Patterns of Consumption in Mexico, 2002-2010

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Abstract

This paper contributes to the analysis of intertemporal household consumption in Mexico.We find evidence that consumption is driven by income uncertainty and demographic factors. This result is an appealing explanation of the hump-shaped pattern of consumption over time. Our work draws heavily on Gourinchas & Parker (2002) and Attanasio et al. (1999) ideas. We develop a methodology of four steps to show that estimated consumption mimics actual consumption patterns.

Keywords: Intertemporal Consumption, Numerical solutions of life-cycle models

Introduction

The understanding of household´s consumption choice over time is one of the most important challenges in modern macroeconomics (Gollier, 2001). In this light, the life-cycle consumption theory is an appealing framework to explain parsimonious representation of intertemporal consumption. [4] Its canonical theoretical framework claims that the optimal consumption path must be smoothed over time. In other words, if technology and preferences are aligned consumption could look like a straight flat line. However, stylized facts show that both income and consumption features a hump-shaped form over time. See Attanasio *et al.*(1999) , Gourinchas & Parker (2003) and Attanasio & Székely (1999). In theory, one way to find an explanation of it is to incorporate income uncertainty and demographic factors into the canonical model. The standard approach under the life cycle consumption framework is to estimate the parameters of the model. One step forward is to simulate consumption with the estimated structural parameters and verify whether it replicates actual data or not. In this regard, we show that intertemporal consumption in Mexico in the 2002-2012 period is driven by time variable discount factor, which depends upon family composition and incomevolatility. The main implication of such a result is that consumption tracks income. Furthermore,we find that the parameters of such discount factors areeconometrically significant and the age in which consumption is maximized is closeto the actual one. Our results are valid at national level. Finally, we find that the parameters that define the income stochastic process are also significant. A way forward to understand consumption en Mexico would be to disentangle the results by population groups according to education levels or city size. Vázque & Ramírez (2011), for instance, explore consumption patterns for households in rural areas in which the head of the household is a woman.

2. Literature Review

The intertemporal consumption theory builds on the articles of Modigliani &Brumberg (1954) and Friedman (1957).The permanent income hypothesis arises from those papers: consumption depends upon current assets and the flows of income over time. And Hall (1978), which is a seminal paper that test the orthogonality of the error term in the Euler equation with respect to past information. In particular, the hypothesis that income changes in the past do not explain future consumption changes is not rejected. Only new information affects current consumption. Put another way, consumption follow a random walk.

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[4]Another approaches to consumption behavior are Diamond, Ramsey or real business cycle settings.

According to Bagliano &Bertola (2004), empirical literature has been focused on two issues. One is consumption sensitivity and two is excess smoothness to income innovations.In the firsts strand, Flavin(1981) show that current consumption is excessively sensitive to expected income changes in comparison to permanent income shocks. In the second strand, is the smooth reaction of consumption to unexpected changes in income. Campbell & Deaton (1989) show that consumption could be explained by consumption innovations, which have a component that cannot be incorporated into an econometric specification.

On the other hand, Campbell & Mankiw (1989) cope with the implications of liquidity constrains, in other words, the agents are assumed to be net savers which bounded consumption smoothness possibilities. In this regard, Deaton (1991), and Hubbard *et al.* (1994) show that liquidity constrains increase the rate of savings and decrease intertemporal welfare.The empirical implications with a Constant Relative Risk Aversion utility function and lognormal distribution of returns and consumption are derived by Hansen & Singleton (1983) and extended by Campbell (1996).

There are two seminal papers that show that consumption tracks income due to a flexible discount factor and income volatility. One is Attanasio *et al.* (1999) acknowledge that data shows that consumption over time tracks income. This stylized factsis against the life cycle model, which claims that consumption patterns is smoothed and to some extent independent of current income. They have counterfactual experiments in 4 particular scenarios. In scenario one income uncertainty with demographic effects mimics the actual consumption. In scenario 2 with income uncertainty and no demographic effects consumption is increasing over time. In scenario three with no uncertainty and with demographic effects consumption is hump shaped but biased towards left. Finally, in scenario 4 with no uncertainty and no demographic effects consumption is decreasing over time. The other is Gourinchas &Parker (2002) show that consumers behave a buffer-stock agents and after 40 years old they behave as a certaintyequivalent consumer.

