Cross Country Evidence on Consumption Persistence

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Abstract

The detection and measurement of the level of persistence on aggregate and disaggregate private consumption in Italy, Norway and United Kingdom are the main focus of the paper. Using a non-parametric methodology it is concluded that we cannot reject the presence of a significant degree of persistence in aggregate and disaggregate consumption in the three countries.

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. Given that cultural differences are not easily changed, a possible instrument is the interest rate.

Keywords: Consumption, Persistence, Italy, Norway, the United Kingdom.

JEL Classification: C14, C22, E21

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1. Introduction and Motivation

The recent world economic and financial crises are being mitigated by a massive fiscal countercyclical stimulus that mainly acts through private consumer spending. The economic rational is well known as well as the (macro) economic reasons why some countries are recovering faster and better than others. However, these (macro) economic relations are not the only ones (or even the most relevant) that determine households' consumption behavior, even in the present economic circumstances. The structure of preferences might be a factor and particularly if consumers have intertemporally dependent preferences then that may 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 act through consumption. Persistence can reduce the incidence, the length, and the severity of shocks and of changes of the economic conditions. Furthermore, measuring the response of consumption to a shock is also important because it may show at what time it is more essential to act in order to overcome a 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 1980's and only recently a factual interest in the phenomenon came about. The importance and the need to (theoretically and empirically) study the phenomenon are further strengthened by the current economic and financial crisis, where 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 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 (see, for instance, Taylor, 1980; Rotemberg & Woodford, 1997; Huang & Liu, 2002).[1] On the other hand, given the alleged inability of standard real business cycle models to reproduce the evolution of output shown in real world conditions (Cogley & Nason, 1995) the inertial hypothesis was also used to explain the (strong) persistence of output that could be observed in reality (see, among others, Bouakez & Kano, 2006; and Maury & Tripier, 2003). However, this response did not close the debate, in which the possibility of monetary policy shocks affecting aggregate output is central. Indeed the persistence of shocks on aggregate output has been, still is (and most probably will be for some time) one of the issues predominantly subject to examination.

For the empirical evidence that monetary policy shocks can have permanent effects on aggregate output (or unemployment) there have been proposed some theoretical explanations, notably imperfect information and short-run nominal price stickiness (see, for example, Kiley, 2000; and Wang & Wen, 2006). Furthermore, Jonsson (1997), Lockwood (1997) and Svensson (1997), analyzed the consequences for output or unemployment persistence due to the establishment of inflation contracts. 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 turn upside down the political business cycle which, in its typical form, is associated with depressions at the beginning of the mandate followed by pre-election inflationary expansions (see, for example, Gärtner, 1996,1999; as well as Caleiro, 2009). Quite recently, an increase of interest in analyzing the persistence of output, as well as of inflation, was registered considering its relationship with the degree of openness of the economies (Guender, 2006), the exchange-rate regime (Giugale & Korobow, 2000) or the structural change on the preferences of consumers, firms or policy-makers.

Despite the absence of microeconomic foundations for macroeconomic persistence, the literature on intertemporally dependent preferences is a well-built theoretical basis for inertial behaviour 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 & Heal (1973) and Constantinidies (1990) showed that when instantaneous

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

well-being is determined by both the current (the level effect) and past (the habit or persistence effect) level of consumption throughout a process of 'learning-by-consuming', the intertemporal dependent preferences might be a reason to cause a permanent cyclical behavior of consumption along its time path. This hypothesis, built upon the importance of habits, has also been tentatively used to explain the behaviour of the growth rate and of the savings rate during a recession (Carroll, 2000; Wendner, 2000). Moreover, Belbute & Brito (2008) show that the presence of the inertial effect can not only lower the long run equilibrium level of 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, the literature in the fields of psychology and marketing on the persistence of consumer, habits has gained relevance but, to the best of our knowledge, without exploring its relationship with persistence. Belbute & Caleiro (2009) may be viewed as a first step on the way to explain how the behavior of consumers in a country with specific psycho-social habits of consumptions may lead to persistence of consumption at an aggregate level.

