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Borrowing Constraints and Savings in Turkey

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Abstract

Since 2002, Turkish economy experienced financial liberalization with three striking trends: (1) accelerated growth rate, (2) a sharp decline in the real interest rate, and (3) a sustained fall in the saving rate of each age-groups. This thesis studies this period and attempts to explain the evolution of age-saving profile for Turkey with the relaxation of borrowing constraints. We provide micro-level evidence to point the errors of conventional household head approach while calculating age-saving profile of Turkey. Then, motivated by the evidence, we provide cohort level saving rates through nonlinear least squares estimation. Lastly, we show that using accelerated growth rate and decreased interest rate of Turkish economy, simple three-period OLG framework account for the change in saving rate for different age-groups between 2004 and 2014. The model's single borrowing constraint mechanism displays substantial quantitative power in explaining the change in savings across cohorts in Turkey over the last decade.

Keywords : Borrowing constraints, saving, Financial liberalization, Life-cycle household saving

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Özet

Türkiye ekonomisinin 2002 yılından sonra yaşadığı finansal liberalizasyon 3 trend ile gerçekleşmiştir: (1) hızlı büyüme, (2) reel faizlerde sert düşüş ve (3) her yaş grubunun tasarruf oranlarında düzenli bir azalma. Bu tez çalışması bu döneme odaklanmaktadır ve borçlanma kısıtları teorisinden faydalanarak yaşlara göre tasarruf oranlarının değişimini açıklamayı hedeflemektedir. Öncelikle, mikro seviyedeki veriler kullanılarak Türkiye için yaşlara göre tasarruf oranlarının hesaplanmasında hane reisi yaşını kullanan yöntemlerin hatalı olduğu gösterilmiştir. Daha sonra bu delillerden yola çıkarak doğrusal olmayan en küçük kareler yöntemi kullanılmış ve yaşlara göre tasarruf oranları bu yöntemle hesaplanmıştır. Son olarak, yüksek büyüme oranları ve düşük reel faiz oranları kullanıldığında, standart OLG modelinin değişik yaş grupları için 2004-2014 yılları arasındaki tasarruf oranı değişimini açıkladığı görülmüştür. Modelin tek borçlanma kısıtı mekanizmasının Türkiye'de farklı jenerasyonların son 10 yılda tecrübe ettiği tasarruf değişimini kantitatif açıdan açıklayabildiği gözlemlenmiştir.

Anahtar sözcükler: Borçlanma kısıtları, tasarruflar, finansal liberalizasyon, hanehalkı yaşam döngüsü tasarrufları

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Contents

List of Figures

List of Tables

1 Introduction

Turkey's saving rate and its decreasing trend preserves its importance both in the academic field and on daily debates. There is a consensus that this trend should be reversed and saving rate in Turkey has to be increased. As Figure 1 shows, the major part of the total domestic saving rate of Turkey is the private saving rate and households' saving decision determines the private saving rate. Then, the problem and the debates about the problem needs to turn around the household saving rate. At this point, policy makers tries to introduce some mechanisms such as Private Pension System to increase national savings through increasing household saving rate. However, current events show that forcing utility maximizer agents to save by such mechanisms would not provide expected results. Therefore, we need to concentrate firstly on our main research question which is "What are the underlying reasons of the decline in household saving rate of Turkey after 2002?". Answering this question would provide researcher a narrower space to concentrate on for further studies that aims to offer a recommendation for solution.

Before trying to understand the reasons behind this fall in saving rates, we will look at the accompanying trends in Turkish economy. Turkish economy experienced financial liberalization with (1) accelerated growth rate, and (2) a sharp decline in the real interest rate. Figure 1 shows the huge decline in the nominal interest rates in the economy. As we will follow a model without money, we concentrate on the real interest rates. The real interest rates decreased from 21% to 1.8% between 2000 and 2015. At the same time, Figure 2 presents that consumer credit level/GDP ratio increased from 0.48% to 8.45% in this period. On the other hand, Figure 3 shows that a large decline starts in all three variables related to saving rates in the beginning of 2000s. Private saving rate falls from 19.6% to 11.7% between 2003 and 2014 while household saving rate experiences 1 percentage greater decrease than private saving rate by 8.8% decline at that period.

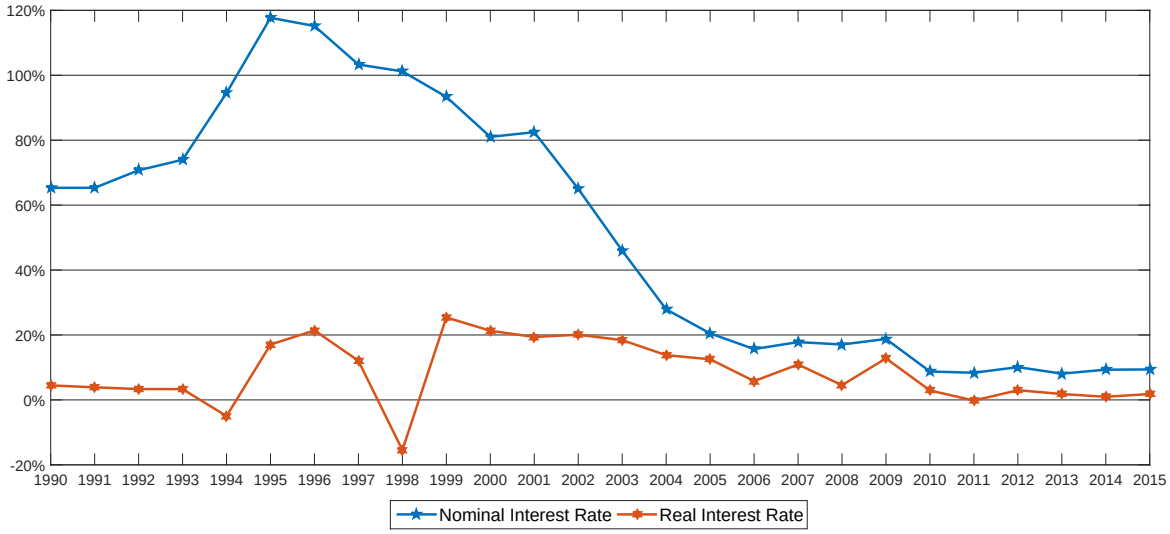


Figure 1: Nominal and Real Interest Rates (1990-2015)

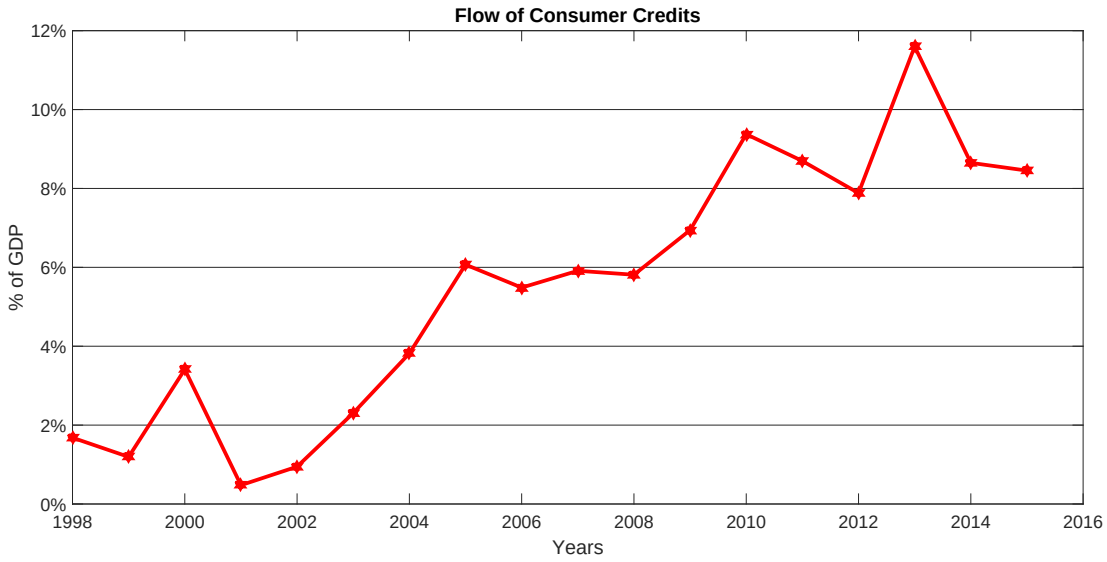


Figure 2: Consumer Credits/ GDP (1998-2015)

