CentER

Discussion paper

No. 2002-62

SAVING AND HABIT FORMATION: EVIDENCE FROM DUTCH PANEL DATA

By Rob Alessie, Frederica Teppa

July 2002

ISSN 0924-7815

Saving and Habit Formation: Evidence from Dutch Panel Data[*]

Rob Alessie[†]
Free University Amsterdam & Tinbergen Institute
Federica Teppa
Tilburg University & CentER

July, 2002

Abstract

This paper focuses on the role of habit formation in individual preferences over consumption and saving. We closely relate to Alessie and Lusardi's (1997) model as we estimate a model which is based on their closed-form solution, where saving is expressed as a function of lagged saving and other regressors. Alternatively, we could use an Euler-equation approach (see e.g. Guariglia and Rossi (2001) and Dynan (2000)), but we will argue that this approach may yield spuriously negative estimates of the habit formation parameter because in surveys consumption is typically measured with considerable error. A second reason to use the closed form solution as a basis of the empirical model is that it embodies more information about the habit formation model than the Euler equation. Therefore, the closed form solution allows for a more powerful test of the validity of the habit formation model than the Euler equation approach.

Jel–Classification: D91

Keywords: Habit Formation, Permanent Income, Precautionary Savings

---

[*] We thank Arie Kapteyn for his helpful suggestions.

[†] Corresponding author: Free University Amsterdam - Department of Economics - De Boelelaan 1105, Room 2A40 - 1081 HV Amsterdam - The Netherlands - tel: +31 20 4446047 - fax: +31 20 4446005 - email: R.J.M.Alessie@fibre.a2000.nl

1 Introduction

The concept of habit formation relies on the idea that one's own past consumption might have an e¤ect on the utility yielded by current consumption: for a given level of current consumption, a larger habit stock lowers utility. Habits were …rst introduced in the context of demand systems (Pollak and Wales, 1969; Phlips, 1972; Pollak, 1975). In the literature a distinction between two types of habits has been made: myopic (or naive) and rational. In the …rst case (Pollak, 1976), consumers are not aware of the e¤ects that their current consumption decisions will have on their future marginal rates of substitution between goods and as a consequence their behavior may be time-inconsistent. In the second case (Lluch, 1974; Phlips, 1974; Spinnewyn, 1981; Muellbauer, 1986), consumers are aware of the habit forming e¤ect of current consumption.

The presence of habit formation may provide an appealing (partial) explanation to a number of anomalous empirical …ndings contrasting some of the permanent income model's predictions, such as the "excess sensitivity" of aggregate consumption growth relative to current labor income growth[1], its "excess smoothness" relative to lagged labor income growth[2], the equity premium[3] puzzle and the risk-free rate[4] puzzle (Abel, 1990; Constantinides, 1990; Campbell and Cochrane, 1999; Seckin, 2000). Moreover, Carroll et al. (2000) show that if one allows for habit formation, then standard growth models can be reconciled with the empirical evidence suggesting that high growth leads to high saving, rather than the other way around. Fuhrer (2000) stresses the relevance of habits in a monetary-policy analysis, as the habit formation speci…cation signi…cantly improves the responses of both spending and in‡ation to monetary-policy actions.

In general, mixed conclusions about the strength of habit formation arise from past studies of time-nonseparable preferences based on aggregate consumption data. A number of studies using US aggregate monthly (Dunn and Singleton, 1986; Eichenbaum et al., 1988; Heaton, 1993) and quarterly (Muellbauer, 1988) consumption data

[1] The permanent income model predicts that consumption changes should be orthogonal to predictable, or lagged, income changes. Yet, the correlation between consumption growth and lagged income growth seems to be one of the most robust features of aggregate data (Flavin, 1981; Blinder and Deaton, 1982; Campbell and Deaton, 1989; Attanasio and Weber, 1993).

[2] The permanent income model predicts that consumption growth should be more volatile than income growth if aggregate income growth has positive serial correlation. Yet, aggregate consumption growth seems to be much smoother than aggregate income growth (Deaton, 1987; Campbell and Deaton, 1989; Gali', 1991).

[3] Under time-separable utility, Mehra and Prescott (1985) could not found a plausible pair of subjective discount rate and relative risk aversion of the representative consumer to match the mean of the annual real rate of interest and of the equity premium in a US sample over a 90-year period. That is, stocks were not su¢ciently riskier than Treasury bills to explain the spread of their returns.

[4] Weil (1989) found that in the same sample used by Mera and Prescott, although individuals like consumption to be very smooth and although the risk-free rate is very low, they still save enough that per-capita consumption grows rapidly.

display very little evidence of habits. However, other studies concerning US data (Ferson and Constantinides, 1991) and Japanese data (Braun et al., 1993) lead to a di¤erent conclusion.

One of the most common approaches in micro-econometric studies used to test the presence of habit formation has been the Euler equation approach. It focuses on a speci…c …rst-order condition implied by the optimization problem faced by a generic consumer, allowing the estimation of preference parameters[5]. In this strand of literature, Hotz, Kydland and Sedlacek (1988) examine whether intertemporally nonseparable utility functions are important in characterizing microdata on life-cycle labor supply behavior among white male workers in the U.S. They …nd empirical support for the hypothesis that agents' preferences directly depend upon past leisure decisions and for the relatively simple speci…cation of nonseparable preferences proposed by Kydland and Prescott (1982). More recently, Meghir and Weber (1996) argue that the within marginal rate of substitution function can be used as a control when evaluation results obtained using the intertemporal Euler equation. They use a large sample of US households, drawn from twelve years of the Consumer Expenditure Survey to model the intertemporal and within period allocation of expenditure on food in the home, transport and services. They found no empirical support for intertemporal non-separability of preferences over food, transport and services. Similarly, Dynan (2000) …nds no evidence of habit formation at the annual frequency. Her analysis on food consumption data from the Panel Study on Income Dynamics indicate that habit formation has at most an extremely limited in‡uence on consumers' behavior. This …nding is robust to a number of changes in the model's speci…cation.

An alternative approach to the Euler equation is adopted by Alessie and Lusardi (1997), who derive closed-form solutions for consumption (and saving) under the assumption of CARA within period preferences.[6] Closed-form solutions for consumption and saving allow a better understanding of some of the issues concerning those variables, as they provide a rich speci…cation that extends some of the previous results in the literature. A problem with the model of Alessie and Lusardi (1997) is that it does not preclude negative consumption. A detailed description of Alessie and Lusardi's model is provided in Section 2 below.

Guariglia and Rossi (2001) generalize Weil's model (1993), based on hybrid non-expected utility preferences, by allowing for habit formation. They obtain a closed-form solution for consumption as a function of labor income and total resources, labor income risk and lagged consumption. They then derive an Euler equation of consumption changes[7], where current consumption changes depend on lagged changes

[5] Whether estimates of structural parameters based on log-linearized Euler equations may be biased (Carroll, 2001) or not (Attanasio and Low, 2002) is still under debate.

