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# Consumption and Wealth in the US, the UK and the Euro Area: A Nonlinear Investigation

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**Abstract**

This paper assesses the importance of nonlinearity in estimating the wealth effects on consumption for the US, the UK and the Euro area. We look at the impact of both (i) aggregate wealth and (ii) disaggregate wealth, namely, by comparing financial wealth effects with housing wealth effects. We also assess the magnitude of the response of consumption using both a linear model and two nonlinear approaches (a quantile regression and a smooth transition regression). We find that the elasticity of consumption with respect to aggregate wealth is largest for the UK and housing wealth effects do not seem to be relevant in the Euro area. As for the quantile regression, it shows that the sensitivity of consumption with respect to wealth and income variation is larger when consumption growth is abnormally high, i.e. during periods of economic booms. The smooth transition regression model is able to track reasonably well the consumption patterns during periods of economic downturn, financial instability and housing market corrections. Our approaches uncover a more complex dynamics of the relationship between consumption and wealth than previous results in the literature, whilst being in accordance with the theoretical background underlying the wealth effects on consumption.

Keywords: consumption, wealth, dynamic OLS, quantile regression, smooth transition.
JEL classification: E21, E44, D12.

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## 1. Introduction

The relationship between wealth and the macroeconomy can be assessed via four major channels: (i) the (wealth) effect on consumption; (ii) the Q effect on investment; (iii) the credit channel; and (iv) the confidence effect on private spending. In this paper, we focus on the first channel, i.e. we look at the importance of wealth effects on consumption.

The interest on the topic has recently revived as a consequence of the financial turmoil. Not surprisingly, numerous academics, central banks and governments have started to question the potential macroeconomic implications of a downturn in house and equity prices and the role that economic policy might play (Barnett, 2008; Rafiq and Mallick, 2008; Arghyrou, 2009; Barnett et al., 2009a, 2009b; Granville and Mallick, 2009; Mallick and Moshin, 2010; Arghyrou and Tsoukalas, 2011; Barnett and Chauvet, 2011).

Although most of the empirical evidence refers to advanced economies and the U.S. (mainly, due to the data availability), the existing literature on the impact of asset wealth fluctuations in the UK and the Euro area is scarce or inexistent, despite their importance as key engines of growth in the developed world. Moreover, the works in this field have typically made use of linear estimation methods.

However, given the nature of the variables and the complexity of economic systems, it is likely that those adjustments occur in different ways, depending on the state of economy, and, in particular, on the evolution of wealth. In fact, asset wealth displays a more volatile behavior than consumption or labor income, a feature that is clearly linked with the state of asset markets.[1] Furthermore, wealth evolves over time and its changes may be asymmetric, as they are likely to depend on the business cycle.[2] Consequently, the relationship between consumption and wealth may also be time-varying.

Surprisingly and despite the usefulness of switching models, only a few authors have pointed to evidence of asymmetry, nonlinearity and persistence in the dynamics of consumption, highlighting that the persistence of consumption growth is typically due to the time that households require to revise their decisions and asymmetry is attributed to the fact that the response of consumption depends on the business cycle (Mignon and

[1] Sousa (2012a) shows that the ratio of housing wealth to human wealth predicts not only stock returns, but also government bond yields.

[2] Sousa (2012b) finds that housing can be used as a hedge against unfavorable wealth shocks.

Dufrénot, 2004; Jawadi, 2008; Jawadi and Leoni, 2012).[3] Our work aims at filling this gap.

The main goal of this paper is, therefore, to measure the wealth effects on consumption for the US, the UK, and the Euro area as a whole. The relationship between consumption and wealth is particularly relevant given the strong effects induced by variation in wealth, as the most recent financial turmoil and subsequent economic downturn document.

In order to adequately assess such effects and relationships, we propose looking at these questions with the lenses of three econometric methodologies: 1) a linear model; 2) a nonlinear approach relying on a quantile regression; and 3) a nonlinear framework based on a smooth transition regression. In this way, while the first specification checks for the natural relationship between consumption and wealth as in previous studies, the second and third modelling procedures provide an extension to the nonlinear context. Interestingly, the quantile approach is suitable to account for nonlinearities in the relationship among consumption, wealth and income and provides a better explanation for the wealth effects on consumption and, hence, the fluctuations in the consumption-wealth ratio. As for the switching model, it has the advantage of accounting for asymmetry, different regimes and structural breaks in such relationship.

Furthermore, we adopt a "disaggregate" approach, in the sense that we estimate the importance of wealth composition. Therefore, the paper provides the first comprehensive and exhaustive nonlinear description of the effects on consumption of aggregate wealth and its major components (i.e. financial wealth and housing wealth) for the US, the UK and euro area.

The linear model suggests that the elasticities of consumption with respect to aggregate wealth are quite similar, the largest being the UK (0.17). This confirms our suggestion regarding the strong linkage between consumption and wealth. Moreover, the disaggregation between asset wealth and labour income is statistically significant for all countries, thereby, indicating that wealth effects on consumption are relevant. Indeed, when we look at the decomposition of asset wealth into its major components (i.e. financial and housing wealth), we can see that it is statistically significant (with the exception of the euro area, where housing wealth effects do not seem to be important).

[3] A different argument can be found in Chattopadhyay and Mallick (2007), who show that when income follows a log-normal distribution, an increase in mean income leads to a reduction in poverty, while an increase in the variance of the income raises poverty.

Therefore, consumption reacts differently by category of asset wealth. Moreover, consumption is broadly more sensitive to changes in financial wealth than to changes in housing wealth, as the elasticities of consumption with respect to financial wealth are generally larger in magnitude.

The quantile regression shows that the relationship between consumption, wealth and income is particularly strong during periods of economic booms. In fact, the elasticities to consumption out of wealth and income are larger at the highest tail of the distribution of consumption growth, that is, when consumption growth is abnormally high. This is especially the case of the US and the euro area. As for the UK, the results are generally weaker in terms of supporting a significant variation of the sensitivity of consumption to wealth and income developments across the different quantiles.

Regarding the STR model, we find that it is able to capture well the nonlinearity of the response of consumption with respect to wealth, in particular, during periods of economic downturn, financial instability and housing market corrections. As a result, it provides a richer characterization of the complex dynamics of the relationship between consumption and wealth that linear frameworks used in previous works are not able to capture.

The rest of the paper is organized as follows. Section 2 presents the econometric methodology and Section 3 describes the data and discusses the main empirical results. Section 4 concludes.

## 2. Econometric Methodology

2.1 The linear model

The trend relationship among consumption, asset wealth and labor income is typically estimated in accordance with Davidson and Hendry (1981) and Blinder and Deaton (1985). Following Stock and Watson (1993), we make use of a dynamic ordinary least squares (DOLS) technique, specifying the following equation

$$\log C_t = \mu + \beta_w \log W_t + \beta_y \log Y_t + \eta_t, \tag{1}$$

where $\eta_t = \sum_{i=-k}^{k} b_{w,i} \Delta \log W_{t-i} + \sum_{i=-k}^{k} b_{y,i} \Delta \log Y_{t-i} + \varepsilon_t$, $C_t$ stands for consumption, $W_t$ for asset wealth, and $Y_t$ for labor income, $\Delta$ denotes the first difference operator, $\mu$ is a constant, and $\varepsilon_t$ is the error term. The parameters of interest, $\beta_w$ and $\beta_y$, represent, respectively, the elasticities of consumption with respect to asset wealth and labor income, and give the percentage response of consumption to one percentage point change in asset wealth and labor income.

It is also important to note that since the impact of different assets' categories on consumption can vary (Poterba and Samwick, 1995; Sousa, 2010a), we can disaggregate wealth into its main components: financial wealth and housing wealth. This is particularly relevant, as it enables to identify the response of consumption to different types of assets and infer about the potential implications for the real economy of episodes such as a housing price bust or a financial crisis effects on consumer's behavior. Using the DOLS technique, we can specify the following equation:

$$\log C_t = \mu + \beta_{fw} \log FW_t + \beta_{hw} \log HW_t + \beta_y \log Y_t + \eta_t, \quad (2)$$

where $\eta_t = \sum_{i=-k}^{k} b_{fw,i} \Delta \log FW_{t-i} + \sum_{i=-k}^{k} b_{hw,i} \Delta \log HW_{t-i} + \sum_{i=-k}^{k} b_{y,i} \Delta \log Y_{t-i} + \varepsilon_t$, $FW_t$ stands for financial wealth, and $HW_t$ for housing wealth. However, this specification assumes that the relationship between consumption, income and wealth is linear and symmetric. Such hypothesis is rather restrictive, because consumers might adjust their behaviour in a different manner depending on the state of the business cycle, the dynamics of the financial markets or the behaviour of the housing sector. Consequently, consumption may response to changes in wealth in nonlinear way and, to investigate this issue, we use two approaches: the quantile regression and the switching models.

