

1. : THE IMPLICATIONS OF DIVERSITY IN CONSUMPTION BEHAVIOUR FOR THE CHOICE OF MONETARY POLICY RULES IN EUROPE

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Abstract

Differences in economic structures across countries have potentially important implications for the conduct of monetary policy in the Euro Area. One facet of this lies in consumer expenditure behaviour. Our objective is to analyse the policy implications of assuming maximal and minimal differences between European economies using the empirical macroeconometric model NiGEM. We assess the performance of three possible ECB monetary policy rules under these different scenarios, using measures of the volatility of prices and output. We take as our benchmark a fully heterogeneous Europe, where individual country consumption functions are estimated separately. We estimate a homogeneous model for core European countries, incorporating countries into the core where it is statistically justified in pooling them. We also estimate a fully homogeneous Europe where all Euro Zone countries are pooled. We find that the two 'pillar strategy' adopted by the ECB dominates other monetary policy frameworks if we are only concerned about price volatility.

Keywords: Consumption function; European asymmetries; monetary policy rules; macroeconometric models; stochastic simulations.

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1. Introduction

Given the recent introduction of a single Euro Area monetary policy, it is important to ask whether the differences between European countries are so substantive that they influence the European Central Bank's implementation of the 'one size fits all' interest rate policy. A pessimistic view is given in Cecchetti (1999). One central difference amongst European countries lies in consumer behaviour, with some more sensitive to particular shocks than others. Differences may, for instance, manifest themselves due to asymmetries in the availability of credit facilities, with the various European countries at contrasting stages of development in their financial systems. The extent of credit restrictions, and their impact on consumer expenditure, is analysed in Bacchetta and Gerlach (1997), Campbell and Mankiw (1989, 1991b) and MacLennan, Muellbauer and Stephens (1998).

It is of course the case that differences between European countries may depend upon the policy environment. Dornbusch, Favero and Giavazzi (1998) argue that asymmetries in the monetary transmission mechanism are mainly due to heterogeneous financial systems and these will diminish over time. Frankel and Rose (1998) suggest that business cycles are more correlated for countries that trade more, and Rose (2000) finds that members of a monetary union trade more with each other than similar countries who are not part of a monetary union. Hence entry into a monetary union may reduce differences in business cycles. However, Krugman (1991) and Hughes Hallett and Piscitelli (1999) suggest that the effect of European economic integration on institutions may not be great. Whether or not more convergence takes place it is clear that the structure of monetary policy responses is important. Clarida, Gali and Gertler. (2000), using a stylised model of the macroeconomy, suggest that both output volatility and inflation variability is affected by the strength with which central banks respond to inflation and the output gap. There is evidence to support this proposition, and for instance Bernanke, Gertler and Watson et. al. (1997) demonstrate that the reaction of the US Fed to the oil price shock of the early 1970s was central to economic outcomes.

In this paper we consider whether differences between European economies can be found in the data and whether they are important for the choice of monetary policy rule. We test for

statistically significant differences between the Euro Area countries and also the UK. We estimate a pooled model using SURE with fixed effects and impose homogeneous coefficients across countries where it is statistically justifiable to do so. We find that this is only possible for a small group of core countries. We also estimate a completely homogeneous model which imposes cross country restrictions. We do not find that it is statistically valid to impose the constraint that all countries are members of a European core, but this is useful in our analysis. This model represents a fully integrated European economy, which, conceivably, will result from implementing a single currency and monetary policy. We compare these models to a completely heterogeneous model which is based on the existing equations from the empirical macromodel, NiGEM.

We go on to consider whether European asymmetries matter for the conduct of monetary policy. Using our three models (an unrestricted model; a fully restricted model; and a statistically justifiable pooled model) we assess the performance of three possible monetary policy rules which the ECB could pursue. These rules are a nominal aggregate rule, an inflation targeting rule and a two pillar strategy, or combined rule. Under the nominal aggregate rule, interest rates are raised and lowered with reference to the deviations of a nominal aggregate (e.g. money GDP or a monetary aggregate) from some target level. Likewise with an inflation targeting rule short term rates are changed in response to deviations of inflation from a target level. The combined nominal aggregate and inflation targeting rule is an approximation of present Euro Area monetary policy of relying on ‘two pillars’ in determining the appropriate level of interest rates.² We examine the volatility of core real and nominal macroeconomic variables using these rules within the context of the National Institute’s Global Econometric Model (NiGEM) and by using stochastic simulations. These simulations are a means of replicating the uncertainty that economic systems face and hence of considering the performance of our monetary rules under multiple economic shocks.

The present remit of European monetary authority to pursue price stability is particularly important in our final analysis. We find that a combined monetary policy rule is important for

reducing price volatility whatever the structure of the Euro Area economies. A ‘two pillars’ approach to monetary policy, in our analysis, always reduces price volatility in the Euro Area. If we do not believe the process of European integration will have a substantial impact on real economic structures, a ‘two pillars’ combined rule dominates other possible monetary rules with respect to output, inflation and price variability. If European economies become more similar in the way suggested by our econometric analysis then it is possible that a nominal aggregate rule may be better if the objective function contains more than stabilising the price level.. The UK would, in most circumstances, be better off moving to a monetary rule which contained more than an inflation target.

The rest of this paper is set out as follows: section two briefly reviews the theoretical and empirical literature on consumption; section three considers the estimation methods used in our analysis; section four examines our estimation results; section five reviews monetary policy responses and NiGEM; section six introduces the stochastic simulation used to assess the various policy rules and European consumer behaviour; section seven and eight considers the results from our stochastic simulations; section nine concludes.

2. The Consumption Function: Theoretical Issues and Empirical Research

We adopt an approach to consumption that takes account of empirical results that suggest a simple application of theory can lead to relationships that fit the data.³ We estimate consumption functions based on the Life Cycle Hypothesis (LCH) of Ando and Modigliani (1963) as derived in Deaton (1992)⁴. In the LCH, planned aggregate consumption (C_t^*) is a function of total resources. Total resources are the sum of human wealth (H_t) and net financial wealth (W_{t-1}). We are confronted by a number of difficulties when estimating a

² European Central Bank’s Monthly Bulletin (1999).

³ We do not follow the strand of literature derived from the Permanent Income Hypothesis (PIH) as set out by Hall (1978) where consumption is modelled as a random walk in a simple intertemporal equilibrium model. All other information would be subsumed in consumption decisions already made, and any news would be taken up in the error term. Bilson (1980), Flavin (1981) and more recently by Campbell and Mankiw (1991a), Shea (1995) and Souleles (1999) have found that changes in income have implications for changes in consumption, apparently refuting this version of the PIH.

simple LCH model. First, planned consumption does not always equal actual consumption owing *inter alia* to lags in adjustment. This suggests that we should use an error correction approach. Second, human wealth is unobservable and typically proxied by some function k of current labour income (i.e. $\tilde{H}_t = k Y_t$)⁵.

Thirdly, a more significant problems lies in the functional form of the relationship. Campbell and Deaton (1989) study the smoothness of the ratio of consumption to measured income, and suggest that income in levels is unlikely to be difference stationary. In particular, the first difference of the level of income does not display constant variance: earlier increases in the level of income, in any reasonable sample of data, are likely to be substantially less than increases later in the sample. This non-constant variance would mean any short run error correction model for consumption, which we utilise later in the paper, would have non-stationary dynamics and the long-run relationship for consumption would potentially be spurious given that not all of our variables are difference stationary. Although we could divide consumption by income, Campbell and Deaton (1989) point out that most logarithmic forms of the consumption function tend to fit the data better than linear models. Campbell and Deaton go on to find that permanent income is less smooth than measured income, since measured income is highly persistent, and aggregate consumption is smooth because it responds with a lag to changes in income. Indeed, the authors show, it is the excess sensitivity to anticipated changes in income which explains that consumption is excessively insensitive to unanticipated changes in income.

Campbell and Mankiw (1991b) work with short run changes in consumption and consider the responsiveness of consumption to income in a cross country study. The authors argue that the processes driving aggregate consumption and income are log-linear rather than linear.

⁴ Planned consumption can consequently be expressed as a function of H_t and W_{t-1} , with $C_t^* = m(H_t + W_{t-1})$ where m is the marginal propensity to consume out of total resources on average across the population.

They suggest that many of the empirical findings of the literature can be explained by a fraction of agents who follow “rules-of-thumb” and consume out of current income whilst a proportion will act as forward looking optimising agents. They find that those countries traditionally considered as financially less developed have a larger proportional of consumers who act as “rule-of-thumbers” and consume out of current income.

Recently, Davis and Palumbo’s (2001) study of the consumption function attempts to determine if, and to what extent, changes in wealth, for example the stock market boom of the late 1990s, affect the growth rate of consumer spending. They examine quarterly aggregate US data from 1960 to 2000. Firstly, they model long-run relationships, and ask in particular whether logged consumption, income and wealth share a common trend. Estimating using Stock and Watson’s (1993) Dynamic Least Squares (DLS), Davis and Palumbo find that there is a statistically significant long run wealth effect on consumer spending. Modelling short run changes in consumer expenditure, the authors consequently report evidence of error correction effects feeding through to consumption.

