# Reading Notes
# "Consumption and Habits: Evidence from Panel Data"

The previous literature discovered the inconsistency between the empirical results and the prediction of models whose preferences included are intertemporally separable. The estimations of these models provided some issues especially about the smoothness of consumption growth. To solve these issues, there is an increasing interest on habit formation, or habit persistence, which suggests that preferences should be assumed as time non-separable.

In addition, the previous studies used some aggregate data sets which contain limited consumption related information. Although some studies did have enough information on consumption and built their evidence on habit persistence, most of them ignored the importance of time invariant unobserved heterogeneity, which led to the inconsistent estimates.

This paper improves the previous empirical works by putting time invariant unobserved heterogeneity across households into consideration when testing whether preferences are time non-separable. By using a special data set which includes household level information up to eight consecutive quarters, the authors estimate the within period marginal rate of substitution and the intertemporal Euler equation on three non-durable goods "food at home", "transport" and "services." Their results imply the necessity of adding fixed effects when testing the intertemporal non-separable preferences.

The authors construct the theoretical model in detail. First of all, the authors issue the utility maximization problem by assuming households maximize the present discounted value of their lifetime utilities. For the utility function, the authors construct it into three parts. The first part contains preference shocks. The second part contains the interaction between two different goods in the same time point. The zero value of the coefficient in front of this part can be used to represent both homothetic separability and additive separability. The third part contains the interaction term between the same goods but in current and past time point. If the coefficient is zero, it will represent intertemporal separability.

Following this utility function, the authors measure both the marginal rate of substitution (MRS) between two goods. The time dependence in it implies the presence of habit if the sign of cross-partial derivatives is negative. What's more, the authors also apply the Euler equation in order to distinguish between liquidity constraints and intertemporal non-separable preferences. The authors provide representations for both MRS and Euler equation in the paper. Moreover, the authors construct error terms for both MRS and the Euler equation, in terms of the expectational errors and the preference shocks. More importantly, considering the time invariant unobserved heterogeneity, or fixed effects, the authors transform the previous error terms into new forms by "differencing" them. Therefore, in general this paper provides four types of equations: "in levels" and "in differences" in both MRS and Euler equation.

The data set used is the Continuous Family Expenditure Survey which includes quarterly information on 3200 households. Compared to other data sets used in similar works, this data set can be used to eliminate fixed effects and generate consistent estimated parameters. The empirical

strategy used for estimation is generalized method of moments (GMM). In addition, as shown in the result section, the authors also perform Sargan tests of overidentification. Using the data set, the authors estimate two models focusing on food versus services and transport versus services. The error terms of the equation in both levels and differences can be expressed by household level variables.

For the results, the authors first show the estimation of MRS and the Euler equations in levels. The results from Sargan test show that the instruments validity is rejected and imply that the model may misspecify. The estimated parameters for both MRS and Euler equations imply that preferences are intertemporally separable. This means that there is no habit formation. Also, because the results from Euler equation are similar to those from MRS, there is no liquidity constraints. Then, the MRS in levels can be used to test additive separability and homothetic separability. However, these results on rejecting or not rejecting the separability hypothesis can probably be biased because in level equations do not include time invariant unobserved heterogeneity.

In the following, the authors put time invariant unobserved heterogeneity into consideration. The Sargan test results imply that after controlling the unobserved heterogeneity, the model does not misspecify. The estimated parameters for food and services in the MRS illustrate intertemporal non-separabilities in preferences; however, the parameters for transport do not. In the Euler equations, the estimated parameters for food show the presence of habit formation; but for transport and services, preferences are intertemporally separable.

The authors also provide analysis on intertemporal elasticity of substitution (IES) and the degree of habit formation. By constructing the new expression of IES, the authors provide estimations of the IES based on estimated parameters in the equations in differences. Furthermore, by using the estimates from MRS in differences, the authors calculate the degree of habit formation.

In conclusion, the authors in this paper put serious consideration on time invariant unobserved heterogeneity across households. Before controlling unobserved heterogeneity, preferences in both models are intertemporally separable. Also, the Sargan test implies the misspecification issue. However, after controlling time invariant observed heterogeneity, the Sargan test shows that the instruments are selected properly and there is evidence of habit formation for food and services.

One possible limitation in this paper is that the transport equation does not show intertemporal non-separabilities in preferences. The authors have already provided reasons that they do not include variables like the number of vehicles.