## 2.2 The quantile regression approach

To assess nonlinearities in the relationship between consumption, wealth and income, we propose to use a quantile regression (Koenker and Hallock, 2001). The rationale for this can explained by the fact that the distribution of consumption level can be characterised by the several quantiles.

We focus on the usefulness of quantile regressions that allow probability intervals to be constructed and, then, used to assess whether a particular consumption level is unusually low or high. Such figures can be associated with extreme levels of asset wealth or labour income.

An advantage of the quantile regression technique consists in relating the quantiles with explanatory variables that can help improving our understanding about the wealth and income effects on consumption. In addition, the technique is able to deal well with distribution asymmetries or deviations from normality.

The typical model aimed at explaining consumption would be of the form:

$$C_t = \Phi_1 W_t + \Phi_2 Y_t + \varepsilon_t, \quad (3)$$

where $\Phi_1 W_t + \Phi_2 Y_t$ is the conditional mean of the level of consumption and $\varepsilon_t$ is the error term.

The above equation can be estimated with ordinary least squares (OLS), thereby, providing mean estimates of the relation between the economic content of $W_t$ and $Y_t$ and $C_t$.

In practice, we estimate the quantiles of the whole conditional distribution of the consumption level. So for each quantile, we will have an equation for the conditional quantile of consumption, denoted by $q_\alpha(C_t \mid I_t)$, where $I_t$ contains information known at time t:

$$q_\alpha(C_t \mid I_t) = \Phi_{1\alpha} W_t + \Phi_{2\alpha} Y_t + u_t, \qquad \alpha \in (0,1). \quad (4)$$

Equation (4) is more general than the OLS approach, in the sense that it is less restrictive as the slope coefficients $\Phi_{1,\alpha}$ and $\Phi_{2,\alpha}$ can vary by quantiles. Thus, the model can be used to estimate a time-varying distribution of consumption.

Note that if the effect of explanatory variables on consumption arises through capturing particular states of extreme variation in wealth or income, we would expect to find the largest impact of such variables in the tails of the consumption distribution. Economic theory suggests that if we consider such variables, we should expect them to have a large coefficient in the quantile regression sufficiently close to the left and right tail (very small or very large $\alpha$ values) and a small coefficient close to the center (the median).

Following Koenker and Bassett (1978) and Koenker and d'Orey (1987, 1994), the parameters of the quantile prediction model are estimated by replacing the conventional quadratic loss function with the so-called `tick' loss function:

$$L_\alpha(e_{t+1}) = (\alpha - 1\{e_{t+1} < 0\}) e_{t+1}, \quad (5)$$

where $e_t = C_t \hat{q}_{\alpha,t}$ is the forecast error, $\hat{q}_{\alpha,t} = q_\alpha(C_t \mid \Im_t)$ denotes the conditional quantile forecast computed at time t, and $\mathbf{1}\{\cdot\}$ is the indicator function.

Confidence intervals are computed based on inversion of a rank test described in Koenker (2004). The first order condition associated with minimizing the expected value of (10) with respect to the forecast, $\hat{q}_{\alpha,t}$, is the $\alpha$-quantile of the consumption distribution (Koenker, 2005), implying that the optimal forecast is the conditional quantile $\hat{q}_{\alpha,t} = F_{\varepsilon}^{-1}(\alpha)$, where $F_t$ is the conditional distribution function of consumption.

## 2.3 The smooth transition regression model

While the quantile approach accounts for nonlinearity without specifying its type, the smooth transition regression (STR) model has the advantage of testing for a specific nonlinearity associated with switching regimes in consumption dynamics. That is, we allow the regression coefficients of the relationship between consumption, wealth and income to change smoothly from one regime to another, and, therefore, this provides a better structural framework for analysing the behaviour of consumption.

A standard STR model for a nonlinear consumption function can be defined as follows:[4]

$$\log C_t = \psi' z_t + \omega' z_t G(\eta, c, s_t) + \varepsilon_t, \qquad t = 1,...,T \tag{6}$$

where $z_t = (1, \log C_{t-1},..., \log C_{t-n}; \log Y_t, \log W_t; x_{1,t},..., x_{m,t})'$ is the vector of the explanatory variables and h=n+2+m. The parameters $\psi = (\psi_0, \psi_1,..., \psi_h)'$ and $\omega = (\omega_0, \omega_1,..., \omega_h)'$ denote ((h+1)×1) parameter vectors in the linear and nonlinear parts of the model, respectively. The error term is assumed to be independent and identically distributed with zero mean and constant variance, $\varepsilon_t \sim \text{iid}(0, \sigma^2)$. The transition function, $G(\eta,c,s_t)$, is continuous and bounded between zero and one in the transition variable, $s_t$. This can be an element or a linear combination of $z_t$ or even a deterministic trend or the lag of the endogenous variable. The slope parameter $\eta$ indicates the smoothness of the transition between regimes, and the location parameter c determines where the transition occurs.

The transition function can be defined in several ways. For instance, one may consider a logistic STR model (also known as LSTR1 model), where the transition-function is assumed to be a logistic function of order one:

$$G(\eta, c, s_t) = [1 + \exp\{-\eta(s_t - c)\}]^{-1}, \qquad \eta > 0. \tag{7}$$

Accordingly, the STR model is equivalent to a linear model with stochastically time-varying coefficients and can be rewritten as:

[4] For further details on the STR model, see Granger and Teräsvirta (1993) and Teräsvirta (1998).

$$\log C_t = [\psi' + \omega' G(\eta, c, s_t)] z_t + \varepsilon_t \Leftrightarrow i_t = \zeta' z_t + \varepsilon_t, \quad t = 1,...,T. \tag{8}$$

Given the properties of $G(\eta,c,s_t)$, the combined parameters, $\zeta$, will fluctuate between $\psi$ and $\psi+\omega$ and change monotonically as a function of $s_t$. The more the transition variable moves beyond the threshold, the closer $G(\eta,c,s_t)$ will be to one, and the closer the parameters $\zeta$ will be to $\psi+\omega$; similarly, the further $s_t$ approaches the threshold, c, the closer the transition function will be close to zero and the closer the parameters $\zeta$ will be to $\psi$.

As in practice a monotonic transition may not be a satisfactory alternative, one can also use the quadratic logistic STR model (or LSTR2 model):

$$G(\eta, c, s_t) = [1 + \exp\{-\eta(s_t - c_1)(s_t - c_2)\}]^{-1}, \tag{9}$$

where $\eta>0$, $c=\{c_1,c_2\}$ and $c_1 \geq c_2$. This transition function is symmetric about $(c_1+c_2)/2$ and asymmetric otherwise, and the model becomes linear when $\eta \rightarrow 0$. If $\eta \rightarrow \infty$ and $c_1 \neq c_2$, $G(\eta,c,s_t)$ becomes equal to zero for $c_1 \leq s_t \leq c_2$ and equal to 1 for other values; and when $s_t \rightarrow \pm\infty$, $G(\eta,c,s_t) \rightarrow 1$.

Finally, we also consider the case of the exponential STR model (ESTR model) for which the transition function is exponentional, and corresponds to:

$$G(\eta, c, s_t) = 1 - \exp\{-\eta(s_t - c))^2 \qquad \eta > 0, \tag{10}$$

This specification also corresponds to the particular case of the LSTR2 model where $c_1=c_2$. Therefore, the transition function is symmetric.

## 3. Data and Empirical Results

3.1 Data

We use quarterly data for the US, the UK, and the euro area, for the periods 1947:1-2008:4, 1963:1-2008:1 and 1980:1-2008:1, respectively.

All variables are measured at constant prices and expressed in the logarithmic form of per capita terms.