As the decline observed at the aggregate level, then the next question should be "What is the distribution of this decline between different age groups?". Then we will understand how did different age groups contribute to the fall in the aggregate saving rate. To

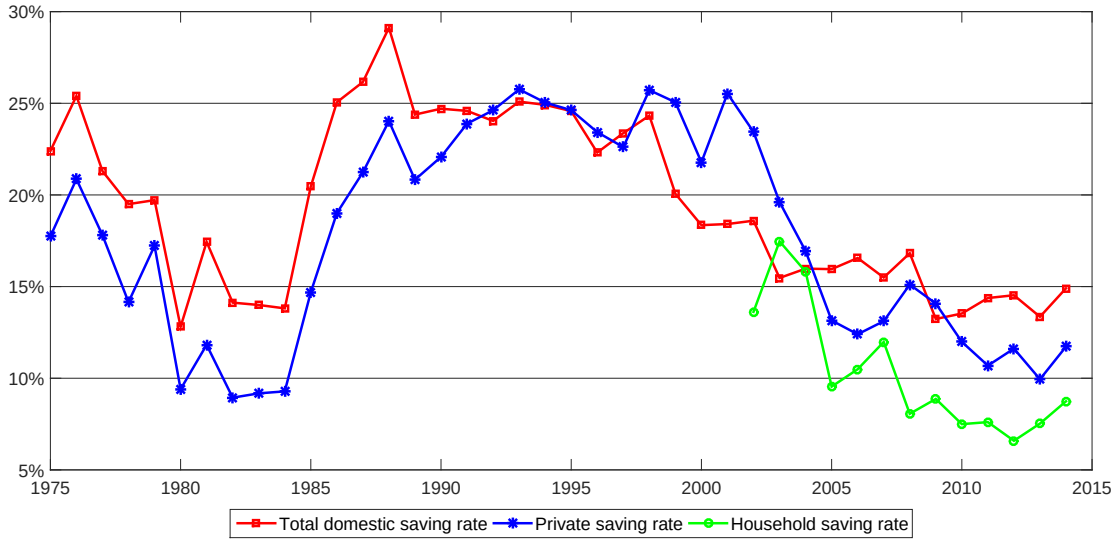


Figure 3: Saving rates in Turkey

address this question we will use Household Budget Survey to show micro-evidence on saving behaviour by age groups. Household Budget Survey suffers from data availability for consumption on individual level. As a common practice to overcome this problem **?** for 2003-2010 period and **?** for 2005 use age of household head to show age-saving profiles. However **?** asserts that if there exist multi-generational households(quite common in Turkey) then selection and aggregation biases arise. **?** considers Deaton-Paxson critique and disaggregate aggregate household saving into age groups with a linear regression model. We will try to remove these biases and estimate corrected age-saving profile with non-linear least squares estimation by using household specific controls (Section 3). After we derive the estimation results we will move one step further for explanation of the cause of this decline. Then the next question to be answered is "Do relaxing of borrowing constraints (financial liberalization) in Turkey can explain the decrease in household saving rate?". **?** and **?** found a role for the credit/GDP ratio and change in private credit % of GDP as a significant determinant for private saving of Turkey,respectively. Additionaly, **?** found a negative effect of mortgage and non-mortgage consumer credit on private saving

rates. Inspired by the work of **?** that show the relaxed borrowing constraints explain considerable amount of the fall in US private saving rate for young cohorts and at aggregate level, can we explain the realized trend between 2004 and 2014 with an overlapping generations model with a borrowing constraints?

In an important work, **?** show that imperfections in the credit markets may prevent households from borrowing or might have effect of postponing consumption and increasing savings. **?** supports this idea by claiming that precautionary motives interact with liquidity constraints because the inability to borrow when times are bad provides an additional motive for accumulating assets when times are good. Therefore, loosening of credit constraints might be the reason behind the behaviour of households in Turkey.

? built a closed-economy, three period overlapping-generations model with household credit constraints to illustrate the relationship between liquidity constraints and saving. They assume that young are individuals borrow to finance their consumption but with liquidity constraints they can borrow at most a proportion of the present value of their lifetime income. **?** extends their framework with the multi-country, open-economy setup, the asymmetry in household credit constraints across countries. Their model explains a significant portion of the rise in saving rates for most age groups in China(more credit constrained economy) and the simultaneous increase in borrowing of the young in the US(less credit constrained economy). As we have calculated that saving rate of each cohort, especially younger cohorts, decreased significantly between 2004 and 2014, this fact can be explained by the loosening of credit constraint of these age groups. **?** assume constant credit constraint parameter across time and we extend this framework by allowing time-varying credit constraints parameter for Turkey. Because indicators for credit constraint parameter changed dramatically between 2002 and 2014. **?** use maximum loan-to-value ratio and consumer credit as a percentage of net national product as indicator of liquidity constraints while **?** use the total amount of mortgage debt and gross

household debt-to-GDP. We follow **?** and build an overlapping-generations with borrowing constraints on young households and we will add bequest motive for old cohorts on their basic theoretical framework. As we have observed that the most significant fall in saving rate experienced for young cohorts in Turkey, we will use gross household debt % of GDP data to reflect financial liberalization of Turkey in the model.

Life-cycle hypothesis of saving by **?** shows that age-saving profile of an agent should be hump-shaped. Consumers borrow when young and save when middle-aged for the retirement and then dissave all of their accumulated assets. However age-saving profile of Turkey that we have estimated is not in accordance with the life-cycle theory. The saving rate is negative for the younger cohorts and increases with the age. There is no decrease in the saving rate with the retirement. Therefore standard models faces difficulties to explain the saving rate of the old cohort in Turkey and new models or extensions of existing model needs further consideration for the old agents. The paper proceeds as follow. In the section 2 we will develop the theoretical framework and provide some intuitions, analytical results and show numerical illustrations about the analytical results. In the section 3 we will examine micro-level evidence on age-saving behaviour of Turkey and section 4 will provide fully calibrated quantitative results for Turkish economy. Section 5 will conclude.

2 Model

We develop a small-economy model along the lines of **?** with three differences. First, we extend their baseline framework by incorporating bequest motive. Second, unlike **?** we will use time-varying credit constraint parameter and as a third difference we will use real interest rate from the real world data to concentrate on explaining the household behavior of agents in Turkey.

The economy is populated with overlapping generations of consumers who live for three periods and we denote generations by $\gamma \in \{y, m, o\}$. Young ($\gamma = y$) agents and middle-aged ($\gamma = m$) agents supply one unit of labor and they will retire when they are old ($\gamma = o$). The young agents will be credit-constrained and the severity of the constraint will be different across years. Old agents do not decumulate all capital stock, they will leave bequest for their offspring. Then, we obtain a more realistic saving behavior for the old agents in Turkey.

