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Unobserved Heterogeneity and Intertemporal Nonseparability: Evidence from Consumption Panel Data[*]

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Abstract

In this paper we analyze the importance of intertemporal non-separabilities for consumption decisions using household data. We follow the test suggested by Meghir and Weber (1996), so we exploit the variability of the within-period marginal rate of substitution (MRS) between commodities. We also check for the presence of liquidity constraints by comparing the results obtained from the MRS to those of the Euler equations. For that purpose, we use a Spanish data set in which households are observed up to eight consecutive quarters. This length of the temporal dimension is crucial, since it allows both to account for the dynamics of consumption in the preferences as well as to control for time invariant unobserved heterogeneity across households. Our results confirm the importance of accounting for fixed effects when analyzing intertemporal consumption decisions allowing for time non-separabilities. Once we control for fixed effects and use the adequate set of instruments we do not find evidence of misspecification and the results yield supporting evidence of habit formation.

Keywords: Consumption, panel data, unobserved heterogeneity, habits, durability.
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1 Introduction

Traditionally the analysis of individual's decisions in a framework where preferences are not separable over time has not been a usual task among applied economists. On the contrary, during the last twenty …ve years, many studies have analyzed the consumption behaviour using separable preference structures. In this paper we build on previous work to analyze the importance of intertemporal non-separabilities for consumption decisions using household data. We follow the approach in Meghir and Weber (1996) and estimate the within-period Marginal Rate of Substitution (MRS) between commodities, which is robust to the presence of credit market imperfections. For that purpose, we use a Spanish data set in which households are observed up to eight consecutive quarters. This represents an important advantage compared to the Consumer Expenditure Survey (CEX) used in Meghir and Weber (1996), since the length of the observation period permits to take into account time invariant unobserved heterogeneity across households ("…xed e¤ects") and, therefore, to account for the dynamics properly. Moreover, a proper set of instruments can be used since additional lagged values of the variables are available.

The assumption of intertemporal separability of preferences does not have a particularly convincing justi…cation beyond the analytical convenience. It is easy to …nd situations in which the assumption of time separability is broken. Two examples of time non-separability are those of durability and of habit formation. In both cases, current utility depends not only on current consumption, but also on lagged consumption. For a given level of current expenditure, larger habits lower utility while durable goods increase it. The explanation for the strong correlation between current and lagged consumption in terms of habits goes back to the relative income hypothesis by Duesenberry (1949). Later, the habit formation analysis was incorporated into dynamic optimization models through intertemporal non-separable preferences (i.e. Kydland and Prescott, 1982, Constantinides, 1990, and recently Boldrin, Christiano and Fisher, 2001).

Many studies have used data on consumption to analyze the implications of time separable preferences.[1] Although recently there has been growing interest in studying the behaviour

[1] See for example Hall and Mishkin (1982), Zeldes (1989) and Attanasio (1999(for a complete list of

when preferences are assumed to be time non-separable, most of the empirical work on time dependence of preferences has been done on aggregate data.[2] Apart from the well-known aggregation problems (see Attanasio and Weber, 1993, Attanasio, 1999, or Blundell and Stocker, 2001), simple life-cycle considerations open a new research agenda for testing these models at the microeconomic level. The lack of empirical microeconomic evidence presumably arises from data availability constraints: many of the available data sets with detailed information on consumption do not provide enough information over time for the same household. Two recent exceptions are the works by Meghir and Weber (1996) and Dynan (2001). Of these two papers, the latter uses yearly information on food consumption from the Panel Study of Income Dynamics (PSID) and finds no evidence of habit formation. However, one of the main drawbacks is that, since the PSID only offers information on food consumption, it is necessary to assume separability between food and the rest of goods and, as emphasized by Browning and Meghir (1991), this is a strong restriction. Moreover, and although many observations per household are available, Dynan (2001) does not account for time invariant unobserved heterogeneity across households in the empirical model. Meghir and Weber (1996), within a richer framework, present a test for habit formation which is robust to the presence of liquidity constraints. Using quarterly data from the CEX, they estimate Euler and MRS equations and find that, when other non-durable commodities are controlled for, there is no evidence of habit persistence in the demand system of food at home, transport and services. Nevertheless, although the CEX does follow households over four consecutive quarters, this is not enough to control for time invariant unobserved heterogeneity. If fixed effects do affect the preference specification, either directly or indirectly through their correlation with other variables affecting preferences, previous evidence is based on inconsistent estimates of the structural parameters of the model.

In this paper we overcome this potential problem and address the importance of the time invariant unobserved heterogeneity across households using data from the Spanish Family Expenditure Survey (Encuesta Continua de Presupuestos Familiares, ECPF).[3] As it has

references.

[2] See for example Ferson and Constantinides, (1991), and Fuhrer, (2000).

[3] This survey has recently attracted international attention (see Browning and Collado, 2001).

been emphasized, the length of the temporal dimension is crucial for studying models which involve complex dynamics. Therefore, the key to identify the structural parameters in the presence of fixed effects is that we can use information up to eight consecutive quarters for some households in the survey.

We estimate a structural model built into a life cycle framework. Rational consumers decide how much to consume when current utility depends on current and lagged consumption levels. This time dependence is modelled using a simple and flexible preference specification. To keep our exercise close to Meghir and Weber (1996), we model three goods: food at home, transport, and services. We estimate the within period MRS between goods, which will depend on past and future quantities of consumption goods under time non-separable preferences. We also estimate the intertemporal Euler equations. Nevertheless, as Meghir and Weber (1996) point out, the absence of dynamics from the Euler equation in itself is not informative since misspecification can bias the dynamic structure to zero. The presence of dynamic effects in the Euler equation can be interpreted as intertemporal nonseparability in preferences only if the same dynamic effects are found in the MRS. Divergence of the results will imply that unobservables are distorting the intertemporal allocations and this would be evidence of binding liquidity constraints. Therefore, and given the purpose of this paper, we mainly focus on the MRS since it allows us to identify time-nonseparabilities even in the presence of liquidity constraints.

In the empirical section we ask whether any direct effects of lagged or leaded consumption on current consumption exists, apart from those generated by the existence of unobserved individual effects. Two sets of estimates are presented. The first one presents the results from the MRS equations without accounting for fixed effects. The second set of results examines the implications of accounting for unobserved individual effects when analyzing the existence of time separabilities. In both cases the results from the Euler equations are also reported.

Our results confirm the importance of accounting for unobserved heterogeneity when analyzing consumption decisions allowing for time non-separabilities: the Sargan test for the validity of instruments in the MRS indicates that, when unobserved heterogeneity is not accounted for, these are correlated with the error term. However, once we control for the fixed effects and use the adequate set of instruments we do not find evidence of misspecification. Therefore, it seems crucial to have enough information per household (at least five observations) in order to account for the dynamics properly. The reason is that fixed effects are correlated with most of the conditionings and they need to be ruled out by a proper transformation of the empirical specification. Moreover, we find evidence of intertemporal non-separabilities in the equations for food and transport, while for services the parameter is not significant at standard levels. The parameters that measure non-separabilities imply habit formation in the three equations, as a priori expected given the goods we model. Moreover, by comparing results from estimating preferences accounting for fixed effects using MRS to those obtained using Euler equations, we obtain that (i) the structure of preferences estimated in both cases is the same for food, (ii) we find no evidence of dynamics when we estimate preferences for transport using the Euler equation, but dynamics are identified when estimating the MRS (this result could be interpreted as evidence of binding liquidity constraints), and (iii) when we estimate the Euler equation for services, we still find no evidence of dynamics.

