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Consumption Smoothing and Borrowing Constraints: Evidence from Household Surveys of Iran*

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Abstract

We use Iranian Household Expenditure and Income Survey," to analyze the dynamics of consumption of the households. We observe evidence of excess sensitivity in a cohort pseudo panel of Iranian households. Excess sensitivity, however, is absent for government employees who have better access to nance due to the structure of labor market and banking system in Iran. Our results support the idea that borrowing constraints is the main cause for evidence of excess sensitivity. This indicates that actual consumption prole is sub-optimal and hence deepening financial access will decrease the welfare loss of this sub-optimality. In the paper, we have also provided estimates of elasticity of inter-temporal substitution for the Iranian households for the first time, and they are consistent with those of other developing countries.

Keywords. Consumption Smoothing, Permanent Income Hypothesis, Euler Equation, Excess Sensitivity, Borrowing Constraints.

JEL Classification C55, D12, D14, D91, E21, O53

1 Introduction

Friedman (1957), by introducing the "Permanent Income Hypothesis" (PIH), showed that, estimation of consumption function does not reveal any information about consumption, and estimated income elasticity is the ratio of total variance in income contributed by permanent income (Friedman, 1957, pp.31-32). There was no way to test the PIH and after Friedman (1957), there was no indication of the way for continuing empirical research on consumption.

With his seminal work on the stochastic implications of PIH, Hall (1978) started consumption and saving empirical research in a new way. Hall (1978)

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showed that the Euler equation[1] of an inter-temporal consumption choice model (consistent with Friedman (1957)'s PIH) can be estimated in order to assess the PIH. One of the most important implications of this model is that marginal utility of consumption is random walk and thus other than current consumption, no information known at present time can help predict future consumption. Further research did not support this finding.

Flavin (1981); Hall and Mishkin (1982); Hansen and Singleton (1983) and Campbell and Deaton (1989) showed that current income helps predict future consumption change, which is called "Excess Sensitivity" in the literature (Attanasio, 1999). Excess sensitivity is, in fact, in contradiction with PIH. Evidence of excess sensitivity shows that observed consumption profile is not *optimal* and thus indicating negative welfare effects.

The literature that tries to answer why excess sensitivity is observed, might be summed up in three categories. The first explains excess sensitivity as a result of shortcomings of the simple inter-temporal model, and tries to overcome the problem by adding durable goods (Deaton, 1992), consumption habits (Korniotis, 2010; Gayle and Khorunzhina, 2009), envy (Casado et al., 2012), etc. to the model. The second group of explanations focuses on econometric issues. Research shows that using aggregate data may lead to biased estimations (Attanasio and Weber, 1993, 1995). Other studies focus on the method of estimation. There seems to be a trade-off between using the linear form of Euler equation (ignoring second and higher order effects) and estimating the nonlinear form using GMM methods (that are shown to be consistent only in large-T samples).

The third route in excess sensitivity literature focuses on borrowing constraints. Zeldes (1989) divides households to two groups: one with enough savings as unconstrained households and the other with presumably borrowing constrained households. Zeldes (1989) shows that excess sensitivity is present in the second group, thus relates excess sensitivity to borrowing constraints. Johnson and Li (2010) use the debt-payment-to-income ratio as an indicator of borrowing constraints and confirm earlier results.

Our research can be classified in the third route. We study the existence of excess sensitivity in the Iranian households' consumption data, using an intrinsic quality of financial access in Iran. We show that observing excess sensitivity is related to borrowing constraints. We do not observe evidence of excess sensitivity in government employees. Due to the structure of labor market and banking system in Iran, they have more access to all types of finance. We analyze our results and find out that they are robust to the choice of interest rate variables and also inclusion of taste shifters.

The rest of paper is organized as follows: In Section 2 we analyze a simple inter-temporal consumption choice model and extract the Euler equation of the base model. Section 3 reviews the structure of households' access to loan in Iran and shows that there is a clear advantage of government employees in financial accessibility. Also we review macroeconomic aggregates for different types of households. Section 4 gives the results of base model estimation together with model and variable modification results. Section 5 outlines the concluding remarks. Appendix A gives a short introduction to the Iranian HEIS data, as it

[1] Euler equation is the optimal condition (F.O.C) relating current consumption to future consumption.

is not very well-known in economics literature, and the preparation steps of the data used in estimations.

2 An Inter-temporal Consumption Choice Model

Consider a basic inter-temporal consumption choice problem (Attanasio and Weber, 2010):

$$\max \mathrm{E}_t \sum_{j=0}^{T-t} \beta_{t+j} U(C_{t+j}, \mathbf{z}_{t+j}, \nu_{t+j}) \tag{1}$$

such that for every j these constraints hold:

$$W_{t+j+1} = W_{t+j} R_{t+j} + y_{t+j} - C_{t+j} \tag{2}$$

$$W_{t+j} = \sum_{i=1}^{N} A^i_{t+j} \tag{3}$$

$$R_{t+j} - 1 = \sum_{i=1}^{N} \omega^i_{t+j} (R^i_{t+j} - 1) \tag{4}$$

$$W_T \geq 0 \tag{5}$$

in which consumer maximizes her expected utility over life-time and her utility at time $t+j$ depends on the level of *consumption*, C_{t+j}, a vector of other variables that influence utility, $\mathbf{z}_{t+j}$, such as leisure hours and demographical attributes of household, and an unobservable variable that influences utility, ν_{t+j}, known as preferences shock. E_t is the expectations operator with information available at time t.

Equation (2) is a regular budget constraint in which total wealth varies based on the level of income and consumption in each period. This model can include endogenous income choice (considering labor hours an item in $\mathbf{z}_{t+j}$). Total wealth W_{t+j} is defined based on a set of assets (A^i_{t+j}'s), and its gross return rate R_{t+j} is based on those assets' return rates in equations (3) and (4), where ω^i is asset i's share in consumer's portfolio. The last equation is a limit on wealth in last period of time, i.e. consumer has to pay all her debt before she dies (no default assumption).

An implicit assumption in the model is additive separability of utility along time, i.e. we can write utility as sum of utility in each period. This assumption rules out situations like durable goods and consumption habits. Another assumption is considering consumption as an aggregate good, which is based on Gorman (1959).

Solving the model, we derive the first order conditions that relates consumption at time t to consumption at time $t+1$,

$$U_C(C_t, \mathbf{z}_t, \nu_t) = \lambda_t \tag{6}$$

$$\lambda_t = \mathrm{E}_t[\lambda_{t+1} \beta R^k_{t+1}] \tag{7}$$

in which λ_t is Lagrange multiplier for budget constraint in period t. Equation (7) holds for every asset k which consumer can buy and sell freely. Assuming there is at least one such asset, we drop k from now on. Combining these equations to drop λ we have

$$\mathrm{E}_t \left[\frac{U_C(C_{t+1}, \mathbf{z}_{t+1}, \nu_{t+1})}{U_C(C_t, \mathbf{z}_t, \nu_t)} \beta R_{t+1} - 1 \right] = 0 \tag{8}$$

