index

We want to assess the specificity of some of the components of the confidence index in accounting for overall confidence. We should thus test the forecasting power of each one of the questions provided by the indicator. Obviously, no single question improves significantly the forecasts. However, different combinations depending on the current economic situation provide interesting insights. Some survey questions have more forecasting powers than others. The unemployment question ought to be integrated for instance as job availability has a high influence on the willingness to spend.

As explained by Praet and Vuchelen (1984), "The principal components analysis allows us to gather the information provided by a set of variables in a smaller set of un-correlated variables which describe the major part of the variance of the original set". We have applied that technique to the 12 opinion variables. It appears that 8 of them share significant correlation. The weights of the first principal components place the financial and economic situation at the highest level. The subjective expectations indeed influence consumer confidence in a more direct way than the realised figures. However, these expectations are also (partly) derived from the objective data published in the press.

Our correlation and common factor analysis leads us to propose four alternatives that all perform as well as the old and new CCI proposed by the Commission in 2001 over the complete sample. They lay emphasis on the current economic situation, the future financial situation, the future ability to save and the future situation of unemployment. We used these four alternatives in the first part and they helped us to prove to what extent different measures of consumer confidence can modify the forecasting capacity of qualitative data. Our alternative specifications display higher coefficient of (coincident) correlation than the official CCI. All our alternatives include questions 2 and 3 that display the highest correlation.

The four alternatives

Alternative 1: Question 2 and Question 3
Alternative 2: Question 2, Question 3 and Question 11
Alternative 3: Question 1, Question 2, Question 3 and Question 11
Alternative 4: Question 2, Question 3, Question 7 and Question 11

We observe that the four alternatives provide high correlation coefficients with consumption growth. The first alternative performs best, followed then by the fourth one. We can infer then that the previous general economic situation, the future personal financial situation and future unemployment are the most important questions of the indicator as they provide the highest correlation

	Consumption (y-on-y growth rates)
CCI alternative 1	0.799
1 quarter lag	0.793
CCI alternative 2	0.767
1 quarter lag	0.753
CCI alternative 3	0.781
1 quarter lag	0.759
CCI alternative 4	0.791
1 quarter lag	0.733

Likewise, these two alternatives, perform well when correlated with disposable income and gross domestic product. In the first case, they display strong leading abilities reaching leads of two quarters with the fourth alternative. In the second case, they are all coincident

	Disposable income (y-on-y)	GDP (y-on-y)
CCI alternative 1	0.799	0.763
1 quarter lag	0.856	0.667
2 quarters lag	0.856	0.537
CCI alternative 2	0.802	0.749
1 quarter lag	0.852	0.644
2 quarters lag	0.840	0.502
CCI alternative 3	0.823	0.748
1 quarter lag	0.863	0.641
2 quarters lag	0.844	0.501
CCI alternative 4	0.732	0.745
1 quarter lag	0.807	0.645
2 quarters lag	0.817	0.502