2.1 Production

The production technology uses capital and labor to produce a homogeneous good. Let K_t denote the aggregate capital stock at the beginning of period t, and $e_t L_{y,t} + L_{m,t}$ the total labor input employed in period t. $L_{\gamma,t}$ denotes the size of generation γ in period t and e_t is the relative productivity of young workers ($e_t < 1$). The gross output in the country is

$$Y_t = (K_t)^{\alpha}[A_t(e_t L_{y,t} + L_{m,t})]^{1-\alpha} \tag{1}$$

where $0 < \alpha < 1$, and A_t is the productivity. Capital and labor markets are competitive and each factor earns its marginal product. The wage rates per unit of labor in youth and middle age are

$$w_{y,t} = e_t(1-\alpha)A_t(k_t)^{\alpha} \tag{2}$$

$$w_{m,t} = (1-\alpha)A_t(k_t)^{\alpha}, \tag{3}$$

where $k_t = K_t/[A_t(e_t L_{y,t} + L_{m,t})]$ is the capital-effective-labor ratio. The rental rate earned by capital in production equals the marginal product of capital, $r_{K,t} = \alpha(k_t)^{\alpha-1}$,

and the gross rate of return earned between period *t-1* and t is

$$R_t = 1 - \delta + r_{K,t} \tag{4}$$

Let $g_{A,t}$ and $g_{L,t}$ denote the growth rate of productivity and of the young cohort size, respectively, then

$$A_t = (1 + g_{A,t})A_{t-1}\,, \tag{5}$$

$$L_{y,t} = (1 + g_{L,t})L_{y,t-1}\,. \tag{6}$$

2.2 Households

A consumer born in period t earns the wage rate $w_{y,t}$ when young and $w_{m,t+1}$ when middle-aged. $c_{\gamma,t}$ denotes the consumption level of generation γ born in period t. The lifetime utility of a consumer born in period t is

$$U_t = u(c_{y,t}) + \beta u(c_{m,t+1}) + \beta^2 u(c_{o,t+2}) + \phi\beta^2 u(b_{t+2}) \tag{7}$$

with standard isoelastic preferences $u(c) = (c^{1-\frac{1}{\sigma}} - 1)/(1 - \frac{1}{\sigma})$. The discount factor β satisfies $0 < \beta < 1$ and the intertemporal elasticity of substitution coefficient satisfies $\sigma \leq 1$.

Let $a_{\gamma,t+1}$ to denote the asset holding of the generation γ at the end of the period t and b_{t+2} is the bequest that the consumer in old age leaves to his $1 + g_{L,t+1}$ children, shared equally amongst them. The consumer chooses consumption in each period, and bequest

in the old age, and maximizes lifetime utility subject to following budget constraints

$$
\begin{aligned}
c_{y,t} + a_{y,t+1} &= w_{y,t}, \\
c_{m,t+1} + a_{m,t+2} &= w_{m,t+1} + R_{t+1}a_{y,t+1} + \frac{b_{t+1}}{1+g_{L,t}}, \\
c_{o,t+2} + b_{t+2} &= R_{t+2}a_{m,t+2}
\end{aligned}
$$

We assume that young individuals can borrow ($a_{y,t+1} < 0$) but they can only borrow up to a fraction θ_t of the present value of their future labor income,

$$a_{y,t+1} \geq -\theta_t \frac{w_{m,t+1}}{R_{t+1}} \tag{8}$$

Additionally, we will be interested in the case in which the credit constraint will be binding all times,

$$a_{y,t+1} = -\theta_t \frac{w_{m,t+1}}{R_{t+1}} \tag{9}$$

Then the net asset position of the middle-aged agent and the the amount of bequest left by the old agent are derived from the Euler equations,

$$a_{m,t+1} = (1+\phi^{-\sigma}) \frac{\left[(1-\theta_{t-1})(1-\alpha)A_t(k_t)^{\alpha} + \frac{b_t}{1+g_{L,t-1}}\right]}{1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}(R_{t+1})^{1-\sigma}} \tag{10}$$

$$b_t = R_t \frac{\left[(1-\theta_{t-2})(1-\alpha)A_{t-1}(k_{t-1})^{\alpha} + \frac{b_{t-1}}{1+g_{L,t-2}}\right]}{1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}(R_t)^{1-\sigma}} \tag{11}$$

2.3 Closed-Economy Equilibrium

The capital market equilibrium requires that total capital stock accumulated at the end of period t (K_{t+1}) equal to the aggregate wealth of the economy

$$K_{t+1} = L_{y,t}a_{y,t+1} + L_{m,t}a_{m,t+1} \tag{12}$$

which gives with the (9) and (10) law of motion for k_{t+1}. In the full depreciation case where $\delta = 1$, the dynamic of k_{t+1} and b_t/A_t is given implicitly by

$$(1+g_{A,t+1})(1+g_{L,t})\left[1+e_{t+1}(1+g_{L,t+1})+\theta_t\frac{(1-\alpha)}{\alpha}\right]k_{t+1} = (1+\phi^{-\sigma})\frac{\left[(1-\theta_{t-1})(1-\alpha)(k_t)^{\alpha}+\frac{b_t}{A_t}\frac{1}{(1+g_{L,t-1})}\right]}{1+\phi^{-\sigma}+\{\alpha(k_{t+1})^{\alpha-1}\}^{1-\sigma}}$$

where $\frac{b_t}{A_t}$ is derived as

$$\frac{b_t}{A_t} = R_t\frac{\left[(1-\theta_{t-2})(1-\alpha)\frac{(k_{t-1})^{\alpha}}{1+g_{A,t}}+\frac{b_{t-1}}{A_{t-1}}\frac{1}{(1+g_{A,t})(1+g_{L,t-2})}\right]}{1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}R_t^{1-\sigma}} \tag{13}$$

2.4 Savings

Here we provide formal definitions of aggregate and cohort-level savings. Then we show the response of the cohort-level and aggregate saving rate to a fall in the interest rate with a relaxed borrowing constraint.

The response of the saving rate for each cohort to change in interest rate and borrowing

constraint is derived from the equations below,

$$
\begin{aligned}
S_{y,t} &= -L_{y,t}\frac{\theta_t}{R_{t+1}}w_{m,t+1} \\
\frac{S_{y,t}}{Y_t} &= -(1+g_{A,t+1})\frac{1+g_{L,t}}{1+e_t(1+g_{L,t})}\frac{\theta_t}{R_{t+1}}(\frac{k_{t+1}}{k_t})^{\alpha} \\
S_{m,t} &= L_{m,t}[a_{m,t+1}-a_{y,t}] \\
\frac{S_{m,t}}{Y_t} &= \frac{\left[\frac{(1+\phi^{-\sigma})(1-\theta_{t-1})}{1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}(1-\delta+\alpha(k_{t+1})^{\alpha-1})^{1-\sigma}}+\frac{\theta_{t-1}}{1-\delta+\alpha(k_t)^{\alpha-1}}\right](1-\alpha)}{(1+e_t(1+g_{L,t}))}+ \\
&\quad \frac{b_t}{A_t}\frac{1}{1+g_{L,t-1}}\frac{1+\phi^{-\sigma}}{(1+e_t(1+g_{L,t}))(k_t)^{\alpha}(1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}(1-\delta+\alpha(k_{t+1})^{\alpha-1})^{1-\sigma})} \\
S_{o,t} &= L_{o,t}[b_t-a_{m,t}] \\
\frac{S_{o,t}}{Y_t} &= \frac{[-\delta-\phi^{-\sigma}+\alpha(k_t)^{\alpha-1}]\left[(1-\theta_{t-2})(1-\alpha)(k_{t-1})^{\alpha}+\left(\frac{b_{t-1}}{A_{t-1}}\right)\frac{1}{1+g_{L,t-2}}\right]}{(1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}(1-\delta+\alpha(k_t)^{\alpha-1})^{1-\sigma})(1+e_t(1+g_{L,t}))(1+g_{L,t-1})(k_t)^{\alpha}(1+g_{A,t})}.
\end{aligned}
$$