The equation above, known as Euler Equation can be considered an orthogonality condition and —with an assumption on the form of temporal utility function— estimated using Generalized Method of Moments (GMM) of Hansen and Singleton (1982). One common assumption for the utility function form in the literature is iso-elastic function.[2] If we want to include taste shifters and inseparability of leisure we have:

$$U(C_t, \mathbf{z}_t, \nu_t) = \frac{C_t^{1-\gamma} - 1}{1-\gamma} \times e^{\boldsymbol{\theta} \mathbf{z}_t + \nu_t}, \tag{9}$$

that leads to the Euler Equation:

$$\mathrm{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \beta R_{t+1} e^{\boldsymbol{\theta} \Delta \mathbf{z}_{t+1} + \Delta \nu_{t+1}} - 1 \right] = 0 \tag{10}$$

GMM estimates are asymptotically (large T) consistent, but with limited time-span and in presence of measurement error, estimates are shown to be biased (Alan et al., 2009). So it is better to extract a linear model for estimation. Assuming that the relevant variables are log-normal and following the steps in Hansen and Singleton (1983) and defining $c_t = \ln(C_t)$ and $r_t = \ln(R_t)$, from (10) we have

$$\Delta c_{t+1} = \frac{1}{\gamma} \left(k_t + r_{t+1} + \boldsymbol{\theta} \Delta \mathbf{z}_{t+1} + \Delta \nu_{t+1} \right) + u_{t+1} \tag{11}$$

where u_t is the expectation error and k_t is

$$k_t = \ln(\beta) + \gamma^2 \operatorname{var}_t(\Delta c_{t+1}) + \operatorname{var}_t(r_{t+1}) - 2\gamma \operatorname{cov}_t(\Delta c_{t+1}, r_{t+1}) \tag{12}$$

where the t subscript on var and cov indicates that these second moments are conditional on the information available at time t. If the conditional distribution of the relevant variables are not log-normal, the term k_t will include higher order conditional moments too (Attanasio and Low, 2004). As these second and higher order moments are not observable, we rewrite the Euler Equation as

$$\Delta c_{t+1} = \alpha + \frac{1}{\gamma} r_{t+1} + \boldsymbol{\vartheta}' \Delta \mathbf{z}_{t+1} + \varepsilon_{t+1} \tag{13}$$

where the constant term $\alpha = \bar{k}/\gamma$, in which $\bar{k}$ includes $\ln(\beta)$ and unconditional mean of second (and higher) orders moments of Δc_t and r_t. The disturbance term ε_t includes expectations error u_t, unobserved preferences shock ν_t, and deviation of k_t from $\bar{k}$. $\boldsymbol{\vartheta}$ equals to $\boldsymbol{\theta}/\gamma$.

[2] Iso-elastic utility function is also called power utility function or *Constant Relative Risk Aversion* (CRRA) utility function. γ is the *coefficient of relative risk aversion* and using this model the *elasticity of inter-temporal substitution* equals to $1/\gamma$. For $\gamma \to 1$ the limit of this function is $\ln(C)$.

2.1 Excess Sensitivity

The advantage of using Euler equation is that it's implications are independent of assumptions about stochastic environment of consumer such as the process of income flow, time horizon and other information in variables $\mathbf{z}$.

Using iso-elastic form for utility function, the consumption growth Δc_t should only be dependent upon interest rate with the subsequent result that no other information would help predict consumption growth.

Different models with different resulting Euler equations can be used to test the hypothesis, but the common practice to test the idea is to add ζy_{t+1} to the right hand side of linear Euler Equation and to test if ζ is statistically equal to zero or not. If it is significantly different from zero, then the result will be in support of the *excess sensitivity* .Flavin (1981), Hall and Mishkin (1982), Hansen and Singleton (1983), Mankiw et al. (1985) and Campbell and Deaton (1989) provide evidence on the existence of excess sensitivity.

One of the explanations for excess sensitivity is that the simple model lacks important properties of consumption choice. For example in the very simple models, it is assumed that consumption and leisure are additively separable in intra-temporal utility, that means the utility gained from consumption does not depend on the utility gained from leisure. But we know that with consumption increase, the marginal utility of one extra leisure hours increases. We have already considered this in our model and leisure time can be one of the variables in $\mathbf{z}$. This form of utility has been used in literature to explain partially the excess sensitivity evident in simpler models (Attanasio and Browning, 1995; Attanasio and Weber, 1995; Blundell et al., 1994; Meghir and Weber, 1996; Casado et al., 2012).

Other forms of extending theoretical model [in the form of modifying and augmenting utility function] includes modeling of durable goods [with no assumption on additive separability of durable good services utility from non-durable good consumption], consumption habits and envy (Deaton, 1992; Korniotis, 2010; Gayle and Khorunzhina, 2009; Casado et al., 2012).

Most of the early empirical literature used aggregate country or state data, but later studies showed that using aggregate data leads to biased estimates of parameters (Attanasio and Weber, 1993; Attanasio and Browning, 1995). Iso-elastic utility function leads to logarithm of consumption in linear Euler Equation. As the average of logarithm of consumption (obtained from model) is not equal to logarithm of average of consumption (obtained from data), using aggregate data is misleading. Even if one wants to estimate a time-series model on country data, one should first take logarithms of consumption of households and then aggregate them which is not possible using published National Accounts data around the world.

There is an important line in consumption modeling research that attributes excess sensitivity neither to econometric issues nor to utility function additivity assumption shortcomings, but to borrowing constraints starting from Zeldes (1989) and Deaton (1991). In terms of our model, equation (5) changes to

$$W_{t+j+1} \geq 0 \tag{5'}$$

and (7) changes to

$$\lambda_t = \mathrm{E}_t[\lambda_{t+1}\beta R^k_{t+1}] + \mu_{t+1} \tag{7'}$$

where μ_t is the Lagrange multiplier for borrowing constraint and can be interpreted as shadow price (Bianchi and Mendoza, 2010). μ_t is positive on periods that the constraint ($5'$) is binding. As Parker (2008) shows, relative to the unconstrained equilibrium, the constraint can create a causal link from an increase in income to consumption. Testing this idea in empirical studies is not that easy. The long tradition in analyzing occasionally binding constraints in optimization problem of households and firms is to test the Euler equation in different groups of observations that are different in access to borrowing. Zeldes (1989) divides households based on whether they have at least two months' worth of saving or estimated non-housing wealth or not. Johnson and Li (2010) divide households based on their debt-payment-to-income ratio. The problem with the study of Johnson and Li (2010) is that they consider household with low debt-payment-to-income as able to borrow, but this household might have already borrowing constraint and that's why they have low debt-payment-to-income ratio, so in fact there is an endogeneity problem in using the debt-payment-to-income ratio as an indicator of borrowing constraints.

3 Data

Our main data source is the "Iranian Urban and Rural Households' Expenditures and Income Surveys", (HEIS), also known as "Household Budget Surveys", published yearly by the Statistics Center of Iran (SCI). These surveys gather extensive data on expenditures of households. We use the data during years 1997 to 2012 (1376 to 1391 in Persian Calendar). The data is in fact a time series of cross-sections and is not a real panel. SCI has started to sample as a rolling panel with only one fifth of new households in each year since 2009, and thus this rolling panel property of HEIS data cannot be used. We use these data to build synthetic panel of cohorts. HEIS data are thoroughly introduced at appendix A.

As there is no bond market in Iran, and the interest rates in banking system are controlled by the Central Bank, it is hard to decide what to use as risk-free interest rate. We have collected a broad range of interest rates which could be considered interest rate on savings of household. These include different saving accounts maximum rate allowed by the Central Bank that year, a weighted average of rates of deposits in banking network reported by CBI and a return-rate on durable goods, as it is shown that Iranian households use durable goods as a means of saving. Results of estimating Euler equations are reported for all these rates.