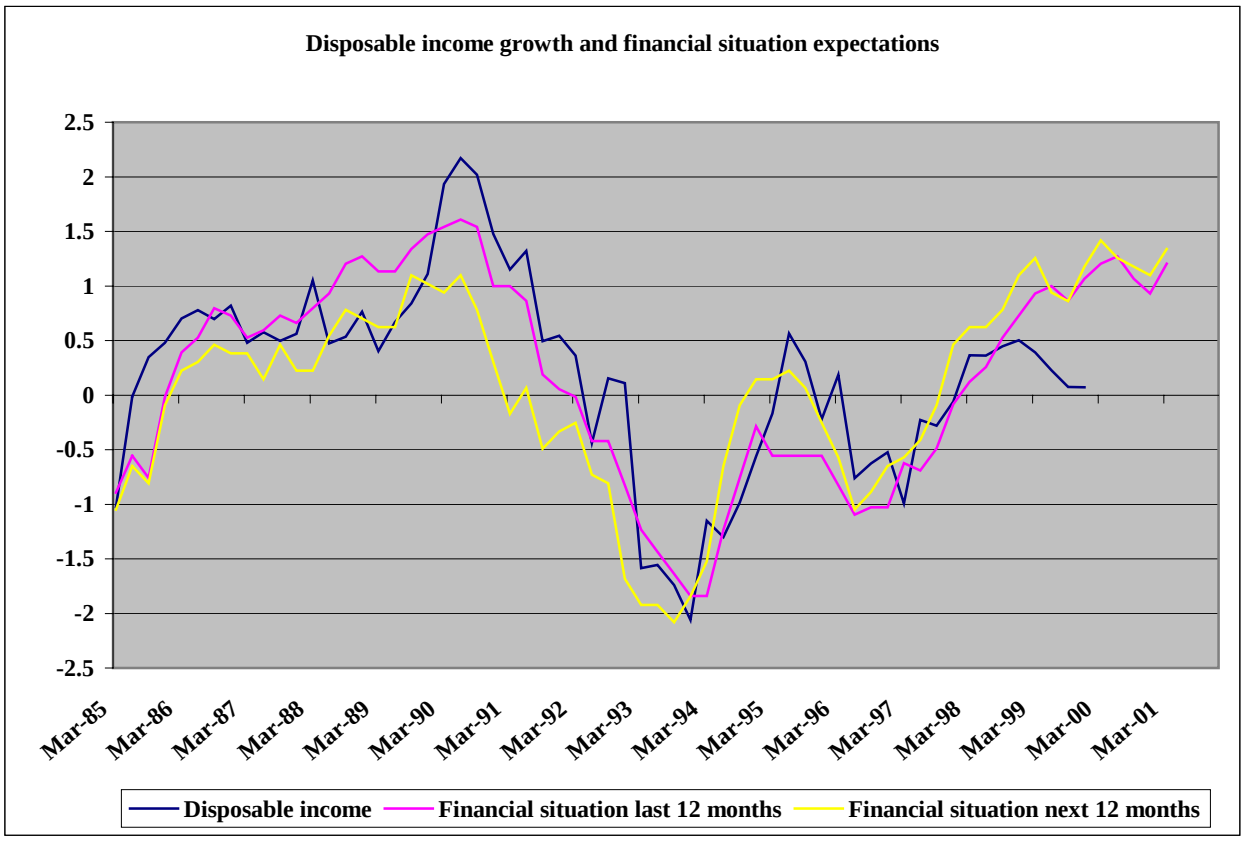
Consistency analysis

We have checked whether the survey results provided close correlation coefficients with their respective underlying variables. The results are satisfactory since all the R2 are ranging from 0.74 to 0.94. We can summarise these results by reviewing each of the questions and indicating their respective R2. Past and future personal financial situation is strongly correlated with disposable income (respectively 0.87 -coincident and 0.81 – 2 quarters lead). Past and future general economic situation is also strongly correlated with its own underlying variable, GDP (respectively 0.79 – coincident and 0.75 – coincident). Expectations on unemployment and its underlying variable also provide high correlation coefficients (0.91 – 1 quarter lead). Same for past and future prices (0.94 – coincident and 0.89 – 1 quarter lead) and current and future major purchases (0.74 – coincident and 0.78 – coincident).

Correlation matrices (1985q1 to 2000q4)

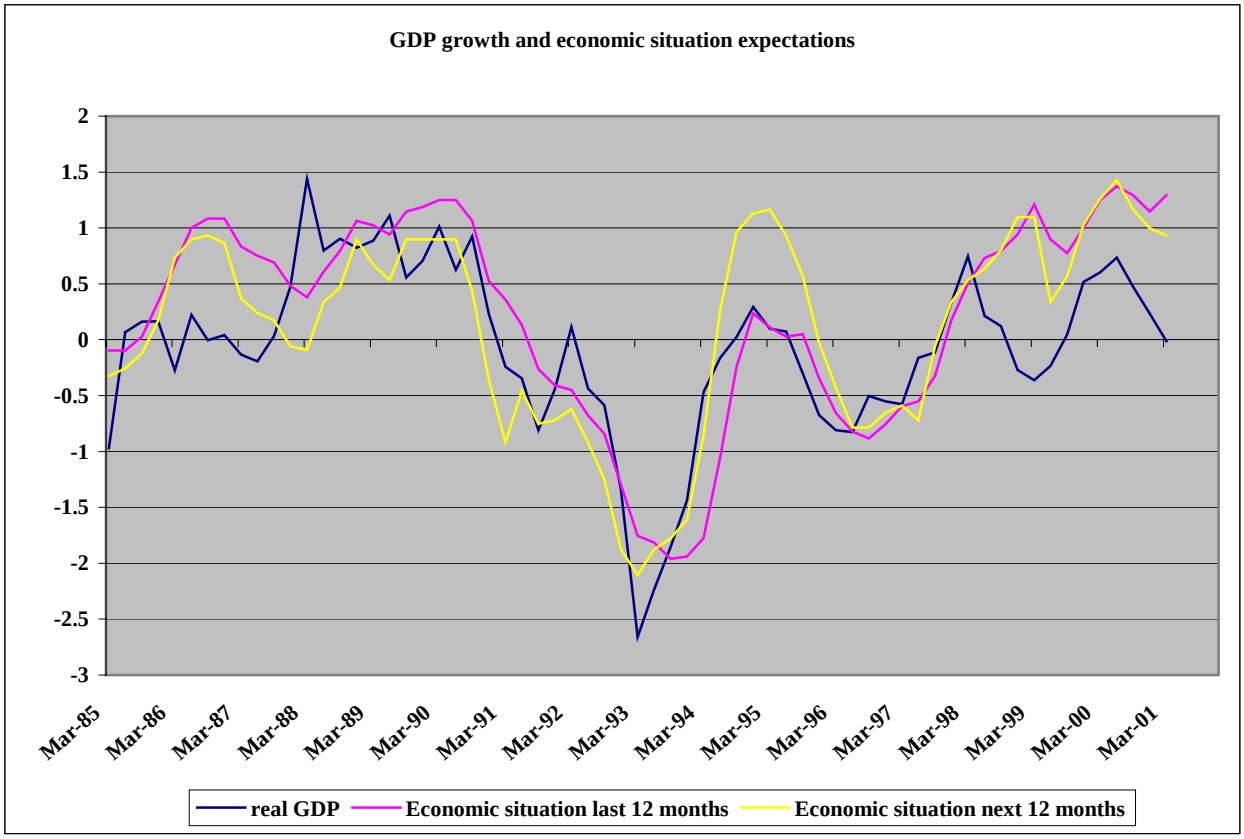
Personal financial situation (expectations) and disposable income (y-o-y realised)

