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Borrowing constraints and saving in Turkey

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ABSTRACT

The Turkish macroeconomic experience since 2002 has been characterized by three striking trends: (1) an accelerated growth rate of income, (2) a sharp decline in the real interest rate, and (3) a sustained fall in the saving rate of different age-groups. During the same period, there has also been a significant increase in access to credit by Turkish households. In this paper, we argue that a model which incorporates a borrowing constraint mechanism together with the observed increases in the expected growth rate of income and the substantial declines in the real interest rate is able to explain the change in saving across cohorts in Turkey over the last decade. We provide both micro-level evidence on the age-saving profile for Turkey as well as quantitative results from a simple three-period OLG framework with borrowing constraints to account for the change in the saving rate for different age-groups between 2004 and 2014.

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1. Introduction

The decline in Turkey's saving rate during the last decade has attracted both academic research and substantial daily debate. Since private saving constitutes the major component of total domestic saving in Turkey, understanding the determinants of households' saving decisions is a crucial step in understanding the evolution of the private saving rate. While recent policy initiatives such as the introduction of the privately-funded pension system have sought to increase domestic saving through offering incentives for increased saving by households, we argue that a more fundamental approach is needed to understand the underlying reasons of the decline in the household saving rate of Turkey after 2002. Such an approach must also take into account the accompanying developments in the Turkish macroeconomic experience during this period.

Fig. 1 shows the behavior of the domestic saving rate and its components between 1975 and 2015. This figure shows that barring the experience of the pre-1980 era, the dramatic decline in the saving rate in Turkey occurs after 2002. Specifically, the private saving rate falls from 19.6% to 11.7% between 2003 and 2014 while the household saving rate experiences a 1 percentage point greater decline than the private saving rate, falling to 8.7% over the same period.[1] To understand the reasons for this decline, we argue that two other trends in the Turkish economy during this period must also be taken into account. These are the huge declines in nominal and real interest rates together with a dramatic increase in the access to credit by Turkish households. As Fig. 2 shows, real interest rates decreased from 21% to 1.8% between 2000 and 2015. At the same time, Fig. 3 shows that the ratio of consumer credit-GDP

[1] Recently, the Turkish Statistical Agency (TurkStat) has updated Turkey's National Income Accounts and has published a revised saving rate based on the TurkStat Institutional Accounts. We compared these data which are available for 2009–2015 with the data for 2009–2014 that was used to generate Fig. 1. In results that are available upon request, we find that the saving rate based on the updated national income accounts tends to be higher than our results. We attribute this result to a new definition of saving based on a revised definition of the "household", namely, Households including Non-Profit Institutions Serving Households (NPISH). However, we also find that our measures of the saving rate are consistent with those used by Van Rijckeghem and Üçer (2009) and Ceritoğlu and Eren (2014). Our results are available upon request.

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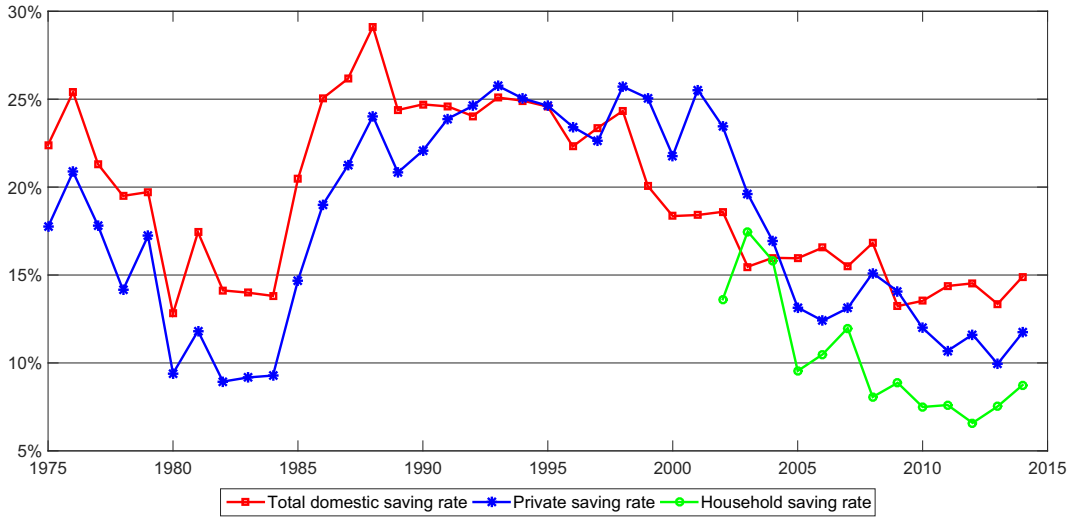

Fig. 1. Saving rates in Turkey.
Source: Ministry of Development of Turkey, Authors' calculations based on TurkStat Household Budget Survey (2002–2014).