The paper is organized as follows: Section 2 describes the theoretical model. Section 3 presents a description of our data set. In Section 4 we describe the empirical specification, analyze the sources of error, identification hypotheses, and estimation strategy. The empirical results are discussed in Section 5. Finally, Section 6 presents some concluding remarks.

2 The model

In this section we describe the main ingredients of the approach followed to characterize the intertemporal allocation of consumption. Following Meghir and Weber (1996), we present a model in which borrowing restrictions are present and we focus on the estimation of MRS equations. It is well known that liquidity constraints invalidate the standard Euler equations by introducing dependence on variables in the information set of the consumer. Therefore, in a test based on a single good or a composite of non-durable goods one can never be sure that such dependence in the data comes from liquidity constraints or intertemporal non-separabilities. Nevertheless, this identification problem can be solved by looking at several commodities. It is possible to exploit the fact that MRS between commodities depends on past quantities of consumption if preferences are nonseparable over time, without contamination from the effects due to the presence of liquidity constraints.

Given that the purpose of this paper is to analyze the existence of time-nonseparabilities, we study the dynamic structure of consumption by looking at the MRS. One important difference in our approach is given by the time dimension of our data set compared to the CEX used by Meghir and Weber. This has two important implications: (i) We can properly transform the model to rule out fixed effects (this is important both because fixed effects are correlated with lagged and leaded endogenous variables and because of their potential correlation with demographic variables), and (ii) We can looks for a proper set of instruments, since more lags of the instrumental variables are available.

We limit the study to three non-durable goods: food at home, transport and services.[4] We assume that the household maximizes the present discounted value of a lifetime utility

$$\max E_t \sum_{k=t}^{T} \beta^{k-t} U_k(C_k; C_{k-1}; X_k); \tag{1}$$

where E_t represents the rational expectations operator, $C_t = (c_{1t}; \ldots; c_{nt})$ is a vector of goods, and X captures other family variables including labor supply decisions and other goods which can be nonseparable from the goods we model. The households are subject to the standard dynamic budget constraint:

$$W_{t+1} = (W_t + Y_t - p_t' C_t)(1 + r_t); \tag{2}$$

where W_t represents the beginning of period assets, r_t is the nominal interest rate between periods t and $t+1$, β is the discount factor, p_t is a vector of prices, and Y_t is disposable household income. Finally, as in Zeldes (1989), we define the following function describing

[4] The reason is that these goods cannot generally be used as a means of alleviating liquidity constraints and are generally consumed by all households and hence we minimize the presence of zeros. It also allows for a closer comparison with Meghir and Weber.

liquidity constraints

$$W_{t+1} \geq f(\xi_{it}); \tag{3}$$

where ξ_{it} is a vector of household's characteristics other than consumption decisions.

The optimal allocation of consumption goods can be described by the following first order conditions of the maximization of (1) subject to (2) and (3)

$$\frac{\partial U_t}{\partial c_{jt}} + \beta E_t \frac{\partial U_{t+1}}{\partial c_{jt}} - \beta p_{jt} E_t [(1 + r_t)(\lambda_{t+1} + \phi_t)] = 0; \tag{4}$$

$$\lambda_t = E_t [\beta(1 + r_t)(\lambda_{t+1} + \phi_t)]; \tag{5}$$

where λ_t and ϕ_t represent the multipliers of the budget and the liquidity constraint, respectively. Therefore, the presence of time non-separabilities implies that future utility affects both the MRS between goods as well as the Euler equations. Notice that in the absence of liquidity constraints, $\phi_t = 0$, and we obtain the standard first order conditions. However, the presence of liquidity constraints makes the estimation of the model difficult given that the multipliers are unobservable (see, for instance, Attanasio, 1995, and references therein).

Meghir and Weber (1996) emphasize that the presence of liquidity constraints affects all the goods in the same way, that is through the marginal utility of wealth (λ_t). This can be seen combining espressions (4) and (5) to obtain

$$\frac{\partial U_t}{\partial c_{jt}} + \beta E_t \frac{\partial U_{t+1}}{\partial c_{jt}} = p_{jt} \lambda_t. \tag{6}$$

From (6) it follows that the MRS between two goods in the same period does not depend of the marginal utility of wealth and of the existence of liquidity constraints. Formally, using the optimal allocation of consumption for another good (o) we have:

$$\frac{\partial U_t}{\partial c_{jt}} + \beta E_t \frac{\partial U_{t+1}}{\partial c_{jt}} = \frac{p_{jt}}{p_{ot}} \left[\frac{\partial U_t}{\partial c_{ot}} + \beta E_t \frac{\partial U_{t+1}}{\partial c_{ot}} \right]. \tag{7}$$

Given that we model more than two goods and since the MRS between any two goods depends on all the quantities but only on the relative prices of the two goods, it is possible to identify one MRS from another. In fact, the key to identify one MRS from another crucially depends on the variation of relative prices. Moreover, the time dependence observed in the MRS can be understood in terms of the existence of habits or durability in consumption decisions. These two possibilities depend on the sign of the cross-partial derivatives $\frac{\partial U_{t+1}}{\partial c_{jt}}$, where habit persistence implies that their coefficients are negative and durability implies positive coefficients. The intuition in the habit formation case is that, for a given level of current expenditure, a larger habit stock lowers utility. Durability has essentially the opposite effect (see Ferson and Constantinides, 1991). Estimating the sign of the coefficients addresses the question of which effect is dominant.

Of course, the MRS abstracts from intertemporal substitution effects, i.e. the consumption allocation across goods is independent on the interest rates. Nevertheless, under $\phi_t = 0$; it is still possible to analyze households's intertemporal attitudes using the martingale property of λ_t implied by (5) to derive the Euler equation for each good:

$$\frac{\partial U_t}{\partial c_{jt}} + \beta E_t \frac{\partial U_{t+1}}{\partial c_{jt}} = E_t \left\{ \left[\frac{\partial U_{t+1}}{\partial c_{jt+1}} + \beta E_t \frac{\partial U_{t+2}}{\partial c_{jt+1}} \right] \beta (1 + r_t) \frac{p_{jt}}{p_{jt+1}} \right\} . \tag{8}$$

Thus, while the MRS is robust to the presence of liquidity constraints, this is not true for the Euler equation. Therefore, the analysis of the MRS is informative about the existence of intertemporal non-separabilities without reference to the Euler equation (i.e. to intertemporal substitution attitudes). This is the spirit of the test suggested by Meghir and Weber (1996): the presence of dynamics in the MRS identifies intertemporal non-separabilities, so we should expect the same dynamic effects to be present in the Euler equation in the absence of liquidity constraints. Nevertheless, the absence of dynamics in the MRS and their presence in the Euler equation suggests that liquidity constraints will distort intertemporal allocations (i.e. the estimates of the Euler equation).

Notwithstanding, identification of dynamics in the within period allocation of goods can be influenced by the presence of preference shocks or unobserved heterogeneity. Thus, the empirical specification of preferences requires to properly account for these effects.