Ludvigson and Steindel (1999) examine wealth effects in the logged long-run consumption relationship using DLS and find a statistically significant wealth and income effect and that, along with consumption, these variables share a common trend, using quarterly US data. The authors note that there may be substantial deviations from this trend in the short-run. Utilising the approach adopted in this paper, Lettau and Ludvigson (2001) go on to find that deviation from this common trend are a powerful predictor of excess returns on aggregate stock market indexes for US data.

We adopt a logarithmic form of the consumption function to ensure that income, in natural logs, is difference stationary and hence ensure that our long-run relationship can be non-spurious.

$$\ln C_t = \mathbf{a}_0 + \mathbf{b}_1 \ln Y_t + \mathbf{b}_2 \ln W_{t-1} + \mathbf{x}_t \quad (1)$$

⁵ If C_t is actual consumption and \tilde{C}_t is target consumption (equivalent to planned consumption but based on a specification using the human wealth proxy, \tilde{H}_t): $C_t = \tilde{C}_t + \mathbf{e}_t$

A short run model which has equation (1) as a cointegrating vector can also be derived from an different line of work begun by Davidson, Hendry, Srba and Yeo (1978)⁶. This approach nests a long run relationship for consumption within an error correction model and allows a significant role for current income. Those adopting such an approach include Davidson and Hendry (1981), Hendry, Muellbauer and Murphy (1990), Bladen-Hovell and Richards (1983) and Dewhurst (1989). Hendry and von Ungern-Sternberg (1981) extended DHSY by including a measure of net wealth as an integral control mechanism. Following in this vein we estimated short run consumption functions which nest equation (5) and additionally assume that the variables in the long run relationship are contemporaneously cointegrated. The short run equation used throughout the rest of the paper is therefore

$$\Delta \ln C_t = \mathbf{a}_0 - \mathbf{a}_1 (\ln C_{t-1} - \mathbf{b}_1 \ln Y_{t-1} - \mathbf{b}_2 \ln W_{t-1}) + \mathbf{q}_i \Delta \ln Y_{t-i} + \mathbf{q}_j \Delta \ln C_{t-j} \quad (2)$$

where $\mathbf{a}_t = \mathbf{a}_{tY} + \mathbf{a}_{tW}$, equation (6) can be re-parameterised as

$$\Delta \ln C_t = \mathbf{a}_0 - \mathbf{a}_{tY} (\ln C_{t-1} - \ln Y_{t-1}) - \mathbf{a}_{tW} (\ln C_{t-1} - \ln W_{t-1}) + \mathbf{q}_i \Delta \ln Y_{t-i} + \mathbf{q}_j \Delta \ln C_{t-j} \quad (3)$$

since we impose static homogeneity in the estimation which follows (the long run elasticities sum to one, i.e. $\mathbf{b}_1 + \mathbf{b}_2 = 1$). Equations of this form fit the data well and appear to be a good description of aggregate economic behaviour.

Recent work estimating variants of these consumption functions and utilising a panel approach includes Pesaran, Shin and Smith (1999). Pesaran et al. develop an intermediate panel estimator, the Pooled Mean Group Estimator (PMGE), which does not pool coefficients or merely construct the mean of individual cross section estimates. They estimate, as an empirical example utilising this procedure, a traditional consumption function in line with Hendry and von Ungern Sternberg (1981). They use the rate of inflation as a proxy for wealth and show that the per capita consumption income ratio explains short-run changes in consumption for 23 OECD countries over the period 1962-1993. They find a long-run elasticity larger than 0.9 on income in their consumption function, which is significantly less

hence $C_t = m(\tilde{H}_t + W_{t-1}) + \mathbf{e}_t$ and $C_t = aY_t + bW_{t-1} + \mathbf{e}_t$

⁶ Davidson, Hendry, Srba and Yeo (1978) is hereafter DHSY.

than unity, when using Pooled Mean Group estimation. They are able to accept homogeneity of long-run coefficients for income and inflation across 23 countries using a Hausman test of the equivalence of PMG and Mean Group Estimation. However a likelihood ratio test rejects homogeneity. Unfortunately, the Hausman test and likelihood ratio test continues to provide dichotomous results even when the number of cross sections is reduced to nine.

Other authors have used panel estimation, and Carruth, Gibson and Tsakalotos (1999) utilise a similar approach to ours using SURE estimation to examine the similarities between the 15 EU countries consumption functions over the sample period 1955 to 1992 using annual data. They estimate specifications based on Hendry and von Ungern Sternberg and coinciding with Pesaran et al. (1999). Carruth et al. (1999) reject commonalities at the EU15 level and with a core of five countries (Germany, France, Netherlands, Belgium and Luxembourg) using Wald tests based on SURE estimation.

3. Estimation Approach

Our objective in this paper is to compare the policy implications of different estimated models of consumption behaviour in Europe where commonalities are estimated or imposed using an empirically based macro model, NiGEM. We call our comparator equations on NiGEM, Model 1, and they are set out in appendix one. We then estimate a pooled consumption model where commonalities are statistically justified and those countries exhibiting atypical characteristics are excluded (Model 2). Finally, we estimate a model which imposes common equation coefficients across countries, irrespective of whether they are statistically acceptable or not (Model 3).

Our pooled models are estimated by Zellner's (1962) Seemingly Unrelated Regression Estimation (SURE). SURE allows us to test linear cross equation restrictions. This method freely estimates the contemporaneous error covariances but requires N to be reasonably small relative to T . Hence they are ideal in the present context of around one hundred observations for at most nine countries. Non-zero error covariances may be due to omitted common effects – it could be argued that this is a problem of misspecification and not error correlation. One

suggestion has been that we should remove common effects by subtracting cross sectional means but this approach is not without problems of its own.⁷

We estimate equations that embed the long run equilibrium with short-run adjustment around it, and hence we circumventing any difficulty with potential non-stationarity of our log levels data. We also adopt a general to specific methodology to estimation. Data sources are set out in the appendix. We use total consumer expenditure (C_t), real personal disposable income (Y_t) and net financial wealth (W_t): these three variables enter our long-run relationships. Dynamic terms for consumption and income are included where necessary. We have quarterly data which is seasonally adjusted and spans the sample period 1973Q2 to 1997Q3, giving us 98 observations for each of the nine countries that we use in our full panel model.

4. Estimation Results

In this section we present our results from the different approaches to estimating consumption equations for European countries in this section. These proxy different descriptions of the Euro Area that could possibly exist as European integration proceeds. Our baseline model can be seen as a description of one where all countries are assumed to be different, and in our results below we describe this as Model 1. The equations are set out in Appendix one. They are used in the version of NiGEM used in our policy analyses here and in other papers using stochastic simulations such as Barrell and Dury (2000a,b). Our defendable commonalties model is one that might be used by a policy maker who assumed that similarities were possible, but did not presume they were always present. We call this Model 2 in our results below. Our model with a completely homogeneous Europe might be used by a policy maker who believed that the European economies behaved in a similar way, whilst still allowing for some differences that could be absorbed in intercepts. We describe this as Model 3 in our results below.

⁷ Alternative methods include incorporating aggregate variables or using a spatial model to consider explicit interaction between near neighbours. See Pesaran and Smith (1995) for a discussion.

4.1 Statistically Valid SURE Estimation: Model 2

We may ask whether it is theoretically and empirically justifiable to pool some of the countries' coefficients together, and we may for instance expect countries bordering Germany to behave differently from Nordic or Mediterranean countries. On the one hand, the northern European countries may be sufficiently similar that they form an economic core and can be pooled together in a fixed effects SURE model. On the other hand, the UK, for example, is often considered as an economic outsider being different from the core on the basis of property wealth (see Kennedy and Anderson, 1994, and CEPR, 1997).

Whilst testing for poolability we have a very strong hypothesis about the similarities of the countries. We can test whether the ratio of income to wealth in the long run relationship for consumption is equivalent across countries (i.e. that there is a common long-run relationship) and that we have static homogeneity. We can also test whether the level of the error correction term is the same for all countries in the pool, and in addition whether the short run dynamics are the same for each country. Economic theory has strong propositions regarding long-run relationships but not so much the short run, but differences in dynamic responses affect the ability to design and coordinate policies. We consider it to be unlikely that we can pool all our countries coefficients at the present stage of European integration, but we presume we can pool a core, and we can ask which countries enter the core.

