

AN OVERLAPPING GENERATIONS ANALYSIS OF
SOCIAL SECURITY REFORM IN TURKEY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ÇAĞAÇAN DEĞER

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN THE DEPARTMENT OF
ECONOMICS

JULY 2011

Approval of the Graduate School of Social Sciences

Prof. Dr. Meliha Altunışık
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy.

Prof. Dr. Erdal Özmen
Head of Department

This is to certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

Assoc. Prof. Dr. Ebru Voyvoda
Supervisor

Examining Committee Members:

Prof. Dr. Erinç Yeldan (Bilkent U., ECON) _____

Assoc. Prof. Dr. Ebru Voyvoda (METU, ECON) _____

Prof. Dr. Alper Güzel (OMU, ECON) _____

Prof. Dr. Serdar Sayan (TOBB-ETU, ECON) _____

Assoc. Prof. Dr. Şirin Saracoğlu (METU, ECON) _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: ÇAĞAÇAN DEĞER

Signature :

ABSTRACT

AN OVERLAPPING GENERATIONS ANALYSIS OF SOCIAL SECURITY REFORM IN TURKEY

Değer, Çağaçan

Ph.D., Department of Economics

Supervisor : Assoc. Prof. Dr. Ebru Voyvoda

July 2011, 178 pages

The aim of this study is to analyse the impacts of the social security system reform performed in Turkey within the first decade of the 2000s. Specifically, the effects of the parametric changes brought about by the reform in the retirement system are investigated. For the stated purpose, a 30-period overlapping generations (OLG) model has been constructed and a parametric social security system reform has been implemented within the constructed model. The results show that the reform causes increases in the deficits of the social security system in the short run, and reductions in deficits are possible only in the medium to long run.

Keywords: dynamic general equilibrium analysis, overlapping generations models, social security reform, retirement system

ÖZ

TÜRKİYE'DE SOSYAL GÜENLİK REFORMUNUN ARDIŞIK NESİLLER ANALİZİ

Değer, Çağaçan

Doktora, İktisat Bölümü

Tez Yöneticisi : Doç. Dr. Ebru Voyvoda

Temmuz 2011, 178 sayfa

Bu çalışmanın amacı 2000'lerin ilk on yılı içerisinde gerçekleştirilen sosyal güvenlik sistemi reformunun etkilerini analiz etmektir. Özellikle reformun emeklilik sisteminde ortaya çıkardığı parametrik değişikliklerin etkileri incelenmiştir. Bu amaca yönelik olarak 30 dönemlik bir ardışık nesiller (OLG, Overlapping Generations) modeli geliştirilmiş ve inşa edilen model çerçevesinde bir parametrik sosyal güvenlik reformu uygulanmıştır. Sonuçlar, reformun sosyal güvenlik sistemi açıklarının kısa vadede artmasına sebep olduğunu göstermektedir. Açıklarda azalma ancak orta ve uzun vadede mümkündür.

Anahtar Kelimeler: dinamik genel denge analizi, ardışık nesiller modelleri, sosyal güvenlik reformu, emeklilik sistemi

*to Özge, Almıla, Rasime and Atila
for being the sufficient condition of existence*

ACKNOWLEDGMENTS

I am deeply grateful to my thesis supervisor Assoc. Prof. Dr. Ebru Voyvoda. She has shown great patience to my tendency to diverge, and her guidance and support during all phases of this study was way beyond the call of duty.

I also would like to thank Prof. Dr. Erinç Yeldan, Prof. Dr. Alper Güzel, Prof. Dr. Serdar Sayan and Assoc. Prof. Dr. Şirin Saraçoğlu, for their precious contributions. Their discourses were perception enhancing for me not only in relation to thesis studies, but also in terms of being an academician.

During my stay as a graduate student and a research assistant, the members of the Department of Economics of METU have provided a most friendly environment to work in. Their comradeship has proven to be especially invaluable whenever this study appeared, at least to me, to be a harsh experience.

As a resident of METU, I have spent many years at the METU dormitories. During these years, I had the honour to make many precious friends. Their examples on friendship have simply made me a better human; for which I am most grateful and indebted.

I also would like to thank the members of the Department of Economics of Ege University for their never wavering support. I am especially grateful to Prof. Dr. Neşe Kumral. If she had not shown so much faith in me, I probably would not find the courage to take the first step in this study.

The most important thing my family taught me was to choose a path, or create one, and walk it. They have been most supportive on my path, and I know that they will continue to do so. I am most thankful for the freedom, and the wisdom they have provided on how to exercise the freedom.

And finally; thank you, Özge. You are a dream, of a precious stone, shining in a crystal clear creek flowing through a never ending forest, come true.

TABLE OF CONTENTS

PLAGIARISM	iii
ABSTRACT	iv
ÖZ	v
DEDICATION	vi
ACKNOWLEDGMENTS	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiv
CHAPTERS	
1 INTRODUCTION	1
1.1 Social Security in Turkey	1
1.2 Tools of Analysis: General Equilibrium and OLG Model	3
1.3 An Outline	5
2 SOCIAL SECURITY IN TURKEY: PAST AND REFORM	7
2.1 Origins of Social Security Institutions in Turkey	7
2.2 Problems of the Social Security System in Turkey	8
2.2.1 Budget Imbalances	9
2.2.2 Active/Passive Imbalances	9
2.2.3 Demographics	10
2.2.4 Inefficient Use of Revenues	12
2.2.5 Inefficiency in Contribution Collection	13
2.2.6 Early Retirement	15
2.2.7 Informal Employment	17

2.3	The First Reform Wave: Law no 4447 of Year 1999	19
2.4	The Second Wave: Laws no 5510 of Year 2006 and 5754 of Year 2008	23
2.5	Summary	26
2.5.1	Retirement Age	26
2.5.2	Working Life Average Income	27
2.5.3	Update Coefficient	27
2.5.4	Replacement Rate	27
2.5.5	Contribution Rate	28
2.5.6	Conclusion	28
3	A SIMPLE OLG MODEL AND DIRECTIONS FOR EXTENSION	30
3.1	A Two Period OLG Model	31
3.1.1	Consumer Behaviour	31
3.1.2	Production	33
3.1.3	Social Security System	34
3.1.4	Equilibrium	35
3.2	Avenues for Extension	36
3.2.1	Sources of Earnings	37
3.2.2	Bequest Motive	41
3.2.3	Age Variation of Wage Income	43
3.2.4	Saving Behaviour and Bequests	49
3.2.5	Government and Social Security Institutions	54
3.2.6	A Summary of Identified Extensions	54
4	AN OVERLAPPING GENERATIONS MODEL OF TURKISH SOCIAL SECURITY SYSTEM	56
4.1	OLG Model: A Review	56
4.2	The Model	60
4.2.1	Demographics	60
4.2.2	Consumer Behaviour	61
4.2.2.1	BK Consumer	62
4.2.2.2	ES Consumer	64

	4.2.2.3	SSK Consumer	66
	4.2.2.4	Bequests and Inheritance	67
	4.2.3	Production	67
	4.2.4	Social Security System	68
	4.2.5	Government and International Economy	70
	4.2.6	Equilibrium	71
	4.2.7	Macroeconomic Framework	73
4.3		SAM, Calibration and the Steady State	79
	4.3.1	Demographics	79
	4.3.2	Age Efficiency Indices and Labour Supply	82
	4.3.3	SAM Construction	89
	4.3.4	Calibration of Wages and Social Security Parameters	94
	4.3.5	Calibration of Preferences and BK Social Security Parameters	99
4.4		Solution for the Steady State	104
	4.4.1	Microeconomic Variables	105
	4.4.2	Social Security Results	107
	4.4.3	Summary	107
5		ANALYSIS OF AGEING POPULATION AND THE REFORM	109
	5.1	Effects of Ageing Population	110
	5.2	Analysis of the Social Security Reform	115
	5.2.1	The Parametric Social Security Shock	115
	5.2.2	Social Security Aggregates	117
	5.2.3	Fiscal Effects of the Reform	120
	5.2.4	Effects on Factor Prices	120
	5.2.5	Effects on Consumer Behaviour	121
	5.2.6	Capital Stock and Output	128
	5.2.7	Welfare Analysis	130
	5.2.8	A Summary of Results	132
6		CONCLUSION	134

REFERENCES	138
----------------------	-----

APPENDICES

A	Mathematical Appendix	144
A.1	Derivation of the Economy Resource Constraint	144
A.2	Confirmation that Saving/Investment and Asset Return Accounts of SAM Balance	147
A.3	Population and Labor Growth	148
A.3.1	Population Growth	148
A.3.2	Labor Growth	150
A.4	Consumer Decision Growth and Aggregate Variable Growth	151
A.4.1	Asset stock of consumer to physical capital	151
A.4.2	Physical Capital to Factor Prices	151
A.4.3	Factor Prices to Budget Constraint and Income	152
A.4.4	A Digression on Consumption	153
A.4.5	Equality of Saving and Consumption Growth	153
A.4.6	From Saving Growth Back to Asset Decision Growth	154
A.4.7	Summary: Steady State Growth Rates	154
B	Data Appendix	156
B.1	Definition of Income Subitems	156
B.2	SAM in Levels	158
C	Curriculum Vitae	159
D	Turkish Summary	162

LIST OF TABLES

TABLES

Table 2.1	Social Security Deficits as Percentage of GDP: 1996-2003	9
Table 2.2	Active/Passive Ratios	10
Table 2.3	Basic Demographic Information	11
Table 2.4	Accrued vs Realised Contribution Payments	14
Table 2.5	Age Distribution of Pensioners in 2007	15
Table 2.6	Age Distribution of BK Pensioners 1994-2005	16
Table 2.7	Status in Employment (%)	18
Table 2.8	Retirement Age of Women by Law no 4447	20
Table 2.9	Pension Parameters After Law no 4447	22
Table 2.10	Parameters of Pension System by Laws no 5510 and 5754	25
Table 3.1	Number of High Age Individuals in Data	41
Table 3.2	Cohort Structure in 2003 and 2005 Datasets	45
Table 4.1	Social Accounting Matrix	75
Table 4.2	Social Security Population in 2007	81
Table 4.3	Age Efficiency Indices	87
Table 4.4	Shares of Saving and Consumption by Social Security Institution Membership	90
Table 4.5	The SAM: Available Data and Calculated Elements	91
Table 4.6	Balanced SAM as Percentage of GDP	95
Table 4.7	Calibrated Parameters	97
Table 5.1	Introduced Parameter Shock: Method	116
Table 5.2	Introduced Parameter Shock: Values	116

Table B.1 SAM Elements in millions of 1998 TL	158
---	-----

LIST OF FIGURES

FIGURES

Figure 2.1	Annual Population Growth Rate with Projections	11
Figure 3.1	Shares of Wage and Asset Income in Aggregate Income	40
Figure 3.2	Life Cycle Distribution of Real Wage and Asset Income	42
Figure 3.3	Age Effects on Wage for ES Members	47
Figure 3.4	Cohort Effects on Wage for ES Members	47
Figure 3.5	Age Effects on Wage for SSK Members	48
Figure 3.6	Cohort Effects on Wage for SSK Members	48
Figure 3.7	Age Effects on Saving Rate for BK Members	50
Figure 3.8	Cohort Effects on Saving Rate for BK Members	50
Figure 3.9	Age Effects on Saving Rate for ES Members	52
Figure 3.10	Cohort Effects on Saving Rate for ES Members	52
Figure 3.11	Age Effects on Saving Rate for SSK Members	53
Figure 3.12	Cohort Effects on Saving Rate for SSK Members	53
Figure 4.1	Aggregate Population by Social Security Membership	82
Figure 4.2	ES Cohort Effects from Age Efficiency Regression	84
Figure 4.3	ES Age Efficiency Polynomial	84
Figure 4.4	SSK Cohort Effects from Age Efficiency Regression	85
Figure 4.5	SSK Age Efficiency Polynomial	85
Figure 4.6	Private Labour Supply by SSK Members	88
Figure 4.7	Number of Active SSK Members	88
Figure 4.8	Steady State Consumption Decisions of Representative Consumers	106

Figure 4.9	Steady State Asset Stock Decisions of Representative Consumers	106
Figure 5.1	Aggregate Population Growth Rate	111
Figure 5.2	Social Security Deficits in 1998 TLs	112
Figure 5.3	Per Effective Worker Revenue and Expenditure of BK Institution	112
Figure 5.4	Per Effective Worker Revenue and Expenditure of ES Institution	113
Figure 5.5	Per Effective Worker Revenue and Expenditure of SSK Institution	113
Figure 5.6	Rate of Social Security System's Aggregate Deficit to Output	114
Figure 5.7	Tax Rate	114
Figure 5.8	Rate of Experiment Path Social Security Deficits to Base Path	118
Figure 5.9	Pension Receipt of Representative BK Consumer on Experiment Path	118
Figure 5.10	Pension Receipt of Representative ES Consumer on Experiment Path	119
Figure 5.11	Pension Receipt of Representative SSK Consumer on Experiment Path	119
Figure 5.12	Ratio of Tax Rate on Experiment Path to Tax Rate on Base Path	120
Figure 5.13	Ratio of Factor Prices on Experiment Path to Factor Prices on Base Path	121
Figure 5.14	Ratio of BK Consumer Consumption Decisions on Experiment Path to Base Path	123
Figure 5.15	Ratio of ES Consumer Consumption Decisions on Experiment Path to Base Path	123
Figure 5.16	Ratio of SSK Consumer Consumption Decisions on Experiment Path to Base Path	124
Figure 5.17	Growth Rate of BK Consumer Age 1 Consumption Decisions Along the Experiment Path	124
Figure 5.18	Ratio of BK Consumer Asset Stock Decisions on Experiment Path to Base Path	126
Figure 5.19	Ratio of ES Consumer Asset Stock Decisions on Experiment Path to Base Path	126
Figure 5.20	Ratio of SSK Consumer Asset Stock Decisions on Experiment Path to Base Path	127

Figure 5.21 Ratio of Age 2 SSK Consumer Asset Stock Decisions on Experiment Path to Base Path	127
Figure 5.22 Ratio of Capital Stock on Experiment Path to Base Path	129
Figure 5.23 Ratio of Output on Experiment Path to Base Path	129
Figure 5.24 Ratio of Remaining Lifetime Utilities on Experiment Path to Base Path . .	131
Figure 5.25 Ratio of Lifetime Utility on Experiment Path to Base Path	131
Figure 5.26 Ratio of Social Welfare on Experiment Path to Base Path	132

CHAPTER 1

INTRODUCTION

Social security systems have been a rising interest for both developed and developing countries during the last two decades. Primarily concerned with financial sustainability, governments have gone ahead with reforms on social security systems. Turkey has not been an exception to this reform wave. The Turkish pension reform introduced within the first decade of the 2000s is the focus of this thesis.

The analysis starts with a brief exposition of the evolution of the social security system in Turkey. Then the research question is presented, followed by a discussion on the method of analysis. The introduction is concluded by an outline of the rest of the analysis conducted.

1.1 Social Security in Turkey

Until recently, the social security system in Turkey was formed around three major social security institutions: BK (Social Security Organization for Artisans and the Self-Employed, Esnaf ve Sanatkarlar ve Diğer Bağımsız Çalışanlar Sosyal Sigortalar Kurumu), ES (Retirement Fund, Emekli Sandığı), and SSK (Institute of Social Insurances, Sosyal Sigortalar Kurumu). One major difference among these institutions was their coverage in terms of employment status of partakers.

Of these institutions, the first to be officially founded was ES. By Law no 5434 that went into effect in 1950, ES was founded to provide retirement support and health insurance to public servants and military personnel. The institution was designed to ensure social security to their relatives in case the insured individual dies. In accordance with Law no 5434, the major items of expenditure of ES are retirement benefit payments and health expenditures.

These expenditures are financed by contributions paid by partakers and employers, which are primarily public institutions.

Even though there existed a number of social security regulations related to labourers in the private sector, these were not brought together until 1960s. These regulations were brought together in mid 1960s due to the principles laid down by the 1961 Constitution and the First Development Plan adopted in 1963 (Özbek, 2006). The result was Law no 506, which went into effect in 1965 and formed the foundation of SSK. The major contribution of the law was to bring together the existing legislation on social security of labourers and expand the system's coverage by defining everyone that works under a service contract as a partaker. By late 1970s, the coverage of SSK was extended to include agricultural workers and providers of home services. The major income items of SSK were defined to be contributions paid by labourers and employers. Expenditures consisted of benefit payments and health expenditures.

According to Özbek (2006), also outlined in the First Development Plan was the foundation of a social security institution to cover artisans and the self-employed individuals. This structure was realized in 1971 by Law no 1479 that formed the legal basis of BK. Initially focused on covering retirement and disability related benefits, the structure of BK was changed in 1985 to cover health expenditures as well. While these payments form the expenditure items of BK, the major source of income is the contribution receipts from partakers.

Despite initial surpluses, the social security institutions began to run deficits by early 1990s. Figure 7.6 of TURKSTAT (2009) shows that expenditure coverage of the social security system was above 100% up to year 1992. In 1993, the coverage falls to 92.5% and falls steadily in the following years. In year 2004, only 66.4% of expenditures of the social security institutions are covered by the collected revenues.

The deficits were covered by the government. The data on transfers from the consolidated budget of the government to the social security institutions can be obtained from the website of the General Directorate of Budget and Fiscal Control, Ministry of Finance. The data shows that in 1990, the transfers were 0.3% of GDP, increased steadily during the 1990s and reached 4.34% of GDP in year 2003. State Planning Organisation's Social and Economic Indicators 1950-2010 shows that total budget transfers to social security institutions reached 5.53% of GDP in 2009. Hence in the last two decades, social security institutions ended up as considerable expenditure items on the government budget.

It was mainly such sizeable deficits that led to a reform in the social security system of Turkey. The reform was conducted in two parts. The first part was Law no 4447 of 1999. The main effect of this law was to increase the retirement age in Turkey. The result of the second part, completed after 2005, was the foundation of SGK (Sosyal Güvenlik Kurumu, Social Security Institution) that gathered the three major social security institutions, BK, ES and SSK, under a single institution. The aim was to unite the members of these institutions under common rules of social security. Major contributions of the reform process were to change retirement age, to introduce new pension calculation methods and to change replacement and contribution rates.

The aim of this study is to analyse the effects of social security reform in Turkey. One question that needs an answer is whether the reform is adequate for financial self sufficiency of the social security system. Will the deficits decrease through time, or will transfers to social security institutions continue to be a major item on government budget? Another question that needs to be addressed is the welfare impact of the performed reform from a generational perspective. Will future generations be better off or worse off? How will the well-being of the society evolve? This text aims to address these questions.

1.2 Tools of Analysis: General Equilibrium and OLG Model

The analysis in this thesis focuses not only on the evolution of macroeconomic variables but also on the changes in micro behaviour. As such, it requires a framework that integrates not only the micro behaviour displayed by agents and the macroeconomic state of the economy but also the linkages between micro and macro layers, requiring, in turn, a tool that captures the interconnectedness of the economy as in a general equilibrium model.

Construction of a general equilibrium model can be thought of summarizing an economy with a number of equations. At the core of the model is the specification of agent behaviour. In a standard setup, a general equilibrium model may include consumers that optimize utility gained from consumption subject to their budget constraints. Such a static optimization problem would yield optimal consumption as the result. Also, one may include production by a representative firm in order to account for supply of output and demand for factors of production. The factor incomes generated by production are to be allocated to the consumer in accordance with the specified consumer budget constraint.

Such a construct can be used to observe the effects of various shocks on the economy. For example, a positive technology shock may be introduced to the firm's production function in order to analyse the effects of technological progress. Still, such a construct needs to be further improved in order to be of use in this research.

Two points related to the modelling concerns need to be made at this point. Firstly, the constructed model needs to be dynamic in nature so that it is possible to observe the effects of shocks or policy changes through time. A number of approaches are possible to come up with a dynamic model. One can change the values of model parameters or exogenous values through time. In essence, this is solving a static model for a number of times. For a truly dynamic structure, one needs to introduce dynamism into agent behaviour. The standard approach is to introduce a time perspective to the consumer. That is, the representative consumer is assumed to maximize lifetime utility subject to available lifetime resources.

Introduction of time to the consumer problem may take two forms. The first approach assumes that the consumer lives for an infinite number of time periods. A textbook example for such models is the Ramsey-Cass-Koopmans model. The second approach assumes that the consumer lives for a given number of time periods, and then dies. The standard in limited lifetime models is the OLG (overlapping generations) model. Both approaches include maximization of lifetime utility subject to lifetime resources.

The second modelling concern is the need to account for the age variation of individuals at a given time period. The Turkish retirement system is a PAYG (pay-as-you-go) system where current contributions to social security system are used to pay the current benefits to retirees. Therefore, the model needs to include individuals that are at different stages of life at a given time period. Specifically, the model has to represent the coexistence of both actives, the people paying contributions to the social security system, and the passives, the people receiving pensions from the system, at a given time period.

The framework that accounts for both these modelling concerns is the OLG (overlapping generations) model. The OLG model is based on a representative consumer with a finite lifetime. Utility is maximized by the representative consumer subject to lifetime budget constraint. At any given time period, a number of new consumers are born to coexist with older consumers and a number of consumers die and leave the economy. The OLG model addresses the modelling concerns in this study by introducing the needed dynamic consumer behaviour and

presents age variation at a given time period. Hence the OLG model is chosen to be the core of the methodology adopted in this study.

1.3 An Outline

In the following chapter, development of the social security system in Turkey is described, along with its major problems. The social security reform process in Turkey is also described in this chapter, with an emphasis on the changes in the parameters of the social security system.

Following this, Chapter 3 first provides a brief literature survey on OLG models. Then a simple OLG model with social security is constructed for illustrative purposes. This discussion is followed by notes on the shortcomings of a simple OLG model given the research question and the directions to which the basic model should be extended. The proposed extensions are supported by the available relevant data.

Under the light of Chapter 3, Chapter 4 presents the construction of a relatively large scale OLG model. The model includes three representative consumers. Each consumer is assumed to represent the members of one social security institution; i.e. BK, ES or SSK. In turn, each social security institution is defined with different budget specifications and different social security parameters. The deficits of the social security institutions are covered by the government that collects taxes and borrows from domestic and foreign sources. The constructed model is calibrated to year 2007 Turkish data and then run to obtain results for the steady state.

Chapter 5 follows with the analysis of a parametric social security reform. First, the effects of the ageing population are briefly discussed. It is observed that the ageing population causes increases in the expenditures of the social security institutions, for the share of passive members in the social security system increases. The need to finance the increasing deficits of the social security system forces the government to increase the tax rate.

This analysis is followed by an examination of a parametric shock that includes decreases in contribution and replacement rates. It is observed that the introduced shock creates three subgroups of each representative consumer. The first group consists of the consumers born

and retired before the shock. The second group includes the consumers born before the shock and retired after the shock. Members of the third group are the consumers born and retired after the shock.

Calculation of the time path taken by the variables of the model points out the importance of the pension received by consumers born and retired before the shock. Since this group receives a pension calculated using high replacement rates, they constitute a non-decreasing expenditure item for the social security system. On the other hand, the contribution rates fall as part of the shock, causing revenues of the institutions fall. Hence the social security deficits increase in the short run and fall below the initial steady state values only in the medium to long run.

The reduced replacement rates imply low pensions which, in turn, force the consumers to save more in order to finance retirement. The increased savings cause higher capital stock accumulation. Increasing capital stock leads to higher output. Thus it is concluded that the shock has expansionary effects.

Conducted welfare analysis shows that, of the consumers who were alive when the shock was introduced, the representative consumers closest to retirement at the time of the shock are worst effected. Examination of the transition path of the representative consumers' indirect utility function values, from pre-shock steady state to post-shock steady state, shows that public workers, i.e. consumers covered by ES, are worst effected from the shock. The society as a whole experiences welfare losses in the short run, but there are gains in the medium run. Results of the conducted analysis are summarised in Chapter 6, which concludes by pointing to potential avenues for extending this study.

CHAPTER 2

SOCIAL SECURITY IN TURKEY: PAST AND REFORM

The aim of this chapter is to present a historical review of social security in Turkey with an emphasis on the retirement pension regulations. The text starts with the identification of historical origins and proceeds to examine how the social security system evolved until late 1990s. Then the social security reform in Turkey from 1999 to 2008 is reviewed with reference to the related laws. The chapter concludes with a summary of changes in the social security parameters, i.e. replacement rates and contribution rates, and the new pension calculation method introduced by the reform laws.

2.1 Origins of Social Security Institutions in Turkey

The current structure of Turkish social security system did not come into being until after the World War 2. Prior to 1950, existing legislature on social security was primarily related to civil servants and labourers. However, this legislature was considered fragmented. The segmented structure that related to civil servants was united in 1950, by the foundation of ES (Emekli Sandığı). Founded by Law no 5434 in 1950, ES primarily covers public workers and civil servants and could be regarded as a conclusion of a segmented system that dates back all the way to mid 19th century (Özbek, 2006, p.251)

Starting with the 1960s, the institutionalisation of the Turkish social security system gained pace. Article 48 of the 1961 Constitution defined social security as a universal right and charged the state with the responsibility to establish the necessary institutional framework to provide social security to citizens. The principle was reflected in the First 5 Year Development Plan as well. It was stated in the first plan that industrialisation and urbanisation would

increase the need for social security (SPO, 1963, p.66). Thus one of the stated aims in the 1st 5 Year Development Plan was the establishment of a general social security system in 15 years (SPO, 1963, p.109-110).

In accordance with these principles, SSK (Social Insurance Institution, Sosyal Sigortalar Kurumu) was founded in 1964 by the Social Insurance Act, Law no 506. The main contribution of this law was to bring the existing fragmented social security structure related to labourers together and can be regarded as a continuation of İşçi Sigortaları Kurumu (Labourer Insurance Institution) that was formed in 1945 by Law no 4792. The partakers of SSK were defined as anyone who works under a service contract. In 1971, Law no 1479 founded BK (Bağ-Kur, Social Security Institution of Craftsmen, Tradesmen and Other Self-Employed People) to cover self-employed individuals.

The created structure of social security was formulated around three social security institutions; BK, ES and SSK. These institutions were supplemented by a variety of much smaller structures that provide insurance to the individuals working in banks, insurance companies, trade chambers and stock markets. Stated to be typical of Southern European welfare regimes (Buğra & Keyder, 2006, p. 212), this fragmented structure has caused differences in benefits provided by the institutions. Of these three institutions, ES is regarded to provide the most comprehensive social security whereas BK is stated to have a limited scope (Özgür, 2008, p.36).

Coverage of these institutions broadened through time and various practices changed by a number of laws and regulations. Even though the system was self-sufficient for a number of decades, problems began to arise in 1990s. The institutions began to run deficits continuously and these deficits increased in size. We next examine the various problems faced by the social security system in Turkey.

2.2 Problems of the Social Security System in Turkey

Turkish social security system has been experiencing a number of problems since early 1990s. The task undertaken in this section is to briefly review these problems. The conducted review has been supported with relevant data whenever possible.

2.2.1 Budget Imbalances

The social security institutions were able to run at least balanced budgets for some time. The funds created by these institutions were even used as a source of domestic saving during the 1970s (Akyüz, 2008, p.82-85). However, by 1990s, these institutions began to run deficits. These deficits were financed by transfers from the government budget.

Data on the transfers from the consolidated budget of the government to the social security institutions can be obtained from the website of the General Directorate of Budget and Fiscal Control, Ministry of Finance. The data shows that these transfers increased from 0.31% of GDP in 1990 to 1.37% of GDP in 1995. Table 2.1 presents, from different sources, the deficits of the social security system as percentage of GDP. The increasing trend in social security deficits continues in the second half of the 1990s and reaches 3.42% of GDP according to Social and Economics Indicators: 1950-2010 of SPO. By 2009, the transfers to social security reach 5.53% of GDP. These deficits, financed by transfers from the government budget, were regarded as one of the major signals that social security needed restructuring.

Table 2.1: Social Security Deficits as Percentage of GDP: 1996-2003

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BK	0.33	0.58	0.76	0.72	0.69	0.62	0.74	1.16	NA	NA	NA	NA	NA	NA
ES	0.28	0.42	0.38	0.65	0.85	1.02	1.36	1.39	NA	NA	NA	NA	NA	NA
SSK	1.25	1.34	1.20	1.48	0.53	1.07	1.33	1.59	NA	NA	NA	NA	NA	NA
Total	1.86	2.34	2.34	2.86	2.07	2.70	3.43	4.14	NA	NA	NA	NA	NA	NA
Budget Transfers to Social Security	1.69	1.96	1.99	2.63	1.94	2.34	2.85	3.42	3.38	3.58	3.02	3.92	3.70	5.53

Source: For BK, ES and SSK rows, deficit data is from Table 5 of Telli (2004). GDP figures are from TURKSTAT (2009). The total row is author's calculation. Budget transfer data is from SPO's Economic and Social Indicators: 1950-210, Chapter 5, Table 43. NA represents data not available in Telli (2004).

2.2.2 Active/Passive Imbalances

An other serious imbalance in the social security system is the path of active/passive rate during 1990s, presented below in Table 2.2. The active/passive rate measures the ratio of active

members, the members that pay contributions to the corresponding institution, to the passive members, the beneficiaries of the system.

Table 2.2: Active/Passive Ratios

Active/Passive Ratio										
	1989	1993	1995	1996	1997	1998	1999	2003	2004	2005
BK	5.1	3.7	3.03	2.8	2.72	2.63	2.6	2.34	2.27	2.1
ES	1.9	1.8	1.97	1.87	1.79	1.77	1.69	1.64	1.57	1.51
SSK	2.4	2.3	2.41	2.36	2.33	2.29	2.21	1.66	1.63	1.72

Source: Data for years 1989 and 1993 are from Table 17 of SPO (1995, p.113). Data for years 1995 and 1999 are from Table 22 of SPO (2000a, p.108). Data for years 1996, 1997 and 1998 are from Table II-21 of SPO (2000b, p.116). Data for years 2003, 2004 and 2005 are from Table 1 of SPO (2007, p.9).

In Table 2.2, a steady decline in active/passive ratio is evident. This fall implies that a given working partaker of the social security who pays contributions now has to cover the costs of more individuals within the system. Given the parameters of the system, the social security institutions need to reduce expenditures and increase revenues to cope with both increasing deficits and falling active/passive rates.

2.2.3 Demographics

The Turkish population has been regarded young relative to developed countries. But the population growth rate projections of TURKSTAT show that, within the first half of the 21st century, Turkish population will get older. Figure 2.1 and Table 2.3 below underline the situation.

For the 15 years covered in Table 2.3, life expectancy is observed to be increasing whereas infant mortality rate is falling. Both total fertility and population growth rates are showing a steady decline. All these observations indicate that the population will get older.

TURKSTAT also has demographic projections based on the Address Based Population Registration System. These projections are displayed in Figure 2.1 and confirm the expectation that population growth rate tends to fall. Thus it is expected that in the future, a higher proportion of the population will be of relatively higher ages.

Table 2.3: Basic Demographic Information

	Life Expectancy at Birth (Year)	Infant Mortality Rate (‰)	Total Fertility Rate (Number of Children)	Population Growth Rate (‰)
1990	67,4	51,5	2,9	17,0
1991	67,7	50,1	2,9	16,6
1992	68,1	48,9	2,8	16,3
1993	68,5	47,6	2,8	16,0
1994	68,8	46,4	2,7	15,7
1995	69,2	45,2	2,6	15,4
1996	69,6	42,9	2,6	15,0
1997	70,1	39,6	2,5	14,7
1998	70,3	38,6	2,5	14,4
1999	70,7	34,9	2,4	14,1
2000	71,0	31,5	2,4	13,8
2001	71,4	28,4	2,3	13,5
2002	71,8	25,6	2,3	13,2
2003	72,1	23,1	2,3	12,9
2004	72,5	20,9	2,2	12,6
2005	72,9	18,9	2,2	12,3
2006	73,2	17,5	2,2	12,1

Source: TURKSTAT Population and Development Indicators; <http://nkg.die.gov.tr/>; Access date: 21 July 2010.

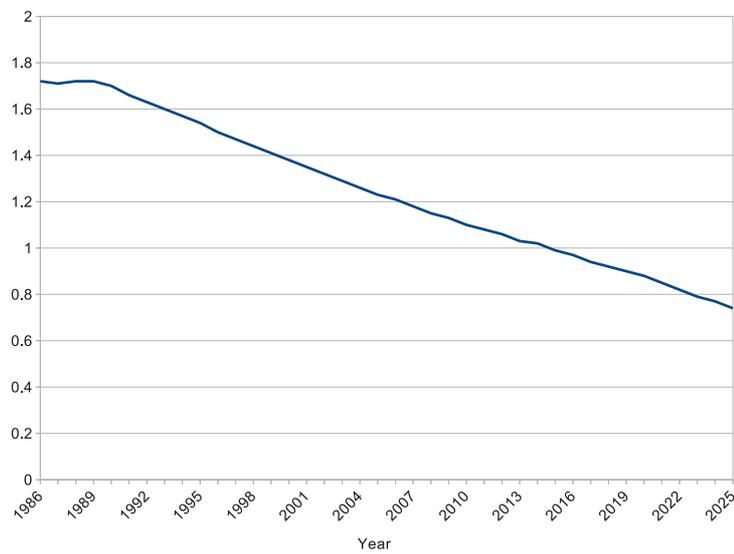


Figure 2.1: Annual Population Growth Rate with Projections

Source: Author's graph based on TURKSTAT Population Statistics and Projections; http://www.turkstat.gov.tr/VeriBilgi.do?tb_id=39&ust_id=11; Access Date 21 July 2010.

Such an ageing process is expected to have adverse effects on the social security system. As the population becomes older, the number of passives are expected to increase and the active/passive rate would fall even further. Given contribution rates, the social security institutions would not be able to cope with the increases in expenditures.

2.2.4 Inefficient Use of Revenues

One of the issues frequently raised about social security is that social security institutions were able to operate with surpluses prior to 1990s. However, the funds accumulated through these surpluses are claimed to be mismanaged.

Relevant legislation enables social security institutions to accumulate asset stocks. Article 20 of Law no 4792 states that SSK can use the available revenues excess of expenditures to deposit in national banks, to purchase government bonds, to engage in residential construction for the passives who receive disability pension and old age pension or to acquire partnerships in enterprises or found enterprises. Article 22 of Law no 5434 states that ES may acquire real estate, invest in government bonds, acquire stock exchange or make deposits in public banks. Article 16 of Law no 1479 allows BK to acquire real estate, obtain government bonds and deposit in public banks in addition to acquire shares of private enterprises.

Tables in SPO (1972, p.802-803) and SPO (1979, p.141-142) show that the funds accumulated by ES and SSK were primarily deposited in banks or were used to purchase government bonds. The funds accumulated by BK in 1970s were also placed in bank deposits or used to acquire government bonds. The BK funds have been used to finance work place construction credits (SPO, 1979, p.142). Thus the funds accumulated by the social security institutions were primarily used to finance the government or the private sector. Especially SSK funds were used heavily to finance infrastructure investments and state economic enterprises; final destination of these funds, however, was the private sector (Akyüz, 2008, p.83-100).

PETROL-İŞ (2005) claims that at least SSK funds were used through the DYB (Devlet Yatırım Bankası, State Investment Bank) as a source for domestic savings and received inadequate return, especially in the 1970s. However, if the accumulated funds of SSK had been invested with a 2% real return as of 1960, by the end of 1997 SSK would have more than \$20 billion in resources (Özgür, 2008, p.46). Duygulu and Pehlivan (2004, p.43) calculates that

SSK funds received a return of 7.7% in 2000, 8.8% in 2001 and 6.8% in 2002. Given that inflation was well over 10% in those years, these returns are quite inadequate in real terms. Findings along these lines have led to the conclusion that the resources gathered by the social security institutions were primarily used, at low interest rates, to finance the public sector or the private sector through credit channels of the public banks. Such disregard for actuarial perspective lays the foundation for the claim that the social security institutions were financially mismanaged.

2.2.5 Inefficiency in Contribution Collection

One of the problems facing the social security system is the inability of the system to collect all of the accrued contributions. As an example, Tuncay and Alper (1997, p.88) states that for SSK the rate of collected contributions to accrued contributions has fluctuated between 70% and 80% and never reached 100%. The data on the issue is limited; nevertheless, a fragmented picture has been presented in Table 2.4.

The table shows that the ratio of realised contribution collections to accrued amounts for SSK and BK. The first two columns, SSK-1 and SSK-2, differ only with regard to data source and have been presented to enable reader awareness. The table supports the claim that social security institutions are unable to collect all the accrued contributions. One may assume, with a most optimistic approach, that there 10 to 15% uncollected contribution.

McGillivray (2001, p.10) reports a number of comparison points for evasion of contribution payment. For the US, 10% of total contribution liabilities were not paid in 1997 (Manchester, 1999, p.302-303). In 1996, 1.4% of the employers are reported to have defaulted on contributions in Singapore (CPF, 1996, p.43). The defaulting rate was 4% in 1996 and 1997 in Malaysia (EPF, 1997, p.22). For the Russian Federation, the contribution gap is estimated to be 26% in 1997 (Cichon, 1999). The contribution evasion in Turkey is not the worst one, but nonetheless there is considerable revenue leakage.

This contribution evasion problem is usually laid upon two reasons. Firstly, the social security system has limited personnel for inspection purposes. Duygulu and Pehlivan (2004, p.48) reports that as of 31 December 2002, Review Committee of SSK has only 249 inspectors and 100 deputy inspectors on active duty. This personnel was responsible for the auditing of

777,177 business establishments in 2003. Comprehensive auditing with such limited personnel would be difficult to perform.

The second item is recurrent amnesties throughout the 1990s and 2000s related to the social security system. The examples of amnesties abound. A default contribution amnesty in 1992 Law no 3780 pardons the debts of BK participants in 1991 and before. Law no 4247 dated 1997 enables payment of old debts in 10 instalments and pardons 50% of the fines for default. In 2001, indebted participants are allowed to pay delayed contributions in 18 instalments with 3% default fine. More recently, in 2006, Law no 5458, has enabled restructuring the default contributions. The latest example is Law no 6111, which went into effect in February 2011 and included an other restructuring opportunity for the unpaid social security contributions.

Such recurring amnesties and low inspection capabilities create moral hazards. For US, Luitel and Sobel (2007) finds that repeated tax amnesties create revenue losses related to disincentives for long term compliance. Though research on repeated social security amnesties is virtually non-existent, similar dynamics can be assumed to hold for social security contribution evasion. In the Turkish case, the possibility of getting caught while avoiding obligations is low. Even if debt to the social security institutions accumulates, probability of an amnesty is considered high. Thus participants evade meeting the obligations of the social security system and revenue contribution falls.

Table 2.4: Accrued vs Realised Contribution Payments

	SSK-1	SSK-2	BK
1993	74.42	74.4	55
1994	72.05	75.2	64
1995	81.35	81.4	74
1996	85.3	85.3	55
1997	85.44		
1998	84.52		
1999	79.11	84.5	56
2000	84.37		
2001	81.67		
2002	82.26		

Source: Column SSK-1 is from Table 3 of Duygulu and Pehlivan (2004, p.25). Columns SSK-2 and BK have been compiled from SPO (2000a, p.107), SPO (1995, p.111), SPO (1997, p.183) and SPO (1998, p.223)

Table 2.5: Age Distribution of Pensioners in 2007

	ES Pensioners	BK Pensioners	SSK Pensioners
0-39	0.73%	0.00%	0.25%
40-44	2.39%	0.30%	2.55%
45-49	10.94%	6.45%	15.99%
50-54	24.77%	12.10%	21.31%
55-59	21.41%	17.76%	20.09%
60-64	15.13%	17.32%	14.91%
65-69	9.82%	15.70%	11.31%
70-74	6.30%	15.11%	7.36%
75+	8.51%	15.27%	6.23%

Source: Author's calculations based on data compiled from BK Annual Statistics, Table 14; ES Annual Statistics, Table 6; SSK Annual Statistics, Table 68. Data is available at <http://www.sgk.gov.tr/wps/portal/Anasayfa/Istatistikler>, Access Date: 24 July 2010.

2.2.6 Early Retirement

One of the reasons for the difficulties confronting the social security system is identified as the early retirement problem. For SSK, the founding law sets the retirement age to 60 for both men and women. This age criteria was lowered in 1965 by Law no 506 to 55 for women but maintained at 60 for men. The age limit was further decreased by Law no 1186 in 1969 to 50 for women and 55 for men, but was once more increased to 55 for women and 60 for men by Law no 3246 of 1985. However, the age criteria was removed by the Law no 3774 passed in year 1992. By this law, entitlement to retirement pension became conditional upon being an active member for 20 years in the case of women and 25 years in the case of men. Thus a woman who entered the system at the age of 18 would be able to retire at age 38; a man would be able to retire at age 43.

The effect of such legislation is evident in data as well. Table 2.5 presents the age distribution of BK, ES and SSK beneficiaries. The striking point is that in 2007 more than 50% of retirement pension recipients of ES and SSK are aged 59 and below. For BK, the rate is observed to be more than 35%.

Table 2.6 presents the evolution of BK pensioners' age distribution through time. The striking point here is that through the considered time period, the share of BK pensioners aged 45-59 in all BK pensioners has increased steadily from 23% in 1994 to 32% in 2005.

Table 2.6: Age Distribution of BK Pensioners 1994-2005

	45-49	50-54	55-59	60-64	65-69	70-74	75+
1994	0.21%	1.04%	21.73%	34.42%	23.04%	11.35%	8.17%
1995	0.50%	1.76%	20.92%	32.55%	23.46%	12.41%	8.34%
1996	2.20%	4.38%	18.87%	30.00%	22.92%	13.09%	8.47%
1997	2.58%	5.45%	17.94%	27.55%	23.49%	13.98%	8.83%
1998	3.04%	6.89%	16.47%	23.76%	25.72%	14.51%	9.31%
1999	3.16%	7.62%	16.18%	21.43%	29.59%	16.83%	4.88%
2000	3.09%	8.07%	16.70%	21.18%	29.02%	16.70%	4.90%
2001	3.28%	8.09%	17.17%	20.18%	29.13%	16.87%	4.98%
2002	3.45%	8.09%	16.14%	19.72%	29.79%	17.35%	5.14%
2003	3.65%	8.28%	16.85%	18.61%	29.66%	17.40%	5.20%
2004	4.10%	8.56%	17.49%	18.03%	18.38%	19.20%	13.87%
2005	5.25%	9.61%	17.45%	17.42%	17.87%	17.66%	14.44%

Source: Author's calculations based on data compiled from <http://www.sgk.gov.tr/wps/portal/Anasayfa/Istatistikler>, Access Date: 23 July 2010. Data is under the link of "Time Series". See Tables 16 and 17 on data for age distribution of BK pensioners under the Laws no 1479 and 2926.