First, we observe that young agents would borrow more if there exists a lower discount rate and higher present value of the lifetime income. The response of the middle-aged and old agents is ambiguous and depends on the value of other parameters. Then a decrease in the interest rate leads to a decline in the saving rate of the young and its effect on aggregate savings is ambiguous. Second, financial liberalization (higher θ) triggers the response of the young agents to lower interest rate with greater decline in the saving rates. Young cohort finds an opportunity to borrow with the higher borrowing constraint parameter and this follows from the fact that

$$
\frac{\partial^2(S_{y,t}/Y_t)}{\theta_t R_{t+1}} > 0 \tag{14}
$$

It is clear from the definition of $\frac{S_{y,t}}{Y_t}$ that lower interest rate decreases the saving rate of the young. However equation (16) shows that consumers in countries with relaxed borrowing constraints, would find further opportunities to borrow. This result will be

shown numerically in the next subsection by comparison of two countries with and without financial liberalization.

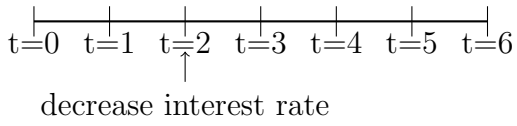
2.5 Numerical Experiments

In this subsection we conduct two basic experiments to show the numerical results of our analytical results provided above. We compare two economy; the first with the financial liberalization after some period (increasing θ) and the second without the financial liberalization (constant θ). Higher productivity growth and lower interest rates with the financial liberalization is the facts of Turkish economy in 2000s. Therefore, we will show the effects of these two phenomena with and without financial liberalization thorough basic simulations. In the three-period OLG model each period is equivalent to 1 year. The discount factor $\beta = 0.97$ and the intertemporal elasticity of substitution is taken to be $\sigma = 0.5$. The depreciation rate is 9 percent per year, capital share $\alpha = 0.25$ and the relative productivity of the young workers $e = 0.33$. The main goal of these two experiments to show the different responses of two economies. Therefore we set borrowing constraint parameter for the two economies at the same level $\theta = 0.02$ initially. Then we will increase the borrowing constraint parameter of the first economy θ_1 (relaxing the borrowing constraint) and keep the second economies parameter θ_2 at 0.02. At the same time, we will decrease interest rate exogenously in the first experiment and increase productivity in the second experiment to observe different responses of two economies.

Experiment 1

In this experiment, we will loosen the borrowing constraint of the first economy in the second period and decrease the interest rate for both economies. θ_1 is increased from 0.02 to 0.2 from the second period to sixth period. Interest rate for both economies starts to

decrease linearly between period 2 and period 6. Then we will observe the response of the financially liberalized economy to a decrease in the interest rate against the economy without financial liberalization.



We illustrate the experiment 1 above. Then Figure 4 shows the results of the experiment. We observe that young agents decreased their saving rate dramatically with the lower interest rates but there is no response from the young cohort in the country 2 without financial liberalization, as we expected. Aggregate saving rate falls considerably in the country 1 with the relaxed borrowing constraints against tiny decline in the country 2. The figure shows that young agents with the financial liberalization borrow more than their counterparts in the country without financial liberalization in response to decrease in the interest rates. Although lower interest rates provides a borrowing opportunity for young agents, stricter borrowing constraints in country 2 leads to minimal response on saving rates of young cohort.

Experiment 2

In this experiment, we will loosen the borrowing constraint of the first economy in the second period and increase the productivity growth for both economies. θ_1 is increased from 0.02 to 0.2 from the second period to sixth period. Productivity growth for both economies starts to increase from 1.5% to 5% linearly between period 2 and period 6. Interest rate is taken to be constant.

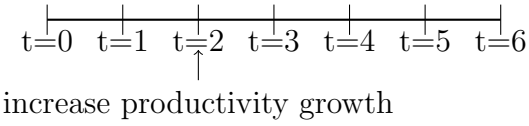


Figure 5 displays the results for the experiment 2. The outcomes are similar to the result of the first experiment. Young agents borrow significantly against higher expected future

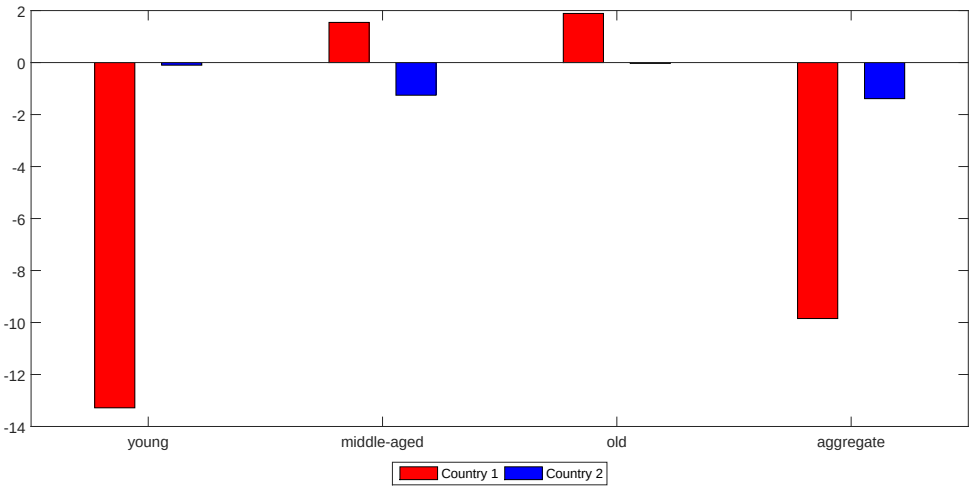


Figure 4: Experiment 1: Interest Rate Decrease

lifetime income in country 1. However young group of the second country can not react to higher lifetime income due to severe borrowing constraints. Consequently, aggregate saving rates decrease in the country 1 considerably while there exist a slight increase in the country 2.

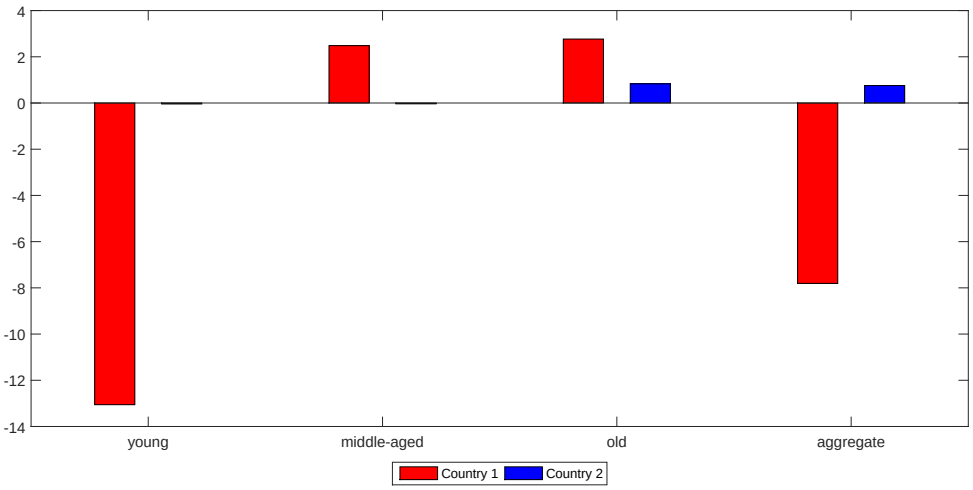


Figure 5: Experiment 2: Productivity Growth

3 Micro Evidence on Savings by Age Groups

In this section we will provide some evidence for potential biases of Household Budget Survey data. Then we will show our estimation method and compare its results with the previous approaches. TurkStat revealed Household Budget Survey (HBS) in 1994 for only this year and started providing data after 8 years in 2002. Now data is available over the period of 2002-2014 for each year. HBS records detailed information on income, consumption and demographic characteristics of households. The number of the sample of households in the surveys fluctuates between 8000 and 10000 but for only in 2003 Turkstat used 25764 sample of household. The one major objective of our study is to provide age-saving profile of Turkey and we need income and consumption data on individual level to calculate the results. HBS provides income data both at the individual and aggregate level but the consumption data is available only at the household level. Therefore we need to estimate consumption data at individual level by using aggregate consumption data. We will use the term "household head approach" for the conventional method. HBS