3.1 Credit in Iran

Credit in Iran is largely dependent on the work status of household head. Labor market in Iran is divided into two parts, with great differences. The government provides a large part of employment for households. From around 21 million workers in Iran, about 2.5 million work for the government. In urban households, 63.4% of household heads are working, of which 17.8% work for the government, 40% work for private sector, 35% work for themselves and 6.8% of them are employers. The contract of most of the government workers (about 87–91%) is *official* life-time employment.

Owing to this type of contract, their employment and income flow is benign and banks and other institutions consider them as safe costumers. It is also common to see home furniture and appliance stores to sell durable goods with *[government] employee check*. On the other hand, as a large part of banking network in Iran is government-owned, there are always special facilities for the government workers. *Non-official* government workers enjoy some of these facilities too, but not as much.

Household surveys show that the government employees get loans double as much as other households as we can see in table 1 (Equality of proportions rejected for all kinds of loans with p-values $< 2.2 \times 10^{-16}$).

Table 1: Loans given to Iranian Households

% of HH's	Housing Loan	Non-Housing Loan	All Loans	No Loan
Govt. Employee	4.78	21.49	24.79	75.2
Other	2.13	12.57	14.30	85.70
Overall	2.38	13.68	15.50	84.50

Source: HEIS 2012 data by Statistics Center of Iran

Loan levels (for those who got loans) differ too, but when we control for the household economic level (dividing loans to household yearly expenditures), the difference disappears. Figures 1 shows the important determinants of access to loan in Iranian households. As we can see in panel (a) urban/rural households do get more loans in comparison with rural ones. Panel (h) shows that owning a house (without considering the qualities of the house) makes a very small difference in getting a loan. As panels (c),(d),(e), (f) and (g) show, household head's age, education, income and working sector are important in access to loan.

To check if more loans for the government workers are due to their income level, we run probit models with variables explaining access to loans. Table 2 provides the results on variations of probit estimations of loan access in Iran. In this table, models F1 to F3 are estimated on entire sample, but models S1 to S3 are estimated on only employee households, and thus dropping households whose heads run their own business and may employ other workers. Different models used different kind of education effect on getting loans. Probit models are estimated considering sample weights in building the likelihood function of the model[3]. The average marginal effect of working as a government employee on getting a loan is from 4.29% to 5.88% in all models.

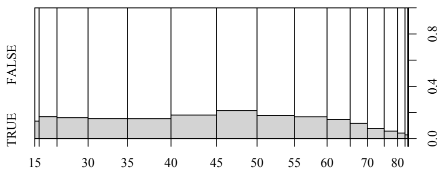
3.2 Consumption and Income Trends in Iran

We have calculated the main economic aggregates for households. Average real income, expenditures and non-durable expenditures (aka. consumption), are shown at Figures 2 and 3a for all Iranian households. Figure 3 shows non-durable expenditures and income for households with heads working in different

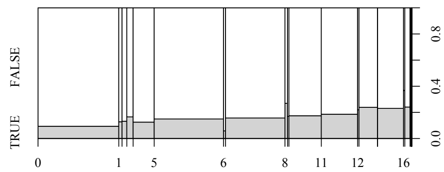
[3]**svyglm** function in R package **survey** (Lumley, 2004, 2014) provides these estimates.

(a) Region

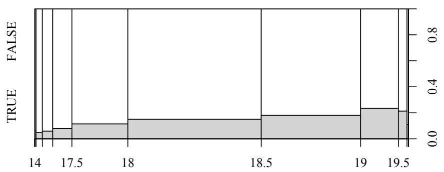
(b) Head's Gender



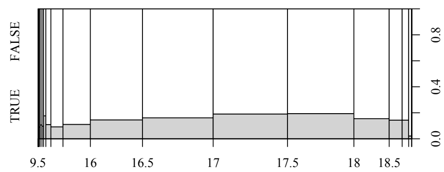
(c) Head's Age



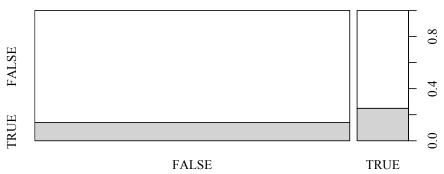
(d) Head's Education



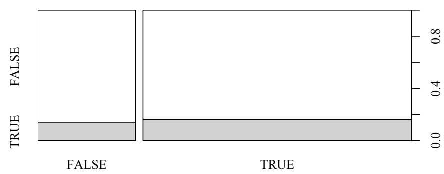
(e) log of Monetary Income



(f) log of Non-Monetary Income



(g) Is Government Employee?



(h) Owns House?

Figure 1: Determinants of Access to Loan in Iranian Households: Household has credited a loan in 2012

Source: HEIS 2012 data by Statistics Center of Iran

Table 2: Survey Probit Model: Determinants of Access to Loan in Iranian Households

	F1	F2	F3	S1	S2	S3
(Intercept)	-5.72^{***}	-5.41^{***}	-5.43^{***}	-5.89^{***}	-5.15^{***}	-5.19^{***}
	(0.42)	(0.43)	(0.43)	(0.77)	(0.79)	(0.82)
Urban	-0.05^{**}	-0.06^{**}	-0.06^{**}	-0.02	-0.04	-0.04
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Female Head	0.06	0.05	0.06	0.01	-0.02	-0.01
	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.08)
Age	0.02^{***}	0.02^{***}	0.02^{***}	-0.02^{*}	-0.02^{*}	-0.02^{*}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age^2	0.00^{***}	0.00^{***}	0.00^{***}	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Employed	-0.07^{**}	-0.06^{*}	-0.06^{*}	-0.20^{**}	-0.20^{**}	-0.20^{**}
	(0.04)	(0.04)	(0.04)	(0.10)	(0.10)	(0.10)
Married	0.28^{***}	0.29^{***}	0.29^{***}	0.36^{***}	0.36^{***}	0.36^{***}
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)
Widowed	0.15^{*}	0.17^{**}	0.19^{**}	0.35	0.36	0.36
	(0.08)	(0.08)	(0.08)	(0.23)	(0.23)	(0.23)
Divorced	0.02	0.02	0.02	0.12	0.12	0.12
	(0.12)	(0.13)	(0.13)	(0.18)	(0.18)	(0.18)
Size	-0.01	-0.01	-0.01	-0.02^{**}	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
House Owner	0.11^{***}	0.11^{***}	0.11^{***}	0.10^{**}	0.10^{**}	0.10^{**}
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Government Employee	0.26^{***}	0.21^{***}	0.22^{***}	0.25^{***}	0.19^{***}	0.20^{***}
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Independent Worker	0.06^{**}	0.06^{**}	0.06^{**}			
	(0.03)	(0.03)	(0.03)			
log Monetary Income	0.21^{***}	0.19^{***}	0.19^{***}	0.26^{***}	0.21^{***}	0.22^{***}
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.05)
log Non-monetary Income	0.02^{***}	0.01^{***}	0.01^{***}	0.02^{***}	0.02^{***}	0.02^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Head Literate	0.11^{***}			0.13^{**}		
	(0.04)			(0.06)		
Head Edu: Primary		0.08^{**}			0.09	
		(0.04)			(0.07)	
Head Edu: Secondary		0.15^{***}			0.17^{**}	
		(0.04)			(0.07)	
Head Edu: Univeristy		0.23^{***}			0.30^{***}	
		(0.05)			(0.08)	
Head Education Years			0.02^{***}			0.03^{**}
			(0.01)			(0.01)
Head Education Years^2			0.00			0.00
			(0.00)			(0.00)
Deviance	31208.71	31183.73	30897.17	15116.61	15090.21	15050.27
Dispersion	1.00	1.00	1.00	1.00	1.00	1.00
Num. obs.	37538	37538	37057	17118	17118	17041
AIC	29579.98	29559.29	29308.95	14375.71	14353.75	14314.55

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is the probability of getting a loan. Models F1 to F3 use full data, while S1 to S3 use a subsample of only employees. Problit models are estimated using Generalized Linear Models for Surveys **svyglm** by **survey** package (Lumley, 2004, 2014) on Iranian Urban and Rural Household Expenditures and Income Survey 2012 data.

sectors, and figure 4 shows these variable for each cohort.