We consider whether we can pool the countries by utilising a Wald test which combines the restrictions of all of our coefficients. This is distributed as a $\chi^2(n)$ where n is the number of restrictions. The results in Table 1 do not accept the null hypothesis that even a sub-sample of our countries (i.e. Germany, Netherlands, Austria and France) form a core of European countries with the Wald test at the 5% level (Pooled Intermediate Model 2). It is unlikely that we would therefore find evidence in favour of pooling our countries for a more restrictive null, for example, pooling the entire sample of nine countries. We also test whether it is appropriate to use the Mean Group Coefficients for our European core. These are the average of the unrestricted estimates of our four countries. We reject the null hypothesis that the

unrestricted coefficients are equivalent to the Mean Group results with a test statistic of $\chi^2\{16\}=147.772$.

Table 1: Core Countries Pooled Estimates.

	Pooled Intermediate Model	Mean Group Intermediate Model	Statistically Acceptable Pooled Model 2
$a_{1Y}*(lnC-lnY)_{t-1,i}$	-0.157 (-6.6)	-0.206 (-4.6)	-0.143 (-6.5)
$a_{1W}*(lnC-lnW)_{t-1,i}$	-0.012 (-4.0)	-0.010 (-4.0)	-0.011 (-4.2)
$q_1*\ddot{A}lnC_{t-1,i}$	-0.181 (-4.5)	-0.199 (-8.0)	-0.182 (-5.3)
$q_2*\ddot{A}lnY_{t,i}$	0.520 (13.3)	0.469 (2.8)	
$q_{2a}*\ddot{A}lnY_{t,GE:OE}$			0.852 (19.7)
$q_{2b}*\ddot{A}lnY_{t,FR:NL}$			0.161 (3.2)
Joint Wald Statistic	$\chi^2\{12\}=132.788$ [0.000]	$\chi^2\{16\}=147.772$ [0.000]	$\chi^2\{11\}=19.378$ [0.056]

Notes: Mean Group coefficients are calculated as the averages on the unrestricted equations estimated by SURE. The Pooled Group is estimated by fixed effects SURE (fixed effects which are not reported). Countries included are Germany (GE), France (FR), Netherlands (NL) and Austria (OE). Estimation is by SURE. T-statistics are in parentheses. Probability values are in brackets. Sample period is 1973Q2 to 1997Q3 for each country. The variance estimator used to calculate the Mean Group t-statistics is presented in Pesaran et al. (1999).

Although we can not pool all the coefficients of our four countries, we can justify pooling some of the coefficients of the core countries. We test the joint restrictions on Pooled Model 2 with a Wald test and consider the individual t-statistics. Overall the restrictions are accepted at the 5% level with a test statistic of $\chi^2(11)=19.378$ and p-value = 0.056. In terms of the individual coefficients, the error correction terms to income and net wealth may be pooled for our core, as can the lagged dependent variable. This is not the case for the dynamic term in income but we can pool Germany and Austria (the null hypothesis of equivalence between these two countries coefficients is not rejected with a t-statistic = 1.588) and also France and the Netherlands together (t-statistic = 0.785). Given these minor differences we can produce a reasonable description of core behaviour and in the stochastic simulations impose the restrictions from the Statistically Acceptable Pooled Model 2 in Table 1.

We also experimented with the other European countries to consider whether we could find evidence of poolability with the core countries. Much as we expect, including Belgium in a very restrictive core specification (i.e. the Pooled Intermediate Model in Table 1) was not accepted with a test statistic $\chi^2(16) = 223.981$ [p-value = 0.000]. This was related to the significance of the individual restrictions on income and the two short run dynamic terms. It is conceivable that this is due to data issues since we may expect Belgium to be part of the core. Experimenting with a less restrictive model we found that we can only pool Belgian Net Wealth with the core. Similarly we found that it was only possible to include the Italian error correction term to net wealth with our core countries. When we undertake the Wald Test for Finland we can only accept the restriction that the parameters for net wealth is equal to that of the core countries. In contrast Ramaswamy and Sloek (1998) have found that Finland is part of the core. Carruth et al. do not find evidence of consumption function poolability for five countries (Belgium, France, Germany, Netherlands and Luxembourg). Luxembourg is excluded from our estimation approach. The Carruth et al. (1999) results may be explained by the fact that they use a much earlier sample period (1955-92). We also tested the UK where there are substantial adjustment costs to consumption, as in the core countries, since our coefficient on lagged change in consumption is highly poolable with a Wald test statistic of $\chi^2(11) = 11.314$; P-value = 0.417. Nevertheless, we can not accepted that either of the error correction terms or the dynamic term for income are poolable.

4.2 Restricted SURE including all countries: Model 3

It is possible to choose to pool Germany, France, Spain, Italy, Netherlands, Belgium, Finland, Austria and the U.K. and estimate them within a balanced SURE set up. Pooling will constrain both the coefficients on the error correction terms and the dynamics to be homogeneous for each country. Individual difference in consumption behaviour would only be reflected in the heterogeneous constant terms. The results for this restricted or pooled model are given in Table 2 along with some information about the unrestricted estimates. The individual estimates of the income related error correction term range from -0.291 to -0.004, that for the wealth related error correction term for -0.029 to 0.000. The range of the dynamic

term in consumption is -0.270 to 0.811 and that on income from 0.028 to 0.850. These estimates compare to the pooled group values of -0.039, -0.004, 0.108 and 0.181. It is interesting to note that the pooled value lies at the bottom of the range for income and for wealth, indicating the direction of bias Pesaran and Smith (1995) suggest we should expect in an inappropriately constructed dynamic panel. The combined Wald test statistic rejects the null hypothesis of homogeneity of long run and dynamic coefficients across countries ($\chi^2\{32\}=658.246$ compared to a critical value of 45.91 at the 5% level), suggesting that it is potentially misleading to pool the nine countries. Additionally we find that it is inappropriate to impose the Mean Group coefficients on our core of countries with a $\chi^2\{36\}=923.136$ and probability value of 0.000. Nevertheless, the results from the pooled estimation serve as the basis of our discussion of a homogeneous Europe (i.e. Pooled Model 3) as they form an extreme description of how Europe may change as a result of the introduction of a Common Currency and of other financial innovations linked with the Single Market.

Table 2: Fully Homogeneous Model.

	Group Maximum	Group Minimum	Mean Group	Pooled Model 3
$a_{1Y}*(lnC-lnY)_{t-1,i}$	-0.004	-0.291	-0.114 (-3.3)	-0.039 (-6.6)
$a_{1W}*(lnC-lnW)_{t-1,i}$	0.000	-0.029	-0.008 (-2.7)	-0.004 (-3.9)
$q_1*\Delta lnC_{t-1,i}$	0.811	-0.270	0.097 (0.8)	0.108 (3.5)
$q_2*\Delta lnY_{t,i}$	0.850	0.028	0.292 (3.2)	0.181 (9.3)
Joint Wald Statistic			$\chi^2\{36\}=923.136$ [0.000]	$\chi^2\{32\}=658.246$ [0.000]

Notes: Mean Group coefficients are calculated as the averages on the unrestricted equations estimated by SURE. The Pooled Group is estimated by fixed effects SURE (fixed effects which are not included in Table 3). Dummy for France, shift in the intercept from 1992Q1 onwards. Italy has a dummy equal to one in 1992Q3 and 1992Q4. Belgium has a dummy equal to one from 1992Q3 to 1993Q1. The UK has a dummy equal to one from 1990Q3. Sample period for estimation is 1973Q2 to 1997Q3 for each country. T-statistics are in parentheses. The variance estimator used to calculate the Mean Group t-statistics is presented in Pesaran et al. (1999).

Imposing the Pooled Group estimated coefficients results in the error correction terms to income and to net wealth are both significant and. We also have significant dynamic terms for lagged consumption and income, with the change in income and the previous period's

consumption both having a positive effect. We include constant terms for each of the countries, which can be considered as the fixed effect term in traditional panel approaches.⁸

5. The Macroeconometric Model and Policy Responses

The theoretical structure and relevant simulation properties of NiGEM are detailed in Barrell and Sefton (1997) and Barrell, Dury, Hurst and Pain (2001). Each country modelled consists of a supply side, a demand side and a set of asset accumulation relationships. The exchange rate relationships are determined by the Uncovered Interest Rate Parity condition and hence will be forward looking. In addition to structural relationships of the economy the model also contains a number of policy reaction functions. In particular, it is assumed that taxes will rise and fall to ensure the budgetary position is kept within prescribed bounds to ensure the government remains solvent.

In this paper we concentrate on the macromodel's implications for monetary rules under our various consumption function specifications.⁹ The three monetary rules that we inspect here are a monetary or nominal aggregate targeting rule, an inflation targeting rule and a combined rule. A combined rule is considered to be the 'best' description of the policy rule utilised by the ECB at the moment. This 'two pillar' strategy is based on an assessment of developments in a de-trended reference value for Euro Area broad money (M3) combined with a concern for inflationary developments in the short-run.¹⁰ We also experiment with different feedback coefficients on the rules. For example, where a combined reaction function for the short term interest rate (r_t) is of the form

$$r_t = g_1(NOMY_t - NOMY_t^*) + g_2(p_t - p_t^*) \quad (4)$$

⁸ Additionally, when we utilise the estimation results from our fully homogenous model in our stochastic simulations we pool Ireland and Portugal. These were not estimated since there was a paucity of data for these two countries, which would have led to issues related to unbalanced SURE or a substantial reduction in the span of the balanced SURE. We calibrate Ireland from the UK's estimated equation and Portugal's is from the Spanish consumption function.