Consumption corresponds to the expenditure in nondurable consumption goods and services excluding clothing and shoes (US), consumption excluding durable and semi-durable goods (UK), and private consumption (euro area). Aggregate wealth is the defined as the sum of net financial wealth and net housing wealth. Data on wealth are lagged once, so that it corresponds to beginning-of-the-period values. Income only includes after-tax labour income.

For the US, the data comes from the Bureau of Economic Analysis, the U.S. Department of Commerce and the Flow of Funds Accounts from the Board of Governors of Federal Reserve System. For the UK, the main data sources are the Office for National Statistics (ONS), the Halifax plc, the Nationwide Building Society and the Office of the Deputy Prime Minister. For the Euro area, the data is provided by the European Central Bank (ECB). Euro area aggregates are calculated as weighted average of euro-11 before 1999. As for the period after 1999, they are defined as the break-corrected series that cover the real-time composition of the Euro area.

### 3.2 The linear model

First, we use the Augmented Dickey and Fuller (1979) and the Phillips and Perron (1988) tests to investigate the stationarity for time series under consideration. Second, we assess the cointegration among the series by using the methodology of Engle and Granger (1987) and Johansen (1991). Finally, we estimate the relationship among consumption, wealth (and its main components, financial and housing wealth) and labour income by following the works of Davidson and Hendry (1981) and Blinder and Deaton (1985).

Table 1 shows the estimates (ignoring coefficient estimates on the first differences) for the shared trend among consumption, asset wealth, W, and income, Y. It can be seen that the elasticities of consumption with respect to aggregate wealth are quite similar, the largest being the UK (0.17). Moreover, the disaggregation between asset wealth and labour income is statistically significant for all countries. The table also presents the unit root tests to the residuals of the cointegration relationship based on the methodologies of Engle and Granger (1987) and Johansen (1991) and shows that they are stationary (one can reject the null of a unit root).

[INSERT TABLE 1 HERE]

Table 2 reports the estimates of the elasticities of consumption with respect to financial wealth, FW, housing wealth, HW, and labour income, Y. First, it shows that the disaggregation between financial and housing wealth is statistically significant (with the exception of the Euro area, where housing wealth effects do not seem to be important in reflection of relatively stable dynamics of this component of wealth and the important of the rental market), therefore, giving rise to the idea that consumption reacts differently by category of asset wealth. Moreover, consumption is broadly more sensitive to changes in financial wealth than to changes in housing wealth, as the elasticities of consumption with respect to financial wealth are in general larger in magnitude. Finally, the cointegration tests suggest that the residuals of the cointegration relationship among consumption, financial wealth, housing wealth and labour income are stationary.

[INSERT TABLE 2 HERE]

However, it is important to note that that the relationship between consumption and wealth may vary over time and, thus, wealth effects on consumption can be asymmetric. In order to capture such nonlinearities, we consider two approaches: the quantile regression and the STR model.

### 3.3 The quantile regression approach

If the effect of wealth and income on the distribution of consumption is particularly important at capturing specific states of extreme variation, then: (i) a large coefficient (in magnitude) is expected when consumption is sufficiently close to the tails of the distribution (i.e. for very small or very large $\alpha$ values); and (ii) a small coefficient should be observed when investment growth is close to the median.

In Figures 1 and 2: (a) for each coefficient, the dotted line shows the quantile regression estimates for quantiles ranging from 0.10 to 0.90; (b) the red solid line represents the OLS coefficient; (c) the two red dashed lines depict conventional 90 percent confidence intervals for the OLS coefficient; and (d) the shaded grey area plots a 90 percent pointwise confidence band for the quantile regression estimates.

Figures 1 and 2 present the evidence for the US. When we consider aggregate wealth (Figure 1), the results suggest that the elasticity of consumption with respect to labour income tends to be larger at the left tail of the distribution, although there is a substantial amount of uncertainty. In contrast, Figure 2 shows the there is a nonlinear relationship between the two components of wealth (i.e. financial and housing wealth) and labour income. In particular, while consumption tends to be more sensitive to financial wealth during periods of high consumption growth, it is generally less responsive to changes in housing wealth.

[INSERT FIGURE 1 HERE]

[INSERT FIGURE 2 HERE]

Table 3 presents the coefficients associated with asset wealth (and its main components) and labour income in the OLS and the quantile regressions. It suggests that the elasticities of consumption with respect to financial wealth and housing wealth are larger at the highest tail of the distribution (0.28 and 0.16, respectively) than at the lowest tail of the distribution (0.09 and 0.01, respectively). Consequently, these components of wealth seem to be more relevant for the dynamics of consumption during periods of economic booms. In the case of the OLS estimates, they are similar to the median quantile estimates and, therefore, do not track well periods of extreme variation in consumption.

[INSERT TABLE 3 HERE]

Figures 3 and 4 display the results for the UK. In general, the quantile regression approach does not improve the predictability of consumption vis-a-vis the OLS regression. In fact, the error bands associated with the quantile estimates typically overlap the ones associated with the OLS and, consequently, the existing evidence does not seem to support a nonlinear relationship between consumption, wealth and income.

[INSERT FIGURE 3 HERE]

[INSERT FIGURE 4 HERE]

Table 4 summarizes the coefficients associated with asset wealth (and its main components) and labour income in the OLS and the quantile regressions. We find that the elasticity of consumption with respect to aggregate wealth is larger at the highest quantiles (0.21) than at the lowest quantiles (0.13). As a result, consumption becomes more responsive to wealth changes during economic booms.

[INSERT TABLE 4 HERE]

Finally, Figures 5 and 6 summarize the evidence for the Euro area as a whole with regard to the OLS and quantile regressions, where the consumption is explained by asset wealth (or its major components) and labour income. Both the OLS and quantile estimates (and their confidence bands) lie well above the zero line, suggesting that an increase in wealth or labour income has a positive effect on consumption. Interestingly, Figure 5 shows that while the impact of asset wealth tends to be larger at the left tail of the distribution of consumption, the effect of labour income is smaller. This may be also due to the fact that labour income is typically less volatile than asset wealth. Putting it differently, when the level of consumption is very low, consumption is highly sensitive to changes in wealth, but the responsiveness to changes in labour income is smaller. Additionally, the quantile regressions show that, despite the amount of uncertainty regarding the estimates, the size of the coefficient associated to wealth is largely different from the mean response at quantiles below 0.25.

[INSERT FIGURE 5 HERE]

As for Figure 6, it can be seen that financial wealth and housing wealth effects on consumption are typically larger at the lowest quantiles of the consumption distribution, highlighting that these components of wealth play a major role during consumption slumps.

[INSERT FIGURE 6 HERE]

To have an idea of the order of magnitude, Table 5 shows the coefficients associated with asset wealth (and its main components) and labour income in the OLS and the quantile regressions. It can be seen that while the elasticity of consumption with respect to aggregate wealth is 0.04 at the lowest tail of the distribution (quantile 0.025), it rises to 0.10 at the highest tail of the distribution (quantile 0.975). Therefore, aggregate wealth is especially relevant at capturing the dynamics of the highest quantiles of consumption. As for the OLS estimates, they are generally close to those that link the median response of consumption to a given change in asset wealth or labour income. In light of the differences in magnitude observed across different quantiles, this implies that the OLS regressions are not able to capture periods of extreme variation in consumption.

[INSERT TABLE 5 HERE]

### 3.4 The smooth transition regression model

We move now to the STR modelling in order to explicitly check for nonlinearity and switching regimes in the dynamics of consumption. We carry out a three-step procedure. First, we implement the linearity tests of Lukkonen et al. (1988). Second, we select the suitable transition function between consumption regimes. Finally, we estimate the STR model by the Nonlinear Least Squares (NLS).

#### 3.4.1 Specification tests

In line with the habit-formation model, we estimate the effect of past consumption on current consumption. Therefore, we use information criteria and autocorrelation functions to specify linear models and determinate the optimal lag number, p. According to our results, $p = 1$ for the US and the UK and $p = 3$ for the euro area. The linearity tests have been carried out for several transition variables and the optimal variable is the one that minimizes the p-value. We report the results of in Table 6.