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

Our paper extends the literature by measuring the degree of private consumption persistence using two different approaches depending on whether the corresponding time series have stationary or non-stationary behaviour. 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 by the standard time series analysis. By definition, when the time series has no-stationary behavior it does not revert to its mean and thus it does not exhibit inertial behavior. In this case we will measure persistence by using a non-parametric methodology proposed by Marques (2004) and Dias & Marques (2010). This new measure of persistence can be defined as the unconditional probability of a stationary stochastic process not crossing its mean in 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 statistical significant level of persistence of disaggregate private consumption of each country, although in some cases with

statistically differences between items within and among countries. Plainly, these results are imperative from a policy point of view. First of all, 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 paper 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 is occupied with the empirical results, put in confrontation with the expected results from the model in section 2. Section 6 concludes.

2. A model of consumption persistence

Let us consider a consumer that possesses an instantaneous utility function defined to be $U_t = ln(c_t)$, where c_t denotes the level of consumption on 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, which, if not spent, can be capitalized at an interest rate ρ. 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.[2]

For the moment let us apparently ignore the existence of persistence of consumption, being understood as the influence of last consumption, say γc_{t-1} on current consumption, c_t. The higher γ, the greater the influence of past consumption experiences over current level of consumption and thus the greater the degree of persistence. Under these circumstances, it is straightforward to show that the optimal levels of consumption will be given by

[2] Plainly, given the time horizon of the consumer, it makes no sense not to spend all the resources on the last period, therefore $a_3 = 0$, which means $c_2 = (1 + r)a_2$.

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

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

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

Plainly, this shows that the persistence of consumption is present and should be always considered. As a matter of fact, one can consider that the above problem can be restated in terms of the determination of the optimal level of persistence of consumption, γ, which is given by

$$\delta = \beta(1+r) \tag{4}$$

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

3. Persistence: definitions and methodological notes

Persistence can be broadly defined as the speed with which a variable, say, 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 the more inertial the slower it converges (or returns) to its previous level, after the occurrence of a stimulus. Persistence is, thus, inversely related with the concept of mean reversion.

The implication of this definition is that the degree of persistence can be associated with the speed with which consumption responds to a shock and with the length (permanent or temporary) of the shock effects. When the value is small, consumption responds quickly to a shock and tends to stay more time away from its trend. Conversely, when the value is high, the speed of adjustment by consumption is low and it will tend to return more quickly to its baseline.[3]

[3] Given that the persistence is a long-run effect of a shock or innovation, the concept is intimately linked to the impulse response function associated to autoregressive models which actually is not a useful measure of persistence given its infinite length.

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

Some authors have proposed to obtain those estimates by the use of *autoregressive models* as the estimates of persistence at time *t* will express how long we expect that a shock will take to die off (if ever), given their. A univariate AR(k) process is characterised 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*, as well as by a number of other factors, whose effect is captured by the random term $\varepsilon_{i,t}$. Alternatively, (5) can also be reparameterized as follows:

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

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 reparameterized 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

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

with

$$\mu = \frac{\alpha}{1-\rho} \tag{10}$$

being the "unconditional mean" of y_t series.

This formulation has the advantage of showing that persistence is related with to concept of "mean reversion," present in equation (8) or (9) by the term by $(\rho - 1)(y_{t-1} - \mu)$. As long as $(\rho - 1) < 0$ (or alternatively, $(\rho < 1)$)[4], any unit deviation from the mean in period t-1, $(y_{t-1} - \mu)$, will force the series in the next period to a (positive or negative) change in the subsequent period by the amount $(\rho - 1)$ and, thus, bringing it close to the mean[5]. Andrews & Chen (1994) proposed the "sum of the autoregressive coefficients" (7) as a measure of persistence.[6] 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 non-stationary) hypothesis (that is $\rho = 1$), random shocks have a permanent effect on the system. Therefore, fluctuations are not transitory, and there is no tendency of the system to return to a stable value.