	Disposable income
Financial situation over the last 12 months	**0.867628**
1 quarter lag	0.861302
2 quarters lag	0.811539
3 quarters lag	0.738226
Financial situation over the next 12 months	0.741026
1 quarter lag	0.808864
2 quarters lag	**0.812697**
3 quarters lag	0.761427



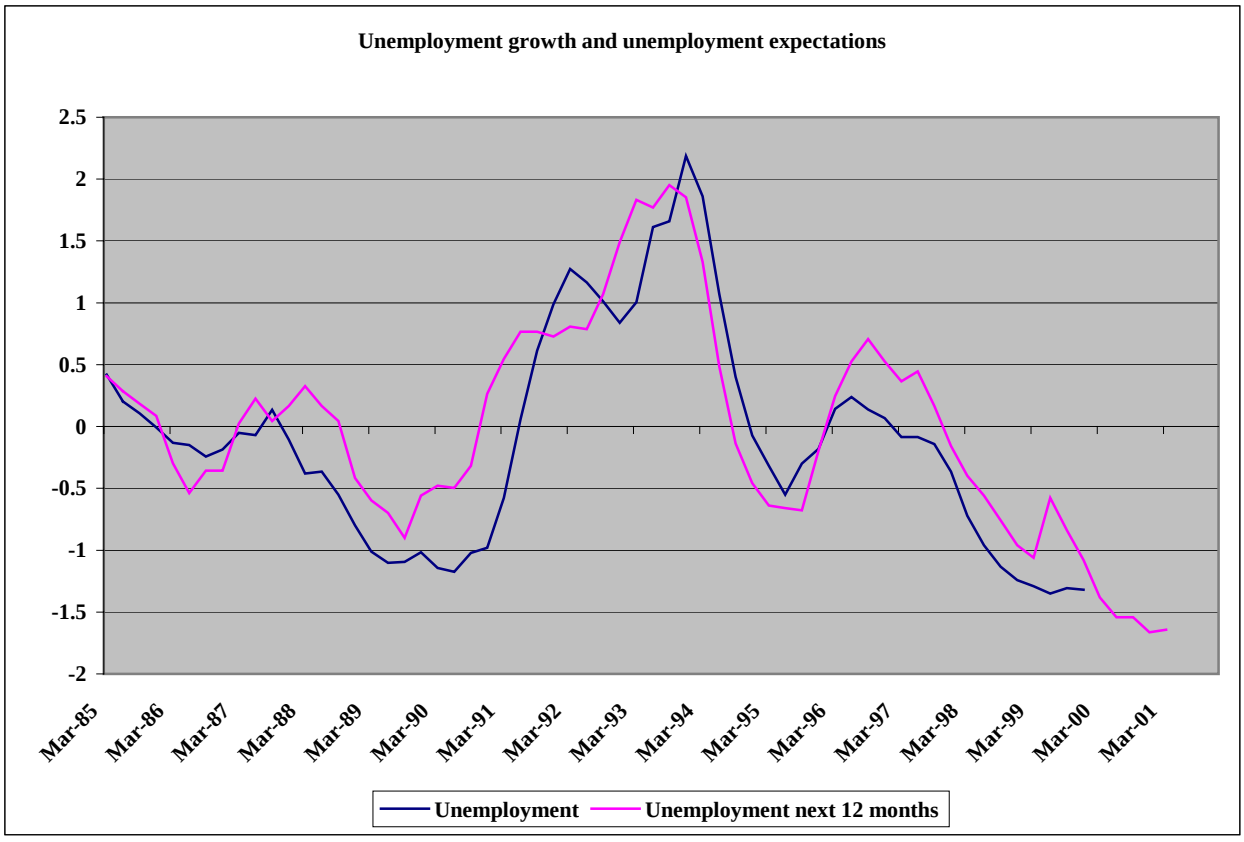
General economic situation (expectations) and GDP (y-o-y realised)

	GDP
Economic situation over the last 12 months	**0.789968**
1 quarter lag	0.695852
2 quarters lag	0.573260
3 quarters lag	0.456928
Economic situation over the next 12 months	**0.753845**
1 quarter lag	0.705591
2 quarters lag	0.585467
3 quarters lag	0.434214