provides the age of the household head and household head approach uses total household income and total household consumption data to calculate saving rate of that household and household head at that age represents household and its other member's saving rate. However "household head approach" is subject to some measurement errors and these errors with its proposed solution with "individual approach" will explained in the next subsection.

3.1 Aggregation and Selection Biases

? have shown that if multi-generational households are present in a country, household head approach causes problems while showing the age-saving profile of the economy. If more than one generation is living in a household, the saving rate of the household members other than household head will be obscured by aggregation bias. Assume that there is a household with a young agent aged below 25, an old agent above 65 and a household head at the age of 40. The household head approach assigns the household's total saving rate to the household head and the young and old agent's saving rate would not be represented. The other members' saving rate will not be represented. Another problem with aggregation bias is the under-estimation of the saving rate of the household head. For example, suppose a household head with a high saving rate, living with the young and old dependants who have negative saving rates. Then if we estimate her saving rate with household approach, it will be lower than her actual saving rate and that age's saving rate would be wrongly calculated.

Table 1 shows that multi-generational household[1] is an important issue in Turkey. Multi-generational households comprise 28.3% and 31.4% percentage of all sample in 2004 and 2014 in Turkey, respectively. Therefore we would expect to observe the different results

[1] A household with one adult or several adults in the same generation considered as uni-generational. If the number of age difference between two adult exceeds 20 years there exists multi-generation

between household head approach and individual approach due to possible aggregation bias in the results of the household approach.

Table 1: Multi-Generational Households in Turkey

	2004	2014
Uni-generation	71.7%	68.6%
2 generations	20.1%	21.8%
3 generations	8.2%	9.6%

Note: Share of individuals living in households comprising uni, two or three generations.
Source: Author's calculations based on HBS data.

The next problem with the household head approach is the selection bias. If the selection of household head is not random there occurs another potential bias. Selection bias is observed when being a head of the household is correlated with some variable such as income and household approach would result in problematic estimation for age-saving profile. For example, if the household heads are the members with the highest income in the household, the saving rate of the younger and older members (generally earn lower than middle-aged agents), would be misrepresented.

Figure 6 is the first evidence for selection bias in HBS of Turkstat. It displays the income premium of household heads by age. Figure basically shows that the household head agents have greater income than other agents who are at the same age but not household head. We observe from the figure that young household heads are richer than their non-household counterparts and the greatest income premium is realised for the youngest age-groups. Its explanation is that only the wealthier individuals can afford to live independently when young. If we assume that high individual income is correlated with high saving rate, then household head approach would over-estimate the saving rate of the young cohort. Income premium for young household heads falls between 2004 and 2014 and we expect the selection bias problem to become less severe in the 2014 than in the 2004.

Figure 7 shows the second evidence for non-randomness of household head selection. We

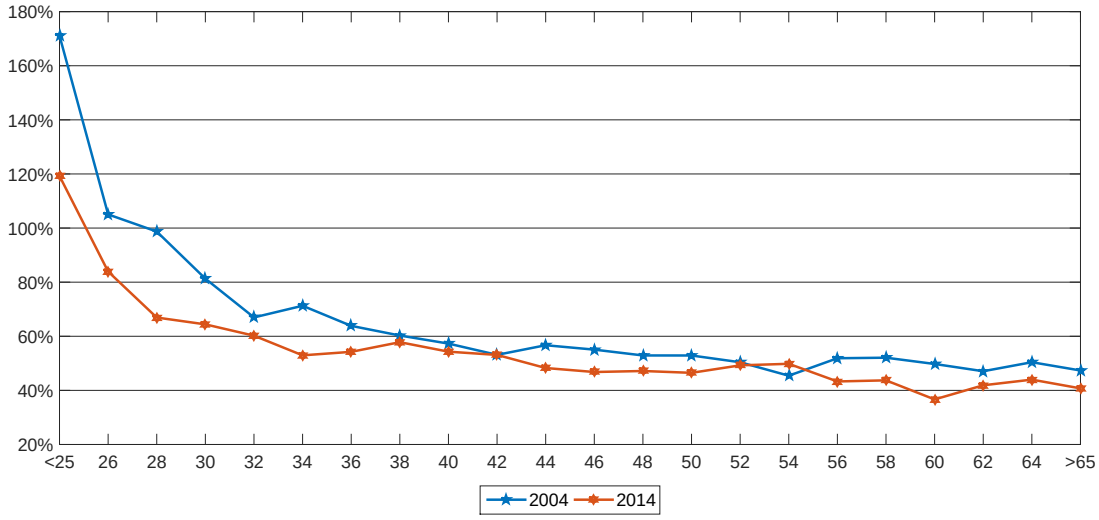


Figure 6: Income Premium of Household Heads in Turkey (in log)

Note: Income premium of household heads is the log difference between the average income of heads of a given age and the average income of all individuals of that same age.

Source: HBS (2004-2014)

observe that the frequency of young agents in the entire sample is 3.5% and 2.5% in 2004 and 2014, respectively. However, this proportion falls sharply to nearly 0.5% for both years if the sample is comprised of only household heads. Then we know that young agents are less likely to be household head and it is related to their lower income than middle-aged agents. This evidence provide adequate information to believe that household headship is not selected randomly.

As a last figure to show selection bias reality on HBS is the figure 8 which plots the average age of household head against the age of the individual for years 2004 and 2014. If everyone were a household head or lived with the persons of the same age, the plot would be the 45-degree line. The plot lies above the 45-degree line for young people (individuals living with their parents), moves together with the 45-degree line for middle-aged agents and fall below the line for the elderly (individuals living with their children). Household head approach would not hold any problem if the plot derived from HBS was close to the

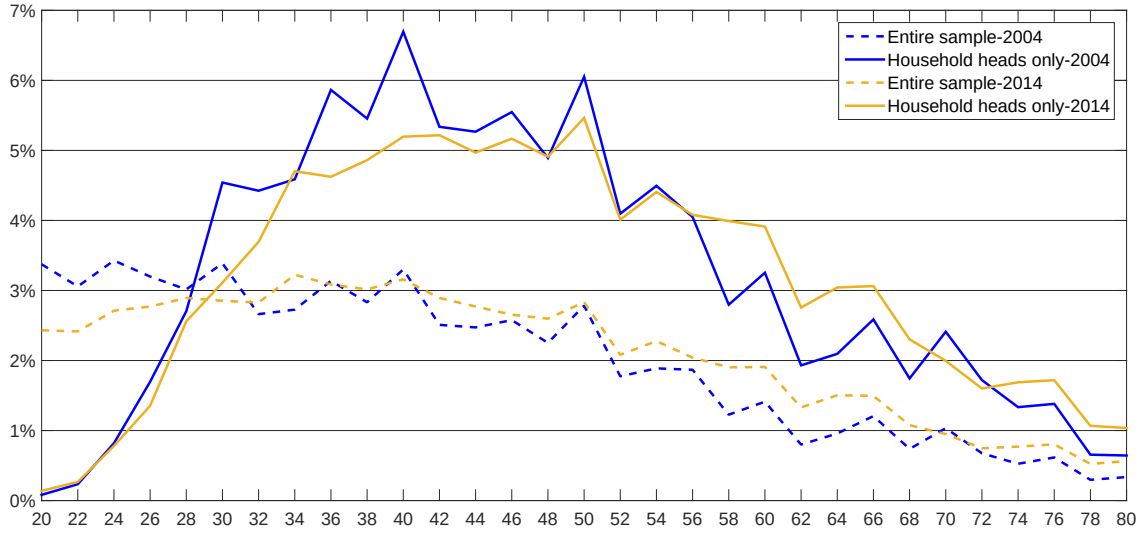


Figure 7: Frequency of observations for 2004 and 2014

45-degree line but the figure show that this method might lead to biases in estimating saving rates.