3 The data

In a time non-separable framework there exist intrinsic consumption dynamics given that current utility depends on current and lagged consumption. Thus, because of the importance of this temporal dimension, it is crucial to have enough information over time on the same household to test this type of models. In this paper, we use eleven years (1985-95) of a Spanish data set, the Continuous Family Expenditure Survey (hereinafter ECPF). The ECPF is a rotating panel based on a survey conducted by the Spanish National Statistics Office (Instituto Nacional de Estadística, INE). The ECPF reports interviews for about 3,200 households every quarter randomly rotating at 12.5 per cent each quarter. As a result, we can follow a household for a maximum of eight consecutive quarters.

This survey has important advantages over other data sets which have consumption information. The available data sets for the US (the CEX and the PSID) and the UK (Family Expenditure Survey, FES) report information on consumption, income, demographic characteristics and other variables. Nevertheless, in the FES each household is interviewed only once (see Attanasio and Weber, 1993, and Attanasio and Browning, 1993) and the PSID only reports information on food consumption and, therefore, it makes no possible to control for the presence of other goods which may well be nonseparable from food. Attanasio and Weber (1995) show how this can lead to misleading results. By contrast, in the CEX each household is interviewed five quarters, although only four are available (see Attanasio, 1993a and 1993b, for additional details). The ECPF shares with the CEX some structural characteristics, and differs crucially in others. The fact that it is a longer panel represents the main advantage over the CEX. The panel dimension of the CEX is unfortunately very short: four observations per household are not enough to control for a time invariant component in the preference specification. This is precisely the main reason for using the ECPF in order to test the specific model discussed in this paper.

In Table 1 we present the structure of the data in terms of the number of interviews completed by the households. Firstly, we should note that there is some evidence of attrition in the sample. Secondly, during this period, a relatively large number of households complete eight consecutive interviews. Since our results could be affected by attrition bias, we use the unbalanced panel in the estimation process.

Our sample includes married couples (since we want to capture the effect of male and female labour market status on goods consumption), with or without dependent children whose head is aged 25-60 and whose expenditure on the goods we model is positive.[5] To minimize the number of zeros we have aggregate to some extent expenditures on services. We also dropped households with extremely low monetary income (<300 euros). In order to estimate the MRS and Euler equations in levels, we need household information for at least three and four consecutive quarters respectively. In order to estimate the MRS in differences, four observations per household are required, while for the Euler equations we need household information for five consecutive quarters. Therefore, we have excluded those households observed for less quarters than the needed in each case. After filtering the sample we are left with 3,764 and 3,160 households for the estimation of the MRS and Euler equations in levels, respectively. The number of households for the estimation in differences is 1,945 and 1,499, respectively.

In order to keep our analysis as close as possible to Meghir and Weber (1996), we condition on similar goods and characteristics. The goods we explicitly model are food consumed at home, transport and services. Food at home does not include alcohol expenditures. Services include education, medical and other nondurable expenditures. Transport includes public and private transport expenditures, including fuel and maintenance. We also include, and treat as given, a group of nondurable goods composed by clothing and footwear, and nondurable housing expenditures. We refer these group of goods as "collateral goods".[6] Participation dummies, variables for number of children, age and education of the husband and seasonal dummies have been also included. Table A1 in the Appendix reports the mean and the standard deviation of the variables used in the analysis.

Since the intertemporal variability of the relative prices is crucial to have identification, Figure 1 shows the evolution of food and transport prices relative to services for the period considered. As can be seen, both relative prices vary over time and move differently. The

[5] Given the nature of these goods, it is likely that zeros represent coding errors and not corner solutions or infrequency of purchases.

[6] Meghir and Weber (1996) condition on three collateral goods separately.

correlation between them is 0.64, so it seems possible to identify one MRS from another.

Finally, in order to check the quality of the data and the dependence of consumption, we look at the correlation patterns exhibited by the three goods we model in the ECPF over the period 1985-95. We estimate a simple reduced form autoregressive model by OLS for the log of food, transport and services. Table 2 shows the regressions which include seasonal dummies. This shows evidence of correlation of consumption over four consecutive quarters. In what follows we will try to match this autoregressive behaviour within our structural model.

4 Empirical Specification

As noted before, in order to keep our analysis as close as possible to Meghir and Weber (1996), we assume that preferences for the three goods are described by a flexible direct translog utility function modified to allow for time non-separabilities and preference shocks:

$$
\begin{aligned}
U_t \; = \; & \sum_{j=1} \left[\alpha_{jt} c_{jt} + a_j \ln c_{jt} \right] + 0.5 \sum_{j=1} \sum_{k=1} b_{jk} \ln c_{jt} \ln c_{kt} \\
& + \sum_{j=1} \gamma_j \ln c_{jt} \ln c_{jt-1};
\end{aligned}
\tag{9}
$$

where a_j, b_{jk}, and γ_j are coefficients to be estimated and α_{it} are random parameters reflecting preference shocks. This preference specification is very flexible and it allows testing several interesting hypothesis. Intertemporal separability implies that $\gamma_j = 0, \forall j$. Homothetic separability implies $b_{jj} = 0$ for all goods, and $b_{jk} = 0$ for any two goods $(j;k)$ implies additive separability. Given these preferences, the marginal utility of any good h is given by the following expression

$$
MU_{ht} = \left\{ \alpha_{ht} + \frac{a_h}{c_{ht}} + \sum_k b_{hk} \frac{\ln c_{kt}}{c_{ht}} + \gamma_h \frac{\ln c_{ht-1}}{c_{ht}} + \gamma_h \beta E_t \frac{\ln c_{ht+1}}{c_{ht}} \right\} : \tag{10}
$$

In order to estimate the MRS and the Euler equations we use the same normalization restrictions on the coefficients. Therefore, the equations to be estimated take the form:

$$
\frac{1}{p_{jt}} MU_{jt} = \frac{1}{p_{ot}} MU_{ot}; \tag{11}
$$

for the MRS between two goods j and o consumed at period t, and

$$\frac{1}{p_{jt}} MU_{jt} = E_t \left[\frac{(1+r_t)}{p_{ot+1}} MU_{ot+1} \right]; \tag{12}$$

for the Euler equations which relates the good jth at period t to the good oth at period $t+1$, where j represents food and transport, and the numeraire o are services.

Notice that both conditions are linear in known transformed variables, which makes estimation easier. Another approach, frequently used in the literature (see for example Dynan, 2001) could be using the log-linear approximation of the first order conditions. But this approach introduces a conditional variance term in the consumption growth equation and, therefore, is subject to the criticisms raised by Carroll (1992) and Attanasio (1999). In our case, linearity is achieved without imposing constant conditional variance and log-normality in the joint distribution of consumption changes and interest rates (see Hansen and Singleton, 1982). This approach, contrary to the log-transformation, is robust to the existence of the precautionary saving motive.

Finally, we consider that coefficients a_j depend on households's characteristics (Z) as follows:

$$a_{jt} = a_{j0} + \sum_k a_{jk} z_{kt}. \tag{13}$$

Households with different backgrounds or at different stages in their lives may have different preferences for consumption. Therefore, we allow preferences to differ systematically across households with respect to some observable and unobservable household specific variables which are relevant for the intertemporal optimization problem. In our empirical analysis the variables included in the vector Z are the age and education of the head of the household, family composition variables, seasonal dummies, collateral goods and theirs interaction with female labor market status. To estimate the models, the coefficients in the MRS and Euler equations have been normalized by setting the services coefficient a_{o0} equal to 1.[7]

[7] Although a different normalization restriction can be used, our aim to use this one is to keep our analysis as close as possible to Meghir and Weber (1996).