[INSERT TABLE 6 HERE]

Then, we check for threshold breaks using the Hansen (1996) test. This test assesses the null hypothesis of "no threshold" against its alternative of "a threshold" and is based on a bootstrap technique. The results do not reject the hypothesis of a threshold break for the US at 5% significance level and for the Euro area at 10% significance level.

We also evaluate the importance of nonlinearity via the Tsay (1996) test and the Teräsvirta (1994) LM test, that is, we test linearity versus an alternative of LSTR or ESTR. According to Tsay (1996) test, linearity is strongly rejected against the STAR specification for the three countries under analysis. While these two tests do not explicitly specify the alternative nonlinear model when linearity is rejected, the Teräsvirta (1994) test provides evidence of nonlinearity and indicates the appropriate transition function. Accordingly, the ESTR model seems to fit well the dynamics of consumption in the case of the US, while the exponential transition functions seem to be the best candidates to describe the transition in the UK and the euro area. We now move to the STR estimation by the NLS.

3.4.2 Estimation results

As suggested by Teräsvirta (1994), the STR estimation is done in several steps. First, we estimate the linear model by OLS, so that we can initialize the nonlinear coefficients. Second, we do the same for the transition function parameters, and the standardization on the transition speed is also required in order to achieve convergence of the nonlinear optimization algorithm. We report that main estimation output in Table 7.

We note that lagged consumption affects current consumption, which corroborates the existence of habit-formation. However, this is less significant for the nonlinear model than for the linear model.

Moreover, we find evidence of nonlinearity, but the dynamics is different across countries. Indeed, while wealth effects do not seem to be statistically significant in the euro area, they are important for the UK and the US.[5] Furthermore, these effects vary according to the consumption regime and to wealth component. Indeed, while financial wealth affects positively and significantly the consumption dynamics in the first regime, its impact is rather negative (although not statistically significant) in the second regime.

[5] For the Euro area, housing wealth effects are not significant either in the linear model or in the nonlinear model.

For housing wealth, the effects are not significant for the US and the UK in the first regime, but they are negative at the 10% significance level in the second regime.

There are two potential explanations for the heterogeneity associated to the disaggregate wealth effects. On the one hand, the sign and impact of housing wealth effects in the second regime may be linked with periods of housing market busts such as the subprime crisis that led to strong losses in the real estate market, in particular, for the US and the UK. On the other hand, the weaker sensitivity of consumption with respect to financial wealth in the second regime can reflect the sharp collapse of the financial sector associated to the 2008-2009 financial turmoil, which reduced the relative importance of financial wealth in households' asset wealth.

The empirical findings also suggest the existence of asymmetry in the wealth effects on consumption. Indeed, in the first regime, we find a positive link between consumption and income, which is euro area stronger for the UK. In the second regime, the results show a negative relationship between the two variables, again in accordance with the larger uncertainty, the low consumer confidence and the higher risk aversion that characterize this state of the world. In what concerns the nonlinear estimators, the threshold parameter is statistically significant and negative for the UK and the US. As for the transition variable, it corresponds to housing wealth effect in the case of the US and lagged consumption for the UK and the euro area.

[INSERT TABLE 7 HERE]

To check the robustness of our estimations, we evaluate the statistical properties of the residuals of the nonlinear model via several misspecification tests, which are reported in Table 8. Overall, we do not reject the normality. The residuals are stationary, do not exhibit any ARCH effect and linearity tests do not reject the null hypothesis of "no omitted residual nonlinearity". In addition, the residual variance ratio is less than one for all countries, suggesting that accounting for nonlinearity and switching regimes improves the characterization of the consumption dynamics.

The same conclusion can be reached by looking at Figure 7, which suggests that nonlinear models capture better in the dynamics of consumption during economic downturns.

[INSERT FIGURE 7 HERE]

We also reproduce the estimated transition function patterns in Figure 8, which displays the different states associated with consumption and its reaction to wealth. It can be seen that, at least, two regimes emerge. In the first regime, consumption growth is strongly persistent and near a unit root and may follow a random walk. In the second regime, consumption growth is close to a white noise.

[INSERT FIGURE 8 HERE]

Finally, in Figure 9, we show that our nonlinear modelling captures the most important consumption misalignments induced by financial crises and economic downturns, such as the 1973 and 1979 oil crashes, the 1982 debt crisis, the 1987 stock market crash, the internet bubble of 2000, the 2007 subprime crisis and the 2008-2009 global financial turmoil.[6] Additionally, the large volatility for estimated transition functions indicates strong evidence of time-varying correction in the consumption behaviour.

[INSERT FIGURE 9 HERE]

## 4. Conclusion

This paper assesses the importance of nonlinearity in estimating the wealth effects on consumption for the US, the UK and the euro area. We look at the impact of both (i) aggregate wealth and (ii) disaggregate wealth, namely, by comparing financial wealth effects with housing wealth effects. We also assess the magnitude of the response of consumption using both a linear model and two nonlinear approaches (the smooth transition regression and the quantile regression).

We find that the elasticity of consumption with respect to aggregate wealth is largest for the UK. In addition, the decomposition of asset wealth into its major components (i.e. financial and housing wealth) is statistically significant, with the exception of the euro area, where housing wealth effects do not seem to be important.

Then, two nonlinear approaches have been carried out to better characterize the elasticity of household consumption toward wealth effects. On the one hand, the quantile regression shows that the relationship between consumption, wealth and income is particularly strong during periods of economic booms, as the elasticities of consumption with respect to wealth and income are larger when consumption growth is abnormally high. On the other hand, the STR modelling suggests further evidence of structural breaks and time-varying and threshold wealth effects on consumption.

[6] Mallick and Granville (2005) argue that debt relief (which could be achieved, for instance, via fiscal consolidation) would only provide a temporary (although not sustainable) solution to consumption and, therefore, poverty reduction.

Overall, our approach uncovers a more complex dynamics of the relationship between consumption and wealth than linear models found in the previous literature, whilst being in accordance with the theoretical background underlying wealth effects on consumption.

These results are also interesting from a policy perspective, as they can help investors, managers and economists to better forecast consumption changes and assess regime of consumption after a specific wealth shock (Arghyrou, 2007, 2009; Agnello et al., 2012; Castro and Sousa, 2011; Sousa, 2010b, 2012b).

## References


Agnello, L, Castro, V., and R. M. Sousa (2012). How does fiscal policy react to wealth composition and asset prices? Journal of Macroeconomics, 34(3), 874-890.

Arghyrou, M. G. (2007). The price effects of joining the euro: Modelling the Greek experience using non-linear price-adjustment models. Applied Economics, 39(4), 493-503.

Arghyrou, M. G. (2009). Monetary policy before and after the euro: evidence from Greece. Empirical Economics, 36(3), 621-643.

Arghyrou, M. G., and J. D. Tsoukalas (2011). The Greek debt crisis: Likely causes, mechanics and outcomes. The World Economy, 34(2), 173-191.

Barnett, W. A. (2008). The supply of money. In: Darity, W. A. (Ed.). International Encyclopedia of the Social Sciences, 2nd Edition, Vol. 5, MacMillan Reference, Detroit, 260-261.

Barnett, W. A., Chauvet, M., and H. Tierney (2009a). Measurement error in monetary aggregates: A Markov Switching Factor approach. Macroeconomic Dynamics, 13(S2), 381-412.

Barnett, W. A., Chauvet, M., and H. Tierney (2009b). Nonlinear measurement errors in monetary aggregates. JSM Proceedings, American Statistical Association.

Barnett, W. A., and M. Chauvet (2011). How better monetary statistics could have signalled the financial crisis. Journal of Econometrics, 161(1), 6-23.

Blinder, A., and A. Deaton (1985). The time-series consumption function revisited. Brookings Papers on Economic Activity, 2, 465-511.

Castro, V., and R. M. Sousa (2011). How do central banks react to wealth composition and asset prices? Economic Modelling, 29(3), 641-653.

Chattopadhyay, A. K., and S. K. Mallick (2007). Income distribution dependence of poverty measure: A theoretical analysis. Physica A: Statistical Mechanics and its Applications, 377(1), 241-252.

Davidson, J., and D. Hendry (1981). Interpreting econometric evidence: the behavior of consumers' expenditure in the UK. European Economic Review, 16(1), 177-192.

Dickey, D. A., and W. A. Fuller (1979). Distributions of the estimators for autoregressive time series with a unit root. Journal of American Statistical Association, 74, 427-431.