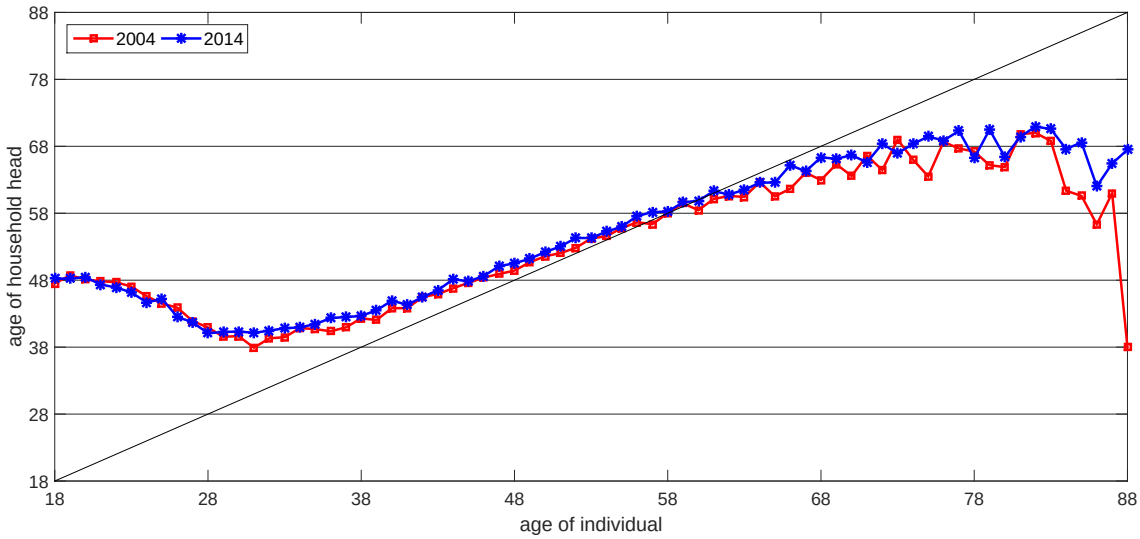


Figure 8: Average Age of Household Head By Age of Individual

3.2 Estimation Method

After we show the potential errors of household head approach, in this part we will try to improve this approach with available data. As we have noted above, HBS data provide income data at individual level. Then individual consumption data will be the only input to calculate individual saving rate. Here we will follow **?** and disaggregate individual consumption for each age-group from household consumption data which is available from the survey.

We will recover individual consumption from household data by a projection method which is proposed by **?** and **?**. The idea is to project total household consumption on the household members which are in the various age-groups, controlling for their household-specific indicators. Following **?**, we will identify individual consumption from household consumption by estimating the following model on the cross-section of households for every year

$$C_h = \exp(\boldsymbol{\gamma} \cdot \boldsymbol{Z}_h)\left(\sum_{j \in J} c_j N_{h,j}\right) + \epsilon_h,$$

where C_h is the total consumption for household h, $N_{h,j}$ denotes the number of members of household h in age bracket j, and $\boldsymbol{Z}_h$ denotes a set of household-specific controls. Following **?** we use 33 age brackets in J - from 19-20 to 83 above - and control variables get into equation in an exponential term.

The control variables are:

- **Household composition**: number of children aged between 0 and 10, number of children aged between 10 and 18, number of adults in the household and number of the young and old dependants. Young and old dependants are defined as individuals aged 19-25 and 65 above, respectively and have a low income with no saving decision. The coefficient of number of children is negative. Normally, we would expect a

higher consumption with larger household. However we show in the Table 2 that the number of children decreases with the income of the household. By the assumption of positive correlation between income and consumption, negative coefficient for number of children is unanticipated.

Table 2: Average Number of Children

Income quintile	2004	2014
0	1.93	1.14
1	1.56	1.33
2	1.44	1.29
3	1.43	1.20
4	1.29	1.09

Note: Average number of children for households in each income quintile
Source: Author's calculations based on HBS data.

- **Household income group**: households are grouped into income quantiles (from the lowest 20% to the top 20%). The coefficient associated with this variable is positive as individuals living in richer households consume more.

A roughness penalization term is introduced to sustain smoothness of the estimated consumption function $c_j = c(j)$ between age brackets. This term is defined as:

$$P = \kappa^2 \int [c''(j)]^2 da,$$

where κ controls the extent of the smoothness and fixes to 10. The discretized version of P can be written as $\kappa^2(\boldsymbol{M}\boldsymbol{c}_j)'(\boldsymbol{M}\boldsymbol{c}_j)$, where $\boldsymbol{M}$ is a 31×33 matrix

$$M = \begin{bmatrix} 1 & -2 & 1 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 1 & -2 & \cdots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \cdots & -2 & 1 & 0 \\ 0 & 0 & 0 & 0 & \cdots & 1 & -2 & 1 \end{bmatrix}$$

and $c_j = \left[c_j\right]_{j \in J}$ is a 33 x 1 vector. Pre-multiplying c_j by M produces a vector of second differences.

3.3 Results

Figure 9 and 10 represents estimated age-saving profiles for individual approach and its comparison with household head approach in 2004 and 2014, respectively. We observe that young individuals save less in the individual approach as we expected by income premium and selection bias for each year. Then the selection for the household approach is shown in these figures for young cohort. Another thing is aggregation bias which puts negative pressure for household head's saving rate in the household approach. Figure 9 and 10 shows that older cohorts save more in the individual approach which is the result of the aggregation bias of the household approach. **?** claims that household approach shows lower saving rates for middle-aged agents due to aggregation bias. In the case for Turkey, aggregation bias puts downward pressure for old saving rate. Its one possible explanation is provided in the Table 3. We observe that household head age is increasing with the multi-generational. As we expect to observe aggregation bias in the multi-generational households, the results that we show in figures are in accordance with the theory.

Figure 11 displays the change in the saving rate over the 10 years period between 2004 and 2014. We find a decrease in the saving rate for each age-group except the old (55-64) cohort. For the youngest, the largest decrease is observed with 16 percentage points. Its

Table 3: Aggregation Bias

	2004	2014
Uni-generation	44.55	46.84
2 generations	51.93	53.88
3 generations	56.13	57.26

Note: Average number of household head age for each type of households
Source: Author's calculations based on HBS data.