These observations may not be of much meaning without the context of lifetime expectation. According to WDI (World Development Indicators dataset of the World Bank), lifetime expectancy at birth for Turkey has increased from 50 years in 1960 to 72 in 2008. Thus a person retired at age 60 has 12 years to spend in retirement. This seems a logical time period to spend in retirement. However, for the Turkish case, consider a woman born in 1980. This person becomes 18 years old in 1998, starts working and becomes an active member of the social security system. Under Law no 3774 of year 1992, she may retire at age 38 in year 2018.

According to WDI data, life expectancy of females born in 1980 is 62 years. Then, the considered person receives pensions for nearly 25 years. OECD (2011, p.61) shows that, compared to other OECD countries, Turkey has the highest number of years spent in retirement. Men from Poland spend 14 years in retirement whereas men from Germany spend 17 years. OECD average is 18.3 years. Closest to Turkey is Greece with men spending 23.6 years in retirement. OECD (2011, p.61) reports that Turkish men spend 29.4 years in retirement. Thus the time spent in retirement is quite high for the Turkish case.

Life expectancy increases as time passes; if the social security system is such that people retire early, the system will face considerable expenditure burdens in the medium and long

run. Thus, given increasing life expectancy, early retirement opportunity is a threat to the sustainability of the social security system.

2.2.7 Informal Employment

In a very broad sense, informal economy can be defined as the sum of economic activities that could be taxed if they were reported to the proper authorities. Informal employment, in this broad definition, corresponds to employment without due official notifications. Hence, the wage income of an individual would not be subject to taxes and social security contribution collection. Also, an individual working in the informal economy would not benefit from the social protection provided by the state.

Due to differences in conceptual definition of informal economy and variations in adopted methodologies, estimated size of the informal economy varies considerably for Turkey. In a comparison of 110 countries in terms of informality, Schneider (2002, p.8) reports the size of informal economy in Turkey to be 32% of GNP in 2002. A report by the Presidency of the Revenue Administration of the Ministry of Finance presents a review of estimates on informal economy in Turkey (GİB, 2009, p.6). The review includes studies on a number of years in 1990s. Depending on the employed method and considered year, the size of informal economy fluctuates between 2% and 66% of GNP.

In an examination of labour market segmentation, Başak (2005, p.83) states that status of employment can provide clues as to the size of informal employment, for casual or temporary workers are mostly uncovered by social security. Thus the rate of casual workers in employment may be taken as an indicator of informality. Such employment status information is available in Table 2.7.

A casual observation of Table 2.7 shows that the share of casual employment, and hence informality, has been increasing through the 1990s. Başak (2005, p.90) also reports, from Boratav, Yeldan, and Köse (2000) and Yeldan (2001), that informal employment is 41% of total labour employment in 1990 and fluctuates between 40% and 50% in the first half of 1990s. Such high informal employment figures point to considerable losses in terms of contribution collection for the social security system. Therefore, policies aimed at reducing informality would contribute to solving the financial problems of the social security system.

Table 2.7: Status in Employment (%)

Year	Period	Wage and Salary Earner (Regular)	Casual Worker (Casual Employee)	Employer	Self-employed	Unpaid Family Worker
1989	April	58,75	8,06	7,03	19,60	6,57
	October	58,50	9,08	6,61	19,68	6,12
1990	April	61,01	7,88	7,49	17,96	5,66
	October	59,39	6,80	9,13	18,53	6,15
1991	April	57,84	8,01	10,26	17,88	6,00
	October	59,31	8,44	9,58	17,72	4,94
1992	April	56,48	9,57	10,30	17,04	6,61
	October	57,51	8,70	10,73	17,54	5,53
1993	April	58,25	9,16	11,04	16,46	5,10
	October	58,16	9,51	10,53	16,33	5,47
1994	April	57,91	9,10	10,69	16,20	6,10
	October	55,54	11,77	9,83	16,93	5,93
1995	April	57,13	11,21	9,86	15,99	5,81
	October	57,80	10,63	9,97	16,51	5,10
1996	April	58,60	10,56	10,07	15,58	5,19
	October	58,07	10,54	10,66	14,95	5,79
1997	April	57,38	11,38	10,19	15,79	5,27
	October	59,35	11,95	8,71	16,21	3,78
1998	April	59,06	10,14	10,55	15,47	4,78
	October	59,46	11,30	10,51	14,25	4,48
1999	April	58,00	10,85	8,52	16,23	6,41
	October	59,59	12,21	9,33	14,83	4,04
2001	April	63,06	9,64	7,84	15,58	3,88
	October	60,34	10,58	8,28	15,34	5,45
2002	April	64,88	7,89	8,19	14,77	4,28
	October	62,64	10,21	8,58	13,30	5,27
2003	April	65,99	7,92	7,70	14,55	3,85
	October	62,86	9,87	7,20	15,28	4,79

Source: Author's calculations based on Başak (2005, p.84)

However, policies targeting informality should be carefully considered. Current reductions in informality implies more active members and higher revenues for the social security system. But an increase in the number of actives now means an increase in the number of passives, and social security expenditures, in the future. Hence from the financial sustainability point of view, policies aimed at the reduction of informality are double edged swords.

2.3 The First Reform Wave: Law no 4447 of Year 1999

Akyüz (2008) states that 1990s was the scene to a considerable debate by both domestic and international actors regarding the need for social security reform in Turkey. The result was Law no 4447, accepted by the National Assembly in 1999 despite considerable protest from labour unions. Law no 4447 is titled Law on Unemployment Insurance. The law establishes the Unemployment Insurance Fund, defines contributions to be paid to this fund and determines the conditions for being entitled to unemployment insurance. It introduces considerable changes to the social security system in general, as well.

One major change introduced by Law no 4447 was the introduction of retirement age of 58 for women and 60 for men. These retirement ages would be applicable only to new members. For the partakers already in the system, a gradual transition to new retirement ages was considered. The resulting retirement ages are presented in Table 2.8.

Law no 4447 can be considered as a nullification of Law no 3774 of year 1992, which eliminated retirement age criteria to entitlement to pensions. Reintroduction of retirement age criteria was protested by the labour unions with the claim that the law would force people to retire at the grave. The opposition party applied to the Constitutional Court in protest of Law no 4447. The Constitutional Court reached a decision in 2001 and Law no 4447 was revised in terms of retirement ages and some changes applicable to ES members. The decision of the Court, with the relevant legal grounds, was announced in the Official Gazette on November 23, 2001.

Law no 4447 also defined changes on other parameters and methods of the pension system. Specifically, calculation of pensions, replacement rates and update coefficients were explicitly defined. These definitions are summarised in Table 2.9.

Table 2.8: Retirement Age of Women by Law no 4447

	Before 1999	By Law 4447 (1999-2002)*	By Revised 4447 (2002 and after)
2000	38	38	38
2001	38	41	38
2002	38	43	38
2003	38	45	39
2004	38	47	40
2005	38	48	41
2006	38	49	42
2007	38	50	43
2008	38	51	44
2009	38	58	45
2010	38	58	46
2011	38	58	47
2012	38	58	48
2013	38	58	49
2014	38	58	50
2015	38	58	51
2016	38	58	52
2017	38	58	53
2018	38	58	54
2019	38	58	55
2020	38	58	56
2021-2060	38	58	58

* These retirement ages were available in Law no 4447 but could not be put into effect due to the decision of the Constitutional Court.

Source: Sayan (2005, p.42)

Consider first the BK members. Income subject to contribution payment for BK members were defined through a 24 step income chart. Accordingly, partaker enters the system at one of the first 12 steps and rises automatically through the first 12 steps. Moving beyond the 12th step is conditional upon the partaker's application. Prior to Law no 4447, last working year income was taken as the level of income to base pension calculation upon.

In a typical PAYG pension system, active members pay contributions out of income. Upon entitlement to retirement pension, pension is calculated by multiplying the income that is to form the basis of pension calculation with a replacement rate. In the text that follows, the income that forms the basis of pension calculation is referred to as work life average income. For BK, work life average income was taken as the last working year income prior to Law no 4447.

Law no 4447 introduces the concept of taking an average of lifetime income for the calculation of pensions. When a partaker applies for pension, first the work life average income of the partaker is calculated. For this calculation, first the amount of time the partaker had spent at each step is determined and a total working life income is computed. Then a weighted average of this total working income is taken, where weights are the time periods spent at each step. This average income forms the basis for the calculation of pension amount. Pension is then obtained by multiplying the average income with the replacement rate.

Regarding the replacement rate; for the first 10 active years, the partaker gets 3.5% points for each year under Law no 4447. For the next 15 years, 2% points are added. Each year after the 25th year adds 1.5% to the calculation of replacement rate. Thus a person who has actively worked for 25 years receives $10 \times 3.5 + 15 \times 2 = 65\%$ as the replacement rate.

The contributions to be paid by active BK members for retirement are 20% of the income step the partaker claims to be at. The chart for income steps is updated every year by CPI and real GDP growth. Therefore, the update coefficient used to bring past income levels to the date of application for retirement can be considered to be an amalgam of CPI and real GDP.

Table 2.9: Pension Parameters After Law no 4447

	BK	ES	SSK
Retirement age	58-60 for new entrants Gradual transition for old members	58-60 for new entrants Gradual transition for old members	58-60 for new entrants Gradual transition for old members
Income definition	Weighted average from 24 step income chart	defined by seniority steps chart of Article 23, Law no 657	Updated lifetime income divided by total time of contribution payment
Income update	CPI and real GDP growth	Not Applicable	CPI and real GDP growth
Replacement rate	3.5% for 10 years + 2% for next 15 years + 1.5% for additional years	75% for 25 years of service; +1% for each additional year; -1% for each less year	3.5% for 10 years + 2% for next 15 years + 1.5% for additional years
Contribution rate	40% (of the income step declared by the partaker) 20% health and 20% pension	35% (20% by institution + 15% partaker)	11% for health (6% employer + 5% partaker) 20% for pension (11% employer +9% partaker)
Pension update	CPI	Public wage increase	CPI

Source: Author's compilation from Laws no 4447, 5434 and 657.

For SSK members, past incomes are updated to the date of application for retirement by CPI and real GDP growth to obtain the total working life income. This is then averaged to the time periods of contribution payment to obtain work life average income. Replacement rate calculation follows the same method for BK. The income update is based on CPI and real GDP growth, as was for BK. For a SSK partaker, the employer pays 6% for health contribution and 11% for disability, death and old age pension contribution. The partaker pays 5% for health contribution and 9% for disability, death and old age pension.

The payments to civil servants are calculated through a chart defined in Article 43 of Law no 657. The chart presents the seniority steps of civil servants and the related coefficients that form the basis of public wage for civil servants at different positions. Progress of a civil servant through this chart is automatic; typically, an individual rises one step each year up to a seniority ceiling that is specific to various job positions. Compensations specific to the task performed by the civil servant are added to obtain the gross income of the civil servant. This gross income serves for deduction of taxes and social security contributions. A 15% contribution is paid by the partaker whereas the employer institution of the government pays a 20% contribution.

The income that forms the basis for pension calculation is the income received due to the placement in seniority chart; that is, work life average income is the wage received in the last work year. Since these are updated by budget related regulations annually, there is not a fixed update mechanism that is used to update past income to current date to form a lifetime average income. The replacement rate is 75% for 25 years of service. For each year more than 25, 1% is added and for each year less, 1% is deducted.

As stated by Özgür (2008, p.47), Law no 4447 increases the retirement age of ES partakers but brings no other change for the ES structure. Specifically, parametric changes brought by Law no 4447 were annulled by the Constitutional Court and ES remained a relatively generous institution in the social security system of Turkey.

Akgeyik, Yılmaz, and Seker (2007, p.126-130) argues that an important aspect of the reform wave initiated by Law no 4447 is the introduced set of institutional rearrangements. The first of these rearrangements is the unemployment insurance defined in Law no 4447 itself. Another arrangement is the executive order no 618 of year 2000. This Executive Order lays the foundation for an institution that would increase the coordination between BK and SSK. This can be regarded as a first step to the unification of the social security institutions; an administrative reform implemented not much later. Such institutional changes were supplemented by the foundation of the Individual Retirement System by Law no 4632 in 2001. This system enables private financial institutions to set up voluntary retirement accounts in support of existing obligatory public retirement system.

2.4 The Second Wave: Laws no 5510 of Year 2006 and 5754 of Year 2008

In April 2006 Law no 5486 on social insurance and general health insurance was adopted by the National Assembly. However, President Ahmet Necdet Sezer sent the law back to the Assembly for reconsideration, stating that some adjustments done to the social security system were “not fair, reasonable and measurable in line with the state governed by the rule of law” (Özgür, 2008, p.62).

After reconsideration, Law no 5502 was adopted in May 2006. In accordance with this law, the SGK (Sosyal Güvenlik Kurumu, Social Security Institution) was founded under the Ministry of Labour and Social Security in order to unify BK, ES and SSK under a single institution.

Also in May 2006, Law no 5510 was adopted. Law no 5510 defined the parametric structure of the social security system from scratch and attempted to unify members of BK, ES and SSK in terms of social security practices.

An application to the Constitutional Court claimed that Law no 5510 was not in accordance with the social state, equality and social security rights principles in the constitution. In response to this, the Constitutional Court abolished some of the articles of Law no 5510. A point to note is that all changes introduced to the pension system of civil servants were annulled for the law would cause a loss of social rights for civil servants (Özgür, 2008, p.69). Due to the decision of the Constitutional Court, the enforcement date of Law no 5510 was moved from January 2007 to January 2008 and certain aspects of Law no 5510 were changed by Law no 5754 in 2008. The pension parameters specified by this second reform wave are presented in Table 2.10.

The partakers of the social security system are defined by Article 4 of Law no 5510. According to this article, the partaker definitions are such that BK members are covered by Article 4-b, ES members are covered by 4-c and SSK members are covered by 4-a.

By Law no 5510, retirement age for new members is stated to be 58 for women and 60 for men. After a period of transition between 2036 and 2048, the retirement age is projected to increase to 65 for both genders. An individual who has entered the social security system before 1999, the transitory retirement ages stated in Law no 4447 and summarised in Table 2.8 would hold. If one enters the system after 1999 but before 2008, retirement ages are 58 and 60, due to Law no 4447.

Now consider the work life average income from which the pension is calculated. Firstly, it should be noted that the ES partakers who were already active members when Law no 5510 went into effect will continue to operate under Law no 5434 for the determination of income that forms the basis of pension. That is, the last working age income of an ES member is used for pension calculation.

For BK and SSK members, calculation of income to form the basis for the calculation of pension is an amalgam of old and new methods. For the years before Law no 5510 went into effect, old methods are used to obtain the income used to calculate pension. For the years after introduction of Law no 5510, income is calculated by the methods introduced by Law

Table 2.10: Parameters of Pension System by Laws no 5510 and 5754

	Law no 5510	Law no 5754
Retirement age	58-60 59-61 in 2036-2037 60-62 in 2038-2039 61-63 in 2040-2041 62-64 in 2042-2043 63-65 in 2044-2045 64-65 in 2046-2047 65 in 2048 and later	58-60 59-61 in 2036-2037 60-62 in 2038-2039 61-63 in 2040-2041 62-64 in 2042-2043 63-65 in 2044-2045 64-65 in 2046-2047 65 in 2048 and later
Income definition	Past incomes updated by update coefficient averaged by duration of activeness	Past incomes updated by update coefficient averaged by duration of activeness
Income update	$1 + 1/2 * (\text{change in CPI} + \text{change in income subject to contribution})$	$1 + \text{CPI} + 30\%$ of real GDP growth
Replacement rate	2.5% until 2015; 2% in 2016 and later	Fixed at 2%
Contribution rate	12.5% health (7.5% employr + 5% partaker) 20% for pension (11% employr + 9% partaker)	12.5% health (7.5% employr + 5% partaker) 20% for pension (11% employr + 9% partaker)
Pension Update	CPI	CPI

Source: Author's compilation from Articles 3, 28, 29, 55 and 81 of Law no 5510 and Articles 1, 16, 17 and 48 of Law no 5754.

no 5510. The average lifetime income to form the basis of pension calculation is the sum of incomes obtained by these two calculation methods. A new entrant to the social security under Law no 5510 will have his or her incomes updated by the new update coefficient.

Update coefficient, used to bring past income to current value, was based on CPI and real GDP growth before Law no 5510. The past income was increased by both CPI and real GDP, separately. By Law no 5754, update coefficient is defined as CPI and 30% of real GDP growth, plus 1.

The diverse replacement rates are unified under a fixed rate of 2% for each year. Contributions are also unified at 20% for pension and 12.5% for health. Government is now defined as an active and systematic supporter of the pension system. By Article 81 of Law no 5510, the government pays 5% contribution for every active member. Pension values are updated by CPI.

2.5 Summary

The aim of this section is to summarise the parametric changes in the retirement system. The considered parameters are retirement age, definition of income that forms the basis of pension calculation or working life average income, update of working life average income to the date of application for pension, replacement rates, contribution rates and update rules for pensions.

2.5.1 Retirement Age

Before Law no 4447 of year 1999, retirement age is not fixed. Retirement is conditional upon being an active member for 20 years for women and 25 years for men. Thus, if a man enters the system at age 20, this person may retire at age 45. By Law no 4447, retirement age is increased to 58 for men and 60 for women. However, this age criteria is applicable to new members and the retirement age of existing members increases gradually (Table 2.8). Law no 5510 dated 2008 maintains this and introduces further increases from 2036 to 2047 (Table 2.10).

2.5.2 Working Life Average Income

Prior to 1999, pensions of BK, ES and SSK partakers were calculated through the income they receive in the last period of working life. After Law no 4447 of 1999, the principle of calculating working life average income is introduced to the pension system. The idea is to take an average of the incomes partakers have declared to receive during their working years. This average income is then used to calculate pension through replacement rate. This method is applied after 1999, due to Law no 4447, and is maintained by Law no 5510 of 2008. However, members of ES are excepted from this application. For ES members, income received in the last working period of life is the basis of pension calculation. Still, an individual who enters the system as a public worker after Law no 5510 is subject to working life average income for pension calculation.

2.5.3 Update Coefficient

As the concept of using working life average income for pension calculation is introduced to the social security system, there rose the need to update past incomes to the date of application for pension so that past incomes are reflected by their real values. Such a coefficient was not defined prior to 1999, for pension calculation was then based on last working year income. By Law no 4447 of 1999, past incomes are updated by CPI and real GDP growth separately up to the year of application for pension in cases of BK and SSK. In 2008 and later, the update coefficient is defined as CPI plus 30% of real GDP growth plus 1, by Law no 5754. Since ES members receive pension due to the last working period income, ES members are not subject to such update coefficients.

2.5.4 Replacement Rate

Before 1999, BK and SSK members that completed active membership of 25 years were entitled to a replacement rate of 70%. For each additional year, an additional 1 point was added up to 90%. ES members were entitled to 75% replacement rate after 25 years of service and the replacement rate increases 1 point for each additional year of service. By Law no 4447 of 1999, this is maintained for ES members. BK and SSK members receive 3.5% for the first 10 years; 2% for the next 15 years and 1.5% for any added year. By Law no 5754, this is

fixed at 2% per year for all new members. However, if a person had entered the system before Law no 5510; that individual will receive 3% for replacement rate during the first 10 years of active participation in the social security system.

2.5.5 Contribution Rate

For ES; before 1999, contribution rate was stated as 35% by Article 14 of Law no 5434. Of this rate, 15% was stated to be paid by the partaker and 20% was the responsibility of the employing institution. This rate is maintained till Law no 5510 of 2006. BK members used to pay a total of 40% of their income as contribution to social security system; this also holds till Law no 5510. For SSK, the rate is 31%. These contribution rates are unified by Law no 5510 to be 32.5% of the income subject to contribution collection. Of this number, 20% is retirement contribution; 9% is paid by insurance holder and 11% paid by the employer. Health insurance contribution accounts for the remaining 12.5%; 5% is paid by the partaker and 7.5% is the employer share.

2.5.6 Conclusion

This chapter has outlined not only the origins of the Turkish social security system but also the changes in the retirement system brought about by the social security reform realised within the first decade of the 21st century in Turkey, after an exposition of the reasons in favour of a reform. The reform has been initialised with concerns for the sustainability of the social security system.

Prior to 1999, a SSK or BK member who worked for 40 years was entitled to a replacement rate of 85% and ES member was entitled to 90%. After Law no 5510, the rate is now 80% under the assumption of 2% for each active year. This implies a reduction in expenditures, given work life average income that forms the basis for pension calculation. Contribution rates fall to 32.5% from 40% for BK, from 35% for ES. For SSK, the contribution rate is maintained.

The general observation is that both contribution and replacement rates have decreased for the Turkish social security system. The low contribution rates may lead to reduced social security revenues. However, this could be negated by the decreases in the replacement rates. For the

reduced replacement rates would imply low pensions and thus reduced expenditure levels for the social security institutions. This brief discussion shows that the changes in contribution rates and replacement rates have contradicting effects on the budget of the social security system.

For each participant, the government is now responsible for a portion of the contributions. Yet the government has been covering social security deficits for a considerable period of time now. Introducing the government as a legally defined contributor simply legitimises the existing deficit coverage mechanism and does not constitute a major change.

On top of these, the retirement eligibility age has increased. Later retirement would imply a decrease in the number of passive members and an increase in the number of active members. However, in the long run, all the current actives will be retired, causing once more an expenditure increase for the social security system.

Obviously, there are many sides to the system. A more concrete analysis of the effects of the reform requires more detailed numerical approach. The next chapter turns to the OLG model, the basic tool of analysis adopted in this study. Then the study proceeds to construct a large scale dynamic general equilibrium model to analyse the effects of the reform summarised here.

CHAPTER 3

A SIMPLE OLG MODEL AND DIRECTIONS FOR EXTENSION

The origins of OLG models go back to Samuelson (1958) and Diamond (1965). In order to characterise interest rates in a dynamic economy with population growth, Samuelson (1958) constructs a model in which consumers live for three time periods and receive fixed endowments. Diamond (1965), on the other hand, introduces a model where agents live for only two time periods and examines both the long run competitive equilibrium in a growth model and the effects of government debt on this equilibrium.

Despite such an early manifestation, “it took a while for Samuelson’s framework to impose itself on the profession” as observed by Weil (2008, p.116). Pointing out that Solow (2006) admits omitting the OLG model in a 1983 book on *Paul Samuelson and Modern Economic Theory*, Weil (2008) notes that diffusion of OLG models and their increasing popularity begin with a number of textbooks written in 1980s.

Still, models with a finite lifetime seem to have considerable impact in the 1980s. For example, Blanchard (1985) develops a model in which consumers face uncertainty regarding survival to the next period. Should the instantaneous probability of death be zero, this corresponds to a model with infinite lifetime. A positive probability implies a limited lifetime. Blanchard (1985) states that the model is better adapted to finite horizon issues like debt and deficits.

Apparently, OLG model was not completely unnoticed prior to 1980s, for Kotlikoff (1998) claims that a generation of graduate students were quite impressed by Martin Feldstein’s works in 1970s on fiscal policy and his debate with Barro (1974). Such intellectual influence must have been crucial in developing an OLG model with considerable practical applications

and probably one of the fruits of such fascination was Auerbach and Kotlikoff (1987) which develops a large scale OLG model in which individuals lived for 55 periods.

In the Auerbach and Kotlikoff (1987) model, or the A-K Model as it is commonly known, consumers gain utility from consumption and leisure; hence labour supply is endogenised. Taxation is introduced with exogenous government consumption. Thus the model dynamics may lead to government budget deficits or surpluses, given tax rates. The model is calibrated to US data and the obtained framework is used to analyse a broad range of fiscal policy issues.

The A-K model was one of the pioneering works that paved the way for the formulation of large scale OLG models to analyse various issues. The increase in scale was matched by details added to the model, as research questions required.

Aiming to create a familiarity with the basic tool of the analysis, this chapter presents a prototype OLG model. The first part of the chapter summarises a two-period OLG model with retirement and pensions. The prototype model is wrapped around a representative consumer who lives for 2 periods. There is a PAYG social security system that collects contributions and distributes pensions. The second part of the chapter is dedicated to identifying how the simple model should be extended to be more suitable for research on Turkish social security system.

3.1 A Two Period OLG Model

3.1.1 Consumer Behaviour

A representative consumer is assumed to live for 2 periods. Thus the model has two living individuals at any time period t ; one young and one old. Behaviour of the representative consumer is to maximize lifetime utility by choosing how much to consume each period of life and how much of available resources to put aside for future consumption. Specifically, lifetime utility of the representative consumer in this section is taken to be:

$$\sum_{g=1}^2 \beta^{g-1} \frac{c_{g,t+g-1}^{1-\eta} - 1}{1-\eta} \quad (3.1)$$

where g stands for age, t stands for time and $c_{g,t+g-1}$ is the consumption of consumer born at time t and aged g at time $t + g - 1$. The η parameter of the lifetime utility function is the

measure of relative risk aversion. For this specific functional form, it is the inverse of the intertemporal elasticity of substitution. Mathematically, this function introduces concavity to the utility function. A higher η implies higher risk aversion, lower intertemporal substitution and higher curvature. The last parameter, β , is the discount factor that shows the weight of the future consumption in lifetime utility.

The consumer is assumed to work in exchange for wage when young. This receipt of wage is used to finance young-age consumption, asset stock to be transferred to the next period and social security contributions paid to the social security institution. Asset stock of the consumer represents a claim on the capital stock, which is the only asset in this economy. Given these, the budget constraint when young is:

$$c_{1,t} + a_{2,t+1} \leq (1 - \tau_t)w_t \quad (3.2)$$

where w_t is wage, $a_{2,t+1}$ is asset stock set aside and τ_t is the rate of social security contributions collected by the social security institution. At old age, the consumer receives benefits from the social security system and earns interest from the asset stock already accumulated. These income items are used to finance old age consumption. Hence budget constraint when old is:

$$c_{2,t+1} \leq (1 + r_{t+1})a_{2,t+1} + pen_{t+1} \quad (3.3)$$

where r_{t+1} is the interest rate that applies at time $t + 1$ and pen_{t+1} is the pension received at time $t + 1$.

Given this framework, the consumer's optimization problem is as follows:

$$\begin{aligned} \max_{c_{1,t}, c_{2,t+1}, a_{2,t+1}} \quad & \sum_{g=1}^2 \beta^{g-1} \frac{c_{g,t+g-1}^{1-\eta} - 1}{1-\eta} \\ \text{s.t.} \quad & c_{1,t} + a_{1,t} \leq (1 - \tau_t)w_t \\ & c_{2,t+1} \leq (1 + r_{t+1})a_{1,t} + pen_{t+1} \\ & c_{1,t}, c_{2,t+1}, a_{2,t+1} \geq 0 \end{aligned} \quad (3.4)$$

The first order conditions for this maximization problem lead to:

$$\frac{c_{2,t+1}}{c_{1,t}} = [\beta(1 + r_{t+1})]^{\frac{1}{\eta}} \quad (3.5)$$

which is the well-known consumption Euler equation that relates consecutive consumption choices through time. Should the right hand side of this equation be greater than 1, an increasing lifetime consumption profile would be observed.

Denoting $\chi = [\beta(1 + r_{t+1})]^{-\frac{1}{\eta}}$ and making use of the Euler equation and budget constraints, one can obtain consumption when young as:

$$c_{1,t} = \frac{1}{(1 + r_{t+1}) + \chi} [(1 + r_{t+1})(1 - \tau_t)w_t + pen_{t+1}] \quad (3.6)$$

Old age consumption, $c_{2,t+1}$ can be obtained through the Euler equation.

As wage income increases, young consumption increases. An increase in pension income, pen_{t+1} , also increases consumption by young. An increase in social security contribution rate, τ_t , would contract the budget set and thus decrease consumption when young. But, a comparative static analysis of Equation 3.6 reveals that the effect of a change in interest rate on consumption when young is uncertain. By the Euler in Equation 3.5, one can observe that this uncertainty exists for consumption when old, as well. Also, by the budget of young consumer, Equation 3.2, we obtain

$$a_{2,t+1} = (1 - \tau_t)w_t - c_{1,t} \quad (3.7)$$

Therefore, the uncertainty extends to asset accumulation, too.

This uncertainty is due to two opposing effects of a change in the interest rate on consumer behaviour. Consider an increase in the interest rate to illustrate. A higher interest rate implies a higher return from a given asset stock. Thus the lifetime budget set expands and there is room for increasing consumption when young. In essence this is an income effect.

The other effect can be readily observed from Equation 3.5, the consumption Euler. Given second period consumption, consumption when young will decrease as a result of an increase in the interest rate. Running in the background is a substitution effect. As the interest rate increases, it is possible to transfer more resources to old age. This is done by decreasing consumption when young and increasing asset stock choice. Hence old age consumption increases vis-á-vis young age consumption.

3.1.2 Production

The production side of this model is summarized through a representative firm. The firm operates under perfect competition and displays profit maximizing behaviour. Production is assumed to take place through a constant returns to scale Cobb-Douglas technology that uses capital and labour as inputs and includes labour augmenting technological growth. Denoting

output as Y_t , functional form of production technology is:

$$Y_t = K_t^\alpha (\Gamma_t L_t)^{1-\alpha} \quad (3.8)$$

where K_t represents capital, L_t is labour and Γ_t is technology. Exogenous technological evolution is considered to follow:

$$\Gamma_{t+1} = \theta \Gamma_t \quad (3.9)$$

where θ is the time invariant technological growth. Denoting depreciation of capital with δ and solving the profit maximization problem would provide the two first order conditions:

$$r_t = \alpha K_t^{\alpha-1} (\Gamma_t L_t)^{1-\alpha} - \delta \quad (3.10)$$

$$w_t = (1 - \alpha) \Gamma_t K_t^\alpha (\Gamma_t L_t)^{-\alpha} \quad (3.11)$$

3.1.3 Social Security System

The social security system in this basic setup consists of an institution that collects social security contributions out of wage income of young workers and distributes pensions to old retired consumers. It is assumed in this setup that this institution always runs a balanced budget. Therefore, given lack of population dynamics and the assumption that there is only one young and one old consumer in the economy,

$$pen_t = \tau_t w_t \quad (3.12)$$

is the social security institution budget constraint. Further, pension benefits are assumed to be a portion of wage income of young consumers at time t :

$$pen_t = rep_t w_t \quad (3.13)$$

Here rep_t denotes the replacement ratio. Merging these two equations yields:

$$\tau_t = \frac{rep_t}{1 + rep_t} \quad (3.14)$$

That is, given the policy on replacement rate, contribution rate is chosen so as to balance the social security institution budget constraint. Deceptively simple, this equation places a restriction on the available policy analysis options in this model. Given the dependency of contribution rate on replacement rate, a contribution rate policy shock would not be independent of replacement rate shocks. Hence one can examine only the effects of replacement rate or contribution rate related social security policies within this model.

3.1.4 Equilibrium

Equilibrium in this 2 period OLG model is as follows:

Given policy on replacement ratios, an equilibrium for the model consists of sequences of consumption choices $\{c_{1,t}, c_{2,t+1}\}$, asset stock decision $\{a_{1,t}\}$, factor prices $\{w_t, r_t\}$, pension payments $\{pen_t\}$ and social security contribution rates $\{\tau_t\}$ such that:

i) Given factor prices and contribution rate, consumer chooses consumption when young, consumption when old and intertemporal reallocation of resources through asset holdings so that lifetime utility, Equation 3.1, is maximised subject to the budget constraints stated in Equations 3.2 and 3.3.

ii) Given factor prices and production technology, firms choose factor demands to maximise profits.

iii) The contribution rate is set so that social security institution budget as in Equation 3.12 is balanced.

iv) Good market clears.

v) Asset market clears.

A number of explanations are in order. Firstly, consider asset market clearance. Assets held by the old consumer at time t constitutes the asset stock of the economy so that $A_t = a_{2,t}$. Since the only asset that can be held is physical capital, $A_t = K_t$. Thus capital stock is a direct result of the consumer saving behaviour.

Secondly, consider the good market equilibrium. Production is either consumed or invested;

$$Y_t = C_t + K_{t+1} - (1 - \delta)K_t \quad (3.15)$$

Note that investment is defined as $I_t = K_{t+1} - (1 - \delta)K_t$. From the consumer point of view, obtained disposable income is spent on consumption and asset stock. Thus, taking into account that social security institution budget is balanced as in Equation 3.12;

$$A_{t+1} - A_t = K_{t+1} - (1 - \delta)K_t \quad (3.16)$$

This equation states that changes in two stock variables, assets and capital, match each other. Changes in asset stock is saving, $S_t = A_{t+1} - A_t$. Also making use of investment definition as

the change in physical capital stock, Equation 3.16 can be written in flow terms:

$$S_t = I_t \quad (3.17)$$

At time period t , this model would be solved for,

- Consumption of the young consumer, $c_{1,t}$, consumption of the old consumer, $c_{2,t}$ and asset stock decision of the young consumer $a_{2,t+1}$,
- Lacking technological growth, the capital stock as $K_t = a_{2,t} = a_{2,t+1}$
- Given that there exists only one consumer for each age cell, labour supply $L_t = 1$
- Given capital stock and labour supply, factor prices w_t and r_t
- Given wage and replacement rate, pension pen_t
- Given replacement rate and wage, the contribution rate that balances the social security system's budget, τ_t

The model discussed so far outlines the basics of an OLG model with social security. However, it must be improved in order to represent the Turkish social security system. Next section turns to the task of identifying key points the model needs to have in order to be useful to research on social security reform in Turkey.

3.2 Avenues for Extension

Having completed a discussion of the basic OLG model, the focus is now turned on how to augment the basic model so that it can account for the basic characteristics of the Turkish economy and represent the Turkish social security system. One of the most obvious considerations is to extend the demographic structure. A 2 period model is not adequate for practical purposes. Thus a 30 period model is adopted. It is assumed that the individuals enter the economy after age 20 and live till age 80. Thus each model age corresponds to 2 calendar years. The specification is broad enough to represent coexisting cohorts but not too broad to make the model computation excessively complex and costly in terms of computing time.

In order to account for the social security system, the population also needs to be divided in accordance with membership in social security institutions, BK, ES and SSK. To account for varying behaviours of members of different social security systems, the model can be formulated around three types of representative consumers.

In what follows, we delve further into additions to be made on the basic model. After consideration of material abilities of members of different social security institutions, the interaction between government and social security institutions is emphasised. This part of the chapter concludes by summarising a list of changes to be made to the basic model.

3.2.1 Sources of Earnings

The social security institutions, BK, ES and SSK, have partakers that are defined in the laws which set these institutions up. The members of these institutions are differentiated basically due to employment conditions. Specifically, BK covers artisans and self-employed individuals, including farmers, ES covers public workers and SSK covers everyone that works under a service contract. Using a different terminology, BK covers capitalists (or entrepreneurs), SSK covers private sector labourers and ES covers public workers and civil servants. Given such diverse employment positions of partakers, members of different social security institutions should have different sources of income. For example, one would expect the major source of income for a SSK member to be labour income rather than asset income and BK member to have asset income as the major source of income. Such differences in income sources requires differentiating the budget constraints in the optimization problems of representative consumers depending on the social security institution they belong to.

In order to identify how to differentiate the partakers of the three institutions, it is useful to search for clues in available micro data. The data focused on is the one collected on individuals through the Household Budget Surveys conducted by TURKSTAT in 2003, 2004 and 2005. The individuals dataset of these surveys includes detailed information on income items. Some of these items are aggregated to create wage income, assumed to represent income due to participation in production process as a labourer. Asset income is due to ownership of real estate (including land), bank deposits in domestic and foreign currency, profit shares, entrepreneurial income and agricultural income. The exact coverage of these items, in terms of variables in the individuals' dataset, is presented in Appendix B at the end of this study.

In order to correspond to a 30 period OLG model that is equivalent to a 60 year lifetime between ages 20 and 80, an age variable has been introduced to the dataset. This variable represents the ages in the OLG model to be constructed and has been formulated so that it has the value of 1 for calendar ages of 21 and 22; 2 for calendar ages of 23 and 24; 3 for calendar ages 25 and 26 and so forth. The individuals with the calendar age of less than 21 and more than 80 have been dropped from the dataset. Then, for each model age, means of wage income and asset income are calculated. The analysis conducted here relies on the shares of mean wage and asset income in mean aggregate income.

Rest of the analysis conducted in this sub-section relies on the concept of pseudo panel put forward by Deaton (1985) and previously used on Turkish micro data by Cilasun (2009). The idea of creating a pseudo panel stems from the fact that most micro data collections do not follow individuals or similar cross section units through time. They are collections of cross sectional data rather than true panels. This prevents the use of panel data techniques. The response is to create groups with similar characteristics, or cohorts, through which a synthetic panel or pseudo panel can be created.

The Household Budget Survey conducted by Turkish Statistical Institute also does not follow individuals or households through time and thus actually is a collection of cross sections. It is therefore possible to create a pseudo-panel from the available survey data. In this study, cohorts are chosen on the basis of model ages for each social security institution. As an example, consider BK partakers aged 21 and 22 in year 2003. These individuals form the model age 1 cohort and are represented by their mean wage income, mean asset income and mean aggregate income where means are taken for model ages. The BK partakers aged 23 and 24 in year 2004 are taken to represent the behaviour of model age 2 consumer. Similarly, calendar ages of 25 and 26 correspond to model age 3. Thus one can obtain mean income information for representative consumers of BK with model age 1, 2 and 3 by using the available cross section data. Similarly, the individuals aged 25 and 26 in year 2003 form the model age 3 cohort. Those with the calendar age of 27 and 28 will be the cohort of model age 4 in the year 2004 dataset and calendar age 29 and 30 will be model age 5 in the 2005 dataset. The process can be repeated for all calendar years and a lifetime profile can be obtained for mean wage and asset income for all model ages. Obtained profiles, similar to those obtained by Cilasun (2009), are presented in Figure 3.1.

The striking finding is that asset income accounts for nearly all the income for a young BK consumer. For a 30 period lifetime that spans the calendar ages of 20 to 80, importance of assets as a source of income begins to fall only in the later periods of life. This is in accordance with the behaviour expected from the well established life cycle theories of consumer behaviour. The consumer is eroding the asset stock towards the end of life. Thus asset income falls at later periods of life. It can be stated that a consumption smoothing is at work; asset stock is eroded in the later periods of life to maintain a given level of consumption or to reduce consumption volatility through lifetime.

Picture is reversed for ES and SSK consumers. Major source of income for these individuals is wage income and asset income rises only in later stages of life to a 20% of total income. The core conclusion of this section is that the basic model presented previously has to account for different sources of income as put forward by the available data. Specifically, the model has to recognise that BK members are primarily asset holders and members of other social security institutions are primarily wage earners. These differences should be accounted for in the budget constraint specifications of representative consumers.

One point to raise an eyebrow at is the age coverage implied by Figure 3.1. Note that there are no observations for the individuals with model age 23 and above for ES and SSK members. The situation is emphasised by the following table where the number of observations in model age cohorts 20 and above are listed for each year of survey data, divided by social security institution.

It should be noted that this low number of individuals in each model age cohort is a fact of the dataset but need not indicate that the highest model age for ES and SSK members should be 22, as implied by Figure 3.1.

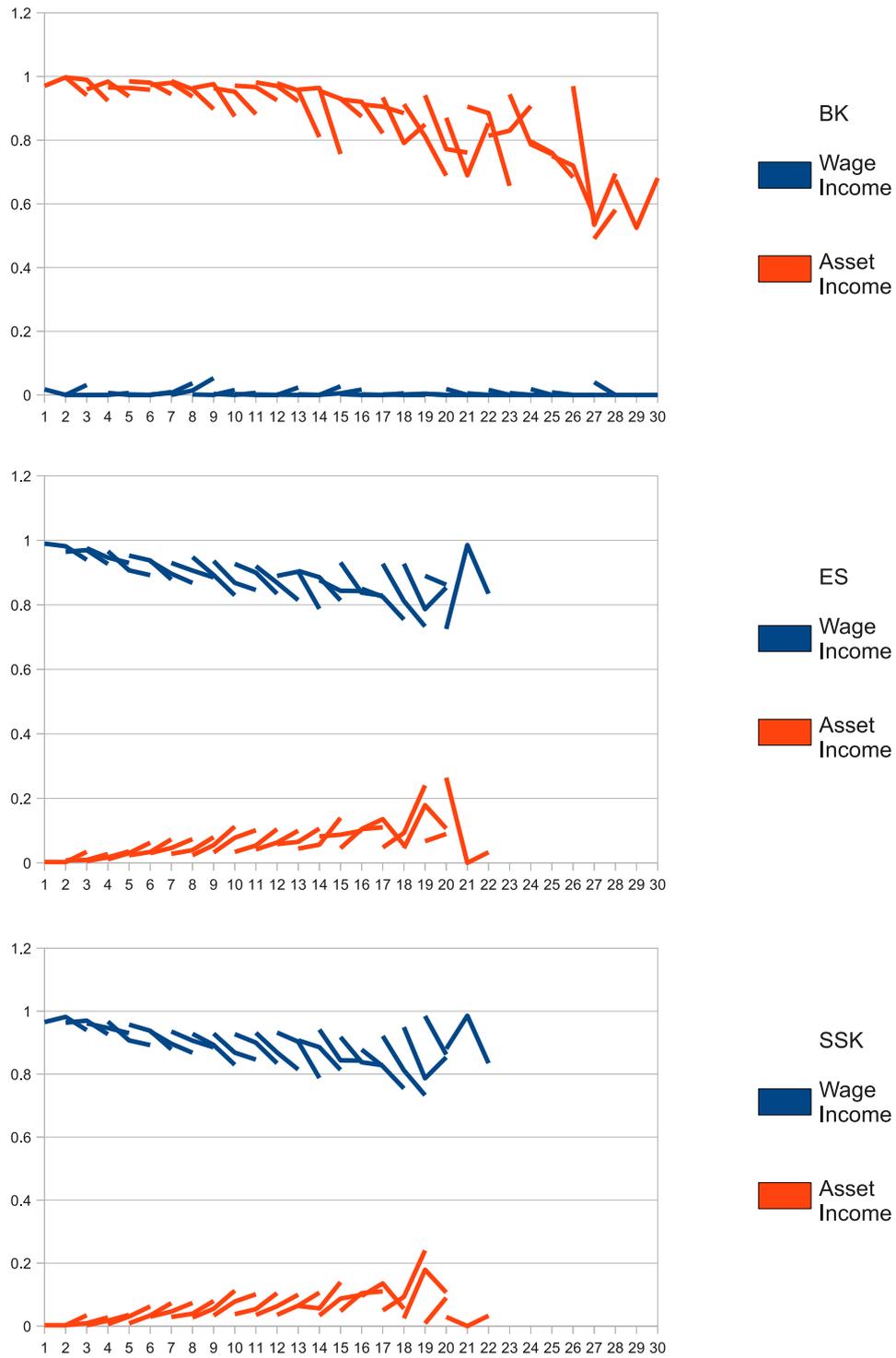


Figure 3.1: Shares of Wage and Asset Income in Aggregate Income

Table 3.1: Number of High Age Individuals in Data

Model Age	2003		2004		2005	
	ES	SSK	ES	SSK	ES	SSK
20	5	10	4	2	3	0
21	8	6	1	1	0	2
22	5	1	0	2	2	1
23	1	4	0	3	1	0
24	0	6	0	1	0	1
25	0	0	0	0	0	0
26	0	2	0	0	0	0
27	1	0	0	0	0	0
28	0	1	0	0	0	0
29	0	0	0	0	0	0
30	0	0	0	0	0	0

Source: Author's calculations from Household Budget Surveys 2003-2005.