Of particular interest is the labor supply behavior, which is expected to affect the utility derived from consumption. This happens when decisions on consumption and leisure are taken simultaneously, making them to be non-separable. Both research on labor supply and the recent literature on non-durable consumption have controlled for these factors as determinants of the life-cycle shape of consumption (see, for instance, Attanasio and Browning, 1993). Therefore, dummies for the labor force participation of wife and husband have been included within the vector Z. Since these variables should be considered endogenous, we instrument them with their lagged values.[8] Moreover, the goods we model could be non-separable from other goods. These may be market commodities more or less durable, such as clothing or household services. We include these expenditures within the vector Z: We refer these as "collateral" goods. Finally, a dummy for wife's labour market status has been interacted with the quantities of food, transport, services, and collateral goods.

4.1 Stochastic Terms: The role of Unobserved Heterogeneity

4.1.1 Within Period Consumption Allocation: The MRS

In the empirical analysis of the model we have to take into account the presence of two sources of stochastic variability. Firstly, the expectation errors, $u^t_{j,t+1}$, which by assumption of rational expectations are orthogonal to variables dated at time t.[9] Secondly, the existence of preference shocks, ϱ_{jt}.

Thus, under the assumption of rational expectations, the error term of the MRS takes the following form:

$$\varepsilon_{jt}^{MRS} = \left[\frac{\varrho_{ot} + \gamma_o u^t_{ot+1}}{p_{ot}}\right] - \left[\frac{\varrho_{jt} + \gamma_j u^t_{jt+1}}{p_{jt}}\right]. \tag{14}$$

Notice that, under absence of autocorrelation, (14) is orthogonal to information known in period t and to choice variables dated at $t - 1$ or earlier. Therefore, we can take choices dated

[8] Rigidities in the Spanish labour market makes the lagged participation dummies good instruments for contemporaneous ones.

[9] Notice that these errors can be correlated across households, so we cannot rule out the effects of aggregate shocks. However, since we use data for a long time period (1985-1995), we assume that aggregate shocks possibly correlated across households are averaged out.

$t-1$ as instruments (quantities at $t-1$, income at $t-1$, and lagged labour market status), and also demographic composition at period t since it is taken as predetermined. Notice that, because of random preference shocks, choices made in period t are not valid instruments. Meghir and Weber (1996) emphasized that, under the assumption that preferences shocks ϱ_{jt} are purely idiosyncratic and independent across individuals, prices dated at t can be considered as strictly exogenous and information on prices at time t and earlier can also be used as valid instruments. Additionally, notice that the two MRS equations we estimate (food at t versus services at t and transport at t versus services at t) contain a common set of coefficients. Imposing the equality of them provides additional overtidentifying restrictions. We will refer to the estimation of these equations as estimates in "levels" since, as will be clearer below, we do not allow for the presence of unobserved heterogeneity affecting the preference specification.

Nevertheless, the existence of time invariant unobserved heterogeneity affecting the preference shocks, leads to inconsistent estimates of the equation in levels. The reason is that choices dated $t-1$ are not valid instruments. Specifically, let's assume that preference shocks for individual h can be written as follows:

$$\varrho_{jt}(\eta^h) = \eta^h + \vartheta^h_{jt}, \tag{15}$$

$$\varrho_{ot}(\eta^h) = \eta^h + \vartheta^h_{ot}, \tag{16}$$

where there are permanent shocks (η^h) affecting household's consumption choice (the superscript h is an index for households). Under the previous assumptions we can rewrite the error term ε^{MRS}_{jt} as follows:

$$\varepsilon^{MRS}_{jt}(\eta^h) = \eta^h \left[\frac{1}{p_{ot}} - \frac{1}{p_{jt}}\right] + \left[\frac{\vartheta^h_{ot} + \gamma_o u^{t,h}_{ot+1}}{p_{ot}}\right] - \left[\frac{\vartheta^h_{jt} + \gamma_j u^{t,h}_{jt+1}}{p_{jt}}\right]. \tag{17}$$

Notice that the presence of fixed effects makes choice variables in any period invalid instruments. It is evident from the previous expression that first differencing the equation does not eliminate the fixed effects. Thus, in order to drop out the fixed effect, we define the variable $\kappa^M_{jt} = \left[\frac{1}{p_{ot}} - \frac{1}{p_{jt}}\right]$. Then, if one multiplies the MRS at time t by κ^M_{jt-1} and that at time $t-1$ by κ^M_{jt}, the difference between the two expressions yields the following expression for the error term that is independent of the fixed effects:

$$\varepsilon^{MRS}_{jth} = \left[\frac{\vartheta^h_{ot} + \gamma_o u^{t;h}_{ot+1}}{p_{ot}}\right]\kappa^M_{jt-1} - \left[\frac{\vartheta^h_{ot-1} + \gamma_o u^{t-1;h}_{ot}}{p_{ot-1}}\right]\kappa^M_{jt} - \left[\frac{\vartheta^h_{jt} + \gamma_j u^{t;h}_{jt+1}}{p_{jt}}\right]\kappa^M_{jt-1} + \left[\frac{\vartheta^h_{jt-1} + \gamma_j u^{t-1;h}_{jt}}{p_{jt-1}}\right]\kappa^M_{jt}. \tag{18}$$

We will refer to this transformation as the estimates in "differences". In this case, the error of the differenced equation is orthogonal to the choice variables dated $t-2$ and earlier, and we can use them as valid instruments.

4.1.2 Intertemporal Consumption Allocation: The Euler Equation

The error term of the Euler equation takes the following form:

$$\varepsilon^E_{jt} = \left(\frac{-\varrho_{ot+1}(1+r_t)}{p_{ot+1}} - \frac{\varrho_{jt}}{p_{jt}}\right) + u^t_{o;t+1} + u^t_{o;t+2} - u^t_{j;t+1}. \tag{19}$$

As usual, the error term has a MA(1) structure. As in the case of the MRS, in absence of fixed effects the error term is orthogonal to information known in period t and to choice variables dated at $t-1$ and earlier. Nevertheless, under the specifications for preference shocks (15) and (16), the error term for individual h can be expressed as follows:

$$\varepsilon^E_{jt}(\eta^h) = \eta^h\left(\frac{-(1+r_t)}{p_{ot+1}} - \frac{1}{p_{jt}}\right) + \left[\frac{-\vartheta^h_{ot+1}(1+r_t)}{p_{ot+1}} - \frac{\vartheta^h_{jt}}{p_{jt}}\right] + u^{t;h}_{o;t+1} + u^{t;h}_{o;t+2} - u^{t;h}_{j;t+1}. \tag{20}$$

In this case choice variables do depend on the error term and, therefore, can not be used as valid instruments.

