Cross Country Evidence on Consumption Persistence

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Abstract **- The main focus of this article is the detection and measurement of the level of persistence in aggregate and disaggregate private consumption in Italy, Norway and the United Kingdom. Using a non-parametric methodology, we conclude that the presence of a significant degree of persistence in aggregate and disaggregate consumption in those three countries cannot be rejected.**

These results are essential from a policy point of view. Persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to boost output via long-lasting increases in consumption. One instrument that might be useful in addressing this issue is interest rates.

Keywords *- Consumption, Persistence, Italy, Norway, the United Kingdom.*

1. Introduction and Motivation

This paper addresses the issue of the degree of persistence in both aggregate and disaggregate private consumption and identifies its economic policy implications. Persistence can be thought of as a measure of the speed at which a variable returns to its baseline after a shock. In this sense, when the degree of persistence is small, a shock tends to have more temporary effects and conversely when the degree of persistence is high, a shock tends to have more long-lasting effects.

The recent world economic and financial crises are being mitigated by a massive fiscal countercyclical stimulus trend that mainly functions through private consumer spending. The economic rationale for this pattern is well known, as are the (macro-) economic reasons why some countries are recovering faster and better than others. However, these (macro) economic considerations are not the only (or the most important) factors in households' consumption behavior, even under the present economic circumstances. The structure of preferences might be a factor, particularly if consumers have inter-temporally dependent preferences. Indeed, this might be a reason for consumption to display some sort of persistence or inertia.

The presence of inertia can substantially change the reaction of households to a policy shock or to innovations. This is particularly problematic for the formulation and the effectiveness of the present countercyclical policies that function through consumption. Persistence can reduce the incidence, length, and severity of shocks and changes in economic conditions. Furthermore, measuring the response of consumption to a shock is also important because it may show when it is more essential to act to overcome the harmful effect of a shock.

Traditionally, macroeconomic policies play the dominant role in smoothing the business cycle, but the effectiveness of those policies depends upon the economy's resilience. That is, the success of those policies depends upon the ability of the economic system to absorb the shock and to return to the baseline. Therefore, given the presence of persistence in consumption, the key question is whether it is viable and effective to design countercyclical policies that act through consumption expenditures, even if they are optimal.

The literature on the importance of persistence in macroeconomics is inexplicably insufficient. The first macroeconomic studies incorporating the issue of persistence appeared only in the early 1980s, and only recently did a factual interest, from an empirical point of view, in the phenomenon emerge. The importance and the need to (theoretically and empirically) study the phenomenon are further strengthened by the current economic and financial crisis, in which the persistence of the recession is a central issue. In addition, the literature on the persistence of

consumer habits has recently also gained some relevance in psychology and marketing.

The first studies that explicitly considered the importance of persistence were of a macroeconomic nature and began by highlighting the role of both staggered wage-setting and staggered price-setting as a source of persistent real effects of monetary shocks (Taylor 1980; Rotemberg and Woodford 1997; Huang and Liu 2002)[1]. On the other hand, given the alleged inability of standard real business cycle models to reproduce the evolution of output shown under real-world conditions (Cogley and Nason 1995), the inertial hypothesis was also used to explain the (strong) persistence of output that was observed in reality (Bouakez and Kano 2006; Maury and Tripier 2003). However, this development did not lead to a consensus, and the possibility of monetary policy shocks affecting aggregate output remained central to the debate. Indeed, the persistence of shocks on aggregate output has been, and still is, one of the issues most often subject to examination, and this will probably be the case for some time.

Multiple theoretical explanations have been proposed for the empirical evidence that monetary policy shocks can have a permanent effect on aggregate output (or unemployment). These explanations include imperfect information and short-run nominal price stickiness (Kiley 2000; Wang and Wen 2006). Furthermore, Jonsson (1997), Lockwood (1997) and Svensson (1997) have analyzed the consequences of inflation contracts on output or unemployment persistence. All these studies share the idea that, whether or not price rigidity is responsible for output or unemployment persistence, this should be seen as an empirical issue rather than a theoretical one.

Another interesting consequence of output persistence is that it may invert the political business cycle, which is typically associated with depressions at the beginning of the mandate followed by pre-election inflationary expansion (Gärtner 1996,1999; Caleiro 2009). Quite recently, increased interest in analyzing the persistence of output and inflation has been registered, and this has included studies of their relationship with the degree of openness of the economies (Guender 2006), the exchange-rate regime (Giugale and Korobow 2000) or the structural changes in the preferences of consumers, firms or policy-makers.

[1]See also Ascari (2003) for a critique of the real role of staggered wage-setting and staggered price-setting as sources of inertia.

The literature on inter-temporally dependent preferences is a well-built microeconomic theoretical basis for inertial behavior and, therefore, for persistence. Indeed, in a seminal work, Dusenberry (1949) called attention to the importance of past consumption on the current consumption level of households. Ryder and Heal (1973) and Constantinidies (1990) show that when instantaneous well-being is determined by both the current level of consumption (through the level effect) and its past level (through the habit or persistence effect) throughout a process of 'learning-by-consuming', the inter-temporal dependent preferences might cause permanent cyclical consumption behavior along its time path. This hypothesis, built upon the importance of habits, has also been tentatively used to explain the behavior of the growth rate and of the savings rate during a recession (Carroll 2000; Wendner 2000). Moreover, Belbute and Brito (2008) show that the presence of the inertial effect can not only lower the long-run equilibrium level for natural capital and the growth rate of the economy but also reduce the effectiveness of an environmental policy that is meant to improve environmental quality as well as sustainability.

In addition, in the literature in the fields of psychology and marketing, the study of habits has gained relevance but has not, to the best of our knowledge, been explored in terms of its relationship with persistence. Belbute and Caleiro (2009) may be viewed as a first step towards explaining how the behavior of consumers in a country with specific psychosocial consumption habits may lead to the persistence of consumption at an aggregate level.

