DOES THE 2008 REFORM CONTRIBUTE TO SUSTAINABILITY?

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ABSTRACT

Due to considerable financial sustainability concerns, Turkey has reformed her social security system. The last leg of this reform process took place in 2008 and included changes in replacement and contribution rates. This paper aims to analyse the impact of the parameter changes on financial sustainability of the system and the consumer well-being. Focus of the analysis is on the changes in the replacement rates and the contribution rates. The paper contributes by providing a complex quantitative analysis of the parameter changes through an OLG (overlapping generations) model. It is found that the simultaneous reduction of replacement and contribution rates is a reform design flaw and actually worsens the deficits of the system. One other finding is that the closer a person is to retirement at the time of the reform, the worse the impact of the reform is on the person.

Keywords: Social security reform, overlapping generations model, Turkey 2008 reform

2008 REFORMU SÜRDÜRÜLEBİLİRLİĞE KATKI YAPIYOR MU?

ÖZ

Finansal sürdürülebilirliğe dair önemli kaygılardan dolayı Türkiye sosyal güvenlik sisteminde reforma gitmiştir. Bu sürecin son aşaması 2008'de gerçekleşmiş ve bağlama oranıyla prim oranında değişimleri içermiştir. Bu çalışma parametre değişikliklerinin sistemin finansal sürdürülebilirliğine ve tüketicilere etkisini incelemeyi amaçlamaktadır. Analiz, bağlama oranı ve prim oranı değişikliklerine odaklanmaktadır. Çalışma, parametre değişikliklerinin ardışık nesiller modeli ile niceliksel analizini yaparak literatüre katkı yapmaktadır. Yapılan analiz bağlama ve prim oranlarının eş anlı düşürülmesinin bir reform tasarım hatası olduğunu ve bunun sistemin açıklarının kötüleşmesine etkisi olacağını işaret etmektedir. Tüketici üzerindeki etkilere dair temel bulgu ise, reform anında emekliliğe daha yakın olan çalışmaktaki bireylerin reformdan en olumsuz etkilenenler olduğu yönündedir.

Anahtar Sözcükler: Sosyal güvenlik reformu, ardışık nesiller modeli, Türkiye 2008 reformu

INTRODUCTION

The 1990s and 2000s were times of debate on the financial sustainability of social security systems, given the ageing populations of different economies. Policy response has been reforms in public social security systems. The reform wave has covered not only developed but also developing countries. Turkey has been no exception, with the country's pay-as-you-go social security system running deficits in the 1990s. These deficits have increased at such a pace that, according to the Monthly Statistical Bulletins of the Social Security Institute they have reached nearly 5% of national income by 2005 and Turkey has responded by enacting reforms.

The first reform wave of the Turkish system was in 1999. It aimed to increase retirement ages, thus restore the balance between the number of premium paying workers and pension receiving retirees. The second wave included the foundation of the Social Security Institution in 2006, an attempt at unifying the fragmented nature of the Turkish system. Following this, in 2008, a parametric reform was enacted. This last reform focused on changing the key parameters of the social security system, specifically replacement rates and contribution rates, and changing pension calculation methods.

The aim of this study is to analyse the effect of the social security system reform in Turkey. Specifically, the impact of the changes in the replacement rate and the contribution rate introduced in the final stages of the reform are investigated. The study focuses on the implications of the reform on social security system's financial sustainability and consumer behaviour. The adopted methodology is along the lines of Auerbach and Kotlikoff (1987); i.e. a large scale OLG (overlapping generations) model has been constructed and numerical simulations have been performed.

Introduced by Samuelson (1958) and Diamond (1965), the OLG model is one of the most frequently used theoretical constructs in economics. Following standard microeconomic foundations, the model is based on a consumer that maximises lifetime utility subject to budget constraints at different ages through the life. The key point is that the consumer lives for a limited number of time periods and dies to leave the economy. Thus, when the larger picture of a theoretical economy is considered, the model is able to present the coexistence of individuals from different generations.

The structure is especially well suited to the analysis of public social security systems of a PAYG (pay-as-you-go) nature. In PAYG systems, pensions of the retirees are paid out of the premiums collected from the workers. Thus coexisting actives, i.e. contribution paying workers, and passives, i.e. pension receiving retirees, can be represented simultaneously. The method is well established and has been used

to analyse reforms in a number of countries. The literature includes case studies of countries such as Italy by Magnani (2011), Brazil by Ferreira (2005), Germany by Fehr and Jess (2007), Spain by Rojas (2005), France by Legendre (2010) and USA by Fuster, İmrohoroğlu and İmrohoroğlu (2007) and De Nardi, İmrohoroğlu and Sargent (1999). Given the PAYG nature of the Turkish system, the method is appropriate for the analysis to be conducted.

Existing studies of the Turkish social security system are more of a descriptive nature, as exemplified by Alper (2011) and Alper (2015). Modelling oriented quantitative studies of the social security system in Turkey are less in numbers. Among these limited studies, Sayan and Kiracı (2001) consider the deficit of the Turkish PAYG system as the objective of a constrained optimisation problem in order to examine deficit minimising parameter alternatives. Tuncay and Kiraci (2002) construct an actuarial model and simulate the implications of a private, defined contribution pension scheme under different investment strategies. Alper, Değer and Sayan (2012) present estimations of the population covered by the social security system and the implied deficits of the social security system, concluding that any deficit reductions implied by the reform waves in Turkey are of a transitory nature.