[6] The study of Alessie and Lusardi (1997) does not contain an empirical part. In other words, they have not tested empirically the validity of their theoretical model.

[7] The Euler equation used by Guariglia and Rossi does not su¤er from "death to Euler equation critique" of Carroll (1997). The basic idea behind this critique is that the estimation of log-linearized Euler equations using instrumental variables methods on cross-section household data should be

and labor income risk. They estimate this Euler equation using data from the British Household Panel Survey for the period 1992-97 and they ﬁnd that both labor income risk and past changes in consumption are important in determining current changes in consumption. In particular, for all the estimators they adopt (OLS, within groups, ﬁrst-diﬀerenced GMM and System GMM) the lagged changes in consumption display a strong statistically signiﬁcant negative eﬀect on the current changes. This suggests that the utility function exhibits durability in Deaton's (1992) sense, rather than habit formation. It is worthwhile saying that Guariglia and Rossi's empirical model can be justiﬁed by the model by Alessie and Lusardi. In other words Guariglia and Rossi (2001) cannot infer empirically whether or not their complicated extension of Weil's model describes household behavior in a better way than the model of Alessie and Lusardi (1997).

In this paper we estimate the models of Alessie and Lusardi (1997) and Guariglia and Rossi (2001). Our empircal models will be based on their closed-form solutions. In these closed form solutions saving is expressed as a function of lagged saving and other regressors. Alternatively, we could have used the Euler-equation approach (see e.g. Guariglia and Rossi (2001) and Dynan (2000)), but we will argue that this approach may yield spuriously negative estimates of the habit formation parameter because in surveys consumption is typically measured with considerable error. A second reason to use the closed form solution as a basis of the empirical model is that it embodies more information about the habit formation model than the Euler equation. Therefore, the closed form solution allows for a more powerful test of the validity of the habit formation model than the Euler equation approach. For example, contrary to Guariglia and Rossi (2001) we are able to discriminate empirically between the models of Alessie and Lusardi (1997) and Guariglia and Rossi (2001). However, we have to qualify a bit the remark about he advantages of using the closed for solution in the empirical exercise: the closed form solution approach relies more heavily on proxy variables (e.g. we need a proxy for the expected discounted value of future income changes).

The remainder of the paper is organized as follows. In the following section 2 we describe the theoretical model. Section 3 illustrates our dataset, and section 4 presents the corresponding empirical evidence. Section 5 concludes the paper.

---

abandoned as it does not yield any useful information. Guariglia and Rossi do not need to log-linearize the Euler equation, as they use a Constant Absolute Risk Aversion instantaneous utility function. However, as we said before, in the models of both Guariglia and Rossi (2001) and Alessie and Lusardi (1997) negative consumption is possible, which may sound strange.

2 The theoretical model for habit formation and precautionary saving

In this section we describe the theoretical model we will use for empirical tests. We strictly refer to Alessie and Lusardi's (1997) model of habit formation, in its precautionary saving specification.

The reference model is the one by Caballero (1990), with a negative exponential utility function and an uncertain non-capital income, following a moving-average process with ψ_i representing the $i-$th MA coefficient. Hence:

$$E_t y_\tau - E_{t-1} y_\tau = \psi_{\tau-1} w_t \tag{1}$$

where $\psi_0 = 1$, $\sum_{\tau=t}^{\infty}(1+r)^{t-\tau}\psi_{\tau-t} < \infty$ and w_t is an i.i.d. innovation. Alessie and Lusardi extend Caballero's model by allowing for habit formation.

Assuming an infinite planning horizon, households choose current and future consumption in such a way that the following expected intertemporal non-additive utility function is maximized:

$$\mathrm{Max} E_t \sum_{\tau=t}^{\infty} (1+\rho)^{t-\tau} \left(-\frac{1}{\theta} e^{-\theta(c_\tau - \gamma c_{\tau-1})} \right) \tag{2}$$

subject to an intertemporal budget constraint:

$$\sum_{\tau=t}^{\infty} (1+r)^{t-\tau} c_\tau = (1+r) A_{t-1} + \sum_{\tau=t}^{\infty} (1+r)^{t-\tau} y_\tau \tag{3}$$

where A_{t-1} and $c_{t-1}$are given. E_t is the expectations operator, c_τ denotes consumption in period τ, y_τ is non-capital income, A_τ is non-human wealth, r is the real fixed interest rate and ρ is the rate of time preference. Current utility depends not only on current consumption, but also on consumption a period ago. Note that the infinite horizon over which the optimization occurs is a crucial assumption, which might not be realistic. However, this assumption allows us to rewrite the intertemporal budget constraint in the following way:

$$\sum_{\tau=t}^{\infty} (1+r)^{t-\tau} c_\tau = -\gamma c_{t-1} + \frac{(1+r-\gamma)}{(1+r)} \left[(1+r) A_{t-1} + \sum_{\tau=t}^{\infty} (1+r)^{t-\tau} y_\tau \right] \tag{4}$$

Given this equation, Alessie and Lusardi (1997) prove the following:

- The stochastic process of $c^*_\tau = c_\tau - \gamma c_{\tau-1}$ is a martingale with drift:

$$c^*_\tau = c^*_{\tau-1} + \Gamma_{\tau-1} + \varepsilon_\tau \tag{5}$$

  where ε_τ denotes the innovation in consumption c^*_τ and $\Gamma_{\tau-1}$ is a measure of the effect of precautionary saving (see below).

- The relation between the consumption innovation π_τ and the income innovation w_τ can be written as:

$$\pi_\tau = \psi^* w_\tau \qquad (6)$$

where $\psi^* = \left(1 - \frac{\gamma}{1+r}\right) \frac{r}{1+r} \sum_{i=0}^{\infty} \psi_i (1+r)^{-i}$.

This means that if habit formation is not present ($\gamma = 0$), then the consumption innovation equals the annuity value of the contemporaneous innovation in income; when habit formation is there, the consumption innovation equals $\left(1 - \frac{\gamma}{1+r}\right)$ times the revision in permanent income. As a consequence, the larger the habit formation coefficient γ, the smaller ψ^*, and consequently, the less sensitive consumption is to income shocks.

- The consumption function implied by the maximization problem above has the following form:

$$c_t = \frac{\gamma}{1+r} c_{t-1} + \left(1 - \frac{\gamma}{1+r}\right) Y_{pt} - \frac{r}{1+r} \sum_{\tau=t+1}^{\infty} (1+r)^{t-\tau} \sum_{\tau=t+1}^{\tau} \Gamma_{j-1} \qquad (7)$$

and $\Gamma_{j-1} = \frac{1}{\theta} \ln E_{j-1} \exp(-\theta \psi^* w_j)$ and $Y_{pt} = \frac{r}{1+r}\left[(1+r)A_{t-1} + \sum_{\tau=t}^{\infty}(1+r)^{t-\tau} y_\tau\right]$ denotes permanent income.