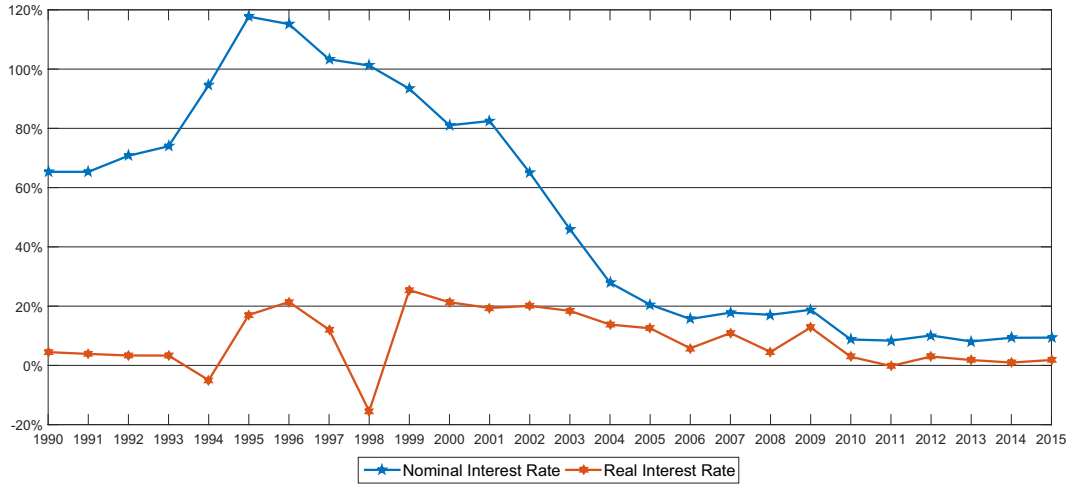

Fig. 2. Nominal and real interest rates (1990–2015).
Source: Central Bank of the Republic of Turkey, World Bank.

increased from 0.48% to 8.45% in this period.

In our analysis, we examine the distribution of saving between different age groups in order to understand how different age groups contributed to the fall in the aggregate saving rate. For this purpose, we use the Household Budget Survey to provide micro-level evidence on saving behavior by age groups. The Household Budget Survey suffers from data availability for consumption at the individual level. As a way of overcoming this problem, Ceritoğlu and Eren (2014) and Cilasun and Kirdar (2009) use the age of the household head to derive age-saving profiles for the 2003–2010 and 2005 periods, respectively. However Deaton and Paxson (2000) assert that if there exist multi-generational households (which is quite common in Turkey), then selection and aggregation biases may arise from this practice. Van Rijckeghem and Üçer (2009) consider the Deaton-Paxson critique and disaggregate total household saving into age groups with a linear regression model. Ceritoğlu and Eren (2014) also consider the age distribution of all family members, and quantify the impact of demographic change on household saving, which is expected to take place in the following years in Turkey. As in Van Rijckeghem and Üçer (2009), they estimate a simple linear regression model from 2003 to 2010 using the Household Budget Survey. In our analysis, we deal with such biases by estimating corrected age-saving profiles with non-linear least squares estimation by using household specific controls (see Section 3).

The determinants of saving have been studied in the related literature. Özcan et al. (2003) and Van Rijckeghem (2010) find a role for the credit-GDP ratio and the change in the private credit-GDP ratio as significant determinants for private saving in Turkey, respectively. Additionally, Tunç and Yavaş (2016) find a negative effect of mortgage and non-mortgage consumer credit on private saving rates. In earlier work, Modigliani (1986) shows that imperfections in credit markets may prevent households from borrowing, thereby postponing consumption and increasing saving. Deaton (1989) 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. These studies suggest that loosening of credit constraints may provide a way to explain the declining household saving rates in Turkey.

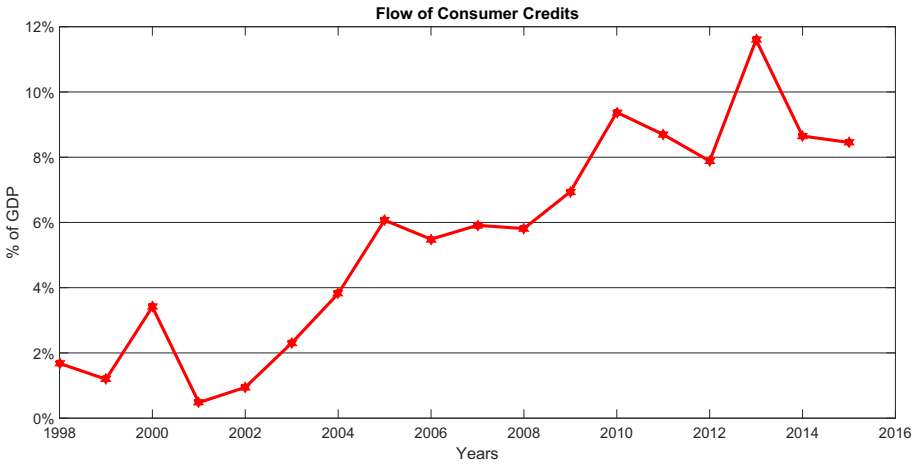

Fig. 3. Consumer Credit-GDP ratio (1998–2015).
Source: The Bank Association of Turkey, Authors' calculations.

Jappelli and Pagano (1994) build 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 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. Coeurdacier et al. (2015) extend their framework to a multi-country, open-economy setup, with asymmetry in household credit constraints across countries. They seek to account for differences in US and Chinese private saving rates through the existence of differential borrowing constraints across these countries as well as the decline in saving rates of young cohorts through the relaxation of such constraints over time. They consider a two-country overlapping generations model with the differential incidence of borrowing constraints, and examine both the autarkic and integrated equilibrium for such an economy. Their model explains a significant portion of the high saving rates for most age groups in China - a more credit constrained economy - and the simultaneous high borrowing rates of the young in the US - a less credit constrained economy.

In this paper, we follow the approach in Coeurdacier et al. (2015) and examine the choice problem of overlapping generations of consumers who face a relaxation of borrowing constraints over time as well as changes in an exogenously given real interest rate. While Coeurdacier et al. (2015) assume constant credit constraint parameters across time, we extend their framework by allowing time-varying credit constraint parameter to account for the observed decline in household saving in Turkey, which we document to be most significant for younger cohorts. Our approach is motivated by the fact that access to credit in Turkey improved dramatically between 2002 and 2014. Jappelli and Pagano (1994) use the maximum loan-to-value ratio and consumer credit as a percentage of net national product as an indicator of liquidity constraints while Coeurdacier et al. (2015) use the total amount of mortgage debt and gross household debt-to-GDP. In our analysis, we use the gross household debt as a percentage of GDP to measure the extent of financial liberalization in Turkey. As in Coeurdacier et al. (2015), we assume that the borrowing constraints bind for young households. Additionally, we assume that a bequest motive for old cohorts captures the incidence of substantial intergenerational transfer of wealth that exists in Turkey.