There is also a number of studies that portray the Turkish social security system through OLG type models. Kenç and Sayan (2001) employ an OLG general equilibrium model to investigate the international spillover effects of ageing population. Using an open economy framework, they conclude that an ageing Europe compounds the macroeconomic effects of ageing in Turkey. As part of a report on the topic, Alper, İmrohoroğlu and Sayan (2004) propose an OLG model able to account for the introduction of voluntary private retirement plans in Turkey. The report concludes that the private saving mechanism contributes to capital accumulation and may lower employment costs on employers and that any costs related to the transition are reduced if the transition is spread through time. Eren and İleri (2015) present an OLG model of a privatised retirement system with government subsidies and conclude not only that the system contributes to capital formation, but also that this contribution may be further enhanced with reductions in the fees related to private pensions.

Despite their contributions to the understanding of the social security system in Turkey, these studies have three major shortcomings. Firstly, the parametric reform of 2008 in Turkey is yet to be addressed by a detailed quantitative analysis. Secondly, these models lack a clear foundation for a representation of ageing population. Thirdly, they fail to account for the fragmented nature of the social security system in Turkey. This study contributes by addressing these shortcomings.

The first section of the paper presents a brief history of the Turkish social security system, highlights the fragmented structure and the sustainability problem of the system and summarises the conducted reforms. The constructed model is exposed in Section 2, the conducted numerical simulations and obtained results are available in Section 3. The manuscript concludes by outlining the results and raising policy related points.

1. SOCIAL SECURITY IN TURKEY: A BRIEF HISTORY

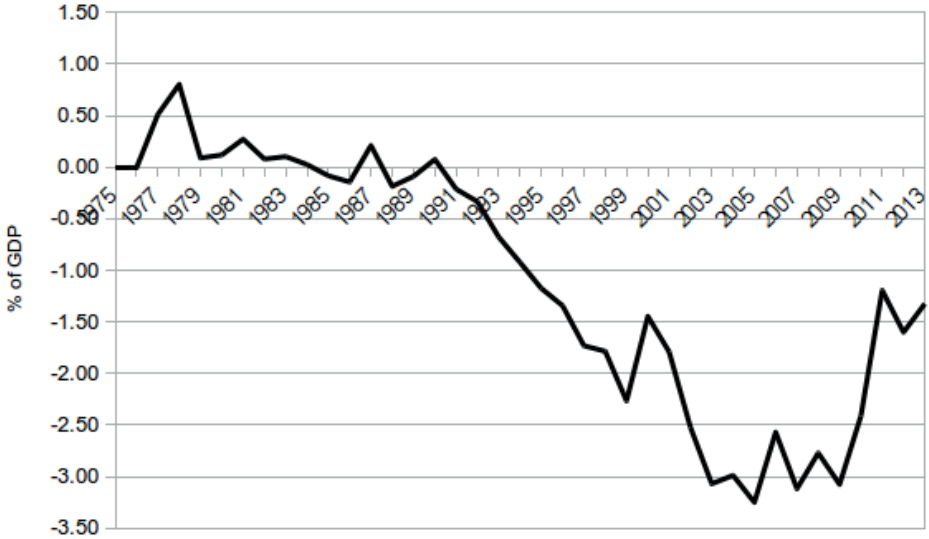
The origin of the Turkish social security system goes back to the post-World War 2 era. Origins of modern social security systems frequently start with a support system for public workers; Turkey is not an exception. Year 1950 saw the enactment of Law No 5434 which founded ES (Emekli Sandığı, Pension Fund) to provide social security coverage for public workers. The 1961 Constitution of Turkey provided another acceleration for the institutionalisation of the system. The 1961 Constitution defined social security as a right for citizens and obligated the state to take the necessary steps to realise its provision. This change was reflected in the First Five Year Development Plan of Turkey covering the 1963-1967 period. These plans are guidelines to be followed during the planned phase and, true to the plan, a second institution was founded in 1965. Called SSK (Sosyal Sigortalar Kurumu, Social Insurance Institution), this institution focused on covering mostly private sector workers through identifying its coverage as people who are employed through a service provision contract. A last major step in institutionalisation was the foundation of BK (Esnaf Ve Sanatkarlar Ve Diğer Bağımsız Çalışanlar Sigortalar Kurumu, Tradesmen and Artisans and Other Independent Employees Insurance Institution) in 1972 to cover, as the name implies, independent workers such as artisans. The structure was further enhanced in the 1980s with the addition of agricultural workers. However, this expansion was kept within the already existing three institutions. Thus in 1990s the social security system of Turkey was structured around three institutions with different coverages. This fragmented nature of the system continues to be reflected in its current structure.

Though initially designed as a funded system, the system functions as a pay-as-you-go system with defined benefits and defined contributions along a mixture of Bismarckian and Beveridgian lines. Being in coverage is a constitutional right; the system is Beveridgian in this regard. In practice, the system is financed out of contribution payments from members; a very Bismarckian characteristic. But given that the system has both defined benefits and defined contributions, deficits eventually emerged and have been financed by government transfers. Thus the tax base has become an important support factor, introducing Beveridgian elements to the financial side of the system. The system continues to function as an unfunded

pay-as-you-go system; actives of a given time period pay contributions to finance the expenditures done to cover the passives of the system.

At its onset, the system was running surpluses. But in the 1990s, these surpluses turned to deficits. A glimpse of this process can be had through Figure 1, which shows the government transfers done to cover the system's deficits. There is hardly any deficit until 1990s but as of 1990, deficits keep worsening. One main culprit of these developments is the early retirement opportunities introduced in the 1980s. Due to Law No 3774 that went into effect in 1992, age requirement for retirement is removed and retirement eligibility is tied solely to the number of days for which contribution is paid. Due to this law, it became possible for a woman to enter a job at age 20, pay premiums for 20 years (25 for men) and retire at an extremely early age of 40.

Figure 1: Transfers to the social security system from the government budget (% of GDP)



Source: Ministry of Development, Economic and Social Indicators. Author's compilation from Table 5.2, i.e. social funds. For the full data, see: https://tinyurl.com/y2avjfdn . Access date: March 14, 2018.