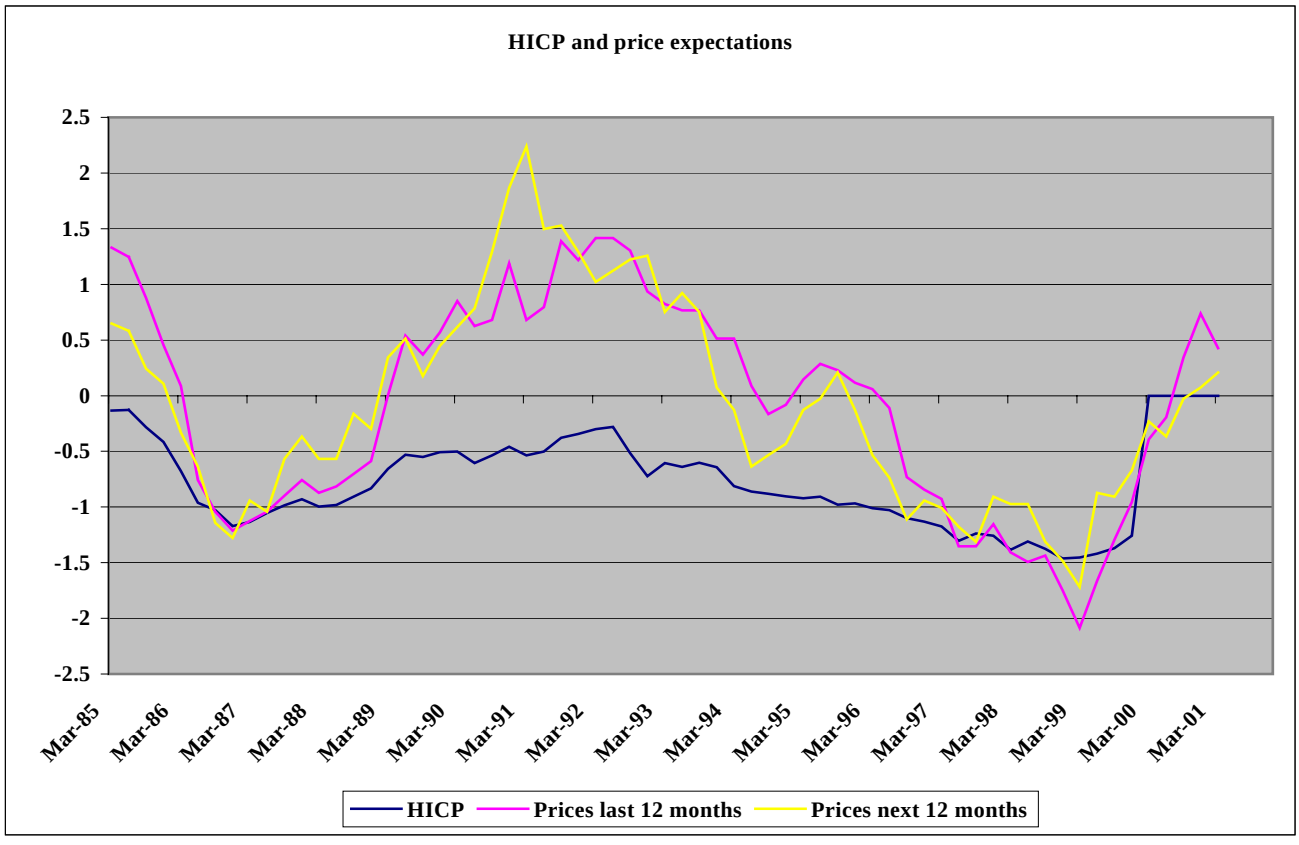
Unemployment (expectations) and unemployment (y-o-y realised)

	Unemployment
Unemployment over the next 12 months	0.878
1 quarter lag	**0.908**
2 quarters lag	0.860
3 quarters lag	0.751



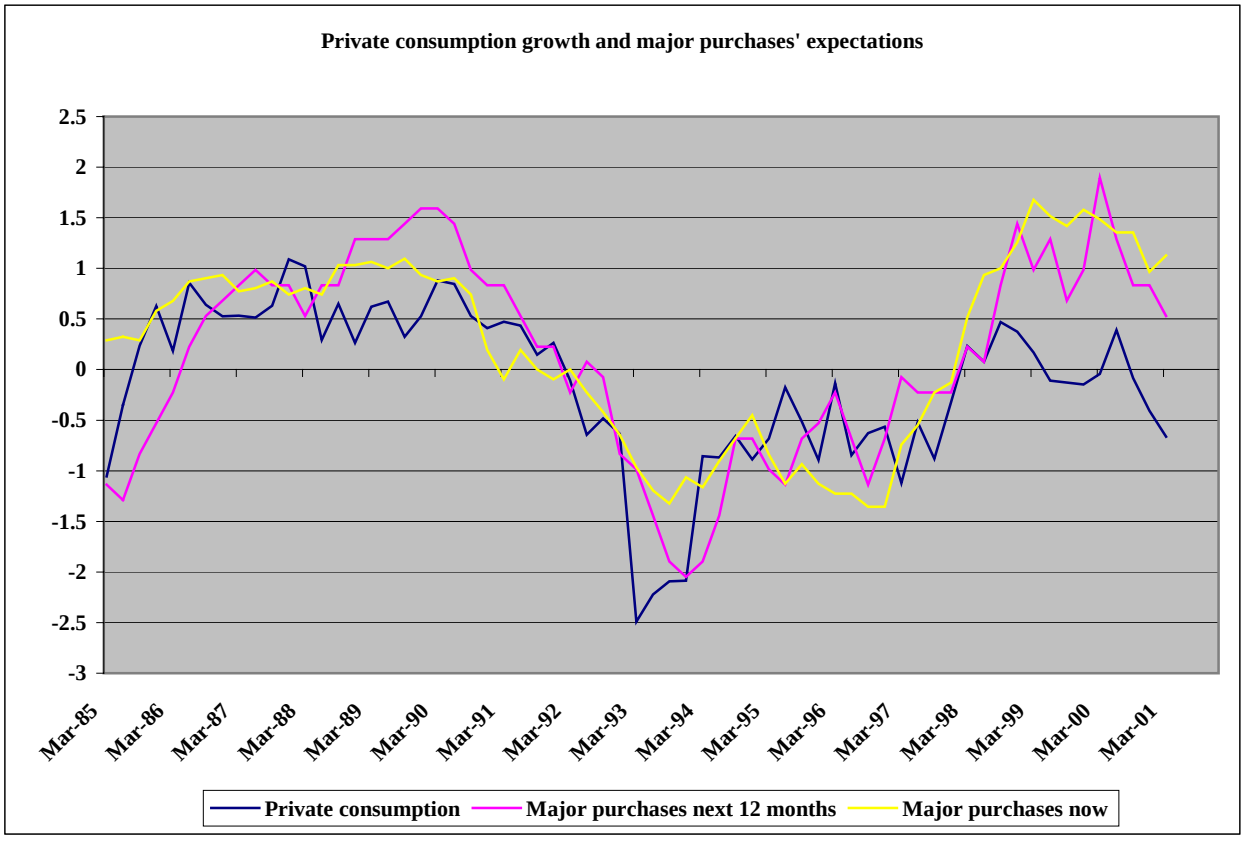
Prices (expectations) and HICP (y-o-y realised)