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

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

$$\gamma = 1 - \frac{n}{T} \tag{11}$$

where *n* stands for the number of times the series crosses the mean during a time interval with *T* + 1 observations,[7] to measure the absence of mean reversion of 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, It measures how often the series does not revert to its mean and (high/low) persistence

[4] In this case the time series is said to be stationary or equivalently, it does not have an auto-regressive "unit root."
[5] By definition, a unit root process does not exhibit this property of mean reversion.
[6] Authors have, indeed, proposed other alternative measures of persistence, such as the largest autoregressive root, the spectrum at zero frequency, or the so called half-life. For a technical appraisal of these other measures see, for instance, Marques (2004) and Dias & Marques (2010).
[7] The ratio *n/T* gives the degree of mean reversion.

means that, after a shock, the series *reverts* to (or *crosses*) its mean more (seldom/frequently). To put it differently, the less a time series cuts its mean, the greater will be the degree of persistence and thus the higher the value of γ.

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

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

One possibility is to consider that 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 detrended time series to measure persistence as in (3). But, again, this method is only viable when time series is a trend-stationary process and residuals are a white noise process.

Using the alternative measure of persistence, γ, given by (11), also has advantages as 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[8].

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 non-stationary nature of data for persistence.

4.1 A brief description of data set

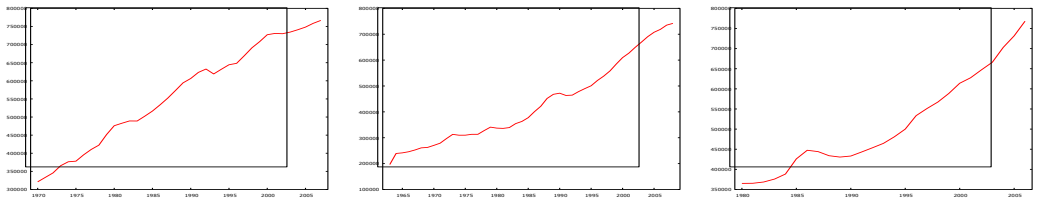
We use annual data for the period 1977 to 2003 for both aggregate and disaggregated private consumption for Italy (1970 to 2007), the United Kingdom (1963 to 2008) and Norway (1980 to 2006). Data for aggregate and disaggregate private consumption for each country were obtained

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

from Eurostat which classifies household consumption expenditure by consumption purpose according to the COICOP classification - Classification Of Individual Consumption by Purpose (see Commission Regulation 113/2002 of 23 January 2002). Aggregate private consumption is defined as the sum of private consumption for the twelve categories at two-digit level 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" includes "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 not possible to make any direct association between the two categories. In particular, it not possible to have a precise outlook about these four aggregate households expenses using the three-digit variables. This prevents us from measuring persistence of these four important categories of household expenses.

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



a) b) c)

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%

Clearly, "Food and non-alcoholic beverages" (Food, hereafter), "Furnishing, household equipment and routine maintenance of the house" (Furnishing, hereafter) 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 where 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 where 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 suggest 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).

One major problem with unit roots test is the implicit assumption that deterministic trend is well determined. But, as Perron (1989) 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 broken series. In our empirical analysis below we fully consider the possibility of both known and unknown structural breaks only for aggregate consumption for the three countries. The known break is 1992 for Italy and United Kingdom and is consistent with the decision of these two countries to leave the European Monetary System (EMS) in the summer of 1993[9]. For Norway the break point is 1994 and it is consistent with the moment when the European Economic Area (EEA) came into effect[10]. We used the Chow (1966) test to confirm this dates as a structural break. For all cases we followed the Perron (1989)'s strategies to test the null hypothesis that the

[9] Because these sample periods include years before and after integration the European Economic Community and the Euro Zone we also considered a possible structural break in 1973 for the United Kingdom (integration in EEC) and 1999 for Italy (entrance into the Euro Zone). The Chow test did not confirm these dates as candidates to be structural breaks.