There are some facts evident in these figures. First, we can see that income was reported less than total expenditures until early 2000s. We believe this is just an understating of income in those years and does not bear any economic meaning.

However, other evidences in these figures are macroeconomic facts. We can see that following the 2007–2008 recession, households' real income has dropped even to less than total expenditure. This happens again in 2011–2012 at the

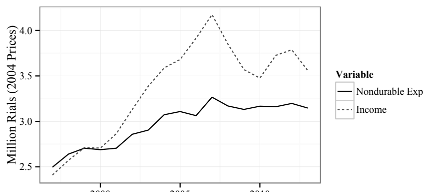
Figure 2: Income, Expenditures and Non-durable Expenditures for Iranian Household

Source: HEIS 1997–2012 data by Statistics Center of Iran

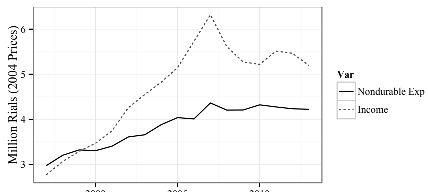
most severe recession since the Iran-Iraq war[4]. Comparing figure (b) with figures (c) and (d), one can observe that following these drops in the real income, consumption of government employees does not drop that much, but private-sector employees experience a drop in their consumption at the first told recession, and non-employees lower their consumption at both recessions. The analysis of income and consumption (non-durable expenditures) in different cohorts reveals that we can ponder the famous *hump-shaped* consumption profile in Iranian cohorts[5]. The effect of recessions is also evident on all cohorts' income.

[4]Based on Reports from Monetary and Banking Research Institute, Central Bank of Islamic Republic of Iran

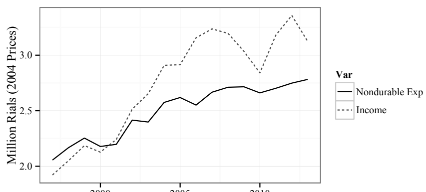
[5]Although the pseudo-panels used for estimations in the following sections of the paper use 5-year cohorts, we use 10-year cohorts in these graphs to be concise.



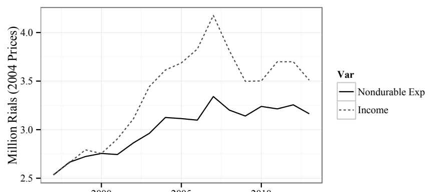
(a) All



(b) Government Employees



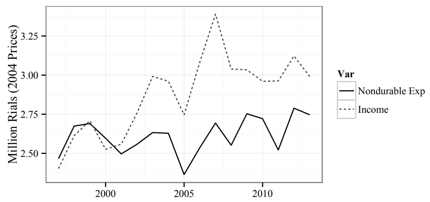
(c) Private Sector Employees



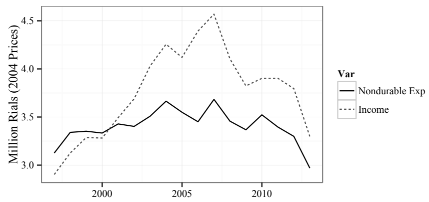
(d) Non-Employees

Figure 3: Income and Non-durable Expenditures for Iranian Household by Working Sector

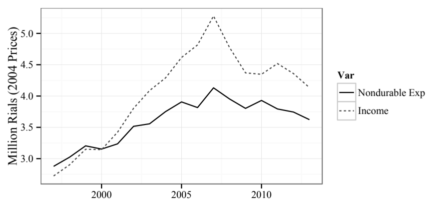
Source: HEIS 1997–2012 data by Statistics Center of Iran



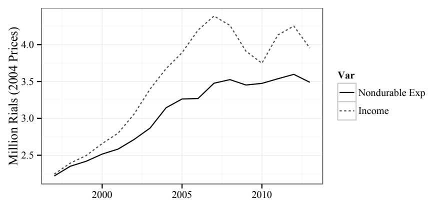
(a) Cohort 1931–40



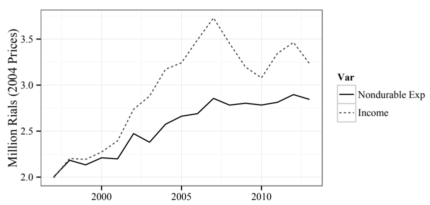
(b) Cohort 1941–50



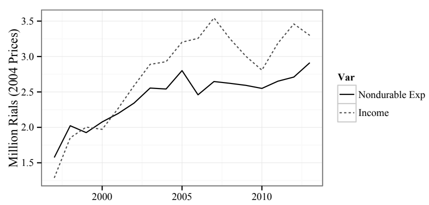
(c) Cohort 1951–60



(d) Cohort 1961–70



(e) Cohort 1971–80



(f) Cohort 1981–90

Figure 4: Income and Non-durable Expenditures for Iranian Household by 10-Year Cohorts

Source: HEIS 1997–2012 data by Statistics Center of Iran

4 Results

As we saw in Section 2.1, to test the existence of excess sensitivity, we have to estimate the Euler Equation with an additional income growth variable as in (14).

$$\Delta c_{i,t} = \alpha_i + \sigma r_t + \zeta \Delta y_{i,t} + \boldsymbol{\vartheta} \Delta \mathbf{z}_{i,t} + \varepsilon_{it} \tag{14}$$

where $\sigma = 1/\gamma$ and ζ is the coefficient of excess sensitivity. Endogenity of right-hand regressors is a serious problem in this estimation. Endogenity causes inconsistency of the usual OLS estimates and requires instrumental variable (IV) methods like two-stage least squares (2SLS) to obtain consistent coefficients. There are two 2SLS estimators by (Balestra and Varadharajan-Krishnakumar, 1987) and (Baltagi, 1981) to estimate linear models with instrumental variables in panel data which differ in the matrix manipulation of instruments (Baltagi, 2008). We estimate the models using both methods[6], but as there is no significant difference, only report estimations by Balestra and Varadharajan-Krishnakumar (1987) method.

Tables 3 shows the results of the Euler equation estimation for different subsample panels. After creating cohort synthetic panels and calculating weighted average of variables for each year-cohort, these panels are used in estimation of the equation (14). The model with results reported in column (1), uses cohort panel data from all households. As we can see the coefficient of the difference in the real per equivalent capita income is significant, and thus there is evidence of excess sensitivity in Iranian household data. The model with results reported in column (2), uses data from households that are government employee. We believe that these are the households with the weakest borrowing constrained households in Iran. And we can also see that the coefficient of excess sensitivity is not significant for this group. Columns (3) and (4) report the Euler equation estimations for private sector employees and non-employees that are considered the households with the tightest borrowing constrained. We observe that these households experience excess sensitivity.