Dynamic programming methods can be found at Stockey, Lucas &Prescott(1989), Adda & Cooper (2003) or Miranda &Fackler (2002). A critical assessment of this paradigm (life cycle consumption theory) are Modigliani (1986), Blanchard &Fisher (1989) or Romer (2011).

3. Theoretical Framework

Thestructural model of optimal life-cycle consumption under income uncertainty and time varying discount factor is the following problem for a household:

$$max\left\{E_t\sum_{j=1}^{T}\beta e^{\theta_1(W_{t+1}-W_t)+\theta_2(Z_{t+1}-Z_t)}\frac{C_{t+j}^{1-\gamma}}{1-\gamma}\right\}$$

subject to

$$A_{t+j+1}=\left(1+R_{t+j+1}\right)\left(A_{t+j}+Y_{t+j}-C_{t+j}\right),$$

where C_{t+j} is the household consumption level at $t+j$, W_{t+j} is the number of persons older than 15 years (adults) at $t+j$, Z_{t+1} is the number persons up to 15 years old (children) at $t+j$, and R_{t+j} is the gross ex-post rate of return.γ is risk aversion parameter of Constant Relative Risk Aversion within period utility function at one particular point. And θ_1 and θ_2 determine the value of the discount factor over time. $A_{t+j}+Y_{t+j}$ is cash on consumer´s hand. Attanasio et al. (1999) show that the household composition determines valuation of felicity in time dimension. The overall utility is additively separable. Finally, we can infer from this specification that marginal utility depends flexibly of the composition of family members, between children and adults. We assume that after T periods the agent is dead and does not have any bequest motive.

On the other hand, income evolves stochastically in the following fashion (see Gourinchas & Parker, 2001 or Adda &Cooper, 2003):

$Y_t = P_t U_t$,

$P_t = G_t P_t N_t$,

$$lnU_t \sim N(0,\sigma_u^2)$$

$lnN_t \sim N(0,\sigma_n^2)$ and

$G_t = lnY_t - lnY_{t-1}$.

U_t is a transitory shock at t, P_t is permanent component of income, G_t is a drift determined by income. The optimal consumption path satisfies the following non linear Euler equation for T periods.

$$E_t \left\{ \left(\frac{C_{t+1}}{C_t} \right)^{\gamma} \frac{1+R_{t+1}}{1+\delta} e^{\theta_1 (W_{t+1}-W_t)+\theta_2 (Z_{t+1}-Z_t)+\varepsilon_t} \right\} - 1 \quad \mathbf{(1)}$$

Unfortunately, there is no analytical solution to solve this system of T equations. It must be solved numerically. The conventional interpretation of this equation is that at the optimal path is that the loss of utility of refraining from consuming 1 unit today is equal to the reward derived the next period at present value.