⁹ Fiscal policy targets under EMU are discussed in Barrell and Pina (2000).

¹⁰ Taylor (1993) suggested that a rule incorporating inflation and real GDP provides a reasonably good descriptions of US policy since 1987. Gerlach and Snable (1998) and Peersman and Smets (1999) are of the view that if the ECB conducted monetary policy using a Taylor Rule, it would not be much different from the behaviour in the 1990s of the countries forming EMU. See Begg (1997) for a further discussion of monetary policy rules and EMU.

and the two weightings give the relative importance of departures from target nominal output ($NOMY_t^*$) and inflation (p_t^*). We assume that the weighting on departures from the nominal output target (g_1) is equal to 50 and the weighting on inflation (g_2) is equal to one when we utilise inflation targeting – on its own or in a combined rule. Inflation targeting is adopted on the basis of the Consumer Price Index (CPI) and all rules utilise contemporaneous outcomes.

6. Stochastic Simulations

In this section we briefly discuss the bootstrap method used in this study, and more details can be found in Barrell, Dury and Hurst (2002) and Blake (1996). Economic systems face considerable uncertainty and will be confronted by a number of economic shocks. By applying shocks repeatedly on NiGEM, we can replicate on our model the uncertainty the economic environment faces. Stochastic simulations do this by taking repeated random draws from a particular distribution and shocking our model with them. We can then derive the higher moments of the endogenous variables, in particular, the variability of our variables.

Our shocks are generated by repeatedly drawing random errors from individual time periods for all equation from the matrix of single equation residuals (SER). The shocks drawn will have the same contemporaneous distribution as those for the SER. Consequently the error term's historical correlation is maintained across variables but not through time. We have calculated the historical shocks for NiGEM for all its 1000 equations. Our set of shocks have been applied repeatedly to our forecast base line which runs 24 years into the future. The model is run in rational expectations mode. Each application produces a new future history which depends upon the shocks applied, the counterfactual base line used and the period in which the shocks are applied. The shocks are applied quarter by quarter for the period 1999 to 2003. This involves running the model “forward” to calculate the expectations that would be a reasonable response to the news contained in the shock. The model is solved for long enough to ensure that the results are independent of the end points of the run.

7. Stochastic Simulation Results - The choice of monetary policy rules

In this section we consider the impact of our stochastic simulations on the variability of important macroeconomic variables including, output, prices and inflation. In particular, we have calculated the effect of our monetary policy rules on the Root Mean Squared Deviations (RMSD) of these variables for our European countries. Following Bryant et al. (1993), our volatility statistic is of the form

$$RMSD = \sqrt{N^{-1} \sum_{t=1}^N \left\{ J^{-1} \sum_{j=1}^J \left[\frac{(x_{it}^j - x_{it}^B)}{x_{it}^B} \right]^2 \right\}} \quad (5)$$

where x_{it}^j is the value of the variable i in period t from the j th trial, x_{it}^B is the value of the variable i on the base in period t and J is the number of trials taken. This can be seen as an average of the deviations from target. We have three policy rules in this case which consist of the nominal GDP targeting rule (NOM), the inflation targeting rule (INFT) and the combined rule (CR). We compare the NOM rule to the other two policies using an index and we shade our results where they improve upon the NOM benchmark. Our discussion focuses on the overall outcomes for the Euro Area economy, but Tables 3 to 5 give country detail. The ECB makes its decisions on the basis of Euro Area outturns, and the country detail may only be of interest to the members of the Council when discussing the overall framework for policy.

Table 6 sets out the overall results from our analyses, and it is clear that if the world were as described in the base case model with all countries allowed to be different, then there would be a clear case for the ECB to choose the Combined Rule (CR) over the NOM and INFT rules as it performs better for each of inflation, output and the price level. Indeed, as can be seen from Tables 3 to 5, if the world were as the base case then all (barring a possible exception for Portugal) members of the Euro Area would choose CR whatever the weights on output, inflation and price level variability they had in their objective functions. If we lived in a world where our defendable differences were in place and were recognised by the monetary authorities, then there is a possibility that the core European central banks in Germany, France, Austria and Belgium might prefer a nominal rule over the combined rule, but this

choice is not unambiguously supported by all criteria, and the outcome would depend upon both the weights and the relative sizes attached to each of the variances.

If we lived in the world of defensible similarities (model 2) then inflation targeting would be significantly more effective at stabilising output in the Euro Area than would either of the other rules, whilst targeting a nominal aggregate on its own would help stabilise inflation. This result is as expected given the discussion of the literature on inflation targets summarised in Barrell and Dury (2000b). The wage equations on our model are generally forward looking, and in such a world we would put a nominal aggregate in the rule in order to help stabilise output, as expectations of deflationary spirals are less likely to build up when a nominal anchor is included. The less inertial the real part of the world the less important the nominal aggregate is in helping stabilise output, and our model two has less inertial consumption equations (as gauged by the size of the overall error correction mechanism at least). However, in this world nominal aggregate targeting would be significantly better at stabilising inflation than would either of the other two rules. In a world where we assume everyone to be similar then output variability is noticeably (but not significantly) higher with the nominal target, but inflation variability is significantly lower. However, whichever world we live in, or think we live in, the combined rule performs very significantly better at stabilising the price level than either of its competitors. Hence, if the price level were the only thing taken into account by the ECB then the combined rule would dominate the other rules as it is robust rule across different worlds.

There are of course reasons for taking into account each of the three indicators discussed in the tables. Barrell and Dury (2000a) discuss the background to the objectives that the ECB may have. The ECB is independent, and it sets its own targets, with a remit to maintain price stability in the medium term. This could of course be achieved by targeting the price level directly, or it could be done through targeting a nominal aggregate as long as it were clear how the ECB might deal with supply side shifts that permanently changed the level of output.

Table 3: Variability of Output; Index value for CR and INF (Rule NOM = 100)

	Model 1			Model 2			Model 3	
	CR	INFT		CR	INFT		CR	INFT
GE	98	104		102	100		96	96
FR	95	109		103	105		134	108
SP	99	110		78	72		87	116
IT	99	107		111	90		88	101
NL	99	102		103	101		99	104
BG	100	102		97	96		103	108
PT	99	102		99	98		93	99
IR	100	102		102	113		103	103
FN	94	108		98	107		119	112
OE	100	102		99	107		90	104
EL	98	105		102	96		97	98
UK	105	110		95	91		123	105

Notes: The combined rule is CR, Inflation targeting is INF and the nominal rule is NOM. Model 1 is a heterogeneous Europe. Model 2 is a homogeneous core European model. Model 3 is a fully homogeneous Europe. The error bounds around these ratios can be calculated as an F test on the ratio of two variances with the number of trials (4000) as the degrees of freedom. At the 95% level, the bounds are 3.15 percent above and 3.05 percent below the observed values

Table 4: Variability of Price level; Index value for CR and INF (Rule NOM = 100)

	Model 1			Model 2			Model 3	
	CR	INFT		CR	INFT		CR	INFT
GE	82	119		80	113		101	124
FR	92	129		99	133		101	125
SP	94	107		79	107		95	112
IT	85	139		79	138		97	142
NL	87	112		91	112		95	112
BG	90	118		98	118		102	118
PT	93	107		88	102		100	99
IR	95	120		106	113		100	112
FN	94	134		102	128		101	129
OE	92	109		81	101		97	116
EL	81	131		79	124		98	136
UK	80	93		83	92		86	93

Notes: The combined rule is CR, Inflation targeting is INF and the nominal rule is NOM. Model 1 is a heterogeneous Europe. Model 2 is a homogeneous core European model. Model 3 is a fully homogeneous Europe. The error bounds around these ratios can be calculated as an F test on the ratio of two variances with the number of trials (4000) as the degrees of freedom. At the 95% level, the bounds are 3.15 percent above and 3.05 percent below the observed values

Table 5: Variability of Inflation; Index value for CR and INF (Rule NOM = 100)

	Model 1			Model 2			Model 3	
	CR	INFT		CR	INFT		CR	INFT
GE	97	105		108	99		110	104
FR	95	111		89	93		183	144
SP	97	108		93	104		110	118
IT	100	109		107	102		83	105
NL	98	104		108	84		99	91
BG	99	100		97	93		104	112
PT	102	100		82	97		94	121
IR	96	104		118	83		117	98
FN	100	109		102	107		76	89
OE	100	102		92	87		93	101
EL	93	111		108	108		113	108
UK	98	98		83	91		121	114

Notes: The combined rule is CR, Inflation targeting is INF and the nominal rule is NOM. Model 1 is a heterogeneous Europe. Model 2 is a homogeneous core European model. Model 3 is a fully homogeneous Europe. The error bounds around these ratios can be calculated as an F test on the ratio of two variances with the number of trials (4000) as the degrees of freedom. At the 95% level, the bounds are 3.15 percent above and 3.05 percent below the observed values

Table 6: Euro Area and the UK across different rules with increasing inertia in consumption. Index values for CR and INFT; NOM = 100.