A first step of the reform process was the re-introduction of the retirement age obligation in to the retirement eligibility criteria. This initiated a legal process that began in 1999 and ended in 2002 with Law no 4447. Currently, age of 58 for women and 60 for men must be filled to retire. A more comprehensive reform took place

from 2006 to 2008. Firstly, in order to merge the practices of different institutions a single social security institution was founded in 2006. Then, in 2008, through Law no 5754, parameters of the system have been changed to enable unity in practices and enhance the financial sustainability of the system.

Given the focus of this study on the reform in 2008, a deeper look at the parameter changes brought about by Laws 5510 and 5754 is crucial. First major parameter impact of the reform was on contribution rates. Prior to these laws, BK members were obliged to pay a 40% premium, ES members 35% and SSK members 31%. The reform unified these contribution rates at 32.5% for all participants.

The second major change was the calculation of the replacement rate. The divided system before the reform had different rates for the members of different institutions. For BK and SSK members, the rate was 3.5% for the first 10 years, 2% for the additional 10 years and 1.5% for any additional years. Thus a 40-year work life implies 10x3.5 + 10x2 + 20x1.5 = 85% replacement rate. For public members covered by ES, the ratio is 75% for the first 25 years and +1% for each additional year. A 40-year work life implies 75 + 15x1 = 90% replacement rate. Two points are obvious: firstly, the replacement rates are quite generous. Secondly, generosity is especially evident in the case of public workers. In its final form, Law No 5510 is changed through Law no 5754 to state that a prospective pensioner gets 2% for each year of premium payment. That is, an active work life of 40 years now implies a uniform 80% replacement rate for all participants.

The reform was done to maintain the financial sustainability of the system. Writing just a few years after the reform, Alper (2011) claims that the expected turnaround is yet to be realised. Alper (2015) also claims that a 1.85 active-passive ratio after one and a half decade of increased retirement age gives adverse signals for sustainability. Not only Figure 1 but also the data from the Social Security Institute confirm. According to Figure 1, the deficit remains above 3% of GDP until 2011. And according to online data from the Fiscal Statistics section of the Monthly Statistical Bulletin of the Social Security Institute, budget transfers to Social Security Institution have dipped to just below 4% of GDP between 2011 and 2015 but have increased back to more than 4% in 2016 and 2017. Thus the system is hardly out of financial hardship and a sharp eye in terms of not only policy but also research needs to be kept on the system.

2. THE MODEL

The model proposed to analyse the social security reform in Turkey is a dynamic general equilibrium model formulated around the OLG model. There are three types of consumers to reflect the diversities in the social security system. All

the consumers maximize their respective intertemporal utilities subject to budget constraints. The model also includes a government that covers the deficits of the social security institutions. Finally, international connections are added to close the model. The details of the model are as follows.

2.1. Demography

In the model, a representative consumer is assumed to live for 30 periods; working and paying contributions in the first 15 periods, and retired and receiving pensions in the last 15 periods. The choice of a 30 period lifetime is mostly due to computation time related technical restrictions. The numerical solution of the model extends to days, and an expansion of the model to account for a longer lifetime would increase the computation time exponentially. The model's age structure can be related to calendar ages by assuming that i) age in the model stands for two calendar years, and, ii) representative agents enter the economy at the age of 20. Therefore, a consumer aged 1 in the model corresponds to 20-21 years of calendar age. This practise of aggregating age and time in the model is most common for applied OLG models; Auerbach and Kotlikoff (1987) and De Nardi, İmrohoroğlu and Sargent (1999) formulate age structures so that new adults in the model are 21 years old. In their modelling exercise, Kenç and Sayan (2001) assume that one model time period equals five years and employ a 12 period model "to limit the computational burden" (Kenç and Sayan, 2001: 682). Magnani (2011) matches one model period to five years. Bouzahzah, De la Croix and Docquier (2002) consider a lifetime of only 6 periods, with consumers entering the economy at the calendar age of 18. Rojas (2005) takes each model period corresponding to 5 years.

The demographic structure is based on the evolution of age 1 cohort. Specifically;

$$N_{1,t+1,s} = \rho_{t,s} N_{1,t,s} \quad (1)$$

where $N_{1,t,s}$ is cohort size, $\rho_{t,s}$ is age 1 cohort growth rate. The index t stands for time and s stands for consumer type; i.e. $s = priv, pub, ind$. The index *ind* refers to independent artisans and craftsmen who are members of the BK institution, *pub* refers to public workers covered by ES, and *priv* refers to private sector workers covered by SSK. As detailed below, these consumers are differentiated by the values of preference parameters in their utility functions and budget items.

2.2. Consumers

At the core of the model are three type of consumers that derive utility from consumption. The behaviour of these consumers are represented by an intertemporal

utility maximisation problem with budget constraints limiting behaviour. Each consumer type with relevant modelling details are clarified below.

Private Sector Workers:

Private sector workers are the people working under a service contract, mostly in the private sector, and are covered by Law no 5510 Article 4a, formerly by the institutional structure of SSK. A representative private sector worker is assumed to maximise the following lifetime utility function:

$$U = \sum_{g=1}^{30} \beta_{priv}^{g-1} \frac{c_{g,t+g-1,priv}^{1-\eta_{priv}} - 1}{1-\eta_{priv}} + \beta_{priv}^{29} \gamma_{30,priv} \frac{beq_{30,t+29,priv}^{1-\eta_{priv}} - 1}{1-\eta_{priv}} \quad (2)$$

where, β is the utility discount rate, η represents risk aversion and $\gamma_{30,priv}$ is the bequest weight in lifetime utility. The consumer derives utility from consuming, $c_{g,t+g-1,priv}$, and leaving bequests, $beq_{30,t+29,priv}$, for the following generations.