The goal of our article is to contribute to the design of public countercyclical policies that act through private aggregate and disaggregate consumption. We do so by measuring the degree of persistence associated with private consumption (by type) for Italy, Norway and the United Kingdom. This allows us to highlight the influence that differences in preferences and cultures (Latin, Nordic and Anglo-Saxon) might have on the level of persistence.

Our article extends the literature by measuring the degree of private consumption persistence using one of two different approaches, depending on whether the corresponding time series exhibits stationary or non-stationary behavior. In the first case, persistence is

measured by estimating the sum of the auto-regressive coefficients of the appropriate autoregressive models. However, when the null hypothesis of a unit root cannot be rejected, persistence cannot be measured using the standard time series analysis. By definition, when the time series exhibits nonstationary behavior, it does not revert to its mean, and thus, it does not exhibit inertial behavior. In this case, we will measure persistence using a nonparametric methodology proposed by Marques (2004) and Dias and Marques (2010). This new measure of persistence can be defined as the unconditional probability that a stationary stochastic process will not cross its mean during time t.

Our results show that we cannot reject the presence of a significant level of persistence in aggregate consumption in the three countries. We also find a statistically significant level of persistence of disaggregate private consumption in each country, although, in some cases, there are statistical differences between items within and among countries. Clearly, these results are imperative from a policy point of view. Persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to boost output via long-lasting increases in consumption.

This article is organized as follows. In Section 2, a theoretical model of optimal consumption leading to persistence is presented. Section 3 offers some methodological notes about persistence. Section 4 presents the data. Section 5 details the empirical results as contrasted with the expected results from the model in Section 2. Section 6 concludes the article.

2. A Model of Consumption Persistence

Let us consider a consumer who possesses an instantaneous utility function defined as $U_t = ln(c_t)$, where c_t denotes the level of consumption in moment *t*. As usual, let us assume that the consumer consumes until moment 2, such that his/her objective function is

$$U = \sum_{t=0}^{2} \beta^t ln(c_t) \qquad (1)$$

where β is the discount factor.

To support the consumption expenditures, the consumer has some monetary resources available that can be capitalized at an interest rate r if not spent. This means that the maximization of (1) must consider the inter-temporal restrictions:

$$a_{t+1} = (1+r)a_t - c_t \qquad (2)$$

for $t = 0, 1, 2$ where $a_0 = \bar{a}_0$ denotes the initial level of (monetary) resources. Clearly, given the time horizon of the consumer, it makes no sense not to spend all of the resources on the last period. Therefore, $a_3 = 0$ which means $c_2 = (1+r)a_2$.

For the moment, let us ignore the persistence of consumption, which is understood as the influence of prior consumption, γc_{t-1}, on current consumption c_t. The higher γ is the greater the influence of past consumption experiences on the current level of consumption and, thus, the greater the degree of persistence. Under these circumstances, it is straightforward to demonstrate that the optimal levels of consumption can be given by

$$c_0 = \frac{(1+r)}{1+\beta+\beta^2}\bar{a}_0; \quad c_0 = \beta\frac{(1+r)^2}{1+\beta+\beta^2}\bar{a}_0, \quad c_0 = \beta^2\frac{(1+r)^3}{1+\beta+\beta^2}\bar{a}_0$$

From these expressions, it is easy to see that the relationship between the present and past consumption levels is given by

$$c_t = \beta(1+r)c_{t-1} \qquad (3)$$

This shows that the persistence of consumption is a factor and should always be considered. As a matter of fact, one can restate the above problem in terms of the optimal level of persistence of consumption, γ, which is given by

$$\gamma = \beta(1+r). \qquad (4)$$

Clearly, for a given interest rate, the optimal level of persistence increases according to how much the consumer cares about the future. This result has obvious implications: (a) it has to do with the time horizon of consumers, therefore making it possible to differ in accordance with the characteristics of different cultures; and (b) it has to do with the durability (or not) of the consumption of goods,

therefore making it possible to differ in accordance with the characteristics of the different goods.

3. Persistence: Definitions and Methodological Notes

Persistence can be broadly defined as the speed with which a variable (e.g., consumption) returns to its baseline (or its previous level) after, say, a shock (for instance, a macroeconomic policy measure) or an "innovation." In other words, consumption is said to be more inertial when it more slowly converges (or returns) to its previous level after the occurrence of a stimulus. Persistence is thus inversely related to the concept of mean reversion.

The implication of that definition is that the degree of persistence can be associated with both the speed with which consumption responds to a shock and the length (permanent or temporary) of the shock effects. When the value is small, consumption responds quickly to a shock and returns quickly to its trend. Conversely, when the value is high, the speed of adjustment is low, and consumption will tend to converge more slowly to its baseline. Therefore, if the degree of persistence is small, a shock tends to have temporary effects and conversely if the degree of persistence is high, a shock tends do have more long-lasting effect.

Quantifying the response of consumption to a shock is indeed important not only because it may allow one to assessing the effectiveness of economic policy measures but also because it may show at what point it is more appropriate to act to overcome a harmful effect of a shock to consumption. By definition, quantifying the response of consumption to shocks implies evaluating the persistence of consumption.

Some authors have proposed that obtaining those estimates via the use of *autoregressive models* as estimates of persistence at time *t* will indicate how long we expect a shock to take to die off (if it ever does). A univariate AR(k) process is characterized by the following expression:

$$y_t = \alpha + \sum_{j=1}^{k} \beta_j y_{t-j} + \varepsilon_t \qquad (5)$$

where y_t denotes the aggregate and disaggregate private consumption at moment *t*, which is explained by a constant α, by past values up to lag *k*, and by a number of other factors whose effect is captured by the random term ε_t. Alternatively, (5) can also be re-parameterized as follows:

$$\Delta y_t = \alpha + \sum_{j=1}^{k-1} \delta_j \Delta y_{t-j} + (\rho - 1) y_{t-1} + \varepsilon_i \quad (6)$$

where

$$\rho = \sum_{j=1}^{k} \beta_j \qquad (7)$$

is the "sum of the auto-regressive coefficients" and $\delta_j = -\sum_{i=j+1}^{k} \beta_i$.