Equation (7) says that consumption depends on past consumption, permanent income and precautionary saving. Equation (7) is additive and precautionary saving depends on the properties of income risk. The parameter γ affects the relative importance of the three terms. In particular, the stronger the habit, the bigger the weight put on past consumption[8] and the lower the effect of income uncertainty on consumption.

If the model is written in terms of saving rather than consumption, the closed-form solution for saving takes the following form:

$$s_t = \gamma s_{t-1} + \frac{\gamma}{1+r} \Delta y_t - \left(1 - \frac{\gamma}{1+r}\right) \sum_{\tau=t}^{\infty} (1+r)^{t-\tau} E_t \Delta y_\tau + \frac{r}{1+r} \sum_{\tau=t+1}^{\infty} (1+r)^{t-\tau} \sum_{j=t+1}^{\tau} \Gamma_{j-1} \qquad (8)$$

Similarly, saving depends on past saving, current and future income changes and properties of the income process. Once again, the importance of each component is a function of γ, that is of the strength of habit. In the case of no habits ($\gamma = 0$), the equation above is the standard "saving for a rainy day" equation; when there is habit formation ($\gamma > 0$), the stronger the habit, the lower the role of future income changes and of income uncertainty and the higher the one of past saving.

[8] This is consistent with the fact that "among its potentially important empirical implications, habit formation causes consumers to adjust slowly to shocks in permanent income" (Dynan, 2000)

Guariglia and Rossi (2001) generalize Weil's model (1993), based on hybrid non-expected utility preferences, by allowing for habit formation. They obtain the following closed-form solution for consumption as a function of labor income and total resources, labor income risk and lagged consumption[9]:

$$c_t = \left(1 - \frac{\gamma}{1+r}\right)\left(1 - \frac{\delta - 1}{r}\right) Y_{pt} + \delta\frac{\gamma}{1+r} c_{t-1} + \varepsilon^* \tag{9}$$

where $\delta = \left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\alpha}}$ (ρ denotes the rate of time preference) and ε^* ($\varepsilon^* < 0$) denotes the precautionary saving component which depends on, among other things, the variance of future income shocks and the habit formation parameter γ.[10] Notice that if $r = \rho$, then $\delta = 1$. In that case model (9) is observationally equivalent to model (7). Model (9) implies the following saving equation:

$$\begin{aligned} s_t = & \left(\delta - 1 + \gamma\frac{r+1-\delta}{1+r}\right)\left(\frac{1}{r}\cdot y_t + \frac{1+r}{r} s_{t-1}\right) - \\ & - \left(1 - \frac{\gamma}{1+r}\right)\frac{1+r-\delta}{1+r}\sum_{\tau=t}(1+r)^{t-\tau}(y_\tau - y_t) + \frac{\gamma(1-\delta)}{r} c_{t-1} - \varepsilon^* \end{aligned} \tag{10}$$

3 Description of the dataset

The empirical analysis is based on six waves of the CentER Savings Survey (CSS), drawn from 1993 to 1998. The CSS (formerly known as the VSB panel) is a panel survey started in 1993 and run every year. Until 1997, the CentER Savings Survey consisted of two samples. The first sample (REP) was intended to be representative of the Dutch population; it consists of some 2000 households in each wave, including refreshment samples compensating for panel attrition. The second sample (HIP) was representative of the top 10 percent of the income distribution and initially it contained some 900 households. In 1998 on most respondents of the second sample stopped, so that since that year on the CSS includes only the REP.

The CentER Savings Survey consists of five questionnaires: work and pensions, accommodation and mortgages, income and health, assets and liabilities, economic and psychological concepts. The questionnaires are sent to the respondents by modem, the respondents fill in the questionnaires at their home computers, and the answers are returned in the same way. This means that the questionnaires are self-administered and the respondents can answer the questionnaires at a time that is convenient for them.

For our purposes we focus mainly on the assets and liabilities questionnaire and the economic and psychological concepts. The former provides detailed information

[9] See equation (10) of Guariglia and Rossi (2001)

[10] See equation (11) of Guariglia and Rossi (2001). The higher the variance of future income shocks, the more negative the precautionary saving term ε^* becomes. Like in the model of Alessie amd Lusardi (1997) Guariglia and Rossi's model predicts that the larger the habit formation coefficient γ, the less sensitive consumption is to income shocks (i.e precationary becomes less important).

about forty asset and debt categories, both …nancial and real[11]. For most of these categories, respondents are …rst asked to indicate whether they own the type. If they do, they then have to answer a set of questions about the amounts and the precise nature of each asset/liability. Non-response is not an issue for the ownership questions, but it is for some of the questions on the amounts. We then adopt the same methodology by Alessie, Hochguertel and van Soest (2002), that is we have imputed the amounts for those who reported to be owners but did not provide an amount. The imputed values are based on amounts held in adjacent years and on regression models that relate observed amounts to household characteristics. Prediction errors are taken into account by drawing errors from the estimated error term distribution in the regression models, where full account is taken of the covariance structure of the error terms over time. For all respondents these data have been aggregated into total income per component and total asset per component. On the basis of the various income components, total gross and total net income (on the respondent level) were computed also.

The economic and psychological concepts questionnaire represents a very rich set of questions about several topics, including personal characteristics, household income, expectations about future income, attitude towards saving and saving behavior, risk perception and risk aversion, expectations for the future and comparison with the current situation, planning of …nancial matters. For our purposes, we focus on a number of questions related to saving behavior.

Equation (8) is the starting point of our empirical analysis. We now provide a description of the variables used in the estimation procedure.

1. In the CSS, the dependent variable s_{it} (saving by household i in year t) can be measured as follows: …rst we use information about whether any money has been put aside in the previous 12 months by an individual. Then they are asked to indicate how much money their household has put aside in the same period. In our analysis we do not use limited dependent variable estimation technique for reasons explained in footnote .... It is therefore important to deal with "no money put aside" answers (1907 cases out of the 6602 cases). We have further investigated these cases by crossing them with other informative variables in the questionnaire, in order to check for potential dissaving. In particular, we have considered the following question:

   "Over the past 12 months, would you say the expenditures of your household were higher than the income of the household, about equal the income of the household, or lower than the income of the household?"

   Second, we treat the dependent variable, s_{it}, as a continuous variable, represented by the amount of money put aside.[12] We built this variable as follows.

[11] A detailed description of these assets and liabilities is provided by Alessie, Hochguertel and van Soest (2002).