The life-cycle hypothesis of saving by Modigliani and Brumberg (1954) shows that the age-saving profile of an agent should be hump-shaped, suggesting that consumers borrow when young, save when middle-aged for retirement, and then dissave all of their accumulated assets. However, we find that the estimated age-saving profile of Turkey is not in accordance with the life-cycle theory in that the saving rate is negative for the younger cohorts and increases with the age. Furthermore, there is no decrease in the saving rate with the incidence of retirement. From these facts, we infer that standard models face difficulties in explaining the saving rate of older cohorts in Turkey and new models or extensions of existing models need further consideration to account for the behavior of old agents.

The paper proceeds as follow. In Section 2 we develop the theoretical framework. In Section 3, we examine micro-level evidence on age-saving behavior of Turkey while in Section 4, we provide fully calibrated quantitative results for Turkish economy. Section 5 concludes.

2. The model

We develop a small-economy model along the lines of Coeurdacier et al. (2015) with three differences. First, we extend their baseline framework by incorporating a bequest motive. Second, unlike Coeurdacier et al. (2015), we use a time-varying credit constraint parameter and third, we take the value of the real interest rate exogenously based on actual data to concentrate on explaining household behavior of agents in an environment with cheaper and greater access to credit, as occurred in the post-2002 period in Turkey.

The economy is populated with overlapping generations of consumers who live for three periods, where each generation is denoted by $\gamma \in \{y, m, o\}$. Young ($\gamma = y$) agents and middle-aged ($\gamma = m$) agents supply one unit of labor and they retire when they are old ($\gamma = o$). The young agents are assumed to be credit-constrained, with the severity of the constraint being assumed to vary across years. Old agents do not decumulate all the capital stock, and instead they leave bequests for their offspring at the end of their life. This feature allows us to obtain a more realistic saving behavior for 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

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

where $0 < \alpha < 1$, and A_t is the level of 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

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

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

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 $u(c) = \left(c^{1-\frac{1}{\sigma}} - 1\right)\Big/\left(1 - \frac{1}{\sigma}\right)$. 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. Then the problem of the consumer is to choose consumption and bequests to solve the problem

$$\max_{\left(c_{y,t}, c_{m,t+1}, c_{o,t+2}, b_{t+2}\right)} u(c_{y,t}) + \beta u(c_{m,t+1}) + \beta^2 u(c_{o,t+2}) + \phi\beta^2 u(b_{t+2})$$

subject to

$$c_{y,t} + a_{y,t+1} \leq w_{y,t},$$

$$c_{m,t+1} + a_{m,t+2} \leq w_{m,t+1} + R_{t+1}a_{y,t+1} + \frac{b_{t+1}}{1 + g_{L,t}},$$

$$c_{o,t+2} + b_{t+2} \leq R_{t+2}a_{m,t+2}.$$

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,

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

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

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

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

$$a_{m,t+1} = \left(1 + \phi^{-\sigma}\right)\frac{\left[(1-\theta_{t-1})(1-\alpha)A_t(k_t)^{\alpha} + \frac{b_t}{1+g_{L,t-1}}\right]}{1 + \phi^{-\sigma} + (\beta\phi)^{-\sigma}(R_{t+1})^{1-\sigma}} \tag{9}$$

$$b_t = R_t\frac{\left[(1-\theta_{t-2})(1-\alpha)A_{t-1}(k_{t-1})^{\alpha} + \frac{b_{t-1}}{1+g_{L,t-2}}\right]}{1 + \phi^{-\sigma} + (\beta\phi)^{-\sigma}(R_t)^{1-\sigma}} \tag{10}$$

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

$$K_{t+1} = L_{y,t}a_{y,t+1} + L_{m,t}a_{m,t+1} \tag{11}$$

which, together with the expressions for the saving of the young and old, namely, (8) and (9), gives the law of motion for k_{t+1}. In the full depreciation case where $\delta = 1$, the dynamics of k_{t+1} and b_t/A_t are given implicitly by

$$\begin{aligned}&\left(1 + g_{A,t+1}\right)\left(1 + g_{L,t}\right)\left[1 + e_{t+1}\left(1 + g_{L,t+1}\right) + \theta_t\frac{(1-\alpha)}{\alpha}\right]k_{t+1}\\ &\quad = \left(1 + \phi^{-\sigma}\right)\frac{\left[(1-\theta_{t-1})(1-\alpha)(k_t)^{\alpha} + \frac{b_t}{A_t}\frac{1}{(1+g_{L,t-1})}\right]}{1 + \phi^{-\sigma} + \left\{\alpha(k_{t+1})^{\alpha-1}\right\}^{1-\sigma}}.\end{aligned} \tag{12}$$

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. Saving

Here we provide formal definitions of aggregate and cohort-level saving. 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 a change in the interest rate and a relaxation of the borrowing constraint is derived from the equations below. The first set of equations provide definitions of the saving of each generation as

$$S_{y,t} = -L_{y,t}\frac{\theta_t}{R_{t+1}}w_{m,t+1} \tag{14}$$

$$S_{m,t} = L_{m,t}\left[a_{m,t+1} - a_{y,t}\right] \tag{15}$$

$$S_{o,t} = L_{o,t}\left[b_t - a_{m,t}\right], \tag{16}$$

while the following equations show the saving-output ratios for the each cohort alive at time t.