Engle, R., and C. Granger (1987). Co-integration and error-correction: representation, estimation and testing. Econometrica, 55(2), 251-276.

Granger, C., and T. Teräsvirta (1993). Modelling Nonlinear Economic Relationships. Oxford University Press, Oxford.

Granville, B., and S. K. Mallick (2009). Monetary and financial stability in the euro area: Pro-cyclicality versus trade-off. Journal of International Financial Markets, Institutions and Money, 19(4), 662-674.

Hansen, B. (1996). Inference when a nuisance parameter is not identified under the null hypothesis. Econometrica, 64, 413-430.

Jawadi F. (2008). Does nonlinear econometrics confirm the macroeconomic models of consumption? Economics Bulletin, 5(17), 1-11.

Jawadi, F., and P. Léoni (2012). Nonlinearity, cyclicity and persistence in consumption and income relationships: Research in honor of Melvin J. Hinich. Macroeconomic Dynamics, forthcoming.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. Econometrica, 59, 1551-1580.

Khmaladze, E. (1981). Martingale approach in the theory of goodness-of-it tests. Theory of Probability and its Applications, 26, 240-257.

Koenker, R. (2004). Confidence intervals for regression quantiles. Proceedings of the 5th Prague Symposium on Asymptotic Statistics, New York: Springer-Verlag, 349-359.

Koenker, R. (2005). Quantile regression. Econometric Society Monograph Series, Cambridge University Press.

Koenker, R. and G. Bassett (1978). Regression quantiles. Econometrica, 46, 33-50.

Koenker, R., and K. F. Hallock (2001). Quantile regression. Journal of Economic Perspectives, 15(4), 143-156.

Koenker, R., and V. d'Orey (1994). Remark on Alg. AAS 229: Computing dual regression quantiles and regression rank scores. Applied Statistics, 43, 410-414.

Koenker, R., and V. d’Orey (1987). Computing regression quantiles. Applied Statistics, 36, 383-393.

Koenker, R., and Z. Xiao (2002). Inference on the quantile regression process. Econometrica, 70(4), 1583-1612.

Luukkonen, R., Saikkonen, P., and T. Teräsvirta (1988). Testing linearity against smooth transition autoregressive models. Biometrika, 75(3), 491-499.

Mallick, S. K., and B. Granville (2005). How best to link poverty reduction and debt sustainability in IMF-World Bank models? International Review of Applied Economics, 19(1), 67-85.

Mallick, S. K., and M. Moshin (2010). On the real effects of inflation in open economies: Theory and empirics. Empirical Economics, 39(3), 643-673.

Mignon, V., and G. Dufrénot (2004). Modeling the French consumption function using SETAR models. Economics Bulletin, 3(20), 1-16.

Newey, W., and K. West (1987). A simple positive semi-definite, heterokedasticity, and autocorrelation consistent covariance matrix. Econometrica, 55(3), 703-708.

Phillips, P. C. B., and P. Perron (1988). Testing for a unit root in time series regression. Biometrica, 75(2), 335-346.

Poterba, J., and A. Samwick (1995). Stock ownership patterns, stock market fluctuations, and consumption, Brookings Papers on Economic Activity, 2, 295-372.

Rafiq, M. S., and S. K. Mallick, 2008. The effect of monetary policy on output in EMU3: a sign restriction approach. Journal of Macroeconomics, 30, 1756-1791.

Sousa, R. M. (2010a). Consumption, (dis)aggregate wealth, and asset returns. Journal of Empirical Finance, 17(4), 606-622.

Sousa, R. M. (2010b). Housing wealth, financial wealth, money demand and policy rule: Evidence from the Euro Area. The North American Journal of Economics and Finance, 21(1), 88-105.

Sousa, R. M. (2012a). Linking wealth and labour income with stock returns and government bond yields. European Journal of Finance, forthcoming.

Sousa, R. M. (2012b). What is the impact of wealth shocks on asset allocation? Quantitative Finance, forthcoming.

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

Terasvirta, T. (1994). Specification, estimation and evaluation of smooth transition autoregressive models. Journal of the American Statistical Association, 89(425), 208-218.

Teräsvirta, T. (1998). Modeling economic relationships with smooth transition regressions. In Aman, U., and D. Giles (Eds.), Handbook of Applied Economic Statistics, 15, 507-552. Dekker, New York.

Tsay, R. S. (1996). Nonlinearity tests for time series. Biometrika, 73(2), 461-466.

## List of Tables

**Table 1**: Cointegration estimations
(consumption, asset wealth and labour income).

| | W | Y | ADF t-statistic | Johansen t-statistic | |
|---|---|---|---|---|---|
| | | | Lags: 1 | $\lambda_{max}$ | $\lambda_{trace}$ |
| US | 0.14*** | 1.05*** | -2.78*** | 6.98 | 13.55 |
| | (4.92) | (21.76) | | | |
| UK | 0.17*** | 0.75*** | -4.20*** | 31.67 | 42.98** |
| | (10.41) | (20.49) | | | |
| Euro area | 0.11*** | 0.80*** | -3.43*** | 15.31* | 19.63* |
| | (4.32) | (16.11) | | | |

Notes: Newey-West (1987) corrected t-statistics appear in parenthesis. *, **, *** - statistically significant at the 10%, 5%, and 1% level, respectively.

**Table 2**: Cointegration estimations
(consumption, financial wealth, housing wealth and labour income).

| | FW | HW | Y | ADF t-statistic | Johansen t-statistic | |
|---|---|---|---|---|---|---|
| | | | | Lags: 1 | $\lambda_{max}$ | $\lambda_{trace}$ |
| US | 0.09*** | -0.04*** | 1.16*** | -3.15*** | 17.68 | 29.12 |
| | (5.93) | (-3.87) | (30.95) | | | |
| UK | 0.10*** | 0.07*** | 0.75*** | -4.45*** | 26.03* | 45.35* |
| | (11.61) | (7.56) | (22.01) | | | |
| Euro area | 0.11*** | 0.02 | 0.71*** | -2.83*** | 45.14** | 69.38** |
| | (8.80) | (1.47) | (17.25) | | | |

Notes: Newey-West (1987) corrected t-statistics appear in parenthesis. *, **, *** - statistically significant at the 10%, 5%, and 1% level, respectively.

**Table 3**: Quantiles for asset wealth (and its major components) and labour income: Evidence for the US.

| Quantile | W | Y | FW | HW | Y |
|---|---|---|---|---|---|
| 2.5% | 0.33 | 0.68 | 0.24 | 0.12 | 0.64 |
| 25% | 0.35 | 0.70 | 0.25 | 0.13 | 0.66 |
| 50% | 0.36 | 0.71 | 0.26 | 0.14 | 0.67 |
| 75% | 0.37 | 0.72 | 0.26 | 0.14 | 0.68 |
| 97.5% | 0.38 | 0.74 | 0.28 | 0.16 | 0.70 |
| OLS | 0.36 | 0.71 | 0.26 | 0.13 | 0.68 |
| Khmaladze (1981) and Koenker and Xiao (2002) Test (p-value): | 0.01*** | | 0.00*** | | |

Notes: The Khmaladze (1981) and Koenker and Xiao (2002) test computes a joint test that all the covariate effects satisfy the null hypothesis of equality of the slope coefficients across quantiles. ***, **, * - statically significant at the 10%, 5% and 1% level, respectively.

**Table 4**: Quantiles for asset wealth (and its major components) and labour income: Evidence for the UK.

| Quantile | W | Y | FW | HW | Y |
|---|---|---|---|---|---|
| 2.5% | 0.13 | 0.63 | 0.07 | 0.04 | 0.68 |
| 25% | 0.16 | 0.69 | 0.08 | 0.06 | 0.73 |
| 50% | 0.17 | 0.72 | 0.09 | 0.06 | 0.75 |
| 75% | 0.18 | 0.75 | 0.10 | 0.07 | 0.78 |
| 97.5% | 0.21 | 0.80 | 0.11 | 0.09 | 0.83 |
| OLS | 0.18 | 0.71 | 0.10 | 0.07 | 0.73 |
| Khmaladze (1981) and Koenker and Xiao (2002) Test (p-value): | 0.00*** | | 0.00*** | | |

Notes: The Khmaladze (1981) and Koenker and Xiao (2002) test computes a joint test that all the covariate effects satisfy the null hypothesis of equality of the slope coefficients across quantiles. ***, **, * - statically significant at the 10%, 5% and 1% level, respectively.