3.2.2 Bequest Motive

The previous analysis on sources of income raises two important points. Consider Figure 3.1 to see these. Firstly, note that consumers under the coverage of ES and SSK have no asset income at the beginning of life. On the other hand, BK consumers have nearly all their income due to asset income at the beginning of life. Apparently, BK consumers enter the economic life with some resources. Secondly, BK consumers run down asset income towards the end of life. ES and SSK consumers have some asset income as well, but of relatively lower levels.

In order to examine the phenomenon more clearly, Figure 3.2 is presented. This figure displays the mean wage and asset income of BK, ES and SSK consumers through a pseudo panel. The available data has been turned to real terms using the CPI series from the Electronic Data Delivery System of the Central Bank of the Republic of Turkey. The CPI data has the year 2003 as the base year.

This figure confirms that BK consumers receive no wage income and display a standard life-cycle behaviour; low asset income at the early and late phases of life coupled with a peak around the middle of lifetime. It is also clearly seen from the top panel that BK consumers start life with some asset income and do not run down asset income to zero. Such behaviour can be modelled through a simple bequest-inheritance behaviour BK consumers leave some resources after they die; this is transferred to the newborn BK consumer.

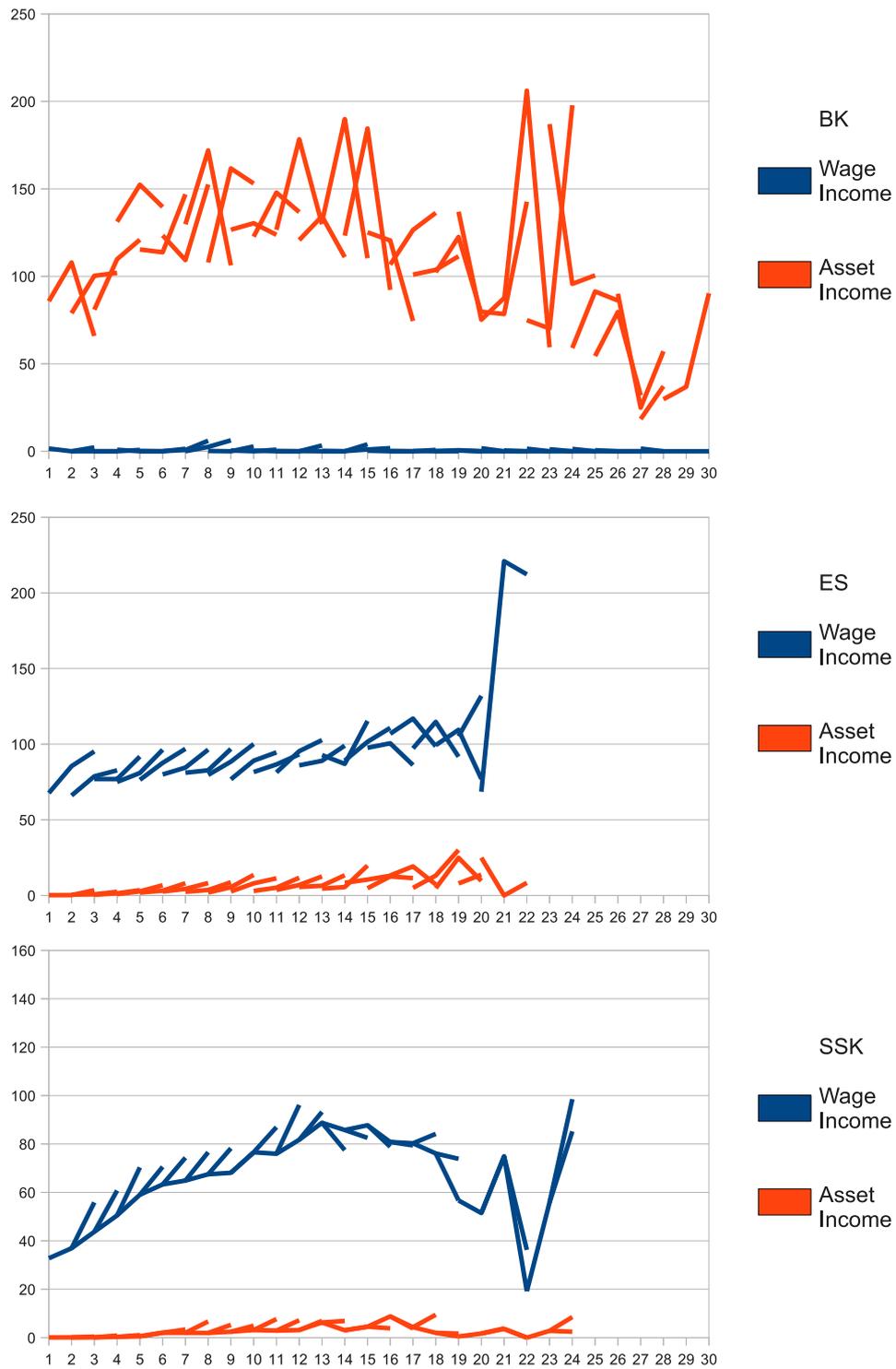


Figure 3.2: Life Cycle Distribution of Real Wage and Asset Income

Some asset income is available to ES and SSK consumers towards the end of lifetime; however, none is received at the beginning of life. Then one can assume that the asset stock accumulated is left behind but not transferred to the newborn ES and SSK consumers. Thus the bequest and inheritance mechanism entails BK consumers receiving all bequests left behind as inheritance. As a reflection of the saving behaviour, one may think that the highest amount of bequest left is by BK consumers, followed by ES and then SSK consumers.

Given lack of uncertainty, therefore exclusion of accidental bequests, there exist limited options for including bequest motive into the model. One such option is to introduce the idea that consumers derive utility from leaving bequests. Then bequest is an argument of the utility function for all consumers but the relevant parameters should be set up so that BK consumer leaves more bequest compared to other consumers.

3.2.3 Age Variation of Wage Income

An other phenomenon observed through Figure 3.2 is that wage income of consumers fluctuates by age. For the ES consumers, this fluctuation seems to be relatively low. Still, an increase in wage earning towards the end of life is evident. The situation is much more striking for the SSK consumers. Starting at a relatively low point, wage income of the SSK consumer follows a humpbacked profile; increases towards the middle of life and falls towards the end.

In order to examine the phenomenon more clearly, the method applied by Cilasun (2009, p. 48) on Turkish micro data will be adopted. The method is due Deaton and Paxson (1993) and is in essence a decomposition of time, age and cohort effects of a micro variable, where cohort is defined through birth year. Time effect would be due to the characteristics of a survey year in which the data is collected; a crisis year may reflect characteristics that are unique to the survey year. Cohort effect would be due to the year of birth. For example, a person born just before the World War II may be more of a penny saver simply because of the harsh conditions experienced during the war time.

The method to isolate these effects is to regress wage received at time t and age g by an individual on a set of age, time and cohort dummies. Available survey data is from Household Budget surveys conducted in 2003, 2004 and 2005. The data is rearranged so that the age variable corresponds to a 30 period OLG model. That is, the individuals aged 21-22 in year

2003 are considered to be of model age 1. The individuals aged 23-24 in year 2004 are of model age 2 and are considered to be the next age of model age 1 in year 2003. In year 2005, calendar ages 25-26 are considered model age 3. Thus a pseudo panel in the spirit of Deaton (1985) is formed.

The individuals aged 21-22 in year 2003 are born in year 1981 and 1982 and form cohort 1. However, forming a model age by two calendar ages makes the year 2004 dataset of no use in identifying birth year based cohort effects. In order to see this clearly, consider the model age 1 group in 2003. These individuals are born in 1981-1982 and will be of cohort group 1. In the 2005 dataset, individuals in the model age group 2 will be of calendar age 23 and 24, with birth years 1981-1982 and therefore will be members of cohort group 1. On the other hand, individuals aged 21-22 in 2004 dataset will be model age 1 and will have 1982 and 1983 as birth years. Similarly, individuals aged 23-24 in 2004 dataset are of model age 2 and are born in 1980 and 1981. Then it is not clear whether model age 1 and model age 2 groups of the 2004 dataset will be in cohort group 1 or if they will be members of other cohorts.

Since the Household Budget Surveys are available in consecutive years, it is not possible to make use of all three surveys in an OLG setup in which one model age corresponds to two calendar ages. Thus 2004 dataset must be omitted and only 2003 and 2005 surveys are of practical use for the cohort related micro data purposes of this study.

Table 3.2 has been prepared to present the age and cohort structure clearly. The first and third columns show calendar ages in years 2003 and 2005. Second and fourth columns are the corresponding model ages. Birth years are available in fifth and sixth columns. Last column identifies cohort groups. As an example; calendar ages of 23 and 24 in year 2003 are of model age 2. These individuals have birth years 1979-1980 and are in cohort 2. This model age is followed with model age 3 in year 2005, which includes the individuals of calendar age 25 and 26. This group has birth year 1979-1980 as well and thus is also of cohort group 2. Note the existence of the outlier cohort 31, born into the 2005 data.

Dummy matrices corresponding to model ages, cohorts and two survey years have been prepared. For the case of ES it is noted that cohorts and ages 24, 25, 26, 28, 29 and 30 are never observed. One dummy from age, cohort and year blocks have been removed. Remaining dummies are regressed on real mean wage without a constant term. Obtained age effects are presented in Figure 3.3.

Table 3.2: Cohort Structure in 2003 and 2005 Datasets

2003 C Age	Model Age	2005 C Age	Model Age	2003 Data Birth Year	2005 Data Birth Year	Cohort
		21-22	1		1983-1984	31
21-22	1	23-24	2	1981-1982	1981-1982	1
23-24	2	25-26	3	1979-1980	1979-1980	2
25-26	3	27-28	4	1977-1978	1977-1978	3
27-28	4	29-30	5	1975-1976	1975-1976	4
29-30	5	31-32	6	1973-1974	1973-1974	5
31-32	6	33-34	7	1971-1972	1971-1972	6
33-34	7	35-36	8	1969-1970	1969-1970	7
35-36	8	37-38	9	1967-1968	1967-1968	8
37-38	9	39-40	10	1965-1966	1965-1966	9
39-40	10	41-42	11	1963-1964	1963-1964	10
41-42	11	43-44	12	1961-1962	1961-1962	11
43-44	12	45-46	13	1959-1960	1959-1960	12
45-46	13	47-48	14	1957-1958	1957-1958	13
47-48	14	49-50	15	1955-1956	1955-1956	14
49-50	15	51-52	16	1953-1954	1953-1954	15
51-52	16	53-54	17	1951-1952	1951-1952	16
53-54	17	55-56	18	1949-1950	1949-1950	17
55-56	18	57-58	19	1947-1948	1947-1948	18
57-58	19	59-60	20	1945-1946	1945-1946	19
59-60	20	61-62	21	1943-1944	1943-1944	20
61-62	21	63-64	22	1941-1942	1941-1942	21
63-64	22	65-66	23	1939-1940	1939-1940	22
65-66	23	67-68	24	1937-1938	1937-1938	23
67-68	24	69-70	25	1935-1936	1935-1936	24
69-70	25	71-72	26	1933-1934	1933-1934	25
71-72	26	73-74	27	1931-1932	1931-1932	26
73-74	27	75-76	28	1929-1930	1929-1930	27
75-76	28	77-78	29	1927-1928	1927-1928	28
77-78	29	79-80	30	1925-1926	1925-1926	29
79-80	30			1923-1924		30

Source: Author's construction.

Note: C Age stands for Calendar Age.

The age effects are observed to be increasing in age. That is, higher age at a given time period implies higher wage earning for an ES member. However, at very high ages, the relationship appears to be irregular. Still, an increasing age effect is consistent with what one would expect from the wage system of Turkish government workers. Public wage is determined through a seniority chart through which individuals progress automatically. Higher age therefore would imply higher wage earning.

Obtained cohort results are available in Figure 3.4. Mostly, a falling cohort effect is observed for ES members but a reversal is evident in the right hand side of the graph. At a given time, the further back is the birth year, lower is the wage. One may connect this phenomenon to the fact that people born in the distant past had relatively less access to education, which enables moving faster up the seniority chart of the public workers. Nowadays, a 25 year old without an undergraduate degree would lead to rising eyebrows whereas in the distant past having one would. Thus it is possible that individuals with more recent birth dates are enjoying the benefit of rising faster in the public workers' seniority chart due to higher education levels.

Similar decomposition analysis for SSK members is also conducted. For the case of SSK, cohorts and ages 24, 25, 26 28, 29 and 30 are not observed in data. Obtained age effects for SSK members have been presented in Figure 3.5. Age effects follow a humpback shaped profile. It is possible that a very young worker is regarded inexperienced and is paid a relatively low wage. At higher ages, decreasing wages may have different reasons; a most simple one would be depreciating human capital coupled with falling cognitive skills. Cohort effects of SSK members have a U-shape, as seen in Figure 3.6. Closer the birth date to current date, higher is the wage earning. Also, if birth date is very distant in the past, wage receipt increases. Medium cohorts, however, receive relatively less wages.

Given such variations in wage receipts, it would not be logical to assume that individuals of each age at a given time period receive the same wage. Hence it is necessary in the model to let wage receipts of individuals vary by age. The proposed addition is to introduce age efficiency indices into the model. It will be assumed that an individual aged g receives $w_{g,t} = e_{g,t}w_t$ as wage rather than w_t , where $e_{g,t}$ denotes age efficiency. The parameters $e_{g,t}$ imply that at a given time period t individual aged g supplies $e_{g,t}$ units of labour rather than 1 unit inelastically and thus allow wage receipt variations.

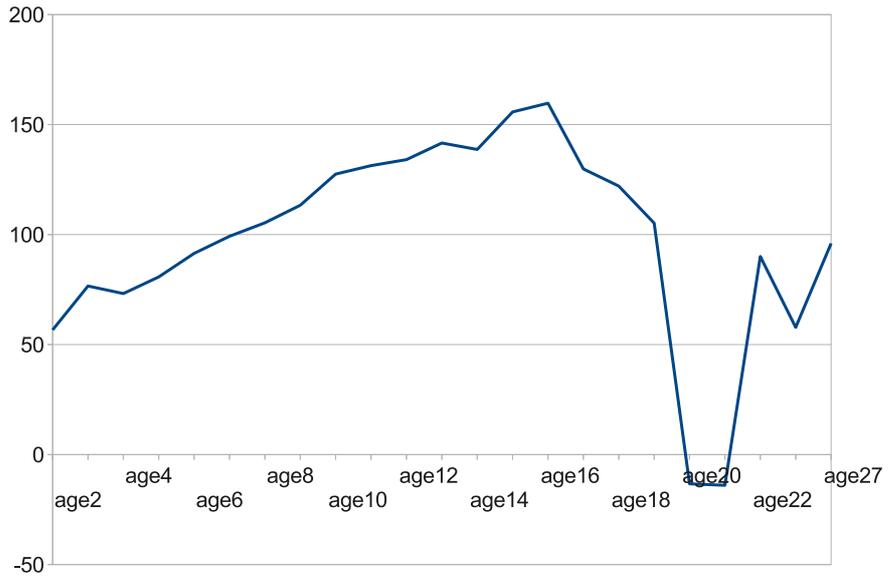


Figure 3.3: Age Effects on Wage for ES Members

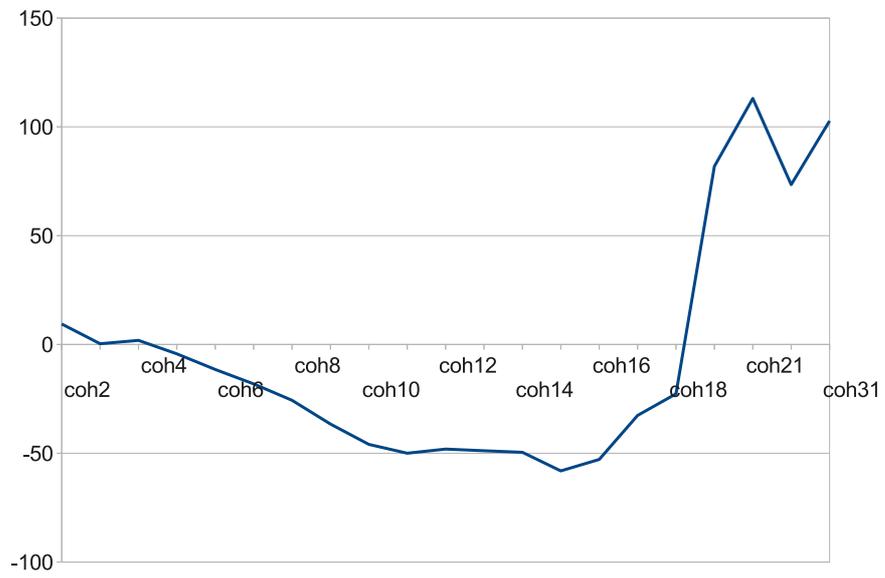


Figure 3.4: Cohort Effects on Wage for ES Members

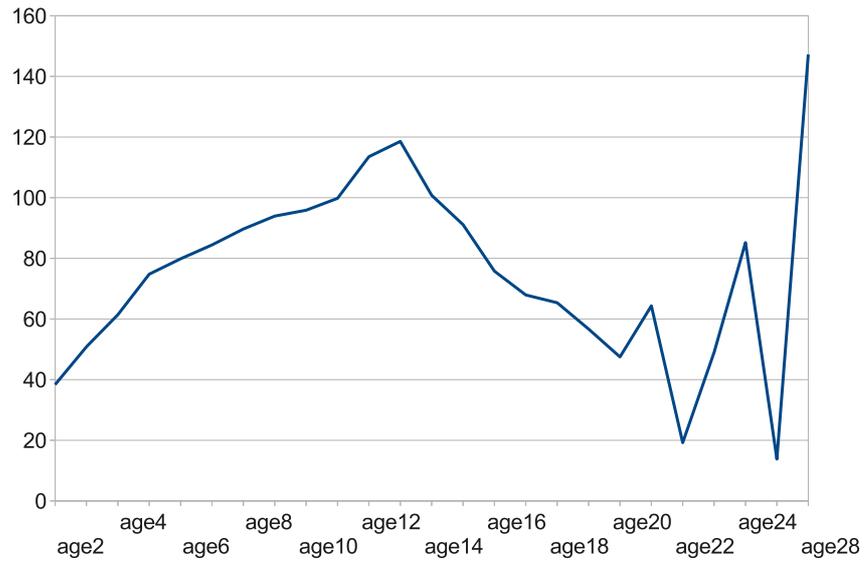


Figure 3.5: Age Effects on Wage for SSK Members

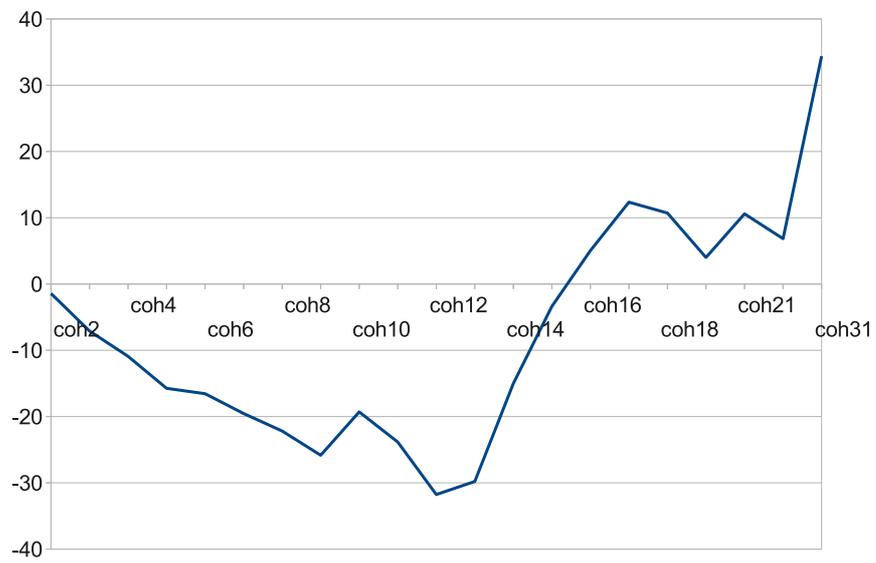


Figure 3.6: Cohort Effects on Wage for SSK Members

3.2.4 Saving Behaviour and Bequests

One other item to be considered is the saving rate. For this section, saving rate is defined as income less consumption expenditure divided by income. Income and expenditure data are available from the Household Budget Survey of TURKSTAT. However, these data are available from household and individual datasets separately, creating the need to merge the datasets appropriately.

First, the individuals dataset has been organised to drop the individuals aged less than 21 and more than 80. Then, model ages that correspond to 2 calendar ages are introduced. Since expenditure data in the household database is available for the household unit, only household heads are kept from the individuals' dataset. That is, the expenditure data can be related to only one individual in the household. However, expenditure data in the household has to be weighted so that it represents an individual rather than a household. This is achieved through the adult equivalent index available in the household data. The index shows how many adults the household represents by taking age into account. Then the household and individual datasets are merged so that expenditure, income and age data for individuals, taken as household heads, are available.

Next step is to clear the data from abnormalities; an extreme example is an individual that displays a saving rate above 10. Then, mean saving rate for each age group is calculated. The resulting dataset has mean saving rate for each model age group. This process has been repeated for 2003, 2004 and 2005 Household Budget Surveys and for members of each social security institution BK, ES and SSK separately.

The adopted methodology is to examine pure age effects after accounting for cohort effects. The methodology relies on the concept of a pseudo panel. This method has been applied above; it is due Deaton and Paxson (1993) and is applied for Turkish micro data by Cilasun (2009). However, as explained previously, year 2004 data introduces complications for definition of birth year cohorts and therefore has been excluded from the analysis.

In accordance with the adopted methodology, age, time and cohort dummies have been added to the created pseudo panel dataset. Dropping a number of dummies that stand for unobserved ages and cohorts, the dummies have been regressed on mean saving rate. Obtained age effects for BK members are presented in Figure 3.7.

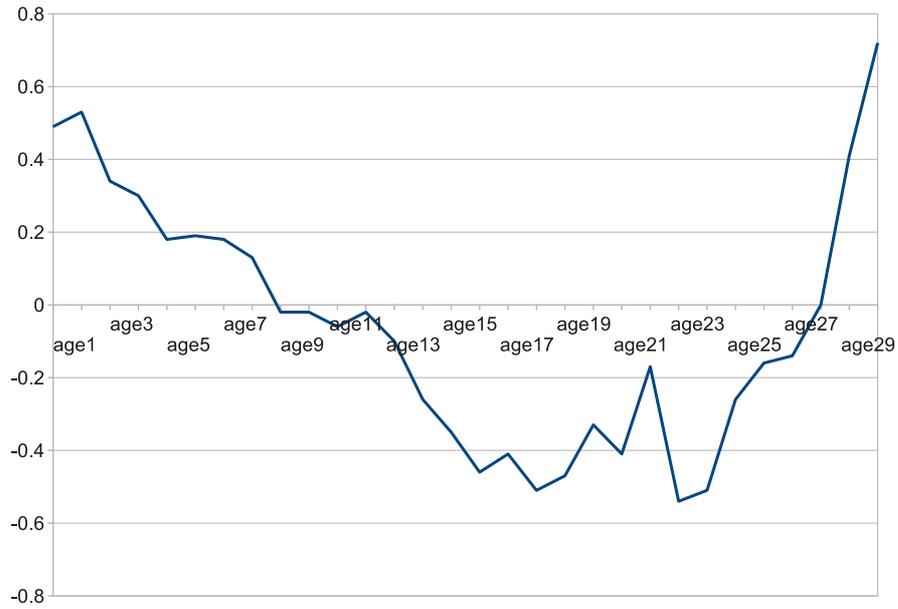


Figure 3.7: Age Effects on Saving Rate for BK Members

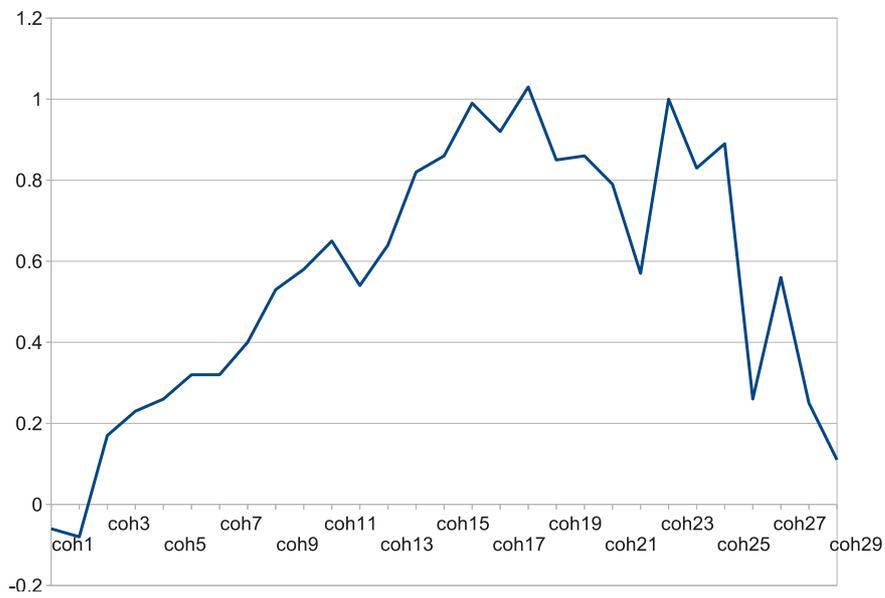


Figure 3.8: Cohort Effects on Saving Rate for BK Members

Striking in this figure is that for most of the lifetime the age effect on the saving rate is decreasing. This presents the possibility that BK members are born with a stock of asset but erode it through time. However, towards the end of the life, the relationship turns positive. That is, being very old has a positive effect on the saving rate. This can be taken to imply that BK members leave some resources behind as they die; or, in other words, some bequest is left by BK members.

Presented in Figure 3.8 are cohort effects on BK saving rates. It should be kept in mind that a higher numbered cohort implies that the individual is born further back in the past. Given this point, Figure 3.8 implies that an individual born in the recent past has a lower saving rate. However, if the birth year is further back in the past, saving rate increases. This increase is reversed after cohort 15; roughly speaking, the BK members born before 1950 have decreasing saving rates.

Next consider the age effects on saving rate for ES consumers. Observed in Figure 3.9 is that age effects are initially decreasing for ES consumers. In other words, getting older has a negative effect on the saving rate. However, the age effects start to increase in the second half of the lifetime and maintain the increasing trend. Similar to the BK case, getting old has a positive effect on the saving rate and points to a bequest leaving behaviour

Corresponding cohort effects for ES members are reported in Figure 3.10. The figure implies that the more distant in the past one is born, higher is the saving rate. However, the final portions of the figure present an irregular relationship. It is not possible to argue in favour of an obvious positive or negative relationship between birth year cohort and saving rate.

Next in this train of thought, consider Figure 3.11, where age effects on saving rate for SSK members are presented. For the first half of the lifecycle, a humpbacked profile is observed. For the first few periods of the lifetime, the effect of increasing age on the saving rate is positive. Later, though, the age effect is decreasing. In the second half of life, age has an increasing effect on the saving rate. Once more the possibility for a bequest leaving behaviour arises.

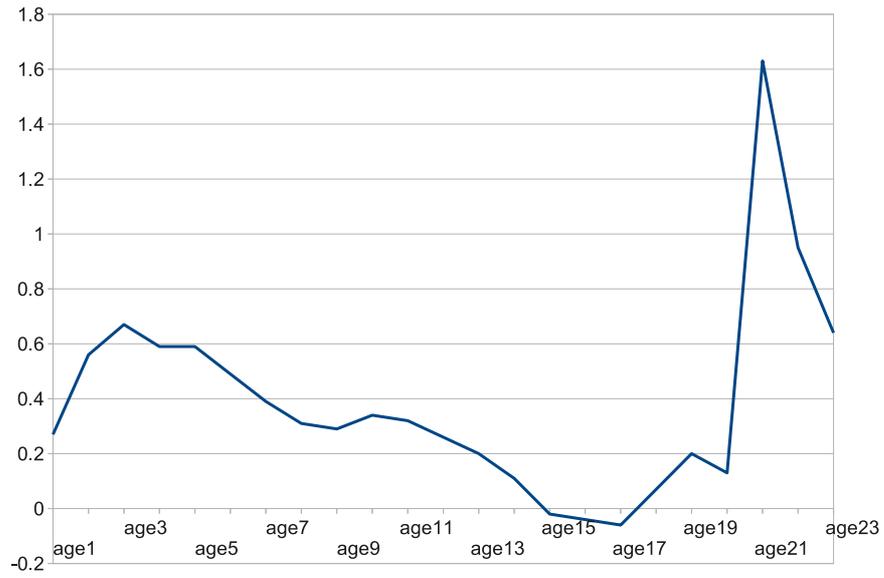


Figure 3.9: Age Effects on Saving Rate for ES Members

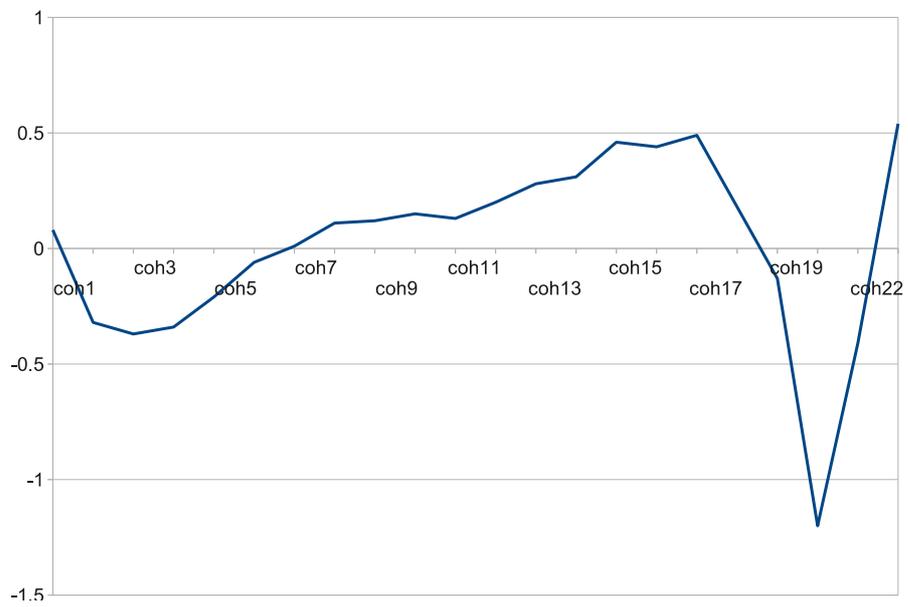


Figure 3.10: Cohort Effects on Saving Rate for ES Members

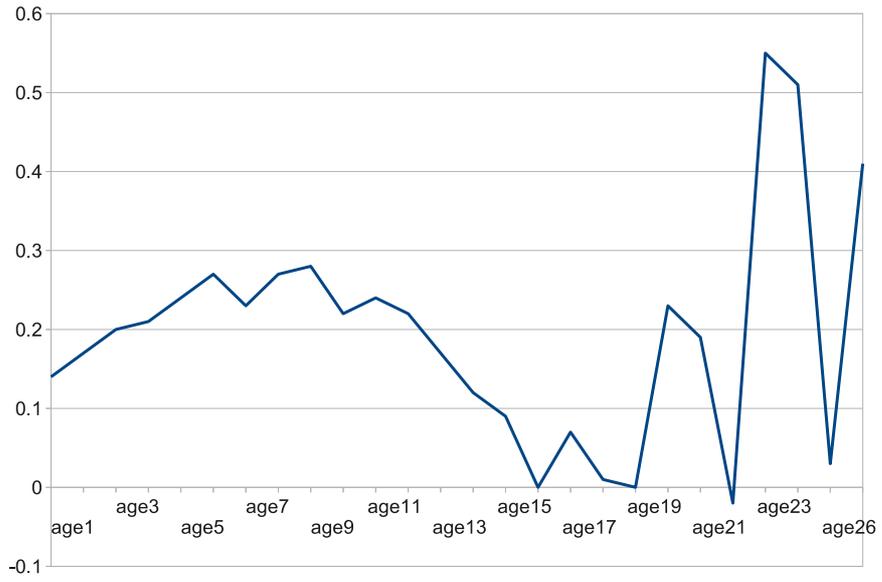


Figure 3.11: Age Effects on Saving Rate for SSK Members

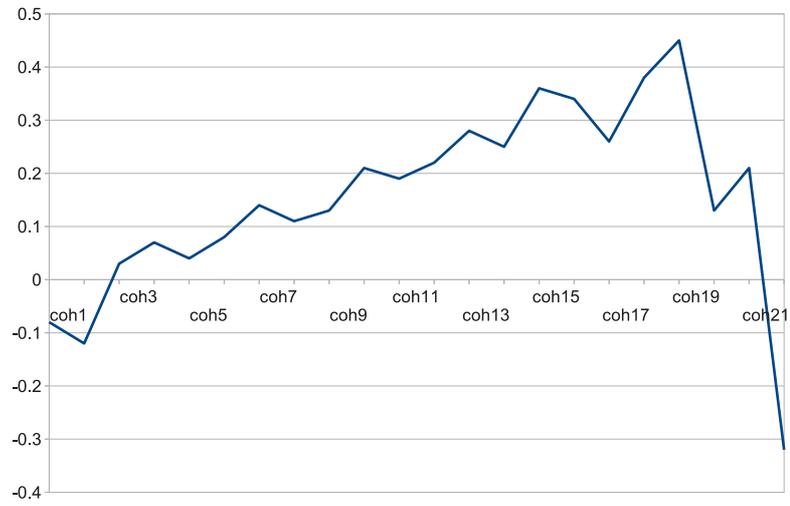


Figure 3.12: Cohort Effects on Saving Rate for SSK Members

Finally, consider the cohort effects on saving rate for SSK members, in Figure 3.12. There is a clear positive relationship. Further in the past is the birth date, higher is the effect on the saving rate.

The analysis conducted in this section has implications in favour of a bequest motive. All the consumers appear to set aside resources at high ages. However, not all seem to receive inheritance. From the previous section, Figure 3.2 shows the levels of asset income and points out that only BK consumers have an asset stock at the beginning of life. Thus it should be assumed that members of all social security institutions leave bequests but only BK members receive an inheritance.

Regarding saving rates; BK members display a consistently decreasing age effect on saving rate (Figure 3.7). Despite the jumps in very early and relatively later ages, ES members also display a negative relationship between age and saving rates (Figure 3.9). A concrete comment for the overall trend is more difficult to extract for SSK members from Figure 3.11.

3.2.5 Government and Social Security Institutions

As discussed above, Turkish social security institutions began to run deficits as of early 1990s. These deficits were financed by the government. Thus the basic model needs to be augmented by three separate social security institutions and their interaction with the government budget.

It is possible to set up social security systems contribution rate and replacement rate parameters so that the institutions display deficits. This can be handled during calibration. Regarding government, there is the need to introduce revenue and expenditure items for the government. Basic revenue item would be the collected tax revenues. In addition to an exogenous government consumption of goods and services, there is the need to let the government budget run deficits, in order to account for the existence of government deficits and government debt stock in Turkish economy.

3.2.6 A Summary of Identified Extensions

Based on the analysis conducted in the second part of this chapter, the items that need to be included to the basic OLG model can be summarised as follows:

- A 2 period model is not adequate to represent the age diversity that would be present in any given economy. Hence lifetime of the consumers is extended to 30 periods.
- There need to be three social security institutions, BK, ES and SSK. These institutions need to be defined so that they can run budget deficits.
- Since social security institution deficits are financed by the government, there is the need to introduce a government. The budget of the government should be set up so as to account for transfers to social security institutions and government budget deficits.
- In order to detail the behavioural differences between members of different social security institutions, three types of representative consumers should be introduced.
- Budget constraints need to be differentiated in order to account for variations in income sources. BK consumers receive only asset income; ES and SSK consumers receive relatively modest asset income and are primarily wage earners.
- ES and SSK consumers receive fluctuating incomes, implying age efficiency indices. These indices allow wage income to fluctuate through lifetime; a phenomenon observed in Figure 3.2. Budget constraints need to be adjusted to include age efficiency indices.
- BK, ES and SSK consumers all leave bequests. This needs to be introduced into the utility functions so that leaving bequests provides utility.
- Only BK consumers receive inheritance; hence representative BK consumer's budget constraint needs to reflect this.
- BK consumers leave more bequests than ES and SSK consumers; the utility parameters need to be calibrated with this observation in mind.

Next chapter deals with formulating a large scale OLG model for the Turkish economy that includes these items.

CHAPTER 4

AN OVERLAPPING GENERATIONS MODEL OF TURKISH SOCIAL SECURITY SYSTEM

The aim of this chapter is to construct the model to be used in the analysis and provide numerical results for the steady state. The chapter can be considered to consist of three main parts. The first part summarises OLG models constructed for various research questions, with an emphasis on social security related constructs. The second part of the chapter introduces the theoretical model constructed in this thesis to analyse social security in Turkey. The third part presents the calibration and the solution for the steady state.

4.1 OLG Model: A Review

Foundations of the OLG models were laid by Samuelson (1958) and Diamond (1965). The construction and numerical solution of large scale OLG models were pioneered by Auerbach and Kotlikoff (1987). The construction of OLG models with details relevant to various research questions became quite common by 2000s.

The research questions addressed by OLG models vary considerably. Stephan, Muller-Furstenberger, and Previdoli (1997) compares models with finitely and infinitely lived agents to determine which is better suited for analysis of global environmental policies. The models are similar with regard to the connections between economy and environment. Pollution has feedback effects to production and carbon emissions are taxed. The two period OLG model does not have altruistic behaviour, hence consideration of future generations in terms of environmental quality is not a concern. The analysis concludes that the approaches are complements rather than substitutes.

In order to analyse wage inequality in US, Heckman, Lochner, and Taber (1998) constructs an OLG model with a detailed human capital accumulation process and skill differences. The model endogenises schooling choice and differentiates between schooling human capital and on the job training related human capital formation. Welfare analysis for workers with different skill levels is conducted. The constructed model is used to assess the wage effects of immigration of low skilled labour, which is an alternative to skill-based technical change as an explanation of wage differentials.

Concerned with why high income households save a higher fraction of income than low income households in US, Huggett and Ventura (2000) constructs an 80 period OLG model. The model includes lifetime uncertainty and labour productivity uncertainty at the individual agent level. Government is also introduced with income taxes, in the form of labour and capital income taxes, and social security taxes. Different specifications of labour endowments, and therefore wage earnings, enable differentiation of consumer incomes and, thus, provides a framework for analysis of saving behaviour by consumers with different income levels.

Stating that wealth is more unequally distributed than earnings in the US, Heer (2001) questions whether intergenerational transfers may account for this stylised fact. Constructing a closed OLG economy with government, Heer (2001) introduces representative consumers living for 60 periods. In order to include the altruistic behaviour, the utility maximising agent is the household that includes one parent and one child. Utility is derived from consumption and the accidental bequest left to the child. Different assumptions on bequest related parameters enable examination of altruistic behaviour in relation to wealth distribution.

Exploiting the OLG model's potential for representing demographic dynamics, Brooks (2004) examines the effect of the baby boom on asset returns. The representative consumer lives for four periods. In the first period, the consumer is a child and is provided for by the parents. In age two, the consumer has a child in turn and has to provide for the child. At age three, the child leaves the parent and the representative consumer works only for himself. Consumer is retired at age four. Cohort size shocks are used to capture the baby boom's effect under the assumption of no borrowing constraint, in one case, and exogenous borrowing constraints in an other.

Social Security Analysis with the OLG Model

The large scale OLG model constructed by Auerbach and Kotlikoff (1987) led the way for the use of OLG models in not only fiscal policy but also social security related research. In Chapter 10 of Auerbach and Kotlikoff (1987), transition to unfunded social security in US with various assumptions on the tax base is examined. Efficiency gains from alternative formulations of social security benefit and tax linkage are also discussed.

Following this lead, İmrohoroğlu, İmrohoroğlu, and Joines (1995) constructs a 65 period OLG model with lifetime uncertainty, accidental bequests and income uncertainty. Calibrated to the US economy, the model is employed to search for optimal social security parameter values. İmrohoroğlu et al. (1995) constitutes a first step in a sequence of research on US social security. Later, Imrohoroglu, Imrohoroglu, and Joines (1999) introduces land as a fixed factor of production to rule out dynamic inefficiency and argue whether the social security system is beneficial for it replaces annuity markets as an insurance against uncertain lifetime. In order to asses the welfare distribution effect of social security, Fuster, Imrohoroglu, and Imrohoroglu (2003) constructs an OLG model with two sided altruism.

More recently, the OLG model has been employed to analyse the social security systems and implemented reforms in various countries. Ferreira (2005) constructs a 55 period OLG model with endogenous labour supply and a deficit-running government in order to compare the effects of alternative pension reforms in Brazil. The model has an endogenous labour social security tax rate, solved to balance the budget of the social security system. The proposed reforms are alternative ways of fully privatising the existing pay-as-you-go social security system of Brazil. The paper concludes that elimination of social security labour tax, by allowing the consumers to choose lifetime distribution of resources freely, causes substantial welfare improvements.

Pensions in Germany are taxed and a reform of the German social security system enacted in 2004 focuses on changing the taxation of pensions. In order to analyse the effects of the reform, Fehr and Jess (2007) constructs an OLG model that differentiates consumers by income classes and occupation types. Members of different occupational types are covered by different pension systems. To reflect the longer life expectation of high income individuals, the rich income class is assumed to have a longer lifetime. Calibrated to the German economy,

the model is used to analyse alternative taxation methods with an emphasis on welfare effects on different types of consumers.

In Italy, the social security reform took on the form of increases in retirement eligibility age. The Berlusconi government increased the retirement age to 60, applicable from January 2008 onward. The Prodi government softened this reform in 2007, fixing retirement age at 58 and introducing a gradual increase to 62. In order to compare the effects of these two reforms, Magnani (2008) constructs a 15 period OLG model. It is concluded that the increase in the retirement age has positive effects on the finances of the social security system in the short run, for people are forced to retire late and keep contributing to the system. However, in the long run, people forced to retire receive high pensions. The long run increase in social security expenditure offsets the short run increase in revenues, raising the possibility that the reform is a temporary solution for Italy.