$$\frac{S_{y,t}}{Y_t} = -\left(1+g_{A,t+1}\right)\frac{1+g_{L,t}}{1+e_t\left(1+g_{L,t}\right)}\frac{\theta_t}{R_{t+1}}\left(\frac{k_{t+1}}{k_t}\right)^{\alpha}$$

$$\frac{S_{m,t}}{Y_t} = \frac{\left[\frac{\left(1+\phi^{-\sigma}\right)\left(1-\theta_{t-1}\right)}{1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}\left(1-\delta+\alpha(k_{t+1})^{\alpha-1}\right)^{1-\sigma}}+\frac{\theta_{t-1}}{1-\delta+\alpha(k_t)^{\alpha-1}}\right](1-\alpha)}{\left(1+e_t\left(1+g_{L,t}\right)\right)} + \frac{b_t}{A_t}\frac{1}{1+g_{L,t-1}}\frac{1+\phi^{-\sigma}}{\left(1+e_t\left(1+g_{L,t}\right)\right)(k_t)^{\alpha}\left(1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}\left(1-\delta+\alpha(k_{t+1})^{\alpha-1}\right)^{1-\sigma}\right)}$$

$$\frac{S_{o,t}}{Y_t} = \frac{\left[-\delta-\phi^{-\sigma}+\alpha(k_t)^{\alpha-1}\right]\left[(1-\theta_{t-2})(1-\alpha)(k_{t-1})^{\alpha}+\left(\frac{b_{t-1}}{A_{t-1}}\right)\frac{1}{1+g_{L,t-2}}\right]}{\left(1+\phi^{-\sigma}+(\beta\phi)^{-\sigma}\left(1-\delta+\alpha(k_t)^{\alpha-1}\right)^{1-\sigma}\right)\left(1+e_t\left(1+g_{L,t}\right)\right)\left(1+g_{L,t-1}\right)(k_t)^{\alpha}\left(1+g_{A,t}\right)}.$$

First, we observe that young agents would borrow more if there exists a lower discount rate and a higher present value of the lifetime income, captured by $w_{m,t+1}$. The response of the middle-aged and old agents is ambiguous and depends on the value of the other parameters. A decrease in the interest rate leads to a decline in the saving rate of the young but its effect on aggregate saving is ambiguous. Second, a relaxation of borrowing constraints (captured by a higher θ_t) leads to a greater decline in saving of the young agents in response to a lower interest rate. This follows from the fact that

$$\frac{\partial^2\left(S_{y,t}/Y_t\right)}{\partial R_{t+1}\partial\theta_t} = \left(1+g_{A,t+1}\right)\frac{1+g_{L,t}}{1+e_t\left(1+g_{L,t}\right)}\frac{1}{R_{t+1}^2}\left(\frac{k_{t+1}}{k_t}\right)^{\alpha} > 0, \tag{17}$$

This result says that the more relaxed is the borrowing constraint, the greater is the decrease in the saving rate in response to a decline in the real interest rate.

3. Micro evidence on saving by age groups

In this section, we describe how to estimate individual saving rates using data from the Household Budget Survey obtained from the Turkish Statistical Institute (TurkStat). TurkStat held the Household Budget Survey (HBS) in 1994 and then started providing data after 8 years in 2002. We make use of data from the HBS over the period of 2002–2014 for each year, although new releases are available for 2015 and 2016. HBS records detailed information on income, consumption and demographic characteristics of households. The number of households in the surveys fluctuates between 8000 and 10000, with the largest sample of 25,764 households being available for 2003. One of the major objectives of our study is to provide age-saving profiles for Turkey, for which we need income and consumption data at the individual level. HBS provides income data both at the individual and the aggregate level but the consumption data are available only at the household level. Therefore, we need to estimate consumption data at the 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. Thus, the household head approach uses data on total household income and total household consumption to calculate the saving rate of the household, where the saving rate of the household head at a given age represents the savings of all members of the household, including its head. However, the "household head approach" is subject to some measurement errors and biases. In the next section, we describe these errors together with our proposed solution based on the "individual approach".

3.1. Aggregation and selection biases

Deaton and Paxson (2000) have shown that if multigenerational households are present in a country, the household head approach yields biased results for calculating the age-saving profile in the economy. If more than one generation lives in a household, the saving rate of the household members other than the 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 while the young and old agent's saving rate are not represented. Another problem which arises due to such 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 lives with young and old dependents who have negative saving rates. Then, if we estimate his/her saving rate with the household head approach, it will be lower than his/her actual saving rate, implying the saving rate for that particular age group will be calculated incorrectly.

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: Authors' calculations based on HBS data.

Table 1 shows that the existence of multi-generational households[2] is an important issue in Turkey. Multi-generational households comprise 28.3% and 31.4% percentage of the samples in 2004 and 2014 in Turkey, respectively. Therefore we would expect to observe different results between the household-head approach and individual approach due to possible aggregation bias based on the results of the household head approach.

The next problem with the household head approach has to do with selection bias. If the selection of the household head is not random, there occurs another potential bias. Selection bias may occur when being a head of the household is correlated with some variable such as income. In this case, the household-head approach will result in biased estimation for age-saving profiles. For example, if household heads are the members with the highest income in the household, the saving rate of the younger and older members (who generally earn lower than middle-aged agents), will be misrepresented.

Fig. 4 is the first piece of evidence for selection bias in the HBS. It displays the income premium of household heads by age, and shows that the household heads have greater income than other agents who are of the same age but who are not classified as a household head. We observe from the figure that young household heads are richer than their non-household head counterparts and the greatest income premium is realized 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 a high saving rate, then the household-head approach will over-estimate the saving rate of the young cohort. We observe that the income premium for young household heads falls between 2004 and 2014 so that we expect the selection bias problem to become less severe in 2014 compared to 2004.