Again, the AR(k) process (5) (or (6)) can also be re-parameterized and written as

$$(y_t - \mu) = \sum_{j=1}^{p-1} \delta_j \Delta(y_{t-j} - \mu) + \rho(y_{t-1} - \mu) + \varepsilon_t \qquad (8)$$

or equivalently

$$\Delta y_t = \sum_{j=1}^{p-1} \delta_j \Delta(y_{t-j} - \mu) + (\rho - 1)(y_{t-1} - \mu) \qquad (9)$$

with

$$\mu = \frac{\alpha}{1 - \rho} \qquad (10)$$

being the "unconditional mean" of the y_t series.

This formulation has the advantage of showing that persistence is related to the concept of "mean reversion" present in equation (8) or (9) by the term $(\rho - 1)(y_{t-1} - \mu)$. As long as $(\rho - 1) < 0$ (or alternatively, $\rho < 1$), i.e., as long as the time series is said to be stationary, any unit deviation from the mean in period *t* - 1, $(y_{t-1} - \mu)$, will force the series in the next period to display (positive or negative) change in the amount $(\rho - 1)$, thus bringing it close to the mean.

Andrews and Chen (1994) propose the "sum of the autoregressive coefficients" (7) to be a measure of persistence, while other authors have proposed alternative measures of persistence, such as the largest

autoregressive root, the spectrum at zero frequency, or "half-life." For a technical appraisal of these other measures, see, for instance, Marques (2004) and Dias and Marques (2010). The rationale for this measure comes from the fact that for $|\rho| < 1$, the cumulative effect of a shock on y_j is given by $\frac{1}{1-\rho}$.

One important implication of stationary autoregressive processes (that is, $\rho < 1$) is that any shock has transitory effects, whereas under the autoregressive unit roots (or nonstationary) hypothesis (that is $\rho = 1$), random shocks have a permanent effect on the system. Therefore, fluctuations are not transitory, and the system has no tendency to return to a stable value.

Unfortunately, the procedure described above is inappropriate when a data series is a "non stationary" process, i.e. when a series that has moved away from its mean does not reveal a tendency to return to it. Therefore, the existence of a unit root in the data generation process makes it impossible to accept the results of a traditional OLS estimation.

Marques (2004) and Dias and Marques (2010) have suggested a nonparametric measure of persistence, *γ*, based on the relationship between persistence and mean reversion. In particular, Marques (2004) and Dias and Marques (2010) suggested using the statistic

$$\gamma = 1 - \frac{n}{T} \qquad (11)$$

where *n* stands for the number of times the series crosses the mean during a time interval with *T* + 1 observations—the ratio n/T provides the degree of mean reversion—to measure the absence of mean reversion in a given series, given that it may be seen as the unconditional probability of that given series *not crossing* its mean in period *t*. In short, (11) measures how often the series does not revert to its mean, and (high/low) persistence indicates whether, after a shock, the series *reverts* to (or *crosses*) its mean more seldom or frequently. To put it differently, the less often a time series crosses its mean, the greater the degree of persistence and, thus, the higher the value of γ.

As Dias and Marques (2010) have shown, there is a one-to-one relationship between the sum of the autoregressive coefficients ρ given by (7) and the non-parametric measure γ given by (11) when the data are generated using an AR(1) process. However, such a relationship no longer exists once higher-order autoregressive processes are considered, therefore giving rise to possibly crucial differences when measuring persistence in the series.

Expressions (8) or (9) are also useful because they help one to understand the importance of the mean and, in particular, what mean one should use to measure persistence. Clearly, to compute the estimate of persistence for each kind of consumption, the mean of each series must be computed, and therefore assumptions must be made about its behavior over time. As suggested in Marques (2004) and Dias and Marques (2010), a time-varying mean is more appropriate than the simple average for all the period under investigation.

One possibility is to consider whether the mean follows a linear deterministic trend given by $\mu_t = \bar{\mu} + \delta t + \varepsilon_t$ (with ε_t being a white noise process) and use the de-trended time series to measure persistence, as in (3). Again, however, this method is only viable when the time series represents a trend-stationary process and the residuals represent a white noise process.

Using the alternative measure of persistence *γ* given by (11) also has advantages because it does not impose the need to assume a particular specification for the data generation process and, therefore, does not require a model for the series under investigation to be specified and estimated γ is indeed extracting all the information about the persistence from the data.[2]

4. Data and Preliminary Data Analysis

This section describes the basic data set, presents the results of the unit root tests, and discusses the implications of the nonstationary nature of the data for persistence.

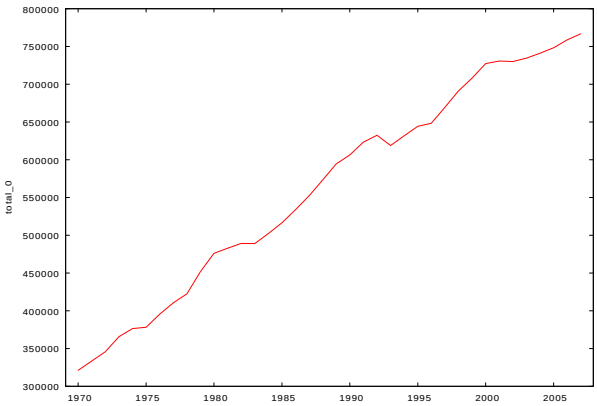
4.1 Brief description of data set

We use annual data for both aggregate and disaggregate private consumption for Italy (1970 to 2007), the United Kingdom (1963 to 2008) and Norway (1980 to 2006). Data for aggregate and disaggregate private consumption for each country were obtained from Eurostat, which classifies

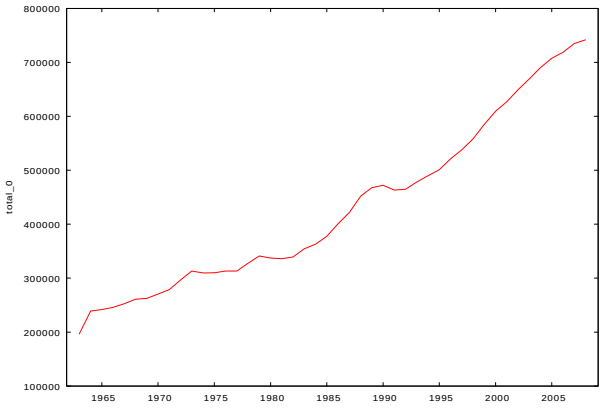
[2]The statistical properties of *γ* are extensively analysed in Marques (2004) and in Dias and Marques (2010).

household consumption expenditure by consumption purpose according to the Classification Of Individual Consumption by Purpose, COICOP (see Commission Regulation 113/2002 of January 23, 2002). Aggregate private consumption is defined as the sum of private consumption levels for the 12 categories at the two-digit level, as shown in Table 1.