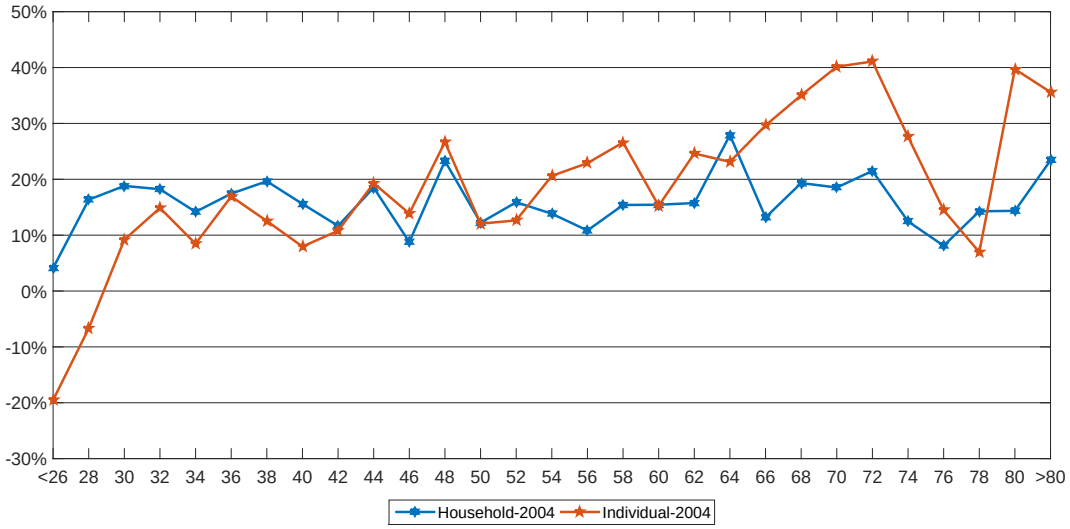


Figure 9: Comparison of Individual Approach with Household Approach
Note:
Source: HBS 2004

possible explanations are provided in the introduction and we will try to explain this trend in the next section by two different extensions of the model presented in the section 2.

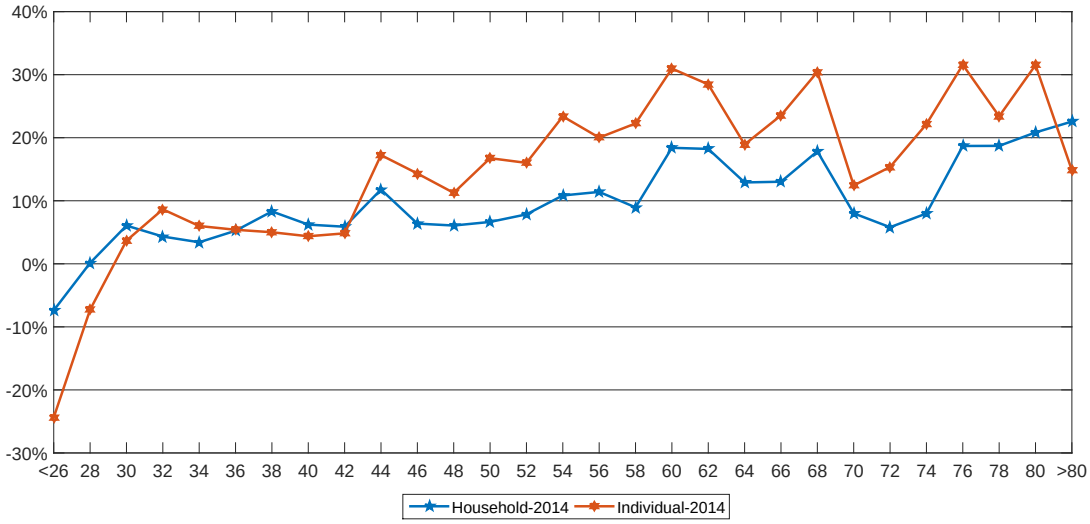


Figure 10: Comparison of Individual Approach with Household Approach

Note:

Source: HBS 2014

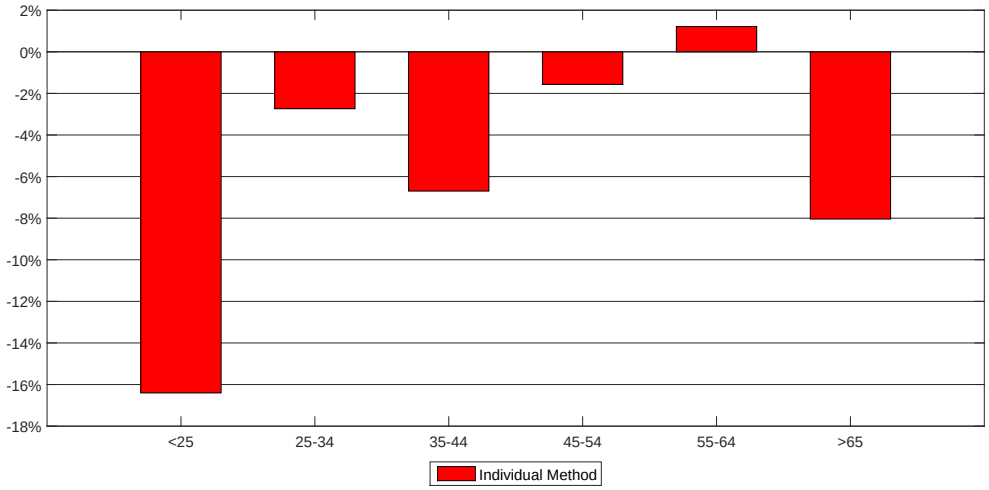


Figure 11: Change in Saving Rate by Age Groups in Turkey: 2004-2014

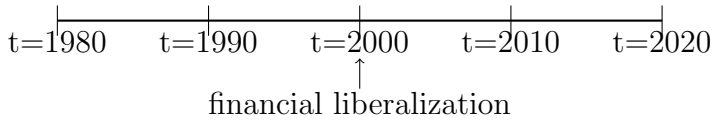
Note:

Source: HBS (2004-2014)

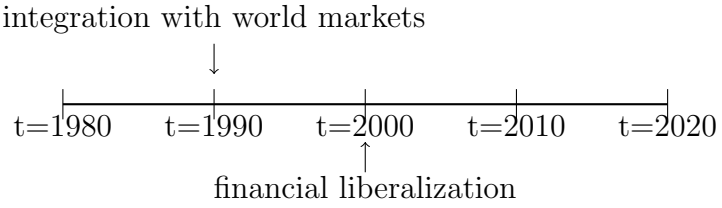
4 Model vs. Data

In the numerical experiments we have shown the basic mechanisms to help build intuition. In this section we will comprehensively calibrate the model in order to match the evolution of saving rate in Turkey at the cohort level. After we provide calibration methods, we will compare the model-predicted saving rates with those observed from the data. First, we will simulate the model with a closed-economy. In this model (model(1)), interest rates will be derived endogenously by autarky market clearing equation. Then we will simulate the economy as if it is a small-open economy. In this model (model(2)), we will assume interest rates as exogenous and they will be taken from the real world data. Both simulation will start from the autarky equilibrium, 1980. We start simulation from 1980 and simulate the economy until 2020. In our three period OLG framework one model period is equivalent to 10 years. In each simulation, the financial liberalization will start in the economy in 2000. For model(2), we assume that the country moves out of autarky and integrates with world markets in 1990 and takes the real interest rate exogenously. Here we present the summary of the simulations:

Model(1): closed-economy and R_t is determined by market clearing equation in each period



Model(2): R_t is exogenously taken from data



4.1 Calibration

We simulate the model by calibrating the model parameters according to evolution of each parameter in the data. Table 4 and Table 5 provide the full calibration summary. Details and explanations of the evolution of parameters will be provided below.