**Table 5**: Quantiles for asset wealth (and its major components) and labour income: Evidence for the euro area.

| Quantile | W | Y | FW | HW | Y |
|---|---|---|---|---|---|
| 2.5% | 0.04 | 0.83 | 0.09 | 0.01 | 0.65 |
| 25% | 0.06 | 0.87 | 0.11 | 0.02 | 0.69 |
| 50% | 0.07 | 0.89 | 0.11 | 0.02 | 0.72 |
| 75% | 0.08 | 0.91 | 0.12 | 0.03 | 0.74 |
| 97.5% | 0.10 | 0.94 | 0.13 | 0.04 | 0.78 |
| OLS | 0.09 | 0.85 | 0.12 | 0.03 | 0.69 |
| Khmaladze (1981) and Koenker and Xiao (2002) Test (p-value): | 0.00*** | | 0.00*** | | |

Notes: The Khmaladze (1981) and Koenker and Xiao (2002) test computes a joint test that all the covariate effects satisfy the null hypothesis of equality of the slope coefficients across quantiles. ***, **, * - statically significant at the 10%, 5% and 1% level, respectively.

**Table 6**: STR model - specification tests (p-value).

| | | | Hansen (1996) test | Tasy (1996) test | Teräsvirta (1994) tests | | | | Model |
|---|---|---|---|---|---|---|---|---|---|
| | p | $s_t$ | | | $H_{01}$ | $H_{02}$ | $H_{03}$ | $H_{12}$ | |
| US | 1 | $HW_t$ | $0.00^a$ | $0.00^b$ | 0.41 | 0.07 | 0.43 | 0.02 | ESTR |
| UK | 1 | $C_{t-2}$ | $0.18^a$ | $0.00^b$ | 0.23 | 0.52 | 0.00 | 0.01 | ESTR or LSTR |
| Euro area | 2 | $C_{t-1}$ | $0.23^a$ | $0.05^b$ | 0.01 | 0.31 | 0.63 | 0.05 | LSTR or ESTR |

Note: (a) refers to the Bootstrap p-value. (b) refers to the p-value of Fisher statistics for the Tsay (1996) test. H10, H20, H30 and H12 correspond to the null hypotheses of the Teräsvirta (1994) test. $s_t$ refers to the optimal transition variable.

**Table 7**: STR model - estimation results.

| | US | UK | Euro area |
|---|---|---|---|
| P | 1 | 1 | 2 |
| $s_t$ | HW | C | $C_1$ |
| Regime 1 | | | |
| constant | 0.002 | 0.002 | 0.002 |
| | (1.63) | (0.44) | (1.2) |
| $C_{t-1}$ | 0.10 | $-1.51^{**}$ | 0.27 |
| | (0.67) | (-1.64) | (0.34) |
| $C_{t-2}$ | - | - | -0.18 |
| | | | (-0.70) |
| $Y_t$ | $0.30^{*}$ | $1.36^{*}$ | 1.16 |
| | (4.4) | (2.05) | (3.3) |
| $FW_t$ | $0.07^{*}$ | $0.18^{**}$ | - |
| | (2.3) | (1.92) | |
| $HW_t$ | -0.03 | 0.10 | - |
| | (-0.45) | (0.51) | |
| Regime 2 | | | |
| constant | 0.001 | 0.004 | -0.002 |
| | (0.55) | (0.77) | (-0.86) |
| $C_{t-1}$ | 0.15 | 1.29 | -0.34 |
| | (0.76) | (1.4) | (-0.43) |
| $C_{t-2}$ | - | - | 0.43 |
| | | | (1.6) |
| $Y_t$ | $-0.18^{*}$ | $-1.31^{*}$ | -0.48 |
| | (-2.2) | (-1.99) | (-1.3) |
| $FW_t$ | -0.06 | -0.15 | - |
| | (-1.61) | (-1.6) | |
| $HW_t$ | 0.06 | -0.002 | - |
| | (0.83) | (-0.01) | |
| $\gamma$ | 1.21 | 15.1 | 2.33 |
| | - | - | - |
| C | $-0.02^{*}$ | $-0.002^{*}$ | -0.002 |
| | (-2.8) | (-7.9) | (-1.5) |

Note: (*) and (***) refer to the significativity at 5% and 10%.

**Table 8**: Misspecification tests.

| | US | UK | Euro area |
|---|---|---|---|
| $\sigma^{ESTR}/\sigma^{L}$ | 0.92 | 0.81 | 0.93 |
| JB (*p*-value) | 0.05 | 0.26 | 0.14 |
| ADF ($p$ = 1) | -10.6 | -7.81 | -6.67 |
| ARCH (*p*-value) | 0.69 | 0.53 | 0.61 |
| NLR test (*p*-value) | 0.90 | 0.10 | 0.83 |

## List of Figures

**Figure 1**: OLS and quantile regressions: Evidence for the US (consumption, asset wealth and labour income).

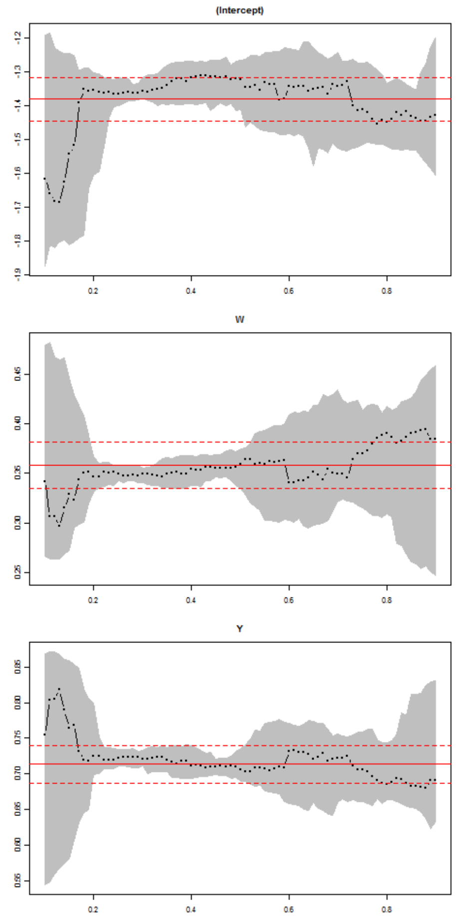



**Figure 2**: OLS and quantile regressions: Evidence for the US (consumption, financial wealth, housing wealth and labour income).