Following the increase in urban public pension system's replacement rates in 2005, Yang (2009) constructs a two period OLG model. The model takes into account the coexistence of funded and unfunded systems, as is the case for the Chinese social security system. The conducted analysis examines the effects of the increased replacement rates and searches for the optimum replacement rate for China.

Concerned with high pension expenditures, Austrian social security system was reformed from 2000 to 2004 (Jaag, Keuschnigg, & Keuschnigg, 2010, p.572). The reform included changes in pension calculation method and elimination of early retirement opportunities. Jaag et al. (2010) states that increases in retirement age are perceived, by individuals, as an increase in tax. For the time period of paying social security related contributions is extended, more of lifetime resources are claimed by the social security system as contributions. Hence, contributions become an implicit tax from the individual's perspective. Such perception is a labour market dis-incentive and thus social security reform may have adverse effects on labour supply behaviour. In order to assess this, Jaag et al. (2010) proceeds to construct an OLG model with detailed endogenous labour supply behaviour to analyse the labour market impact of social security reform.

The reviewed studies address different questions or analyse policy changes in various countries. The OLG model constructed in each study has unique characteristics required for the specific aim. If labour market is the focus of analysis, the model has a detailed labour mar-

ket structure. If the aim is to analyse reform in a given country, that country's social security system is modelled in detail. In order to analyse the social security reform in Turkey, an OLG model that represents the social security structure of Turkey is constructed and presented in the next section.

4.2 The Model

Given the discussion in Chapter 2 on how to extend the basic model, this section presents a large scale OLG model to analyse social security reform in Turkey. The formulated structure is a 30 period OLG model with three social security institutions and, therefore, three types of consumers. Corresponding to each social security institution is a representative consumer. Aggregation is through introduced population dynamics. The economy is open with government accounts well defined; however, the specifications of government and international connections are relatively simple. This discussion on agent behaviour is followed by the introduction of a SAM (Social Accounting Matrix) that is useful for checking whether the aggregate values calculated through the model are consistent.

4.2.1 Demographics

The lifetime of a representative consumer is assumed to be $GL=30$ periods. At the foundation of the population dynamics is the assumption that the number of age 1 consumers of social security institution s at period $t+1$ is a multiple of the number of age 1 consumers of social security institution s at period t . Letting $N_{1,t,s}$ represent the number of institution s consumers aged 1 at time t , we have:

$$N_{1,t+1,s} = \rho_{t,s} N_{1,t,s} \quad (4.1)$$

where $\rho_{t,s}$ is the growth rate of age 1 cohort from t to $t+1$. Thus, for each social security institution s at time $t+1$, the number of consumers aged 2 is the same as the number of consumers aged 1 at time t . Similarly, number of age 3 consumers at time $t+2$ is equal to the number of age 1 consumers at time t . In general; $N_{g,t+g-1,s} = N_{1,t,s}$, where $g = 1, \dots, GL$ represents age. Extending the same discussion backwards in time would show that the number of consumers in age g cohort at time t is equal to the number of consumers in age 1 cohort at time $t-g+1$; that is, $N_{g,t,s} = N_{1,t-g+1,s}$.

This specification incorporates the idea that the model is populated by three types of consumers, differentiated by employment status and, accordingly, income sources. First group's income is due to capital stock ownership and claims on government's domestic debt stock. This group is under the coverage of social security institution BK. The second group is employed by the government and works in exchange for public wage. These consumers are members of ES. The third group works for the private sector in exchange for market wage and represents the partakers of SSK. Implications of this specification on population growth are discussed in Appendix A.3. ¹

4.2.2 Consumer Behaviour

A representative consumer that lives for GL periods is assumed to derive utility from consumption and bequests left at the end of lifetime. The lifetime utility is defined as:

$$U = \sum_{g=1}^{GL} \beta_s^{g-1} u(c_{g,t+g-1,s}, beq_{g,t+g-1,s}) \quad (4.2)$$

where the index s represents the social security institution, index g represents age and index t represents time. Here $c_{g,t+g-1,s}$ is age g consumption at time $t+g-1$ of the consumer that is in the coverage of social security institution s . Similarly, $beq_{g,t+g-1,s}$ stands for bequest. The parameter β_s is the discount parameter for future consumption. The related instantaneous utility function is assumed to be of constant relative risk aversion form;

$$u(c_{g,t+g-1,s}, beq_{g,t+g-1,s}) = \frac{c_{g,t+g-1,s}^{1-\eta_s}}{1-\eta_s} + \gamma_{g,s} \frac{beq_{g,t+g-1,s}^{1-\eta_s}}{1-\eta_s} \quad (4.3)$$

Here, $\gamma_{g,s}$ is the weight of bequest in instantaneous utility. Note that $\gamma_{g,s} = 0$ when $g \neq GL$ and $\gamma_{g,s} > 0$ when $g = GL$ for it is assumed that bequests are left only at the final period of life. Risk aversion is represented by η_s .

so

Complementary to this parametric differentiation in preferences is the differentiation in material abilities. In accordance with the insights obtained in Chapter 3 regarding micro behaviour,

¹ As a side note; the number of ES members can be regarded as a policy variable for the government. That is, the government may decide to decrease the number of public workers. It is argued in the Appendix A that such a policy can be realized through changing the growth rate of age 1 cohort of public workers, $\rho_{t,es}$, with the note of caution that the growth rate of members of other social security institutions should be realigned in order to preserve aggregate population dynamics.

the resource constraints faced by members of each social security institution will now be considered in turn. Characterisation of representative consumer behaviour for each social security institution is also summarised.

4.2.2.1 BK Consumer

The BK consumer has no wage income but has returns to assets held as the main source of income. There are two types of assets in the economy; capital and government's domestic debt stock. The representative BK consumer has no labour but participates in the production process through supplying capital. It is assumed that the consumer lives for GL periods, of which GW are spent working. Working, in the case of BK consumer, corresponds to being an active member of the social security system. For visualisation purposes, one can assume that the BK consumer is born with a transfer and engages in entrepreneurial activities that enable the consumer to receive asset income through the lifetime. The transfer received at the beginning of lifetime is assumed to be an inheritance receipt that is related to the aggregate bequest stock of the economy at time t .

The BK consumer supplies no labour and receives no wage income. A pension contribution is made out of income to the social security institution BK. After GW periods, this consumer is assumed to retire and receive pension.

Consumers in the model may acquire two types of assets. One of these is a claim on physical capital. Second one is related to the debt stock of the government. As will be explained below in more detail, the social security system and the government are modelled so that they may end up with deficits. The deficits of the social security system are financed by the government whereas the government deficits are financed by borrowing. The consumer is modelled without a portfolio decision behaviour; thus the asset stock of the consumer determines the capital stock, given the domestic debt stock of the government.

Based on these arguments, the budget constraint of a newborn BK consumer is:

$$c_{1,t,bk} + a_{2,t+1,bk} \leq inh_t \quad for \quad g = 1 \quad (4.4)$$

This budget constraint implies that consumption at age 1, $c_{1,t,bk}$, and stock of assets to be left to age 2, $a_{2,t+1,bk}$, are financed by receipts of inheritance. Note that individual is born with no assets, hence $a_{1,t,bk} = 0$ has been imposed. However, a start-up capital for life, may be

available through the received inheritances. The consumer decides on how much to consume and how much to save. Saving is the change in the asset stock. Therefore, for age 1, saving is the asset stock left to age 2; i.e. $a_{2,t+1,bk} - a_{1,t,bk} = a_{2,t+1,bk}$.

For the following periods of lifetime;

$$c_{g,t+g-1,bk} + a_{g+1,t+g,bk} \leq [1 + r_{t+g-1}(1 - \tau_{t+g-1,bk})]a_{g,t+g-1,bk} \quad \text{for } g = 2, \dots, GW \quad (4.5)$$

This reflects that the “working” BK consumer finances consumption, saving and social security contributions solely by asset income. Saving is the the change in asset stock; $a_{g+1,t+g,bk} - a_{g,t+g-1,bk}$. A restatement of this is that asset stock is accumulated through saving.

The working age budget constraint holds until retirement, after which it becomes:

$$c_{g,t+g-1,bk} + a_{g+1,t+g,bk} \leq (1 + r_{t+g-1})a_{g,t+g-1,bk} + pen_{g,t+g-1,bk} \\ \text{for } g = GW + 1, \dots, GL - 1 \quad (4.6)$$

Now the BK consumer is no more a contributor but a recipient of the social security institution. In other words, the consumer becomes a passive member of the social security system. For the final period of lifetime;

$$c_{GL,t+GL-1,bk} + beq_{GL,t+GL-1,bk} \leq (1 + r_{t+GL-1})a_{GL,t+GL-1,bk} + pen_{GL,t+GL-1,bk} \\ \text{for } g = GL \quad (4.7)$$

Consumption and the amount of bequest to be left is financed by available asset income and pension receipt.

The characterization of a representative BK member consumer is through the maximisation of lifetime utility, Equation 4.2, subject to budget constraints in Equations 4.4, 4.5, 4.6 and 4.7. This optimization exercise yields the standard consumption Euler for the BK consumer;

$$u_1(c_{g,t+g-1,bk}, beq_{g,t+g-1,bk}) = \beta_{bk}[1 + r_{t+g}(1 - \tau_{t+g-1,bk})]u_1(c_{g+1,t+g,bk}, beq_{g+1,t+g,bk}) \\ \text{for } g = 1, \dots, GW - 1 \\ u_1(c_{g,t+g-1,bk}, beq_{g,t+g-1,bk}) = \beta_{bk}[1 + r_{t+g}]u_1(c_{g+1,t+g,bk}, beq_{g+1,t+g,bk}) \\ \text{for } g = GW, \dots, GL - 1 \quad (4.8)$$

where $u(\cdot)$ represents the instantaneous utility presented in Equation 4.3 and $u_1(\cdot)$ is the derivative with respect to the first argument. On the left hand side is marginal utility of consumption

at age g . On the right hand side is marginal utility of consumption at age $g+1$ made comparable to age g marginal utility by the interest rate and the intertemporal discount rate. Utility maximising consumption decision requires these marginal utilities to be equal.

For the bequest decision, one obtains:

$$u_1(c_{GL,t+GL-1,bk}, beq_{GL,t+GL-1,bk}) = u_2(c_{GL,t+GL-1,bk}, beq_{GL,t+GL-1,bk}) \quad (4.9)$$

Similar to the consumption Euler, this states that the characterization of the bequest decision relies on equating the marginal utilities of bequest to be left and consumption in the final period of lifetime.

4.2.2.2 ES Consumer

Next consider the representative member of the ES, who works in the public sector in exchange for the public wage. The analysis in Chapter 3 has revealed this wage to be the major source of income for the representative ES consumer accompanied with a relatively modest asset income. Given existence of an asset stock, however minor, a lifetime planning behaviour is introduced for the representative ES consumer as well.

The ES consumer is employed by the government. It is assumed that an ES consumer aged g at time t supplies $e_{g,t,es}$ units of labour. Such a specification of age efficiency in labour supply enables differentiation of wage income received by ES consumers of different ages. In a lifetime of GL periods, GW periods are spent working in exchange for public wage.

Asset stock is accumulated through saving to transfer resources through time and yields interest income. It is assumed that bequests are left in the final period of life. During working life, social security contributions are paid out of wage income to ES. In retirement, pension benefits are received. Given these specifications, the budget constraint of a representative ES consumer in the first period of lifetime is:

$$c_{1,t,es} + a_{2,t+1,es} \leq (1 - \tau_{t,es})w_{t,p}e_{1,t,es} \quad \text{for } g = 1 \quad (4.10)$$

where $e_{1,t,es}$ is age efficiency at age 1 and $w_{t,p}$ is the public wage received by the public workers. Note that no inheritance is received.

For the rest of the working life, the ES consumer faces the following constraint

$$c_{g,t+g-1,es} + a_{g+1,t+g,es} \leq (1 + r_{t+g-1})a_{g,t+g-1,es} + (1 - \tau_{t+g-1,es})w_{t+g-1,p}e_{g,t+g-1,es} \quad \text{for } g = 2, \dots, GW \quad (4.11)$$

The decisions on consumption, $c_{g,t+g-1,es}$, and saving $a_{g+1,t+g,es} - a_{g,t+g-1,es}$, are financed by wage income and the interest return from the existing asset stock. During retirement;

$$c_{g,t+g-1,es} + a_{g+1,t+g,es} \leq (1 + r_{t+g-1})a_{g,t+g-1,es} + pen_{g,t+g-1,es} \quad \text{for } g = GW + 1, \dots, GL - 1 \quad (4.12)$$

Note that wage income is no more available. Consumption and saving decisions are financed by the returns to the existing asset holdings and the pensions received from the social security institution ES. For the final period of life;

$$c_{GL,t+GL-1,es} + beq_{GL,t+GL-1,es} \leq (1 + r_{t+GL-1})a_{GL,t+GL-1,es} + pen_{GL,t+GL-1,es} \quad \text{for } g = GL \quad (4.13)$$

No asset stock is left after lifetime; that is, $a_{GL+1,t+GL,es} = 0$. However, there is a bequest expenditure at the final period of lifetime. The consumption and bequest decisions are financed by pensions and the interest return to the existing asset stock. The characterization of the behaviour of the representative ES consumer includes maximisation of the lifetime utility function, Equation 4.2, subject to the budget constraints in Equations 4.10, 4.11, 4.12 and 4.13.

This optimisation exercise yields two basic results. First is the consumption Euler equation;

$$u_1(c_{g,t+g-1,es}, beq_{g,t+g-1,es}) = \beta_{es}(1 + r_{t+g})u_1(c_{g+1,t+g,es}, beq_{g+1,t+g,es}) \quad \text{for } g = 1, \dots, GL - 1 \quad (4.14)$$

This basically states that the consumption decision for two consecutive periods is reached by comparing the marginal utilities of consumption in these two time periods, with the marginal utility of future consumption made comparable to marginal utility of current consumption by the interest rate and the intertemporal discount parameter for ES consumers.

Second basic conclusion from the characterisation process is:

$$u_1(c_{GL,t+GL-1,es}, beq_{GL,t+GL-1,es}) = u_2(c_{GL,t+GL-1,es}, beq_{GL,t+GL-1,es}) \quad (4.15)$$

That is; the decision of bequest to be left is based on a comparison of marginal utility of consumption in the last period of life and the marginal utility of bequest to be left.

4.2.2.3 SSK Consumer

The final group of consumers are members of SSK. The members of SSK are basically the workers in the private sector; those who work in exchange for wage or salary. In accordance with the discussions in Chapter 3, the major source of income for a representative SSK member will be private wage income, backed up by a relatively small asset income. Age efficiency indices, $e_{g,t,ssk}$, imply that SSK consumer supplies different levels of labour at different ages and account for the fluctuation of wage income through the lifetime. Bequest decision is also introduced for the SSK consumer. The budget constraint for the first period of life is;

$$c_{1,t,ssk} + a_{2,t+1,ssk} \leq (1 - \tau_{t,ssk})w_t e_{1,t,ssk} \quad \text{for } g = 1 \quad (4.16)$$

Note that wage income denoted w_t is private sector wage and not public wage. During the other periods of the working lifetime;

$$c_{g,t+g-1,ssk} + a_{g+1,t+g,ssk} \leq (1 + r_{t+g-1})a_{g,t+g-1,ssk} + (1 - \tau_{t+g-1,ssk})w_{t+g-1}e_{g,t+g-1,ssk} \\ \text{for } g = 2, \dots, GW \quad (4.17)$$

will hold whereas during retirement:

$$c_{g,t+g-1,ssk} + a_{g+1,t+g,ssk} \leq (1 + r_{t+g-1})a_{g,t+g-1,ssk} + pen_{g,t+g-1,ssk} \\ \text{for } g = GW + 1, \dots, GL - 1 \quad (4.18)$$

will be the budget constraint. The material abilities in the final period of lifetime will be summarised by:

$$c_{GL,t+GL-1,ssk} + beq_{GL,t+GL-1,ssk} \leq (1 + r_{t+GL-1})a_{GL,t+GL-1,ssk} + pen_{GL,t+GL-1,ssk} \\ \text{for } g = GL \quad (4.19)$$

where the bequest expenditure has been integrated. The characterisation of behaviour for the representative SSK consumer involves maximising the lifetime utility in Equation 4.2 subject to the budget constraints summarised by Equations 4.16, 4.17, 4.18 and 4.19. As was the case for the BK and ES consumers, two major results obtained from this exercise. Firstly;

$$u_1(c_{g,t+g-1,ssk}, beq_{g,t+g-1,ssk}) = \beta_{ssk}(1 + r_{t+g})u_1(c_{g+1,t+g,ssk}, beq_{g+1,t+g,ssk}) \\ \text{for } g = 1, \dots, GL - 1 \quad (4.20)$$

Equation 4.20 is the consumption Euler equation that governs the choice of consumption sequence. Second result is:

$$u_1(c_{GL,t+GL-1,ssk}, beq_{GL,t+GL-1,ssk}) = u_2(c_{GL,t+GL-1,ssk}, beq_{GL,t+GL-1,ssk}) \quad (4.21)$$

where marginal utilities of consumption in the final period of lifetime and bequest to be left are equated.

4.2.2.4 Bequests and Inheritance

At any time period t , all the consumers in the final period of their life are assumed to set aside an amount as bequest. These bequests are assumed to be gathered by a fictional agency to be equally distributed to all the newborn BK consumers at time period t . Thus the amount of inheritance at time t is:

$$inh_t = \frac{\sum_{s=bk,es,ssk} beq_{GL,t,s} N_{GL,t,s}}{N_{1,t,bk}} \quad (4.22)$$

4.2.3 Production

Production side of the economy is represented by a single sector that includes profit maximising firms engaged in perfect competition. The inputs used are private labour supplied by the active members of SSK, $L_{t,ssk}$ and capital, K_t .²

Production is assumed to take place in accordance with a Cobb-Douglas production function that displays constant returns to scale and labor-augmenting technological growth:

$$Y_t = K_t^\alpha (\Gamma_t L_{t,ssk})^{1-\alpha} \quad (4.23)$$

where Γ_t represents technology and α is the share of capital in production. Technology is assumed to grow at rate θ so we have:

$$\Gamma_{t+1} = \theta_t \Gamma_t \quad (4.24)$$

The physical capital accumulation is a result of the interaction between consumer asset stock accumulation and the debt stock of the government; this setup will be explained in more

² The index of SSK is adopted for conceptual clarity; the consumers that supply labour to the production process are under the coverage of the social security institution SSK.

detail below in Section 4.2.5. Labour supply available for production is the sum of the labour supplies of consumers under the coverage of SSK; that is, $L_{t,ssk} = \sum_{g=1}^{GL} e_{g,t,ssk} N_{g,t,ssk}$.

A portion, τ_t , of output is claimed by the government as tax. Employment of labour by firm leads to wage payment and contribution payments by employers to social security institution SSK. Employment of a unit of efficient labour by the firm has the cost of $(1 + \tau_{t,eSSK})\hat{w}_t$ where $\tau_{t,eSSK}$ represents the contribution rate to be paid and \hat{w}_t is efficient wage; i.e. wage per technology augmented labour. The employer contribution rate should not be confused with the contribution rate paid to SSK by the representative consumer out of wage income; i.e. $\tau_{t,ssk}$.

The profit function therefore is stated as:

$$\Pi_t = (1 - \tau_t)Y_t - (1 + \tau_{t,eSSK})\hat{w}_t(\Gamma_t L_{t,ssk}) - r_t K_t \quad (4.25)$$

Solving the profit maximisation problem yields;

$$\hat{w}_t = \frac{1 - \tau_t}{1 + \tau_{t,eSSK}} (1 - \alpha) K_t^\alpha (\Gamma_t L_{t,ssk})^{-\alpha} \quad (4.26)$$

as wage per efficient private worker and

$$r_t = (1 - \tau_t) \alpha K_t^{\alpha-1} (\Gamma_t L_{t,ssk})^{1-\alpha} \quad (4.27)$$

as the interest rate. Note, however, that the wage income received by consumers is not based on wage per efficient labour but rather on wage per worker. This wage is defined as:

$$w_t = \frac{1 - \tau_t}{1 + \tau_{t,eSSK}} (1 - \alpha) \Gamma_t K_t^\alpha (\Gamma_t L_{t,ssk})^{-\alpha} \quad (4.28)$$

4.2.4 Social Security System

The social security system is formulated around three social security institutions indexed by $s = bk, es, ssk$. These institutions are financed by the social security contributions paid by consumers and employers. Contributions collected at any time period t are distributed to the beneficiaries of the social security institutions; thus the social security system is in essence a pay-as-you-go (PAYG) system.

For BK, contributions are collected from the returns to asset holdings of working age consumers. The passive consumers under the coverage of BK receive benefits proportional to the

income received at the last working age. The pension of age g representative consumer of BK at time t is calculated as:

$$pen_{g,t,bk} = rep_{t-g+GW,bk}(r_{t-g+GW} a_{GW,t-g+GW,bk}) \quad g = GW + 1, \dots, GL \quad (4.29)$$

That is, pensions are paid with a replacement rate, rep , that provides a portion of pre-retirement income. For the case of BK consumers, this is the interest earning due to asset stock.

In aggregate terms, the budget of the social security institution BK at time t is summarised as;

$$DEF_{t,bk} = \sum_{g=GW+1}^{GL} pen_{g,t,bk} N_{g,t,bk} - \sum_{g=1}^{GW} \tau_{t,bk} r_t a_{g,t,bk} N_{g,t,bk} \quad (4.30)$$

This equation states that the excess of spending of BK over revenues constitutes a deficit; $DEF_{t,bk}$. Should the deficit be zero, BK runs a balanced budget.³

For ES, a portion of contributions are paid either out of receipt of public wage due ES consumers whereas an other portion is paid by the government, which is the employer of ES members. Pensions are set through the replacement ratio so that a portion of pre-retirement income is guaranteed. Specifically;

$$pen_{g,t,es} = rep_{t-g+GW,es} e_{GW,t-g+GW,es} w_{t-g+GW,p} \quad g = GW + 1, \dots, GL \quad (4.31)$$

This implies the budget constraint of ES as;

$$DEF_{t,es} = \sum_{g=GW+1}^{GL} pen_{g,t,es} N_{g,t,es} - \sum_{g=1}^{GW} \tau_{t,es} w_{t,p} e_{g,t,es} N_{g,t,es} - \sum_{g=1}^{GW} \tau_{t,eES} w_{t,p} e_{g,t,es} N_{g,t,es} \quad (4.32)$$

First term on the right hand side is the expenditure of ES. Second term represents the contributions paid by the consumers under the coverage of ES out of public wage income. Last term on the right hand side is the contribution payment made by the government to ES as the employer of active ES members.

A set of policy experiment options are open to this specification as well. One may, for instance, examine the effect of changes in public wage on contribution rates required to balance the ES budget. One may play with replacement rates and examine the effect on ES deficits.

Lastly consider SSK, partakers of which are the consumers that work in the private sector in exchange for private wage. The actives of SSK pay contributions out of wage income. For a

³ It is possible to come up with alternative formulations on this equation to address a number of questions. For example, given replacement rate, one may look for the contribution rate that leads to a decreasing deficit.

given replacement rate, SSK pension received by an age g passive at time t is defined as:

$$pen_{g,t,ssk} = rep_{t-g+GW,ssk} e_{GW,t-g+GW,ssk} w_{t-g+GW} \quad g = GW + 1, \dots, GL \quad (4.33)$$

where w_t is the market wage, not to be confused with the exogenous public wage, $w_{t,p}$. SSK has the following budget constraint:

$$DEF_{t,ssk} = \sum_{g=GW+1}^{GL} pen_{g,t,ssk} N_{g,t,ssk} - \sum_{g=1}^{GW} \tau_{t,SSK} w_t e_{g,t,ssk} N_{g,t,ssk} - \sum_{g=1}^{GW} \tau_{t,ES} w_t e_{g,t,ssk} N_{g,t,ssk} \quad (4.34)$$

This budget equation implies that expenditures of SSK are financed by contributions collected from active SSK members and private sector employers. Any excess of expenditure over revenues constitutes a deficit. A set of experiment options are open for SSK as well, along the lines briefly stated for BK and ES.

4.2.5 Government and International Economy

The government and international economic relations defined in this model are relatively simple. Government receives taxes out of production by the rate τ_t . Government consumption is assumed to be exogenous, denoted G_t . As an employer, government makes social security payments to ES; $GOV_ES_t = \sum_{g=1}^{GW} \tau_{t,eS} e_{g,t,es} w_{t,p} N_{g,t,es}$. An other expenditure item is the wage payments made to the public employees. The choice of public wage is exogenously performed by the government.

Should the social security institutions run a deficit, the deficit is covered by the government. Thus one other expenditure item of the government is the transfers made to the social security institutions. It is possible for the government to run a deficit itself. The government's deficits are assumed to be financed out of borrowing through issuing debt instruments. The borrowing is carried out from domestic or foreign sources. Thus the accumulated debt stock consists of domestic debt and foreign debt.

The government budget constraint is, therefore, defined as:

$$\tau_t Y_t + DEB_{t+1} + DEB_{f,t+1} = (1 + r_t) DEB_t + (1 + r_{f,t}) DEB_{f,t} + G_t + \sum_{g=1}^{GW} w_{t,p} e_{g,t,es} N_{g,t,es} + GOV_ES_t + DEF_{t,bk} + DEF_{t,es} + DEF_{t,ssk} \quad (4.35)$$

First term on the left hand side is the tax revenue of the government. This is followed by next period domestic and foreign debt stocks of the government, respectively. The first two terms

on the right side of the equation are foreign and domestic debt stocks and interest payments on debt stock. Note that a foreign interest rate applies on the interest payment on the foreign debt stock.

Government consumption, G_t , is followed by the wage payment by government to public workers. Next is the government payment to ES, GOV_ES_t , due to accrued social security payments for the government is an employer. Last three terms are the transfers from government to social security institutions done in order to cover the deficits of the social security institutions.

Regarding international flows, there exist imports, exports, borrowing from the rest of the world and interest payments to the rest of the world due to the foreign debt stock. Imports are defined as a portion, mpi , of the national income; $M_t = mpiY_t$. Thus the international economic flows are defined as:

$$M_t + r_{f,t}DEB_{f,t} = BOR_{f,t} + X_t \quad (4.36)$$

where $BOR_{f,t} = DEB_{f,t+1} - DEB_{f,t}$ is the foreign borrowing and X_t is exports. Given exogenous path for foreign debt, this equation solves for exports.

4.2.6 Equilibrium

The definition of the equilibrium in this model is as follows:

An equilibrium for the model consists of sequences of consumption choices, asset stock decisions, bequest decisions and factor of production demands such that

- i) Given social security policies, received inheritance inh_t , wage rate w_t and interest rate r_t , consumer under the coverage of any social security institution s chooses consumption sequence $\{c_{g,t+g-1,s}\}_{g=1}^{GL}$, asset stock sequence $\{a_{g,t+g-1,s}\}_{g=2}^{GL}$ and bequest $\{beq_{GL,t+GL-1,s}\}$ so that lifetime utility is maximized subject to budget constraints.*
- ii) Given factor prices w_t and r_t firms demand capital K_t and labour $L_{t,ssk}$ at each time period t so as to maximize profits.*

- iii) *Social security institution budgets as defined in Equations 4.30, 4.32 and 4.34 hold at each time period t .*
- iv) *Government budget as it was stated in Equation 4.35 holds at each time period t .*
- v) *Labour market clears at each time period t .*
- vi) *Asset market clears at each time period t .*
- vii) *The good market clears at each time period t .*

The first three items in this list are self explanatory. Consumer optimisation problems have been stated in the sections above and the Euler equations that result from these characterisation processes have been presented as Equations 4.8 and 4.9 for BK, Equations 4.14 and 4.15 for ES and finally as Equations 4.20 and 4.21 for SSK. The result of the characterisation of profit maximisation is presented in Equations 4.27, 4.26 and 4.28. These three equations are stated as factor prices; they can be manipulated algebraically to represent factor demand by firm given factor prices. The budgets of social security institutions are available in Equations 4.30, 4.32 and 4.34. ⁴

The fourth item is also self-explanatory but implies a number of policy experiments. For example, given budget status of social security institutions, one may investigate the tax rate choices that would decrease the debt stock of the government. As part of a fiscal policy analysis, one may investigate the path foreign and domestic borrowing must follow to reduce the tax rate.

The fifth item states the market clearance condition for labour Labour supply is inelastic and every age g private sector worker supplies $e_{g,t,ssk}$ units of labour The available labour supply is assumed to be employed by the private production sector so that;

$$L_{t,ssk} = \sum_{g=1}^{GL} e_{g,t,ssk} N_{g,t,ssk} \quad (4.37)$$

Thus the wage Equations 4.26 and 4.28 solve for the factor prices, given equilibrium labour quantity and asset stock. ⁵

⁴ A set of alternative implications of social security institution budgets have already been stated. To remember, consider an example; one may take deficit and replacement rate as given to solve for the contribution rate to make the budget of the institution hold. Similarly, factor demand equations may be manipulated for alternative questions. One may take both private wage and private labour as exogenous to solve for unemployment. Thus the model setup has implications for a set of specifications.

⁵ An other endogenous variable like unemployment may be introduced in this setup, if private wage is given.

The sixth item is related to asset market clearance. The consumers hold physical capital and government debt. The model does not have a portfolio decision setup for the consumer. All the assets have the same return. The asset market clears according to:

$$\sum_{s=bk,es,ssk} \sum_{g=1}^{GL} a_{g,t,s} = K_t + DEB_t \quad (4.38)$$

The asset holdings of consumers of various ages at time t , $a_{g,t,s}$, is a result of the consumer's optimisation problem. The path for the domestic debt stock is exogenous to the model. Then, the asset market equilibrium solves for the capital stock in the economy. Given the capital stock, interest rate is obtained from Equation 4.27 of the firm profit maximisation problem.

The last item states that goods market clears;

$$Y_t = C_t + I_t + G_t \quad (4.39)$$

where $I_t = K_{t+1} - K_t$. The derivation of this condition from consumer budget constraints is available in the mathematical appendix. As an extension to that derivation;

$$S_t = I_t + BOR_t$$

holds for the model, with $BOR_t = DEB_{t+1} - DEB_t$.

4.2.7 Macroeconomic Framework

In order to present the macroeconomic framework of the model, a SAM (Social Accounting Matrix) has been created. A SAM is a snapshot of the economy at a given point in time; it provides a static picture of the economy for that year. It includes revenues and expenditures of agents and accounts of the economy. Basically, rows record flows of revenues whereas columns summarise expenditure flows. In a general equilibrium framework, row and column sums of a SAM should match, implying that all expenditures and revenues in the economy are accounted for. The SAM for the current model is presented in Table 4.1 with X pointing the cells where there should be data due to the setup of the model presented so far.

The first row of the SAM accounts for the uses of the output from production activity. The column counterpart of activity row keeps track of expenditures related to production. First three items on activity row are consumption by consumers of different social security institutions. Given the consumption behaviour by the representative consumer of social security

institution s , these three cells are:

$$C_{t,s} = \sum_{g=1}^{GL} c_{g,t,s} N_{g,t,s} \quad (4.40)$$

On the government column of this row is government consumption expenditure on goods and services. This is exogenously given as G_t . The last column of this row records investment on physical capital stock;

$$I_t = K_{t+1} - K_t \quad (4.41)$$

Last column on this row is the revenue of activity account from the rest of the world. This cell records exports. Due Equation 4.36, exports are defined as:

$$X_t = BOR_{f,t} - M_t - r_{f,t} DEB_{f,t} \quad (4.42)$$

Second and third rows in the SAM are income receipts of factors of production. Specifically, on the row that corresponds to labour and activity column there is:

$$W_t = w_t L_{t,ssk} \quad (4.43)$$

This is the labour earning due to participation in production in the private sector. Also on the same row but on the column of government is the wage receipt of labour from the government;

$$W_{t,p} = w_{t,p} L_{t,es} \quad (4.44)$$

For the capital row we have

$$R_t = r_t K_t \quad (4.45)$$

which is the return to capital from the production process.

Fourth, fifth and sixth rows show income items of consumers. First consider the BK consumers on the fourth row. Along this row, on the column that corresponds to the social security institution BK are the pension receipts of retired BK consumers from the BK institution;

$$\sum_{g=GW+1}^{GL} pen_{g,t,bk} N_{g,t,bk} \quad (4.46)$$

Next on this row is the asset income of BK consumers, listed on the asset returns column;

$$\sum_{g=1}^{GL} r_t a_{g,t,bk} N_{g,t,bk} \quad (4.47)$$

Table 4.1: Social Accounting Matrix

	Activity	Labour	Capital	HHbk	HHes	HHssk	BK	ES	SSK	Government	S/I	Asset Returns	Inh/Beq	ROW
Activity				X	X	X				X	X			X
Labour	X									X				
Capital	X													
HHbk							X					X	X	
HHes		X						X				X		
HHssk		X							X			X		
BK				X						X				
ES					X					X				
SSK	X					X				X				
Government	X										X			
S/I				X	X	X								X
Asset Returns			X							X				
Inh/Beq				X	X	X								
ROW	X											X		

Note: X denotes a cell with an entry. The model does not cover the empty cells.

Last on the BK consumer row is the inheritance receipt of newborn BK consumers;

$$inh_t N_{1,t,bk} \quad (4.48)$$

Next consider the revenues of ES consumers summarised on the fifth row. First at the intersection of this row and the labour column is the public wage income of ES consumers due to employment by the government;

$$\sum_{g=1}^{GW} w_{t,p} e_{g,t,es} N_{g,t,es} \quad (4.49)$$

Second item along this row is the pension receipts of retired ES consumers from social security institution ES;

$$\sum_{g=GW+1}^{GL} pen_{g,t,es} N_{g,t,es} \quad (4.50)$$

Returns from the asset holdings of ES consumers is summarised at the asset returns column on the same row;

$$\sum_{g=1}^{GL} r_t a_{g,t,es} N_{g,t,es} \quad (4.51)$$

On the sixth row are the revenues of SSK consumers. These consumers supply labour to the private sector in exchange for the market wage. The wage income is recorded in the cell at the intersection of this row and labour column as:

$$\sum_{g=1}^{GW} w_t e_{g,t,ssk} N_{g,t,ssk} \quad (4.52)$$

Next on this row is the pension receipts of SSK consumers from social security institution SSK;

$$\sum_{g=GW+1}^{GL} pen_{g,t,ssk} N_{g,t,ssk} \quad (4.53)$$

Last on this row is the asset return received by the SSK consumers, recorded on the asset returns column:

$$\sum_{g=1}^{GL} r_t a_{g,t,ssk} N_{g,t,ssk} \quad (4.54)$$

On the seventh, eighth and ninth rows are the revenues of social security institutions. Consider the row for BK. First on this row are contribution receipts from consumers under the coverage of BK, collected from asset income of BK consumers;

$$\sum_{g=2}^{GW} \tau_{t,bk} r_t a_{g,t,bk} N_{g,t,bk} \quad (4.55)$$

Any deficit of the social security institutions are covered by the government. The transfer received by BK from the government is recorded on this row, at the government column, as $DEF_{t,bk}$.

On row eight are revenues of ES. Contributions collected from working age consumers covered by ES are located on this row and the ES consumer column;

$$\sum_{g=1}^{GW} \tau_{t,es} w_{t,p} e_{g,t,es} N_{g,t,es} \quad (4.56)$$

Next to be mentioned on this row is the intersection of ES row and government column. This entry requires care for it records two flows. One of these is the contribution payments from the government to ES, for the government is the employer of public workers and pays contributions, $GOV_{ES}_t = \sum_{g=1}^{GW} \tau_{t,eES} e_{g,t,es} w_{t,p} N_{g,t,es}$. Secondly, government covers the deficit of social security institution ES, $DEF_{t,es}$. Hence this cell records;

$$DEF_{t,es} + \sum_{g=1}^{GW} \tau_{t,eES} e_{g,t,es} w_{t,p} N_{g,t,es} \quad (4.57)$$

On the ninth row are the revenue items of SSK. First on this row is the contribution payments from the employers of private workers;

$$\sum_{g=1}^{GW} \tau_{t,eSSK} w_t e_{g,t,ssk} N_{g,t,ssk} \quad (4.58)$$

The contributions collected out of wage incomes of working SSK consumers are recorded as;

$$\sum_{g=1}^{GW} \tau_{t,ssk} w_t e_{g,t,ssk} N_{g,t,ssk} \quad (4.59)$$

at the intersection of this row and SSK consumer column. The deficit of SSK, covered by the government, is recorded as $DEF_{t,ssk}$ on the government column.

On row ten are the revenues of the government. First is the tax collected from the production activity $\tau_t Y_t$. An other source of income for the government is the realised domestic borrowing which, in essence, is the change in the domestic debt stock of the government; $BOR_t = DEB_{t+1} - DEB_t$. A final source of revenue for the government is borrowing from the rest of the world; $BOR_{f,t} = DEB_{f,t+1} - DEB_{f,t}$. Both domestic and foreign borrowing of the government are recorded on the government row and S/I column.

On row eleven are the revenues of the saving/investment account, S/I in short. This account has the task of balancing the changes in asset stocks. Remember that consumers may hold two

types of assets, capital and government domestic debt, but do not have an explicit portfolio decision that governs how much to invest in which asset. Rather, consumers are viewed to acquire, through saving, a homogeneous asset stock and obtain return from this asset stock. The S/I account enables balancing the changes in asset holding of consumers with the sources of the assets. Also, the task of tracking foreign borrowing by the government is also performed by this account.

The first item on S/I row are savings by consumers. In a generic form;

$$\sum_{g=1}^{GL-1} (a_{g+1,t+1,s} - a_{g,t,s})N_{g,t,s} \quad (4.60)$$

where $s = bk, es, ssk$ enables tracing saving by members of three social security institutions. Note that saving is simply the change in the asset holding of consumers so that in aggregate terms one can state that saving is the change in the asset stock: $S_t = A_{t+1} - A_t$. On the intersection of the S/I row and the ROW column is borrowing by the government from the rest of the world; $BOR_{f,t}$.

On the corresponding columns of S/I account are investment and government borrowing. The identity of the S/I column and row sums states $S_t + BOR_{f,t} = I_t + BOR_t + BOR_{f,t}$; saving is equal to the sum of investment and domestic government borrowing. In stock terms, $A_{t+1} - A_t = K_{t+1} - K_t + DEB_{t+1} - DEB_t$. That is, changes in the asset stock held by consumers is equal to the sum of the changes in capital stock and government's domestic debt stock.

Each type of asset creates an interest income. Physical capital yields interest income due to being used in the production process. Government pays interest on debt. Consumers receive interest earnings simply by holding these assets. Foreign debts accrues an interest payment to the rest of the world. These flows of asset returns are accounted for by row and column twelve, titled Asset Returns. On this row are interest earnings of capital at the intersection with the capital column and interest payments on foreign and domestic debt at the intersection with the government column. On the asset returns column are the asset incomes of households and government's interest payment to the rest of the world, $r_{f,t}DEB_{f,t}$.

The S/I and Asset Returns accounts form a crude financial market. Changes in asset stocks and returns to asset stocks are accounted separately. It is argued in the mathematical appendix that when taken together, these two accounts balance simply because each of these accounts are in balance.

The row before the last traces the bequests left by the consumers at the final age of their life as;

$$\sum_{s=BK,ES,SSK} beq_{GL,t,s} N_{GL,t,s} = inh_t N_{1,t,BK} \quad (4.61)$$

With $s = BK, ES, SSK$ one can trace the bequests left by members of all three social security institutions, as was stated for saving above.

Last row and column, labelled ROW, account for international flows. In accordance with Equation 4.36, this account claims:

$$M_t + r_{f,t} DEB_{f,t} = BOR_{f,t} + X_t$$

That is, injection of resources into the economy from the rest of the world, $BOR_{f,t} + X_t$, are balanced by leakages, $M_t + r_{f,t} DEB_{f,t}$. One may also visualise that $X_t - M_t$ is the current account balance and $r_{f,t} DEB_{f,t} - BOR_{f,t}$ is the capital account balance. Thus, the balance of payments is in balance for this economy.

4.3 SAM, Calibration and the Steady State

The aim of this section is to present the underlying principles to be employed for the calibration of the proposed model to the steady state equilibrium. The model is calibrated to year 2007. The choice is due to the fact that just after year 2007, laws 5510 and 5754 are in effect and the reform process is complete.

This section starts with the discussion on calibration of population related parameters. This is followed by SAM construction, which includes explanations on how the SAM is balanced. Making use of the constructed SAM, model parameters are calibrated.

4.3.1 Demographics

It should be noted that the aggregate population to be considered in the model is the formal population; i.e. the actives and passives covered by the social security institutions. The actives are the people of working age and pay contributions to the relevant social security institutions. The passives are the retirees who receive pensions. Due to lack of detailed data on population coverage of the social security system, especially in terms of population projection, aggregate population is used to obtain population growth rates.

Remember from Equation 4.1 that the demographic structure evolves according to

$$N_{1,t+1,s} = \rho_{t,s} N_{1,t,s} \quad s = bk, es, ssk$$

Here, the values for the three $\rho_{t,s}$ parameters need to be determined. At the steady state, these three parameters will be equal and time invariant; $\rho_{t,s} = \rho$. Also at the steady state, this parameter will be equal to the aggregate population growth rate.

It is also necessary to have age 1 cell size at year 2007, i.e. the number of people of model age 1 at year 2007. This data is necessary for members of each social security institution in order to trigger the population dynamics of the model. The adopted calibration strategy for age 1 cell sizes, $N_{1,t,s}$, relies on the requirement that population growth rate at the steady state has to be constant.

The population at time t under the coverage of social security institution s is

$$N_{t,s} = N_{1,t,s} + N_{2,t,s} + N_{3,t,s} + \dots + N_{30,t,s}$$

If the economy is on the balanced growth path, $N_{2,t,s} = N_{1,t-1,s} = \frac{N_{1,t,s}}{\rho}$. Through recursive computation, this can be generalised to $N_{g,t,s} = \frac{N_{1,t,s}}{\rho^{g-1}}$ for $g=2 \dots 30$. Then, for the aggregate population;

$$\begin{aligned} N_{t,s} &= N_{1,t,s} + \frac{N_{1,t,s}}{\rho} + \frac{N_{1,t,s}}{\rho^2} + \dots + \frac{N_{30,t,s}}{\rho^{29}} \\ &= N_{1,t,s} \left[1 + \frac{1}{\rho} + \frac{1}{\rho^2} + \dots + \frac{1}{\rho^{29}} \right] \end{aligned}$$

Thus the size of age 1 cell can be calculated given the growth rate, ρ , and the number of people under the coverage of each social security institution, $N_{t,s}$.

Average annual population growth from 1990 to 2009 from TURKSTAT population data yields $\rho = 1.0143$. Using this value, the population data at the initial steady state is calculated and reported in Table 4.2. At the bottom row of the table are the age 1 cell sizes for each social security system.