In order to account for the presence of fixed effects we proceed along the lines suggested for the MRS. In particular, we define the variable $\kappa^E_{jt} = \left[\frac{-(1+r_t)}{p_{ot+1}} - \frac{1}{p_{jt}}\right]$, then if one multiplies the Euler equation at time t by κ^E_{jt-1} and that at time $t-1$ by κ^E_{jt}, the difference between the two expressions does not depend on the fixed effects. Therefore, choice variables dated at $t-2$ and earlier can be used as instruments in order to obtain consistent estimates of the structural parameters. Notice that since services related variables are now dated at $t+1$, more instruments are available for the Euler equations than for the MRS, for which services variables are dated at t. Nevertheless, the same set of instruments have been used in both cases. Cross-equation restrictions provide again additional overidentifying restrictions.[10]

4.2 Estimation

The two models we estimate consist of two equations each: food versus services and transport versus services. For the MRS all equations are dated at t, while for the Euler equations services are dated at $t+1$. Estimation is performed using the generalized method of moments (GMM, see Hansen (1982)). Let's define an error term ε_{jht} for the jth equation and individual h in period t, such that

$$E_t(\varepsilon_{jht} \mid I_{ht}) = 0; \tag{21}$$

where $E_t(.)$ denotes the conditional expectation given information at time t and I_{ht} is an instrument uncorrelated with ε_{jht}. Therefore we have the following set of orthogonality conditions:

$$E_t(\varepsilon_{jht} I_{ht}) = 0. \tag{22}$$

These orthogonality conditions define the estimator. The GMM estimates are based on minimizing the quadratic form $\sum_j \varepsilon_j' A \varepsilon_j$, where $A = L(L'L)^{-1}L$, being L the matrix of instruments. Hansen (1982) and Arellano and Bond (1991) discussed the weighting matrix A and provided conditions under which the parameter estimates are consistent and asymptotically normal and the minimized value of the quadratic form is asymptotically chi-square under the null hypothesis.

For the MRS representation the error term of the equation in levels has the following

[10] Notice that, in order to estimate both the MRS and the intertemporal Euler conditions using the same normalization restrictions on the coefficients, we estimate Euler equations in which services are dated at $t+1$ and food and transport are dated at t. Nevertheless, other Euler equations could have been chosen (for example, food dated at $t+1$ and transport and services dated at t).

form (dropping the h subscript denoting individuals):

$$\varepsilon_{jt} = \frac{1}{e_{ot}} - \frac{a_{j0}}{e_{jt}} - \sum_k a_{jk}\left(\frac{z_{kt}}{e_{jt}}\right) - \sum_s b_{sj}\left(\frac{\ln x_{st}}{e_{jt}}\right) + \sum_k a_{ok}\left(\frac{z_{kt}}{e_{ot}}\right) + \sum_s b_{so}\left(\frac{\ln x_{st}}{e_{ot}}\right)$$
$$- \gamma_{j1}\frac{\ln x_{jt-1}}{e_{jt}} - \gamma_{j2}\frac{\ln x_{jt+1}}{e_{jt}} + \gamma_{o1}\frac{\ln x_{ot-1}}{e_{ot}} + \gamma_{o2}\frac{\ln x_{ot+1}}{e_{ot}}; \quad (23)$$

for j equal to food and transport. In (23) e_{jt} is the nominal expenditure on good j, x_{jt} is the quantity for good j, and z_{kt} represents household composition variables and the rest of the variables included in the estimation. The parameters of good "o" (services) appear in both equations and we have imposed the normalization restrcition that $a_{o0} = 1$.

To estimate this system, we first minimize the quadratic form for j = food/services, transport/services to obtain parameter estimates with no cross-equation restrictions. We then apply minimum distance to the unrestricted coefficients to impose the cross-equation restrictions given by the theoretical model and to recover the structural parameters. First of all, we impose the equality of the parameters of the services equation across the two MRS and the two Euler equations. Secondly, symmetry is imposed (i.e. the effect of food on transport and services is imposed to be equal to the effect of transport and services on food, and the effect of transport on services is imposed to be equal to the effect of services on transport). Finally, we impose equality of the parameters for the lag and lead of quantities in each equation, which is also a restriction given by our theoretical model (see equations (4) and (5)).

Similarly for the Euler equation we have

$$\varepsilon_{jt} = \frac{R_t}{e_{ot+1}} - \frac{a_{j0}}{e_{jt}} - \sum_k a_{jk}\left(\frac{z_{kt}}{e_{jt}}\right) - \sum_s b_{sj}\left(\frac{\ln x_{st}}{e_{jt}}\right) +$$
$$\sum_k a_{ok}\left(\frac{z_{kt+1}R_t}{e_{ot+1}}\right) + \sum_s b_{so}\left(\frac{\ln x_{st+1}R_t}{e_{ot+1}}\right)$$
$$- \gamma_{j1}\frac{\ln x_{jt-1}}{e_{jt}} - \gamma_{j2}\frac{\ln x_{jt+1}}{e_{jt}} + \gamma_{o1}\frac{\ln x_{ot}R_t}{e_{ot+1}} + \gamma_{o2}\frac{\ln x_{ot+2}R_t}{e_{ot+1}}; \quad (24)$$

where j = food and transport and $R_t = \beta(1 + r_t)$. Conditional on the discount factor, β, the estimation problem is linear. We do not explicitly estimate the discount factor, but we tried several different values. In particular, the results we present are obtained for $\beta = 0.99$.[11] The equation contains the same conditioning characteristics as the MRS.

[11] Nevertheless, the results are robust to small changes of the discount factor β (i.e. 0.995 or 0.997). Esti-

Regarding the equations in differences, we have the same type of expressions, but with the variables defined as explained in previous section.

Concerning the testing of the theoretical restrictions, Sargan test for overidentyfing restrictions are also reported. Given that we estimate models in "differences" in order to account for the possible presence of fixed effects, Sargan statistics for instrument validity would provide evidence of significant correlation between the instruments and the error term. If correlated heterogeneity is important, the Sargan test should detect this problem in the estimation in levels.

5 Results

In this section we report the results of the estimation of the models described in the previous section. Two sets of estimates are presented. The first one contains the estimates of the MRS in levels, since we are interested in the comparison with the results in Meghir and Weber (1996). The second set of results examines the presence of dynamics in the MRS after controlling for unobserved heterogeneity. In all cases, estimates of the Euler equations are also presented, in order to see if the conclusions obtained from the MRS estimates are confirmed, together with the relevant tests for the overidentifying restrictions. We only present the structural estimates, that is, the estimates once all within and cross equations restrictions are imposed. Finally, the implicit within period income and price elasticities have been also computed.

5.1 Estimation in Levels

Table 3 reports the results from the estimation of the MRS for food, transport and services. The set of instruments includes: dummies for education, number of children, age and age squared of the husband, seasonal dummies, prices of all goods ant interest rate, dated at

mates conditional on an assumed value for β are less efficient than the joint estimation of all the parameters in the model including β (see Novales, 1985), but also less reliable for the accuracy of estimates of the rest of the structural parameters.

t. Prices and interest rate have also been included dated at $t - 1$,[12] together with labour market status of the spouses, quantities of all goods, income and some interactions of income with demographics. Most of the above are also included divided by expenditures on food, transport and services dated at $t - 1$ to match as much as possible the specifications we estimate.

The first interesting result is that the Sargan test for the validity of instruments (before imposing cross equation restrictions) is high both for the food/services and transport/services MRS. The test statistic for food/services MRS gives a value of 125.17, while for transport/services it is 76.97. The 5 percent critical value from the chi-squared for 21 degrees of freedom is 32.67, providing evidence of a significant correlation between the instruments and the error term. Therefore, this result is consistent with the presence of correlated fixed effects, which leads to rejection of the null hypothesis of the validity of the instruments. The Euler equations (see Table 4) reproduce previous result that from the Sargan overidentifying restrictions test it appears that the instruments are correlated with the error term, possible due to the presence of fixed effects. These results are in line with those reported by Meghir and Weber (1996), which also lead to strong rejection of the overidentifying restrictions.