At the first period of life, the private sector worker faces the following budget constraint:

$$c_{1,t,priv} + a_{2,t+1,priv} \leq (1-\tau_{t,priv}) w_{t,priv} e_{1,t,priv} \quad (3)$$

where $c_{1,t,priv}$ is the consumption of age 1 private sector worker aged 1 at time t. The assets left to age 2 are $a_{2,t+1,priv}$. These expenditures are financed by wage earnings, $w_{t,priv}$, corrected for age efficiency, $e_{1,t,priv}$, and net of social security contributions, $\tau_{t,priv}$.

The exposition of the inter-temporal utility and the budget constraint present two features of the model that require elaboration. Firstly, it is assumed that the private sector workers leave bequests but receive no inheritance. This assumption is due to Değer (2011)'s observations on life-cycle behaviour of income items. Data from Turkey's Household Budget Surveys show that independent workers, a group of consumers detailed below, are observed to have positive asset related income at the first period of their life. But this asset related income decreases through their life. The asset income does not fall to zero at the end of life, either. Wage earners, public or private, do not have such income at the beginning of their lifetime. They accumulate savings throughout their life, but their asset related income does not fall to zero at the end of life either. For modelling purposes, this is represented by assuming that all consumers leave bequests but only independent workers receive inheritance. The calibration is done by noting that the amount of bequest left by wage earners is considerably less than the bequest left by the independent workers. Hence private sector workers are assumed to leave bequests, with utility as the driving motive, but receive no inheritance.

Secondly, the concept of age efficiency is introduced to the wage earning behaviour. This assumption reflects the idea that given an economy-wide equilibrium wage, a consumer's actual wage earning deviates due to age. Representative of changes in productivity, this phenomenon is observed for the Turkish case by Cilasun (2009) and Değer (2011). Hence the age efficiency indices have been introduced to the model.

For the remaining working periods of life the private sector worker faces the following constraint:

$$c_{g,t+g-1,priv} + a_{g+1,t+g,priv} \leq (1 + r_{r+g-1})a_{g,t+g-1,priv} + (1 - \tau_{t,priv})w_{t,priv}e_{1,t,priv} \quad (4)$$

where $g=2,...,15$. Accumulated assets now start yielding returns, r_{t+g-1}. Upon retirement, wage income is replaced by pensions, $pen_{t+g-1,priv}$:

$$c_{g,t+g-1,priv} + a_{g+1,t+g,priv} \leq (1 + r_{r+g-1})a_{g,t+g-1,priv} + pen_{t+g-1,priv} \quad (5)$$

with $g=16,...,29$. And for the last period of life, bequest to be left, $beq_{30,t+29,priv}$, becomes an expenditure item:

$$c_{30,t+29,priv} + beq_{30,t+29,priv} \leq (1 + r_{r+29})a_{30,t+29,priv} + pen_{t+29,priv} \quad (6)$$

The private sector wage earner chooses consumption and saving sequences, and bequest to be left, so as to maximize lifetime utility, subject to the stated budget constraints.

Public Sector Workers:

The setup of the public workers is quite similar to that of the private sector workers. The main difference is that the wage earnings of the private sector workers is based on a market determined wage rate, whereas the wage earnings of public workers rely on an exogenous public wage. Also, public sector workers are covered through Law no 5510 Article 4c, formerly via the institution ES. The utility of the consumer representative of the public sector worker can be summarised as:

$$U = \sum_{g=1}^{30} \beta_{pub}^{g-1} \frac{c_{g,t+g-1,pub}^{1-\eta_{pub}} - 1}{1 - \eta_{pub}} + \beta_{pub}^{29}\gamma_{30,pub} \frac{beq_{30,t+29,pub}^{1-\eta_{pub}} - 1}{1 - \eta_{pub}} \quad (7)$$

where the main difference is the change in the index of consumer type from *priv* to *pub*. At the first period of life, material constraint is stated as follows:

$$c_{1,t,pub} + a_{2,t+1,pub} \leq (1 - \tau_{t,pub}) w_{t,pub} e_{1,t,pub} \quad (8)$$

Note that the private sector wages, $w_{t,priv}$, are replaced by public sector wages, $w_{t,pub}$, as the source of work life income. For the rest of the work life, the following holds:

$$c_{g,t+g-1,pub} + a_{g+1,t+g,pub} \leq (1 + r_{r+g-1}) a_{g,t+g-1,pub} + (1 - \tau_{t,pub}) w_{t,pub} e_{1,t,pub} \quad (9)$$

with $g=2,...,15$. Retirement is differentiated with the introduction of pensions:

$$c_{g,t+g-1,pub} + a_{g+1,t+g,pub} \leq (1 + r_{r+g-1}) a_{g,t+g-1,pub} + pen_{t+g-1,pub} \quad (10)$$

with $g=16,...,29$. At the end of lifetime bequests enter as an expenditure item:

$$c_{30,t+29,pub} + beq_{30,t+29,pub} \leq (1 + r_{r+29}) a_{30,t+29,pub} + pen_{t+29,pub} \quad (11)$$

Once more, the consumer maximises lifetime utility subject to budget constraints by choosing bequests to be left and consumption and saving sequences.