	<i>Model</i>	<i>Euro Area</i>			<i>UK</i>		
		NOM	CR	INFT	NOM	CR	INFT
Output	<i>1</i>	100	98	105	100	105	110
	<i>2</i>	100	102	96	100	95	91
	<i>3</i>	100	97	98	100	123	105
Inflation	<i>1</i>	100	93	111	100	98	98
	<i>2</i>	100	108	108	100	83	91
	<i>3</i>	100	113	108	100	121	114
Price level	<i>1</i>	100	81	131	100	80	93
	<i>2</i>	100	79	124	100	58	60
	<i>3</i>	100	98	136	100	149	102

Notes: NOM = Nominal aggregate targeting rule; CR = Combined rule; INFT = Inflation targeting rule Model 1 = Diverse model of consumption Model 2 = Intermediate model of consumption; Model 3 = common model of consumption. Shading where there is an improvement over the nominal rule. The error bounds around these ratios can be calculated as an F test on the ratio of two variances with the number of trials (4000) as the degrees of freedom. At the 95% level, the bounds are 3.15 percent above and 3.05 percent below the observed values

The ECB might feel that there were other things that should enter its targeting strategy as well as the price level, however. Of course it could have a direct inflation target, but it would still have to bear in mind that price stability means returning toward the target trajectory for prices, and a pure inflation target does not do this. It is also reasonably clear that an increase in output volatility might be associated with an increase in price instability, and hence the ECB might feel that it should react to deviations of output from the baseline projection in order to help stabilise inflation or the price level. Hence the remit of the ECB pushes it toward a two pillar strategy, which is phrased in terms of a nominal monetary aggregate, but which could easily be expressed as a nominal GDP framework.

The choice of rule for the base case for the UK is not as clear as that for the Euro Area economies. Inflation targeting and the combined rule, which includes an inflation target, both perform noticeably better in stabilising inflation than does the nominal rule, as we might expect in a small open economy. Nevertheless, both perform significantly more poorly in stabilising output. However, if Europe changes, and becomes slightly less inertial, as in our Model 2, then the choice of rule changes for the UK, even though we have the same model of the economy there. The change in the outside environment shifts the balance of advantages, and both the combined rule and inflation targeting perform significantly better than the

nominal rule in these circumstances in stabilising both output and inflation. The choice between these two frameworks in this environment would depend upon the weights attached to and the size of the variances of output and inflation that are included in the welfare function used by the Bank of England. However, once we move to the more restrictive, and more inertial, Model 3 we find that the nominal rule is much the better performer. This largely reflects the fact that the UK has a different and more inertial consumption equation in this model of the world. The increase in real side inertia in the UK in this model increases the variability of the price level. We might say that it would be better for the UK not to choose to be in a world where its consumption behaviour converged on that of a very inertial Europe, and if it did so, it would be advised not to adopt an inflation targeting strategy. Of course, our conclusions would be different if the UK were in EMU in these trials, and we should not expect that the reform of consumer behaviour in Europe will make it more inertial.

8. The Choice of Rule and the Choice of Welfare Functions

Policy makers will consider a number of variables in their loss function and not concentrate on merely one. For instance a monetary policy which imposes frequent and large changes in output to achieve a particular inflation target may be considered as not worth the economic costs. In Table 7 we set out the rule choices that would be made with six different welfare functions. We look at the three indicators we discuss above, and then we combine output and inflation, and output and the price level. We finally include a three part welfare function with output, inflation and the price level. If we have more than one variable in the welfare function each enters with the same weight. However, the rule choice cannot always be read from the previous tables, as we weight together the variances of output, inflation and prices, and then compare this sum to the weighted variances under another rule. As the variances of output, inflation and the price level are not (at all) the same, the ratio of the weighted sums underlying Table 7 cannot be read from the weighted sums of the ratios given in Table 6.

We have argued above that the remit of the ECB is to maintain price stability in the medium term, and hence we would argue that even if the targeting rule does not directly

involve the price level, the welfare function should do so. For the Euro Area, whatever the structure of the world, we find that the combined rule would always be chosen if prices were the sole objective. If the stability of the price level is included in the welfare function for Europe then the combined rule would always be chosen unless we had an homogenous Europe that displayed a great deal of inertia as in model 3 and all three target variables were considered in the welfare function. Even in this case we would still advocate the use of a nominal target, and this would be the preferred rule in all other circumstances whatever we put in the objective function and whatever description of consumption in Europe we use. In no circumstances would the ECB choose an inflation targeting regime.

The UK results suggest that inflation targeting strategy that the Chancellor has asked the Bank of England to follow would not often be the preferred rule. If our baseline description of the world were correct then inflation targeting would only be chosen if the only thing that mattered was the variability of inflation. If the baseline description of the world were correct, then including prices in the welfare function would suggest that the Chancellor should have set the Bank the task of achieving a two pillar combined rule strategy. If the welfare function included either the variability of output or the variability of output and inflation then a nominal targeting regime, based for instance on nominal GDP, would perform better than a two pillar strategy or an inflation target. The results echo those in Barrell and Dury (2000a), who argue that many of the apparent gains from joining EMU could be achieved by adopting a strategy with a nominal anchor in it. If the Europeans change to Model 2 and the UK stays outside EMU the case for adopting a combined rule is strengthened, because it is the choice that results from all welfare functions except one based on output alone, when inflation targeting would be chosen. If the world, including the UK, changed and became more inertial, as in our Model 3, then the UK would only choose inflation targeting if the welfare function included output and the price level. However, we are not in this world, and we are unlikely to be unless the UK joins EMU and convergence to a slowly adapting European standard takes place. In this world the Europeans would still choose a rule with a nominal anchor, and not inflation targeting.

Table 7: Preferred rule for different welfare functions.

	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
<i>Euro Area</i>			
Output	CR (INF)	NOM (CR)	CR (INF)
Inflation	CR (INF)	NOM (CR)	NOM (CR)
Price level	CR (INF)	CR (INF)	CR (INF)
Output and inflation	CR (INF)	NOM (CR)	NOM (CR)
Output and Price level	CR (INF)	CR (INF)	CR (INF)
Output, inflation and Price level	CR (INF)	CR (INF)	NOM (INF)
<i>UK</i>			
Output	NOM (INF)	INF (NOM)	NOM (CR)
Inflation	INF (NOM)	CR (NOM)	NOM (CR)
Price level	CR (NOM)	CR (NOM)	CR (NOM)
Output and inflation	NOM (INF)	CR (NOM)	NOM (CR)
Output and price level	CR (INF)	CR (NOM)	INF (CR)
Output, inflation and Price level	CR (INF)	CR (NOM)	NOM (CR)

Notes: The combined rule is CR, Inflation targeting is INF and the nominal rule is NOM. The least preferred rule is in parenthesis. Model 1 is a heterogeneous Europe. Model 2 is a homogeneous core European model. Model 3 is a fully homogeneous Europe.

9. Conclusion

In this paper we compare European economic structures in terms of consumer behaviour and monetary policy rules. In particular, we consider whether economic asymmetries in Europe matter for the conduct of monetary policy. Three different approaches to estimation of consumption functions for a cross section of European countries are implemented on the macroeconomic model NiGEM: an unrestricted model, representing a heterogeneous Europe; a fully restricted model, representing a homogeneous Europe; and a statistically justifiable model, pooling coefficient where they are sufficiently similar. The unrestricted model is based on the existing equations of NiGEM. The pooled models are estimate using SURE methods, with individual country fixed effects. We find that we cannot statistically justify pooling all countries because differences matter. Pooling all countries is nevertheless useful since as an experiment as it gives some information about outturns if monetary union produces similar economic structures for all European consumers. However, we can only find a statistically acceptable model if we pool using the core countries of Germany, the Netherlands, Austria and France.