Notwithstanding these results indicate some potential problems, we can analyze the dynamic structure derived from the models with this preference specification. We first focues on the estimated dynamic structure. Specifically, we are interested in testing intertemporal separability, that is, $\gamma_j = 0, \forall j$: The relevant parameters are those on the log of lagged and leaded consumption, $\ln c_{t-1}$ and $\ln c_{t+1}$, where c is food, transport or services, depending on the equation we are considering. Since female and, especially, male labour market status are quite persistent in Spain, we first estimate the MRS and Euler equations removing the labour market status variables from the specification. Nevertheless, the omission of these variables can lead to seriously incorrect inferences due to lack of separability (see Browning and Meghir, 1991). As in Meghir and Weber (1996), we do not include female and male labour supply in the utility function, but we condition on it. When these variables are included there is evidence that preferences are intertemporally separable: the sets of para-

[12] Meghir and Weber (1996) also include among the set of instruments prices dated at t and $t - 1$, since they are considered exogenous.

meters are not significant individually, so habit formation would be rejected. Moreover, this result still holds when we consider the Euler equation: we cannot reject the null hypothesis of intertemporal separability. The fact that the Euler equation results are compatible with the ones derived from the MRS might be viewed as supporting evidence of no liquidity constraints. At this point, it is important to note that our results do not differ from those in Meghir and Weber (1996). Using a similar estimation strategy and a similar set of instruments, they find that the dynamic structure of preferences implied by the Euler equation is the same as the one implied by the MRS. Hence, they conclude that there is no significant evidence of liquidity constraints.

Using the MRS equations we can also test whether additive separability is a valid assumption for the group of goods we model. That is, the hypothesis that the coefficients $b_{jk} = 0$. The t-statistics for the relevant hypothesis show that the effect of transport and services on food is significant, while the effect of services on transport is not. Moreover, the hypothesis that these goods are in turn separable from the collateral goods can not be rejected according to the t-statistics. Finally, from our results the hypothesis of homothetic separability ($b_{jj} = 0$) can not be rejected. All these results are in line with Meghir and Weber (1996). Nevertheless, as noted in the theoretical section, they could be potentially biased due to spurious dependence, since individual heterogeneity has not been properly accounted for. This issue will be considered in the next section.

5.2 Estimation in Differences: The role of Unobserved Heterogeneity

In this subsection we concentrate on the estimation of models including unobserved heterogeneity in the preference specification as presented in Section 4.1. Our main aim is to see whether there is a difference between dynamic patterns of households depending upon whether unobserved heterogeneity is controlled for or not. Since the effects obtained previously could be in part attributed to fixed effects which introduce a bias in the estimated coefficients, we shall focus on the results that account for correlated unobserved heterogeneity across households. Table 5 contains the estimates for the MRS equations. As explained before, the set of instruments include quantities, nominal expenditures, prices and income in period t ¡ 2. As in the estimates in levels, prices have been included among the set of instruments used in the estimates in di¤erences presented in Table 4. As it has been pointed out previously, this is the approach followed by Meghir and Weber (1996), since prices are considered exogenous. Nevertheless, one could think that prices are not valid instruments, since they appear in the error term. Therefore, in this case, prices dated at period t and t ¡ 1 should not be included among the set of instruments, and only prices dated at period t ¡ 2 and earlier are valid instruments.

As shown in Table 5, the model is not rejected by the Sargan test: in the MRS the test statistic for food/services is 92:17, which at 60 degrees of freedom the 5 percent critical value from the chi-squared is 79:08. For transport/services, the Sargan test in the MRS is 92:06. These results suggest the potential importance that the control for the unobserved heterogeneity has: once it is taken into account, the model is adequately transformed and the instruments are properly selected, there is no clear evidence of misspeci…cation. This result is di¤erent form the one obtained when the preference speci…cation does not account for time invariant e¤ects.

Regarding the hypothesis of intertemporal separability, the estimated parameters from the MRS are signi…cant individually for food and transport, con…rming the existence of habit formation in this case,[13] while the data show evidence of intertemporal separability for services. Wald test for the joint signi…cance of the dynamics in the MRS equation (see Table 7) takes value of 11:05, which should be compared to a Â^2 with 3 degrees of freedom. The 5% per cent critical value is 7:81. This result implies that there is evidence that preferences are nonseparable over time, for food and transport, once we have allowed preferences to be nonseparable across goods and labour market variables.

It is interesting to point out that the dynamic e¤ects obtained from the Euler equations (see Table 6) also o¤er evidence of habit formation in food, while there is no evidence that preferences are nonseparable over time for transport and services. The fact that the dynamic structure from the Euler equation is compatible with the one from the MRS for food

[13] Notice that, although durability is theoretically possible, we are modelling non-durable goods, so this possibility should not appear.

consumption do not indicate the presence of liquidity constraints in this case. Nevertheless, in the case of transport the result is consistent with the (alternative) hypothesis that the Euler equations are misspecified and that liquidity constraints might be empirically important even after controlling for fixed effects.[14] This poses some doubts on the results obtained over a broader category of non-durable goods. That is to say, modelling just one category of goods could have important consequences on the results. Besides the lack of control for fixed effects, this could be also one of the reasons for the results in Dynan (2001).

As in the estimates in levels, it is interesting to look at the separability across goods. The assumption that utility is separable in the goods we explicitly model and other types of expenditures could give rise to spurious dynamics. Looking at the coefficients, there is no evidence of homothetic separability. Regarding the within period separability between goods, we find evidence of nonseparability between food, transport, services and other expenditures (collateral goods), both in the context of the MRS and the Euler equations. In Table 7 we present the relevent Wald test for these hypotheses. It is clear that all separability assumptions are rejected.

As regards the effect of labour market variables, we obtain a significant effect in the MRS and Euler representations. In Table 7 we present Wald test for the significance of the coefficients of the MRS equations that relate to labour market status. The test has 16 degrees of freedom and strongly reject the null. From this result it is evident that labour market variables are highly significant. Quantitatively the effect of female labour market status is also quite large.

Finally, using the results of the estimated models in levels an differences, we have calculated the within period total expenditure elasticities and the price elasticities. Table 8 shows that the elasticities have the expected signs and size. As it can be seen, price and income elasticities for food consumption are clearly smaller than one in absolute value, while these elasticities are close to one for transport and grater than one for services. Moreover, in Table 9 we show the same type of calculations, but using the estimated coefficients for the MRS in levels. The comparison with Table 8 shows that the results are quite different.

[14] Cutanda (2001) finds evidence of liquidity constraints in an Euler equation for non-durable goods using the same data.

When unobserved heterogeneity is not accounted for, the size of the elasticities for food are quite high.

6 Conclusions

In this paper we analyze the importance of accounting for time invariant unobserved heterogeneity when analyzing the existence of intertemporal non-separabilities in consumption decisions. For that purpose, it is crucial to have a data set with household level information for a enough number of periods in order to consistently estimate the Euler equations or the MRS conditions. Using data from the Spanish Continuous Family Expenditure Survey, our principal findings can be summarized as follows:

(a) When time invariant unobserved heterogeneity is not taken into account,we find evidence that preferences are intertemporally separable. This result is obtained both from the MRS and Euler equations. Moreover, the large Sargan tests of overidentifying restrictions shows evidence of misspecification.

(b) Once fixed effects are controlled for, the results yield evidence of habit formation for food consumption and transport. In this case, the Sargan test does not detect significant correlation between the instruments and the error terms.