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

time series have a unit root with a possibly nonzero constant against the alternative that the process is "trend-stationary."

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

Country	Break Point	Method	Lag	ρ	$t_{\rho e}$	ADF_t (5%)
Italy	1992	Perron (1989)- Model B	2	0,728	6,996	-3,950
The United Kingdom	1992	Perron (1989)- Model C	1	0,784	10,750	4,080
Norway	1994	Perron (1989)- Model C	0	0,688	4,359	-4,240

We find evidence for trend-stationarity 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 in the trend (model C - "crash and growth model") for the United kingdom and Norway (see Table 2). In these cases conventional parametric tests are adequate for testing and measure persistence.

5. The level of persistence of the private consumption

This section measures the level of persistence of aggregate and disaggregate private consumption for Italy, the United Kingdom and Norway. A simple visual inspection of the graphs of all time series sample suggests that the measurement of the level of persistence should be performed under 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 the aggregate and disaggregate private consumption is measured using the non-parametric strategy statistic (7) proposed by Marques (2004) and Dias & Marques (2010). To that purpose we will use the residuals of the regressions of models B and C Table 2 and the cyclical component extracted with the Hodrick-Prescott filter. In both cases we compute the overall period and corresponding sub-periods degree of persistence and perform simples test 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 aggregate private consumption of each country and for the overall sample period, the identified sub-periods and

only for the stationary cases. The sum of the auto-regressive coefficients $\hat{\rho}$ is estimated by the following regression.

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

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

Results are presented in Table 3 and suggest a high degree of persistence of private aggregate consumption for the three countries given that one could not reject for each one the null hypothesis of equal persistence for a test of 5%. Lags are included in order to account for serial correlation and t-statistics are heteroscedastic consistent for the persistence coefficient.

Table 3 – Testing change of 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

In order to test the possibility of as change of persistence in the two sub-periods we estimated the following model proposed by Marques (2004)

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

where D_t is a dummy variable which 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 of persistence between the two periods. As heteroscedasticity across sub-periods might be a problem (even though not within sub-periods), the corresponding t-statistics for this parameter in the Table 4 were computed using heteroscedastic consistent standard errors.

Table 4 – Test for a change in persistence

Country	Break Points	Method	*Lags*	$t_{\rho 2}$	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

To summarize, the estimation of the autoregressive coefficients suggest a statistically significant evidence of a strong degree of persistence in the three countries. An exogenous and random shock basically will 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 factor and/or the interest. Results also suggest that there was 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 in order to measure the degree of persistence. We begin by using the innovations from the Perron's crash and growth model. Our results are presented in Table 5 and confirm the presence of a strong level of persistence in the United Kingdom, Italy and although more tenuous, in Norway. The null hypothesis of equal persistence could not be rejected when comparing the level of persistence between Norway and the United Kingdom for a test of 5% and between Norway and Italy for a test of 10%.

Table 5 - Measuring persistence in Aggregate Private Consumption: Non-parametric 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 +

* Stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence) for a test of 5%
+ Stands for rejection of the null of equal persistence between the two sub-periods for a test of 5%

This means that a policy innovation or a random shock that affects household expenditures will tend to have more permanent effects in United Kingdom and Italy than in Norway. Moreover,

these shocks will tend to displace private consumption more quickly from its trend in Norway than in the outer countries. In the context of the current fiscal stimuli that are being implemented to tackle the economic crisis, our results suggest that Norwegian private consumption will reverse more quickly to its long-run trend than what one should 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.