[12] Respondents report the amount of money put aside in classes. Out of this piece of information

For those who have claimed to have put no money aside and whose expenditures were about equal the income of the household, it was clear that they have not saved and not dissaved either. We then have imputed zero as the amount of money put aside (1701 cases). For those who have claimed to have put no money aside and whose expenditures were higher than the income of the household, we have constructed a change in liquid …nancial wealth as a proxy of their dissaving and imputed that negative value as the amount of money put aside (141 observations). Finally, for those who have claimed to have put no money aside and whose expenditures were lower than the income of the household, we have constructed a change in liquid …nancial wealth as a proxy of their saving and imputed that (positive) value as the amount of money put aside, in order to overcome the contradiction (65 cases). In constructing the imputed variable mentioned above, we have used information about wealth. For each year, we have picked the most liquid categories for assets (checking accounts, savings arrangements, linked to a Postbank account, deposit books, savings or deposit accounts, savings certi…cates) net of the most liquid categories of liabilities (private loans and extended lines of credit) and then taken …rst di¤erences. We have deleted extreme values in order to avoid including outliers in our imputations.

Obviously, we could have obtained an alternative saving measure by computing the …rst di¤erences in (liquid) wealth. We will argue in the next section that using this measure may result in a spuriously negative estimate of the habit formation parameter

2. Income change: We build a variable ("Realised income change") from the following set of questions:

   A. "The total net income of your household consists of the income of all members of the household, after deduction of taxes and premiums for social insurance policies, taken as the sum total over the past 12 months. Compared to about one year ago, did the total net income of your household increase, remain about the same, or decrease?"

   B. "By what percentage (approximately) has the total net income of your household increased/decreased?"

   We then transform percentages into amounts and use the latter speci…cation in the empirical estimation.

---

we have constructed a continuous variable by taking the mid-points for each class. Alternatively, we could have adopted a Limited Dependent Variable (LDV) technique (e.g. ordered probit) to obtain estimates of the parameters. However, our empirical habit formation model is obviously dynamic and allows for unobserved heterogeneity by including an individual e¤ect. Obviously, some of the right hand side variables (apart from lagged saving) may be correlated with the individual e¤ect. Estimation of LDV models which allow for both state dependence and correlated unobserved heterogeneity, is notoriously di¢ cult. Therefore, we abstain from such an approach and we make our dependent variable continuous.

3. Expectation on income change: Two time-horizon lenghts are considered, as we exploit the following questions:

   A1. "Do you think the total net income of your household will increase, remain the same, or decrease in the next 12 months?"

   A2. "By what percentage do you think the total net income of your household will increase/decrease in the next 12 months?"

   B1. "Do you think the total net income of your household will increase, remain the same, or decrease in the next 5 years?"

   B2. "By what percentage do you think the total net income of your household will increase/decrease in the next 5 years?"

   Two variables are then constructed: variable "Expected income change (next 12 mths)" refers to questions A1-A2, variable "Expected income change (next 5 years)" refers to questions B1-B2. Both variables are in amounts.

4. Uncertainty on expected income change: For each of the time-horizon lenghts described above, people are asked the following question:

   "How certain do you feel about this income change?"

   Individuals have to indicate their degree of uncertainty among four possibilities: very certain, rather certain, not very certain, not at all certain. Two categorical variables are then built: "... about inc. change (next 12 mths)" and "... about inc. change (next 5 years)" for 12 months expectations and for 5 years expectations, respectively.

5. Background characteristics: We add a number of individual characteristics, such as:

   - gender

   - level of education

   - age classes (in dummies)[13]

   - number of members in the household

   - number of children in the household

   - labor market status (in dummies)

Table 1 reports summary statistics for the variables just described and used in the empirical study. Most of them are self-explanatory. However, it is worth mentioning that gender is a categorical variable, which takes the value 1 for males and 2 for females. In the empirical estimations males are the reference group.

[13] In particular, age1 refers to age less than or equal 30, age 2 is age between 31 and 40, age 3 is age between 41 and 50, age 4 is age between 51 and 60, age 5 is age between 61 and 70, age 6 is age between 71 and 88.

4 Empirical implementation and results

We take equation (8) as starting point of our analysis. We extend this model by allowing for demographic variables (e.g. family size, number of children, education level, age dummies) and for an unobserved individual effect α_i. Since the model contains a lagged endogenous variable (s_{it-1}) and an individual effect α_i, the standard within estimation technique yields inconsistent estimates. Procedures to estimate parameters of standard linear dynamic panel data models are discussed in numerous places. See, for example, Verbeek (2000, Section 10.4) for an accessible overview. To formulate the empirical model, two types of covariates are distinguished: $x_{it} = (x^1_{it}; x^2_{it})'$. The empirical model has the following structure:

$$s_{it} = \gamma s_{it-1} + x_{it}'\theta + \alpha_i + \varepsilon_{it} \tag{11}$$

where we make the following assumptions:

1. $\{x^1_{it}; t = 1; \dots; T\}$ uncorrelated with $\{\varepsilon_{it}; t = 1; \dots; T\}$ (strict exogeneity)
2. $\{x^2_{it}; t = 1; \dots; T\}$ uncorrelated with α_i and $\{\varepsilon_{it}; t = 1; \dots; T\}$
3. $\{\varepsilon^1_{it}; t = 1; \dots; T\}$ are mutually uncorrelated.

x^2_{it} includes some time invariant regressors x^2_i (e.g. gender, education level) which are assumed to be uncorrelated with the individual effects. Time invariant regressors that are not assumed to be uncorrelated with the individual effects are subsumed in the individual effects and not incorporated explicitly in the model. Thus an empty vector x^2_{it} would correspond to the case where any correlation between individual effects and time invariant regressors is allowed for, as in a pure fixed effects model.[14]

Define, for $t = 3; \dots; T$,

$$u_{it} = s_{it} - [x^{1\prime}_{it}\theta_1 + x^{2\prime}_{it}\theta_2 + s_{it-1}\gamma](= \alpha_i + \varepsilon_{it}) \tag{12}$$

and

$$\Delta u_{it} = u_{it} - u_{it-1}(= \varepsilon_{it} - \varepsilon_{it-1}) \tag{13}$$

The model assumptions imply the following moments

- $E[\Delta x^1_{it}\Delta u_{it}] = 0;\ j = 1; 2; ;\ t = 3; \dots; T$ ((strict) exogeneity)
- $E[y_{it-2}\Delta u_{it}] = 0;\ j = 1; 2; ;\ t = 3; \dots; T$ (lagged dependent variables)

[14] Following Hausman and Taylor (1981), coefficients on time invariant regressors correlated with individual effects could still be identified if some time varying regressors are uncorrelated to individual effects. We do not follow this approach since we do not see any natural candidates for this among our time varying regressors.