Demographics

The initial age distribution is taken from the World Population Prospects (2015 revision), for the year 1970. We calculate the model-implied population growth rates $g_{L,t}$ that provide the actual age distribution from 1980 to 2020. The model has three cohorts and it does not enough to perfectly fit the data. Therefore we take the real population growth rate from the data to use in the model and it is shown in the Table 5.

Age-Income Profile

The evolution of the relative productivity parameter, e_t, is matched to the ratio of the average income of individuals under 25 to the average income of those between 35-54. The parameter is measured as 0.21 for 2002 and it is assumed to take the same value for all previous periods due to data limitations. Its evolution through 2020 is shown in the Table 5.

Initial Conditions and Productivity Growth

After we calculate the implied population growth rates and age-income profiles with initial labor force values, we set relative productivity levels along with the productivity growth rates to match the output of the Turkey to the US between 1980 and 2020. We assumed the US productivity grows at an annual rate of 1.5% throughout (**?**) and the resulting annual growth rate of Turkey is given in the Table 5. We take relative capital-effective labor ratio between Turkey and the US as 0.78 for 1990 following **?**. Then we are able to

calculate relative productivity levels A_{TR}/A_{US}, and productivity growth for Turkey using production equation given in the model section.

Real Interest Rate

We calculate the real interest rate of the Turkey and use it as an exogenous parameter in the model. Using Fisher equation

$$i_t = r_t + \pi^e_{t+1}$$

we derive real interest rates and it is shown in the Table 5. We use Weighted Average Interest Rates for up to 1 year Turkish Lira deposits as nominal interest rate i_t of CBRT and yearly inflation rate of World Bank.

Calibrated Parameters

We set credit constraint parameter to match the financial developments in the Turkey. **?** sets the θ of China and US at 0.02 and 0.2, respectively. We use the gross household debt percent of GDP of Turkey and China to determine the evolution of Turkey's borrowing constraint. McKinsey Global Institute provides the gross household debt percent of GDP in China as 3% in 2000 and it is 4% in Turkey in 2003 (There is no information about previous years in Turkey). Therefore we set the borrowing constraint parameter of the year 2000 as 0.02. Gross household debt percent of GDP reaches to 23.77% in 2013. Then we increase the borrowing constraint parameter to its eightfold 0.16 in 2010 and we show its extended evolution in the Table 5. The value of the bequest parameter for the Turkey is chosen to be 2.5% and discount factor β, depreciation rate δ, elasticity of intertemporal substitution σ parameters are set following **?**. The capital share for Turkey is set at 0.4 following **?**.

Table 4: Summary of Calibration

Time discount factor (β)	(annual basis)	0.91
Elasticity of intertemporal substitution (σ)		0.5
Share of capital (α)		0.4
Depreciation rate (δ)	(annual basis)	0.09
Bequest motive parameter (ϕ) in %		2.5

Table 5: Summary of Calibration

Years	$g_{L,t}$ in (%)	$g_{A,t}$ in (%)	e_t	θ_t	R_t in (%)
1980	2	2	0.212	0.02	-
1990	3	2.24	0.212	0.02	6.4
2000	2	-4.12	0.212	0.02	13.8
2010	1	4.34	0.306	0.16	2.48
2020	1	2.01	0.33	0.16	1.82

Note: $g_{L,t}$: Labor Force Growth in %, $g_{A,t}$: Productivity Growth in %, e_t: Age-Income Profile, θ_t: Credit Constraint Parameter in the beginning of the period t, R_t: Real Interest Rate in %

Source: Author's calculations based on HBS data, CBRT for interest rate and World Population Prospects.

4.2 Results

Figure 12 juxtaposes the model-implied changes in saving rates across age-groups with estimates from the data in Turkey between 2004 and 2014. The model(2) can explain the evolution of saving rates in this period better than model(1), as expected. The reason is that the endogenous derivation of real interest rates in the model(1) cannot account for the unusual trend of Turkey. The model(1) matches well the evolution of the saving behavior of young and middle-aged but cannot explain the fall of the saving rate of the old. The model(2) can account for 42 percent of the 16.4% decline in the saving rate of the young and 18 percent of the 8% decline in the saving rate of the old. However the model(2) over predicts the 4.3% fall for the middle-aged saving rate.

Borrowing constraints and its loosening in Turkey, in a relatively simple framework could explain significant part of the evolution of the change in the saving rate both at the aggregate level and at the cohort level. We observe that taking real interest rate exogenous,

increases the model's ability to explain the recent trend in the saving rates of different cohorts over the last decade. The largest decrease is observed for the youngest generations and some explanations are the relaxation of credit constraints, higher expected lifetime income and less uncertainty for the future. The fall in the old saving rate is not as severe as the decrease in the youngest cohort but as their savings contributes significantly to aggregate savings and its proportion increased from 10.2% to 20.9% in this period, saving behavior of the old agents deserves concentrated analysis for future research.

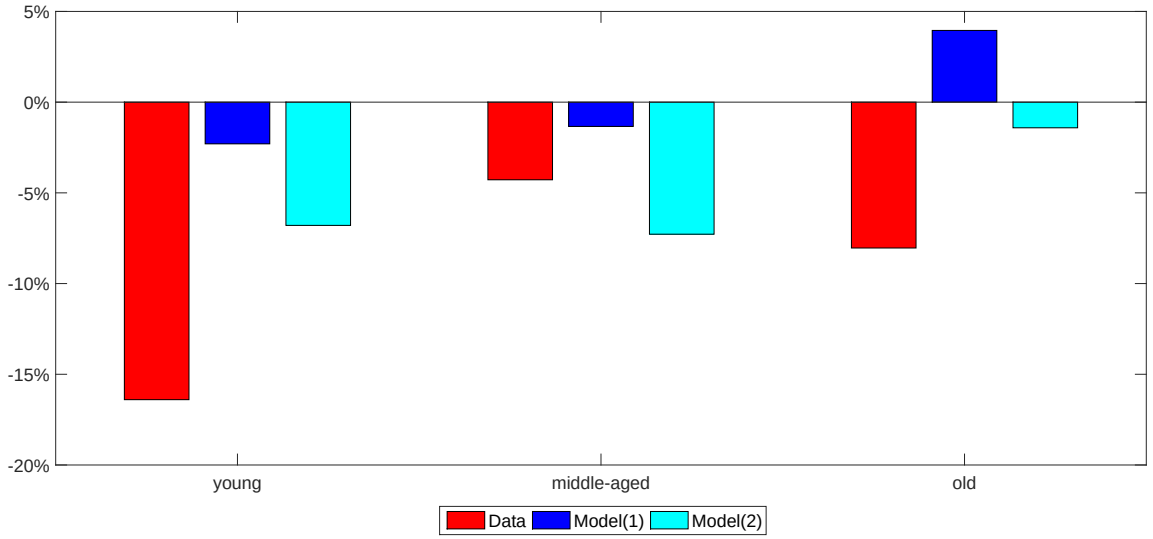


Figure 12: Model vs Data in Turkey: 2004-2014

Note:

Source: HBS (2004-2014)

5 Conclusion

In this thesis, following **?** we have estimated the age-saving profile of Turkey. Then we have tried to explain the change in the saving rates both at the cohort level and at the aggregate level by a single mechanism in a general-equilibrium model. We have provided sufficient evidence to point the necessity of using individual approach while estimating age-saving profiles instead of household head approach. Unlike previous studies, we have estimated cohort level saving rates comprehensively following **?** and **?**. The evidence showed that the aggregation and selection bias has to be considered for Turkey and estimation results supported this evidence. The model displays considerable quantitative power in explaining the change in savings across cohorts in Turkey over the last decade. Its quantitative power increases with the exogenous incorporation of real interest rates into the model.