We also add different variables that might change preferences, as we showed in the model section. A large group of variables are tested in different models, but a few models are reported in Tables 4 to 7. Although in some estimations in Table 4 and 6, the coefficient of excess sensitivity is not significant; but the overall results are the same, i.e. significant excess sensitivity in private sector employees and non-employees but not significant in government employees.

One of the biggest challenges one faces working with macroeconomic data in Iran is the measure of interest rate. There is no government issued bonds market and financial markets are always controlled by government orders. Thus the quality of interest rate one can provide for Iran might be problematic. To control for the effect of the choice of interest rate variable on our results, we estimate Euler Equations on different samples using 11 different measures of interest rate. The first one [Fix N] is calculated from a fixed 36% nominal interest rate. This rate is very common in Iran in unofficial markets, e.g. when changing house rent prepayments to monthly rent. The Central Bank of Islamic Republic of Iran published two time series of weighted interest rate for deposits

[6]These estimators are available in R package **plm** (Croissant and Millo, 2008).

Table 3: Euler Equation Estimation on Households devided by Working Sector

	All	Gov. Emp.	Prv. Emp.	Non Emp.
r_t	0.03	0.11*	0.12*	0.13**
	(0.06)	(0.07)	(0.07)	(0.06)
Δy_{it}	0.28*	0.33	0.38**	0.70***
	(0.15)	(0.28)	(0.15)	(0.16)
R^2	0.59	0.43	0.54	0.65
Adj. R^2	0.52	0.37	0.47	0.57
Num. obs.	147	80	109	141
F Stat.	48.24	21.31	43.82	112.32
p-value	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real weighted average interest rate of deposits in banking system. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model.

in the banking system and trade loans in the banking system, respectively. These rates are used in estimations denoted as Deposit and Loan. Six other measures are rates of saving deposits in banking system including short-term and 1 to 5 year long-term savings. As some studies show that Iranian households use durable goods as a means of saving, we build a time series of return using the price index of durable goods [D Return]. Results generally do not change, except using durable goods return cause models to have negative EIS, but as these rates are not in fact interest rates, so we do not worry about them.

4.1 Estimates of Elasticity of Intertemporal Substitution

The estimates of elastisity of intertemporal substitution (EIS) are one of the important results of our research. We have several estimates on EIS but all [significant ones, dropping the estimations using durable goods return rate] seem to vary in a reasonable range. Among the 31 significant estimates on σ reported in Tables 4 to 11, all are in range $[0.09, 0.24]$, which is not a wide range. Median estimate is 0.12 and estimates average is[7] 0.1345.

Havranek et al. (2014) collect 2735 estimates of the elasticity of intertemporal substitution in consumption from 169 published studies that cover 104 countries during different time periods. Unfortunately this study does not include any research on Iran, but shows a great diversity in the reported value for this parameter. Mean EIS for countries differs in range from -0.171 for Argentina to 3.149 for Austria. The mean estimates for US and UK are 0.594 and 0.487 respectively. Their study shows that EIS is dependent on properties of the country such as GDP per capita, credit availability, real interest and rule of law[8]. Mean estimates of EIS for Brazil, Chile, Colombia, Finland, Hong Kong,

[7] 0.1324 after removing highest and lowest estimates.

[8] Havranek et al. (2014) explain the differences in the estimates of EIS by other explanatory variables such as form of utility function used in deriving Euler Equation (e.g. habits and non-

Table 4: Euler Equation Estimation on All Households, Controlling Taste Shifters and Non-additivity in Utility

	Base	Taste 1	Taste 2	Taste 3	Non-additivity
r_t	0.03	0.01	0.04	0.01	0.10^{**}
	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Δy_{it}	0.28^{*}	0.18	0.30^{**}	0.17	0.40^{***}
	(0.15)	(0.14)	(0.15)	(0.14)	(0.10)
Δlit_{it}		1.08^{***}		1.09^{***}	
		(0.22)		(0.22)	
Δsex_{it}			-0.03	0.10	
			(0.16)	(0.14)	
ΔU_t					-0.01^{*}
					(0.00)
R^2	0.59	0.58	0.59	0.58	0.58
Adj. R^2	0.52	0.51	0.52	0.50	0.51
Num. obs.	147	147	147	147	147
F Stat.	48.24	56.74	34.78	42.36	51.42
p-value	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real weighted average interest rate of deposits in banking system. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model. "Taste 1" is the model with literacy rate change (Δlit_{it}) as taste shifter. "Taste 2" uses the change in share of female household heads (Δsex_{it}) as taste shifter, and Model "Taste 3" uses both. Non-additivity model, uses change in unemployement rate (ΔU_t) as a proxy for the effect of non-additivity in consumer's utility function between leisure and consumption.

Indonesia, Israel, Malaysia, Mexico, Pakistan, Portugal, Singapore, Uruguay and Venezuela are in range $[0.09, 0.24]$. Thus it seems that our estimates of EIS for Iran are compatible with those of developing countries.

separabilities), data used (e.g. no. of households and years, micro-data dummy, frequency), Design of estimation model (e.g. instrument lags and taste shifters), the variable definitions used for consumption (total consumption, nondurable consumption and food) and interest rate (money interest rate, stock return and capital return) and the method of estimation (e.g. ML, 2SLS, OLS).

Table 5: Euler Equation Estimation on Government Employees, Controlling Taste Shifters and Non-additivity in Utility

	Base	Taste 1	Taste 2	Taste 3	Non-additivity
r_t	0.11^{*}	0.12^{*}	0.11^{*}	0.12^{*}	0.10
	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)
Δy_{it}	0.33	0.26	0.36	0.28	0.16
	(0.28)	(0.27)	(0.28)	(0.28)	(0.28)
Δlit_{it}		0.52		0.48	
		(0.38)		(0.40)	
Δsex_{it}			−0.11	−0.05	
			(0.16)	(0.17)	
ΔU_t					0.00
					(0.01)
R^2	0.43	0.41	0.44	0.42	0.38
Adj. R^2	0.37	0.34	0.37	0.35	0.32
Num. obs.	80	80	80	80	80
F Stat.	21.31	12.91	15.15	10.27	7.03
p-value	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real weighted average interest rate of deposits in banking system. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model. "Taste 1" is the model with literacy rate change (Δlit_{it}) as taste shifter. "Taste 2" uses the change in share of female household heads (Δsex_{it}) as taste shifter, and Model "Taste 3" uses both. Non-additivity model, uses change in unemployement rate (ΔU_t) as a proxy for the effect of non-additivity in consumer's utility function between leisure and consumption.

Table 6: Euler Equation Estimation on Private Employees, Controlling Taste Shifters and Non-additivity in Utility

	Base	Taste 1	Taste 2	Taste 3	Non-additivity
r_t	0.12^{*}	0.11^{*}	0.12^{*}	0.11^{*}	0.19^{**}
	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)
Δy_{it}	0.38^{**}	0.28^{*}	0.40^{***}	0.31^{**}	0.24
	(0.15)	(0.15)	(0.15)	(0.15)	(0.18)
Δlit_{it}		0.59^{***}		0.57^{***}	
		(0.20)		(0.19)	
Δsex_{it}			-0.19	-0.04	
			(0.30)	(0.29)	
ΔU_t					-0.01
					(0.01)
R^2	0.54	0.52	0.54	0.54	0.47
Adj. R^2	0.47	0.45	0.46	0.46	0.40
Num. obs.	109	109	109	109	109
F Stat.	43.82	29.36	30.89	23.29	20.35
p-value	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real weighted average interest rate of deposits in banking system. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model. "Taste 1" is the model with literacy rate change (Δlit_{it}) as taste shifter. "Taste 2" uses the change in share of female household heads (Δsex_{it}) as taste shifter, and Model "Taste 3" uses both. Non-additivity model, uses change in unemployement rate (ΔU_t) as a proxy for the effect of non-additivity in consumer's utility function between leisure and consumption.