For a steady state, it is now possible to populate the economy using $N_{g,t,s} = \frac{N_{1,t,s}}{\rho^{g-1}}$ and the corresponding aggregate $N_{g,t} = \frac{N_{1,t}}{\rho^{g-1}}$. The strategy adopted for this task takes the age 1 cell growth rate for BK, $\rho_{t,bk}$, ES, $\rho_{t,es}$ and the whole economy, ρ_t , as given. Since $N_{1,t+1,s} = \rho_{t,s} N_{1,t,s}$ for $s=BK$ and ES and $N_{1,t+1} = \rho_t N_{1,t}$ for the aggregate population, this enables the calculation of all age groups for all the following periods. The SSK population can then be

Table 4.2: Social Security Population in 2007

	BK	ES	SSK	Total
Population	5,055,782	3,811,264	13,970,743	22,837,790
Population Shares	0.2213	0.1668	0.6117	1.0000
Age 1 Cell	205,618	155,004	568,189	928,812

Source: Author's calculations.

calculated by deducing the number of age 1 BK and ES consumers from the number of all age 1 consumers in the economy; $N_{1,t,ssk} = N_{1,t} - (N_{1,t,bk} + N_{1,t,es})$.

The prime advantage of this approach is that, given the distribution of BK and aggregate population to age cells and their respective growth rates, one can change the growth rate of age 1 cell of ES consumers to experiment on changing public employment. For example, by increasing the growth rate of ES age 1 cell, $\rho_{t,es}$, one may consider the effects of a populist policy in which the government employs more workers and increases the share of ES population in the aggregate population.

In addition to the already calculated year 2007 distribution of population covered by the social security system to BK, ES and SSK age cells, the proposed strategy requires the time path of BK, ES and aggregate population age 1 cell growth rates as well, which may differ from the steady state growth rates. As detailed projections for the formal population are not available, the aggregate population projections of TURKSTAT up to year 2025 are used to construct the future path of the population.

The distribution of aggregate population to age cells at a given year is explained above. For year 2008, cell sizes for ages 2 to 30 are actually year 2007 cell sizes for ages 1 to 29; i.e. $N_{g,2008} = N_{g-1,2007}$ for $g=2 \dots 30$. Given year 2008 population, age 1 cell of aggregate population in 2008 can be calculated as $N_{1,2008} = N_{2008} - \sum_{g=2}^{30} N_{g-1,2007}$. This process can be repeated up to year 2025 and can be employed to distribute population to age groups of each social security system, $N_{g,t,s}$ as well.

As part of this methodology, age 1 cell growth rates for BK and ES can be exogenously given to populate the time periods after year 2007. Up to year 2025, the age 1 cell growth rates for aggregate population are picked to match aggregate population growth rate projections of TURKSTAT. Afterwards, all population growth rate is fixed to 1 to stabilise population

dynamics. Throughout this exercise, age 1 cell size for SSK is obtained as $N_{1,t,ssk} = N_{1,t} - N_{1,t,bk} - N_{1,t,es}$. Obtained population for BK, ES and SSK are displayed in Figure 4.1 for 60 time periods; i.e. up to mid 2060s.

It is apparent from the figure that the population increases, but the growth rate of population falls. That is, the share of younger cohorts in the population decreases as time progresses. Thus the presented population dynamics replicate an ageing population for Turkey.

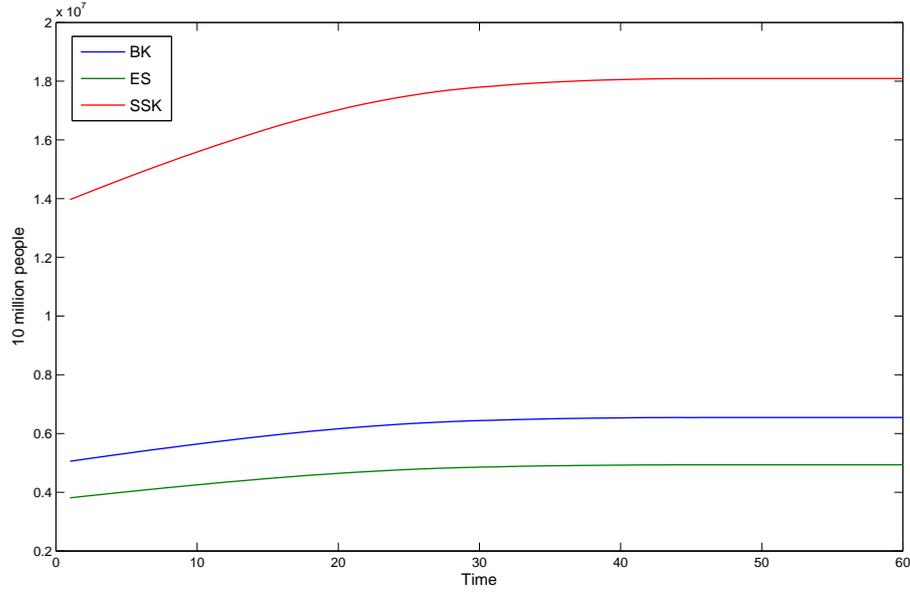


Figure 4.1: Aggregate Population by Social Security Membership

4.3.2 Age Efficiency Indices and Labour Supply

Based on the observation on Turkish micro data that wage earnings of ES and SSK members fluctuate through the lifetime, age efficiency indices have been introduced to the model. Wage earning of an individual aged g at time t is defined as $w_{g,t} = e_{g,t}w_t$. The task of identifying the numerical values for age efficiency indices, $e_{g,t}$, for ES and SSK consumers will now be undertaken.

The methodology based on Deaton and Paxson (1993), implemented by Cilasun (2009) for Turkish data and used previously in Chapter 3 is not applicable for the current purpose. Simply

put, one needs to obtain index values for all the ages. But the method applied in Chapter 3 relies on dummy variables and would not be able to provide age efficiency coefficients when some ages are missing from the dataset; which holds for the current case.

The proposed solution is a hybrid of the method adopted by Cilasun (2009) and Fitzenberger and Wunderlich (2002, p.388-389). Using cohort dummies in addition to an age polynomial as independent variables prevents the omission of some ages caused by gaps in the data while controlling for cohort effects. Within this context, consider the following equation:

$$age_eff = g(age) + COHORT + error \quad (4.62)$$

The dependent variable is age efficiency, measured as the ratio of wage receipts of age g consumer to economywide wage observed at time t . On the right hand side is a polynomial of age, $g(age)$ and cohort dummies, $COHORT$, followed by a standard error term. The age polynomial is specified as ⁶:

$$g(age) = age + age^2 + age^3$$

Running an OLS regression on Equation 4.62 would relate age to age efficiency, after taking into account the cohort effects through the introduced dummies.

The data is from Household Budget Surveys 2003 and 2005. Year 2004 has not been used in order to maintain birth cohort consistency. Data is transformed into real terms through the consumer price index obtained from the Electronic Data Delivery System of the Central Bank of the Republic of Turkey. The price index has year 2003 as the base year. For both ES and SSK members, average real wage receipts for each model age group is calculated. Economywide real wage is calculated for ES and SSK members separately. Age efficiency, as the dependent variable, has been calculated as the ratio of real wage receipt at age g to economywide wage observed at time t .

An OLS regression with the proposed polynomial and dummies as the independent variables and age efficiency as the dependent variable has been run for ES members. Dummies for cohorts 24, 25, 26, 28, 29, 30 and 31 have been omitted from the regression due to lack of observations. Obtained cohort effects for ES are summarised in Figure 4.2.

⁶ Though a similar functional form is adopted, this form is not based on a Mincer type earning function. Behind the Mincer type earning function is a model of human capital, a concept not existing in the model developed here. Rather than a theoretical reason, the adoption of a third degree polynomial is done to account for the tail effects; i.e. to avoid forcing a humpback profile on the calculated age efficiency indices.

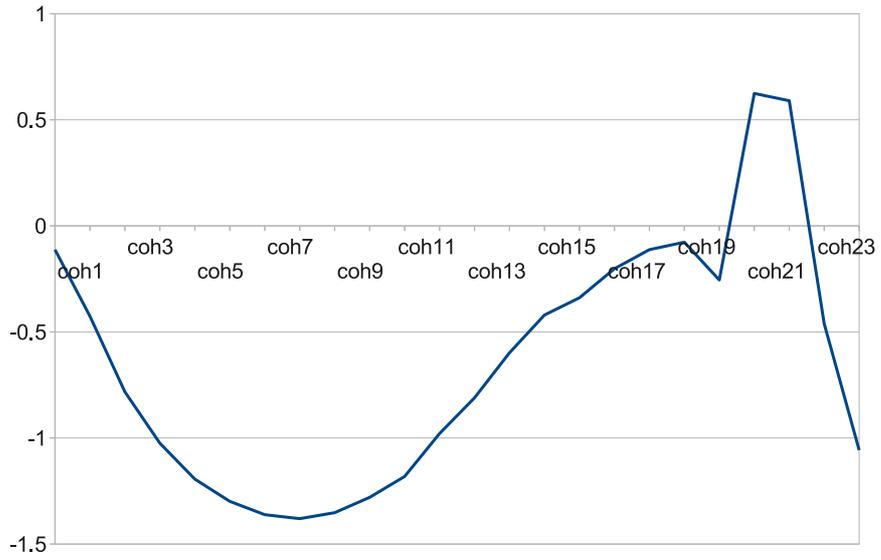


Figure 4.2: ES Cohort Effects from Age Efficiency Regression

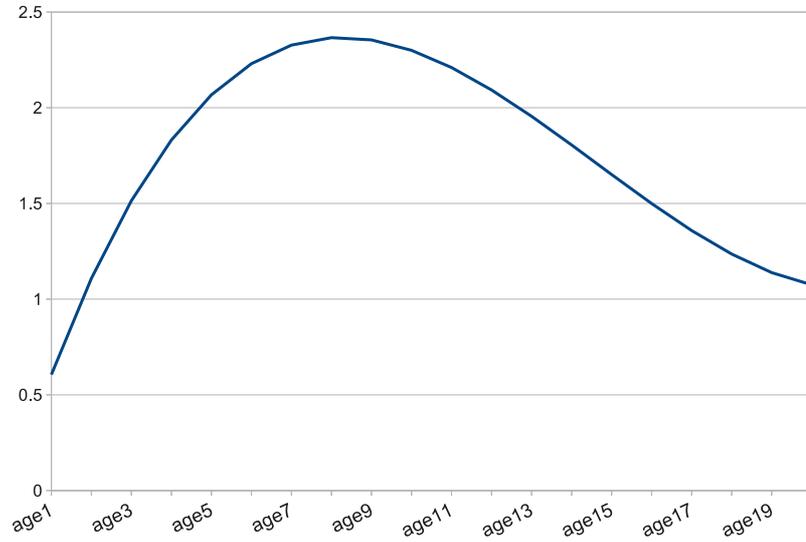


Figure 4.3: ES Age Efficiency Polynomial

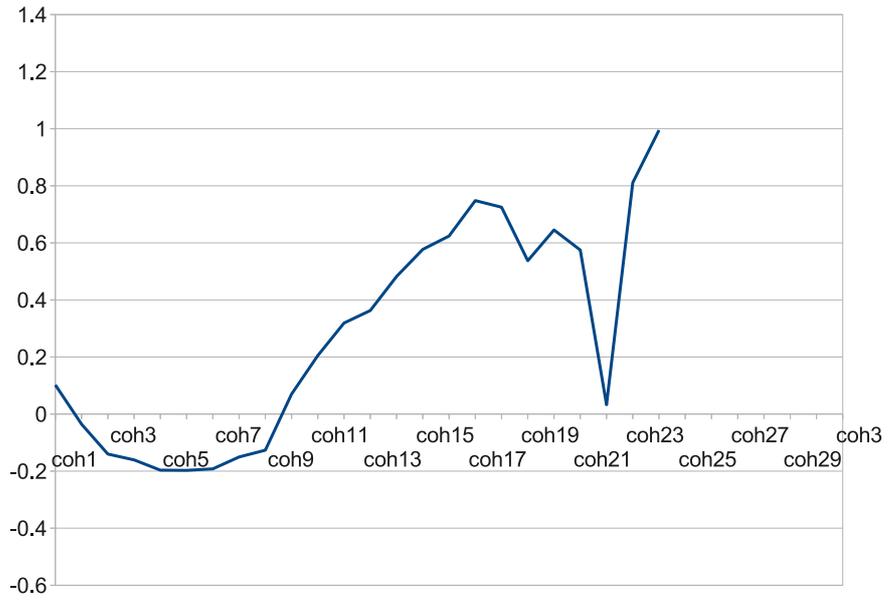


Figure 4.4: SSK Cohort Effects from Age Efficiency Regression

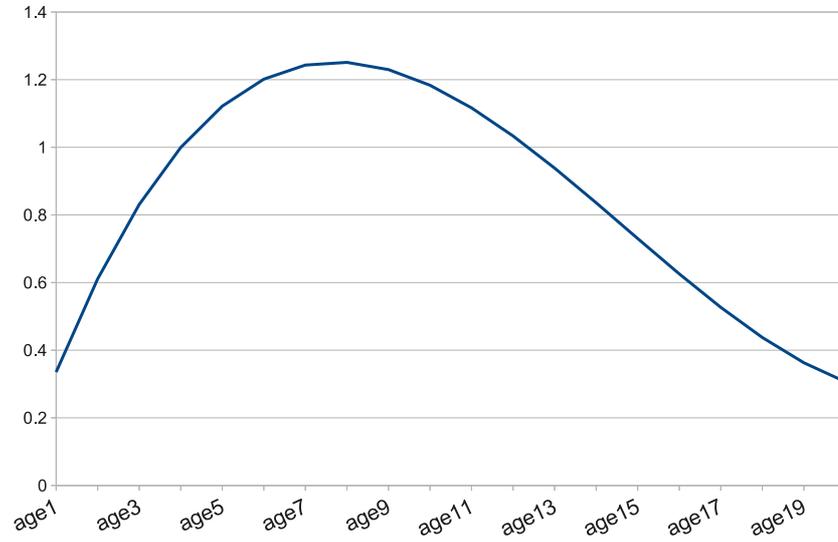


Figure 4.5: SSK Age Efficiency Polynomial

The cohort effects are first decreasing then increasing for ES members. That is, if the birth year of an individual is in the near past or if the birth year is very distant, age efficiency is relatively higher. The in-between birth dates lead to lower age efficiency. These dynamics are strikingly similar to the cohort effects on real wage receipts obtained in Chapter 3.

Next in Figure 4.3 is a graph of the obtained age efficiency polynomial for ES. The humpback profile during working ages is evident. This profile is also quite similar to the age effect profile obtained in Chapter 3.

For the SSK case, there are no observations for cohorts 25, 27, 29 and 30. Omitting these and running an OLS regression yields the cohort effects presented in Figure 4.4. The obtained profile is quite similar to the one obtained for SSK in Chapter 3 but has different level values, as expected.

Next in Figure 4.5 is the graph of the obtained age polynomial. This is also similar to the corresponding figure obtained in Chapter 3. Obtained age efficiency index values are presented Table 4.3.

The demographic structure has been set up and the age efficiency indices have been calibrated. It is now possible to calculate the private labour supply as $L_{t,ssk} = \sum_{g=1}^{15} e_{g,t,ssk} N_{g,t,ssk}$. Obtained private labour supply is presented in Figure 4.6.

The labour supply in Figure 4.6 is drawn for 60 time periods; that is, up to late 2060s. The labour supply is observed to start with 7.5 million labour units and stabilises at 8.85 million labour units by mid 2040s. The number of active SSK members presented below in Figure 4.7. Starting with about 7.7 million people, the number of SSK active members stabilises just above 9 million people by mid 2040s.

Table 4.3: Age Efficiency Indices

Age	ES	SSK
1	0.6061	0.3353
2	1.1083	0.6108
3	1.5142	0.8308
4	1.8314	0.9996
5	2.0676	1.1217
6	2.2303	1.2014
7	2.3273	1.2431
8	2.3662	1.2511
9	2.3545	1.2298
10	2.2999	1.1835
11	2.2101	1.1166
12	2.0927	1.0335
13	1.9553	0.9384
14	1.8055	0.8359
15	1.6510	0.7302
16	1.4995	0.6256
17	1.3584	0.5267
18	1.2356	0.4376
19	1.1385	0.3628
20	1.0749	0.3066
21	1.0524	0.2734
22	1.0785	0.2676
23	1.1610	0.2935
24	1.3075	0.3554
25	1.5256	0.4577
26	1.8229	0.6049
27	2.2070	0.8011
28	2.6857	1.0509
29	3.2664	1.3585
30	3.9570	1.7284

Source: Author's calculations based on Household Budget Surveys 2003 and 2005 conducted by TURKSTAT.

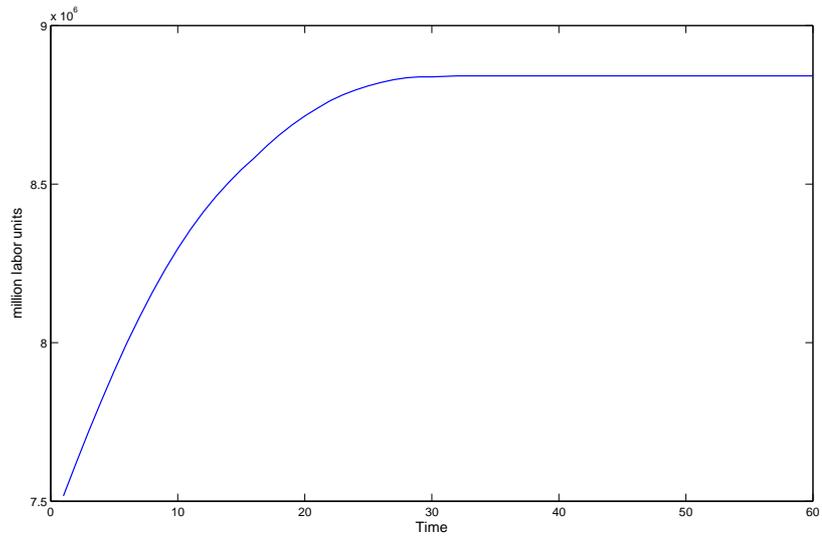


Figure 4.6: Private Labour Supply by SSK Members

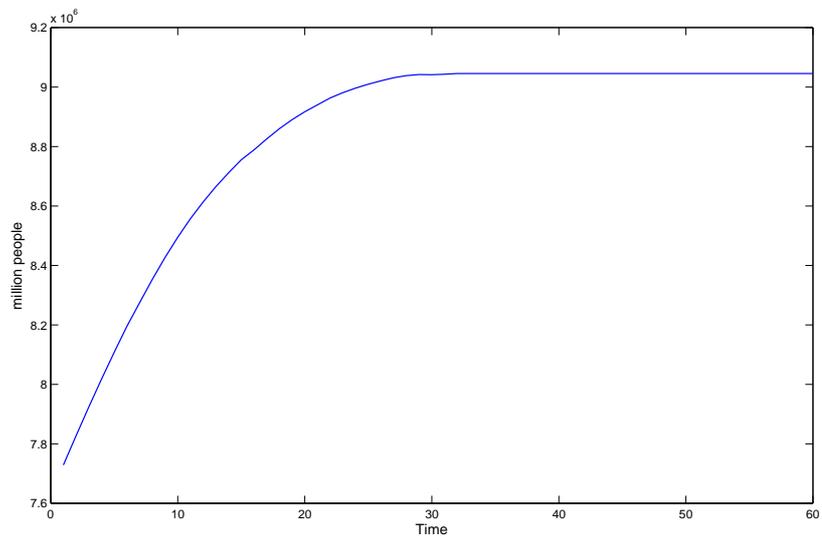


Figure 4.7: Number of Active SSK Members

4.3.3 SAM Construction

The SAM for the constructed model has been presented in Table 4.1 and the related algebraic structure has been outlined in Section 4.2.7. Next, is to gather the data for the cells of the SAM. Note that since the SAM keeps a record of revenues and expenditures in the economy, the row and column sums of the SAM must balance each other. Also note that it may not be possible to find data for every cell of the SAM. Or, the available data may be conceptually incompatible with the formulated model. The idea, therefore, is to adopt a method that both balances the SAM accounts and fills the missing cells.

The SAM balancing exercise has been performed by taking the SAM as a system of equations, with the row and column identities constructing the equations. Underlying equations were represented in Section 4.2.7. The equations for each account are put together so that each row and column is an equation with row and column sums automatically balancing. If some cell entries are available, the created system of equations solves for the missing elements and balances the SAM simultaneously.

Table 4.5 presents the SAM elements as A/D, available in data, or as C, calculated during the SAM balancing practice. The elements on the activity row are elements of GDP from an expenditure perspective. These entries are obtained from the new GDP series of TURKSTAT. However, the available data does not provide consumption according to membership in social security institutions. Shares enabling such division need to be calculated.

In order to find out these shares, Household Budget Surveys conducted in 2003, 2004 and 2005 are used. Individual and household dataset have been merged in order to obtain consumption expenditure for individuals. All observations not under the coverage of BK, ES and SSK have been dropped from the dataset. The data has been aggregated to obtain aggregate consumption and saving at time t by all members of BK, ES and SSK. Shares of BK, ES and SSK members in economywide aggregate saving and consumption have been presented in Table 4.4.

The shares seem stable for the years considered. Still, the last column in Table 4.4 displays the mean values. These mean values are used to divide the consumption data in the SAM to different consumer types.

On the activity column of SAM, income due capital and private labour in exchange for participation in the production process are calculated during the SAM balancing exercise. Data on social security contribution payment of employers to SSK is obtained from the Social Security Institution.

Revenue and expenditure items for social security institutions are available in the May 2010 SSI Fiscal Statistics Report on Social Security Institution (SGK) web page in tables AF7, AF8 and AF9. The report includes aggregate revenues for each institution. Following the example of Telli (2004), the revenue data can be divided into employer and partaker shares in accordance with the contribution rates defined in the relevant laws. For example, the law states that the contribution receipt from an active SSK member is 31% of that person's income. Of this rate, 17% is paid by the employer and 14% is covered by the partaker. Thus, a simple algebra yields that 55% of contribution revenues is paid by employer whereas 45% is paid by the partaker. Revenue items of social security institutions are thus divided into employer contributions and partaker contributions for ES and SSK.

Table 4.4: Shares of Saving and Consumption by Social Security Institution Membership

Saving Shares				
	2003	2004	2005	Mean
BK	0.46	0.50	0.45	0.47
ES	0.19	0.16	0.19	0.18
SSK	0.36	0.34	0.37	0.36
Consumption Shares				
	2003	2004	2005	Mean
BK	0.27	0.29	0.29	0.28
ES	0.26	0.24	0.25	0.25
SSK	0.47	0.47	0.46	0.47

Source: Author's calculation based on Household Budget Surveys 2003, 2004 and 2005.

Table 4.5: The SAM: Available Data and Calculated Elements

	Activity	Labour	Capital	HHbk	HHes	HHsk	BK	ES	SSK	Gov	S/I	Asset_ret	Inh/Beq	ROW
Activity				A/D	A/D	A/D				A/D	A/D			A/D
Labour	C									C				
Capital	C													
HHbk							A/D					C	C	
HHes		C						A/D				C		
HHsk		C							A/D			C		
BK				A/D						C				
ES					A/D					A/D+C				
SSK	A/D					A/D				C				
Gov	A/D										C+C			
S/I				C	C	C								C
Asset_ret			C							A/D+C				
Inh/Beq				C	C	C								
ROW	A/D											A/D		

Note: A/D stands for the SAM elements obtained from various data sources. C stands for elements calculated by the author during the SAM balancing exercise.

The entries of labour row and column are calculated during the SAM balancing exercise. These entries record receipt of wage income from private sector and the government to reallocate to ES and SSK member consumers. Capital account, in turn, records returns to capital and transfers this to asset returns account. Labour and capital accounts are tautologies; by definition, they will always hold.

On the BK consumers' row, labelled HHbk, aggregate asset return receipt and aggregate inheritance receipt are calculated during SAM balancing; same practice is adopted for saving and bequest on the corresponding column. Since asset return is also calculated during SAM balancing, there arises the problem of dividing an aggregate asset return that accrues to all types consumers to either of the three groups. At this point, the saving shares from Table 4.4 are used in conjunction with the fact that at the steady state, share of economy wide aggregate asset returns received by a subgroup must be equal to the share of aggregate saving done by the same subgroup.

In order to see this, denote the share in aggregate saving of group s as $\frac{S_{t,s}}{\sum_s S_{t,s}}$ where S denotes aggregate saving. Since saving is the change in the asset stock, $S_{t,s} = A_{t+1,s} - A_{t,s}$, this share can be rewritten as $\frac{A_{t+1,s} - A_{t,s}}{\sum_s A_{t+1,s} - A_{t,s}}$. Along the balanced growth path, aggregate variables grow at a rate equal to technology growth rate, θ , multiplied by population growth rate, ρ ; hence the ratio becomes $\frac{\theta \rho A_{t,s} - A_{t,s}}{\sum_s \theta \rho A_{t,s} - A_{t,s}}$. Simplifying the parameters and multiplying both numerator and denominator by the interest rate yields $\frac{r_t A_{t,s}}{\sum_s r_t A_{t,s}}$, which is the share of asset return received by group s consumers in the aggregate asset return received by all consumers. Therefore, the saving shares in Table 4.4 are used to split asset returns and savings to each consumer group.

For the accounts of ES and SSK consumers, aggregate wage incomes, asset returns, saving and bequests are calculated while the SAM is balanced. For the asset income and saving items, shares in Table 4.4 are used in conjunction with the above explanations on these shares.

Next consider the social security institutions. Basically, these accounts solve for the deficits of these institutions, given revenues and expenditures. A note of caution is needed for the case of ES, especially for the intersection of ES row and government column. The calculated part here is the deficit of ES covered by the government. Available from data sources is the payment from the government to ES, done for the government is the employer of public workers. The cell records the net value.

For the government account, in addition to social security institutions' deficits on corresponding cells, a number of other elements need to be calculated. On the row, at the intersection with the saving/investment account, are domestic and foreign borrowing done by the government. Along the column are wage payments to public workers that need to be calculated so that the SAM is balanced. At the intersection of asset returns row and government column are interest payments on foreign and domestic debt. Interest payment on foreign debt stock is observed from Treasury's debt statistics and is tied to the foreign interest rate. Interest payment on domestic debt is needs to be calculated.

A point to be made on ROW, saving/investment and asset return accounts is that the domestic borrowing, and the implied domestic debt stock, must be consistent with the observed interest payment on the domestic debt stock. Specifically;

$$r_t BOR_t = r_t DEB_t (\rho\theta - 1)$$

for the domestic debt stock. This relies on $BOR_t = DEB_t (\rho\theta - 1)$; domestic borrowing is equal to the change in the domestic debt stock. The term $r_t DEB_t$ is a single variable for the SAM balancing exercise. Population and technology growth rates are previously calculated. Then, the interest rate on the left hand side needs to be solved for. For the foreign borrowing and debt stock:

$$r_{f,t} BOR_{f,t} = r_{f,t} DEB_{f,t} (\rho\theta - 1)$$

Used within the SAM balancing exercise, this last equation enables solving for the interest rate applicable on the foreign debt.

However, the situation is more complicated for the domestic interest rate case. The domestic interest rate must be consistent with the firm's first order condition for profit maximisation; i.e. Equation 4.27. This requires calibrating a number of parameters and initial stock values simultaneously with the SAM balancing exercise.

First, GDP is calculated from the expenditure side; $Y=C+I+G+X-M$. Then, tax rate is calibrated as the tax revenue cell of SAM divided by Y. Share of capital in output is;

$$\alpha = \frac{R_t}{(1 - \tau)Y_t}$$

where R_t is the capital bill as defined in Equation 4.45 and τ is the government tax rate. Capital

stock is calibrated by arguing that investment is the change in the capital stock; $K_t = \frac{I_t}{\rho\theta-1}$. Using the production function, an initial technology level is calculated as

$$\Gamma_t = \frac{\left(\frac{Y_t}{K_t^\alpha}\right)^{\frac{1}{1-\alpha}}}{L_{t,SSK}}$$

Now the interest rate can be calculated from the first order condition of profit maximisation problem. Including this structure in the SAM equations enables solving for an interest rate that is consistent with the interest payments on domestic debt stock and a domestic borrowing level that is consistent with the steady state growth rate of aggregate variables.

Obtained SAM, with elements presented as percentages of GDP, is available in Table 4.6⁷. The differences between row and column sums of the SAM derived as a result of this exercise are at most 6.0E-8 at levels. Thus row and column identities hold. A group of parameters and variables are calibrated during this exercise. These are interest rate on domestic assets, r , interest rate applied on foreign debt stock, r_f , government tax rate τ , share of capital in production α , initial capital stock K and the initial level of technology Γ . These are presented, together with other calibrated parameters, in Table 4.7.

4.3.4 Calibration of Wages and Social Security Parameters

Apart from the preference parameters and partaker parameters for the representative BK consumer, calibration of most parameters and variable initial values is relatively straightforward. These are examined in two subsections to maintain text clarity.

Wages

Calibration of wages relies on the available labour supplies of active ES and SSK consumers on the one hand and aggregate wage receipt of these consumers on the other hand. Labour supplies have already been obtained from the construction of the demographic structure. Aggregate wage receipts are calculated as part of the SAM balancing exercise. Public wage is the division of aggregate wage income receipt by the labour; i.e. $w = wage_bill/L$. Private wage is obtained from the first order condition of the firm. Obtained public and private wage figures are available in Table 4.7.

⁷ The SAM has also been reproduced in Appendix B in levels.

Table 4.6: Balanced SAM as Percentage of GDP

	Activity	Labourr	Capital	HHbkk	HHess	HHsskk	BK	ES	SSK	Gov	S/I	Asset_ret	Inh/Beq	ROW
Activity				21.71	19.38	36.43				5.94	21.90			23.21
Labour	20.53									11.15				
Capital	58.87													
HHbk							1.38					29.75	11.44	
HHes		11.15						2.10				11.39		
HHssk		20.53							5.44			22.15		
BK				0.71						0.67				
ES					0.46					1.63				
SSK	2.00					1.65				1.80				
Gov	18.60										7.80			
S/I				11.07	4.24	8.24								6.15
Asset_ret			58.87							5.21				
Inh/Beq				9.08	0.55	1.80								
ROW	28.57											0.79		

Source: Author's calculations.

Partaker Contribution Rates

Consider the case of ES first. Given public wage, the total amount of contributions collected from ES actives is $\tau_{es}w_pL_{es}$. This amount is available in the SAM at the intersection of ES row, as a revenue of ES institution, and ES consumers column, as their expenditure. Dividing this SAM cell by w_pL_{es} yields the partaker contribution rate for the representative ES consumer. Same approach holds for SSK consumer as well. Obtained figures are in Table 4.7.

This analysis relies on the model's property that private or public wage is age invariant if one lets age efficiency indices be absorbed by the process of transforming population to labour. For example, wage earning of all ES consumers is $\sum_{g=1}^{GW} w_p e_{g,es} N_{g,es}$ for any time period, with $e_{g,es}$ standing for age efficiency index of active ES consumer aged g . By definition of labour, this can be written as w_pL_{es} . Thus the ES and SSK partaker contribution rate calibration outlined in the above paragraph can be performed. However, the process is not as simple for the BK consumer case.

In order to see this, consider the aggregate partaker contribution collected by BK from the active BK consumers; $\sum_{g=1}^{GW} \tau_{bk} r a_{g,bk} N_{g,bk}$ where $a_{g,bk}$ denotes interest yielding asset stock. Since the asset stock decisions are endogenous, they can not be moved out of the age summation. Hence, calibration of BK partaker contribution rate requires calibration of consumer behaviour in detail; a task undertaken in Section 4.3.5.

Employer Contribution Rates

The government, as the employer of active ES consumers, pays $\sum_{g=1}^{GW} \tau_{eES} w_p e_{g,es} N_{g,es}$ to the social security institution ES. Using once more the definition of public labour supply, $\sum_{g=1}^{GW} \tau_{eES} w_p L_{g,es}$. This aggregate term is available in the SAM. Given public wage, employer contribution rate can be calibrated through a simple division and is presented in Table 4.7. Same approach is employed for SSK employer contribution rate.

Table 4.7: Calibrated Parameters

Preference		
β_{bk}	BK utility discount	0.9871
β_{es}	ES utility discount	0.9989
β_{ssk}	SSK utility discount	1.0051
η_{bk}	BK risk aversion parameter	1.1
η_{es}	ES risk aversion parameter	1.0
η_{ssk}	SSK risk aversion parameter	1.0
γ_{bk}	BK bequest weight in utility	9.8096
γ_{es}	ES bequest weight in utility	0.4374
γ_{ssk}	SSK bequest weight in utility	0.7086
beq_{bk}	BK bequest by representative consumer	650
beq_{es}	ES bequest by representative consumer	53
beq_{ssk}	SSK bequest by representative consumer	47
Production and Prices		
α	Capital share in production	0.7230
Γ_{2007}	Initial technology	1.0442
r	Interest rate	0.0931
r_f	Foreign interest rate	0.0044
w	Private wage	26.59
w_p	Public wage	27.39
Government and Social Security		
τ	Tax rate	0.1860
τ_{bk}	BK partaker contribution rate	0.0487
τ_{es}	ES partaker contribution rate	0.0415
τ_{ssk}	SSK partaker contribution rate	0.0802
τ_{eES}	ES employer contribution rate	0.0553
τ_{eSSK}	SSK employer contribution rate	0.0974
rep_{bk}	BK replacement rate	0.1127
rep_{es}	ES replacement rate	0.3077
rep_{ssk}	SSK replacement rate	0.5078
pen_{bk}	BK pension	6.75
pen_{es}	ES pension	13.64
pen_{ssk}	SSK pension	9.67
Other Parameters		
mpi	Marginal propensity to import	0.29
K/Y	Rate of initial capital stock to output	6.32

Source: Author's calculations.

Pensions at the Steady State

This subsection considers the calculation of pensions received by the representative agent just retired in 2007. Before undertaking this task, remember that at the steady state private wage increases at the rate of technology. The same holds for age g choice of asset stock. That is, $a_{g,t+1} = \theta a_{g,t}$ where θ is technology growth rate and $a_{g,t}$ represents asset stock decision. Also, we assume along the balanced growth path that the public wage grows at the same rate as technology.

A consumer retired at time $t-1$ is aged 16, or $GW+1$, at time t and receives pension for the first time. This pension receipt is calculated as $pen_t = rep w_{t-1}$ for a wage earner or $pen_t = rep r_{t-1} a_{15,t-1}$ for an asset income earner. Given time invariant interest rate at the steady state, pension grows at the same rate as the technology, $pen_{t+1} = \theta pen_t$, simply because asset stock decision grows at the rate of technology and wage increases at the rate of technology ⁸.

At time t , expenditure of any social security institution is calculated as $\sum_{g=GW+1}^{GL} pen_{g,t} N_{g,t}$ where $pen_{g,t}$ is the pension received by age g consumer at time t . Obviously, $pen_{g,t} = pen_{g-1,t-1} = \frac{pen_{g-1,t}}{\theta}$, where the last step is due to the above discussion on growth rates. Thus, the expenditure of social security institutions can be written as

$$pen_{GW+1,t} \sum_{g=GW+1}^{GL} \frac{N_{g,t}}{\theta^{g-GW-1}}$$

Dividing the expenditure of the social security institutions, as recorded in the relevant SAM cells, by $\sum_{g=GW+1}^{GL} \frac{N_{g,t}}{\theta^{g-GW-1}}$ provides the pension received by age 16 consumers of all social security institutions at the base year. Obtained pension figures are available in Table 4.7.

Replacement Rates

Given the pensions, it is possible to solve for the replacement rates applicable to ES and SSK consumers. For ES case, $pen_{GW+1,t,es} = rep_{t-1,es} e_{GW,t-1,es} w_{t-1,p}$ due to Equation 4.31. But, note that the calibration procedure has obtained public wage at time t and $w_{t,p} = \theta w_{t-1,p}$; i.e. public wage grows at the rate of technology at the steady state. Then, $pen_{GW+1,t,es} = rep_{t-1,es} e_{GW,t-1,es} \frac{w_{t,p}}{\theta}$ allows solving for the replacement rate applicable to the representative

⁸ A mathematical argument as to why these growth rates should be so has been presented in Appendices A.3 and A.4.

ES consumer at the steady state. Using Equation 4.33, same approach is applicable to the representative SSK consumer case with public wage replaced with private wage.

For the case of representative BK consumer, Equation 4.29 implies for the BK consumer's pension that $pen_{GW+1,t,bk} = rep_{t-1,bk} r_{t-1} a_{GW,t-1,bk}$. But, if consumer behaviour is not calibrated, it is not possible to know $a_{GW,t-1,bk}$. Therefore, calibration of BK replacement rate is to be undertaken as part of the calibration of preference parameters.

4.3.5 Calibration of Preferences and BK Social Security Parameters

Calibration of preferences requires a much more equation intensive approach, for the preference parameters need to create a micro behaviour consistent with not only the equations that govern the micro behaviour, i.e. Euler equations and the budget constraints, but ensure consistency of agent decision with the aggregates observed in the SAM. Aim of this stage of the calibration is to obtain the values of discount factor applicable to future utility, β_s , the risk aversion parameter η_s , and the share of bequests in utility γ_s . The parameters are indexed by types of representative consumers, for consumers are assumed to display different behaviours due to the observations in micro data.

Two subsections are now considered. The first one calibrates a wage earner's behaviour through the example of ES consumer. The second subsection focuses on the asset income earner; specifically the case of BK consumer.

Calibrating Wage Earner's Micro Behaviour

Consider the representative ES consumer. At time t , there are 30 such representative consumers at different ages and $N_{g,t,es}$ members in each age cell g . For age 1 ES consumer, $c_{2,t+1,es} = c_{1,t,es} (\beta_{es}(1 + r_{t+1}))^{\frac{1}{\eta_{es}}}$. At the steady state, representative consumers' decisions grow at the rate of technology; therefore, $c_{2,t+1,es} = \theta c_{2,t,es}$ where θ is the growth rate of technology. Also, the interest rate is time invariant; $r_{t+1} = r_t$. Thus, it can be stated that; $c_{2,t,es} \theta = c_{1,t,es} (\beta_{es}(1 + r_t))^{\frac{1}{\eta_{es}}}$. Or, in general terms;

$$c_{g+1,t,es} = \frac{c_{g,t,es}}{\theta} (\beta_{es}(1 + r_t))^{\frac{1}{\eta_{es}}} \quad for \quad g = 1 \dots GL - 1 \quad (4.63)$$

The specification in Equation 4.63 relates the consumptions of ES consumers of different ages at a given time period t . In aggregate terms;

$$C_{t,es} = \sum_{g=1}^{30} c_{g,t,es} N_{g,t,es} \quad (4.64)$$

Also part of the estimation process are the budget constraints of the consumers. As a first example, consider the budget constraint of age 1 ES consumer at time t ;

$$c_{1,t,es} + a_{2,t+1,es} = (1 - \tau_{t,es}) e_{g,es} w_{t,p}$$

Note here that $a_{2,t+1,es}$ is the amount of asset left to age 2 at time $t+1$. The representative ES consumer aged 2 at time t will have;

$$c_{2,t,es} + a_{3,t+1,es} = (1 + r_t) a_{2,t,es} + (1 - \tau_{t,es}) e_{g,es} w_{t,p}$$

Since representative consumer's decisions grow at the rate of technology, $a_{2,t,es} = \frac{a_{2,t+1,es}}{\theta}$.

Thus the last expression becomes;

$$c_{2,t,es} + a_{3,t+1,es} = (1 + r_t) \frac{a_{2,t+1,es}}{\theta} + (1 - \tau_{t,es}) e_{g,es} w_{t,p}$$

Generalising for the working age ES representative consumers;

$$c_{g,t,es} + a_{g+1,t+1,es} = (1 + r_t) \frac{a_{g,t+1,es}}{\theta} + (1 - \tau_{t,es}) e_{g,es} w_{t,p} \quad \text{for } g = 1 \dots GW \quad (4.65)$$

Note that $a_{1,t+1,es} = 0$ for the representative ES consumer is born with no asset. For the retired representative ES consumer of age $GW+1=16$;

$$c_{16,t,es} + a_{17,t+1,es} = (1 + r_t) \frac{a_{16,t+1,es}}{\theta} + pen_{16,t,es}$$

For age 17, the budget constraint will be;

$$c_{17,t,es} + a_{18,t+1,es} = (1 + r_t) \frac{a_{17,t+1,es}}{\theta} + pen_{17,t,es}$$

The pension $pen_{16,t,es}$ has already been calibrated. It is also noted that pension grows at the rate of technology at the steady state because; i) private wage is shown to grow at the rate of technology, ii) public wage is assumed to grow at the rate of technology, iii) asset stock decisions grow at the rate of technology. Hence, $pen_{17,t,es} = \frac{pen_{16,t,es}}{\theta}$ and the last equation can be rewritten as;

$$c_{17,t,es} + a_{18,t+1,es} = (1 + r_t) \frac{a_{17,t+1,es}}{\theta} + \frac{pen_{16,t,es}}{\theta}$$

A generalisation yields;

$$c_{g,t,es} + a_{g+1,t+1,es} = (1 + r_t) \frac{a_{g,t+1,es}}{\theta} + \frac{pen_{GW+1,t,es}}{\theta^{g-(GW+1)}} \quad for \quad g = GW + 1 \dots GL - 1 \quad (4.66)$$

For the last age,

$$c_{30,t,es} + beq_{30,t,es} = (1 + r_t) \frac{a_{30,t+1,es}}{\theta} + \frac{pen_{30,t,es}}{\theta^{14}} \quad (4.67)$$

At the end of lifetime, the consumption behaviour is tied to bequest choices through;

$$beq_{30,t,es} = c_{30,t,es} \gamma_{es}^{\frac{1}{\eta_{es}}} \quad (4.68)$$

Finally, saving decisions need to be consistent with the SAM aggregates. This can be checked through whether the aggregate asset return implied by the above equations is consistent with the relevant SAM cell. That is, the sum

$$\sum_{g=2}^{GL} \frac{r_t a_{g,t,es}}{\theta} N_{g,t,es} \quad (4.69)$$

should be equal to the SAM cell at the intersection of ES consumers' row and asset return column. Alternatively, one can check if the aggregate saving done by ES consumers;

$$\sum_{g=1}^{GL} (a_{g+1,t,es} - \frac{a_{g,t,es}}{\theta}) N_{g,t,es}$$

is equal to the SAM cell at the intersection of ES consumers' column and saving/investment row, after imposing $a_{1,t,es} = 0$ and $a_{31,t,es} = 0$.