These results show the importance of distinguishing between which has been called in the literature "true" and "spurious" state dependence (see Heckman (1981)). Improper treatment of unmeasured variables could give rise to a relationship between future and past actions due solely to uncontrolled heterogeneity. However, it might well be the case that individuals have different "propensities" for having different consumption behaviour, independently of the level of consumption in previous periods. These propensities are what we have identified as time invariant unobserved heterogeneity, or habit formation in nondurable consumption.

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Appendix

Data Source:

Rotating panel from the Spanish Continuous Family Expenditure Survey ("Encuesta Contínua de Presupuestos Familiares") from 1985:I to 1995:IV, provided by the National Statistical O¢ce (Instituto Nacional de Estadística, INE). The consumption information in this data set is very detailed. In each of the eight interviews, the person of reference is asked to report expenditures for the three preceding months on more than 300 di¤erent categories.

Variables:

Education: There exists information on the degree of education received by the head of the household. It is grouped in the following categories: Illiterate and no schooling, Primary education, Secondary education, and University education.

Number of children: Variable for number of children younger than 14.

Husband's labour market situation: Dummy equals 1 if the husband is employed and 0 otherwise.

Wife's labour market situation: Dummy equals 1 if the wife is employed and 0 otherwise.

Family Income: Total monetary income.

Interest Rates: Nominal interest rates are a weighted average of the di¤erent amount borrowed by households from banks and saving banks (see Cuenca, 1994 for details).

Table A1.

Descriptive Statistics

(Unbalanced Panel)

Variables	Mean	Std. Deviation
Husband's Age	36.19	7.45
Wife's Age	33.69	7.69
Family Characteristics		
Couples No Children	0.10	0.29
Number of Children < 14	1.90	1.04
Educational Attendance		
Illiterate and No Schooling	0.06	0.23
Primary Education	0.40	0.49
Secondary Education	0.40	0.47
University Education	0.14	0.35
Husband Employed	0.95	0.22
Wife Employed	0.32	0.47
Number of observations	14003	

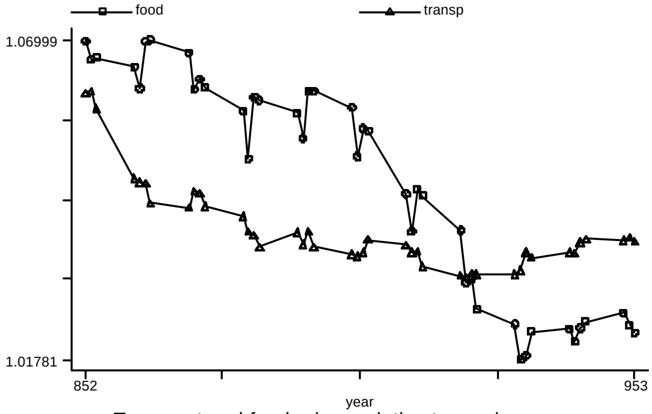
Table 1. Completed Consecutive Interviews

Number of Interviews	Percentage of households
1	15.46
2	10.86
3	9.13
4	10.42
5	10.29
6	8.65
7	8.28
8	26.90
Total	100.00

Table 2. Autoregressive Models

	Food	Transport	Services
Food$_{t-1}$	0.2122 (0.018)	0.0621 (0.035)	0.0392 (0.028)
Food$_{t-2}$	0.1490 (0.019)	0.0120 (0.037)	0.0072 (0.029)
Food$_{t-3}$	0.1635 (0.021)	-0.0295 (0.039)	0.0324 (0.031)
Food$_{t-4}$	0.2382 (0.019)	-0.0399 (0.037)	-0.0242 (0.029)
Transport$_{t-1}$	0.0078 (0.009)	0.2213 (0.018)	0.0214 (0.014)
Transport$_{t-2}$	-0.0025 (0.009)	0.1622 (0.018)	-0.0180 (0.014)
Transport$_{t-3}$	-0.0132 (0.010)	0.1299 (0.019)	0.0223 (0.015)
Transport$_{t-4}$	-0.0066 (0.010)	0.1922 (0.019)	0.0082 (0.015)
Services$_{t-1}$	0.0016 (0.013)	0.0671 (0.025)	0.2720 (0.019)
Services$_{t-2}$	0.0128 (0.013)	0.0570 (0.025)	0.1691 (0.020)
Services$_{t-3}$	0.0064 (0.013)	0.0070 (0.024)	0.1760 (0.019)
Services$_{t-4}$	0.0183 (0.013)	-0.0421 (0.024)	0.2162 (0.019)
Seasonal dummies included			
Number of observations		2606	

Note: Standard errors in parenthesis



Transport and food prices relative to services

Figure 1:

Table 3. Marginal Rate of Substitution Function

	Estimates in Levels		
	Food	Transport	Services
Food	-0.0527		
	(0.0387)		
Transport	-0.0390	0.0066	
	(0.0184)	(0.0073)	
Services	-0.1068	0.0038	0.0054
	(0.0182)	(0.0076)	(0.0121)
Food*Wife Works	0.1713		
	(0.0484)		
Transport*Wife Works	0.0656	0.0104	
	(0.0423)	(0.0157)	
Services*Wife Works	0.2595	-0.0268	0.0454
	(0.0927)	(0.0219)	(0.0576)
Collaterals	-0.0284	-0.0187	-0.0375
	(0.0865)	(0.0231)	(0.0198)
Collaterals*Wife Works	-0.0803	0.0420	0.1230
	(0.2336)	(0.0475)	(0.0912)
Age	0.0012	0.0001	0.0007
	(0.0027)	(0.0005)	(0.0009)

Table 3. Continued

	Food	Transport	Services
Illiterate and No School.	-0.1583	-0.0201	-0.0454
	(0.0897)	(0.0156)	(0.0234)
Secondary Educ.	-0.0373	-0.0115	-0.0375
	(0.0480)	(0.0098)	(0.0210)
University Educ.	-0.0290	-0.0032	-0.0167
	(0.0558)	(0.0164)	(0.0397)
Children<14	-0.0266	-0.0048	-0.0111
	(0.0144)	(0.0039)	(0.0066)
Wife Works	-2.5847	-0.5870	-2.7127
	(1.5586)	(0.3973)	(0.7807)
Husband Works	0.0092	0.0105	0.0157
	(0.1325)	(0.0321)	(0.0424)
$\ln c_{t-1} = \ln c_{t+1}$	-0.0088	0.0005	0.0006
	(0.0129)	(0.0025)	(0.0043)
Constant	3.0564	3.8895	1.0
	(9.2118)	(0.7522)	(-)
Efficient Sargan test (21 d.o.f)	125.17	76.97	
Number of observations	14003	14003	

Note: Quarterly dummies included. Standard errors (robust to heteroskedasticty) in parentheses.