Fig. 5 shows the second piece of evidence regarding non-randomness of the household head selection. We 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 the household head, which is related to their lower income than middle-aged agents. This evidence provide adequate information to believe that the status of the household head is not selected randomly.

Fig. 6 provides the final piece of evidence regarding the selection bias in the HBS. This figure plots the average age of the household head against the age of the individual for the 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 (individuals living with their parents), moves together with the 45-degree line for middle-aged agents, and fall below the line for elderly individuals living with their children. The household-head approach will not create any mis-measurement issues if the plot derived from HBS is close to the 45-degree line. However, as Fig. 6 shows that this is not the case, we conclude that the household-head approach might lead to biases in estimating saving rates.

3.2. Estimation method

In this section, we provide an alternative approach to improve the household-head approach based on the available data. As we have noted above, HBS data provide income data at the individual level but consumption data at the household level. Since individual consumption data are needed to calculate the individual saving rates, here we follow Coeurdacier et al. (2015) and obtain a dis-aggregated series on individual consumption for each age-group from household consumption data that are available from the survey.

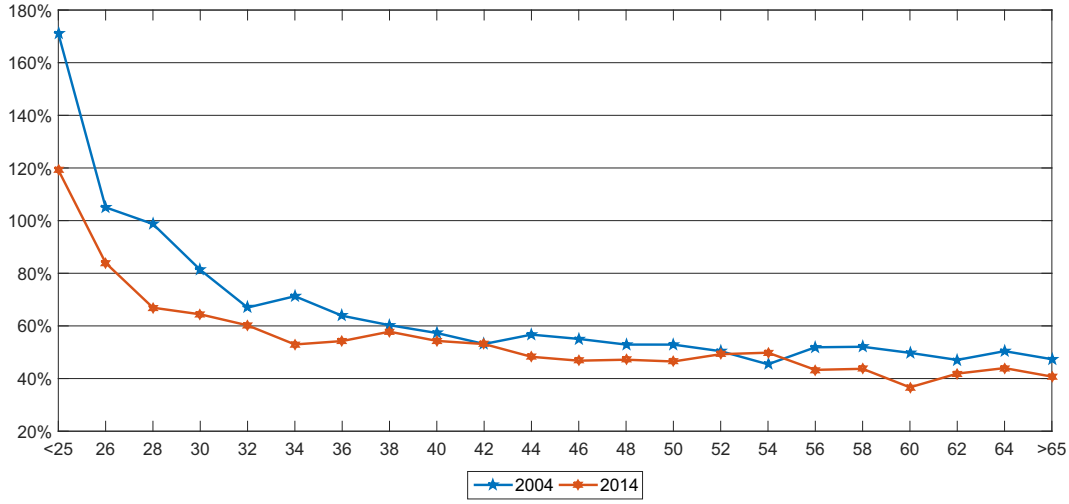

Fig. 4. Income Premium of Household Heads in Turkey (in logs).
Note: Income premium of household heads is the log difference between the average income of heads of a given age and the average income of all individuals of that same age.
Source: Authors' calculations based on TurkStat HBS (2004–2014)

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

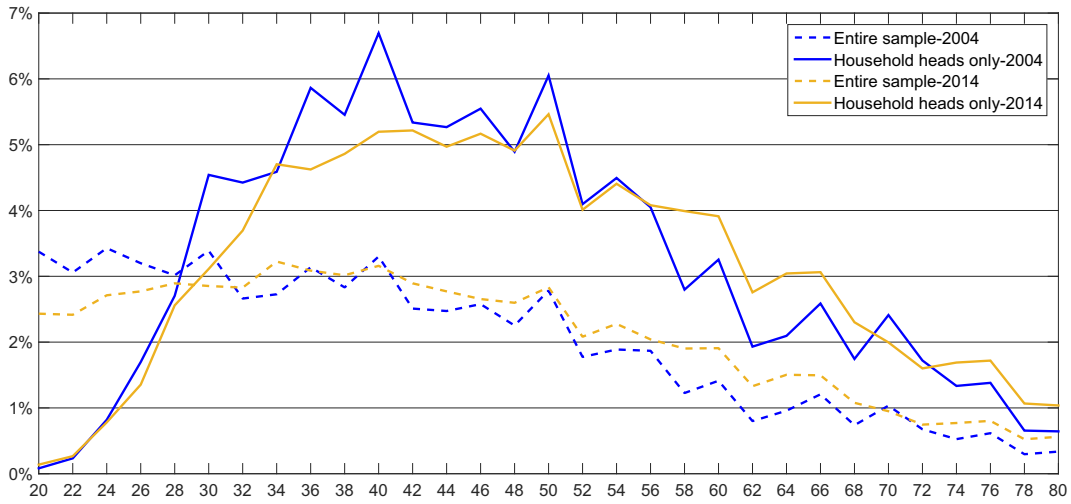

Fig. 5. Frequency of observations by age for 2004 and 2014.
Source: Authors' calculations based on TurkStat HBS (2004–2014)