We then go on to utilise stochastic simulations with a macro-econometric model to represent the uncertain economic environment and the shocks Europe would face. We conclude that there appear to be no circumstances where the ECB would choose inflation targeting as its preferred approach. The ECB has the remit of maintaining price stability in the medium, and it has set out a strategy to achieve this. The ECB two pillar strategy can be described as following a combined monetary rule focussing on a nominal aggregate and on inflation. If the ECB is only concerned with the variability of the price level then the two pillar strategy dominates both inflation targeting and targeting a nominal magnitude on its own, whatever the structure of the world. This strategy also dominates others whatever variables we include in the welfare function if the world is as on our baseline model. It is possible that the ECB might choose to move to a nominal targeting strategy if Europe became more homogenous, but this move would depend upon the elements it includes in its welfare function and on the structure of the world. We also conclude that the UK should not have adopted an inflation target unless the only variable of concern to the Chancellor was the variability of inflation. The UK would indeed, in most circumstances, be better off moving to a rule with a nominal anchor in it

Appendix 1; The NiGEM equations for consumption

These equations have been estimated during the process of model development and are based on the short run error correction relationship in equation (6). Lagged consumption terms are incorporated on the basis of adjustment costs or habits (see Muellbauer and Murphy, 1993a). Additionally interest rates effects are tested for, given they have been found by Muellbauer and Murphy (1993a). The “true” model for consumption is different for each country. Each consumption equation was estimated separately and then individually tested on NiGEM for its simulations properties. Hence the aim has been to estimate a consumption equation which reflects consumer behaviour and additionally ensure that the simulation properties of our model are also a reasonable approximation of the economy. The results for our eleven countries individually are included in Table 1. Some parameters are calibrated, and ‘t’ statistics are not included here where this has been the case. We also include the mean of the eleven countries.

One of the most important estimated variables is the error correction term which varies from a very fast -0.321 in the case of Austria to a quite slow -0.065 for Germany. The German estimated coefficient is below the average. The average long run elasticity of income is 0.884 and we have static homogeneity with a ratio of income to wealth of 7.6 to 1. The estimated coefficient to the change in lagged consumption is on average positive. However, the coefficients on Germany and the Netherlands are both negative for $\Delta \ln C_{t-1}$. The coefficients on income dynamics are typically positive and have an average of 0.324. Although this again masks a considerable range. The terms for the opportunity cost of money enter less frequently but where they do enter the relationships they are consistent with the results for the UK and US from Muellbauer and Murphy (1993a,b).

Table A1: Heterogeneous Individual Country Estimates - Model One

	<i>GE</i>	<i>FR</i>	<i>IT</i>	<i>NE</i>	<i>UK</i>	<i>SP</i>	<i>BG</i>	<i>PT</i>	<i>IR</i>	<i>FN</i>	<i>OE</i>	<i>MEAN</i>
Constant	-0.024	-0.031 (1.3)	-0.025	-0.032 (3.3)	-0.047 (2.5)	0.027 (2.8)	-0.000 (0.0)	0.067 (2.2)	-0.034 (3.2)	0.000 (0.2)	0.032 (0.5)	-0.006
$a_1*(\ln C_{t-1} - \hat{a}_1*\ln Y_{t-1} - (1-\hat{a}_1)*\ln W_{t-1})$	-0.065		-0.076	-0.154 (3.8)			-0.070	-0.142 (2.3)	-0.245 (6.3)	-0.126 (2.3)	-0.321 (3.2)	-0.150
$\hat{a}_1*\ln Y_{t-1}$	0.800		0.800	0.891 (26.7)			0.944 (5.5)	0.846 (21.2)	0.934 (56.1)	0.962 (27.2)	0.934	0.884
$(1-\hat{a}_1)*\ln W_{t-1}$	0.200		0.200	0.109			0.056	0.154 (3.9)	0.066	0.038	0.066	0.116
$a_{1Y}*(\ln C_{t-1} - \ln Y_{t-1})$		-0.123 (3.5)			-0.143 (2.2)	-0.124 (3.1)						
$a_{1W}*(\ln C_{t-1} - \ln W_{t-1})$		-0.020 (1.2)			-0.072 (3.5)	-0.013 (4.3)						
$q_1*\ddot{A}\ln C_{t-1}$	-0.249		0.712	-0.258 (2.7)		0.566 (6.7)				0.310 (2.7)		0.216
$q_2*\ddot{A}\ln C_{t-1}$								0.579 (6.4)				0.579
$q_3*\ddot{A}\ln C_{t-3}$										0.264 (2.3)		0.264
$q_4*\ddot{A}\ln Y_t$	0.729		0.077	0.090 (1.8)			0.103		0.811 (8.7)	0.221 (2.1)	0.234 (2.6)	0.324
$q_5*\ddot{A}\ln Y_{t-1}$		0.242 (3.1)				0.070 (1.1)	0.303 (5.8)		0.609 (6.3)			0.306
$q_6*\ddot{A}\ln Y_{t-3}$		0.179 (2.3)										0.179
$q_7*\ddot{A}\ln(CED_t)$		-0.413 (4.4)								-0.204 (1.2)		-0.309
q_8*SRR_t			0.0001									
q_9*SRR_{t-1}					-0.001 (2.87)							
$q_{10}*LRR_{t-1}$				-0.001 (2.4)					-0.002 (4.7)			

Notes: The error correction term is α_0 . SRR_t is the short run interest rate. LRR_t is the long run interest rate. The first difference of the consumer expenditure deflator is $\ddot{A}ced_t$. Countries include Germany (*GE*), France (*FR*), Italy (*IT*), the Netherlands (*NE*), United Kingdom (*UK*), Spain (*SP*), Belgium (*BG*), Portugal (*PT*), Ireland (*IR*), Finland (*FN*) and Austria (*OE*). Dummy variables include DUM92IT which is equal to one in 1992Q3 and 1992Q4 for Italy, DUMN1 is equal to one after 1980Q2 and removes Dutch interest rates before this period, UKD7923, which is equal to one in 1979Q2 and negative one in 1979Q3 for the UK. DUM812 is a Spanish dummy which is equal to one from 1981Q2 to 1983Q1. Belgium and Austria include dummies for BGD9293 and DUMOE which is a break in intercept before 1992. T-statistics in parenthesis. Coefficients in italics have been calibrated.

Appendix 2

Table A2: Heterogeneous Individual Country Estimates Using SURE Estimation

	<i>GE</i>	<i>FR</i>	<i>IT</i>	<i>NE</i>	<i>UK</i>	<i>SP</i>	<i>BG</i>	<i>FN</i>	<i>OE</i>	<i>Group Max</i>	<i>Group Min</i>	<i>Mean Group</i>	<i>Wald Test on Equivalence to Mean Group</i>	<i>Wald Test on Poolability</i>
Constant	-0.046 (-3.8)	-0.024 (-2.4)	-0.017 (-2.2)	-0.050 (-3.8)	-0.056 (-4.2)	-0.008 (-1.3)	-0.004 (-0.4)	0.003 (2.7)	-0.028 (-1.8)					
$a_{IY}*(lnC_{t-1}-lnY_{t-1})$	-0.291 (-4.6)	-0.099 (-3.3)	-0.027 (-2.7)	-0.188 (-3.9)	-0.107 (-2.9)	-0.048 (-2.4)	-0.025 (-1.6)	-0.004 (-0.1)	-0.241 (-3.5)	-0.004	-0.291	-0.114 (-3.3)	$\chi^2\{9\}=$ 155.325 [0.000]	$\chi^2\{8\}=$ 44.541 [0.000]
$a_{IW}*(lnC_{t-1}-lnW_{t-1})$	-0.007 (-1.6)	-0.008 (-2.1)	-0.006 (-2.3)	-0.016 (-3.4)	-0.029 (-4.5)	0.001 (0.6)	0.000 (0.0)	-0.004 (-2.0)	-0.005 (-0.6)	0.000	-0.029	-0.008 (-2.7)	$\chi^2\{9\}=$ 64.939 [0.000]	$\chi^2\{8\}=$ 33.906 [0.000]
$q_I*\Delta lnC_{t-1}$	-0.083 (-2.0)	-0.235 (-2.8)	0.512 (7.6)	-0.251 (-2.9)	-0.093 (-1.1)	0.811 (15.4)	0.223 (2.7)	0.259 (2.8)	-0.270 (-3.3)	0.811	-0.270	0.097 (0.8)	$\chi^2\{9\}=$ 304.435 [0.000]	$\chi^2\{8\}=$ 296.747 [0.000]
$q_2*\Delta lnY_t$	0.850 (20.8)	0.254 (2.6)	0.150 (2.5)	0.147 (2.6)	0.152 (3.7)	0.028 (1.2)	0.164 (3.8)	0.232 (3.5)	0.647 (4.7)	0.850	0.028	0.292 (3.2)	$\chi^2\{9\}=$ 359.559 [0.000]	$\chi^2\{8\}=$ 325.243 [0.000]
R^2	0.80	0.19	0.59	0.20	0.26	0.74	0.32	0.29	0.34					
<i>LM Het. Test</i>	1.47 [.226]	2.32 [.128]	0.50 [.477]	0.82 [.364]	0.56 [.454]	0.15 [.695]	1.07 [.301]	1.19 [.274]	11.73 [.001]				Joint Test $\chi^2\{36\}=$ 923.136 [0.000]	Joint Test $\chi^2\{32\}=$ 658.246 [0.000]
<i>DW</i>	2.19	1.87	2.05	1.84	1.91	1.44	2.17	1.93	2.04					

Notes: The error correction term is a_Y to income and a_W to wealth. Sample period is 1973Q2 to 1997Q3. Countries include Germany (*GE*), France (*FR*), Italy (*IT*), the Netherlands (*NE*), United Kingdom (*UK*), Spain (*SP*), Belgium (*BG*), Portugal (*PT*), Ireland (*IR*), Finland (*FN*) and Austria (*OE*). Dummy variables include FRD921 which is equal to one in 1992Q1 and 1997Q43 for France, DUM92IT which is equal to one in 1992Q3 and 1992Q4 for Italy, UKD7923, which is equal to one in 1979Q2 and negative one in 1979Q3 for the UK. Belgium BGD9293 which is equal to one from 1992Q3 to 1993Q1. T-statistics in parenthesis. Probability values are in square brackets. Bold coefficients are significant. The Wald Statistic tests the null of equivalence of coefficients.