Each one of these 12 categories includes household expenses that can be aggregated into four one-digit level groups: services, non-durables, semi-durables and durables. For example, expenses with "housing" include "services" (actual rentals paid by tenants, including other actual rentals, services for the maintenance and repair of the dwelling, refuse and sewerage collection, etc.) as well as non-durables, such as materials for the maintenance and repair of the dwelling, water supply, electricity, liquid and solid fuels, gas, heat energy, etc. On the other hand, "transport," for example, includes services (maintenance and repair of personal transport equipment), semi-durables (spare parts and accessories for personal transport equipment), and durables (motor cars, motor cycles, bicycles, etc.). For this reason, it is impossible to isolate any direct association between the two categories. In particular, it would be impossible to develop a precise outlook about these four aggregate household expenses using the three-digit variables. This prevents us from measuring the persistence of these four important categories of household expenses.



a)



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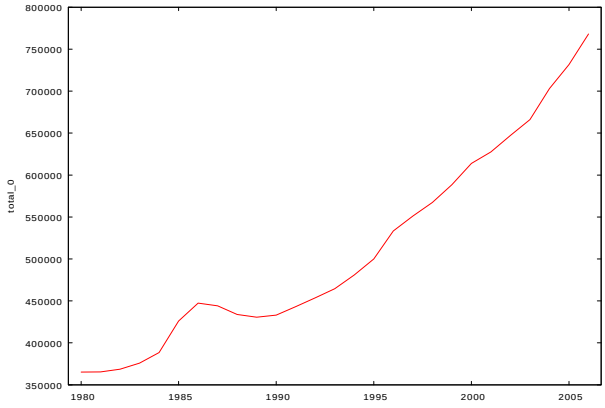

c)

Figure. 1. Aggregate private consumption for Italy (panel a), the United Kingdom (panel b) and Norway (panel c)

Clearly, "Food and non-alcoholic beverages" (hereafter, "food"), "Furnishing, household equipment and routine maintenance of the house" (hereafter, "furnishing") and "Communications" are the three most important components of aggregate consumption. Together, they represent almost 50% of all private consumption but, in recent years, these three groups have consistently reduced their relevance in the three countries. However, the relative importance of these groups is different, with Norway being the country in which these items have more weight. On the other hand, we also detect differences across these countries when we consider each item. For United Kingdom, Food has less weight than for the other two countries.

4.2 Testing Stationary

We test the unit roots hypothesis for aggregate and disaggregate private consumption data for Italy, United Kingdom and Norway by using the modified Dickey–Fuller t test (also known as the Dickey–Fuller Generalized Least Squares test (DF-GLS) proposed by

Elliott et al. (1996). Essentially, the DF-GLS test is an augmented Dickey–Fuller test in which the time series is transformed via a (GLS) regression before performing the test. Elliott et al. (1996) and later studies have shown that this test has significantly greater power than the previous versions of the augmented Dickey–Fuller test. The AD-GLS *t*-test suggests that the null hypothesis of a unit root cannot be rejected for all variables at the 5% significance level (see Tables 1A, 2A and 3A in appendix).

of these two countries to leave the European Monetary System (EMS) in the summer of 1993.[3] For Norway, the breaking point is 1994 and coincides with the moment when the European Economic Area. (EEA) came into effect.[4] We used the Chow (1966) test to confirm these dates as a structural break. For all cases, we have used Perron (1989)'s strategies to test the null hypothesis that the time series have a unit root with a possibly nonzero constant against the alternative that the process is "*trend-stationary.*"

Table 1. Structure of private consumption

Country	Period	Food and non-alcoholic beverages	Clothing and footwear	Housing, water, electricity, gas and other fuels	Furnishings, household equipment and routine maintenance of the house	Health	Transport	Communications	Education	Alcoholic beverages, tobacco and narcotics	Recreation and culture	Restaurants and hotels	Miscellaneous goods and services
Italy	Overall Sample	18,2%	3,5%	9,1%	19,7%	7,9%	2,5%	12,3%	1,7%	0,8%	6,3%	9,1%	8,9%
	1970-1993	19,9%	4,1%	9,4%	20,1%	7,7%	1,9%	11,6%	1,0%	0,8%	5,9%	9,1%	8,5%
	1994-2008	15,2%	2,5%	8,7%	18,9%	8,2%	3,5%	13,6%	2,7%	0,9%	7,0%	9,2%	9,5%
United Kingdom	Overall Sample	12,2%	7,0%	4,9%	22,0%	5,4%	1,8%	14,5%	1,4%	1,3%	6,0%	12,4%	11,0%
	1963-1973	16,0%	10,4%	4,2%	25,4%	5,4%	1,8%	12,7%	0,7%	1,2%	0,9%	12,5%	8,8%
	1974-1993	12,2%	7,4%	4,3%	23,3%	5,1%	1,9%	15,0%	1,1%	1,4%	4,6%	13,4%	10,5%
	1994-2008	9,4%	4,1%	6,3%	17,7%	5,8%	1,6%	15,2%	2,2%	1,4%	11,8%	11,1%	13,5%
Norway	Overall Sample	16,0%	5,9%	5,7%	21,7%	6,0%	2,6%	15,7%	1,5%	0,5%	11,3%	5,6%	7,6%
	1980-1987	17,7%	7,1%	5,5%	23,0%	6,0%	2,1%	18,0%	0,6%	0,5%	8,5%	4,9%	6,0%
	1988-1994	16,4%	6,5%	5,2%	24,0%	5,7%	2,8%	14,5%	0,9%	0,6%	9,7%	5,6%	8,0%
	1995-2006	14,7%	4,6%	6,1%	19,5%	6,1%	2,7%	14,7%	2,5%	0,5%	14,0%	6,1%	8,5%

One major problem with unit root tests is the implicit assumption that deterministic trends are well determined. However, as Perron (1989) has argued, if there is a break in the deterministic component of the time series, then unit root tests will lead to misleading conclusions about the presence or absence of a unit root.