	HICP
Cost of living over the last 12 months	**0.938079**
1 quarter lag	0.892390
2 quarters lag	0.826833
3 quarters lag	0.739879
Cost of living over the next 12 months	0.882365
1 quarter lag	**0.887237**
2 quarters lag	0.873156
3 quarters lag	0.836960



Major purchases (expectations) and consumption (y-o-y realised)

	Consumption
Major purchases over the next 12 months	**0.777644**
1 quarter lag	0.727947
2 quarters lag	0.617891
3 quarters lag	0.517163
Major purchases now	**0.739741**
1 quarter lag	0.734293
2 quarters lag	0.720893
3 quarters lag	0.663786



Appendix 2: Results of the regressions

The equations shown are a selection of the best performing out of a large number which have been tested. The estimation and diagnostic testing have been performed and displayed satisfactory results in terms of: absence of serial correlation in the residuals (Correlograms, Q-statistics and Breusch-Godfrey test), homoscedasticity of the errors (ARCH test), normality of the residuals (Jarque-Bera test) and stability of the coefficients (Chow's breakpoint and forecast tests). The lowest standard error of the regression (that is based on the estimated variance of the residuals) is obtained with the confidence-augmented consumption function. Moreover, the standard errors of the estimated coefficients of the CCI (that measure the precision with which the estimated coefficients measure the true coefficients) in this equation are the lowest.

We have also performed both dynamic and static forecasts. In both cases, the confidence-augmented equation performed best. The root mean squared errors are smaller in the equation including the CCI. We use this forecast error statistic as a relative measure to compare forecasts across our different models. The Theil inequality coefficient is always between 0 and 1, with 0 indicating a perfect fit. This statistic is divided into bias, variance and covariance proportions which measure the discrepancy between the forecasted and actual mean, forecasted and actual variance and the remaining unsystematic forecasting errors respectively. A good forecast displays low bias and variance proportions and a high covariance proportion.

It appears that in the long run there is a constant ratio between consumption and income, since the coefficients on the lagged levels terms are equal in magnitude but opposite in sign. Indeed, after having performed a Wald test, we cannot reject the null hypothesis and we thus impose the restriction to obtain the following equations (see equations 9 to 14). The same restriction, using the Wald test in equation 14, could be imposed for the long run between unemployment and CCI. However, a similar restriction in the short run is rejected. This justifies the specific predicting role of the CCI in the short run, independently from other macroeconomic variables such as unemployment. The equations (apart from the first two ones) appear in their error correction form as specified in Banerjee and al. (1993). We can then separate between the long run relationship and the short run dynamics. The short run relationships are captured

by the terms in first differences while the long run relationships are captured by the terms in levels.

Table 2: Granger tests for causality

Pairwise Granger Causality Tests
Sample: 1970:1 2001:4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
D LOG C does not Granger Cause CCI OLD	58	1.41805	0.25122
CCI OLD does not Granger Cause D LOG C		11.3217	8.1E-05

Pairwise Granger Causality Tests
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
D LOG C does not Granger Cause CCI NEW	58	0.99307	0.37722
CCI NEW does not Granger Cause D LOG C		5.69274	0.00576

Part A: Bi-variate models with private consumption and consumer confidence

We propose in the following part several bi-variate equations whose unique purpose is to establish the statistical link between private consumption and consumer confidence.

Equation 1:

According to Hall's random walk hypothesis, lagged variables should have no predictive power for current consumption. However, consumer confidence with its different specifications seems to perform well since it displays a lead of one quarter. We obtain similar results for the 4 alternatives with or without lagged confidence

$$\Delta \log (C_t) = c + \alpha \ CCI_t + \varepsilon_t$$

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CCI OLD	0.446	0.120	3.723	0.0004
Intercept	0.066	0.116	0.572	0.5692
R-squared	0.192	F-statistic		13.863
S.E. of regression	0.892	Prob(F-statistic)		0.000
Durbin-Watson stat	2.488			

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CCI NEW	0.382	0.132	2.894	0.0053
Intercept	0.070	0.121	0.580	0.5639
R-squared	0.126	F-statistic		8.378
S.E. of regression	0.928	Prob(F-statistic)		0.005
Durbin-Watson stat	2.327			

Equation 2: The bi-variate VAR

Dependent Variable: LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.082	0.010	7.596	0.0000
CCI OLD(-1)	0.025	0.007	3.343	0.0015
LOG C(-1)	0.707	0.133	5.303	0.0000
LOG C(-2)	0.278	0.132	2.111	0.0393
R-squared	0.997	F-statistic		7338.257
S.E. of regression	0.049	Prob(F-statistic)		0.000000
Durbin-Watson stat	2.145			