Table 7: Euler Equation Estimation on Non-employees, Controlling Taste Shifters and Non-additivity in Utility

	Base	Taste 1	Taste 2	Taste 3	Non-additivity
r_t	0.13^{**}	0.03	0.12^{**}	0.03	0.12^{**}
	(0.06)	(0.07)	(0.06)	(0.07)	(0.05)
Δy_{it}	0.70^{***}	0.42^{**}	0.67^{***}	0.40^{**}	0.64^{***}
	(0.16)	(0.19)	(0.15)	(0.18)	(0.11)
Δlit_{it}		0.75^{**}		0.80^{***}	
		(0.30)		(0.29)	
Δsex_{it}			0.26^{*}	0.24^{**}	
			(0.13)	(0.12)	
ΔU_t					0.00
					(0.00)
R^2	0.65	0.71	0.66	0.72	0.65
Adj. R^2	0.57	0.62	0.58	0.62	0.57
Num. obs.	141	141	141	141	141
F Stat.	112.32	98.32	79.78	75.18	76.61
p-value	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real weighted average interest rate of deposits in banking system. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model. "Taste 1" is the model with literacy rate change (Δlit_{it}) as taste shifter. "Taste 2" uses the change in share of female household heads (Δsex_{it}) as taste shifter, and Model "Taste 3" uses both. Non-additivity model, uses change in unemployement rate (ΔU_t) as a proxy for the effect of non-additivity in consumer's utility function between leisure and consumption.

Table 8: Euler Equation Estimation on All Households, Using Different Measures of Interest Rate

	Fix N	Deposit	Loan	Short	1 Y	2 Y	3 Y	4 Y	5 Y	D Return
r_t	0.04	0.03	0.02	0.01	0.03	0.01	0.01	0.01	0.01	-0.17^{***}
	(0.07)	(0.06)	(0.05)	(0.08)	(0.07)	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)
Δy_{it}	0.25^{*}	0.28^{*}	0.20^{*}	0.33^{**}	0.27^{*}	0.19	0.20	0.21	0.25	0.38^{***}
	(0.14)	(0.15)	(0.12)	(0.16)	(0.15)	(0.14)	(0.15)	(0.15)	(0.16)	(0.10)
R^2	0.59	0.59	0.58	0.58	0.59	0.58	0.58	0.58	0.58	0.60
Adj. R^2	0.52	0.52	0.51	0.51	0.52	0.51	0.51	0.51	0.52	0.53
Num. obs.	147	147	147	147	147	147	147	147	147	147
F Stat.	42.62	48.24	33.53	59.38	45.64	31.54	32.38	34.63	41.65	75.89
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real interest rate which differs in each of the models. "Fix N" is the model with fixed nominal interest rate at 36% and thus in fact a model with negative of inflation expectation "Depist" uses the weighted average rates of deposits in banking system. "Loan" uses the weighted average rates of trade loans in banking system. "Short" is the model with short-term savings deposits rate. "1 Y" to "5 Y" use interest rates of 1 Year to 5 Year long-term saving deposits respectively. "D Return" uses the real return of durable goods. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model.

Table 9: Euler Equation Estimation on Government Employees, Using Different Measures of Interest Rate

	Fix N	Deposit	Loan	Short	1 Y	2 Y	3 Y	4 Y	5 Y	D Return
r_t	0.14*	0.11*	0.09	0.10	0.10	0.10	0.10	0.10	0.10	−0.16*
	(0.09)	(0.07)	(0.07)	(0.10)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)
Δy_{it}	0.32	0.33	0.26	0.29	0.28	0.24	0.25	0.27	0.29	0.26
	(0.24)	(0.28)	(0.17)	(0.32)	(0.31)	(0.24)	(0.24)	(0.25)	(0.29)	(0.28)
R^2	0.43	0.43	0.40	0.42	0.42	0.41	0.41	0.42	0.42	0.42
Adj. R^2	0.36	0.37	0.34	0.36	0.36	0.35	0.35	0.35	0.36	0.35
Num. obs.	80	80	80	80	80	80	80	80	80	80
F Stat.	20.89	21.31	17.50	18.38	18.13	15.59	16.36	17.54	18.33	17.68
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real interest rate which differs in each of the models. "Fix N" is the model with fixed nominal interest rate at 36% and thus in fact a model with negative of inflation expectation "Depist" uses the weighted average rates of deposits in banking system. "Loan" uses the weighted average rates of trade loans in banking system. "Short" is the model with short-term savings deposits rate. "1 Y" to "5 Y" use interest rates of 1 Year to 5 Year long-term saving deposits respectively. ' "D Return" uses the real return of durable goods. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model.

Table 10: Euler Equation Estimation on Private Sector Employees, Using Different Measures of Interest Rate

	Fix N	Deposit	Loan	Short	1 Y	2 Y	3 Y	4 Y	5 Y	D Return
r_t	0.14^{*}	0.12^{*}	0.09^{*}	0.11	0.10	0.13^{*}	0.13^{*}	0.13^{*}	0.12^{*}	-0.26^{***}
	(0.09)	(0.07)	(0.06)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)
Δy_{it}	0.36^{**}	0.38^{**}	0.35^{***}	0.33^{**}	0.33^{**}	0.36^{***}	0.36^{***}	0.37^{***}	0.35^{**}	0.37^{***}
	(0.15)	(0.15)	(0.13)	(0.15)	(0.16)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)
R^2	0.54	0.54	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.55
Adj. R^2	0.47	0.47	0.46	0.46	0.47	0.46	0.46	0.46	0.47	0.48
Num. obs.	109	109	109	109	109	109	109	109	109	109
F Stat.	40.53	43.82	39.19	36.39	36.28	40.95	41.29	41.85	40.18	47.01
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real interest rate which differs in each of the models. "Fix N" is the model with fixed nominal interest rate at 36% and thus in fact a model with negative of inflation expectation "Depist" uses the weighted average rates of deposits in banking system. "Loan" uses the weighted average rates of trade loans in banking system. "Short" is the model with short-term savings deposits rate. "1 Y" to "5 Y" use interest rates of 1 Year to 5 Year long-term saving deposits respectively. "D Return" uses the real return of durable goods. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model.