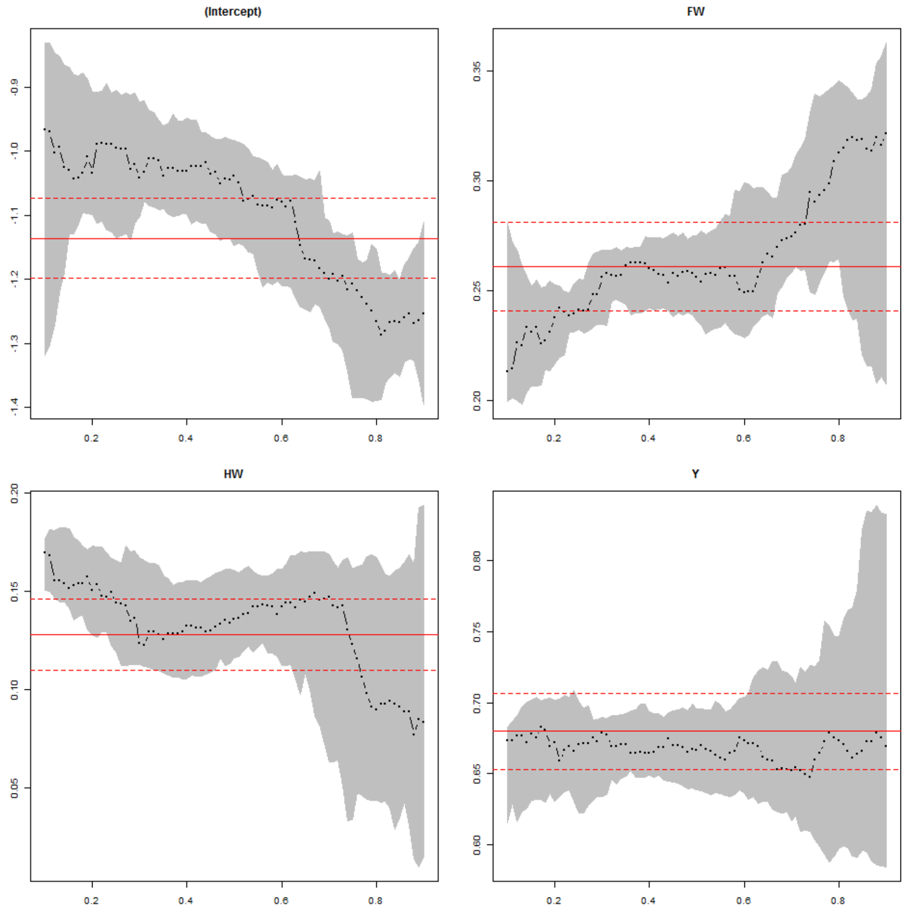


**Figure 3**: OLS and quantile regressions: Evidence for the UK (consumption, asset wealth and labour income).

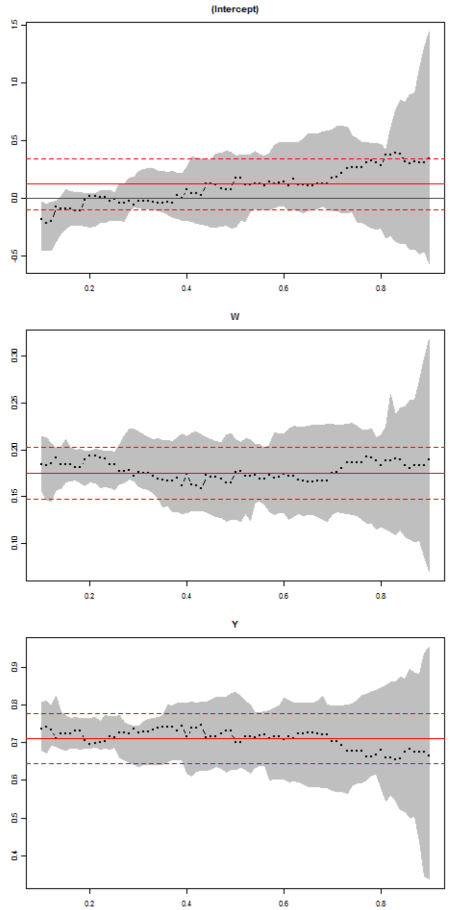



**Figure 4**: OLS and quantile regressions: Evidence for the UK (consumption, financial wealth, housing wealth and labour income).

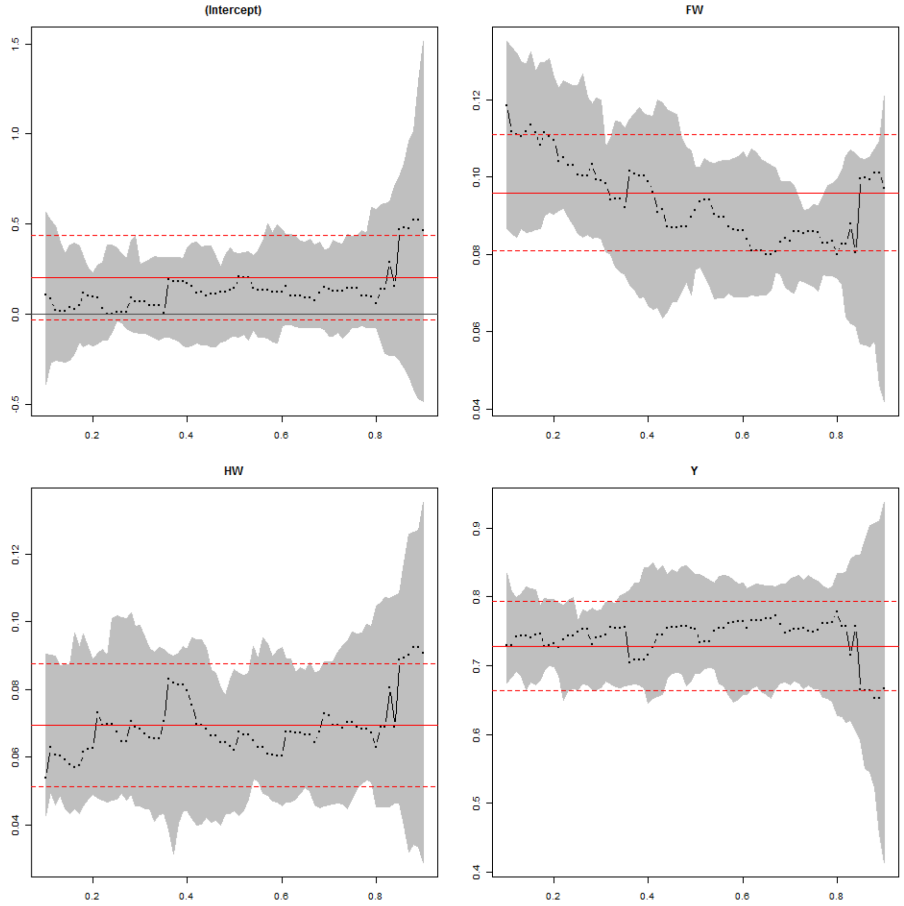


**Figure 5**: OLS and quantile regressions: Evidence for the euro area (consumption, asset wealth and labour income).

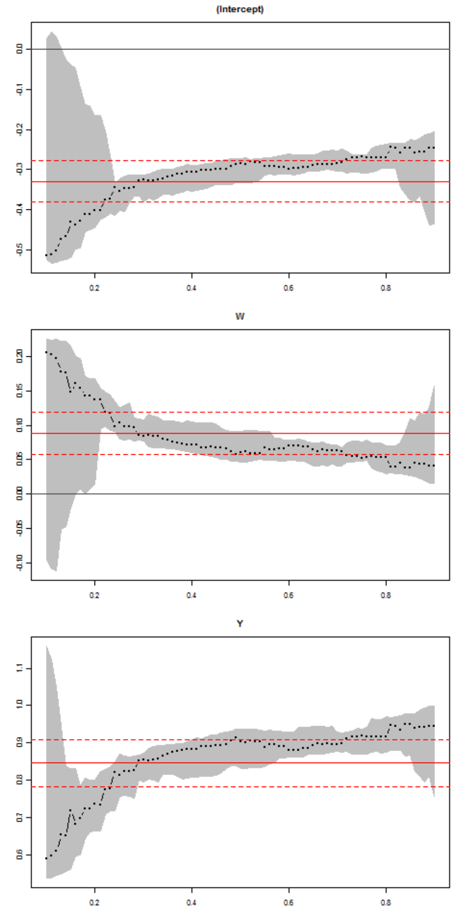



**Figure 6**: OLS and quantile regressions: Evidence for the euro area (consumption, financial wealth, housing wealth and labour income).