Equations 4.63 and 4.64 imply a total of 30 equations for $GL=30$. Equation 4.65 implies 15 equations with $GW=15$. Taking $GL=30$, Equation 4.66 implies 14 equations. Additional two equations on micro behaviour are through Equations 4.67 and 4.68. An additional aggregation is through Equation 4.69. Thus we have a total of 62 equations.

The interest rate, r_t has already been calibrated and is exogenous to this set of equations. Technology growth rate is taken as $\theta = 1.02$. Partaker contribution rate $\tau_{t,es}$ is already calibrated. Age efficiency indices $e_{g,t,es}$ are available. Population has also been calibrated and cell sizes $N_{g,t,es}$ are available. Public wage is also calculated above, leading to a calculated pension level.

Thus this system of 62 equations solves the consumption behaviour $\{c_{g,t,es}\}_{g=1}^{GL}$, asset stock decisions $\{a_{g,t,es}\}_{g=2}^{GL}$, bequest decision $beq_{GL,t,es}$, utility discount parameter β_{es} and the weight of

bequest in utility γ_{es} ; a total of 62 variables. This exercise is performed under the assumption that the risk aversion parameter unit, $\eta_{es} = 1$. Hence, instantaneous utility of representative ES consumer is logarithmic.

The final point takes the discussion back to the SAM elements. A bequest value left by the representative ES consumer is calibrated here. Multiplying this by $N_{30,t,es}$ gives the amount of bequest left by all ES consumers. This value is recorded at the bequest row and ES consumers column of the SAM and is further used, with the calibrated BK and SSK bequests, to calculate inheritance receipt of BK consumer.

With appropriate substitutions, this same approach holds for SSK consumer as well; the major change is to take private wage rather than public wage into account in the budget equations. While fundamentally same, case of BK requires a section on its own.

Calibrating Asset Return Earner's Micro Behaviour

The representative BK consumer, as primarily an asset return earner, deserves special attention. As discussed above, pension calculation and contribution payments for BK consumers rely on the saving decision of the BK consumer. Therefore, calibration of partaker contribution rate and replacement rate for BK are handled within the calibration of micro behaviour

For the working ages, consumption behaviour is governed by;

$$c_{g+1,t,es} = \frac{c_{g,t,es}}{\theta} (\beta_{es}(1 + r_t(1 - \tau_{t,bk}))^{\frac{1}{\eta_{es}}}) \quad for \quad g = 1...GW - 1 \quad (4.70)$$

The contribution rate is multiplied by the interest rate because the active BK members pays contributions out of interest earnings. The retired BK consumers' consumption decisions follow;

$$c_{g+1,t,es} = \frac{c_{g,t,es}}{\theta} (\beta_{es}(1 + r_t)^{\frac{1}{\eta_{es}}}) \quad for \quad g = GW...GL - 1 \quad (4.71)$$

The aggregate consumption by BK consumers will be;

$$C_{t,bk} = \sum_{g=1}^{GL} c_{g,t,bk} N_{g,t,bk} \quad (4.72)$$

Regarding budgets; age 1 BK consumer has;

$$c_{1,t,bk} + a_{2,t+1,bk} = inh_t \quad (4.73)$$

For age 2 consumer, at time t,

$$c_{2,t,bk} + a_{3,t+1,bk} = (1 + r_t(1 - \tau_{t,bk})) \frac{a_{2,t+1,bk}}{\theta}$$

Generalising for the working age BK consumers;

$$c_{g,t,bk} + a_{g+1,t+1,bk} = (1 + r_t(1 - \tau_{t,bk})) \frac{a_{g,t+1,bk}}{\theta} \quad \text{for } g = 2 \dots GW \quad (4.74)$$

For the retired BK consumers;

$$c_{g,t,bk} + a_{g+1,t+1,bk} = (1 + r_t) \frac{a_{g,t+1,bk}}{\theta} \quad \text{for } g = GW + 1 \dots GL - 1 \quad (4.75)$$

for contributions are paid no more. At the end of life, $GL=30$ and BK consumers have;

$$c_{30,t,bk} + beq_{30,t+1,bk} = (1 + r_t) \frac{a_{30,t+1,bk}}{\theta} \quad (4.76)$$

Regarding bequest choices;

$$beq_{30,t,bk} = c_{30,t,bk} \gamma_{es}^{\frac{1}{\eta_{bk}}} \quad (4.77)$$

holds.

For the asset stock decisions, one can use that aggregate asset return implied by the above equations needs to be consistent with the relevant SAM cell. Thus,

$$\sum_{g=2}^{GL} \frac{r_t a_{g,t,bk}}{\theta} N_{g,t,bk} \quad (4.78)$$

should be equal to the SAM cell at the intersection of BK consumers' row and asset return column. Corresponding aggregate saving is;

$$\sum_{g=1}^{GL} (a_{g+1,t,bk} - \frac{a_{g,t,bk}}{\theta}) N_{g,t,bk}$$

Remember that $a_{1,t,bk} = 0$ and $a_{31,t,bk} = 0$ need to be imposed.

Given the asset stock decision at age 15, pension is calculated as $pen_{t,bk} = rep_{t-1,bk} r_{t-1} a_{15,t-1,bk}$.

Since $a_{15,t-1,bk} = \frac{a_{15,t+1,bk}}{\theta^2}$, this is rewritten as

$$pen_{t,bk} = rep_{t-1,bk} r_{t-1} \frac{a_{15,t+1,bk}}{\theta^2} \quad (4.79)$$

Considering that the interest rate and the replacement rate are time invariant at the steady state, this equation can be used to solve for the replacement rate applicable to the BK consumers.

The amount of contributions done by the active BK members is calculated as;

$$\sum_{g=2}^{GL} \tau_{t,bk} r_t \frac{a_{g,t+1,bk}}{\theta} N_{g,t,bk} \quad (4.80)$$

This value needs to be equal to the value at the intersection of BK institution's row and BK consumers' column. This can be used to solve for the time invariant BK contribution rate, τ_{bk} , at the steady state.

Equations 4.70 and 4.71 imply 29 equations together. The consumption aggregation, Equation 4.72, is an other equation. Equations 4.73, 4.74, 4.75 and 4.76 add 30 equations to the system. Bequest decision is governed by 4.77. Checking asset decisions' consistency with the available aggregate data is Equation 4.78. Finally, Equations 4.79 and 4.80 are used to solve for social security parameters. There is a total of 64 equations.

This set of equations take inheritance received by age 1 consumers exogenous as a guess. Once the whole calibration algorithm is run, the system produces an aggregate bequest, from which inheritance is calculated. This inheritance is then fed to the algorithm. If the inheritance receipt is correct, the aggregate saving or asset return receipt of BK consumers matches the relevant SAM cell. Otherwise, inheritance guess is updated and the algorithm is re-run.

Once more, the interest rate is exogenous to BK calibration process. Population data is also previously calculated. Technology growth is taken as $\theta = 1.02$. Pension receipt of the representative BK consumer was calibrated beforehand as well.

The system solves for consumption and asset stock decision sequences of BK consumers, $\{c_{g,t,bk}\}_{g=1}^{GL}$ and $\{a_{g,t,bk}\}_{g=2}^{GL}$ respectively. The bequest decision, $beq_{30,t,bk}$ is also solved for. Assuming a risk aversion parameter $\eta_{bk} = 1.1$, utility discount parameter β_{bk} and bequest weight in the utility γ_{bk} are also obtained. Finally, the replacement rate for BK, rep_{bk} , and contribution rate applicable to the representative BK consumer, τ_{bk} , are obtained. Thus the system of equations used for calibration of BK parameters is a 64 by 64 system. Parameter results are available in Table 4.7.

4.4 Solution for the Steady State

Given the calibrated parameters, the steady state of the model can now be numerically solved. The solution strategy adopted by Auerbach and Kotlikoff (1987) relies on assuming initial

values for a subset of endogenous variables, solving the model and updating the initial assumptions when necessary. The method is called Gauss-Seidel strategy. A similar approach is adopted here. An initial capital stock sequence for 30 periods is the first guess. It is assumed that these 30 periods are on the balanced growth path. Given this guess, the model is solved and a new capital sequence is obtained from the saving decisions of representative consumers. If the calculated capital stock is in the neighbourhood of the assumed sequence, the algorithm stops. Otherwise, the calculated capital stock sequence replaces the guessed sequence. Model is solved again. These steps are repeated until the capital stock converges. Since the initial capital stock is extracted from the SAM, upon which the parameters and initial values of the model rely, the algorithm is expected to converge quickly. During the solution, the exogenous aggregate variables are assumed to grow at a rate equal to population growth rate multiplied by technology growth rate.

This section presents the steady state results obtained by applying the summarised solution method on the constructed model, starting with the micro behaviour

4.4.1 Microeconomic Variables

The lifetime consumption decisions of representative consumers are presented in Figure 4.8. Consistent with the parameter settings, consumption decisions of representative consumers display positive trends. A graph of consumption against age or time should display a constant slope in this model. Despite the appearance in Figure 4.8, the slopes are constant. Only for the case of BK, the slope shifts after age 15. This is expected; after age 15 representative BK consumer is retired and the relevant first order condition no longer includes the contribution payment out of interest income; see Equations 4.70 and 4.71. The illusion of non constant slopes in Figure 4.8 are due to scales; consumption through lifetime displays very high increases. As an example, representative ES consumer's optimum consumption decision increases from 20 units to over 200 units.

The rate of increase is especially high for the ES consumer. ES consumer starts with a modest consumption but reaches the highest consumption level at the end of life. Though not as apparent, SSK members display a considerably high consumption growth through lifetime as well. Lowest growth is displayed by the BK consumer. Lack of volatility for all representative consumers is consistent with the predictions of life-cycle models.

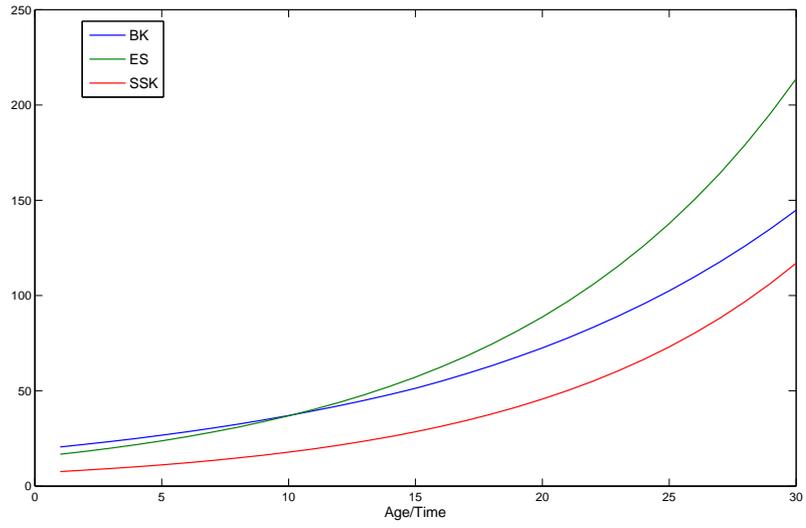


Figure 4.8: Steady State Consumption Decisions of Representative Consumers

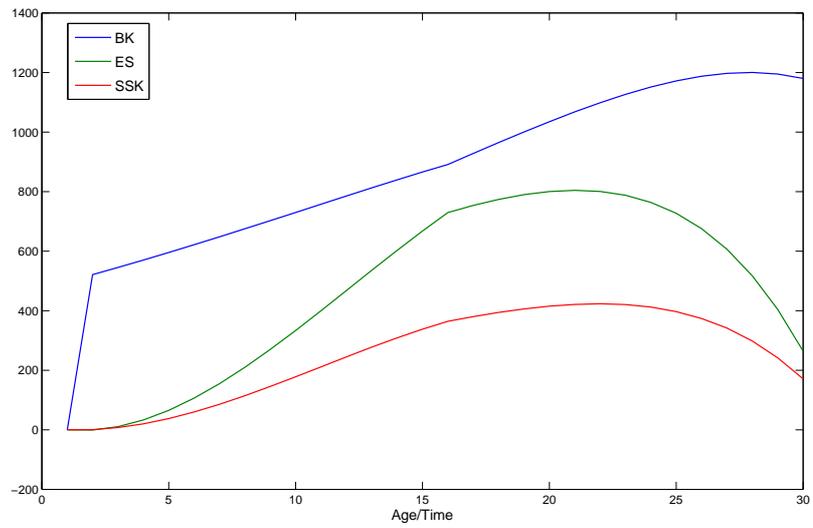


Figure 4.9: Steady State Asset Stock Decisions of Representative Consumers

Next in Figure 4.9 are the accumulated saving decisions of representative consumers at the steady state. For ES consumer, borrowing at the initial period of life is observed; asset stock left to age 2 is negative. Both ES and SSK consumers display humpback shaped asset stock decision profiles. They erode their asset stock towards the end of lifetime. BK consumer keeps accumulating assets. The characteristics displayed in Figure 4.9 are consistent with the micro behaviour observed from the data; BK consumer is the major asset income earner, followed by ES consumer. SSK consumer has the lowest asset stock. For all consumers, a kink in asset stock decision profile is observed at age 16. This is because retirement takes place at the end of age 15. The consumers no more pay contributions but now receive pensions. This change affects asset stock decision at the time of retirement.

4.4.2 Social Security Results

Finally consider the paths of variables regarding social security system results. Obtained pension values are 9.08, 18.35 and 13.01 for BK, ES and SSK representative consumers, respectively. Table 4.7 implies that public and private wage are nearly equal. The variation in pensions are due to different replacement rates; 0.5 for SSK and 0.3 for ES. The age efficiency indices also contribute to pension differences. At age 15, age efficiency index for ES is 1.6 whereas it is 0.7 for SSK. For BK, age efficiency is not at work. Thus one may credit inaccurate income declarations as the cause for low pensions for the case of BK.

Deficits of social security institutions, as percentages of output, are 0.67% for BK, 1.02% for ES and 1.80% for SSK. The total deficit of the social security system is about 3.48% of output. This is more than half of government's total consumption of goods and services, which is about 6% of output; the model replicates the serious social security deficit.

4.4.3 Summary

The construction of the model to be used in this study is now complete. The algebraic framework has been completed and the model has been calibrated to year 2007 of Turkish economy. Observed micro behaviour is smooth, in the sense that consumption and asset stock decisions do not display unexplainable fluctuations. Micro behaviour is consistent with the predictions of standard life cycle models. The aggregates of the model and the resultant prices display

expected behaviour; i.e. aggregates grow at the rate of technology growth times population growth, private wage increases at the rate of technology, interest rate is constant at the steady state.

The model is capable of displaying non negligible social security deficits, as is the case for Turkey. It is now possible to employ the calibrated model to analyse Turkish social security reform. This task is undertaken within the following chapter.

CHAPTER 5

ANALYSIS OF AGEING POPULATION AND THE REFORM

So far, the construction of a 30 period OLG model has been performed and the calibration procedure has been completed. The set of assumed parameter values have been presented. This chapter proceeds to use the constructed model to analyse social security reform.

The analysis focuses on two paths followed by the model economy. The first path starts from an initial steady state, takes ageing population as a shock and reaches a new steady state. This path will be referred to as the base path. The second path takes ageing population as given and receives a social security shock in the form of changes in contribution rates and replacement rates. This path is called the experiment path.¹

The algorithm adopted to solve the time path followed by the economy's variables is similar to the one adopted for the solution of the steady state. Given a number of exogenously evolving variables, a path for the capital stock is assumed. Then, the factor prices implied by the assumed capital path are calculated. Given the factor prices, decision variables of representative consumers (consumption, saving and bequest) are solved. Following this, the capital stock path is recalculated using the asset stock decisions obtained from the representative consumers. If the obtained capital stock path is within the neighbourhood of the assumed path, the algorithm stops. Otherwise, calculated capital path replaces the assumed capital path and the calculations are repeated until convergence occurs².

¹ Rather than a shock-free base path, the phenomenon of ageing population is included in the base path. This is because the social security reform in Turkey is conducted with the background of ageing population. That is, even if the social security reform was not done, the population would age. Therefore the comparison of the reform introduced experiment path needs to be done vis-a-vis a base path that includes the ageing phenomenon. At the core of the social security reform analysis of this thesis is the comparison of these two paths.

² The calculations are performed for 600 time periods. This may be considered too large a time scale for a 30 period OLG model; however, it is necessary to ensure convergence to a steady state.

After the 600th time period, the model is run for one more generation; i.e. 30 periods. During these final periods, the interest rate is assumed to be constant and wage rate is assumed to increase by the rate of technology. That is, a terminal condition is introduced through factor prices that are forced to behave as though they are at the steady state.

A number of exogenous variables have fixed growth rates in the model. Exogenously growing in the model are public wage, government consumption, interest rate applied on foreign interest rate and domestic and foreign debt stocks. Of these, public wage is assumed to grow at the rate of technology; $w_{t+1,p} = \theta w_{t,p}$ where $\theta = 1.02$ is assumed constant. Foreign interest rate, r_f is fixed at 0.0044.

Foreign and domestic debt stocks and government consumption are assumed to grow at a rate equal to population growth multiplied by technology growth. Therefore, as population growth stabilises at unity, the growth rate of domestic and foreign debts stabilise at the growth rate of technology. Defining borrowing as the change in debt stock, the domestic and foreign borrowing sequences are the changes in the exogenously evolving relevant debt stocks.

This chapter first briefly examines the base path, focusing on the effect of ageing population on the social security system's aggregates. Next the effects of social security reform are analysed. The chapter concludes with a summary of obtained results.

5.1 Effects of Ageing Population

As explained previously, age 1 growth rates are taken so that the population replicates population growth rates until mid 2020s. The growth rate for the aggregate population for 60 time periods is displayed in Figure 5.1. The growth rate stabilises at unity by the 50th time period.

Figure 5.2 displays the deficits of the social security institutions for 60 periods. The deficits are observed to increase, especially sharply for SSK. Figures 5.3, 5.4 and 5.5 show revenues and expenditures of social security institutions per effective worker up to 100 periods. For every case, expenditures are observed to increase faster than revenues.

The prime reason is that the ratio of actives to passives steadily decreases from about 1.25 in time period 1 to unity by time period 50. As the number of passives increases faster than the number of actives, the outflow of funds from the social security system in the form of pensions

surpasses the inflow of contributions. This causes deficits to increase for all the social security institutions.

The increasing aggregate deficit of the social security system increases the burden on the government budget. As observed in Figure 5.6, rate of social security system's deficit to output increases sharply in the short run and stabilises just below 5% after time period 50. This causes the tax rate to increase sharply. As Figure 5.7 shows, the tax rate increases to 21% by time period 30.

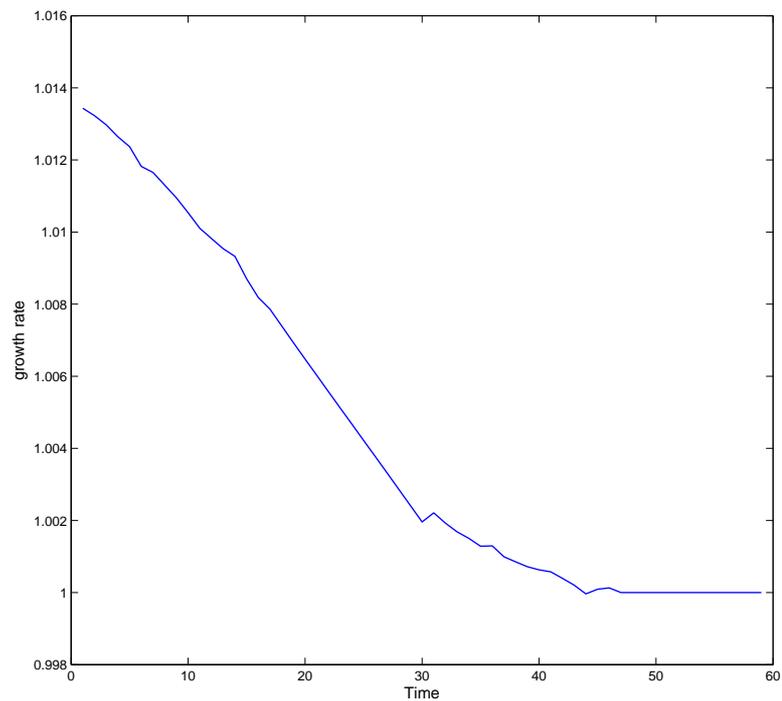


Figure 5.1: Aggregate Population Growth Rate

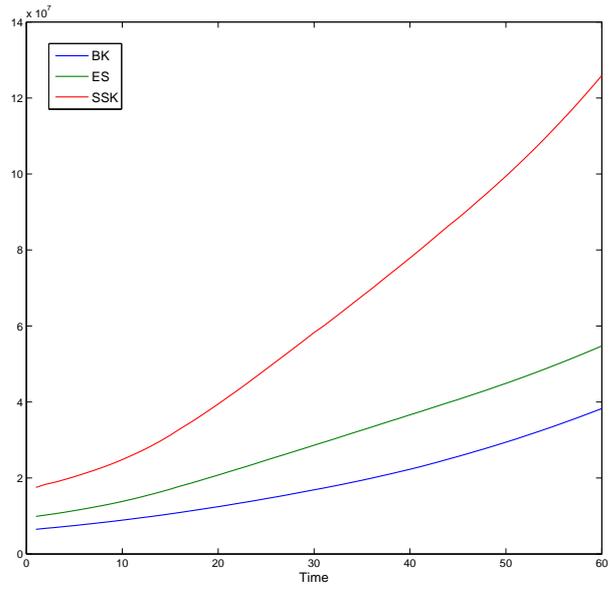


Figure 5.2: Social Security Deficits in 1998 TLs

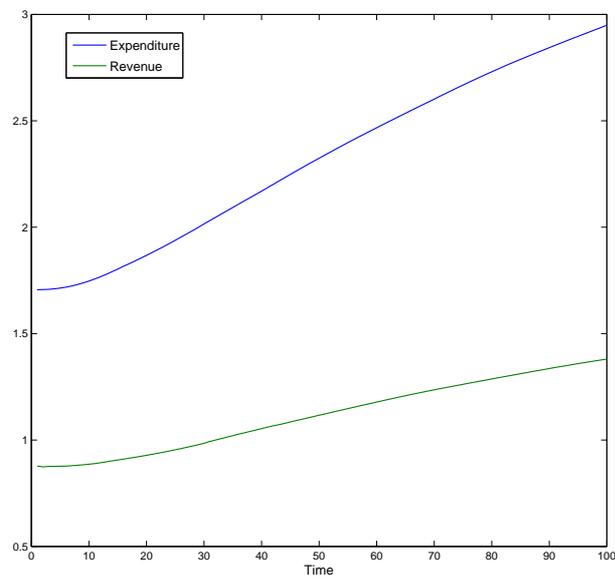


Figure 5.3: Per Effective Worker Revenue and Expenditure of BK Institution

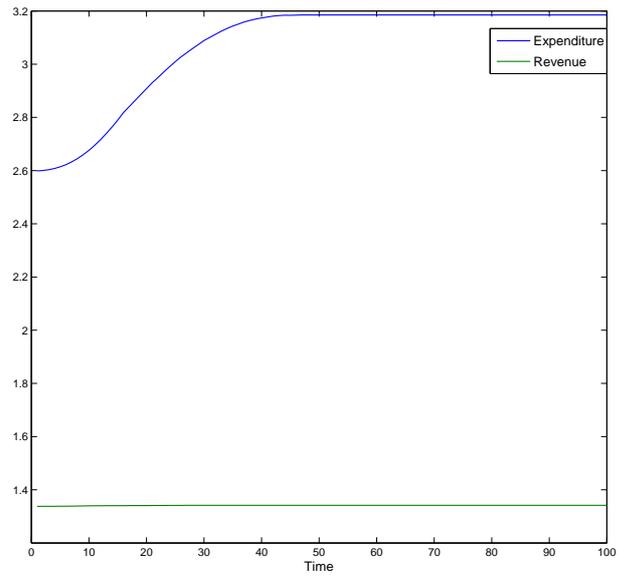


Figure 5.4: Per Effective Worker Revenue and Expenditure of ES Institution

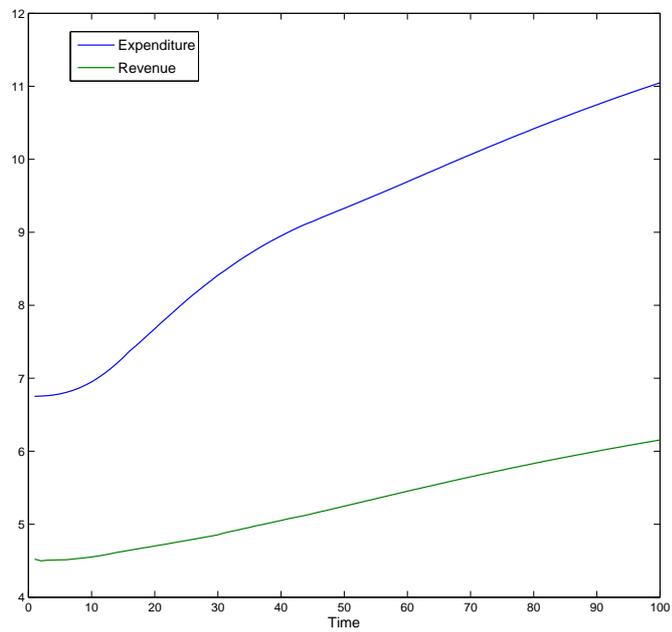


Figure 5.5: Per Effective Worker Revenue and Expenditure of SSK Institution

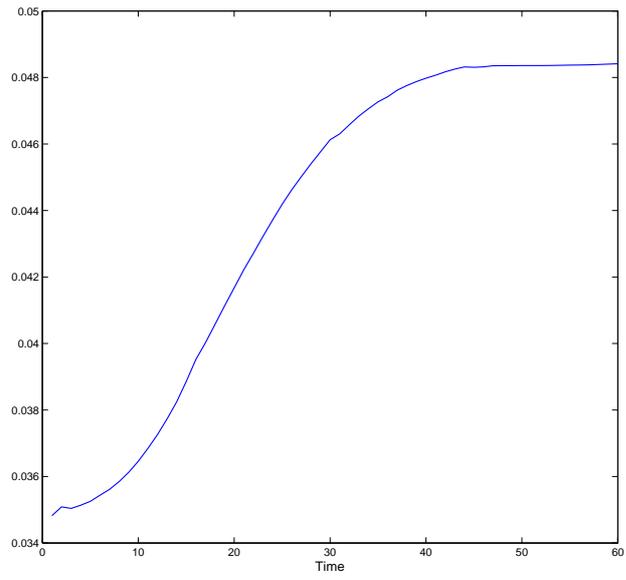


Figure 5.6: Rate of Social Security System's Aggregate Deficit to Output

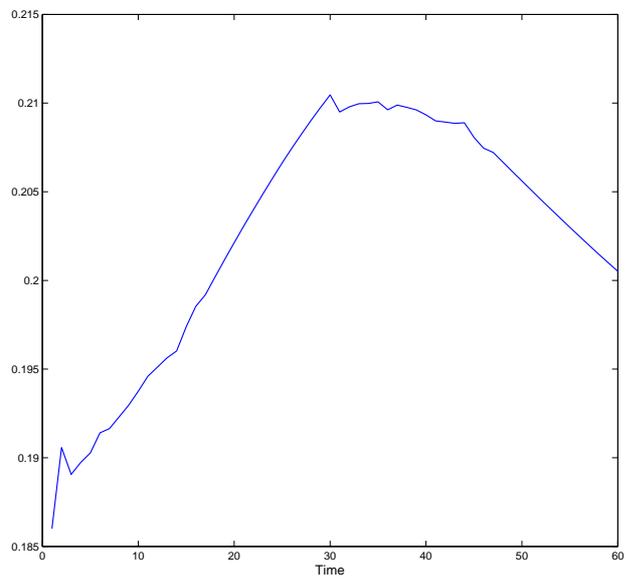


Figure 5.7: Tax Rate

However, the tax rate decreases afterwards to stabilise just below 17% in the very long run. In the medium to long run, ratio of government consumption, government wage expenditure, contribution payments of government to ES and interest payments of domestic and foreign debt to output all decrease. Similarly, the increase in social security system deficit slows down. The decreasing speed and stabilisation of expenditure items enable a lower tax rate that balances the government budget.

5.2 Analysis of the Social Security Reform

A parametric social security reform is considered in this section. The introduced shock is to the replacement rate and the contribution rates. For the base year of 2007, these rates have been calibrated; but are not equal to the ones declared by the relevant laws. Thus a method needs to be adopted to determine how the shock is to be introduced, i.e. how the rates will change from the calibrated values.

This section starts with a note on how the shocked values of parameters of interest are calculated. Then the obtained results are discussed by comparing the base and experiment paths.

5.2.1 The Parametric Social Security Shock

The adopted strategy to identify the shocked parameter values is to change the parameters by the rate of change implied by the laws. Table 5.1 shows pre-reform parameter values, post-reform values and the implied rate of change. Pre-reform parameters have been compiled from the legal texts on BK, ES and SSK. Post-reform parameters have been obtained from Law no 5754. The rates of the pre-reform and post reform parameters have been presented at the end of Table 5.1. This portion implies, as an example, that replacement rate decreases to 80% of the original value after the reform.

Given these rates of change, the parameter values assumed for the experiment path are presented in Table 5.2. Other than the contribution rates of SSK, all the rates are decreased. A decrease in the contribution rates should lead to a decrease in social security system revenues. Decreasing replacement rates imply falling pensions; hence expenditures should decrease as well. Net effect on social security budget is uncertain. Thus one can not identify the effects on

Table 5.1: Introduced Parameter Shock: Method

		Pre-reform	
	BK	ES	SSK
Replacement Rate	75%	80%	75%
Contribution (partaker)	40%	15%	14%
Contribution (employer)	NA	20%	17%
		Post-reform	
	BK	ES	SSK
Replacement Rate	60%	60%	60%
Contribution (partaker)	32.5%	14%	14%
Contribution (employer)	NA	17%	17%
		Post-reform/Pre-reform Rates	
	BK	ES	SSK
Replacement Rate	0.80	0.75	0.80
Contribution (partaker)	0.81	0.93	1.00
Contribution (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 551 and 5754.

Note: Replacement rates are for 30 years of active membership.

Table 5.2: Introduced Parameter Shock: Values

		Base	
	BK	ES	SSK
Replacement Rate	0.1127	0.3077	0.5078
Contribution (partaker)	0.0487	0.0415	0.0802
Contribution (employer)	NA	0.0553	0.0974
		Experiment	
	BK	ES	SSK
Replacement Rate	0.0902	0.2307	0.4063
Contribution (partaker)	0.0394	0.0386	0.0802
Contribution (employer)	NA	0.0470	0.0974

Source: Author's calculations.

the rest of the economy. This underlines the need for a detailed numerical analysis in order to understand the effects of the reform.

5.2.2 Social Security Aggregates

The ratios of social security system's deficits on the experiment path to the deficit on the base path are available in Figure 5.8. The figure is drawn for 60 periods. After an initial increase in deficits, the social security system is observed to experience considerable reductions in deficits. By time period 17, the decreasing trend is reversed. But the deficit on the experiment path still stabilises at a level lower than the base path deficit.

The decrease in the deficits is primarily due to the falling expenditures of the social security system. The underlying fall in expenditures can be analysed through Figures 5.9, 5.10 and 5.11. All the figures display the pension receipt of representative consumers along the experiment path and are drawn for 30 time periods and for all ages. Note that for ages 15 and below, no pension is received.

Figure 5.9 shows the pension receipts of BK consumers. To the right of arrow labelled A are the pension receipts of BK consumers born and retired before the pension reform. To the right of arrow A are the pensions calculated under the new, and lower, replacement rate. The fall in pensions is obvious.

As the consumers retired before the shock die and leave the economy, they are replaced by the consumers retired after the shock. Thus the social security expenditure related to BK consumers falls. At time period 17, all the consumers retired before the reform die and leave the economy. After this point in time, the social security aggregates start to converge to the new steady state along the experiment path.

Figures 5.10 and 5.11 imply that the same dynamics hold for ES and SSK case as well. The main finding is that the prime effect of the social security reform is through reductions of social security system deficits in the short to medium run. However, this trend of decrease partially reverses itself by time period 17. At the new steady state reached through the experiment path, the social security system deficits have fallen.

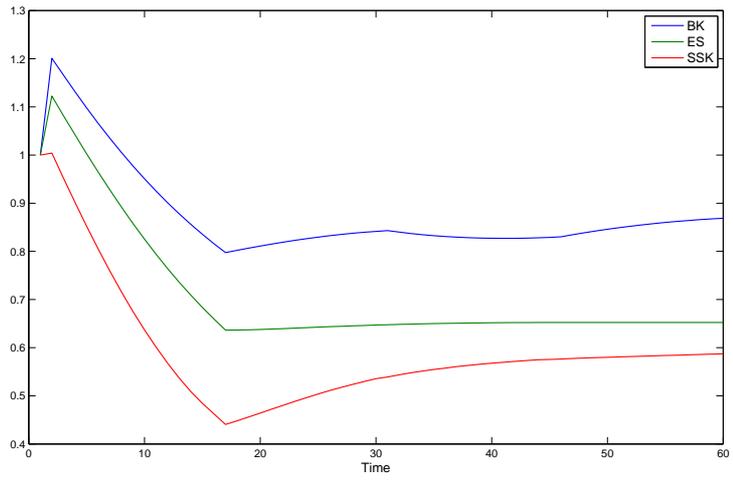


Figure 5.8: Rate of Experiment Path Social Security Deficits to Base Path

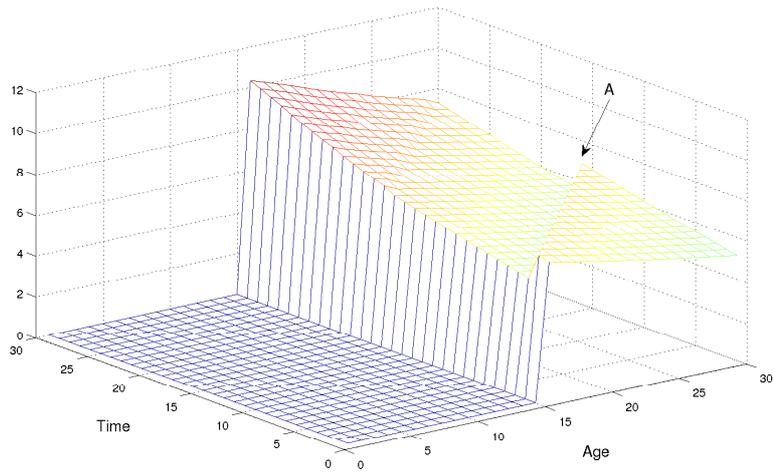


Figure 5.9: Pension Receipt of Representative BK Consumer on Experiment Path

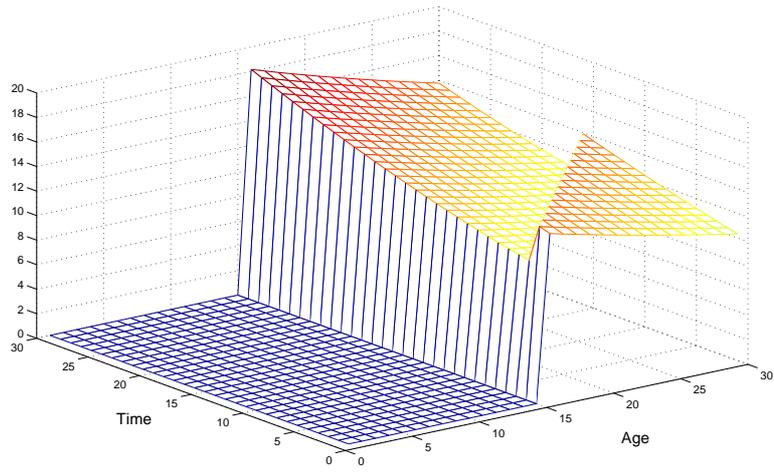


Figure 5.10: Pension Receipt of Representative ES Consumer on Experiment Path

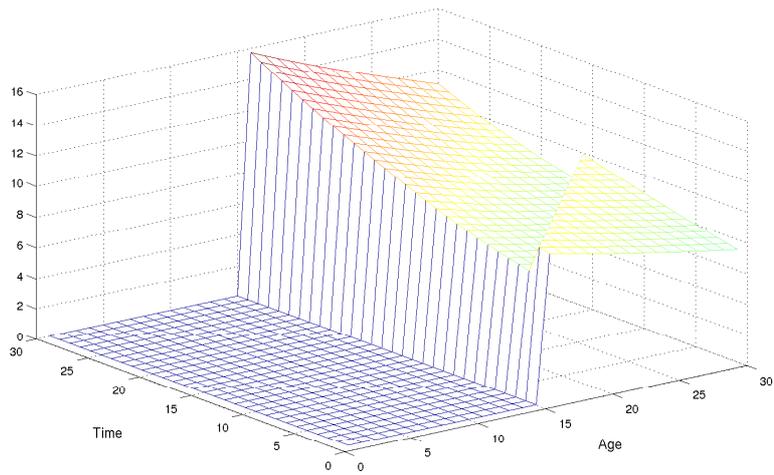


Figure 5.11: Pension Receipt of Representative SSK Consumer on Experiment Path

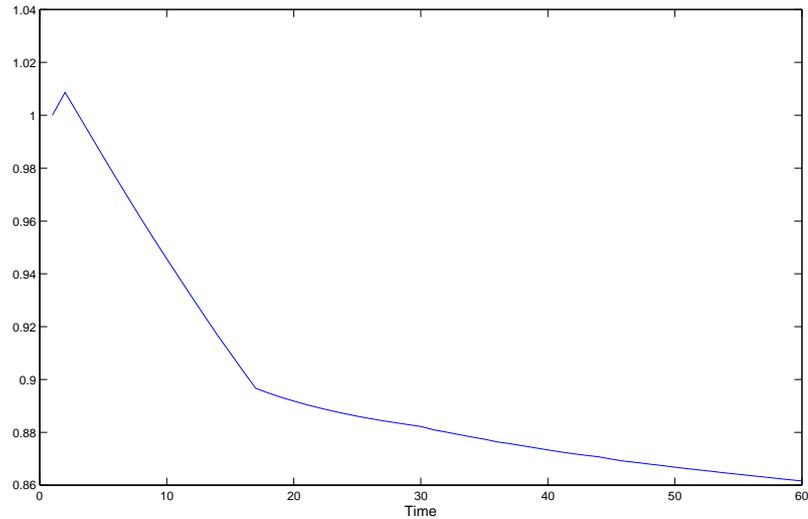


Figure 5.12: Ratio of Tax Rate on Experiment Path to Tax Rate on Base Path

5.2.3 Fiscal Effects of the Reform

Since the deficits of the social security system are covered by the government, one direct effect of the decreasing social security deficits is on the tax rate that balances the government budget. Drawn for 60 periods, Figure 5.12 shows the ratio of the tax rate along the experiment path to the tax rate calculated for the base path.

In addition to the decreasing trend, the sharp fall for the initial 17 periods is observed. The initial sharp fall of the social security system deficit quickly reduces the burden on the government budget. Thus the tax rate required to finance public expenditures quickly falls in the medium run. Afterwards, the decrease in the social security deficits slows down as the consumers retired before the reform leave the economy. Hence, the fall in the tax rate slows down as well.

5.2.4 Effects on Factor Prices

The ratios of factor prices along the experiment path to the factor prices on the base path are displayed in Figure 5.13. The interest rate first increases, compared to the base path, and then

decreases. The kink at time period 17 is primarily due to the change in the tax rate; remember that the firm's profit maximisation problem's first order condition that defines the interest rate has $1 - \tau$ in front of the marginal product of capital. Hence the government tax rate dynamics observed through Figure 5.12 are reflected in the interest rate. Wage displays a steady increase but still a kink around time period 17 is observed; yet another manifestation of the tax rate which, in turn, displays dynamics triggered by the social security aggregates.

After period 17, the wage rate and interest rate ratios diverge. The reason is that the capital stock along the experiment path increases faster than the capital stock on the base path. Once the tax rate effects are done, the differences in capital stock growth rates take over. Since capital stock increases faster along the experiment path, the interest rate falls faster along the experiment path and the wage rate increases faster along the experiment path. Therefore, the experiment path to base path ratios of the factor prices diverge.

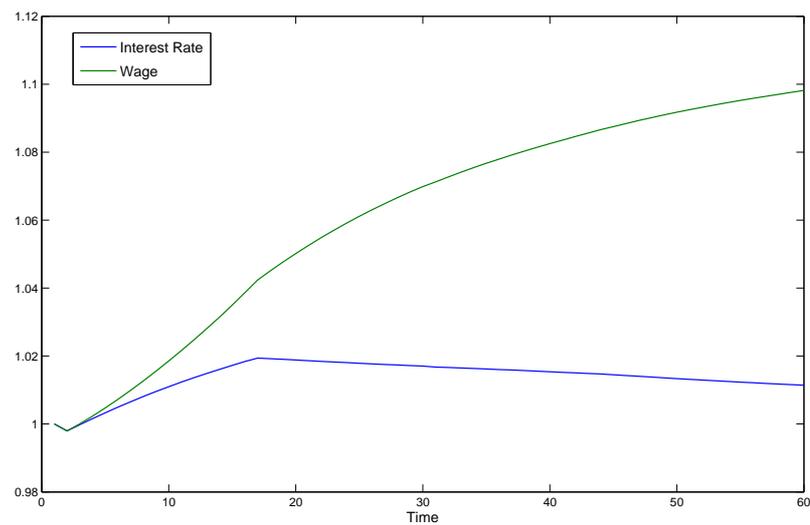


Figure 5.13: Ratio of Factor Prices on Experiment Path to Factor Prices on Base Path

5.2.5 Effects on Consumer Behaviour

The reform reduces replacement rates and contribution rates. Such a reform is expected to have opposing effects on consumer behaviour. Reduced replacement rates imply lowered pensions. Given such reduced resources for old ages, consumers need to increase saving decisions

in order to maintain a given consumption profile. Unless a numerical analysis is conducted, it is a matter of debate to what extent this can be realised, for low pensions also imply a reduced lifetime budget set. On the other hand, reduced contribution rates imply higher resources during working ages. This implies an expansion of the lifetime budget set and thus opposes the effect of the reduced replacement rate.

Drawn for 60 periods, Figure 5.14 shows the rate of consumption decisions of BK consumers on the experiment path to the consumption decisions on the base path. Consumption is observed to be generally higher along the experiment path. The figure also shows the differences in behaviours of three different subgroups of BK consumers. To the right of the arrow labelled A are the consumers born and retired before the reform. These consumers appear to have relatively higher consumptions compared to the group of consumers between arrows A and B. This second group, between arrows A and B, consists of the consumers born before the reform but have retired with the new pension rules. To the left of the kink labelled by arrow B are the ones born after the reform.