On the other hand, we also tested the null hypothesis of change in persistence between the the sub-periods using the strategy proposed by Dias and Marques (2010) by estimating 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 which is 0 $t \leq T_B$ and 1 otherwise. From (14) we can write that $\alpha_1 = 1 - \gamma_1$ and $\alpha_2 = \gamma_1 + \gamma_2$ are the measures for the first and second sub-period, respectively. Therefore, testing the change of persistence amounts to test if α_2 is significantly different from zero.

Our results do not suggest that aggregate consumption has recently changed it level of persistence in Italy and United Kingdom. However, for the Norway, one could reject the null of equal persistence between the two sub-periods. Clearly, Norwegian aggregate private consumption became less persistent after 1994.

This change of the inertial behaviour of aggregate consumption might be due to a change in preferences resulting in a strengthening of consumers' habits. Consumers with stronger habits tend to respond more slowly to a stimulus and thus are more reluctant to change their consumption pattern to a more green economic behaviour, for example. Moreover, as the model in section 2 shows, changes in the households' discount factor as well as in the interest rate 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 if particularly relevant for durables.

The literature also points out that different combinations between habits (harmful/beneficial, addition/not-addiction and addictive/multiplicative) and risk aversion (strong/weak) conditions,[11] may change the consumer willingness to substitute present for future consumption and thus the steady state capital intensity, saving rate and the economic growth rate. In particular, under certain circumstances (see Belbute & Brito, 2008) the stronger habits are the less consumers are

[11] See, for example, Wendner (2003).

willing to postpone their consumption and the grater the impact of inertia over the steady-state capital intensity. Furthermore, given the links among habits, persistence, saving and economic growth (see Shieh et al., 2000; Carrol et al., 1997,2000; Lahiri & Puhakka, 1998; and Wendner, 2002, the presence of persistence in private consumption not only affects the saving and growth rates but also might help to explain the strong evidence that economic growth significantly precedes an increase in saving.

Let us now turn to the case where we measure persistence from the cyclical component extracted from the time series with the HP-Filter and consider first the aggregate private consumption for the three countries presented at 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_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	0,783 *	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: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence) for a test of 5%

\+ The null of equal persistence between the two sub-periods is rejected for a test of 5%

The use of the HP-Filter confirms the presence of a significantly high degree of persistence of aggregate consumption for each country, but as opposed to the previous case, with no statistically significant differences among them. Moreover, results also suggest that British consumers became more reluctant in changing their consumer patterns after the break (persistence increased after 1992). Recall that during the process of ratification of the Maastricht Treaty (formally, the Treaty on European Union, TEU), the speculation caused by the negative result of the first Danish referendum (June 1992) and the uncertainty surrounding the French referendum (September 1992) gave rise to a speculative turbulence in currency markets, forcing Italian and British authorities to withdraw their currencies from the European Exchange Rate Mechanism European in September 16, 1992.[12] For Norway the change of the degree of inertia between the sub-periods is neither clear nor statistically significant.

[12] The "black Wednesday" and the subsequent speculative attacks that followed until the mid of 1993 where only the results of a series of event catalyzed by the reunification of Germany in 1990. The event was unprecedented in history for the merging of a large and rich economy with a smaller economy with a much lower standard of living.

5.3 Persistence of Disaggregate Private Consumption: the HP-Filter case

Having established that aggregate private consumption has a significant degree of inertia for the three countries and in order to assess the potential for the design of optimal public policies, it is important to measure persistence of the various categories of household expenses. In fact, the aggregate measure of persistence hide a wide diversity of the degree of inertia between the categories of consumers' spending. This is a predictable result given that the discount factor, i.e. the concern about the future, was shown to be relevant for the optimal degree of consumption persistence, it being obvious that different types of consumption goods have different durabilities.

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

* stands for the rejection of the null of = 0,5 (absence of persistence) for a test of 5%

\+ Stands for the rejection of the null of equal persistence between the two sub-periods for a test of 5%

Consider first the case of Italy (Table 7) and note that expenses with transportation are the most persistent (0,816) whereas housing expenses exhibit the lower degree of inertia (0,605). However, for the overall period, the null of equal persistence could only be rejected for a test of 5% when we compare housing with transportation and with alcohol & drugs. This result is inconsistent with what we would expect since housing mainly includes services, non-durables and semi-durables items while transport is primarily comprised by of durables goods. Moreover, there is no statistically significant evidence of change in persistence before and after the break for all nine items of private consumption.