Independent Workers:

The independent workers in the model account for the persons working on their own accord, such as artisans and craftsmen. These are covered by Law no 5510, Article 4b, formerly through the institution BK. In terms of utility formulization, this type of consumers are the same as the ones previously clarified; hence the following lifetime utility specification is adopted:

$$U = \sum_{g=1}^{30} \beta_{ind}^{g-1} \frac{c_{g,t+g-1,ind}^{1-\eta_{ind}} - 1}{1 - \eta_{ind}} + \beta_{ind}^{29} \gamma_{30,ind} \frac{beq_{30,t+29,ind}^{1-\eta_{ind}} - 1}{1 - \eta_{ind}} \quad (12)$$

The main difference in the formulation of independent workers is that they do not earn wage income; their lifetime resources evolve around asset related income. This formulation is due to the observations of Değer (2011) on the income sources of different individual groups in the Turkish economy. Değer (2011) observes that the artisans and craftsmen have negligible wage income, and that their main income source is asset related income. Reflecting this, age 1 budget of an independent worker is represented through the following equation:

$$c_{1,t,ind} + a_{2,t+1,ind} \leq inh_t \quad (13)$$

Age 1 budget of this group of consumers states that the consumer begins life with an inheritance, inh_t, received from previous generations. As stated above, this is due to the observations on income sources through the micro data sets. The

inheritance-bequest mechanism is such that the bequests left by all the consumers in the economy are divided and distributed to new born consumers who are independent workers. Therefore:

$$inh_t = \frac{\sum_{i=priv,pub,ind} beq_{30,t,i} N_{30,t,i}}{N_{1,t,ind}} \quad (14)$$

Given the initial resources due to inheritances, rest of the lifetime is financed by the evolution of the asset stock holdings and implied returns. For the remaining working ages:

$$c_{g,t+g-1,ind} + a_{g+1,t+g,ind} \leq \left[1 + r_{r+g-1}\left(1 - \tau_{t+g-1,ind}\right)\right] a_{g,t+g-1,ind} \quad (15)$$

where *g=2,...,15*. Working life expenditures are financed by asset related incomes, net of social security contributions, $\tau_{t+g-1,ind}$. Once more, retirement is marked by the introduction of pensions:

$$c_{g,t+g-1,ind} + a_{g+1,t+g,ind} \leq \left(1 + r_{r+g-1}\right) a_{g,t+g-1,ind} + pen_{t+g-1,ind} \quad (16)$$

where *g=16,...,29*. Note the lack of premium payments; once retired, the consumer is no more obliged to pay contributions. At the end of life:

$$c_{30,t+29,ind} + beq_{30,t+29,ind} \leq (1 + r_{r+29}) a_{30,t+29,ind} + pen_{t+29,ind} \quad (17)$$

Once more, the characterisation of the consumer behaviour relies on the maximisation of the lifetime utility subject to budget constraints.

2.3 Production

The production side of the economy is summarized by a single firm that operates under a constant returns to scale Cobb-Douglas technology:

$$Y_t = K_t^{\alpha} (\Gamma_t L_t)^{1-\alpha} \quad (18)$$

where Γ represents exogenous labour augmenting technology that evolves according to:

$$\Gamma_{t+1} = \theta \Gamma_t \quad (19)$$

Here θ represents the exogenous technology growth rate. The government claims a portion of output, τ_t, as tax. The firm also has to pay social security contributions as an employer. Thus the profit function of the firm is:

$$\Pi_t = (1 - \tau_t) Y_t - w_t \left(1 + \tau_{t,e-priv}\right) L_t - r_t K_t \quad (20)$$

where $\tau_{t,e\text{-}priv}$ is the contribution rate paid by the *private sector employer*. The first order conditions of the profit maximization problem yield the standard results:

$$r_t = (1-\tau_t)\alpha K_t^{\alpha-1}(\Gamma_t L_t)^{1-\alpha} \tag{21}$$

$$w_t = \frac{1-\tau_t}{1+\tau_{t,e-priv}}(1-\alpha)\Gamma_t K_t^{\alpha}(\Gamma_t L_t)^{-\alpha} \tag{22}$$

2.4 Social Security Institutions

Social security institutions present in the model represent the fragmented and PAYG nature of the Turkish system. In order to accurately represent the fragmentation, three social security institutions are assumed to exist. SSK covers the private sector workers, ES covers the public sector workers and BK covers artisans and craftsmen. When equations related to these institutions are presented, these institutions are indexed by the abbreviations SSK, ES and BK.

Pensions are calculated through a replacement rate applied to the pre-retirement income that is subject to contribution collection. For the case of consumers representative of private and public sector workers, this implies that pensions are calculated out of wage income. Specifically, for private sector workers, pension calculated for a person retiring at time t, $pen_{t,priv}$, is calculated as:

$$pen_{t,priv} = rep_{t-1,priv}e_{15,t-1,priv}w_{t-1,priv} \tag{23}$$

where the replacement rate is $rep_{t-1,priv}$. For public sector workers:

$$pen_{t,pub} = rep_{t-1,pub}e_{15,t-1,pub}w_{t-1,pub} \tag{24}$$

In case of independent workers covered by BK, pension calculation is based on asset income:

$$pen_{g,t,ind} = rep_{t-1,ind}r_{t-1}a_{15,t-1,ind} \tag{25}$$

Social security institutions gather contributions and use the revenues to pay pensions. Given exogenous contribution and replacement rates, these institutions may run deficits. These deficits are covered by the government. For the case of SSK, which covers private sector workers, the budget is as follows:

$$\sum_{g=1}^{15}\left(\tau_{t,priv}+\tau_{t,e-priv}\right)w_{t,priv}e_{g,t,priv}N_{g,t,priv} + D_{t,SSK} = \sum_{g=16}^{30} pen_{g,t,priv}\,N_{g,t,priv} \tag{26}$$

The left hand side summarises starts with revenues; specifically, contributions collected from employees at the rate of $\tau_{t,priv}$ and contributions collected from

employers at the rate of $\tau_{t,e\text{-}priv}$. Deficits are denoted as $D_{t,SSK}$. The right hand side of the equation is the pension expenditures.