Dependent Variable: LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.083	0.010	7.796	0.0000
CCI NEW(-1)	0.027	0.007	3.616	0.0006
LOG C(-1)	0.703	0.130	5.386	0.0000
LOG C(-2)	0.275	0.128	2.143	0.0365
R-squared	0.997	F-statistic		7549.462
S.E. of regression	0.049	Prob(F-statistic)		0.000000
Durbin-Watson stat	2.121			

Equation 3: The bi-variate ECM

$$\Delta \log (C_t) = c + \alpha \Delta CCI_t + \beta [\log (C_{t-1}) + \beta_1 \log (C_{t-2}) + \beta_2 CCI_{t-2}] + \varepsilon_t \quad (3)$$

Dependent Variable: D LOG C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.081	0.010	7.921	0.0000
D CCI OLD	0.067	0.022	3.041	0.0037
CCI OLD(-2)	0.029	0.007	3.848	0.0003
LOG C(-1)	-0.290	0.125	-2.304	0.0251
LOG C(-2)	0.277	0.124	2.224	0.0304
R-squared	0.325	F-statistic		6.407
S.E. of regression	0.047	Prob(F-statistic)		0.000
Durbin-Watson stat	2.190			

Dependent Variable: D LOG C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.081	0.011	7.407	0.0000
D (CCI NEW)	0.036	0.020	1.723	0.0907
CCI NEW(-2)	0.028	0.008	3.303	0.0017
LOG C(-1)	-0.280	0.134	-2.093	0.0411
LOG C(-2)	0.260	0.132	1.968	0.0542
R-squared	0.250	F-statistic		4.421
S.E. of regression	0.050	Prob(F-statistic)		0.003
Durbin-Watson stat	2.215			

Part B: Private consumption function without consumer confidence

In this part we build several consumption function in order to select the equation that performs the best in terms of traditional statistic tests and forecasting abilities. It appears that the selected equation includes, beside the traditional series on private consumption and disposable income, a series of unemployment and a series of short-term interest rate. This is this equation (8) that is going to be our benchmark. We present the other functions just as a remainder. They are ranked according to their "statistical and predictive" performance.

Baseline consumption function: $\Delta \log (C_t) = c + \alpha \Delta \log (Y_t) + \beta [\log (C_{t-1}) - \log (Y_{t-1})] + \varepsilon_t$ (4)

Baseline consumption function with prices (data on inflation expectations can also be used to give a measure of uncertainty):$\Delta \log (C_t) = c + \alpha \Delta \log (Y_t) + \beta \Delta \log (HICP_t) + \chi [\log (C_{t-1}) - \log (Y_{t-1})] + \varepsilon_t$ (5)

Baseline consumption function with short-term interest rate, r (the inclusion of interest rates aims at measuring its impact on income and also provides a measure of liquidity constraints): $\Delta \log (C_t) = c + \alpha \Delta \log (Y_t) + \beta r_{t-1} + \chi [\log (C_{t-1}) - \log (Y_{t-1})] + \varepsilon_t$ (6)

Equation 4

Dependent Variable: D LOG C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.028	0.006	4.577	0.0000
D LOG Y	0.636	0.058	10.958	0.0000
LOG C (-1) – LOG Y(-1)	-0.123	0.066	-1.852	0.0667

R-squared	0.555	F-statistic	47.396
S.E. of regression	0.040	Prob(F-statistic)	0.000
Durbin-Watson stat	2.018		

Equation 5

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.052	0.010	4.918	0.0000
D LOG Y	0.554	0.055	9.943	0.0000
D LOG HICP	-0.303	0.092	-3.294	0.0013
LOG C(-1) – LOG Y (-1)	-0.060	0.025	-2.429	0.0167
R-squared	0.588	F-statistic	54.735	
S.E. of regression	0.038	Prob(F-statistic)	0.000	
Durbin-Watson stat	2.241			

Equation 6

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.027	0.006	4.602	0.0000
D LOG Y	0.591	0.052	11.173	0.0000
LOG C(-1) – LOG Y (-1)	-0.057	0.025	-2.254	0.0261
IRST(-1)	-0.013	0.004	-2.937	0.0040
R-squared	0.580	F-statistic		53.09141
S.E. of regression	0.039	Prob(F-statistic)		0.000000
Durbin-Watson stat	2.306			

Equation 7

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.038	0.006	5.764	0.0000
D LOG C(-1)	-0.160	0.065	-2.461	0.0154
D LOG Y	0.595	0.057	10.41	0.0000
LOG C(-1) – LOG Y(-1)	-0.013	0.003	-3.521	0.0006
REAL IRST	-0.012	0.003	-3.254	0.0015
R-squared	0.593	F-statistic		41.199
S.E. of regression	0.038	Prob(F-statistic)		0.000
Durbin-Watson stat	2.076			

Equation 8

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.037	0.006	5.429	0.000
D LOG C(-1)	-0.171	0.064	-2.645	0.0093
D LOG Y	0.618	0.054	11.291	0.0000
D LOG U	-0.021	0.012	-1.741	0.0843
LOG C(-1) – LOG Y(-1)	-0.085	0.028	-3.023	0.1009
IRST(-1)	-0.015	0.004	-3.343	0.0091
R-squared	0.603	F-statistic		34.045
S.E. of regression	0.038	Prob(F-statistic)		0.000
Durbin-Watson stat	2.049			
Forecasting LOG C:	Static		Dynamic	
Root mean squared error	0.023		0.082	
Mean absolute error	0.017		0.079	
Mean absolute percent	2.143		8.089	
error	0.011		0.037	
Theil inequality	0.290		0.914	
coefficient	0.008		0.045	
Bias proportion	0.701		0.040	
Variance proportion				
Covariance proportion				