The literature on trend breaks in unit roots is vast and sometimes controversial but converges to the need to test the null hypothesis of a unit root with a possible known and/or unknown breaks in the series. In our empirical analysis below, we fully consider the possibility of both known and unknown structural breaks for aggregate consumption for the three countries. The known turning point is 1992 for Italy and the United Kingdom coincides with the decision

We find evidence for a stationary trend under the assumption of a process with known structural breaks in the trend (model B - "growth model") for Italy and in both the mean and the trend (model C - "crash and growth model") for the United Kingdom and Norway (see Table 2). In these cases, conventional parametric tests are appropriate for testing and measuring persistence.

[3]The Chow test did not confirm these dates as possible structural breaks because these sample periods include years before, and after the integration of the European Economic Community and the Euro Zone. We also considered a possible structural break in 1973 for the United Kingdom (at the time of its integration into the EEC) and 1999 for Italy (with its entrance into the Euro Zone).

[4]In 1992, the EFTA countries – Norway, Iceland, Switzerland and Liechtenstein - and the European Union established the European Economic Area.

Table 2. Unit root *t*-tests accommodating for the presence of a known structural break

Country	Break Point	Method[(1)]	Lag	ADF_t (5%)
Italy	1992	Model B	2	-3,950
The United Kingdom	1992	Model C	1	4,080
Norway	1994	Model C	0	-4,240

[(1)] See Perron's 1989 models A (crash model), B (growth model) and C (crash and growth model)

5 The Level of Persistence of Private Consumption

This section measures the level of persistence of aggregate and disaggregate private consumption for Italy, Norway and the United Kingdom. A simple visual inspection of the graphs for a sample including all time series suggests that one should measure the level of persistence using a time-varying mean framework.

We will measure persistence using two distinct methodologies. First, for the trend-stationary cases the residuals of the regressions of models B and C in Table 2 are used to compute the degree of persistence (or the sum of the autoregressive coefficients ρ). We restrict this method to the aggregate private consumption of each country. Secondly, the level of persistence for aggregate and disaggregate private consumption is measured using the nonparametric strategy statistic (7) proposed by Marques (2004) and Dias and Marques (2010). We use the residuals of the regressions of models B and C (Table 2) and the cyclical component extracted using the Hodrick-Prescott filter. In both cases, we compute the degree of persistence of the overall period and corresponding sub-periods and perform simple tests on the statistical significance of the estimated level of persistence as well as of the differences between countries and between disaggregate private consumption items.

5.1 A parametric measure of the degree of persistence

The parametric level of persistence for each country is estimated for the aggregate private consumption of each country and for the overall sample period, the identified sub-periods and only the stationary cases. The sum of the auto-regressive coefficients $\hat{\rho}$ is estimated using the following regression:

$$\epsilon_t = \sum_{j=1}^{p-1} \delta_j \Delta\varepsilon_{t-j} + \rho\epsilon_{t-1} + \varepsilon_t \quad (12)$$

where ϵ_t are the residuals of models B and C presented in Table 2 in the Appendix.

The results are presented in Table 3 and suggest a high degree of persistence of private aggregate consumption for the three countries given that one cannot reject the null hypothesis of equal persistence at a 5% significance level for any of them. Lags are included to account for serial correlation, and *t*-statistics are heteroskedastic-consistent for the persistence coefficient.

Table 3. Measuring persistence of private aggregate consumption: the parametric case

Countries	Break Points	Method	Lags	ρ	t_ρ
Italy	1992	Model B	2	0,728	6,996
The United Kingdom	1992	Model C	1	0,784	10,750
Norway	1994	Model C	0	0,688	4,359

To test the possibility of a change in persistence in the two sub-periods, we estimated the following model proposed by Marques (2004):

$$\epsilon_t = \sum_{j=1}^{p-1} \delta_j \Delta\varepsilon_{t-j} + \sum_{j=1}^{p-1} \lambda_j D_t \Delta\varepsilon_{t-j} + \rho_1\epsilon_{t-1} + \rho_2 D_t \epsilon_{t-1} + \varepsilon_t \quad (13)$$

where D_t is a dummy variable that is zero for $t < T_B$ (T_B being the break time) and 1 otherwise. Parameter ρ_2 is basically used to test the change in persistence between the two periods. Because heteroskedasticity across sub-periods might be a problem (even though not within sub-periods), the corresponding *t*-statistics for this parameter in Table 4 were computed using heteroskedastic-consistent standard errors.

Table 4. Test for a change in persistence

Country	Break Points	Method	Lags	$t_{\mu 2}$	Result
Italy	1992	Model B	1	1,578	No Change
United Kingdom	1992	Model C	1	-0,3195	No Change
Norway	1994	Model C	1	-0,028	No Change

In summary, the estimation of the autoregressive coefficients suggests statistically significant evidence of a strong degree of persistence in the three countries. An exogenous and random shock will basically have the same permanent effect on aggregate private consumption in the three countries. In accordance with the model presented in Section 2, these results suggest that there are no significant differences among the three countries' discount factors and/or interest rates. The results also suggest no statistical evidence of a change in the level of persistence between the two sub-periods of the sample for the three countries.

5.2 The non-parametric measure of the degree of persistence

In this section, the non-parametric approach is used to measure the degree of persistence. We begin by using the innovations from Perron's crash and growth model. The results are presented in Table 5 and confirm the presence of a strong level of persistence in the United Kingdom, Italy and (although this is more tenuous) Norway. The null hypothesis of equal persistence could not be rejected in comparing the level of persistence between Norway and the United Kingdom for a test of 5% significance and between Norway and Italy for a test of 10% significance.