The budget for ES, which covers public workers, is similar:

$$\sum_{g=1}^{15}\left(\tau_{t,pub}+\tau_{t,e-pub}\right)w_{t,pub}e_{g,t,pub}N_{g,t,pub}+D_{t,ES}=\sum_{g=16}^{30}pen_{g,t,pub}\,N_{g,t,pub} \qquad (27)$$

The main conceptual difference here is that the employer is now the government and thus contribution payments are received from the government. The last institution is BK, covering independent workers.

$$\sum_{g=1}^{15}\tau_{t,ind}r_t a_{g,t,ind}N_{g,t,ind}+D_{t,BK}=\sum_{g=16}^{30}pen_{g,t,ind}\,N_{g,t,ind} \qquad (28)$$

In this case, the point to note is that contributions are collected from the non-wage incomes of the independent workers.

2.5 Government

The government collects revenues from the production process and borrows domestically and internationally:

$$\tau_t Y_t+BOR_t+BOR_{f,t} \qquad (29)$$

where τ_t represents the government's tax rate, BOR_t stands for domestic borrowing and $BOR_{f,t}$ is foreign borrowing. These revenue items are used to finance the following expenditures:

$$G_t+r_t DEB_t+r_{f,t}DEB_{f,t}+\sum_{g=1}^{15}\left(1+\tau_{t,e-pub}\right)w_{t,pub}e_{t,pub}N_{g,t,pub}+D_{t,BK}+D_{t,ES}+D_{t,SSK} \qquad (30)$$

In order of appearance, these expenditure items are defined as follows: Government purchases goods and services, G_t; makes interest payment on domestic and foreign debt, $r_t DEB_t$, and $r_{f,t}DEB_{f,t}$; as an employer government pays wages and social security contributions; and finally, government covers the deficits of social security institutions, $D_{t,BK}$, $D_{t,ES}$, $D_{t,SSK}$.

2.6 International Economy

Regarding international flows, there exist imports, M_t, exports, X_t, borrowing from the rest of the world, $BOR_{f,t}$, and interest payments to the rest of the world

due to the foreign debt stock, $r_{f,t}DEB_{f,t}$. Imports are defined as a portion, *mpi*, of the national income; $M_t=mpi\ Y_t$. Thus the international economic flows are defined as:

$$M_t + r_{f,t}DEB_{f,t} = BOR_{f,t} + X_t \quad (31)$$

Simple algebraic manipulation would show that current account, which includes only the trade balance, offsets the capital account. Hence the balance of payments always holds.

2.7 Equilibrium and Calibration

The equilibrium of the model is such that:

- representative consumers pick consumption and saving sequences and bequest such that representative consumers maximize their lifetime utility subject to budget constraints,
- firm demands capital and labour so as to maximize profit,
- social security institution budgets hold with deficits covered by the government,
- government chooses a tax rate so that the budget is balanced,
- labour, asset and goods markets clear.

Equilibrium in the goods and the labour market are straightforward. As for the asset market; the representative consumers accumulate assets through saving. Saving occurs by obtaining claims on the government debt or the capital stock. Therefore, denoting asset stock as A_t; the asset stock is such that $A_t=K_t+DEB_t$. Or, in flow terms, investment is defined as $I_t=K_{t+1}-K_t=A_{t+1}-A_t+DEB_{t+1}-DEB_t=S_t-BOR_t$. Given the path of domestic debt sequence and an initial asset stock, the path of the capital stock depends on the saving decisions of consumers.

Table 1: Calibrated Parameters

Preference Parameters	
Utility discount parameter for independent worker, covered by BK (β_{ind})	0.9871
Utility discount parameter for public worker, covered by ES (β_{pub})	0.9989
Utility discount parameter for private worker, covered by SSK (β_{priv})	1.0051
Risk aversion parameter for independent worker, covered by BK (η_{ind})	1.1
Risk aversion parameter for public worker, covered by ES (η_{pub})	1.0
Risk aversion parameter for private worker, covered by SSK (η_{priv})	1.0
Weight of bequest in utility for independent worker, covered by BK (γ_{ind})	9.8096
Weight of bequest in utility for public worker, covered by ES (γ_{pub})	0.4374
Weight of bequest in utility for private worker, covered by SSK (γ_{priv})	0.7086
Bequest left by independent worker, covered by BK (beq_{ind})	650
Bequest left by public worker, covered by ES (beq_{pub})	53
Bequest left by private worker, covered by SSK (beq_{priv})	47
Social Security Parameters	
BK partaker contribution rate (τ_{ind})	0.0487
ES partaker contribution rate (τ_{pub})	0.0415
SSK partaker contribution rate (τ_{priv})	0.0802
ES employer contribution rate ($\tau_{e\text{-}pub}$)	0.0553
SSK employer contribution rate ($\tau_{e\text{-}priv}$)	0.0974
BK replacement rate (rep_{ind})	0.1127
ES replacement rate (rep_{pub})	0.3077
SSK replacement rate (rep_{priv})	0.5078
Miscellaneous	
Capital share (α)	0.7230
Marginal propensity to import	0.29

Source: Author's calculations. Calibration details are presented in the text.

The model is calibrated to year 2007 of the Turkish economy through a SAM (Social Accounting Matrix). The SAM of an economy is a square matrix that records revenue and expenditures of all the actors in the economy. For example, a SAM would have an account for consumers where income of the consumer would

be represented in a row and the expenditures of the consumer would be in a column. Given that consumers spend all their income, row and column sums of the consumer accounts would be equal. Generalised know-how on the construction of a SAM, with a special focus on Turkey, is presented by Erten (2009).

This structure presents a database of the economy that is consistent with the concept of equilibrium. Using the mathematical structure of the model under consideration,

it is possible to calculate parameter values for the model. As an example, assume that a model depicts consumption, C, as: C=mpc.Y where mpc is marginal propensity to consume and Y is income. A SAM would include consumption expenditures, C, and income, Y; hence the parameter of marginal propensity to consume would be mpc = C / Y. For the model above, a SAM has been constructed and employed for the calibration of model parameters.