Appendix 3: Data Sources

Consumption

German Private Consumption, 1995 prices, DM Bn DBSW, Table II-2, Private Konsumausgaben.

French Private Consumption, 1995 prices, FF Bn INSEE, Household Consumption.

Spanish Private Consumption, 1995 prices, Bn Ptas Ministerio de Economía y Hacienda, Final Consumption Expenditure of Households plus Final Consumption Expenditure of Non-profit Organisations.

Italian Private Consumption, 1995 prices, Bn Lire ISTAT, Private Final Consumption Expenditure. pre-1988 linked to OECD.

Dutch Private Consumption, 1995 prices, MN G SN, Private Consumption Expenditures. Datastream.

Belgian Private Consumption, 1995 prices, Bn BFr BNB, Private Consumption Adjusted. Break in series 1986. Datastream.

Finnish Private Consumption, 1995 prices, Mn FIM Central Statistical Office of Finland, Private Consumption Expenditure. Pre-1988 linked to OECD. Datastream.

Austria Private Consumption, 1995 prices, MN Sch WIFO, Private Final Consumption Expenditure, Constant 1995 prices.

UK Private consumption, 1995 prices, £ Mn Economic Trends, TA2, Final Consumption Expenditure of Households plus Non-profit Institutions.

Income

Germany Real Personal Disposable Income, 1995 Bn DM, $GERPDI = (GEPI - GETAX) * 100.0 / GECED$. Personal Income, DM Bn, $GEPI = GECOMP + GETRAN + GEOPI$. GECOMP, Total Compensation, DM Bn DBSW, TABLE II-4, col 3 Gross Wage & Salary Income, Arbeitsnehmerentgelt MRD DM. (BDJA9048B). Personal Tax, DM Bn, $GETAX = GEPI - GEPDI$. GEPDI 196501 200001 Datastream – BDDISPINB. GECED, Consumer expenditure deflator, 1995=100 DBSW, Tables II-2 & II-3, calculate as $(II-3 COL 1 / II-2 COL 1) * 100$. Datastream.

French Real Personal Disposable Income, Bn 1995 FF, $FRRPDI = (FRPI - FRTAX) * 100.0 / FRCED$. FRPI Personal Income, FF Bn OECD, Total income. FRTAX, Personal Tax, FF Bn OECD, Direct Taxes, Households plus Transfers paid by Households. FRCED, Consumer Expenditure Deflator, 1995=100 INSEE, Household Consumption Expenditure Deflator. Datastream.

Spanish Real Personal Disposable Income, Bn 1995 Ptas, $SPRPDI = (SPPI - SPTAX) * 100.0 / SPCED$. Personal Income, Bn Pesetas. OECD, Personal Income. SPTAX, Personal Tax, Bn Pesetas OECD, Direct Tax plus Transfers paid by Households. SPCED, Consumer Expenditure Deflator, 1995=100 QNA, Implicit Price Index, Private Final Consumption Expenditure. Datastream.

Italian Real Personal Disposable Income, 1995 prices, Bn Lire, $ITRPDI = (ITPI - ITTAX) * 100.0 / ITCED$. ITPI, Personal Income, Bn Lire OECD, Total Income. ITTAX, Personal Tax, Bn Lire OECD, Direct Taxes, Households plus Net Transfers paid by Households. $ITTAX = ITTAXC$. Consumer Expenditure Deflator, 1995=100 QNA, Italian Section, table 2, Implicit Price Index for Private Final Consumption. Pre-1988 linked to OECD. Datastream.

Netherlands Real Personal Disposable Income $NLRPDI = (NLPI - NL TAX) * 100 / NL CED$. NLPI is Personal Income, Mill Guilders OECD, current receipts, households. NL TAX, Direct Tax Receipts, Mill Guilders OECD, Direct Tax Households plus Net Transfers paid by Households. NL CED, Consumer Expenditure Deflator, 1995=100 SN, Consumer Expenditure Deflator. Datastream.

Belgium real personal disposable income $BGRPDI = (BGPI - BGTAX) * 100 / BGCED$. BGPI, Personal Income, BN Bfr OECD, Current Receipts, Households. BGTAX, Direct Taxes, Bn BFr OECD, Direct Taxes, Households plus Transfers paid by Households. BGCED, Consumer Expenditure Deflator, 1995=100 BNB, Banque Nationale de Belgique. Private Consumption Deflator. Private Consumption value divided by volume. Break in series 1986. Datastream.

Finland's Real Personal Disposable Income, $FNRPDI = (FNPI - FNTAX) * 100 / FNCED$. FNPI, Personal Income, Mn FIM OECD, Household Disposable Income plus Tax. FNTAX, Personal Tax, Mn FIM OECD, Direct Tax, Households plus social security contribution received by Gov't. FNCED, Consumer Expenditure Deflator, 1995=100 QNA, consumer expenditure deflator, pre-1988 linked to OECD. Datastream.

Austrian Real Personal Disposable Income, $OERPDI = (OEPI - OETAX) * 100 / OECED$. Personal Income, Mill Schilling OECD, Household Disposable Income plus Direct Taxes, Households. OETAX, Personal Tax, Mill Schilling OECD, Direct Taxes, Households plus social security contributions received by the government. OECED, Consumer Expenditure Deflator, 1995=100 WIFO, implicit price indices (1995=100), Private Final Consumption Expenditure. WIFO: Oesterreichisches Institut for Wirtschaftsforschung.

UK Real Personal Disposable Income, Mn 1995 £, $UKRPDI = (UKPI - UKTAX) / (UKCED / 100)$. UKPI, Personal Income, £ Mn, UKPI = UKCOMP+UKTRAN+UKOPI. UKTAX, Personal Tax, £ Mn ET(A), TA28, TA33, TA38. Current Taxes, plus Local and Central Government Social Contributions. UKCOMP, Total Compensation, £ Mn ET(A), TA3, Compensation of Employees. UKCED, Consumer Expenditure Deflator, 1995=100 ET(A), TA2. Nominal Consumers' Expenditure divided by Real Consumers' Expenditure.

Net Financial Wealth

German, Net Wealth, Personal Sector, DM Bn Deutsche Bundesbank Monthly Report (May or June edition.) Table on Households' Saving, Acquisition of Financial Assets and Incurrence of Liabilities in chapter on overall financial flows. Pre 1991 data for West Germany from Sonderdrucke Deutschen Bundesbank NR4, Total Financial Assets minus Liabilities, DM billions.

France, Net Wealth, Personal Sector, FF Bn INSEE, Comptes et Indicateurs Economiques, Tableau 15.13, Comptes de Patrimoine du Secteur: Menages, Actifs Financiers minus Passifs Financiers.

Spain, Net Wealth, Personal Sector, Bn Ptas. Banco de Espana, Financial Accounts of the Spanish Economy, Table iii.2.1. Summary of outstanding Financial Assets and Liabilities, summary by sectors, Household and Private Non-profit Institutions Serving Households. Net financial assets.

Italy, Net Wealth, Personal Sector, Bn Lire Banca D'Italia, Supplementi al Bollettino Statistico, conti finanziari. Table 21, Attivita less Passivita.

Netherlands, Net Wealth, Personal Sector, Mn Guil CPB: Netherlands Bureau of Economic Policy Analysis.

Belgium, Net Wealth, Personal Sector, Bn BFr based on information in BIS working paper no 25 and Bank of Belgium Annual Report.

Finland, Net Wealth, Personal Sector, Mn FIM Bank of Finland estimates.

Austria, Net Wealth, Personal Sector, BN Sch, Bank of Austria estimates.

United Kingdom, Net Wealth, Personal Sector, £ Mn ET(A), TA64, Net Assets of Households and Non-profit Institutions Serving Households (NZE).