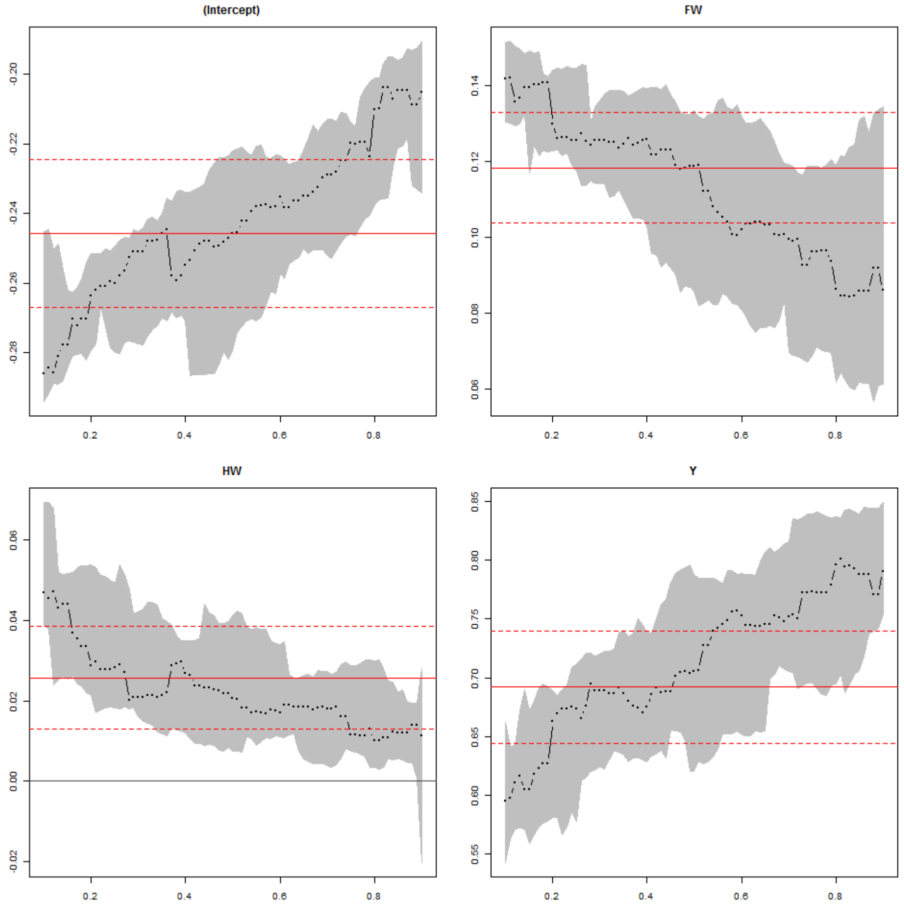


**Figure 7**: Linear and nonlinear estimation.

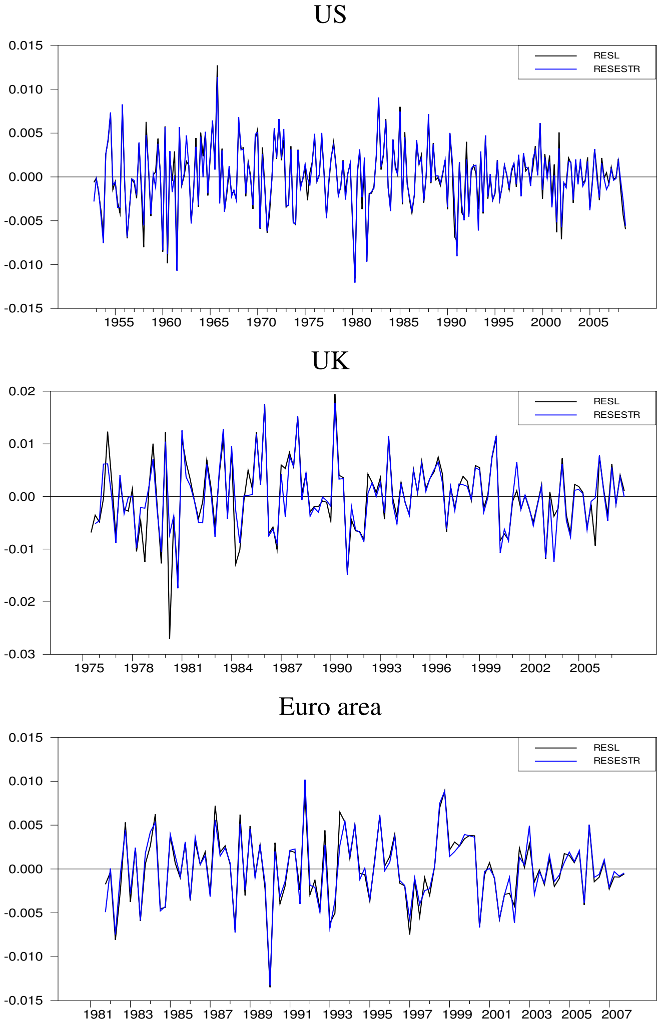



**Figure 8**: Estimated transition functions.

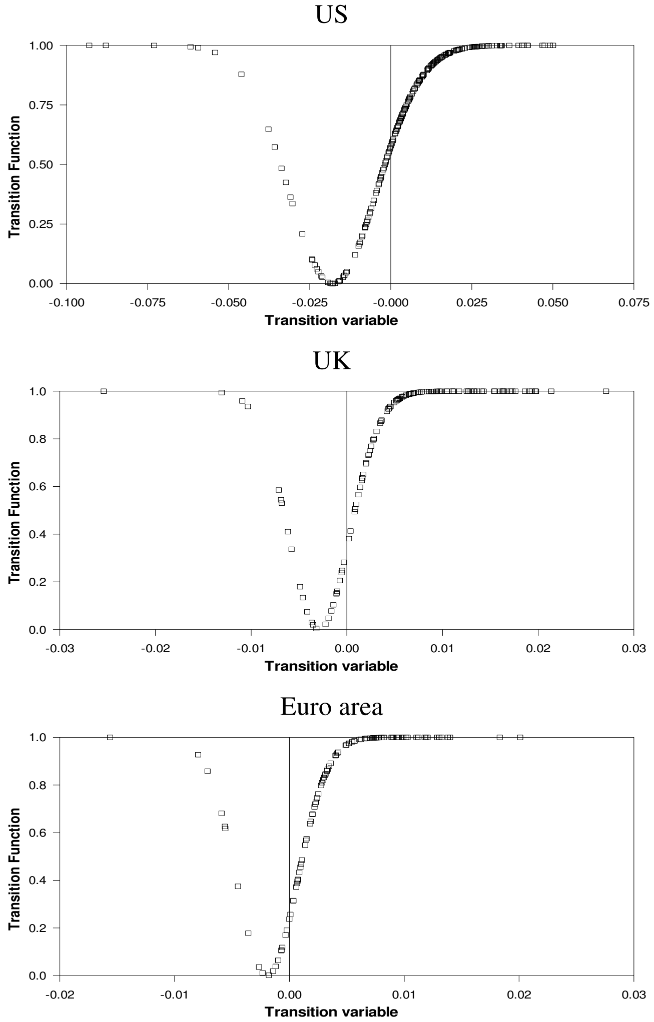
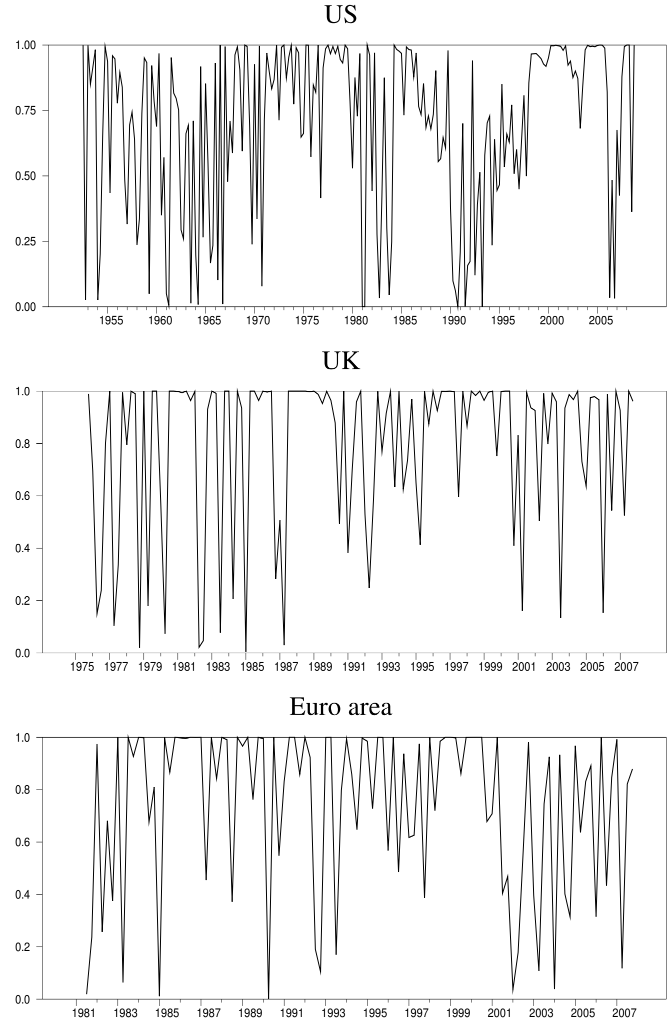



**Figure 9**: Estimated transition probabilities.



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