The model is calibrated through a SAM based on year 2007. The year is chosen for two reasons. Firstly, the policy change to be examined is enacted in 2008. Thus calibrating the model to any year after 2007 would introduce the impact of the shock into the calibration process. Secondly, year 2008 or any year shortly thereafter implies the risk of distortionary behaviour due to the 2008-2009 crisis. Yeyati and Williams (2012) present evidence on the notion that there is a decoupling of emerging markets from the global markets in 2000s. There is evidence that the crisis spread to developing economies with a lag and the bankruptcy of the Lehman Brothers in the fall of 2008 being a crucial breaking point (Naude, 2009:8; Dooley and Hutchison, 2009; Köksal and Orhan, 2013; Dimitriou, Kenourgios and Simos, 2013; Mensi, Hammoudeh, Nguyen and Kang, 2016). Thus in order to evade the potential impact of a global crisis on the data, it is more preferable to choose 2007 as a point in time for calibration. Adopted parameter values based on calibration calculations are presented in Table 1.

Demographic dynamics are calibrated to replicate aggregate formal population and the shares of BK, ES and SSK members in the formal population. Population projections of TURKSTAT up to year 2025 are used to populate the economy. After 2025, age 1 cohort growth is stabilized to unity. These assumptions enable the replication of an ageing economy for the Turkish case.

In order to calibrate the age efficiency index profile, a pseudo-panel in the spirit of Deaton (1985) has been constructed from the Household Budget Surveys of 2003 to 2005. Following Fitzenberger (2002), an age polynomial and a number of cohort dummies were used to isolate pure age effects on wage income.

3. SIMULATION ANALYSIS

Given the calibration of the model to Turkish data, the model is numerically solved for both the steady state and the transition phase through a Gauss-Seidel type algorithm implemented in Matlab. The algorithm assumes the values of a variable in the model. Given that assumed value, the model is solved numerically and the assumed variable is recalculated. If the obtained value is equal to, or in the neighbourhood of, the assumed value, the model is solved and the results are reported. Otherwise, the initial guess is updated and the algorithm is repeated until convergence is obtained. In this study, the time path of the capital stock is guessed. Given the guess, the model is solved numerically. Solution of the model gives consumer saving behaviour and, therefore, a solution for the capital stock. If the obtained values for the time path of the capital are equal to the guessed values of the time path of the capital stock, the algorithm stops. Otherwise, the initial guess is changed and the algorithm is repeated until the calculated and the guessed capital stock values converge.

Conducted analysis focuses on the impact of the changes in the replacement and the contribution rates on consumer behaviour and social security system's sustainability. The logic of the shock on the parameters of interest is based on the change in the parameter values implied by the new laws. These ratios are presented in Table 2. The table shows that the new replacement rate for BK members is 80% of the old value; i.e. it has been reduced by 20%. Contribution rates have also fallen to 81% of their previous values. For private sector workers covered by SSK, contribution rates have not changed; hence, the relevant rates in the table are fixed at unity.

The parametric nature of the reform implies that the replacement rates have fallen for all the individuals covered by the social security institutions. This implies that the reform cuts down expenditures through lower replacement rates, hence lower pensions. This is a solid action to enhance the financial sustainability of the system. However, the reductions in contribution rates imply a reduction in revenues as well. The net impact on sustainability is unclear. There is also the impact of an ageing population, complicating the analysis even further. Thus the need for a general equilibrium type analysis becomes more obvious.

Table 2: Rate of Post-Reform Social Security Parameters to Pre-Reform Values

	BK (independent worker)	ES (public sector worker)	SSK (private sector worker)
Replacement rate	0.80	0.75	0.80
Contribution rate (partaker)	0.81	0.93	1.00
Contribution rate (employer)	NA	0.85	1.00

Source: Author's compilation. Pre-reform values are from Laws no 1479, 5434 and 506. Post-reform values are from Laws no 5510 and 5754. Replacement rate is calculated for 30 years of active participation. NA: Not Applicable.

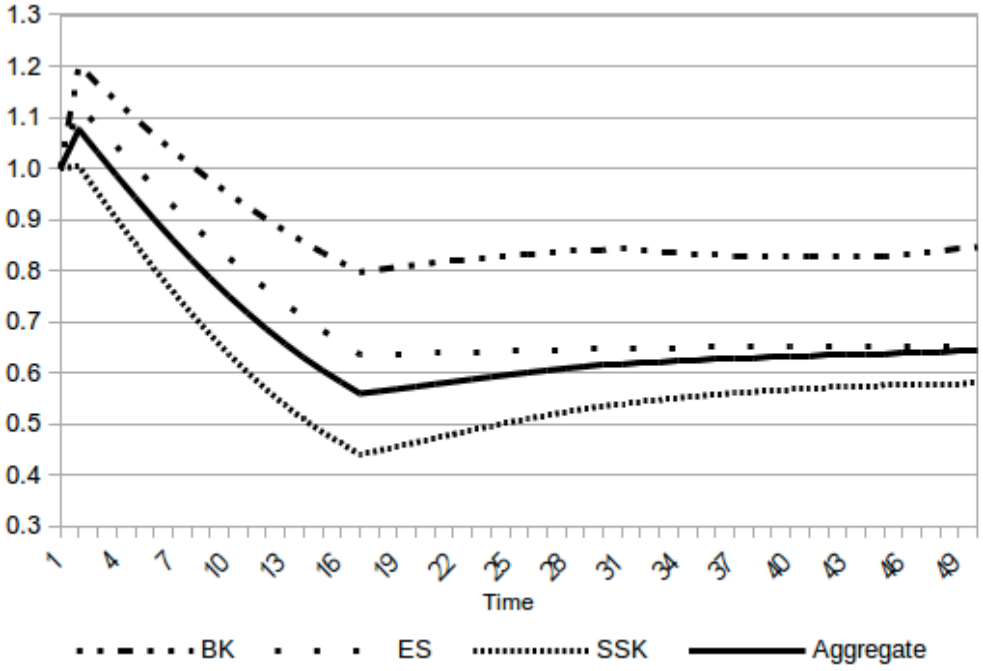
It should be noted that the simulation of the model has been conducted under the assumption of ageing population. That is, the model is always run with an ageing population as the economy moves towards a new steady state. Calculations with solely aging population and no reform have been observed to worsen the financial sustainability problems; however, these results are not reported here.