- $E[x^2_{it}u_{it}] = 0;\ j = 1, 2;\ t = 3, \ldots, T$ (exogeneity and uncorrelated with individual effect)

For a given specification, i.e., given choices of x^1_{it} and x^2_{it}, these moments can be used for standard GMM estimation. According to Blundell et al. (2000), the following additional moment restrictions based upon a mean stationarity assumption can be used to improve efficiency:

$$E\left[\Delta s_{it-1} u_{it}\right] = 0 \tag{14}$$

The GMM estimation technique allows for any type of heteroskedasticity in ε_{it}. Sargan tests for overidentifying restrictions are used to test the validity of the moment restrictions. The assumption that the errors ε_{it} are uncorrelated error terms seems quite strong, but is common in this type of model. This assumption will be tested by checking for second order autocorrelation in the residuals in the differenced equations.[15]

Table 2 reports results for the estimation of coefficients in Equation (8) acording to the following specification. x^1_{it} includes the number of children in a household, the total number of a household components and precautionary saving terms, i.e. the degree of uncertainty about future both short and long run expectated income changes. x^2_{it} includes realized income changes, both short and long run expectations about future income changes, gender, education levels and age dummies. We assume that the mean stationarity assumption holds.

The Sargan statistic does not indicate rejection of the moment conditions. Moreover, autocorrelation tests does not indicate rejection of assumption that $\{\varepsilon^1_{it}; t = 1; \ldots; T\}$ are mutually uncorrelated.

The estimated habit formation parameter γ exhibits a positive and statistically significant sign. If we do not allow for unobserved heterogeneity, the estimate of the habit formation coefficient gets considerably larger: 0.41 (t-value 31.0) from 0.12 (t-value: 3.12). This result indicates that the unobserved heterogeneity may explain the positive raw correlation between saving and lagged saving. Our findings differs from Guariglia and Rossi's results, as they get a negative, strongly significant estimate for γ. As already mentioned in the intoduction, they interpret this negative sign as an indicator of "durability" in Deaton's (1992) sense. Dynan (2000) estimates a similar Euler equation as Guariglia and Rossi (2001) but she considers food consumption instead of total consumption. Dynan also obtains a negative estimate for γ, albeit insignificant. Since food is a clearly non-durable good, her negative estimate cannot be explained by means of a durability argument.

However, another interpretation for the findings of Guariglia and Rossi (2001) and Dynan (2000) can be provided. Their estimates come from the Euler equation for consumption rather than from a closed form solution similar to our equation (11). The data at their disposal refers to consumption expenditures (rather than savings)

[15] To estimate the linear probability model, we use the DPD98 software as described in Arellano and Bond (1998).

which is presumably measured with considerable error. Such measurement errors are responsible for a strong spurious negative correlation between differences in current (Δc_{it}) and past consumption levels (Δc_{it-1}). As a consequence, the OLS estimate of the habit formation parameter γ is biased towards a "negative number": even if the true habit formation coefficient is greater than zero, the estimated coefficient is lower than zero and no standard attenuation bias towards zero occurs. Besides, although they also estimate the parameters of the Euler equation using GMM, their instruments may be too weak to compensate for the measurement error problem.[16] In other words, they may have found a spuriously negative habit formation coefficient.

Another feature to emphasize is that the estimate of the habit formation coefficient γ is close to the one for the realized income changes parameter[17]. This is in line with the theoretical model: in Equation (8) the coefficients γ and $\frac{\gamma}{1+r}$ are virtually the same for small values of r.

As a proxy for expected income changes $\sum_{\tau=t}^{\infty}(1+r)^{t-\tau}E_t\Delta y_\tau$ we use variables "Expected income change (next 12 mths)" and "Expected income change (next 5 years)". Their coefficients should be negative $\left(-1-\frac{\gamma}{1+r}\right)$ because of the "saving for a rainy day" argument (see Campbell (1987)). Obviously, this proxy is not perfect. The estimated coefficient of "Expected income change (next 5 years)" does not differ significantly from 0 (even after excluding "Expected income change (next 12 mths)"), whereas the estimated coefficient for "Expected income change (next 12 mths)" is very significant. Given the small estimated value of γ (0.12) and for reasonable values of the real interest rate, we would expect an estimated coefficient associated with "Expected income change (next 5 years)" of around -0.9. However, we obtain a much smaller value. This suggests either that people have a short time horizon or that they are liquidity constrained[18].

It is interesting to note that if we assume realized and expected income changes to be uncorrelated to the error terms (i.e. if variables "Realised income change ", "Expected income change (next 12 mths)" and "Expected income change (next 5 years)" are included in x^1_{it}), then their coefficients become insignificant. However, in Table 2 the Sargan statistic does not indicate a rejection. Therefore we can assume that these three variables are orthogonal to the individual effect. Moreover, we have to stress that in model (11) ε_{it} should not be interpreted as a forecast error as in an Euler equation. If it were a forecast error we would not be allowed to include the three variables in x^2_{it}: we should have better used lagged values as instruments.

According to our estimation results, precautionary saving does not play an important role in saving behavior: the degree of uncertainty about both short and long run expected income changes is totally insignificant. A potential explanation is that

[16] Dynan (2000) reports partial R^2 of the first stage regressions which are quite low (around 0.015).

[17] The estimated γ is 0.118 and $\frac{\gamma}{1+r}$ is 0.178.

[18] Liquidity constraints effectively shortens the time horizon as shown by e.g. Mariger (1987) or Zeldes (1989).

the habit formation formation e¤ect is rather strong: according to the theoretical model, in fact, the stronger the habit formation the weaker the precautionary saving. It is worth mentioning that if precautionary saving terms are included in x^2_{it} (i.e. precautionary saving is assumed to be orthogonal to the individual e¤ect), then their estimated coe¢cients get negative and signi…cant. However, the Sargan statistic increases from 31.45 to 47.63, suggesting that this latter assumption is clearly rejected.

As for the demographic variables, we observe that females save signi…cantly less than males. The role of education is rather hard to interpret: it seems that very high levels of education leads to bigger amounts of saving. Age classes are strongly signi…cant, both separately (as dummies), with the only exception for the last class, and jointly[19]. The age coe¢cients suggests that, ceteris paribus, saving is a decreasing function of age. Family size and household composition do not play a relevant role in saving behavior. We also extended the model by including labor market status dummies. Obviously, these dummies are presumably correlated with the individual e¤ect. Contrary to Meghir and Weber (1996), we do not …nd any signi…cant e¤ect of labor market variables.

One alternative to the model estimated in Table 2 is to exclude the time invariant education and gender variables completely. This would correspond to the pure …xed e¤ects model, whose results are reported in Table 3. Results for this model are similar to those in Table 2.

It is worth noting that our de…nition of saving is based on information about money put aside and wealth. An alternative de…nition would be computing …rst di¤erences in wealth. In the latter speci…cation, our empirical model would take the following form

$$\Delta A_t = \gamma \Delta A_{t-1} + x'_{it}\theta + \alpha_i + \varepsilon_{it} \quad (15)$$

Obviously, there exists a strong negative correlation between ΔA_t and ΔA_{t-1} because A_t is measured with considerable error. If we estimate Equation (15) by means of OLS we get a negative estimation of γ. Even by applying GMM, we obtain a negative estimate of γ: -0.26 (t-value: 6.29) Moreover, this procedure would imply a loss of one year of observations[20]. As a consequence, we decided not to build (and work with) the saving measure with information about di¤erences in wealth.