Figure 5.15 shows the same rate for ES consumers. The consumers born and retired before the reform are to the right of the kink shown by arrow A. The ones retired after the reform are between arrows A and B. The differences in behaviour are once more obvious in consumption decisions. While the BK consumers appear to enjoy an increase in consumption profile, the ES consumers appear to choose a lower consumption profile through the experiment path. The most probable reason for this is that the public wage growth, equal to the growth rate of technology $\theta = 1.02$, is too low; in order to get an idea on private wage growth, for example, check Figure 5.13.

The case for SSK is displayed in Figure 5.16, once more showing the rate of consumption decisions on the experiment path relative to base path. Like BK consumers, SSK consumers appear to enjoy an increasing consumption profile, while displaying the behaviour differences between consumers retired before reform and consumers retired after reform.

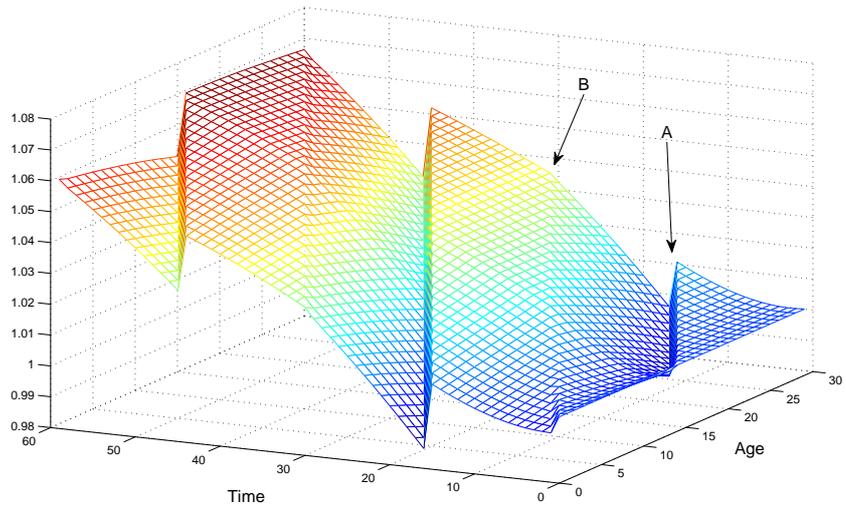


Figure 5.14: Ratio of BK Consumer Consumption Decisions on Experiment Path to Base Path

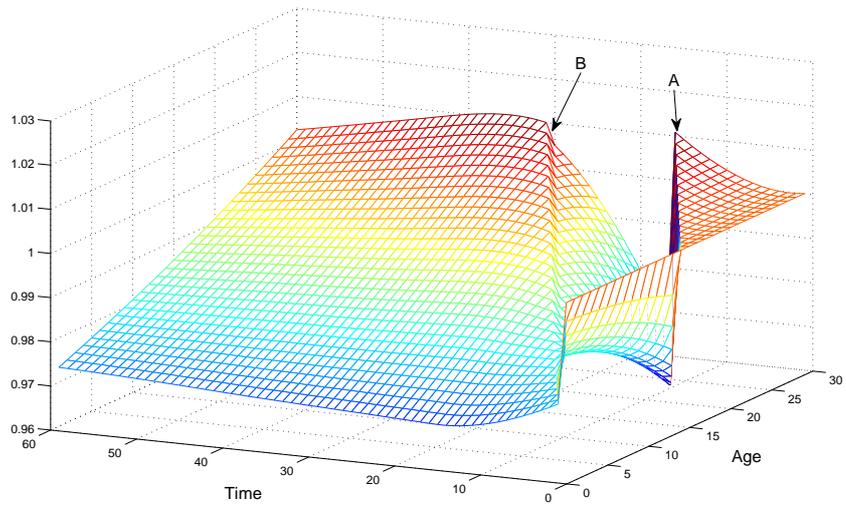


Figure 5.15: Ratio of ES Consumer Consumption Decisions on Experiment Path to Base Path

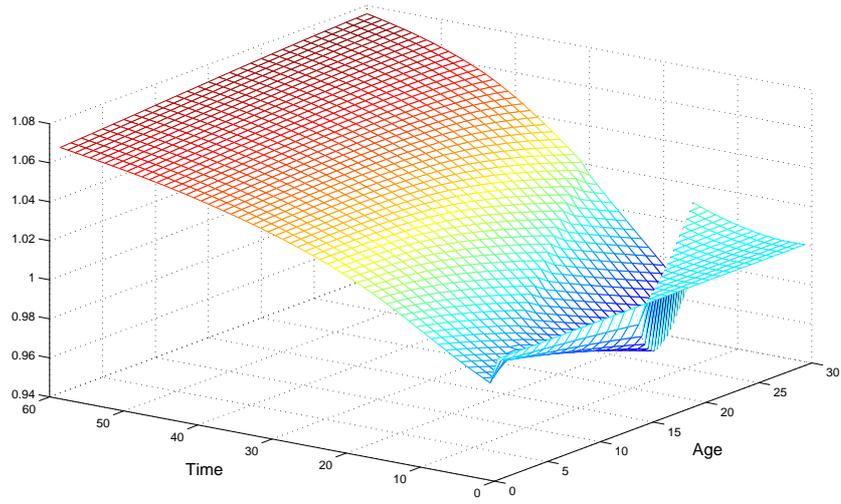


Figure 5.16: Ratio of SSK Consumer Consumption Decisions on Experiment Path to Base Path

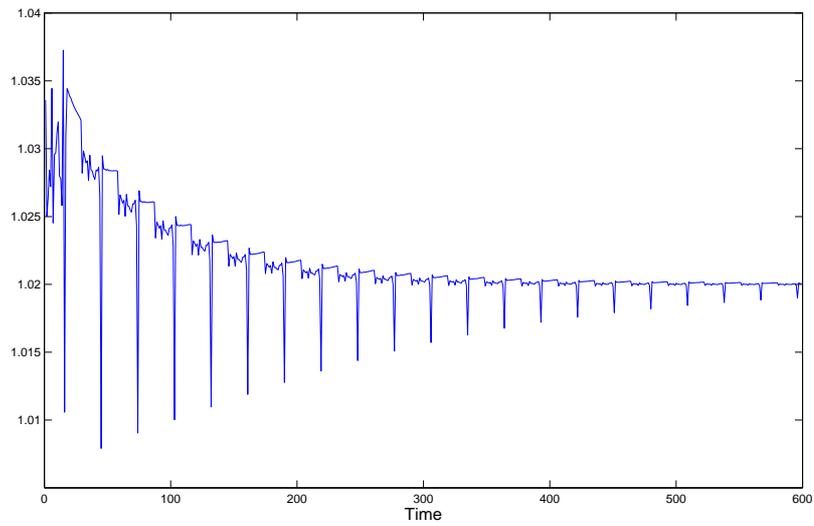


Figure 5.17: Growth Rate of BK Consumer Age 1 Consumption Decisions Along the Experiment Path

One point of curiosity is that the BK consumers born after the reform display fluctuations in consumption decisions by fixed intervals. The phenomenon is exemplified in Figure 5.17, where the growth rate of BK consumer's age 1 consumption decision is displayed for 600 periods. These jumps occur every 30 periods, starting with period 17. At period 17, the consumers born before the reform die and leave the economy. This situation acts as a secondary shock to the economy and effects the factor prices; see the kink in the interest rate in Figure 5.13. Given such a secondary shock, consumer behaviour responds. The response is most visible for the BK consumers for the BK consumer relies on asset income only and is heavily influenced by the interest rate fluctuations. Thus, the consumers born at time period 17, act as if they received a shock. This response continues to replicate itself every generation, i.e. every 30 time periods. However, as observed in Figure 5.17, the effect dies out in the very long run.

The accumulated saving decisions of BK consumers are displayed in Figure 5.18. The increasing trend and the fluctuations, observed for consumption through Figures 5.14 and 5.17, are observed for the asset stock decisions as well.

The asset stock decision rates for ES are displayed in Figure 5.19. The general tendency for the asset stock decisions appears to be an upward shift along the experiment path. The ES consumer displays minor behaviour differences for those retired before the reform and those retired after the reform. In addition, it is observed that the asset stock left to age 2 is considerably lower for the experiment path. Along the base path, asset stock left to age 2 is negative, implying that ES consumers have to borrow during the early stages of life to finance their chosen consumption path. The level of indebtedness decreases along the experiment path; a phenomenon that may be attributed to the decreasing consumption profile observed in Figure 5.15. This is consistent with an upward shift in the asset stock decisions of ES consumers along the experiment path.

The asset stock decision rates for SSK are available in Figure 5.20. Note that this figure is drawn for 60 time periods, as for other figures in this subsection, but for ages 3 to 30. This is because asset stock left to age 2 displays a high jump, as shown in Figure 5.21, and thus makes a surface graph impossible to examine.

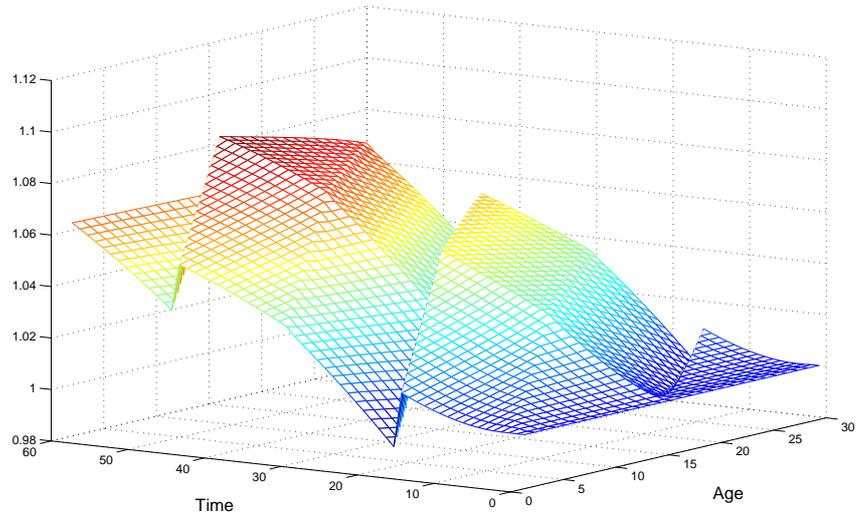


Figure 5.18: Ratio of BK Consumer Asset Stock Decisions on Experiment Path to Base Path

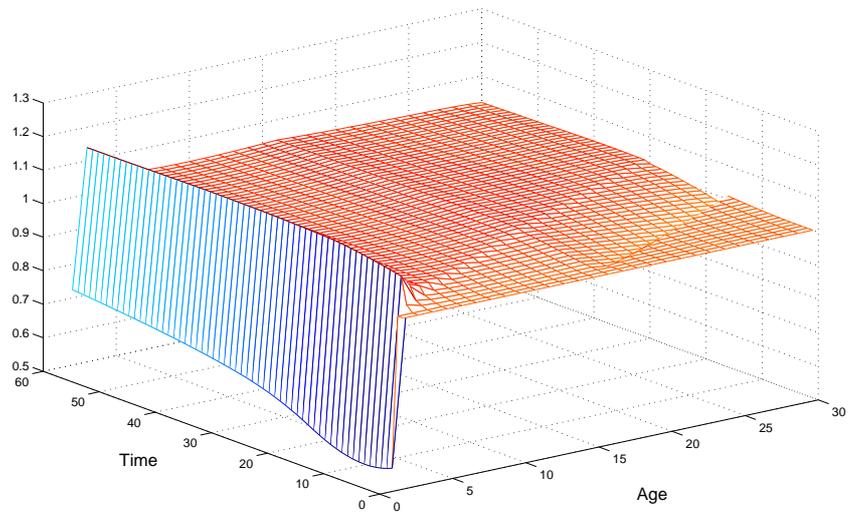


Figure 5.19: Ratio of ES Consumer Asset Stock Decisions on Experiment Path to Base Path

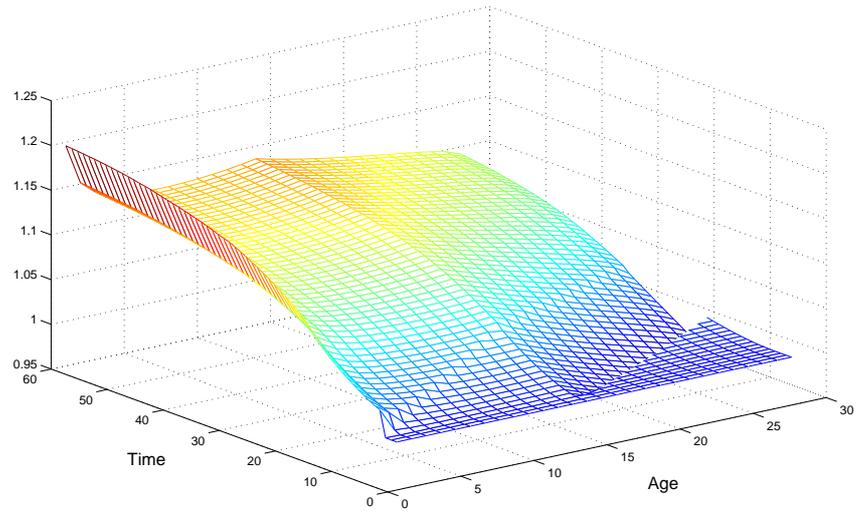


Figure 5.20: Ratio of SSK Consumer Asset Stock Decisions on Experiment Path to Base Path

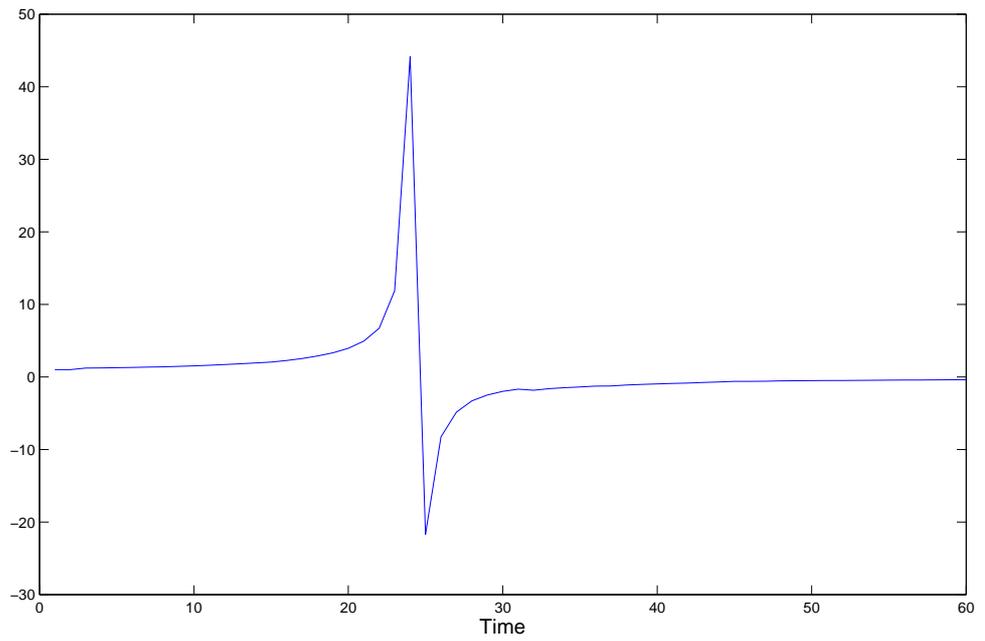


Figure 5.21: Ratio of Age 2 SSK Consumer Asset Stock Decisions on Experiment Path to Base Path

The reason for the jump in Figure 5.21 is that along the base path, SSK consumers start to leave negative asset stock to age 2 after 25 time periods. Along the experiment path, negative age 2 asset stock decisions are not observed. Along the base path the age 2 asset stock decision approaches zero. But it keeps growing along the experiment path. As the gap of these decisions diverge through the two paths, the mentioned jump is observed.

In general, the asset stock decisions of SSK consumers is observed to increase. The conclusion of this section is that ES consumers display lower optimal choices along the experiment path compared to the base path whereas the BK and SSK consumers end up with increased optimal choices.

5.2.6 Capital Stock and Output

Given the evolution of the domestic debt stock of the government, the capital stock is dependent on the asset stock decisions of consumers. ES consumers are argued to display lower asset stock decisions along the experiment path whereas the BK and SSK consumers display increases. The net effect can be examined through Figure 5.22, which shows the rate of capital stock on the experiment path to the capital stock on the base path. The capital stock increases along both paths; however, the increase is faster along the experiment path. This is consistent with the comments on Figure 5.13, where it is stated that the divergent behaviour of factor prices carry clues as to the differences in speed of increase of the capital path along different paths.

Figure 5.23 shows the rate of output along the experiment path to the base path for 60 time periods. Note that the labour supply is the same for both paths. Thus any fluctuations are due to the fluctuations in the capital stock, as can be confirmed by a visual comparison of Figures 5.22 and 5.23. The social security reform has expansionary effects; the output grows faster along the experiment path.

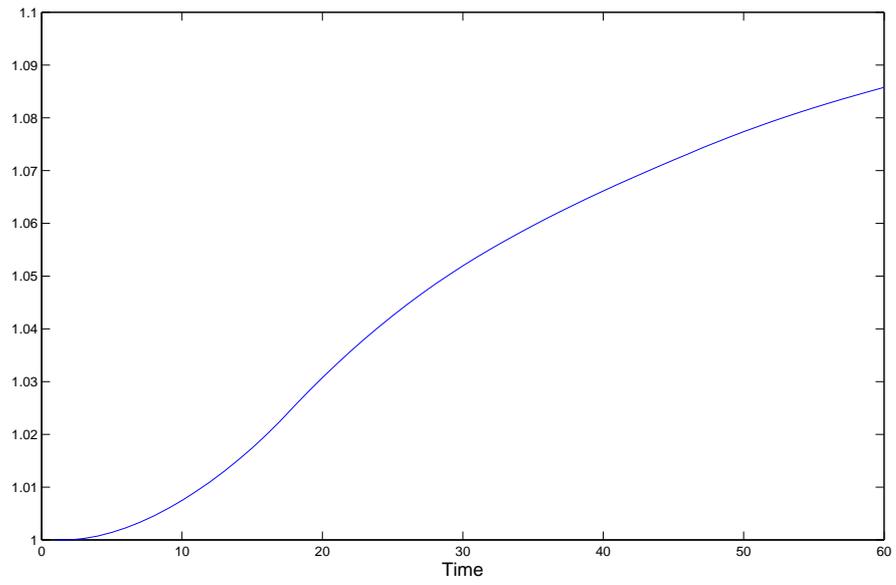


Figure 5.22: Ratio of Capital Stock on Experiment Path to Base Path

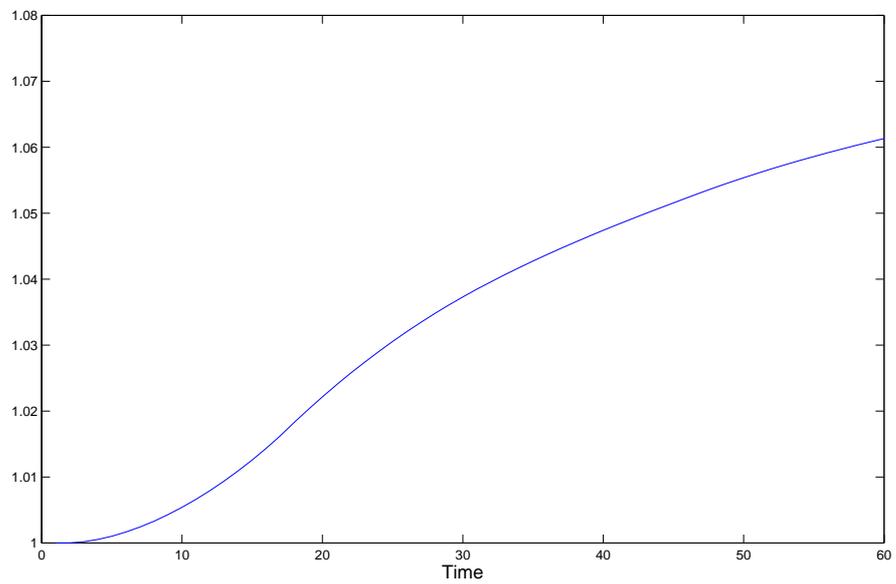


Figure 5.23: Ratio of Output on Experiment Path to Base Path

5.2.7 Welfare Analysis

The welfare analysis is conducted through two approaches. The first one takes the lifetime indirect utility along base and experiment paths and makes comparisons. However, given the differences in preference parameters and the ordinal nature of utility functions, one can only compare a given representative consumer through the two paths. That is, BK consumers along the experiment path can only be compared to BK consumers on the base path and not to ES or SSK consumers.

Second approach relies on constructing a social welfare function. The idea is to examine the changes in utility through time along the two paths, weighed by shares in population. Specifically, letting $u_{g,t,s}^*$ denote the indirect utility of age g representative consumer under the coverage of social security structure s at time t , social welfare is calculated as:

$$SW_t = \sum_{s=bk,es,ssk} \sum_{g=1}^{30} \left(\frac{u_{g,t,s}^* - u_{g,t-1,s}^*}{u_{g,t-1,s}^*} 100 \right) \frac{N_{g,t,s}}{N_t} \quad (5.1)$$

Taking the percentage change into account enables evading the complications brought about by differences in preference parameters. Thus, aggregation over different representative consumers becomes applicable.

We start with considering the remaining lifetime utilities of the consumers born before the reform. Figure 5.24 shows the rate of remaining lifetime utility for these consumers across base and experiment paths. It should be noted that for the BK case, inverse of the remaining lifetime utility is displayed. This is due to the CES instantaneous utility that produces negative utility results. That is, if remaining lifetime utility is -1 on the base path but is -2 on the experiment path, the ratio would yield 2, implying an improvement. However, if the inverse is taken, ratio is 1/2, correctly indicating a worsening.

Regarding the consumers already retired; the more lifetime there is left to live, the better off the consumer is. This is consistent with the consumption Figures 5.14, 5.15 and 5.16, which show increased consumption for the already retired. Also, if a consumer is closer to retirement, that consumer's consumption profile falls compared to the base path. Therefore, the closer a consumer is to retirement, the worse off a consumer is.

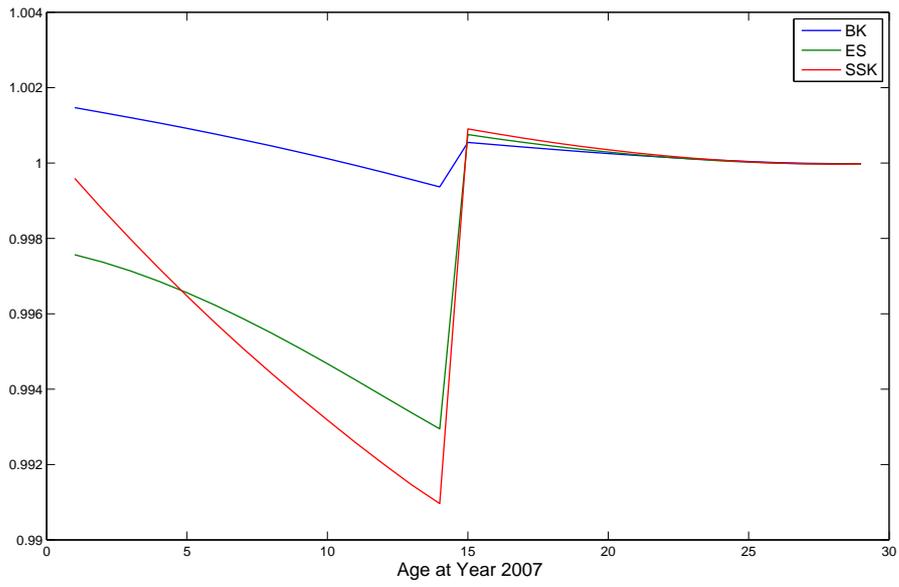


Figure 5.24: Ratio of Remaining Lifetime Utilities on Experiment Path to Base Path

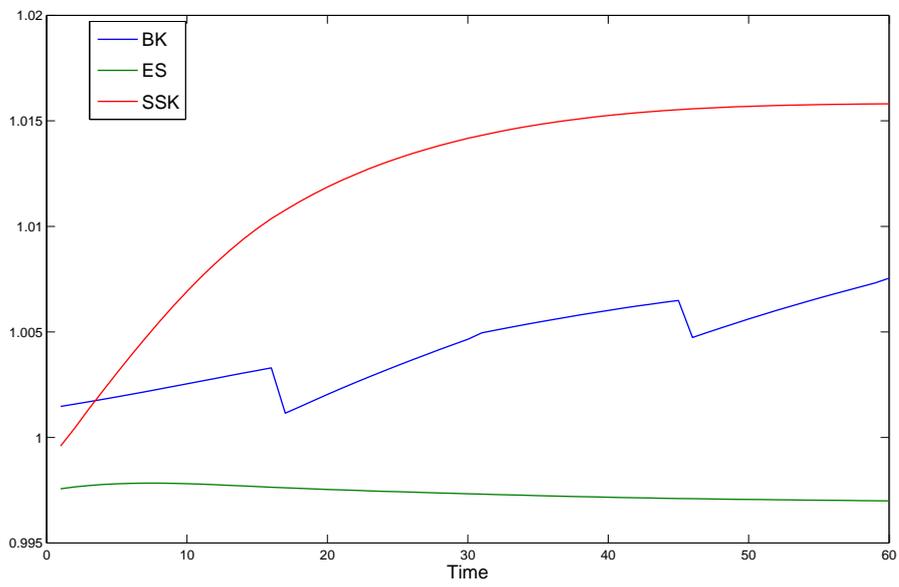


Figure 5.25: Ratio of Lifetime Utility on Experiment Path to Base Path

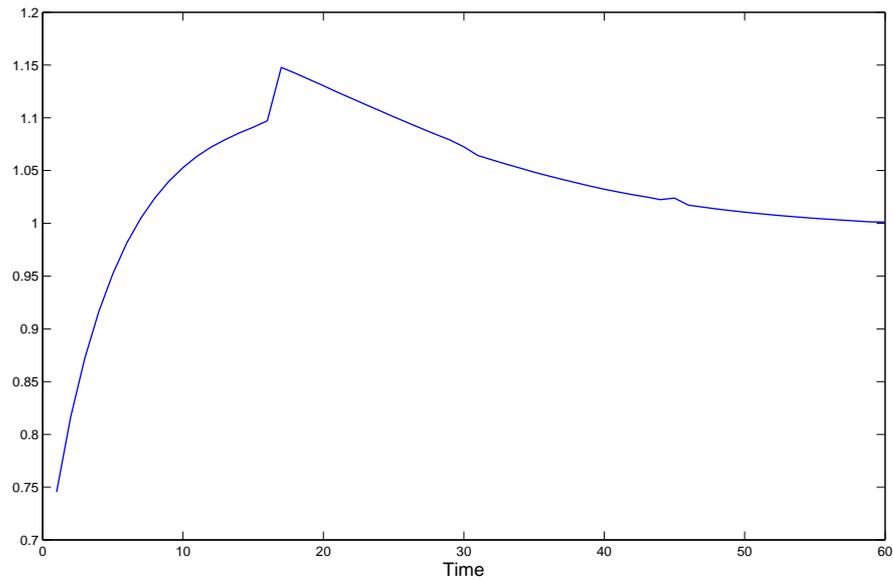


Figure 5.26: Ratio of Social Welfare on Experiment Path to Base Path

Figure 5.25 shows the same ratios for the consumers born after the reform. Both BK and SSK consumers are observed to be better off along the experiment path whereas the ES consumers are left worse off, with worsening situations.

Following in Figure 5.26 is the rates of calculated social welfares along the base and experiment paths. In the short run, the society is observed to be worse off whereas after 10 to 15 years the social welfare improves compared to the base run. The jump at time period 17 is once more observed and is due to the consumption decision differences between consumers retired before the reform and consumers retired after the reform.

5.2.8 A Summary of Results

The conducted analysis shows that the implemented parametric reform has social security system deficit reducing effects in the short run. The short to medium run dynamics are dependent on the pre-reform retirees, who have high pensions, leaving the economy. The falling debts enable relatively low tax rates by decreasing the financial burden on the government.

Regarding well being, the consumers closest to retirement at the time of the reform constitute the worst effected segment of the society. A social welfare analysis shows that ES members are the worst effected members whereas the SSK members are the primary beneficiaries of the reform. The high negative impact on the ES members may be due to the high fall in replacement rates. One should also consider the potential effect of the relatively low public wage growth rate assumed in the parametric structure of the model.

The reform has a budget set expanding effect on BK and SSK consumers. For ES consumers, the outlook is not as bright. Still, the net effect on economic aggregates is positive; asset stock accumulation is faster and the reform is observed to have expansionary effects on output, through capital stock.

CHAPTER 6

CONCLUSION

Reforming social security systems has been an item of policy agenda from 1990s to 2010 for both developed and developing countries. Turkey has joined the wave, completing the social security reform by the end of the first decade of 2000s. The reform, for the Turkish case, has not only introduced parametric changes through replacement rates and contribution rates but also has seen the foundation of a new social security institution that aims to unify the fragmented nature of social security in Turkey.

Contributing to the literature on social security reform analysis, this thesis has attempted to analyse the effects of contribution and replacement rates changes due the social security reform in Turkey. The aim is to explore the potential effects of the reform by constructing a general equilibrium model. An overlapping generations framework, where active and passive members of the population can coexist, has been adopted. A basic OLG model has been enhanced to reflect the basic characteristics of the social security system in Turkey. A 30 period lifetime, with 15 periods of work and 15 periods of retirement has been adopted to reflect the early retirement phenomenon.

Three representative consumers, belonging to either BK, ES or SSK, the three major pre-reform social security institutions of Turkey, were laid at the core of the model. Through analysis of micro data, BK members are identified to be pure asset income earners, which accrues with respect to their holdings of capital and government debt. The representative BK member is assumed to take part in the production process through capital ownership. ES members are assumed to work in exchange for public wage whereas SSK members are the core of the private labour force, working in exchange for the market wage. Observations on fluctuations of wage income by age led to the introduction of age efficiency indices. Having

seen through the micro data that the representative BK member starts life with some positive asset income, an inheritance and bequest mechanism was introduced.

The social security institutions are formulated so that they may run deficits. These deficits are financed by a relatively simple government that collects taxes out of production and borrows from the domestic asset market. Savings of consumers feed the asset market which, in turn, finances government deficits and contributes to capital stock formation.

The constructed model has been calibrated to year 2007, just prior to the completion of the social security reform. Using MATLAB, a code has been written to perform the numerical solution of the constructed model. Results were obtained for a base path, at the background of which is an ageing population. These results were compared to an experiment path, which was calculated under the assumption of reformed contribution rates and replacement rates.

Obtained results point to the following major conclusions:

- Social security system deficits decrease in the short to medium run along the experiment path. This trend is partially reversed after the consumers retired before the reform die and leave the economy.
- Due to falling social security system deficits, the tax rate along the experiment path compared to the base path falls quickly in the first 15 periods. The decreasing trend continues afterwards, at a slower pace, to reach a new steady state.
- The tax rate dynamics are reflected to the factor prices. After 17 periods, since capital stock increases faster along the experiment path, factor price ratios between base path and experiment path diverge. Both the interest rate and the wage rate are higher at the new steady state reached through the experiment path; however, the interest rate is marginally so.
- The closer a consumer is to retirement just before the reform, the worse off that consumer is. Also, the more time the consumer has to live, the better off the consumer is.
- An analysis of lifetime utilities of consumers shows that BK and SSK consumers are better off along the experiment path whereas the ES consumers are worse off.

- A social welfare analysis shows that the society as a whole is worse off in the short run. The social welfare improves only in the medium run, i.e. after 10 to 15 periods.

Obtained welfare results need to be evaluated with caution. The reform includes temporary articles concerning the individuals who enter the social security system before the reform. The model's results state that the consumers closest to retirement are worst effected. However, the temporary articles applicable to these consumers could imply reductions in welfare losses. Similarly, the social welfare effects may change if the temporary articles are taken into account along the experiment path.

In summary, despite welfare improving and growth enhancing effects, the conducted analysis points that the social security reform can handle financial sustainability problems only in the medium run. Turkey may have to face increasing social security system deficits sooner than many think. By 20 time periods, the rising deficits may once more become a concern and start to take place on policy discussions.

Further Research

The current study can be improved through two steps. Firstly, the realised social security reform effects the pension calculation method and retirement age as well. Social security deficits are observed to decrease, after an initial jump, in the short to medium run, but start to increase afterwards. The increasing retirement age may push back the date by which deficits once more increase. The pension calculation method has changed to include lifetime income. If past incomes are low, pensions would fall even further. However, depending on the path taken by the factor prices along the experiment path, incomes may increase, leading to increases in deficits. Also, temporary articles are not taken into account along the experiment path in this thesis. Numerical analysis conducted to see the net results of these sides of the reform may be a good research exercise.

Secondly, informality may be introduced into the model. The size of informal employment is non-negligible in Turkey, fluctuating between 40% and 50% in 1990s according to Boratav et al. (2000) Yeldan (2001). One may assume that the falling contribution rates could lead to reduced informality. Even though this may increase revenues of the social security system in the short run, it would lead to an increase in the number of retirees in the medium to long

run, causing deficits to arise again. Therefore, a modelling exercise that takes into account the informal sector to formal sector transitions would be a considerable contribution to the literature on social security in Turkey.

REFERENCES

- Akgeyik, T., Yılmaz, B. E., & Seker, M. (2007). *En büyük karadelik: Sosyal güvenlik açıkları ve reform tartışmalarının sosyo-ekonomik yansımaları*. Türk Sigorta Enstitüsü Vakfı.
- Akyüz, F. (2008). *Türkiye’de sosyal güvenlik sisteminde yapısal dönüşüm: Eleştirel bir analiz*. Unpublished doctoral dissertation, Graduate School of Social Sciences, Marmara University.
- Auerbach, A. J., & Kotlikoff, L. J. (1987). *Dynamic fiscal policy*. Cambridge University Press.
- Barro, R. J. (1974). Are government bonds net wealth? *Journal of Political Economy*, 82(6), 1095-1117.
- Başak, Z. (2005). *Explaining informalisation via labor market segmentation theory: Evidence from Turkey*. Unpublished master’s thesis, Middle East Technical University, Graduate School of Social Sciences.
- Blanchard, O. J. (1985). Debt, deficits, and finite horizons. *The Journal of Political Economy*, 93(2), 223–247.
- Boratav, K., Yeldan, E., & Köse, A. H. (2000). *Globalisation, distribution and social policy: Turkey, 1980-1998* (Tech. Rep.). CEPA Working Paper Series I, Working Paper No 20.
- Botman, D., & Tuladhar, A. (2008). *Tax and pension reform in the Czech Republic: Implications for growth and debt sustainability* (Working Paper No. WP/08/125). IMF.
- Brooks, R. (2004). *The equity premium and the baby boom* (Econometric Society 2004 North American Winter Meetings No. 155). Econometric Society. Available from <http://ideas.repec.org/p/ecm/nawm04/155.html>
- Buğra, A., & Keyder, Ç. (2006). The Turkish welfare regime in transformation. *Journal of European Social Policy*, 16(13), 211-228.
- Cichon, M. (1999). *In the eye of the storm: The Russian social protection system amidst multiple crises*. (mimeo.). Geneva, International Labour Office.
- Cilasun, S. M. (2009). *Income, consumption and saving behavior of Turkish households*. Unpublished doctoral dissertation, Middle East Technical University.

- Clavijo, S. (2009). *Social security reforms in Colombia: Striking demographic and fiscal balances* (Working Paper No. WP/09/58). IMF.
- CPFB. (1996). *Annual report 1996*. Central Provident Fund Board, Singapore.
- Deaton, A. (1985). Panel data from time series of cross-sections. *Journal of Econometrics*, 30(1-2), 109-126.
- Deaton, A., & Paxson, C. H. (1993). *Saving, growth, and aging in Taiwan* (Working Paper No. 4330). National Bureau of Economic Research.
- Diamond, P. A. (1965). National debt in a neoclassical growth model. *The American Economic Review*, 55(5), 1126–1150.
- Duygulu, E., & Pehlivan, P. (2004). Maliye hesap uzmanları vakfı ekonomik ve mali araştırma yarışması: Sosyal güvenlik kurumlarının kaynak sorunları ve çözüm önerileri. In (chap. Sosyal Güvenlik Kurumlarının Kaynak Sorunları ve Çözüm Önerileri). Maliye Hesap Uzmanları Vakfı.
- Elveren, A. Y. (2008). Social security reform in Turkey: A critical perspective. *Review of Radical Political Economics*, 40(2), 212-232.
- EPF. (1997). *Annual report 1997*. Employees Provident Fund, Kuala Lumpur.
- Fehr, H., & Jess, H. (2007). Who benefits from the reform of pension taxation in germany. *Fiscal Studies*.
- Ferreira, S. (2005). *Pension reform in Brazil: Transitional issues in a model with endogenous labor supply* (IBMEC RJ Economics Discussion Papers No. 2005-02). Economics Research Group, IBMEC Business School - Rio de Janeiro. Retrieved 26 June 2011, from <http://econpapers.repec.org/RePEc:ibr:dpaper:2005-02>
- Fitzenberger, B., & Wunderlich, G. (2002). Gender wage differences in West Germany: A cohort analysis. *German Economic Review*, 3(4), 379-414.
- Fuster, L., Imrohoroglu, A., & Imrohoroglu, S. (2003). A welfare analysis of social security in a dynastic framework. *International Economic Review*, 44(4).
- GİB. (2009). *Kayıtdışı ekonomiyle mücadele stratejisi eylem planı: 2008-2010* (Tech. Rep.). Gelir İdaresi Başkanlığı Strateji Geliştirme Daire Başkanlığı.
- Heckman, J. J., Lochner, L., & Taber, C. (1998). Explaining rising wage inequality: Explorations with a dynamic general equilibrium model of labor earnings with heterogeneous agents. *Review of Economic Dynamics*, 1(1), 1–58.
- Heer, B. (2001). Wealth distribution and optimal inheritance taxation in life-cycle economies with intergenerational transfers. *Scandinavian Journal of Economics*, 103(3), 445-465.

- Huggett, M., & Ventura, G. (2000). Understanding why high income households save more than low income households. *Journal of Monetary Economics*, 45(2), 361–397.
- Imrohoroglu, A., Imrohoroglu, S., & Joines, D. (1999). Social security in an overlapping generations economy with land. *Review of Economic Dynamics*, 2(3).
- İmrohoroğlu, A., İmrohoroğlu, S., & Joines, D. H. (1995). A life cycle analysis of social security. *Economic Theory*, 6(1), 83-114.
- Jaag, C., Keuschnigg, C., & Keuschnigg, M. (2010). Pension reform, retirement, and life-cycle unemployment. *International Tax and Public Finance*, 17(5).
- Kotlikoff, L. J. (1998). *The A-K model: It's past, present, and future* (NBER Working Papers No. 6684). National Bureau of Economic Research, Inc. Retrieved 26 June 2011, from <http://www.nber.org/papers/w6684>
- Luitel, H. S., & Sobel, R. S. (2007). The revenue impact of repeated tax amnesties. *Public Budgeting and Finance*, 27(3).
- Magnani, R. (2008). *A general equilibrium evaluation of the sustainability of the new pension reforms in Italy* (Working Papers No. 2008-25). CEPII Research Center. Retrieved 26 June 2011, from goo.gl/AA84u
- Manchester, J. (1999). Prospects for social security reform. In O. M. et al. (Ed.), (chap. Compliance in social security systems around the world). Philadelphia, PA, Pension Research Council, University of Pennsylvania Press.
- McGillivray, W. (2001). Contribution evasion: Implications for social security pension schemes. *International Social Security Review*, 54.
- Melguizo, A., Munoz, A., Tuesta, D., & Vial, J. (2009). *Pension reform and fiscal policy: Some lessons from Chile* (Working Paper No. 0915). BBVA Economic Research Department.
- OECD. (2007). *Pensions at a glance 2007: Public policies across OECD countries*. Organisation for Economic Cooperation and Development.
- OECD. (2011). *Society at a glance 2011: OECD social indicators*. OECD Publishing.
- Özbek, N. (2006). *Cumhuriyet Türkiye'sinde sosyal güvenlik ve sosyal politikalar*. Tarih Vakfı.
- Özgür, A. (2008). *Pension reform: The Turkish case in the European context*. Unpublished master's thesis, Graduate School of Social Sciences, METU.
- PETROL-İŞ. (2005). *Petrol-iş'in araştırması: Ssk'nin fonlari nasıl buharlaştırıldı? ssk'ya devlet yatırım bankası finanse ettirildi*. Retrieved 26 June 2011, from goo.gl/wumui

- Samuelson, P. A. (1958). An exact consumption-loan model of interest with or without the social contrivance of money. *The Journal of Political Economy*, 66(6), 467–482.
- Sayan, S. (2005, Yaz). Sosyal sigortalar kurumu'nun uzun dönem aktüeryal dengeleri: 1999 reformu ve alternatifleri. *Muğla Üniversitesi İktisadi ve İdari Bilimler Dergisi*(1), 29-55.
- Schneider, F. (2002). *Size and measurement of the informal economy in 110 countries around the world*. Retrieved 26 June 2011, from http://www.amnet.co.il/attachments/informal_economy110.pdf
- Solow, R. M. (2006). Overlapping generations. In M. Szenberg, L. Ramrattan, & A. A. Gottesman (Eds.), *Samuelsonian economics and the twenty first century*. Oxford University Press.
- SPO. (1963). *Birinci beş yıllık kalkınma planı 1963-1967*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (1972). *Üçüncü beş yıllık kalkınma planı*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (1979). *Dördüncü beş yıllık kalkınma planı*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (1995). *Yedinci beş yıllık kalkınma planı*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (1997). *Yedinci beş yıllık kalkınma planı (1996-2000): 1997 yılı programı destek çalışmaları*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (1998). *Yedinci beş yıllık kalkınma planı (1996-2000) 1998 yılı programı destek çalışmaları: Ekonomik ve sosyal sektörlerdeki gelişmeler*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (2000a). *Sekizinci beş yıllık kalkınma planı*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (2000b). *Yedinci beş yıllık kalkınma planı (1996-2000) 2000 yılı programı*. Devlet Planlama Teşkilatı: Ankara.
- SPO. (2007). *Dokuzuncu beş yıllık kalkınma planı sosyal güvenlik özel ihtisas komisyonu raporu*. Devlet Planlama Teşkilatı: Ankara.
- Stephan, G., Muller-Furstenberger, G., & Previdoli, P. (1997). Overlapping generations or infinitely-lived agents: Intergenerational altruism and the economics of global warming. *Environmental and Resource Economics*, 10(1), 27-40.
- Telli, C. (2004). *Sosyal hesaplar üretme yöntemi ve Türkiye uygulaması (Uzmanlık Tezi)*. Devlet Planlama Teşkilatı Yıllık Programlar ve Konjonktür Değerlendirme Genel Müdürlüğü.
- Tuncay, C., & Alper, Y. (1997). *Türk sosyal güvenlik sisteminde yeniden yapılanma: Sorunlar, reform ihtiyacı, arayışlar, çözüm önerileri* (No. TUSIAD-T/97-10-217). Türk Sanayi-

cileri ve İşadamları Derneđi.