References

- Ando, A., Modigliani, F., 1963. The Life Cycle Hypothesis of saving: Aggregate implications and tests, *American Economic Review* 103, 55-84.
- Bacchetta, P., Gerlach, S., 1997. Consumption and credit constraints: International evidence, *Journal of Monetary Economics* 40, 207-38.
- Barrell R., Dury, K., 2000a. Choosing the Regime: Macroeconomic effects of UK entry into EMU, *Journal of Common Market Studies* 37, 625-644.
- Barrell, R., Dury, K., 2000b. An Evaluation of Monetary Targeting Regimes, *National Institute Economic Review* 174, 105-113.
- Barrell, R., Dury, K., Hurst, I., 1999. An encompassing framework for evaluating simple monetary policy rules, *National Institute Discussion Paper # 156*.
- Barrell, R., Dury, K. and Hurst, I. (2002), 'International monetary policy coordination: An evaluation using a large Econometric model', *National Institute Discussion Paper* No. 160 Forthcoming in *Economic Modelling*
- Barrell, R., Dury, K., Hurst, I., Pain, N., 2001. Modelling the World Economy: The NIESR model NIGEM. presented at an ENEPRI workshop, Paris, July.
- Barrell, R., Dury, K., Pain, N., 2000. Decomposing forecast uncertainty, *National Institute Discussion Paper*, presented at RES, St Andrews.
- Barrell, R., Pina, A., 2000. How important are automatic stabilisers in Europe? *EUI Working Papers ECO # 2000/2*.
- Barrell, R., Sefton, J., 1997. Fiscal policy and the Maastricht solvency criteria, *The Manchester School* 65, 259-279.
- Begg, D., 1997. The design of EMU, *IMF Working Paper # 97/99*.
- Bernanke, B., Gertler, M., Watson, M., 1997. Systemic monetary policy and the effect of oil price shocks, *Brookings Papers on Economic Activity* 1, 91-157.
- Bilson, J.F.O., 1980. The rational expectations approach to the consumption function, *European Economic Review* 13, 273-99.
- Bladen-Hovell, R.C., Richards, G.M., 1983. Inflation and Australian savings behaviour, *Australian Economic Papers* 22, 290-301.
- Blake, A., 1996. Forecast error bounds by stochastic simulations, *National Institute Economic Review* 156, 72-79.
- Bryant, R.C., Hooper, P., Mann, C.L., 1993. Evaluating policy regimes: New research in empirical macroeconomics, Washington, Brookings.
- Campbell, J.Y., Deaton, A., 1989. Why is consumption so smooth? *Review of Economic Studies* 56, 357-373.

- Campbell, J.Y., Mankiw, N.G., 1991a. Consumption, income and interest rates: Reinterpreting the time series evidence. In Blanchard, O.J. and Fischer, S. (Eds.) NBER Macroeconomic Annual. Cambridge, Mass., MIT. 185-216.
- Campbell, J.Y., Mankiw, N.G., 1991b. The response of consumption to income: A cross-country investigation, *European Economic Review* 35, 723-67.
- Carruth, A., Gibson, H., Tsakalotos, E., 1999. Are aggregate consumption relationships similar across the European Union? *Regional Studies* 33, 17-26.
- Cecchetti, S.G., 1999. Legal structure, financial structure and the monetary transmission mechanism, *Federal Reserve Bank of New York Economic Policy Review* 5, 9-28.
- CEPR, 1997. The ostrich and the EMU: Policy choices facing the U.K. Report of independent panel chaired by Rupert Pennant-Rea. London, Centre for Economic Policy Research.
- Clarida, R., Galí, J., Gertler, M., 2000. Monetary policy rules and macroeconomic stability: Evidence and some theory, *Quarterly Journal of Economics* CXV, 147- 180.
- Davidson, J.E.H., Hendry, D.F., Srba, F., Yeo, S., 1978. Econometric modelling of the aggregate time-series relationship between consumers' expenditure and income in the United Kingdom, *Economic Journal* 88, 661-692.
- Davidson, J.E.H., Hendry, D.F., 1981. Interpreting econometric evidence: The consumption function in the United Kingdom, *European Economic Review* 16, 177-92.
- Davis, M.A., Palumbo, M.G., 2001. A primer on the economics and time series econometrics of wealth effects, *Finance and Economics Discussion Paper*, Federal Reserve Board Washington.
- Deaton, A., 1991. Saving and liquidity constraints, *Econometrica* 59, 1221-48.
- Deaton, A., 1992. *Understanding Consumption*, Oxford University Press, Oxford.
- Dewhurst, J.H., 1989. Australian State consumption functions, *Australian Economic Papers* 28, 112-21.
- Dornbusch, R., Favero, C., Giavazzi, F., 1998. Immediate challenges for the European Central Bank. *Economic Policy* 26, 17-64.
- Emerson, M., Gros, D., Italianer, A., Pisani-Ferry, J., Reichenbach, H., 1991. *One Market, One Money*. Oxford University Press, Oxford.
- European Central Bank, 1999. Editorial, *Monthly Bulletin*, 1, 9-10.
- Flavin, M.A., 1981. The adjustment of consumption to changing expectations about future income, *Journal of Political Economy* 89, 974-1009.
- Frankel, J.A., Rose, A.K., 1998. The endogeneity of the optimum currency area criteria, *Economic Journal* 108, 1009-1025.
- Gerlach, S., Snable, G., 1998. The Taylor Rule and average interest rates in the EMU-11 area: A note, *Mimeo.*, Bank of International Settlement, Basle.
- Hall, R.E., 1978. Stochastic implications of the Life Cycle-Permanent Income Hypothesis: Theory and evidence, *Journal of Political Economy* 86, 971-987.

Hendry, D.F., Muellbauer, J.N.J., Murphy, A., 1990. The econometrics of DHSY. In: Hey, J. and Winch, D. (Eds.), *A Century of Economics: 100 Years of the Royal Economic Society and the Economic Journal*. Oxford, Basil Blackwell, pp. 298-334.

Hendry, D.F., von Ungern Sternberg, T., 1981. Liquidity and inflation effects on consumers' expenditure. In: Deaton, A. (Ed.), *Essays in the Theory and Measurement of Consumer Behaviour*, Cambridge University Press, Cambridge.

Hughes Hallett, A., Piscitelli, L., 1999. EMU in reality: The effect of a common monetary policy on economies with different transmission mechanisms, *Empirica* 26, 337-358.

Kennedy, N., Anderson, P., 1994. Household saving and real housing prices: An international perspective, BIS Working Paper # 20.

Krugman, P., 1991. Increasing returns and economic geography, *Journal of Political Economy* 99, 483-499.

Lettau, M. and Ludvigson, S. (2001) Consumption, aggregate wealth and expected stock returns. *Journal of Finance* 56, 815-849.

Ludvigson, S., Steindel, C., 1999. How important is the stock market effect on consumption? *Economic Policy Review*, Federal Reserve Bank of New York, July.

MacLennan, J., Muellbauer, J., Stephens, M., 1998. Asymmetries in housing and financial market institutions and EMU, *Oxford Review of Economic Policy* 14, 54-80.

Muellbauer, J., Lattimore, R., 1995. The consumption function: A theoretical and empirical overview. In: Pesaran, M. H. and M. R. Wickens (Eds.), *Handbook of Applied Econometrics, Macroeconomics*, vol. 1. Oxford, Basil Blackwell, pp. 221-311.

Muellbauer, J., Murphy, A., 1993a. Income expectations, wealth and demography in the aggregate US consumption function. Mimeo, Nuffield College, Oxford.

Muellbauer, J., Murphy, A., 1993b. Income expectations, wealth and demography in the aggregate UK consumption function. Mimeo, Nuffield College, Oxford.

Muellbauer, J., Murphy, A., 1994. Explaining regional consumption in the UK, mimeo, Nuffield College, Oxford.

Pesaran, M.H., Shin, Y., Smith, R.P., 1999. Pooled Mean Group estimation of dynamic heterogeneous panels, *Journal of the American Statistical Association* 94, 621-634.

Pesaran, M-H., Smith, R., 1995. Estimation of long-run relationships from dynamic heterogeneous panels, *Journal of Econometrics* 68, 79-114.

Peersman, G., Smets, F., 1999. The Taylor Rule: A useful monetary policy guide for the ECB. *International Finance* 2, 85-116.

Ramaswamy, R., Sloek, T., 1998. The real effects of monetary policy in the European Union: What are the differences? *IMF Staff Papers* 45, 374-396.

Rose, A.K., 2000. One money, one market: The effect of common currencies on trade, *Economic Policy* 30, 7-45.

Shea, J., 1995. Union contracts and the Life-Cycle/Permanent-Income Hypothesis, *American Economic Review* 85, 186-200.

Souleles, N.S., 1999. The response of household consumption to income tax refunds, *American Economic Review* 89, 947-958.

Stock, J.H., Watson, M.W., 1993. A simple estimator of cointegrating vectors in higher order integrated systems, *Econometrica* 61, 783-820.

Taylor, J.B., 1993. Discretion versus policy rules in practice, *Carnegie Rochester Conference Series on Public Policy* 39, 195-214.

Zellner, A., 1962. An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias, *Journal of the American Statistical Society* 57, 348-68.