In order to investigate in more detail the fact that only short-run income expectations have a statistically signi…cant impact on the amount of money put aside, we exploit a question related to family plans about possible future home purchase. Jackman and Sutton (1982) examine the e¤ects of unanticipated interest rate changes on consumers' expenditures in a model with imperfect capital markets. They show that an increase in interest rates causes liquidity-contraints individuals to cut back

[19] The p-value of the Wald test of the hypothesis that all 5 age coe¢cients are jointly equal to zero, is 0.014.

[20] The number of observations drops from 6390 to 3817.

their consumption by the full amount of the increase in their interest payments. In contrast, a fall in interest rates relaxes the liquidity constraint and does not lead to an immediate increase in consumption by the full amount of the fall in interest payments. For a better interpretation of our findings, it is important to say that consumers who anticipate the possibility of interest rate changes may choose to hold some precautionary balances, and so partially offset the impact of interest rate rises, in that their optimal precautionary balances will be set at a level which will permit them to cushion the impact of sufficiently small interest rate rises. In order to investigate this issue, we select people who declared themselves being actively looking for another accommodation to buy. We then interact that piece of information with expectations about income changes over the next 12 months (variable "plexpdi1") and over the next 5 years (variable "plexpdi5"). It turns out (Table 4) that for the 12 month-horizon, thought not significant, the coefficients of income change expectation and of home purchase plans sum up to 0. This suggests that people have a longer horizon when thinking of long-term buying. However, long-run variables in the regression do not exhibit any significance.

Finally, we consider Guariglia and Rossi's extension of the model of Alessie and Lusardi (cf. equation (10)). This model implies that we should extend the empirical model (11) by adding lagged consumption to the right hand side:

$$s_{it} = \gamma s_{it-1} + x'_{it}\theta + \delta c_{it-1} + \alpha_i + \varepsilon_{it} \tag{16}$$

We estimate the parameters of equation (16) by means of GMM (see Table 5). We obtain basically the same results as before, so that we can conclude that Guariglia and Rossi's habit formation model is similar to Alessie and Lusardi's. However, it is important to point out that δ turns out to be significantly different from 0, indicating that the rate of time preference ρ is not equal to the real interest rate r.

5 Conclusions

In this paper we closely relate to Alessie and Lusardi's (1997) model of consumption with habit formation as we estimate a model which is based on their closed-form solution. Our empirical results show evidence in favor of habit formation. This conclusion is not in line with some earlier literature. Dynan (2000) and Guariglia and Rossi (2001) find negative estimates of the habit formation coefficient. Their estimates come from the Euler equation for consumption rather than from a closed form solution.We argue that the data they use in their analysis refers to consumption expenditures (rather than savings) which is presumably measured with considerable error. Such measurement errors may be responsible for a strong spurious negative correlation between differences in current (Δc_{it}) and past consumption levels (Δc_{it-1}). As a consequence, the OLS estimate of the habit formation parameter γ is biased towards a "negative number". Moreover, although they also estimate the parameters of the Euler equation using GMM, their instruments may be too weak to compensate for the measurement error problem. Our impression is that the measurement error in consumption might be an argument against the use of the Euler equation approach to estimate the preference parameters in habit formation models. However, more econometric research (e.g. using Monte Carlo studies) is needed in order to evaluate the statistical properties of GMM methods in estimating those dynamic panel data models where the correlation between the dependent variable and the lagged dependent variable is negative because of the presence of (transitory) measurement errors.

We should note that the habit formation model is not fully accepted by the data. We …nd evidence in favor of a short planning horizon and liquidity constraints. More theoretical research seems to be needed in order to investigate the joint impact of liquidity constraints and habit formation.

When investigating Guariglia and Rossi's extension of the habit formation model of Alessie and Lusardi's we get similar estimation results. However, we …nd support for the fact that the rate of time preference ½ is not equal to the real interest rate r. This means that the two versions of the habit formation model are not observationally equivalent.

Finally, up to this point we have not looked at preference interdependence (Kapteyn et al., 1997), which might (partially) explain the signi…cance of the habit formation coe¢cient we have found. This should be on the agenda for future research

Table 1: Descriptive statistics

Variable	Mean	Std Dev	Min	Max
Saving	7993.3	14151.32	-48042	150000
Lagged saving	8046.6	13805.29	-42500	150000
Gender	1.1384	.34543	1	2
Intermediate/low education	.11311	.31676	0	1
Intermediate/high education	.11250	.31601	0	1
Vocational education, level 1	.11147	.31475	0	1
Vocational education, level 2	.12436	.33003	0	1
Vocational education, level 3	.30190	.45913	0	1
University education	.18675	.38975	0	1
Age1	.03375	.18060	0	1
Age2	.18040	.38456	0	1
Age3	.27347	.44579	0	1
Age4	.21170	.40855	0	1
Age5	.20434	.40326	0	1
Number of household members	2.5003	1.2722	1	9
Number of children	.70669	1.0722	0	7
Realised income change	655.20	11553.47	-105000	462000
Expected income change (next 12 mths)	638.44	79104.90	-330000	5500000
Expected income change (next 5 years)	845.02	10826.15	-210000	178500
Very certain about inc. ch. (next 12 mths)	.25279	.43464	0	1
Rather certain about inc. ch. (next 12 mths)	.65009	.47697	0	1
Not very certain about inc. ch. (next 12 mths)	.08530	.27935	0	1
Not at all certain about inc. ch. (next 12 mths)	.01180	.10803	0	1
Very certain about inc. ch. (next 5 years)	.13548	.34227	0	1
Rather certain about inc. ch. (next 5 years)	.65474	.47550	0	1
Not very certain about inc. ch. (next 5 years)	.18593	.38909	0	1
Not at all certain about inc. ch. (next 5 years)	.02291	.14963	0	1
Working	.41862	.49338	0	1
Retired	.24577	.43059	0	1
Disabled	.03481	.18333	0	1
Self-employed	.19674	.39757	0	1
Other	.10238	.30319	0	1