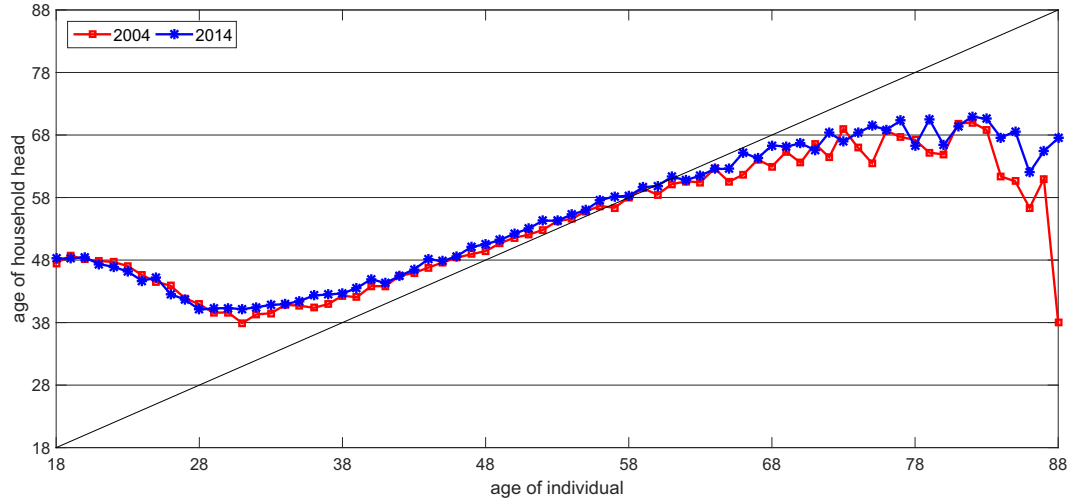

Fig. 6. Average age of household head by age of individual.
Source: Authors' calculations based on TurkStat HBS (2004–2014)

Our approach involves recovering individual consumption from the household data by a projection method which is proposed by Chesher (1997, 1998). The idea is to project total household consumption on the number of household members who are in the various age-groups, controlling for their household-specific indicators. Following Coeurdacier et al. (2015), we identify individual consumption from household consumption by estimating the following model on the cross-section of households for every year

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

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 Coeurdacier et al. (2015) we use 33 age brackets in J - from 19 to 20 to 83 above - and include control variables in the exponential term of the above equation.

The control variables are:

- **Household composition**: the number of children aged between 0 and 10, the number of children aged between 10 and 18, the number of adults in the household, and the number of the young and old dependents. Young and old dependents are defined as individuals aged 19–25 and 65 above, respectively, and have a low income with no saving decision. The coefficient on the number of children is negative. Normally, we would expect a higher consumption with a larger household. However, we show in Table 2 that the number of children decreases with the income of the household. By the assumption of positive correlation between income and consumption, a negative coefficient for the number of children is therefore not unanticipated.

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:

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

where κ controls the extent of the smoothness and fixes to 10. The

Table 2
Average number of children.
- **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.

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: Authors' calculations based on HBS data.

discretized version of P can be written as $\kappa^2(\boldsymbol{Mc}_j)'(\boldsymbol{Mc}_j)$, 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 $c_j = [c_j]_{j \in J}$ is a 33×1 vector. Pre-multiplying c_j by M produces a vector of second differences.

3.3. Results

Figs. 7 and 8 display the estimated age-saving profiles based on the individual approach and its comparison with the household-head approach for 2004 and 2014, respectively. First, we observe that young individuals save less based on the individual approach; this is due to the income premium and selection bias for each year. Second, we observe that aggregation bias attenuates the household head's saving rate according to the household-head approach. Finally, Figs. 7 and 8 show that older cohorts save more according to the individual approach, which is the result of the aggregation bias of the household-head approach. Coeurdacier et al. (2015) claim that the household-head approach shows lower saving rates for middle-aged agents due to aggregation bias. In the case for Turkey, aggregation bias puts downward pressure on the old saving rate. Table 3 provides one possible explanation in that the age of the household head increases in multi-generational households. As we expect to observe aggregation bias for multi-generational households, the results in the figures are in accordance with the theory.

Fig. 9 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. As we argued earlier, one possible explanation for this phenomenon is the relaxation of borrowing constraints combined with higher expected income growth and lower interest rates. In the next section, we will try to account for this trend by two different versions of the model presented in Section 2.

4. The model versus the data

In this section, we will comprehensively calibrate the model in order to match the evolution of the saving rate in Turkey at the cohort level. After we describe the calibration method, we will compare the model-predicted saving rates with those observed from the data. First, we will simulate the model with a closed-economy, which we refer to as Model (1). In this model, interest rates will be derived endogenously by using the autarky market-clearing equation. Then we will simulate the economy as if it is a small-open economy, which we denote by Model (2). In this model, we will assume interest rates are exogenous and measured as observed interest rates using actual data. Both simulations will start from the autarky equilibrium in 1980. We start the simulations in 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 and the borrowing constraint parameter θ_t will evolve to reflect the relaxation of borrowing constraints in Turkey through 2020. For Model (2), we assume that the country moves out of autarky and integrates with world markets in 1990 and take the real interest rate exogenously. Here we present the summary of the simulations:

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

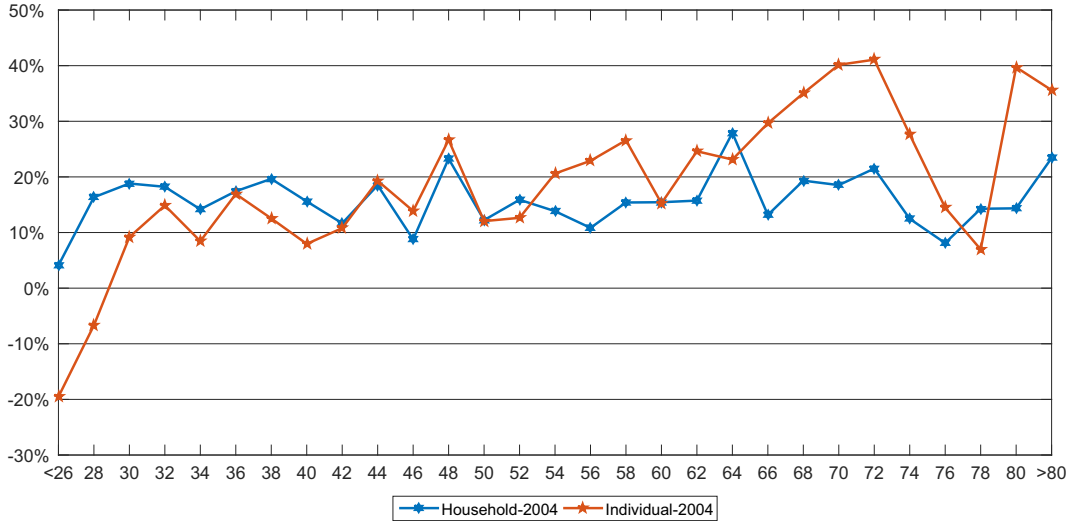

Fig. 7. Comparison of individual approach with household approach for 2004.
Source: HBS 2004.

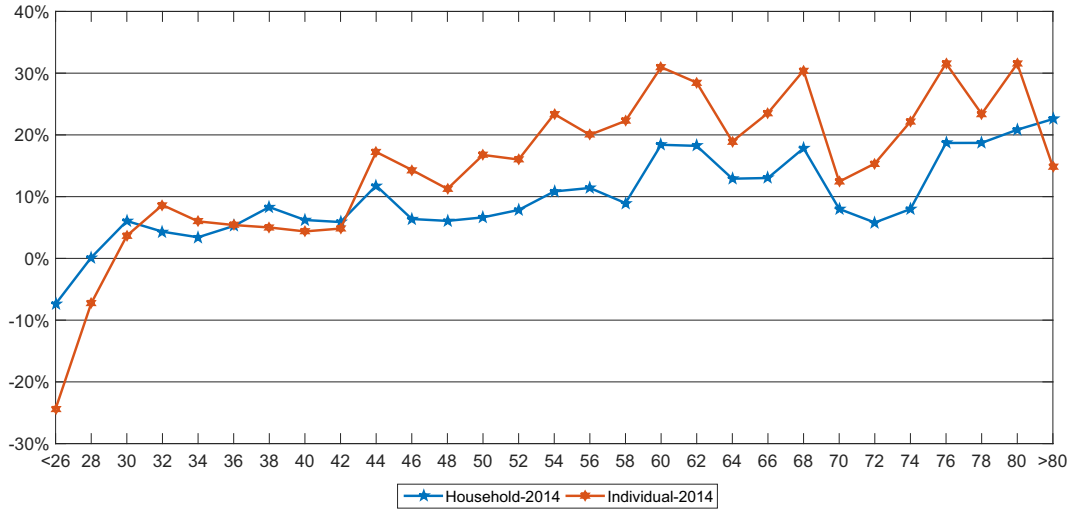

Fig. 8. Comparison of individual approach with household approach for 2014.
Source: HBS 2014.

Table 3
Average age of household head.

	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: Authors' calculations based on HBS data.

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

4.1. Calibration

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

4.1.1. 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, which does not provide a sufficient number of cohorts to perfectly fit the data. Therefore, we take the real population growth rate from the data to use in the model, as displayed in Table 5.

4.1.2. 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 and 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 derived from HBS data and shown in Table 5.

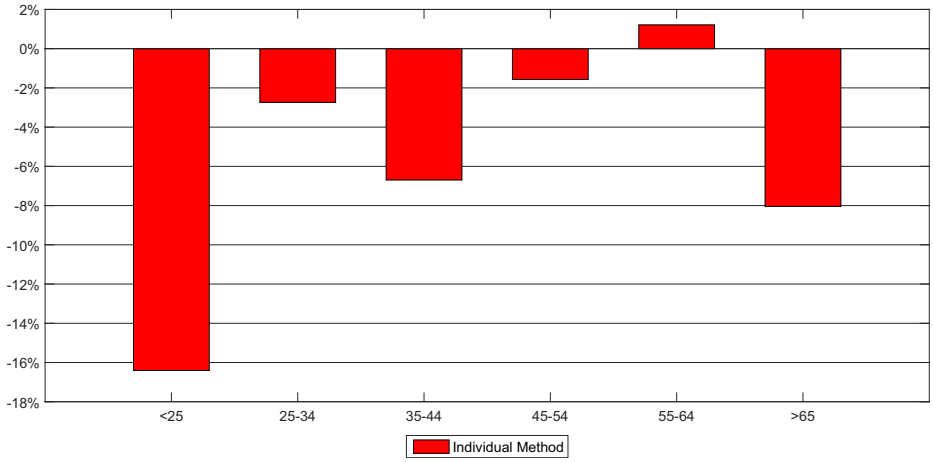

Fig. 9. Change in saving rate by age groups in Turkey: 2004–2014.
Source: HBS (2004–2014).

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: Authors' calculations based on HBS, CBRT data, and World Population Prospects (2015).

4.1.3. 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 growth of Turkey relative to the US between 1980 and 2020. We take the US productivity growth rate as 1.5% throughout all simulation periods following (see Coeurdacier et al. (2015)) while the resulting annual growth rate of Turkey is given in Table 5. We take the relative capital-effective labor ratio between Turkey and the US as 0.78 for 1990 following Hall and Jones (1999). Then we are able to calculate the relative productivity levels A_{TR}/A_{US}, and productivity growth for Turkey using the production equation given in Section 2.

4.1.4. Real interest rate

We calculate the real interest rate for Turkey and use it as an exogenous parameter in Model (2). The real interest rates are calculated using the Fisher equation as

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

We use Weighted Average Interest Rates for up to 1-year Turkish Lira deposits as nominal interest rate i_t from the Central Bank of Turkey (CBRT) and the yearly inflation rate from the World Bank. The implied values of the real interest rate for different years are displayed in Table 5.