Table 5. Measuring persistence in Aggregate Private Consumption: nonparametric approach Perron's crash and growth model

Countries	Overall Sample			1st Sub-Period		2nd Sub-Period	
	T_B	γ	se_g	$\gamma_1 = 1 - \alpha_1$	$se_{\alpha 1}$	α_2	$se_{\alpha 2}$
Italy	1992	0,763 *	0,069	0,739 *	0,091	-0,061	0,145
The United Kingdom	1992	0,870 *	0,050	0,900 *	0,062	0,088	0,106
Norway	1994	0,667 *	0,091	0,800 *	0,120	0,300	0,180 +

*Note: * Denotes the rejection of the null of $\gamma = 0,5$ (absence of persistence) while + denotes the rejection of the null of equal persistence between the two sub-periods for a test of 5% significance level in both cases.*

This means that a policy innovation or a random shock that affects household expenditures will tend to have more permanent effects on United Kingdom and Italy than on Norway. Moreover, these shocks will tend to influence private consumption in Norway to deviate more quickly from its trend than will occur in the other countries. In the context of the current fiscal programs that are being implemented to tackle the economic crisis, our results suggest that Norwegian private consumption will more quickly reverse its long-run trend than one would expect for the United Kingdom and Italian private consumption. To put it in another way, the same fiscal stimulus would be more effective in Norway than in the other two countries.

In addition, we also tested the null hypothesis of a change in persistence between the sub-periods using the strategy proposed by Dias and Marques (2010). We estimated the following model:

$$x_t = \alpha_1 + \alpha_2 d_t + u_t \qquad (14)$$

where x_t equals 1 if the time series crosses its mean and zero otherwise and d_t is a dummy variable that is 0 for $t \leq T_B$ and 1 otherwise. From (14), we can see that $\alpha_1 = 1 - \gamma_1$ and $\alpha_2 = \gamma_1 + \gamma_2$ are the measures for the first and second sub-periods, respectively. Therefore, testing the change of persistence amounts to testing if α_2 is significantly different from zero.

Our results do not suggest that aggregate consumption has recently changed its level of persistence in Italy and the United Kingdom. However, for Norway, one can reject the null hypothesis of equal persistence between the two sub-

periods. Clearly, Norwegian aggregate private consumption became less persistent after 1994.

This change in the inertial behavior of aggregate consumption might be due to a change in preferences resulting in the strengthening of consumer habits. Consumers with stronger habits tend to respond more slowly to a stimulus and thus are more reluctant to change their consumption pattern to include a greater amount of green economic behavior, for example. Moreover, as the model in Section 2 shows, changes in household discount factors and interest rates may also explain changes in consumption persistence. The intensity of the current financial and economic crises may be a reason why households are more reluctant to anticipate their consumption, which is particularly relevant for durables.

The literature also points out that different combinations of habits (harmful/beneficial, addition/not-addiction and addictive/multiplicative) and risk aversion (strong/weak) conditions (Wendner 2003) may change consumer willingness to substitute present for future consumption and may thus effect steady-state capital intensity, the savings rate and the economic growth rate. In particular, under certain circumstances (Belbute and Brito, 2008), stronger habits create fewer consumers' willing to postpone their consumption and create a greater impact of inertia on steady-state capital intensity. Furthermore, given the links among habits, persistence, patterns of saving and economic growth (Shieh et al. 2000; Carrol et al. 1997,2000; Lahiri and Puhakka 1998; Wendner, 2002), the presence of persistence in private consumption not only affects savings and growth rates but also might help to explain the strong evidence that economic growth significantly precedes an increase in the occurrence of saving.

Let us now turn to the case in which we measure persistence based on the cyclical component extracted from the time series with the HP Filter. We will first consider aggregate private consumption for the three countries as presented in Table 5.

Table 6. Persistence in Aggregate Private Consumption: the HP- filter case

Countries	Overall Sample			1rt Sub-Period		2nd Sub-Period	
	T_B	γ	se_γ	$\gamma_1 = 1 - \alpha_1$	$se_{\alpha 1}$	α_2	$se_{\alpha 2}$
Italy	1992	0,763 *	0,069	0,739 *	0,091	-0,061	0,145
The United Kingdom	1992	0,783 *	0,063	0,733 *	0,076	-0,142 +	0,129
Norway	1994	0,778 *	0,080	0,800 *	0,111	0,050	0,167

*Note: * Denotes the rejection of the null of $\gamma = 0,5$ (absence of persistence) whereas + denotes the rejection of the null of equal persistence between the two sub-periods for a test of 5% significance level in both cases.*

The use of the HP filter confirms the presence of a significantly high degree of persistence of aggregate consumption for each country, but unlike in the previous case, there are no statistically significant differences among the countries. Moreover, the results also suggest that British consumers became more reluctant to change their consumer patterns after the turning point (persistence increased after 1992). Recall that during the process of ratification of the Maastricht Treaty (formally the Treaty on the European Union), the speculation caused by the negative results of the first Danish referendum (June 1992) and the uncertainty surrounding the French referendum (September 1992) gave rise to speculative turbulence in currency markets, forcing Italian and British authorities to withdraw their currencies from the European Exchange Rate Mechanism on September 16, 1992. The “black Wednesday” and the speculative attacks that followed until the middle of 1993 were only the result of a series of events catalyzed by the reunification of Germany in 1990. This event was unprecedented in history in merging a large and rich economy with a smaller economy with a much lower standard of living. For Norway, the change in the degree of inertia between the sub-periods is neither clear nor statistically significant.

5.3 Persistence of disaggregate private consumption: the HP filter case

Having established that aggregate private consumption involves a significant degree of inertia for the three countries, to assess the potential design of optimal public policies, it is important to measure persistence within the various categories of household expenses. In fact, the aggregate measures of

persistence occlude the variability in the amount of inertia for the different categories of consumers' spending. This is a predictable result given that the discount factor (i.e., concern about the future) was shown to be relevant to achieving the optimal degree of consumption persistence. It is obvious that different types of consumption goods have different levels of durability.