Part C: Private consumption function with consumer confidence

Our purpose here is to use the previous equation (8) as our benchmark and by adding the CCI in a new equation (9), check whether it displays a specific forecasting power. It appears that consumer confidence indeed has some idiosyncratic features that neither disposable income nor unemployment can capture. However, the new CCI does not seem to provide the same information (at least over the sample we have used).

Equation 9: with the Old CCI

Dependent Variable: D LOG C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.043	0.008	5.026	0.0000
D LOG C(-1)	-0.229	0.088	-2.611	0.0120
D LOG Y	0.583	0.083	6.955	0.0000
D LOG U	-0.077	0.041	-1.858	0.0693
D CCI	0.046	0.021	2.133	0.0381
LOG C (-1) – LOG Y(-1)	-0.173	0.096	-1.789	0.0798
LOG U(-1)	0.116	0.041	2.804	0.0073
LOG U (-2)	-0.097	0.040	-2.409	0.0199
CCI(-2)	0.029	0.011	2.496	0.0160

R-squared	0.738	F-statistic	15.097
S.E. of regression	0.031	Prob(F-statistic)	0.000
Durbin-Watson stat	2.178		

Forecasting LOG C:	Static	Dynamic
Root mean squared error	0.013	0.012
Mean absolute error	0.011	0.010
Mean absolute percent	1.271	1.139
error	0.006	0.005
Theil inequality	0	0
coefficient	0	0
Bias proportion	0.999	0.999
Variance proportion		
Covariance proportion		

Equation 9: with the New CCI

Dependent Variable: D LOG C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.042	0.009	4.462	0.0000
D LOG C(-1)	-0.259	0.092	-2.798	0.0074
D LOG Y	0.609	0.088	6.917	0.0000
D LOG U	-0.095	0.043	-2.187	0.0336
D CCI NEW	0.014	0.019	0.726	0.4711
LOG C(-1)	-0.074	0.094	-0.786	0.4352
LOG Y(-1)	0.062	0.092	0.673	0.5037
LOG U(-1)	0.083	0.045	1.839	0.0720
LOG U(-2)	-0.077	0.046	-1.675	0.1004
CCI NEW(-2)	0.009	0.011	0.886	0.3797
R-squared	0.707417	F-statistic		12.89509
S.E. of regression	0.033185	Prob(F-statistic)		0.000000
Durbin-Watson stat	2.175780			

Part D: Consumer confidence function

Consumer confidence can be partly explained by GDP and unemployment. The short-run dynamics show that these two variables have an impact on confidence. However, the explicative power of these two variables is not significant enough to take it as granted. There still remains some explicative power not displayed by these economic variables. Moreover, the long-run equilibrium does not include any economic determinant.

Equation 10 with the old CCI

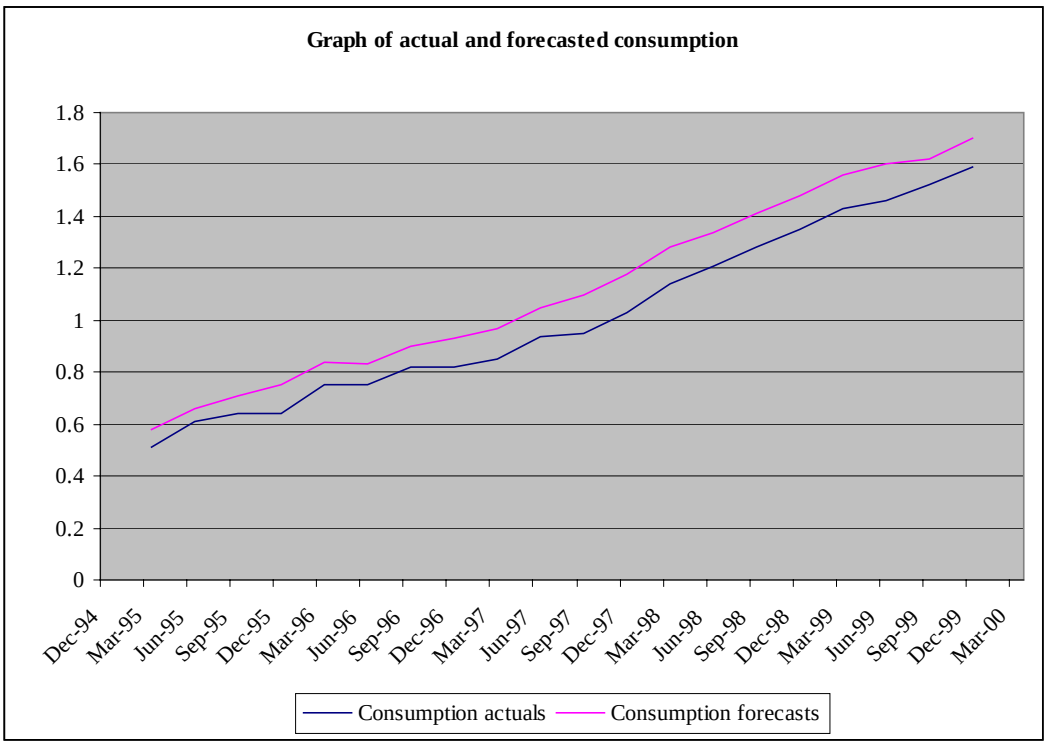
Dependent Variable: D CCI OLD				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	-0.077	0.031	-0.234	0.8156
D LOG GDP	0.065	0.034	1.922	0.0600
D LOG U	-0.076	0.045	-1.682	0.0985
CCI OLD(-1)	0.366	0.124	2.939	0.0049
CCI OLD(-2)	-0.5	0.112	-4.458	0.0000
R-squared	0.464	F-statistic		11.462
S.E. of regression	0.230	Prob(F-statistic)		0.000
Durbin-Watson stat	2.068			