Table 11: Euler Equation Estimation on Non-employees, Using Different Measures of Interest Rate

	Fix N	Deposit	Loan	Short	1 Y	2 Y	3 Y	4 Y	5 Y	D Return
r_t	0.11*	0.13**	0.02	0.18*	0.15**	0.07	0.08	0.10	0.13*	−0.15**
	(0.07)	(0.06)	(0.05)	(0.10)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
Δy_{it}	0.61***	0.70***	0.42***	0.76***	0.71***	0.57***	0.60***	0.64***	0.71***	0.50***
	(0.15)	(0.16)	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)	(0.16)	(0.16)	(0.11)
R^2	0.65	0.65	0.64	0.64	0.65	0.64	0.64	0.64	0.65	0.65
Adj. R^2	0.57	0.57	0.56	0.57	0.57	0.57	0.57	0.57	0.57	0.57
Num. obs.	141	141	141	141	141	141	141	141	141	141
F Stat.	113.36	112.32	83.37	103.11	111.92	109.10	110.80	112.08	109.65	103.63
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Dependent variable is Δc_{it} where c_{it} stands for log real consumption (nondurable expenditure) of cohort i at time t. y_{it} is its log real income, and r_t is the real interest rate which differs in each of the models. "Fix N" is the model with fixed nominal interest rate at 36% and thus in fact a model with negative of inflation expectation "Depist" uses the weighted average rates of deposits in banking system. "Loan" uses the weighted average rates of trade loans in banking system. "Short" is the model with short-term savings deposits rate. "1 Y" to "5 Y" use interest rates of 1 Year to 5 Year long-term saving deposits respectively. "D Return" uses the real return of durable goods. Models are estimated using synthetic cohort panels of Iranian household data. Instruments used are the second and third lag of income growth and second to forth lag of consumption growth and interest rate itself. The 2SLS method of (Balestra and Varadharajan-Krishnakumar, 1987) is used to estimate the model.

5 Conclusion

It is evident that simple rational expectations permanent income hypothesis (REPIH) model is not compatible with data most of the times. The income change can help predict consumption change, and this is called *excess sensitivity.* There are three categories of research in response to the observed excess sensitivity. The first and second categories of research conclude that the actual consumption profile is an optimal profile and we observe excess sensitivity due to either econometrics problems or incomplete form of utility function for the specification of the estimated Euler equation. The third category of research focuses on borrowing constraints, and conclues that actual consumption profile is suboptimal.

Our research is related to the third route of research. As one of the earliest works in this research area, Zeldes (1989) uses the Panel Study of Income Dynamics (PSID) to show that observing excess sensitivity of food expenditure is related to household's savings. In a more recent study, Johnson and Li (2010) use debt-payment-to-income ratio as an indicator of borrowing constraints to show that observed excess sensitivity is related to being borrowing-constrained. We believe Zeldes's work suffers from the assumption of additive separability of food expenditure and other consumption which is not a very viable assumption, and Johnson and Li's work suffers from endogeneity of the measure used to group households into borrowing-constrained and non-borrowing-constrained panels. We use the information on working sector of household head to group households into constrained and non-constrained panels and believe that using this exogenous proxy helps us prevent endogeneity problems of Johnson and Li. Also we use the nondurable consumption expenditures and thus an improvement to the contributions of Zeldes.

We use the Iranian Household Expenditures and Income Surveys data for the first time to estimate the household consumption choice Euler equation and analyze the presence of excess sensitivity. We avoid the problems of using aggregate data mentioned by Attanasio and Weber (1993) as we compute logs on household data and then aggregate them into cohorts. As the length of the panel used to estimate the equation is relatively short (16 years), we prefer to use linear forms and estimate using panel IV method instead of GMM method as GMM estimators are biased in short-time panels. Our results show that excess sensitivity is evident in Iranian household data. And it is related to the credit limits on households. Government employees that enjoy easier access to finance, show no excess sensitivity. However, employees of the private sector and non-employees, show excess sensitivity of consumption growth to income growth. As we have shown that being a government employee increases the chance of getting loan controlling for all other factors, we believe that the important difference between government employees and other households is less binding borrowing constraints on government employees. Thus we have shown that the presence of excess sensitivity is related to borrowing constraints.

Another major contribution of our work is to provide estimates of the elasticity of inter-temporal substitution for Iranian households based on micro-data estimates. The different values we estimate using different measures of interest rate and different panels of households, are all in the range $[0.09, 0.24]$ which is different from what is common to use in DSGE models [which are based on estimates from US and UK], but consistent with the estimates of EIS in other developing countries (Havranek et al., 2014).

A HEIS Data

Iran is one of the countries with a long history of household expenditure surveys. The first expenditure survey in Iran was conducted in 1935 by Bank Melli Iran[9] to obtain the coefficients used for the cost of living indexes. Once again in 1959 the “Economic Research Department” of Bank Melli Iran surveyed households in 23 cities to update the price index coefficients. Since the establishment of Central Bank of Iran (known as *Central Bank of Islamic Republic of Iran* now) in 1960, all central banking duties of Bank Melli were moved to Central Bank, along with all national-level data gatherings. Central Bank of Iran has conducted annual household budget surveys on urban households every year since 1965. The first rural household expenditure survey was conducted by former Department of Public Statistics (later Statistical Center of Iran (SCI)). Since 1965 Statistical Center of Iran has been running this survey annually and has added urban households since 1968. This survey is bigger than that of Central Bank, both in sample and population (covering both rural and urban households) and number of expenditure items surveyed.

So in fact there are two separate annual household expenditure and income surveys in Iran, the one by CBI (which is often called the Household Budget Survey (HBS)) and the one by SCI. We use the SCI’s data as its micro-data is published publicly.

A.1 Steps of Preparing HIES Data

HIES micro-data are published as one raw-data Microsoft Access file (*.mdb or *.accdb) and 2 summary-data Microsoft Excel files (*.xls, *.xlsx, and in some years *.dbf files) for each year. All the data processing and cleaning stages are done using GNU R[10](R Core Team, 2013b). We read data files using R packages **RODBC**, **XLConnect**, and **foreign** (Ripley and Lapsley, 2013; Mirai Solutions GmbH, 2014; R Core Team, 2013a). We use the R package **data.table** for enhanced data processing (Dowle et al., 2013). For each region (urban/rural) there exists 1 table for information on individuals in household, 1 table for socio-economic status of household, 12 tables for non-durable expenditure, 1 for durable expenditure and 1 for investment expenditures of household and 4 tables on income information of all income earner individuals.

As there are inconsistencies between tables in raw data, we made a base table for each year containing only households with available basic data. Then we added other data step-by-step. Expenditure tables were combined and reshaped from long-table format to short-tables. Socio-economic and household income data were extracted from summary files and merged into base table along with expenditure data. Next, we bind all years’ data and merging price data, calculate real values.

We see households in sample with old head that have children older than 40 years and married living with them. This is because of cultural issues, some families consider the eldest person as the household head. But we consider such a family a father living with his son (who is the household head). Thus we

[9]Bank Melli Iran (meaning Iranian National Bank) is a commercial bank that until the establishment of the Central Bank of Iran (CBI) at 1965 did the central banking jobs too.

[10]http://www.r-project.com

redefined the household head as the person who earns highest monetary income, most of time same as the person reported as household head.

Table 12 shows the sample size of each year. As we can see comparing table 12 with population size (table 13), the sample is not proportional in urban and rural areas. In fact the sample is weighted and some households in sample represents only 5 households in population but some other represent more than 16000 population households. These weights should be considered when preparing aggregate measures. These weights are reported from 2005, but we have to estimate the weights for surveys before that. The sample weight is modeled with these variables: province population, year, province dummy, urban/rural region dummy and estimated for years 1997–2004. Facilities provided by R packages **weights**, **Hmisc** and **survey** are used when calculating summary statistics, building cohort panels and fitting probit models on survey data (Pasek et al., 2014; Harrell and Dupont, 2013; Lumley, 2004, 2014).