Table 4. Intertemporal Euler Equations

	Estimates in Levels		
	Food	Transport	Services
Food	0.0037		
	(0.0321)		
Transport	-0.0548	-0.0015	
	(0.0505)	(0.0078)	
Services	-0.0984	-0.0094	0.0139
	(0.0718)	(0.0121)	(0.0127)
Food*Wife Works	0.0695		
	(0.0534)		
Transport*Wife Works	0.1235	-0.0026	
	(0.1354)	(0.0135)	
Services*Wife Works	0.1777	-0.0065	-0.0132
	(0.1963)	(0.0231)	(0.0431)
Collaterals	-0.0387	-0.0093	-0.0453
	(0.0689)	(0.0215)	(0.0129)
Collaterals*Wife Works	0.2393	0.1157	0.2857
	(0.2368)	(0.0552)	(0.0996)
Age	-0.0033	-0.0004	-0.0005
	(0.0025)	(0.0007)	(0.0009)
Age^2	-0.0006	-0.0001	-0.0001
	(0.0002)	(0.0001)	(0.0001)

Table 4. Continued

	Food	Transport	Services
Illiterate and No School.	-0.0522	0.0014	-0.0263
	(0.0913)	(0.0196)	(0.0218)
Secondary Educ.	0.0120	-0.0048	-0.0134
	(0.0401)	(0.0101)	(0.0217)
University Educ.	-0.0997	-0.0269	-0.0849
	(0.0575)	(0.0176)	(0.0418)
Children<14	-0.0106	-0.0017	-0.0033
	(0.0166)	(0.0051)	(0.0080)
Wife Works	-4.2561	-1.3786	-3.2528
	(1.4578)	(0.3698)	(0.6616)
Husband Works	-0.1320	-0.0515	-0.0879
	(0.1386)	(0.0373)	(0.0442)
$\ln c_{t-1} / \ln c_{t+1}$	-0.0228	0.0032	0.0033
	(0.0171)	(0.0037)	(0.0086)
Constant	-10.7699	-4.6802	1.0
	(5.8944)	(1.6633)	(-)
Efficient Sargan test (21 d.o.f)	42.97	57.73	
Number of observations	10239	10239	10239

Note: Quarterly dummies included. Standard errors (robust to heteroskedasticty) in parentheses.

Table 5. Marginal Rate of Substitution Function

	Estimates in Di¤erences		
	Food	Transport	Services
Food	0.0134		
	(0.0109)		
Transport	-0.0513	0.0188	
	(0.0059)	(0.0052)	
Services	-0.0054	-0.0057	0.0064
	(0.0051)	(0.0020)	(0.0024)
Food*Wife Works	0.0138		
	(0.0120)		
Transport*Wife Works	0.0438	-0.0267	
	(0.0081)	(0.0067)	
Services*Wife Works	0.0505	0.0076	0.0065
	(0.0192)	(0.0035)	(0.0131)
Collaterals	-0.0517	-0.0981	-0.0071
	(0.0113)	(0.0082)	(0.0035)
Collaterals*Wife Works	0.0598	0.1016	0.0053
	(0.0257)	(0.0115)	(0.0144)
Age	-0.0049	-0.0005	0.0002
	(0.0018)	(0.0006)	(0.0003)
Age^2	-0.0008	-0.0004	-0.0006
	(0.0002)	(0.0007)	(0.0002)

Table 5. Continued

	Food	Transport	Services
Illiterate and No School.	0.0695	-0.0432	0.0057
	(0.0444)	(0.0186)	(0.0059)
Secondary Educ.	-0.0154	0.0223	0.0112
	(0.0249)	(0.0082)	(0.0056)
University educ.	-0.1769	-0.0255	-0.0205
	(0.0299)	(0.0395)	(0.0109)
Children<14	-0.0114	-0.0031	0.0015
	(0.0094)	(0.0044)	(0.0027)
Wife Works	-1.1415	-0.9919	-0.4663
	(0.2253)	(0.1107)	(0.1733)
Husband Works	-0.0290	-0.0472	-0.0155
	(0.0218)	(0.0207)	(0.0057)
$\ln c_{t-1} = \ln c_{t+1}$	-0.0102	-0.0039	-0.0004
	(0.0040)	(0.0017)	(0.0009)
Constant	0.7240	3.9299	1.0
	(0.3006)	(0.2534)	(-)
Efficient Sargan test (60 d.o.f)	92.17	92.06	
Number of observations	4551	4551	4551

Note: Quarterly dummies included. Standard errors (robust to heteroskedasticty) in parentheses.

Table 6. Intertemporal Euler Equations

	Estimates in Di¤erences		
	Food	Transport	Services
Food	-0.0094		
	(0.0082)		
Transport	-0.0409	0.0148	
	(0.0052)	(0.0055)	
Services	-0.0164	-0.0044	0.0055
	(0.0041)	(0.0015)	(0.0031)
Food*Wife Works	0.0191		
	(0.0128)		
Transport*Wife Works	0.0306	-0.0127	
	(0.0128)	(0.0080)	
Services*Wife Works	0.0063	0.0062	-0.0005
	(0.0172)	(0.0044)	(0.0113)
Collaterals	-0.0125	-0.0721	-0.0010
	(0.0101)	(0.0084)	(0.0045)
Collaterals*Wife Works	0.0489	0.0753	0.0085
	(0.0291)	(0.0133)	(0.0160)
Age	-0.0064	0.0003	0.0004
	(0.0015)	(0.0007)	(0.0003)
Age^2	-0.0009	-0.0004	-0.0003
	(0.0002)	(0.0001)	(0.0003)

Table 6. Continued

	Food	Transport	Services
Illiterate and No School.	0.0275	0.0030	-0.0051
	(0.0555)	(0.0454)	(0.0057)
Secondary Educ.	-0.0438	0.0292	-0.0183
	(0.0185)	(0.0165)	(0.0066)
University educ.	-0.1631	0.0508	-0.0116
	(0.0290)	(0.0549)	(0.0302)
Children<14	0.0085	-0.0096	0.0042
	(0.0132)	(0.0071)	(0.0022)
Wife Works	-0.6501	-0.7340	-0.1396
	(0.2635)	(0.1386)	(0.1831)
Husband Works	-0.0497	-0.0140	-0.0052
	(0.0177)	(0.0165)	(0.0069)
$\ln c_{t-1} = \ln c_{t+1}$	-0.0230	-0.0020	0.0012
	(0.0045)	(0.0025)	(0.0009)
Constant	0.7948	2.2126	1.0
	(0.1095)	(0.2700)	(-)
Efficient Sargan test (60 d.o.f)	95.89	63.79	
Number of observations	2606	2606	2606

Note: Quarterly dummies included. Standard errors (robust to heteroskedasticty) in parentheses.

Table 7. Diagnostics. MRS (Di¤erences)

Test for Intertemporal Separability	11.05 (3 d.o.f)
Test for Additive Separability	96.84 (6.d.o.f)
Separability from Collateral Goods	32.04 (3 d.o.f)
Signi…cance of Labor Market Variables	1277.55 (16 d.o.f)

Table 8. Within Period Elasticities (Di¤erences)

	Price Elasticity			Income Elasticity		
	Food	Transport	Services	Food	Transport	Services
Mean	-0.69	-0.97	-1.10	0.68	0.97	1.54
Q25	-0.90	-0.99	-1.09	0.63	0.97	1.14
Q50	-0.75	-0.98	-1.06	0.75	0.98	1.22
Q75	-0.63	-0.97	-1.04	0.90	0.99	1.39

Table 9. Within Period Elasticities (Levels)

	Price Elasticity			Income Elasticity		
	Food	Transport	Services	Food	Transport	Services
Mean	-1.15	-1.06	-0.33	1.14	1.06	0.22
Q25	-1.32	-1.05	-0.91	0.89	1.02	0.002
Q50	-1.18	-1.03	-0.25	1.18	1.03	0.09
Q75	-0.89	-1.02	-0.01	1.32	1.05	0.74

Note: Qi is the ith percentile.