Table 2: The basic habit formation model: estimation results

Parameter	Coe¢cient	Std Err	t-value
Constant	7776.29	3329.83	2.335
Lagged saving	.118652	.037997	3.122
Gender	-2407.4	964.230	2.496
Intermediate/low education	230.834	980.672	.235
Intermediate/high education	1040.04	1017.00	1.022
Vocational education, level 1	-1332.5	926.223	1.438
Vocational education, level 2	261.847	912.593	.286
Vocational education, level 3	3147.76	970.723	3.242
University education	4666.63	1150.01	4.057
Age1	3256.78	1453.89	2.246
Age2	2566.60	1024.22	2.505
Age3	2102.57	1114.73	1.886
Age4	2326.55	714.559	3.255
Age5	992.959	576.081	1.723
Realised income change	.178989	.030716	5.827
Expected Income change (next 12 mths)	-.00191	.000401	4.771
Expected Income change (next 5 years)	-.01619	.022757	.711
Number of household members	-941.70	1340.96	.702
Number of children	1288.79	1476.76	.872
Rather certain about inc. ch. (next 12 mths)	-535.01	472.856	1.131
Not very certain about inc. ch. (next 12 mths)	54.2176	772.060	.070
Not at all certain about inc. ch. (next 12 mths)	439.567	1241.42	.354
Rather certain about inc. ch. (next 5 years)	-393.32	658.789	.597
Not very certain about inc. ch. (next 5 years)	-633.12	834.009	.759
Not at all certain about inc. ch. (next 5 years)	-1540.6	1920.67	.802
Wald test of joint signi…cance	313.004 df=24 p=.000		
Sargan test	31.453 df=22 p=.087		
Test for …rst-order serial correlation	-4.881 [988] p=.000		
Test for second-order serial correlation	.452 [567] p=.651		

Table 3: Habit formation model without time invariant variables: estimation results

Parameter	Coefficient	Std Err	t-value
Constant	5459.02	2353.79	2.319
Lagged saving	.1153	.039517	2.920
Age1	3394.67	1479.87	2.293
Age2	2549.49	1063.59	2.397
Age3	2377.28	1165.48	2.039
Age4	2609.15	742.442	3.514
Age5	1083.96	599.862	1.807
Realised income change	.1786	.0307	5.812
Expected Income change (next 12 mths)	-.002	.0003	5.600
Expected Income change (next 5 years)	-.001	.0230	.067
Number of household members	-362.10	1381.80	.262
Number of children	1002.86	1525.70	.657
Rather certain about inc. ch. (next 12 mths)	-375.89	531.947	.706
Not very certain about inc. ch. (next 12 mths)	345.524	810.004	.426
Not at all certain about inc. ch. (next 12 mths)	658.380	1271.80	.517
Rather certain about inc. ch. (next 5 years)	-420.92	664.681	.633
Not very certain about inc. ch. (next 5 years)	-595.09	839.370	.708
Not at all certain about inc. ch. (next 5 years)	-1853.7	1943.39	.953
Wald test of joint significance	169.89 df=17 p=.000		
Sargan test	19.709 df=15 p=.183		
Test for first-order serial correlation	-4.802 [988] p=.000		
Test for second-order serial correlation	.452 [567] p=.651		

Table 4: Habit formation and housing purchase in the future

Parameter	Coe¢cient	Std Err	t-value
Constant	8503.58	3212.24	2.647
Lagged saving	.124221	.0370	3.348
Gender	-2463.9	929.766	2.650
Intermediate/low education	375.085	973.212	.385
Intermediate/high education	1102.54	1008.20	1.093
Vocational education, level 1	-1255.7	923.746	1.359
Vocational education, level 2	385.074	905.632	.425
Vocational education, level 3	3206.79	966.660	3.317
University education	4624.34	1128.42	4.098
Age1	3491.18	1451.33	2.405
Age2	2338.28	954.954	2.448
Age3	1971.18	1039.81	1.895
Age4	2152.22	696.748	3.088
Age5	979.325	570.471	1.716
Realised income change	.146961	.038489	3.818
Expected Income change (next 12 mths)	-.08550	.055598	1.537
Expected Income change (next 5 years)	-.00782	.028538	-.274
Plexpdi1 (a)	.084632	.055620	1.521
Plexpdi5 (b)	.016076	.054592	.294
Number of household members	-1422.2	1282.22	1.109
Number of children	2007.10	1393.24	1.440
Rather certain about inc. ch. (next 12 mths)	-550.68	468.422	1.175
Not very certain about inc. ch. (next 12 mths)	95.0793	766.496	.124
Not at all certain about inc. ch. (next 12 mths)	464.041	1195.19	.388
Rather certain about inc. ch. (next 5 years)	-434.25	651.601	.666
Not very certain about inc. ch. (next 5 years)	-655.20	828.411	.790
Not at all certain about inc. ch. (next 5 years)	-1785.8	1866.72	-.956
Wald test of joint signi…cance	381.234 df=26 p=.000		
Sargan test	34.302 df=24 p=.000		
Wald test of joint signi…cance for (a) and (b)	26.404 df=2 p=.000		
Test for …rst-order serial correlation	-4.936 [988] p=.000		
Test for second-order serial correlation	.584 [567] p=.559		

Table 5: The habit formation model of Guariglia and Rossi

Parameter	Coefficient	Std Err	t-value
Constant	7112.06	3792.86	1.875
Lagged saving	.13981	.03613	3.869
Gender	-1515.9	1034.46	1.465
Intermediate/low education	123.319	946.919	.130
Intermediate/high education	305.809	988.474	.309
Vocational education, level 1	-476.16	876.690	.543
Vocational education, level 2	519.959	907.521	.572
Vocational education, level 3	1475.94	964.640	1.530
University education	2257.54	1200.05	1.881
Age1	3450.42	1314.18	2.625
Age2	2267.16	1039.48	2.181
Age3	1435.29	1116.98	1.284
Age4	1309.64	743.275	1.761
Age5	479.581	624.553	.767
Realised income change	.16630	.02941	5.653
Expected income change (next 12 mths)	-.0021	.00029	7.334
Expected income change (next 5 years)	-.0013	.02432	.055
Lagged consumption	.09431	.01262	7.468
Number of household members	-3303.00	1716.69	1.924
Number of children	3525.082	1739.19	2.026
Rather certain about inc. ch. (next 12 mths)	-367.388	482.363	.761
Not very certain about inc. ch. (next 12 mths)	-107.210	754.361	.142
Not at all certain about inc. ch. (next 12 mths)	870.542	1259.65	.691
Rather certain about inc. ch. (next 5 years)	-507.007	657.410	.771
Not very certain about inc. ch. (next 5 years)	-331.132	827.900	.399
Not at all certain about inc. ch. (next 5 years)	-2177.36	1955.21	1.113
Wald test of joint significance	386.695 df=25 p=.000		
Sargan test	35.660 df=23 p=.045		
Test for first-order serial correlation	-4.892 [988] p=.000		
Test for second-order serial correlation	-.085 [567] p=.932		

References

[1] Abel, A. (1990), "Asset Prices under Habit Formation and Catching Up with the Jones, American Economic Review, 40, 38-42.

[2] Alessie, R., Hochguertel, S. and van Soest, A. (2002), "Household Portfolios in the Netherlands", in Guiso, Haliassos and Jappelli (eds.), Household Portfolios, Cambridge, MA: MIT Press.

[3] Alessie, R. and Lusardi, A. (1997), "Consumption, Saving and Habit Formation", Economics Letters, 55, 103-108.