3. Methodology

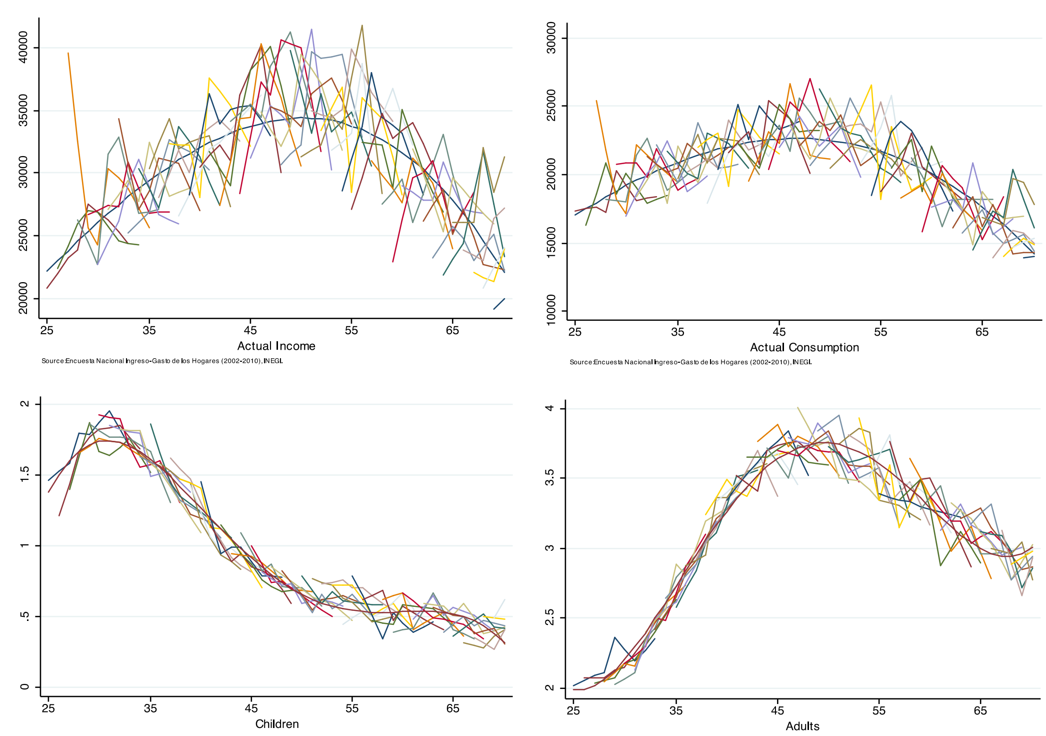
3.1 Data base construction

We follow the average cohort technique by Browning (1985), Attanasio *et al.* (1999) and Attanasio &Szekely (1999). We construct a synthetic agent by averaging the variable *x*over all individuals of age *i* for a particular survey. In the next survey, issued *j* years later, we construct another synthetic agent by averaging the same variable *x* over all individuals of age *i+j*. We assume that both synthetic agents belong to the same cohort. Therefore, for a particular cohort we can follow the variable*x*for years 2002, 2004, 2006, 2008 and 2010. Those years correspond to the National Survey on Consumption and Income of Mexico (ENIGH). We take into consideration at household level the following variables:quarterly monetary income, quarterly consumption, number of children, and number of adults. The age of the agent corresponds to the head of the household from 25 to 70 years old. The information is converted into Mexican pesos of 2003 and is reported quarterly.

Table 1. Descriptive Statistics

Variables per household	2002	2004	2006	2008	2010
Sample size (number of households)	17,021	22,363	20,664	29,157	27,383
Monetary Income	27,934	28,654	31,249	30,822	27,128
Consumption	19,596	20,201	21,488	19,363	19221
Members	4.13	4.05	3.97	4.02	3.89
Adults	3.08	3.03	2.99	3.08	2.99
Children	1.04	1.01	0.97	0.95	0.89

Graph 1. Stylized data on income, consumption and family size



On average the familiar income and consumption is maximized when the age of the household head is 48 years old. Income at this age is 1.5 times larger than when the head of the household is 25. Regarding the peak number of children is at 31 and the peak number of adults is at 50.By casual observation, graph 1 is consistent with Attanasio & Székely (1999)

3.2 Estimation of the parameters

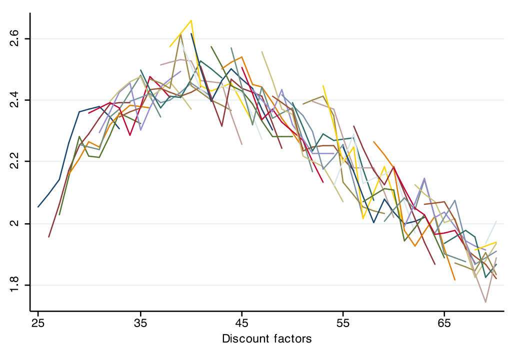
The estimation of the structural parameters derives directly by the Generalized Method of Moments in STATA. It is worth mentioning that linearizing the Euler equation and estimating the parameters by ordinary least squares is not accepted in the literature. Furthermore, the Method of Simultated Moments is very time demanding for a conventional computer. The specification of the model is equation 1.On the other hand, we estimate the parameters that define the random component of income over timefollowing the methodology of Carroll &Samwick (1997).

Table 2. Estimated Parameters

		Coefficients	Standard error
Risk aversion parameter	γ	0.694	0.070
Fixed Discount Factor	β	0.937	0.010
Time varying Discount Factor	θ_1	0.184	0.040
Time varying Discount Factor	θ_2	0.237	0.060
Income uncertainty parameter	σ_n	0.001	0.002
Income uncertainty parameter	σ_v	0.011	0.002

The discount factor over time can be defined as defined as $\exp(\theta_1 W_t + \theta_2 Z_t)$.