In what the United Kingdom is concerned, although results show a wide range of inertia degree across the nine categories, the null hypothesis could only be rejected for a test of 5% for equal persistence between furnishing (0,652) and clothing & shoes (0,804).

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 & Narcotics	1992	0,739 *	0,065	0,733 *	0,082	-0,017	0,139	

* stands for the rejection of the null of = 0,5 (absence of persistence) for a test of 5%

\+ Stands for the rejection of the null of equal persistence between the two sub-periods for a test of 5%

When we consider the sub-periods, results show that it is not possible to reject the null hypothesis of absence of persistence for furnishings. Before the break, education is the item with the higher level of persistence but only statistically different from that of furnishing and of communication. Moreover, the "dynamic" of persistence between sub-periods suggests that for two categories of household expenses (education and communication), there was a clear change of the degree of persistence. In particular, education became less persistent whereas communications turn out to be more persistent.

Finally, the case of Norway confirms the presence of high degree of persistence among seven of the nine categories of household's expenses and with no statistically evidence of differences among them. The null of the absence of a significant degree of persistence could not be rejected for education and alcohol & drugs items, for a test of 5%. Moreover, the results also suggest that it was not possible to reject the null hypothesis of equal persistence before and after the break for three items: clothing, education and alcohol & drugs. In particular, clothing has become more inertial after 1994. Conversely, education and alcohol & drugs turned out to reduce their degree of persistence which means that the effects from random shocks affecting these items became more temporary after the break than 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 & Narcotics	1994	0,630	0,093	0,800 *	0,119	0,383	0,179 +

* stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence) for a test of 5%
+ Stands for the rejection of the null of equal persistence between the two sub-periods for a test of 5%

Finally, when we compare the level of persistence of each items across the three countries we find that housing is statistical significantly more persistent in Norway (0,778) than in Italy (0,605), for a test of 5%. This means that all thinks equal, the same policy shock would have more long-lasting effects in Norwegian housing expenses than in Italy. Conversely, Norwegian private expenses in alcohol & drugs (0,630) are statistically less inertial than their Italian equivalent (0,789), for the same 5% test. Therefore, all thinks equal, the same policy would have more temporary effects over alcohol & drugs private expenses 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 with education where find to be more persistent than the corresponding Norwegian expenses, for a test of 10%.

6. Conclusion

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

Our results show that we cannot reject the presence of a significant process of persistence in aggregate consumption of the three countries and the null hypothesis of equal level or persistence could only be rejected when comparing the United Kingdom and Norway, for a test of 5%. The fact that this result has only been confirmed by one of the three modes used in this paper can be explained by 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 as, for instance, those presented in the model of optimal consumption in Section 2. It being the case that negligible differences in the interest rates between the three countries exist, those results agree with different cultural aspects such as the time horizon of consumers.

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

Plainly, these results are imperative from a policy point of view. First of all, 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. Since cultural differences are not easily changed, a possible instrument is the interest rate. Our results do show that a decrease in the interest rates, in order to boost investment, may also lead to undesirables results from the viewpoint of consumption, in particular for the durables categories

In terms of future work, it is our intention to consider other countries allowing for the accounting of other characteristics that make them different. Since it is obviously difficult to measure the discount factor, a promising avenue seems to include aspects related to the interest rate as well as to 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 for only for few cases. This may be due to the use of annual data which only allow us to capture long term effects. However, households might react differently in the short term to changes in policy or to exogenous and random shocks. For that reason, evaluating the persistence of aggregate and disaggregate private consumption using quarterly or monthly data is a natural extension of our work.

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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