4.1.5. Calibrated parameters

We set the credit constraint parameter to match the financial developments in Turkey over the sample period. Coeurdacier et al. (2015) set the value of θ_t for China and the US at 0.02 and 0.2, respectively. We determine the evolution of Turkey's borrowing constraint based on a comparison of the gross household debt percent of GDP for Turkey and China. The McKinsey Global Institute provides the gross household debt as a percent of GDP in China as 3% in 2000 while 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 as a percent of GDP reaches to 23.77% in 2013. Based on this finding, we increase the borrowing constraint parameter by eightfold to 0.16 in 2010, and we show its extended evolution in 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 Coeurdacier et al. (2015). The capital share for Turkey is set at 0.4 following Altug et al. (2008).

5. Results

Fig. 10 juxtaposes the model-implied changes in saving rates across age-groups with estimates from the data in Turkey between 2004 and 2014. 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 Model (1) cannot account for the unusual trend of real interest rates in Turkey, which experienced macroeconomic reforms and stabilization of the inflation rate in the post-2002 periods. Model (1) matches well the evolution of the saving behavior of young and middle-aged but it cannot explain the fall of the saving rate of the old. 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, Model (2) over-predicts the 4.3% fall in the middle-aged saving rate.

As we surmised earlier, the existence of borrowing constraints and their eventual loosening in a relatively simple framework explains a significant part of the evolution of the change in the saving rate both at the aggregate level and at the cohort level for Turkey. We observe that taking the real interest rate as 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, which may be attributed to the relaxation of credit constraints, higher expected lifetime

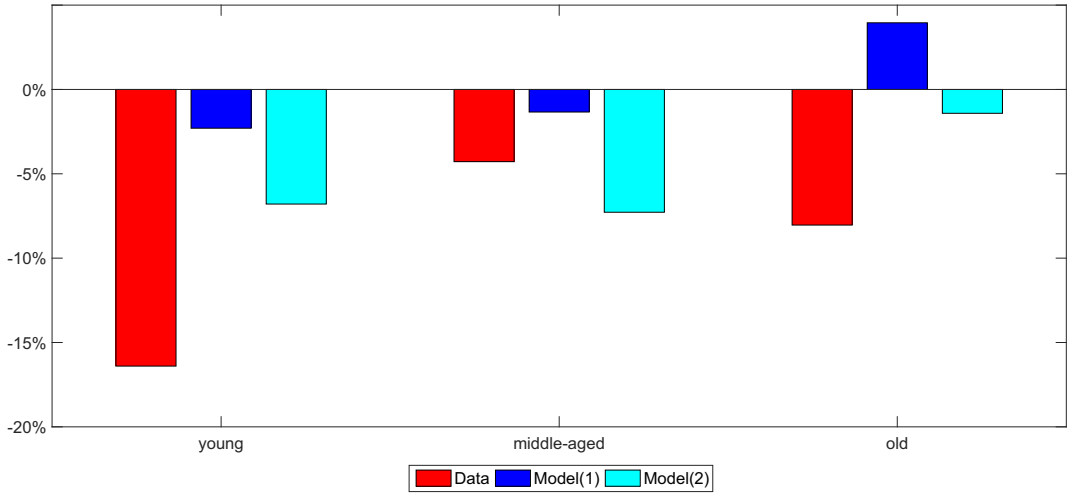

Fig. 10. The Model vs Data in Turkey: 2004–2014.
Source: HBS (2004–2014).

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. However, since their saving contributes significantly to aggregate saving and its proportion increases from 10.2% to 20.9% over this period, the saving behavior of old agents deserves special analysis in future research.

6. Conclusion

In this paper, we seek to account for the dramatic decline in the saving rate in Turkey during the post-2002 period. As part of our analysis, we estimate age-saving profiles for Turkey using the individual approach instead of the household-head approach. Unlike previous studies, we estimate cohort-level saving rates comprehensively following Chesher (1997, 1998). The evidence shows that both aggregation and selection bias have to be considered for Turkey when estimating such age-saving profiles. Following Coeurdacier et al. (2015), we also seek to explain the change in saving rates both at the cohort level and at the aggregate level by relying on a simple mechanism - the relaxation of borrowing constraints - in a basic general-equilibrium model. The theoretical model displays considerable quantitative power in explaining the change in saving across cohorts in Turkey over the last decade. Its quantitative power increases when real interest rates are taken as exogenously given to the model.

Our aim in this paper was to capture some salient aspects of the Turkish saving experience since 2002. While the relaxation of borrowing constraints is intended to capture the experience of financial liberalization and the growth in credit that occurred over this era, our model also captures the income growth that young cohorts experienced by allowing for positive income growth between young and middle-aged cohorts. However, there may be other factors that have been driving the decline in saving rates since 2002. Another factor that may have contributed to the decline in the saving rate is that household expectations improved significantly at the beginning of 2000's, as Turkey embarked on a successful program of stabilization and reform which was buttressed by the prospects of European Union membership.

Our findings also have ramifications for alternative policy measures that have been proposed to increase saving rates in Turkey. One of these is the introduction of privately-funded pension schemes, which may provide inducements for households to increase their saving rates. However, when evaluating the potential outcomes from such schemes, policymakers should note that such inducements may be counter-balanced by other fundamental factors that also determine the optimal intertemporal responses of forward-looking households. Our analysis shows that the increased access to credit through a loosening of borrowing constraints together with income growth over the life-cycle can have substantial effects on the saving behavior of different cohorts. Furthermore, our analysis shows that it is necessary to take into account the age-income profile of households when discussing the saving responses to alternative policy measures, as different cohorts may respond in different ways to similar proposed policy measures.

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