The parameter changes are added as further shocks on the ageing population. In what follows, the evaluation of the results is based on a comparison of the numerical results on an experiment path versus a benchmark path. Hence the reported values in figures are around unity. Anything greater than unity implies an increase under the new parameter values, and vice versa. Given this, we shall first consider the impact on financial sustainability. Then we shall move on to consider the impact of the reform on consumer well-being.

3.1 Impact on Financial Sustainability

As stated above, the change in parameter values has unclear implications regarding financial sustainability. The picture becomes clear with numerical simulations. Figure 2 shows the ratio of the deficits for all institutions on the simulation path to the deficits on the benchmark path, i.e. the path without reform. The time concept, as represented on the x-axis, is model time periods and can be thought of to extend from the calibration year of 2007 to the future.

Figure 2: Social Security Deficits: Ratio of Simulation Path to Benchmark Path



Source: Author's calculations.

It is obvious that the deficits initially increase due to the shock, and the reform actually worsens the financial sustainability problem in the short run. Specifically, compared to a case of no reform, deficit of BK actually increases by nearly 20% and the deficit of ES rises by 10%. The aggregate deficit of the social security system initially increases by about 10%, compared to a baseline scenario of no reform. Falls in deficits are experienced later on; therefore, any improvements in terms of financial sustainability are expected to come in the medium to long run.

What is the reason of the initial adverse impact? The reform actually has a design flaw. Replacement rates are reduced in order to decrease expenditures of the social security system. However, contribution rates are reduced as well. At the time of the reform, the reduction in contribution rates reduces the revenues of the system but the expenditures do not fall. The reason is, at the time of the reform, there are consumers who have retired before the reform with relatively high pensions. These people have earned the right to high pensions and their pensions do not fall with the reduced replacement rates. The new replacement rates apply to those who will retire *after* the reform. Hence the reform creates a group of retirees with high pensions,

preventing the reduction of social security system's expenditures. Deficits fall as these pre-reform pensioners exit the economy. Thus the reform should have included a delayed reduction in contribution rates to avoid the short run worsening of the system deficits.

3.2 Impact on Consumers

The consumer life cycle behaviour with humpback profiles is not impacted qualitatively by the reform. However, extremely adverse effects are observed shortly after the reform. The adversity is experienced by the consumers who are very close to retirement at the time of the reform. These consumers have planned their lifetime saving profile under a given set of parameters, among which is the replacement rate. But when the time to retire, i.e. age 15 in the model, comes, consumers receive an unexpected change in replacement rates. The new rates imply reduced pensions and therefore reduced retirement income. In the simplest terms, the budget sets of these consumer have shrunk. The reduced budget set is not sufficient to maintain a given consumption profile. Thus the consumers who are about to retire at the time of the reform face the necessity to reduce their consumptions for the rest of their lifetime, compared to a no-reform benchmark scenario.

This adverse impact is most noticeable for the consumers closer to retirement. For those at earlier stages of their life, there is sufficient time to adjust the saving profile to the new replacement rates and the implied reduced pensions. Thus the consumers who are at a relatively farther point from retirement in their lifetimes are less affected by the reform. Such effects are not observed on the consumers retired before the reform, or they simply receive a pension fixed prior to the reform.

As for the consumers born after the reform: These consumers prepare their lifetime consumption and saving plans with a full knowledge of the new parameters. Thus they adapt to the new parameters and increase their saving on the experiment path compared to the benchmark path. This increase in saving leads to higher capital formation and growth.

CONCLUSION

This paper conducts an analysis of the 2008 social security reform in Turkey. The analysis is based on numerical simulations conducted on a dynamic general equilibrium model formulated around an OLG model. Analysis reveals a serious design flaw in the reform: the simultaneous reduction of replacement rates and contribution rates does not ease the financial sustainability problem of the Turkish social security system. To the contrary, the deficits worsen in the short run and improve only in the medium to long run.

This adverse impact foreseen by the model is supported by the data. According to Fiscal Statistics section of the Monthly Statistical Bulletin of the Social Security Institute, transfers to the system from government budget have remained between 4% and 5% of national income. The ratio falls to 3% to 4% of national income if one considers the new national income series. But with the new series, the ratio increases to more than 4% as of 2016. If the reform is to have any positive impacts on social security system's deficits, these are yet to be observed in the aggregate data.

One other finding is the adverse impact of the reform on consumers very close to retirement at the time of the reform. Such adversity is due to reduced pensions, caused in turn by reduced replacement rates. The pension reductions enhance saving, a reaction by consumers trying to maintain a lifetime consumption profile. However, the increase in saving is not matched by the data. To the contrary, saving data from the Social and Economic Indicators of the Ministry of Development[1] show that private savings as a share of national income have been falling steadily during the two decades from late 1990s to mid-2010s.

This can be taken as a signal of myopia of consumers; i.e. their inability to plan for the long run. Hence in order to ensure sufficient retirement income, a supplementary saving system is necessary. In this context, the introduction of obligatory private pension plans can be considered as a serious supplementary policy action to prevent old age poverty. The potential impact of such a privatized system on the sustainability of the public PAYG pillar of Turkey remains to be investigated.

1 This data is available from the Ministry of Development web-page. Address: https://goo.gl/Wcc-6vA Access Date: March 20, 2018. For the mentioned saving data, see Table 2.6 The Shares of Total Domestic Savings and Gross Fixed Investments in GDP (1975-2014).

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