The first general conclusion is that one cannot reject the null hypothesis of presence of a statistically significant process of persistence in any of the nine categories of consumer expenses. Moreover, the null hypothesis of the tests of the change in persistence between the two sub-periods could not be rejected for the three countries and all items at a 5% of significance level.

Table 7. Persistence of Disaggregate Private Consumption for Italy: the HP-Filter

Variables	T_B	Overall Sample		1st Sub-Period		2nd SuB-Period	
		γ	$se_{\gamma 1}$	$\gamma = 1 - \alpha_1$	$se_{\alpha 1}$	α_2	$se_{\alpha 2}$
Food	1992	0,711 *	0,073	0,696 *	0,097	-0,038	0,155
Clothing & Shoes	1992	0,763 *	0,069	0,783 *	0,091	0,049	0,145
Housing & Utilities	1992	0,605 *	0,079	0,652 *	0,104	0,119	0,165
Furnishing	1992	0,684 *	0,075	0,652 *	0,099	-0,081	0,158
Health	1992	0,684 *	0,075	0,609	0,098	-0,191	0,155
Transport	1992	0,816 *	0,063	0,826 *	0,083	0,026	0,132
Communications	1992	0,658 *	0,077	0,696 *	0,101	0,096	0,161
Education	1992	0,763 *	0,069	0,783 *	0,091	0,049	0,145
Alcohol and Narcotics	1992	0,789 *	0,066	0,739 *	0,086	-0,128	0,137

*Note: * Denotes the rejection of the null of $\gamma = 0,5$ (absence of persistence) while + denotes the rejection of the null of equal persistence between the two sub-periods for a test of 5% significance level in both cases.*

Consider first the case of Italy (Table 7) and note that transportation expenses are the most persistent (0.816), whereas housing expenses exhibit a lower degree of inertia (0.605). However, for the overall period, the null hypothesis of equal persistence could only be rejected for a test of 5% significance when we compared housing with transportation and with alcohol and drugs. This result is surprising because housing mainly includes services, non-durables and semi-durable items, while transport is primarily composed of durables goods. Moreover, there is no statistically significant evidence of a change in persistence between before and after the break for any of the nine items for private consumption.

In the United Kingdom, although the results show a wide range of degrees of inertia across the nine categories, the null hypothesis of equal persistence could only be rejected for a test of 5% significance for furnishings (0.652) and clothing and shoes (0.804).

When the results for the sub-periods examined here are considered, we find that it is impossible to reject the null hypothesis of absence of persistence for furnishings. Before the break, education is the item with the highest level of persistence, but the figures are only statistically different from those for furnishings and of communication. Moreover, the pattern of persistence between the sub-periods suggests that for two categories of household expenses (education and communication), there was a clear change in the degree of persistence. In particular, education expenses became less persistent, whereas communications expenses turned out to be more persistent.

Table 8. Persistence of Disaggregate Private Consumption for the United Kingdom: the H-P filter

VARIABLES	T_B	Overall Sample		1st Sub-Period		2nd Sub-Period	
		γ	$se_{\gamma 1}$	$\gamma_1 = 1 - \alpha_1$	$se_{\alpha 1}$	α_2	$se_{\alpha 2}$
Food	1992	0,739 *	0,063	0,733 *	0,082	-0,017	0,139
Clothing & Shoes	1992	0,804 *	0,057	0,767 *	0,073	-0,108	0,125
Housing & Utilities	1992	0,696 *	0,065	0,733 *	0,085	0,108	0,145
Furnishing	1992	0,652 *	0,072	0,600	0,088	-0,150	0,149
Health	1992	0,696 *	0,068	0,700 *	0,086	0,013	0,146
Transport	1992	0,696 *	0,063	0,733 *	0,085	0,108	0,145
Communications	1992	0,717 *	0,069	0,633 *	0,081	-0,242 +	0,138
Education	1992	0,739 *	0,063	0,833 *	0,078	0,271 +	0,133
Alcohol and Narcotics	1992	0,739 *	0,065	0,733 *	0,082	-0,017	0,139

Note: Denotes the rejection of the null of $\gamma = 0,5$ (absence of persistence) whereas + denotes the rejection of the null of equal persistence between the two sub-periods for a test of 5% significance level in both cases.*

Finally, the case of Norway confirms the presence of a high degree of persistence in seven of the nine categories of household expenses and no statistical evidence of differences among them. The null hypothesis of the absence of a significant degree of persistence could not be rejected for education or alcohol and drugs at a 5% significance level. Moreover, the results also suggest that it was impossible to reject the null hypothesis of equal persistence before and after the break for three items: clothing, education and alcohol and drugs. In particular, clothing has become more inertial since 1994. Conversely, education and alcohol and drugs reduced their degree of persistence, which means that the effects of random shocks affecting these items became more temporary after the break than they were before.

Table 9. Persistence of Disaggregate Private Consumption for Norway: the H-P filter

Variables	T_B	Overall Sample		1st Sub-Period		2nd Sub-Period	
		γ	$se_{\gamma 1}$	$\gamma_1 = 1 - \alpha_1$	$se_{\alpha 1}$	α_2	$se_{\alpha 2}$
Food	1994	0,704 *	0,087	0,733 *	0,122	0,067	0,183
Clothing & Shoes	1994	0,778 *	0,080	0,667 *	0,106	-0,250 +	0,160
Housing & Utilities	1994	0,778 *	0,080	0,800 *	0,111	0,050	0,167
Furnishing	1994	0,704 *	0,088	0,800 *	0,119	0,217	0,179
Health	1994	0,741 *	0,084	0,800 *	0,116	0,133	0,174
Transport	1994	0,815 *	0,075	0,867 *	0,103	0,117	0,155
Communications	1994	0,778 *	0,080	0,800 *	0,111	0,050	0,167
Education	1994	0,630	0,093	0,867 *	0,108	0,533 +	0,162
Alcohol and Narcotics	1994	0,630	0,093	0,800 *	0,119	0,383 +	0,179

*Note: * Denotes the rejection of the null of $\gamma = 0,5$ (absence of persistence) whereas + denotes the rejection of the null of equal persistence between the two sub-periods for a test of 5% significance level in both cases.*

Finally, the level of persistence of each item across the three countries are compared, we find that housing is more persistent in Norway (0.778) than in Italy (0.605) at a 5% significance level. This means that, all else being equal, the same policy shock will have more long-lasting effects on Norwegian housing expenses than they will in Italy. Conversely, Norwegian private expenses on alcohol and drugs (0.630) are statistically less inertial than their Italian equivalent (0.789) using the same 5% test. Therefore, all else being equal, the same policy will have more

temporary effects on private expenses on alcohol and drugs in Norway than in Italy.