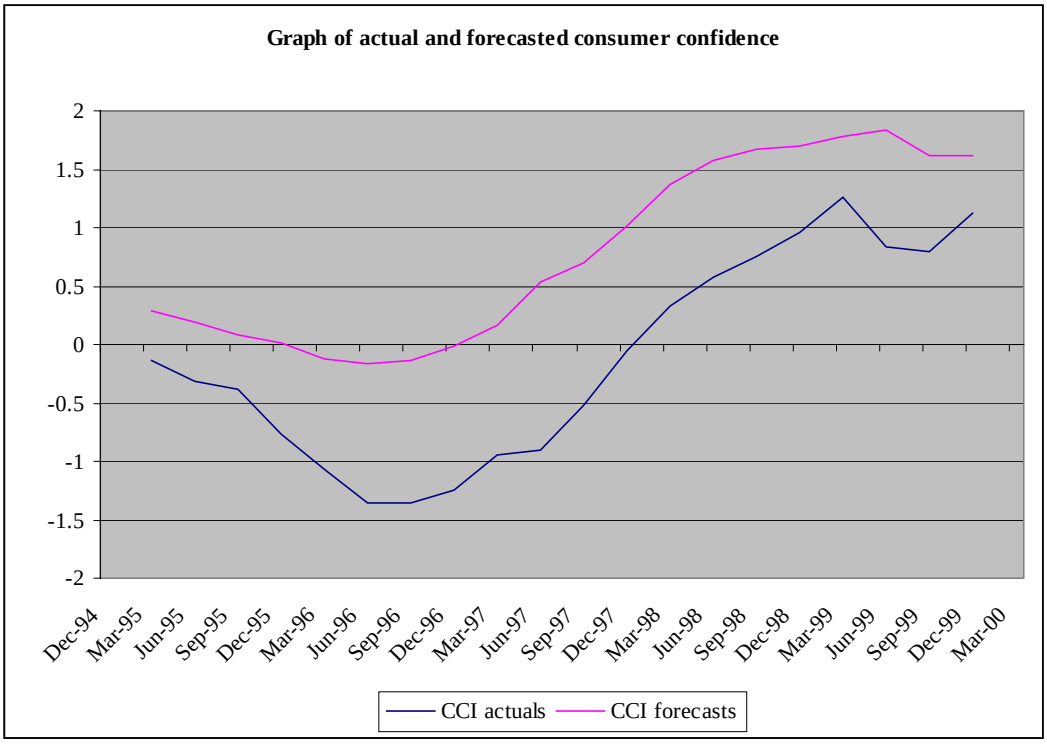
Equation 10 with the new CCI

Dependent Variable: D CCI NEW				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	-0.022	0.036	-0.596	0.5536
D LOG U	-0.118	0.054	-2.183	0.0334
CCINEW(-1)	0.377	0.126	2.994	0.0041
CCINEW(-2)	-0.574	0.108	-5.327	0.0000
R-squared	0.458	F-statistic		15.204
S.E. of regression	0.261	Prob(F-statistic)		0.000
Durbin-Watson stat	2.109			

Appendix 3: Results of the consumption model

Using the two behavioural equations 9 and 10 for consumption and confidence, we set up a model and generate forecasts that we compare with the actual data. Our objective is to create a very elementary consumption model for the euro area, that we can use to forecast and simulate the private consumption under a variety of different scenarios. We have performed dynamic deterministic solutions. The dynamic specification uses the model's solutions as estimates of lagged values of the endogenous variables. The model performs quite well for forecasting consumption but fails to provide accurate results for the CCI. That confirms the forecasting ability of our consumption function including the CCI. It also emphasises the difficulty to forecast the CCI. It then reminds us that the CCI contains non-economic factors that are uneasy to apprehend but strongly needed to improve our forecasts of consumption. We present below both the actual and forecasted figures for consumption and confidence as calculated by the model.





The use of survey results in short-term macro-econometric modelling

Survey results are used in several macro-econometric models such as the DRI/McGraw Hill model and the BUSY model of the European Commission. In these models, consumer confidence plays a role in explaining spending. Apart from the DRI and BUSY models, other users relied on survey results to build their forecasts. Among others, the Brookings-SSRC and the Wharton-EFU integrate qualitative variables to make their short-term forecasts. To integrate survey results within macroeconomic forecasting models does not require to endogenise the survey results as long as their predictive power stay within the forecasting horizon. Endogenising the survey results would necessitate to forecasts their future values which the above results have shown to be difficult.