Table 12: Sample Size in HEIS

Year	Total	Urban	Rural
1997	21950	10968	10982
1998	17477	8285	9192
1999	27464	12731	14733
2000	26941	12320	14621
2001	26961	12337	14624
2002	32152	15114	17038
2003	23134	10959	12175
2004	24534	11619	12915
2005	26900	12925	13975
2006	30970	14175	16795
2007	31283	15018	16265
2008	39088	19381	19707
2009	36868	18665	18203
2010	38285	18701	19584
2011	38513	18727	19786
2012	38192	18535	19657

Source: HEIS data by SCI

Table 13: Population of Iran

Year	Total	Urban	Rural
1996	12398235	7948925	4449310
2006	17501771	12405584	5074866
2011	21185647	15427848	5744614

Source: Iran Census Reports by SCI

Price data used are monthly data from both CBI and SCI. Each category of expenditures is deflated separately by different price indexes. Expenditures from last month are deflated using last month's index but expenditures from last 12 months are deflated using average index of last 12 month. For years that the month of surveying is not reported, price indexes are based on quarters.

As mentioned in section 2, when estimating Euler equation by aggregate data, we have the problem that sum of logs is not equal to log of sums. Thus when building cohort aggregates, we first take logs of variables and then average over each cohort.

References

Alan, S., O. P. Attanasio, and M. Browning (2009, March). Estimating Euler equations with noisy data: two exact GMM estimators. *Journal of Applied Econometrics 24*(2), 309–324.

Attanasio, O. P. (1999). Consumption. In J. Taylor and M. Woodford (Eds.), *Handbook of Macroeconomics*, Chapter 11, pp. 741–812. Elsevier Science B. V.

Attanasio, O. P. and M. Browning (1995). Consumption over the Life Cycle and over the Business Cycle. *American Economic Review 85*(5), 1118–1137.

Attanasio, O. P. and H. Low (2004). Estimating euler equations. *Review of Economic Dynamics 7*(2), 406–435.

Attanasio, O. P. and G. Weber (1993). Consumption Growth , the Interest Rate and Aggregation. *The Review of Economic Studies 60*(3), 631–649.

Attanasio, O. P. and G. Weber (1995, December). Is Consumption Growth Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey. *Journal of Political Economy 103*(6), 1121–1157.

Attanasio, O. P. and G. Weber (2010). Consumption and saving: models of intertemporal allocation and their implications for public policy. *Journal of Economic Literature 48*(September), 693–751.

Balestra, P. and J. Varadharajan-Krishnakumar (1987). Full information estimations of a system of simultaneous equations with error component structure. *Econometric Theory 3*(02), 223–246.

Baltagi, B. (2008). *Econometric analysis of panel data.* John Wiley & Sons.

Baltagi, B. H. (1981). Simultaneous equations with error components. *Journal of econometrics 17*(2), 189–200.

Bianchi, J. and E. G. Mendoza (2010). Overborrowing, financial crises and'macro-prudential'taxes. Technical report, National Bureau of Economic Research.

Blundell, R., M. Browning, and C. Meghir (1994). Consumer Demand and the Life-Cycle Allocation of Household Expenditures. *Review of Economic Studies 61*(1), 57–80.

Campbell, J. and A. S. Deaton (1989). Is Consumption Too Smooth? *Review of Economic Studies 56*(July), 357–373.

Casado, J. M., F. Alvarez-Cuadrado, J. M. Labeaga, and D. Sutthiphisal (2012). Envy and Habits: Panel Data Estimates of Interdependent Preferences.

Croissant, Y. and G. Millo (2008). Panel data econometrics in R: The plm package. *Journal of Statistical Software 27*(2).

Deaton, A. S. (1991). Saving and liquidity constraints. *Econometrica 59*, 1221–1248.

Deaton, A. S. (1992). *Understanding consumption.* Oxford: Oxford University Press.

Dowle, M., T. Short, S. Lianoglou, A. Srinivasan, and R. Saporta (2013). *data.table: Extension of data.frame for fast indexing, fast ordered joins, fast assignment, fast grouping and list columns.* R package version 1.8.10.

Flavin, M. A. (1981). The Adjustment of Consumption to Changing Expectations about Future Income. *Journal of Political Economy 89*(5), 1020–1037.

Friedman, M. (1957). *A Theory of the Consumption Function.* New Jersey, US: Princeton University Press.

Gayle, W.-R. and N. Khorunzhina (2009). Noisy addicts? estimation of optimal consumption choice with habit formation and measurement error. Technical report, SSRN Working paper.

Gorman, W. M. (1959). Separable utility and aggregation. *Econometrica 27*(3), 469–481.

Hall, R. E. (1978). Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy 86*(6), 971–987.

Hall, R. E. and F. S. Mishkin (1982). The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households. *Econometrica 50*(2), 461–481.

Hansen, L. P. and K. J. . Singleton (1982). Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models. *Econometrica 50*(5), 1269–1286.

Hansen, L. P. and K. J. Singleton (1983). Stochastic consumption, risk aversion, and the temporal behavior of asset returns. *Journal of Political Economy 91*(April), 249–265.

Harrell, F. E. and C. Dupont (2013). *Hmisc: Harrell Miscellaneous.* R package version 3.13-0.

Havranek, T., R. Horvath, Z. Irsova, and M. Rusnak (2014, August). Cross-Country Heterogeneity in Intertemporal Substitution. Working Papers, Czech National Bank, Research Department 2014/06, Czech National Bank, Research Department.

Johnson, K. W. and G. Li (2010, September). The Debt-Payment-to-Income Ratio as an Indicator of Borrowing Constraints: Evidence from Two Household Surveys. *Journal of Money, Credit and Banking 42*(7), 1373–1390.

Korniotis, G. M. (2010). Estimating panel models with internal and external habit formation. *Journal of Business & Economic Statistics 28*(1), 145–158.

Lumley, T. (2004). Analysis of complex survey samples. *Journal of Statistical Software 9*(1), 1–19. R package verson 2.2.

Lumley, T. (2014). survey: analysis of complex survey samples. R package version 3.30.

Mankiw, N. G., J. Rotemberg, and L. H. Summers (1985). Intertemporal substitution in macroeconomics. *Quarterly Journal of Economics 100*(February), 225–251.

Meghir, C. and G. Weber (1996). Intertemporal Nonseperability or Borrowing Restrictions? A Disaggregate Analysis Using a U.S. Consumption Panel. *Econometrica 64*(5), 1151–1181.

Mirai Solutions GmbH (2014). *XLConnect: Excel Connector for R.* R package version 0.2-7.

Parker, J. A. (2008). Euler equations. In S. N. Durlauf and L. E. Blume (Eds.), *The New Palgrave Dictionary of Economics*. Basingstoke: Palgrave Macmillan.

Pasek, J., A. Tahk, G. Culter, and M. Schwemmle (2014). *weights: Weighting and Weighted Statistics.* R package version 0.80.

R Core Team (2013a). *foreign: Read Data Stored by Minitab, S, SAS, SPSS, Stata, Systat, dBase, ...* R package version 0.8-55.

R Core Team (2013b). *R: A Language and Environment for Statistical Computing.* Vienna, Austria: R Foundation for Statistical Computing.

Ripley, B. and M. Lapsley (2013). *RODBC: ODBC Database Access.* R package version 1.3-8.

Zeldes, S. P. (1989). Consumption and Liquidity Constraints: An Empirical Investigation. *Journal of Political Economy 79*(2), 305–346.