The null hypothesis of equal persistence was also rejected for a test of 10% when comparing transportation in the United Kingdom (0.696), Italy (0.816) and Norway (0.815). Moreover, Italian private expenses on education were found to be more persistent than the corresponding Norwegian expenses at a 10% significance level.

6 Conclusion

The goal of this article is to analyze the degree of persistence of aggregate and disaggregate private consumption for Italy, Norway and the United Kingdom, and thereby contribute to the design of public countercyclical policies that act through private aggregate and disaggregate consumption. We use a non-parametric methodology proposed by Marques (2004) and Dias and Marques (2010) to measure persistence that is more flexible and broader in scope than other measures used in the literature, particularly estimations of the sum of the autoregressive coefficients.

Our results show that the presence of significant degree of persistence in aggregate consumption in the three countries cannot be refuted. The null hypothesis of an equal level of persistence could only be rejected, at a 5% significance level, when the United Kingdom and Norway were compared. The fact that this result has only been confirmed using one of the three models described in this article is most likely due to the use of different methods to extract the long-term mean. In addition, we only found statistically significant evidence of changes in persistence before and after the known structural break for Norwegian aggregate private consumption.

Clearly, these results are consistent with the theoretically expected results (such as those presented in the model of optimal consumption in section 2). Because negligible differences in the interest rates for the three countries exist, the results accord with different cultural considerations such as the time horizon of consumers.

With few exceptions, the presence of a statistically significant level of persistence in disaggregate private consumption across the three countries also could not be rejected. Furthermore, the hypothesis of equal persistence between items within and across countries could only be rejected in few cases.

Clearly, these results are significant from a policy perspective. As a matter of fact, persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to boost output via long-lasting increases in consumption.

The evidence for high persistence in aggregate consumption in the three countries reflects strong habit formation mechanisms. Therefore private aggregate consumption will react slowly. However, given the high degree of persistence of aggregate private consumption, the good news is that policies that act trough consumption will tend to have long lasting and larger effects.

Furthermore, the implications can also be considered from a relative perspective. The differences in the degree of persistence across different types of private consumption categories suggest that public policies can be implemented in a favorable setting in which their effects will tend to reinforce themselves, be long lasting and larger. In particular, policies may be selective and focused on those categories of consumption that are more persistent.

Because cultural differences are not easily changed, one possible instrument is interest rates. Our results do show that a decrease in interest rates intended to boost investment may also lead to undesirable results from the viewpoint of consumption, particularly for durables.

In future work, it is our intention to consider other countries, allowing for other characteristics that make them different. Because it is obviously difficult to measure the discount factor, one promising avenue seems to be that of considering the interest rate and the degree of aversion to risk. Moreover, our results do not show statistically significant evidence of differences in persistence levels of aggregate and disaggregate private consumption within and among the three countries, except for a few cases. This may be due to the use of annual data, which only allow us to capture long-term effects, whereas households might react differently in the short term to changes in policy or to exogenous and random shocks. For that reason, to evaluate the persistence of aggregate and disaggregate private consumption using quarterly or monthly data would be a natural extension of our work.

Appendix – Unit Roots tests

Table 1A – DF-GLS Unit root tests – Italy

VARIABLE	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-2,150	-3,283	18,241
Food	Constant and Trend	1	-1,410	-3,283	14,244
Clothing	Constant	1	0,613	-2,417	14,818
Housing	Constant and Trend	1	-0,305	-3,348	14,917
Furnishing	Constant and Trend	4	-0,765	-3,081	14,485
Health	Constant and Trend	1	-1,481	-3,348	12,834
Transport	Constant	1	0,987	-2,417	15,954
Communications	Constant	3	0,019	-2,325	12,776
Education	Constant	1	-0,268	-2,417	10,4336
Alcohol and Narcotics	Constant	1	-1,679	-2,417	12,012

Table 2A – DF-GLS Unit root tests – United Kingdom

VARIABLES	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-1,775	-3,50	20,896
Food	Constant	0	0,175	-2,93	16,478
Clothing	Constant	1	2,431	-2,93	15,778
Housing	Constant and Trend	0	-11,498	-3,50	17,383
Furnishing	Constant and Trend	1	-2,190	-3,50	16,505
Health	Constant and Trend	1	-2,757	-3,50	13,857
Transport	Constant and Trend	1	-2,430	-3,50	18,480
Communications	Constant	1	2,268	-2,93	14,519
Education	Constant and Trend	1	-1,990	-3,50	14,683
Alcohol and Narcotics	Constant and Trend	0	-6,119	-3,50	16,766

Table 3A – DF-GLS Unit root tests – Norway

VARIABLE	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-0,560	-3,485	18,056
Food	Constant and Trend	1	-1,527	-3,485	13,889
Clothing	Constant	1	-0,126	-2,485	14,060
Housing	Constant and Trend	2	-1,166	-3,485	14,255
Furnishing	Constant and Trend	1	-0,248	-3,485	13,937
Health	Constant	1	0,427	-2,485	12,529
Transport	Constant and Trend	1	-1,112	-3,485	16,714
Communications	Constant and Trend	1	-0,484	-3,485	14,381
Education	Constant	1	-0,445	-2,485	10,997
Alcohol and Narcotics	Constant	7	-0,271	-2,485	13,771

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