Graph 2. The Discount Factor over time



3.3 Estimation of the consumption rules

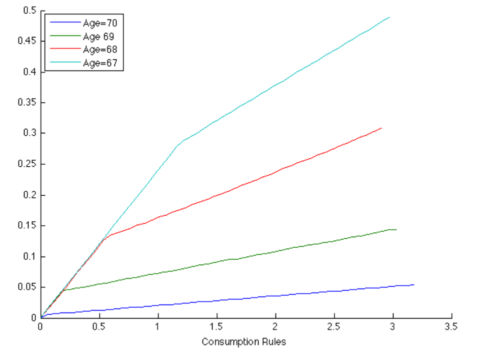
We estimate the consumption rules from 23 years old to 70 years old by satisfying the following equation taken form .

$$C_t(X_t)^{\gamma} = \beta R_{t+1} \frac{e^{\theta_1(W_{t+1})+\theta_2(Z_{t+1})}}{e^{\theta_1(W_t)+\theta_2(Z_t)}} \left(E_t \left[\left(C_{t+1} \left((X_t - C_t) \frac{R}{G_{t+1}N} \right) G_{t+1} N \right)^{\gamma} \right] \right) \quad \textbf{(2)}$$

We combine Gaussian Quadrature and Function approximation techniques to estimate the consumption rules (Miranda & Fackler, 2001). In part of the programs to obtain the parameters we invoke some routines of Miranda &Fackler `s(2001) MATLAB toolbox.[5] From equation 2 we derive graph 2: the higher the cash in hand (A_t+Y_t) the higher the consumption. However, this rule is features lower slope as cash in hand is higher.

[5]MATLAB programs are available upon request.

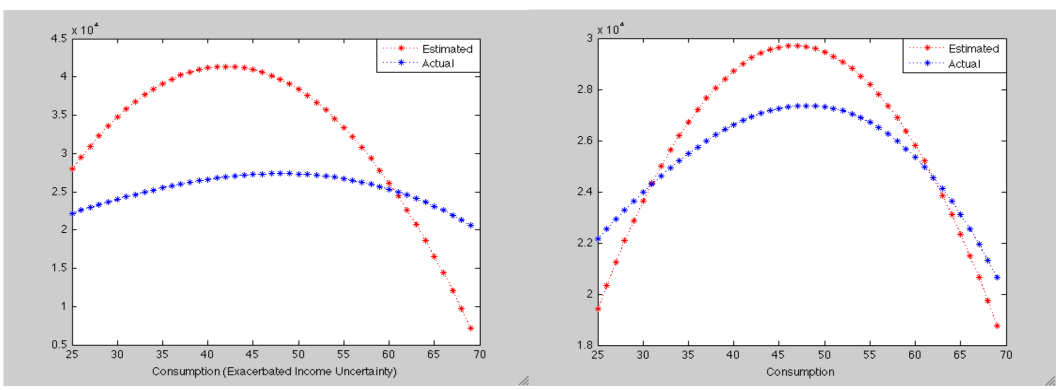
Graph 3. Optimal consumption rules



3.4 Conterfactual Simulations

Our counterfactual simulations pose two scenarios. We generate 1,000 income simulations for 45 periods and solve the theoretical consumption path and we compare it to the actual pattern. One is by exacerbating the income uncertainty. In this case consumption reaches its peak before the actual consumption pattern, and the path is less smoothed. Under the second scenario, the consumption peak coincides with the actual data. Furthermore, the ratio between the actual consumption peak and the consumption at 25 is 1.22; the estimated ratio is 1.5. The main lesson is that consumption life-cycle theory with income uncertainty and time-varying discount factors is an appealing way to explain consumption patterns over time.

Graph 4. Fitted consumption paths



4. Concluding Remarks

This paper explores whether theory can replicate actual data. In particular, we have highlighted that in Mexico in the 2002-2012 period income uncertainty and demographics explain that consumption tracks income. Besides, wehave showed that by exacerbating income uncertainty the consumption peak age is lower versus the model with the estimated structural parameters.

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