[4] Arellano, M. and Bond, S. (1998), "Dynamic Panel Data Estimation Using DPD98 for GAUSS: A Guide for Users", mimeo.

[5] Attanasio, O. and Weber, G. (1993), "Consumption Growth, the Interest Rate and Aggregation", Review of Economic Studies, 60, 631-649.

[6] Attanasio, O. and Low, K. (2002), "Estimating Euler Equations", NBER Working Paper n. t0253.

[7] Blinder, A. and Deaton, A. (1985), "The Time Series Consumption Function Revisited", Brooking Papers on Economic Activity, 465-521.

[8] Blundell, R., S. Bond and F. Windmeijer (2000), "Estimation in Dynamic Panel Data Models: Improving on the Performance of the Standard GMM Estimators," in B. Baltagi (ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels. Advances in Econometrics, 15, JAI Press, Amsterdam.

[9] Braun, P., Constantinides, G. and Ferson, W. (1993), "Time Nonseparability of Aggregate Consumption: International Evidence", European Economic Review, 37, 897-920.

[10] Caballero, R. (1990), "Consumption Puzzles and Precautionary Savings", Journal of Monetary Economics, 25, 113-136.

[11] Campbell, J. (1987), "Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis", Econometrica, 55 (6), 1249-1273.

[12] Campbell, J. and Cochrane, J. (1999), "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior", Journal of Political Economy, 107, 205-51.

[13] Campbell, J. and Deaton, A. (1989), "Why is Consumption So Smooth?", Review of Economic Studies, 56, 357-374.

[14] Carroll, C. (1997), "Death to the Log-Linearized Consumption Euler Equation! (And Very Poor Health to the Second-Order Approximation)", Advances in Macroeconomics, 1,

[15] Carroll, C., Overland, J. and Weil, D. (2000), "Saving and Growth with Habit Formation", American Economic Review, 90 (3), 341-355.

[16] Constantinides, G. (1990), "Habit Formation: A Resolution of the Equity Premium Puzzle", Journal of Political Economy, 98, 519-543.

[17] Deaton, A. (1987), "Life-Cycle Models of Consumption: Is the Evidence Consistent with the Theory?", in Bewley, T. (ed.), Advances in Econometrics, Fifth World Congress, 2, Cambridge, Cambridge University Press, 121-148.

[18] Deaton, A. (1992), Understanding Consumption, Clarendon Press, Oxford.

[19] Dunn, K. and Singleton, K. (1986), "Modeling the Term Structure of Interest Rates under Non-separable Utility and Durability of Goods", Journal of Financial Economics, 17, 27-55.

[20] Dynan, K. (2000), "Habit Formation in Consumer Preferences: Evidence from Panel Data", American Economic Review, 90 (3), 391-406.

[21] Eichenbaum, M., Hansen, L. and Singletone, K. (1988), "A Time Series Analysis of Representative Agent Models of Consumption and Leisure under Uncertainty", Quarterly Journal of Economics, 103, 51-78.

[22] Ferson, W. and Constatinides, G. (1991), "Habit Persistence and Durability in Aggregate Consumption: Empirical Tests", Journal of Financial Economics, 29, 199-240.

[23] Flavin, M. (1981), "The Adjustment of Consumption to Changing Expectations about Future Income", Journal of Political Economy, 89, 974-1009.

[24] Fuhrer, J. (2000), "Habit Formation in Concumtpion and Its Implications for Monetary-Policy Models", American Economic Review, 90 (3), 367-390.

[25] Gali', J. (1990), "Budget constraints and Time Series Evidence on Consumption", American Economic Review, 81, 1238-1253.

[26] Guariglia, A. and Rossi, M. (2001), "Consumption, Habit Formation and Precautionary saving: Evidence from the British Household Panel Survey", mimeo.

[27] Hausman, J. and Taylor, W. (1981), "Panel Data and Unobservable Individual E¤ects", Econometrica, 49, 1377-1398.

[28] Heaton, J. (1993), "The Interaction Between Time-Nonseparable Preferences and Time Aggregation", Econometrica, 61, 353-85.

[29] Hotz, J., Kydland, F. and Sedlacek, G. (1988), "Intertemporal Preferences and Labor Supply", Econometrica, 56, 335-360.

[30] Jackman, R. and Sutton, J. (1982), "Imperfect Capital Markets and the Monetarist Black Box: Liquidity Contraints, In‡ation and the Asymmetric E¤ects of Interest Rate Policy", The Economic Journal, 92, 108-128.

[31] Kapteyn, A., van de Geer, S., van de Stadt, H. and Wansbeek, T. (1997), "Interdependent Preferences: An Econometric Analysis", Journal of Applied Econometrics, 10, 665-686.

[32] Kydland, F. and Prescott, E. (1982), "Time to Build and Aggregate Fluctuations", Econometrica, 50, 1345-1370.

[33] Lluch, C. (1974), "Expenditure, Savings and Habit Formation", International Economic Review, 15, 786-797.

[34] Mariger, R. (1987), "A Life-Cycle Consumption Model with Liquidity Contraints: Theory and Empirical Results", Econometrica, 55 (3), 533-557.

[35] Meghir, C. and Weber, G. (1996), "Intertemporal Nonseparability or Borrowing Restrictions? A Disaggregate Analysis using a U.S. Consumption Panel", Econometrica, 64, 1151-1181.

[36] Mehra R. and Prescott, E. (1985), "The Equity Premium: A Puzzle", Journal of Monetary Economics, 15, 145-161.

[37] Muellbauer, J. (1988), "Habits, Rationality and Myopia in the Life Cycle Consumption Function", Annales d'Economie et de Statistique, 9, 47-70.

[38] Phlips, L. (1972), "A Dynamic Version of the Linear Expenditure Model", Review of Economics and Statistics, 54, 450-458.

[39] Phlips, L. (1974), Applied Consumption Analysis, Amsterdam, North-Holland.

[40] Pollak, R. and Wales, T. (1969), "Estimation of the Linear Expenditure System", Econometrica, 37, 611-628.

[41] Pollak, R. (1970), "Habit Formation and Dynamic Demand Function", Journal of Political Economy, , .

[42] Pollak, R. (1976), "Habit Formation and Long-Run Utility Functions", Journal of Economic Theory", , .

[43] Seckin, A. (2000), "Consumption with Habit Formation", Cirano Scientific Series, 39.

[44] Spinnewijn, F. (1981), "Rational Habit Formation", European Economic Review, 15, 91-109.

[45] Verbeek, M. (2000), A Guide to Modern Econometrics, Wiley & Son, New York.

[46] Weil, P. (1989), "The Equity Premium Puzzle and the Risk-Free Rate Puzzle", Journal of Monetary Economics, 24, 401-421.

[47] Zeldes, S. (1989), "Consumption and Liquidity Constraints: An Empirical Investigation", Journal of Political Economy, 97, 305-346.