TURKSTAT. (2009). *Statistical indicators 1923-2008*. Turkish Statistical Institute.

Weil, P. (2008). *Overlapping generations: the first jubilee* (Open Access publications from Sciences Po). Sciences Po. Retrieved 26 June 2011, from <http://ideas.repec.org/p/ner/sciepo/infohdl2441-8712.html>

Yang, Z. (2009). Urban public pension, replacement rates and population growth rate in China. *Insurance: Mathematics and Economics*.

Yeldan, E. (2001). *Küreselleşme sürecinde Türkiye ekonomisi: Bölüşüm, birikim ve büyüme*. İletişim Yayınları: İstanbul.

APPENDICES

APPENDIX A

Mathematical Appendix

A.1 Derivation of the Economy Resource Constraint

The aim of this section is to present the derivation of the economy resource constraint of the model in Chapter 4. Given the consumer budget constraints in Chapter 4, one can summarise the expenditures of all consumers in the economy at time t as:

$$\sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} c_{g,t,s} N_{g,t,s} + \sum_{s=BK,ES,SSK} \sum_{g=1}^{GL-1} a_{g+1,t+1,s} N_{g,t,s} + \sum_{s=BK,ES,SSK} beq_{GL,t,s} N_{GL,t,s}$$

Let us define $C_t = \sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} c_{g,t,s} N_{g,t,s}$. Also, $A_{t+1} = \sum_{s=BK,ES,SSK} \sum_{g=1}^{GL-1} a_{g+1,t+1,s} N_{g,t,s}$, for $N_{g,t,s} = N_{g+1,t+1,s}$. Then this expression reduces to:

$$C_t + A_{t+1} + \sum_{s=BK,ES,SSK} beq_{GL,t,s} N_{GL,t,s} \quad (\text{A.1})$$

Now consider the revenue items:

$$\begin{aligned} & inh_t N_{1,t,BK} + \sum_{g=1}^{GW} [1 + r_t(1 - \tau_{t,BK})] a_{g,t,BK} N_{g,t,BK} + \sum_{s=ES,SSK} \sum_{g=1}^{GL} (1 + r_t) a_{g,t,s} N_{g,t,s} \\ & + \sum_{g=GW+1}^{GL} (1 + r_t) a_{g,t,BK} N_{g,t,BK} + \sum_{g=1}^{GW} (1 - \tau_{t,SSK}) w_t e_{g,t,SSK} N_{g,t,SSK} + \sum_{g=1}^{GW} (1 - \tau_{t,ES}) w_t e_{g,t,ES} N_{g,t,ES} \\ & + \sum_{s=BK,ES,SSK} \sum_{g=GW+1}^{GL} pen_{t,s} N_{g,t,s} \end{aligned}$$

The second item on the first row is asset stock and return from asset stock of BK consumers at time t and can be decomposed as $\sum_{g=1}^{GW} (1 + r_t) a_{g,t,BK} N_{g,t,BK} - \tau_{t,BK} r_t a_{g,t,BK} N_{g,t,BK}$. First part of this decomposition can be merged with the first item on the second row to obtain the asset stock of all BK consumers at time and the relevant return; $(1 + r_t) A_{t,BK}$. The third item on

the first line is the aggregate asset holdings of ES and SSK consumers, $A_{t,ES}$ and $A_{t,SSK}$, with their returns. Then;

$$\begin{aligned} & inh_t N_{1,t,BK} + (1 + r_t)(A_{t,BK} + A_{t,ES} + A_{t,SSK}) - \sum_{g=1}^{GW} \tau_{t,BK} r_t a_{g,t,BK} N_{g,t,BK} \\ & + \sum_{g=1}^{GW} w_t e_{g,t,SSK} N_{g,t,SSK} - \sum_{g=1}^{GW} \tau_{t,SSK} w_t e_{g,t,SSK} N_{g,t,SSK} \\ & + \sum_{g=1}^{GW} w_{t,p} e_{g,t,ES} N_{g,t,ES} - \sum_{g=1}^{GW} \tau_{t,ES} w_{t,p} e_{g,t,ES} N_{g,t,ES} + \sum_{s=BK,ES,SSK} \sum_{g=GW+1}^{GL} pen_{t,s} N_{g,t,s} \end{aligned}$$

Using the budget constraints of the social security institutions and defining $A_{t,BK} + A_{t,ES} + A_{t,SSK} = A_t$, revenue items become:

$$\begin{aligned} & inh_t N_{1,t,BK} + (1 + r_t)A_t + \sum_{g=1}^{GW} w_t e_{g,t,SSK} N_{g,t,SSK} + \sum_{g=1}^{GW} w_{t,p} e_{g,t,ES} N_{g,t,ES} \\ & + DEF_{t,BK} + DEF_{t,ES} + DEF_{t,SSK} + GOV_ES_t + \sum_{g=1}^{GW} \tau_{t,eSSK} e_{g,t,SSK} w_t N_{g,t,SSK} \end{aligned}$$

where GOV_ES_t is the social security payments from the government to ES for the government is the employer of working ES consumers. Last item on the second row is the social security contributions made by private sector to SSK due to employed workers. Using the government budget constraint;

$$\begin{aligned} & inh_t N_{1,t,BK} + (1 + r_t)A_t + \sum_{g=1}^{GW} w_t e_{g,t,SSK} N_{g,t,SSK} + \tau_t Y_t + DEB_{t+1} + DEB_{f,t+1} \\ & - (1 + r_t)DEB_t - (1 + r_{f,t})DEB_{f,t} - G_t + \sum_{g=1}^{GW} \tau_{t,eSSK} e_{g,t,SSK} w_t N_{g,t,SSK} \quad (A.2) \end{aligned}$$

Now, merge Equations A.1 and A.2 using $A_t = K_t + DEB_t$ and simplify;

$$C_t + I_t + G_t = r_t K_t + \tau_t Y_t + (1 + \tau_{t,eSSK}) w_t \sum_{g=1}^{GW} e_{g,t,SSK} N_{g,t,SSK} + BOR_{f,t} - r_{f,t} DEB_{f,t}$$

Further clarification can be done by using the in text explanations on the international economic aspects of the model;

$$C_t + I_t + G_t + X_t - M_t = r_t K_t + \tau_t Y_t + (1 + \tau_{t,eSSK}) w_t \sum_{g=1}^{GW} e_{g,t,SSK} N_{g,t,SSK}$$

Remember from the explanations on the model in Chapter 4 that wage is

$$w_t = \frac{1 - \tau_t}{1 + \tau_{t,eSSK}} (1 - \alpha) \Gamma_t K_t^\alpha (\Gamma_t L_{t,SSK})^{-\alpha}$$

That is, the ratio of the tax rate and contribution rate is multiplied by the marginal product of labor. The interest rate is;

$$r_t = (1 - \tau_t)\alpha K_t^{\alpha-1} (\Gamma_t L_{t,SSK})^{1-\alpha}$$

Hence tax collected by the government is taken into account in wage and interest rate definitions. Using these;

$$C_t + I_t + G_t X_t - M_t = (1 - \tau_t)MP_K + \tau_t Y_t + (1 - \tau_t)MP_{L_{SSK}} \sum_{g=1}^{GW} e_{g,t,SSK} N_{g,t,SSK}$$

where MP_K is the marginal product of capital and $MP_{L_{SSK}}$ is the marginal product of the labor composed of the working consumers under the coverage of SSK. For a Cobb-Douglas production with constant returns to scale, $Y_t = L_{t,SSK} \frac{\partial Y_t}{\partial L_{t,SSK}} + K_t \frac{\partial Y_t}{\partial K_t}$. Then;

$$Y_t = C_t + I_t + G_t + NX_t$$

where $NX_t = X_t - M_t$ is net exports.

A.2 Confirmation that Saving/Investment and Asset Return Accounts of SAM Balance

This section aims to show that revenue and expenditure items of the saving and investment account and the asset returns account of the SAM (Social Accounting Matrix) presented in Chapter 4 balance each other. The row items on these two accounts are

$$r_t K_t + \sum_s \sum_{g=1}^{GL} (a_{g+1,t+1,s} - a_{g,t,s}) N_{g,t,s} + r_t DEB_t + r_{f,t} DEB_{f,t} + BOR_{f,t}$$

where $BOR_{f,t} = DEB_{f,t+1} - DEB_{f,t}$ is foreign borrowing. Column items are

$$I_t + \sum_s \sum_g r_t a_{g,t,s} N_{g,t,s} + DEB_{t+1} - DEB_t + DEB_{f,t+1} - DEB_{f,t} + r_{f,t} DEB_{f,t}$$

Introducing $A_t = \sum_s \sum_g a_{g,t,s} N_{g,t,s}$ and noting that $N_{g+1,t+1,s} = N_{g,t,s}$ due to the introduced population dynamics of the model in Chapter 4, these row and column equations become

$$r_t K_t + A_{t+1} - A_t + r_t DEB_t + r_{f,t} DEB_{f,t} + BOR_{f,t} \quad (\text{A.3})$$

and

$$I_t + r_t A_t + DEB_{t+1} - DEB_t + DEB_{f,t+1} - DEB_{f,t} + r_{f,t} DEB_{f,t} \quad (\text{A.4})$$

respectively. If the row and column accounts balance each other, it should be possible to obtain one from the other. Consider Equation A.3 with $A_t = K_t + DEB_t$;

$$r_t K_t + K_{t+1} + DEB_{t+1} - K_t - DEB_t + r_t DEB_t + r_{f,t} DEB_{f,t} + DEB_{f,t+1} - DEB_{f,t}$$

Defining $I_t = K_{t+1} - K_t$ and rearranging;

$$I_t + r_t (K_t + DEB_t) + DEB_{t+1} - DEB_t + DEB_{f,t+1} - DEB_{f,t} + r_{f,t} DEB_{f,t}$$

Since $A_t = K_t + DEB_t$,

$$I_t + r_t A_t + DEB_{t+1} - DEB_t + DEB_{f,t+1} - DEB_{f,t} + r_{f,t} DEB_{f,t}$$

which is nothing but Equation A.4. Thus row and column of SAM related to saving, investment and asset return accounts balance.

Note that this derivation also implies

$$S_t = I_t + DEB_{t+1} - DEB_t \quad (\text{A.5})$$

A.3 Population and Labor Growth

The aim of this section is to provide formulas for steady state growth rates for population and labor.

A.3.1 Population Growth

Population growth occurs according to:

$$N_{1,t+1,s} = \rho_{t,s} N_{1,t,s} \quad (\text{A.6})$$

Some recursive algebra shows:

$$N_{g,t,s} = \frac{1}{\prod_{i=1}^{g-1} \rho_{t-i,s}} N_{1,t,s} \quad (\text{A.7})$$

which implies

$$\frac{N_{g,t+1,s}}{N_{g,t,s}} = \rho_{t-g+1,s} \quad (\text{A.8})$$

At the steady state where age 1 growth rate is constant for members of social security institution s ;

$$\frac{N_{g,t+1,s}}{N_{g,t,s}} = \rho_s \quad (\text{A.9})$$

Regarding the sum of members of social security institution s ;

$$\begin{aligned} \frac{N_{t+1,s}}{N_{t,s}} &= \frac{\sum_g N_{g,t+1,s}}{\sum_g N_{g,t,s}} \\ &= \frac{\sum_g \rho_{t-g+1,s} N_{g,t,s}}{\sum_g N_{g,t,s}} \end{aligned} \quad (\text{A.10})$$

At the steady state, it is assumed that age 1 group grows at the constant growth rate $\rho_{t,s} = \rho_s$; therefore,

$$\frac{N_{t+1,s}}{N_{t,s}} = \rho_s \quad (\text{A.11})$$

For aggregate population;

$$\begin{aligned}
\frac{N_{t+1}}{N_t} &= \frac{\sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} N_{g,t+1,s}}{\sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} N_{g,t,s}} \\
&= \frac{\sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} \rho_{t-g+1,s} N_{g,t,s}}{\sum_{s=BK,ES,SSK} \sum_{g=1}^{GL} N_{g,t,s}} \tag{A.12}
\end{aligned}$$

At the steady state, we have $\rho_{t,s} = \rho_s = \rho$. This yields;

$$\frac{N_{t+1}}{N_t} = \rho \tag{A.13}$$

Finally, let us consider how the share of members of a social security institution s' in total population is determined;

$$\begin{aligned}
\frac{N_{t,s'}}{N_t} &= \frac{\sum_g N_{g,t,s'}}{\sum_s \sum_g N_{g,t,s}} \\
&= \frac{\sum_g \frac{1}{\prod_{i=1}^{g-1} \rho_{t-i,s'}} N_{1,t,s'}}{\sum_s \sum_g \frac{1}{\prod_{i=1}^{g-1} \rho_{t-i,s}} N_{1,t,s}} \tag{A.14}
\end{aligned}$$

At the steady state, $\rho_{t,s} = \rho_s = \rho$. Therefore, this simplifies to:

$$\frac{N_{t,s'}}{N_t} = \frac{N_{1,t,s'}}{N_{1,t}} \tag{A.15}$$

It is possible to manipulate the growth rates of age 1 consumers for all social security institutions so that relative sizes of members of different social security institutions differ. For example, to simulate a changing public worker share in the population, one can pick changing values for $\rho_{t,ES}$ during the transition. However, such a practise needs to be coupled with appropriate choices for the growth rates of members of other social security institutions, $\rho_{t,BK}$ and $\rho_{t,SSK}$, so that aggregate population growth is maintained.

A.3.2 Labor Growth

For ES and SSK labor, we have:

$$\frac{L_{t+1,s}}{L_{t,s}} = \frac{\sum_{g=1}^{GW} e_{g,t+1,s} N_{g,t+1,s}}{\sum_{g=1}^{GW} e_{g,t,s} N_{g,t,s}} \quad (\text{A.16})$$

where $e_{g,t,s}$ is the age efficiency index and s is either ES or SSK. Remember that a representative BK consumer provides no labor and has no labor related income. Given growth of age g cohort summarised by Equation A.8 above;

$$\begin{aligned} \frac{L_{t+1,s}}{L_{t,s}} &= \frac{\sum_{g=1}^{GW} e_{g,t+1,s} N_{g,t+1,s}}{\sum_{g=1}^{GW} e_{g,t,s} N_{g,t,s}} \\ &= \frac{\sum_{g=1}^{GW} e_{g,t+1,s} \rho_{t-g+1,s} N_{g,t,s}}{\sum_{g=1}^{GW} e_{g,t,s} N_{g,t,s}} \\ &= n_{t,s} \end{aligned} \quad (\text{A.17})$$

Assuming time invariant labor efficiency so that $e_{g,t,s} = e_{g,s}$ is constant through time and that $\rho_{t,s} = \rho$ as was done for aggregate population above yields;

$$\frac{L_{t+1,s}}{L_{t,s}} = \rho \quad (\text{A.18})$$

as the labor growth at the steady state.

A.4 Consumer Decision Growth and Aggregate Variable Growth

This section shows how consumer decision and macroeconomic variables are interconnected in terms of growth rates at the steady state. Specifically, it is argued that the growth rates of asset stock of a representative consumer, capital stock and factor prices are interconnected. It is shown that representative consumer's asset holding decision changes at the same rate as the technology growth rate. In conclusion, steady state growth rates of all variables are summarised.

Note, however, that this discussion is performed for a single representative consumer. However, it can be generalised to a broader case with more complicated algebra and should reach the same conclusions.

A.4.1 Asset stock of consumer to physical capital

Let us assume that the asset holding of the age g representative consumer evolves according to:

$$a_{g,t+1} = Xa_{g,t} \quad (\text{A.19})$$

Then,

$$\begin{aligned} \frac{A_{t+1}}{A_t} &= \frac{\sum_{g=1}^{GL} a_{g,t+1} N_{g,t+1}}{\sum_{g=1}^{GL} a_{g,t} N_{g,t}} \\ &= \frac{\sum_{g=1}^{GL} Xa_{g,t} \rho N_{g,t}}{\sum_{g=1}^{GL} a_{g,t} N_{g,t}} \\ &= X\rho \end{aligned} \quad (\text{A.20})$$

given population dynamics; i.e. population grows at rate ρ at the steady state. Taking $A_t = K_t$;

$$\frac{A_{t+1}}{A_t} = \frac{K_{t+1}}{K_t} = X\rho \quad (\text{A.21})$$

A.4.2 Physical Capital to Factor Prices

Given production technology, $Y_t = K_t^\alpha [\Gamma_t L_t]^{1-\alpha}$, where Γ_t is technology, interest rate is

$$r_t = \alpha K_t^{\alpha-1} [\Gamma_t L_t]^{1-\alpha} \quad (\text{A.22})$$

from the firm's profit maximisation problem. Therefore;

$$\begin{aligned}\frac{r_{t+1}}{r_t} &= \frac{\alpha K_{t+1}^{\alpha-1} [\Gamma_{t+1} L_{t+1}]^{1-\alpha}}{\alpha K_t^{\alpha-1} [\Gamma_t L_t]^{1-\alpha}} \\ &= X^{\alpha-1} \theta^{1-\alpha}\end{aligned}\quad (\text{A.23})$$

where θ is the technology growth rate at the steady state. For per worker wage;

$$w_t = (1 - \alpha) \Gamma_t K_t^\alpha [\Gamma_t L_t]^{-\alpha} \quad (\text{A.24})$$

which yields:

$$\begin{aligned}\frac{w_{t+1}}{w_t} &= \frac{(1 - \alpha) \Gamma_{t+1} K_{t+1}^\alpha [\Gamma_{t+1} L_{t+1}]^{-\alpha}}{(1 - \alpha) \Gamma_t K_t^\alpha [\Gamma_t L_t]^{-\alpha}} \\ &= X^\alpha \theta^{1-\alpha}\end{aligned}\quad (\text{A.25})$$

A.4.3 Factor Prices to Budget Constraint and Income

Age g consumer at time t has the following budget constraint:

$$c_{g,t} + a_{g+1,t+1} = (1 + r_t) a_{g,t} + f_{g,t} w_t \quad (\text{A.26})$$

Note that this is adequately general; i.e. covers the cases of both working, $f_{g,t} = (1 - \tau_t)$, and retired, $f_{g,t} = rep_t$, consumer. Define saving; $s_{g,t} = a_{g+1,t+1} - a_{g,t}$ and income $i_{g,t} = r_t a_{g,t} + f_{g,t} w_t$;

$$c_{g,t} + s_{g,t} = i_{g,t} \quad (\text{A.27})$$

Regarding income;

$$\begin{aligned}\frac{i_{g,t+1}}{i_{g,t}} &= \frac{r_{t+1} a_{g,t+1} + f_{g,t+1} w_{t+1}}{r_t a_{g,t} + f_{g,t} w_t} \\ &= \frac{X^{\alpha-1} \theta^{1-\alpha} r_t X a_{g,t} + f_g X^\alpha \theta^{1-\alpha} w_t}{r_t a_{g,t} + f_g w_t} \\ &= X^\alpha \theta^{1-\alpha}\end{aligned}\quad (\text{A.28})$$

Note for the second line that we have imposed $f_{g,t+1} = f_{g,t} = f_g$ for at the steady state there is no policy shock and tax rates and replacement rates do not change. Note that this last equation also implies:

$$\frac{c_{g,t+1} + s_{g,t+1}}{c_{g,t} + s_{g,t}} = X^\alpha \theta^{1-\alpha} \quad (\text{A.29})$$

for income is defined from the budget constraint.

A.4.4 A Digression on Consumption

Define $c_{g,t+1} = X_c c_{g,t}$ and $s_{g,t+1} = X_s s_{g,t}$. Using consumption Euler;

$$\begin{aligned} c_{g+1,t+1} &= [\beta(1+r_{t+1})]^{\frac{1}{\eta}} c_{g,t} \\ c_{g+1,t} X_c &= [\beta(1+r_{t+1})]^{\frac{1}{\eta}} c_{g,t} \end{aligned}$$

Therefore;

$$\frac{c_{g+1,t}}{c_{g,t}} = \frac{[\beta(1+r_{t+1})]^{\frac{1}{\eta}}}{X_c} \quad (\text{A.30})$$

is a relationship to be used below.

A.4.5 Equality of Saving and Consumption Growth

Consider 4 consumers; aged g at time t , aged $g+1$ at time t , aged g at time $t+1$ and aged $g+1$ at time $t+1$. The budget constraints of these four consumers are;

$$\begin{aligned} c_{g,t} + s_{g,t} &= i_{g,t} \\ c_{g+1,t} + s_{g+1,t} &= i_{g+1,t} \\ c_{g,t+1} + s_{g,t+1} &= i_{g,t+1} \\ c_{g+1,t+1} + s_{g+1,t+1} &= i_{g+1,t+1} \end{aligned} \quad (\text{A.31})$$

Using Equations A.28 and A.30 in conjunction with $c_{g,t+1} = X_c c_{g,t}$ and $s_{g,t+1} = X_s s_{g,t}$, this system becomes:

$$\begin{aligned} c_{g,t} + s_{g,t} &= i_{g,t} \\ c_{g,t} \frac{[\beta(1+r_{t+1})]^{\frac{1}{\eta}}}{X_c} + s_{g+1,t} &= i_{g+1,t} \\ c_{g,t} X_c + s_{g,t} X_s &= X^\alpha \theta^{1-\alpha} i_{g,t} \\ \beta(1+r_{t+1}) c_{g,t} + s_{g+1,t} X_s &= X^\alpha \theta^{1-\alpha} i_{g+1,t} \end{aligned} \quad (\text{A.32})$$

and can be reduced to

$$\begin{aligned} X_c c_{g,t} + X_s s_{g,t} &= X^\alpha \theta^{1-\alpha} c_{g,t} + X^\alpha \theta^{1-\alpha} s_{g,t} \\ c_{g,t} + X_s s_{g,t} &= [\beta(1+r_{t+1})]^{\frac{1}{\eta}} \frac{X^\alpha \theta^{1-\alpha}}{X_c} c_{g,t} + X^\alpha \theta^{1-\alpha} s_{g+1,t} \end{aligned} \quad (\text{A.33})$$

where line 1 here is obtained by merging first and third equations in Equation A.32 and line 2 by merging second and third equations of Equation A.32. Polynomial equivalence implies:

$$X_s = X_c = X^\alpha \theta^{1-\alpha} \quad (\text{A.34})$$

Saving and consumption by the representative consumer both grow at the same rate.

A.4.6 From Saving Growth Back to Asset Decision Growth

For saving growth, under the assumption of $a_{g,t+1,s} = Xa_{g,t,s}$ we have;

$$\begin{aligned}\frac{s_{g,t+1}}{s_{g,t}} &= \frac{a_{g+1,t+2} - a_{g,t+1}}{a_{g+1,t+1} - a_{g,t}} \\ &= \frac{X^2 a_{g+1,t} - X a_{g,t}}{X a_{g+1,t} - a_{g,t}} \\ &= X\end{aligned}\tag{A.35}$$

But we already know that;

$$\frac{s_{g,t+1}}{s_{g,t}} = X_s\tag{A.36}$$

Then,

$$X = X_s = X_c = X^\alpha \theta^{1-\alpha}\tag{A.37}$$

Solving for X yields:

$$X = X_s = X_c = \theta\tag{A.38}$$

That is, representative consumer's decisions grow at the rate of technology.

A.4.7 Summary: Steady State Growth Rates

Given these derivations, let us summarise the obtained growth rates. At the steady state, asset stock decision and consumption decision of age g consumer evolves according to:

$$\frac{a_{g,t+1}}{a_{g,t}} = \frac{c_{g,t+1}}{c_{g,t}} = \theta$$

Based upon this and the steady state population dynamics, aggregate asset stock and capital stock growth is:

$$\frac{A_{t+1}}{A_t} = \frac{K_{t+1}}{K_t} = \theta\rho$$

Thus for the interest rate;

$$\frac{r_{t+1}}{r_t} = \theta^{\alpha-1} \theta^{1-\alpha} = 1$$

For wage per worker;

$$\frac{w_{t+1}}{w_t} = \theta^\alpha \theta^{1-\alpha} = \theta$$

And given wage per worker, wage per efficient worker, i.e. wage for ΓL , is found to be:

$$\frac{\hat{w}_{t+1}}{\hat{w}_t} = 1$$

APPENDIX B

Data Appendix

B.1 Definition of Income Subitems

In Chapter 2, upon presenting a basic 2-period OLG model, the extensions for the basic 2-period model are discussed. One of the arguments is that members of different social security institutions have different income sources. This argument is backed by presenting income subitems of members of different social security institutions. The data used is the individuals dataset obtained from Household Budget Survey conducted in 2003, 2004 and 2005 by Turkish Statistical Institute. This section of the appendix devoted to data related explanations aims to present the income subitems.

Firstly, wage income is defined as the sum of;

- Annual net cash and in kind wages and salaries (`ucrn_yil` and `ucra_yil` in the database)
- Annual bonuses (`ikr_yil` in the database)
- Annual premiums (`prim_yil` in the database)

Asset income consists of:

- Cash and in kind income due to real estate ownership (`gmkn_yl` and `gmka_yl` in the database)
- Interest income from domestic currency and foreign currency bank deposits (`banka_yl` and `doviz_yl` in the dataset)
- Profit, dividend and security income (`nema_yl` `temet_yl` and `kar_yl` in the database)

- Cash and in kind income due to renting of transportation vehicles and land (toprn_yl and topra_yl in the database)
- Entrepreneur income in cash and in kind (mutsn_yl and mutsa_yl in the database)
- Agricultural income due to harvest, changes in livestock value, revenue from the operation of agricultural equipment outside the farm, forestry, fishery and hunting income and income due to lending of pastures (targ_yl in the database)

Income shares discussed in Chapter 2 are shares of wage and asset income in aggregate income of the individual, variable topgelyl in the relevant dataset.

B.2 SAM in Levels

Table B.1: SAM Elements in millions of 1998 TL

	Activity	Labor	Capital	Hhbk	Hhes	Hhssk	BK	ES	SSK	Gov	S/I	Asset_ret	Inh/Beq	ROW
Activity				211.34	188.7	354.75				57.88	213.25			225.96
Labor	199.86									108.53				
Capital	573.25													
Hhbk							13.39					289.65	111.36	
Hhes		108.53						20.4				110.93		
Hhssk		199.86							53			215.7		
BK				6.89						6.5				
ES					4.5					15.9				
SSK	19.46					16.03				17.51				
Gov	181.1										75.93			
S/I				107.75	41.27	80.24								59.92
Asset_ret			573.25							50.72				
Inh/Beq				88.42	5.4	17.54								
ROW	278.2											7.69		

Note: The SAM elements are turned into real terms using GDP deflator series from the World Development Indicators. Base year is 1998.

APPENDIX C

Curriculum Vitae

PERSONAL INFORMATION

Surname, Name: Değer, Çağaçan

Nationality: Turkish

Date and Place of Birth: 28 November 1977, Üsküdar

Marital Status: Single

email: cagacan@gmail.com

EDUCATION

Degree	Institution	Year of Graduation
MSc	Ege University, Economics	2004
BSc	METU, Economics	2001
High Schools	Parkview Magnet High School Little Rock, AR, USA	1996
	Bornova Anadolu High School Izmir, TURKEY	1995

WORK EXPERIENCE

Year	Place	Enrollment
2004-present	METU, Dept. of Economics	Research Assistant
2002-2004	Ege University, Dept. of Economics	Research Assistant

FOREIGN LANGUAGES Advanced English

PUBLICATIONS

Journal Articles

1. Deęer ., Trkcan B. and Kumral N. (2009) "Competitive Industrial Performance Index and Its Drivers: A Comparative Analysis on Turkey and Selected Countries", *Ege Academic Review*, 9(4).
2. Kumral N. and Deęer . (2004) "High Point Industries of the Aegean Region of Turkey", *Ege Academic Review*, 4(4).

Book Chapters

1. Kumral, N. and Deęer . (2005) "Sanayi Rekabet Performans Endeksi: Trkiye NUTS1 Blgeleri rneęi", in Erlat, Haluk (ed) *Blgesel Geliřme Stratejileri ve Akdeniz Ekonomisi*, Trkiye Ekonomi Kurumu, Ankara, TURKEY
2. Saygılı F., Erdal, F. and Deęer . (2005) "Returns to Scale and Export Performance: An Application on Turkish Manufacturing Industry" in Aktan, Cořkun Can (ed) *Turkish Economy in a Changing World - Volume 1: Selected Proceedings of the First International Conference on Business, Management and Economics, Organised by Yařar University*, Yařar University, İzmir, TURKEY.

Working Papers

1. Deęer . (2008) "Pension Reform in An OLG Model with Multiple Social Security Systems", Economic Research Center METU Working Paper Series No. 08/05.

International Conference Presentations

1. Deęer ., Kumral N. and Trkcan B. (2006) "Avrupa Birlięi ve Trkiye'de Rekabet Gc, Verimlilik ve Byme", Trkiye Ekonomi Kurumu Uluslararası Ekonomi Konferansı, September 11-13, Ankara, TURKEY.

2. Kumral, N. and Değer Ç. (2003) "An Industrial Cluster Study: As a Basis for The Aegean Region's Development Policy", Reinventing Regions in the Global Economy. Regional Studies Association International Conference, April 12-15, Pisa, ITALY.
3. Değer Ç. (2003) "The Possible Trade Effects of the Third Enlargement: The Case of Turkish Exports to EU", European Trade Study Group ETSG2003 Madrid, SPAIN.
4. Kumral, N. and Değer Ç. (2002) "Plant Closure and the Path-Dependent Learning Process", erc/METU International Conference in Economics, September 11-14, Ankara, TURKEY.

APPENDIX D

Turkish Summary

Hem gelişmiş hem de gelişmekte olan ülkeler, sosyal güvenlik sistemlerinin karşı karşıya olduğu finansal sürdürülebilirlik sorunlarına istinaden reformlar yapmak ihtiyacı duymuşlardır. OECD (2007) 1990dan sonra 17 OECD üyesi ülkede önemli reformlar yapıldığını ifade eder. Şili’de 2008 yılında tamamlanan reform örneği Melguizo, Munoz, ve Tuesta (2009) tarafından özetlenip incelenir. Botman ve Tuladhar (2008) Çek Cumhuriyeti’nde maliye politikası reformu çerçevesinde yapılan sosyal güvenlik değişikliklerinin etkilerini analiz eder. Kolombiya’da 1993-2008 yıllarında yapılan sosyal güvenlik sistemi değişiklikleri Clavijo (2009) tarafından özetlenmektedir. Türkiye’de de 1990larda yaşanan sosyal güvenlik açıklarının etkisiyle 1999 ve 2008 yılları arasında sosyal güvenlik reformları gerçekleştirilmiştir.

Türkiye’de mevcut sosyal güvenlik sistemi üç temel kurum, az sayıda destekleyici sandıklar ve özel sigorta sistemi etrafında örgütlenmiştir. Üç temel kurumdan ES (Emekli Sandığı) 1950’de yürürlüğe giren 5434 Sayılı Kanun ile kurulmuştur. Bu kurum kamu çalışanları ve ordu mensuplarına sosyal güvenlik hizmetleri sağlamakla yükümlüdür. Sağlık ve sigorta harcamaları yapan kurumun gelirleri ilgili kanunla çalışanlar ve işveren olarak devlet kurumlarından alınan katkılardan oluşmaktadır.

Emekçilere yönelik olarak bölünmüş bir yapıda olan sosyal güvenlik düzenlemeleri, 1961 Anayasası ve Birinci Beş Yıllık Kalkınma Planı çerçevesinde ortaya konulan ilkeler ışığında birleştirilmiştir. Bu birleşme, 1965’te yürürlüğe giren 506 Sayılı Kanun ile SSK’nın (Sosyal Sigortalar Kurumu’nun) kurulması şeklinde gerçekleşmiştir. Hizmet anlaşması ile çalışan tüm bireyleri kapsamayı amaçlayan kurum, 1970’lerin sonunda tarım sektörü çalışanlarını da kapsamına almıştır. Kurum mensuplarına verdiği sosyal güvenlik hizmetlerini çalışanlar ve işverenler tarafından ödenen primlerle karşılayacak şekilde tasarlanmıştır.

Bağımsız çalışanlar ve zanaatkarları kapsayan bir yapı olarak Bağ-Kur, 1971 yılında 1479 Sayılı Kanun ile kurulmuştur. Kurum ilk olarak emeklilik ve sakatlık maaşlarını içermiştir. Daha sonra kurum hem verdiği sosyal güvenlik hizmetlerini çeşitlendirmiş, hem de tarım sektöründen katılımcıları kapsamına almıştır.

Oluşturulan bu sosyal güvenlik sistemi, 1990'ların başından itibaren açık vermeye başlamıştır. Açıklar 2000'lerde milli gelirin %4'üne kadar yükselmiştir (Elveren, 2008). Bu açıklar, sistemin bir reforma ihtiyacı olduğu yönünde işaret olarak algılanmıştır. Sosyal güvenlik sisteminde reform 1999 yılında 4447 Sayılı Kanun ile başlamış, 2008 yılında 5754 Sayılı Kanun ile tamamlanmıştır. Reform süreci çalışan ve işverenlere uygulanan katkı oranlarını, emeklilik maaşlarının hesaplanmasında kullanılan bağlama oranlarını, emekli maaşı hak etmek için doldurulması gereken yaşı ve emekli maaşı hesabına esas teşkil eden aktif katılımcı gelir hesabını değiştirmiştir.

Bu çalışmanın amacı, Türkiye ekonomisi için parametrik bir sosyal güvenlik sistemi reformunun etkilerini incelemektir. Bu amaçla gerçekleştirilen analiz, reformun sosyal güvenlik sisteminin finansal sürdürülebilirliğine etkileri ile tüketici davranışı ve refahındaki değişiklikleri incelenmesi olarak tasarlanmıştır.

Belirlenen amaç, temsili birey davranışını içeren bir modellemeyi gerektirmektedir. İncelenen olgu olarak sosyal güvenlik, oluşturulan modelde bireylerin zaman kavramının farkında olmalarını gerektirmektedir. Yani oluşturulacak modeldeki temsili tüketici sınırlı bir hayata sahip olmalıdır. Ayrıca temsili birey, hayatı boyunca edindiği kaynakları farklı zaman dilimleri arasında bölüştürerek hayatının farklı aşamalarındaki kararlarını finanse edebilmelidir. Sosyal güvenlik yapısının varlığının tüketici davranışına yansıtılabilmesi için, temsili tüketici hayatının belirli bir döneminde çalışan olarak katkı ödemeleri yapmalıdır. Hayatının kalan süresinde ise tüketici emekli olacak ve emekli maaşı alacaktır. Bu yapı, veri bir zaman diliminde sisteme katkı yapan aktif bireylerle sistemden edinimler sağlayan emeklilerin aynı anda var olmasını sağlar. Dolayısıyla Türkiye'de olduğu gibi nesiller arasında gelirin yeniden dağıtılması ilkesine göre işleyen dağıtım esaslı (pay-as-you-go) bir sosyal güvenlik sisteminin modellenmesi de mümkün olur.

Özetlenen yapı temsili tüketici davranışı ile sosyal güvenlik parametreleri arasında bir bağlantı kurmaktadır. Fakat çalışma sosyal güvenlik sisteminin büyüklüklerinin de hesaplanmasını gerektirmektedir. Bu nedenle, ardışık nesiller modeli ile özetlenen tüketici davranışı bir genel

denge modelinin içine oturtulmuştur. Genel denge modeli temsili tüketici davranışından ortaya çıkan tüketim ve tasarruf gibi kararları ekonominin makro büyüklüklerini oluşturmak için kullanır. Makroekonomik çerçeve ise özellikle faktör fiyatları üzerinden temsili tüketici davranışını etkiler. Sosyal güvenlik büyüklükleri makroekonomik çerçevenin parçası olarak model içerisinde belirlenir. Temsili tüketicinin davranışları ile makroekonomik çerçevenin etkileşmesini sağlamak amacıyla ardışık nesiller yapısı etrafına örülmüş bir genel denge modeli, bu çalışmanın temel aracı olarak belirlenmiştir.

Ardışık nesiller modelinin kökenleri Samuelson (1958) ve Diamond (1965)e dayanmaktadır. Nüfus artışının da olduğu dinamik bir ekonomide faiz oranının seyrini incelemeyi amaçlayan Samuelson (1958), teberru olarak 3 dönem yaşayan tüketicilerin olduğu bir model inşa eder. Diamond (1965) ise 2 dönem yaşayan tüketicilerin olduğu bir büyüme modelinde uzun vade rekabetçi dengeyi ve bu denge üzerinde kamu kesimi borçlanmasının etkilerini inceler.

Çeşitli araştırma hedeflerine yönelik olarak araştırmacılar, temel bir ardışık nesiller modelinde amaçlarına uygun olarak gerekli geliştirmeleri yapmışlardır. Ardışık nesiller modelinin maliye politikalarına uygulanmasında ve sayısal çözümlenmesinin yapılmasında öncü bir çalışma olan Auerbach ve Kotlikoff (1987), elli beş dönem yaşayan temsili tüketicilerin olduğu bir yapı geliştirmiş ve detaylı bir kamu kesimi tanımlayarak maliye politikalarının analizini yapmıştır. Huggett ve Ventura (2000) ABD’de yüksek ve düşük gelirli hanelerin tasarruf davranışlarındaki farklılıkları bir ardışık nesiller modeliyle inceler. Servet dağılımını inceleyen Heer (2001) ise, miras bırakma davranışını modele ekler. Ardışık nesiller modelinin demografik dinamikleri temsil etme yeteneğini kullanan Brooks (2004), İkinci Dünya Savaşı sonrası nüfus artışının varlık fiyatları üzerindeki etkisini analiz eder.

Türkiye’nin sosyal güvenlik sistemini ve bazı tüketici özelliklerini temsil edebilmesi için temel bir ardışık nesiller modelinin belirtilen çalışmalarda olduğu gibi geliştirilmesi gereklidir. Öncelikle, temsili tüketicinin sadece 2 dönem yaşadığı bir model yeterli olmayacaktır. Dolayısıyla inşa edilen modelde temsili tüketicilerin 30 dönem yaşadığı varsayılmıştır.

Reform öncesi mevzuat kadınların 20 yıl erkeklerin ise 25 yıl sosyal güvenlik sisteminde aktif olarak bulunduktan sonra emekliliğe hak kazanmalarına imkan vermektedir. Uygulamanın bir sonucu olarak Türkiye’de erken emeklilik yaygın bir durum olarak ortaya çıkmıştır. Sosyal güvenlik sistemi kapsamındaki nüfusun yaş dağılımının incelenmesi erken emeklilik sorunu vurgulamaktadır. Örneğin, Sosyal Güvenlik Kurumu İstatistikleri’ne göre 2007 yılında

Emekli Sandığı ve Sosyal Sigortalar Kurumu emeklilerinin %50'den fazlası 59 yaş altı gruptadır. Bağ-Kur emeklilerinde ise bu oran %35 civarındadır. Gözlemlenen erken emeklilik olgusunu yansıtmak için modelde temsili tüketicilerin 30 dönemlik ömürlerinin 15 döneminde çalıştıkları, ve dolayısıyla sosyal güvenlik sistemine katkı ödemeleri yaptıkları, kalan 15 dönemde ise emekli olarak sistemden emekli maaşı aldıkları varsayılmıştır.

Sosyal güvenlik kurumları arasındaki katkı ve bağlama oran farklılıklarını yansıtabilmek için model üç farklı temsili tüketici üzerine kurulmuştur. Bu tüketiciler bağlı oldukları sosyal güvenlik kurumları ile ilişkili olarak BK, ES ve SSK tüketicileri olarak isimlendirilmiştir. Tüketicilerin davranışları arasındaki farklılıkları saptayabilmek için TÜİK tarafından yapılan Hanehalkı Bütçe Anketleri'nden edinilen veriler incelenmiştir.

Hanehalkı Bütçe Anketi üzerinden yapılan gözlemler, Bağ-Kur, Emekli Sandığı ve Sosyal Sigortalar Kurumu üyesi bireylerin gelir kalemleri bağlamında da farklılaştığına işaret etmektedir. Anketlerin 2003, 2004 ve 2005 yılları için yarattığı veri seti bireyleri zaman içerisinde takip etmediği için bir panel veri seti değil, kesit verilerin bir derlemesidir. Veri setleri Deaton'ın (1985) sentetik panel yapısı ile düzenlenmiştir. Sentetik panel yapısında t zamanında belirli özelliklere sahip bir grubun ortalama davranışı, t+1 ve sonraki anket yıllarında da izlenerek ilgili grubun sentetik paneli oluşturulabilir. Ardışık nesiller modeli ile uyumlu olarak, 2003 yılında 21 ve 22 yaşlarındaki bireylerin 1 model yaşını temsil ettiği, 2004 yılında 23 ve 24 yaşında olan bireylerin 2 model yaşını temsil ettiği, 2005 yılında 25 ve 26 yaşında olan bireylerin ise 3 model yaşını temsil ettiği varsayılmıştır. Varsayılan model yaşı gruplarının farklı değişkenler için ortalama değerleri hesaplanmak suretiyle 3 yıl için sentetik panel veri seti oluşturulmuştur.

Oluşturulan sentetik panel veri seti BK tüketicilerinin temel gelir kaynağının tasarruftan elde edilen faiz geliri olduğunu işaret etmektedir. Bu tüketicilerin üretim sürecine emek arz etmekten kaynaklanan ücret geliri yoktur. ES ve SSK tüketicileri gelirlerinin büyük kısmını ücret geliri olarak elde etmektedir. Bu tüketiciler göreceli olarak düşük, fakat hayatları boyunca artan varlık gelirine sahiptirler.

Diğer bir gözlem ise, BK tüketicilerinin hayatlarının başında ellerinde bir kaynak bulunduğu yönündedir. Yani BK tüketicileri modellendiğinde, 1 yaşında olan bir tüketicinin elinde yaşam boyu aldığı kararları tetikleyen bir kaynak mevcuttur. Fakat ES ve SSK tüketicileri için sahip olunan emekten başka bir kaynak mevcut değildir.

Tasarruf davranışı üzerine yapılan gözlemler, BK, ES ve SSK tüketicilerinin yaşamlarının sonunda bir miktar kaynağı tüketmeme eğiliminde olduklarına işaret eder. Özellikle BK tüketicilerinde belirgin olan bu gözlem, miras bırakma davranışının modele eklenmesini gerektirmiştir.

Sentetik panel veri seti ile yapılan bu gözlemler, temsili tüketicilerin sosyal güvenlik parametrelerine ek olarak bütçe kısıtları bağlamında da farklılaştırılması gerektiğine işaret eder. İlk olarak, BK tüketicilerin bütçe kısıtlarında ücret geliri yer almaz iken ES ve SSK tüketicileri ücret geliri elde etmelidirler. Emekli Sandığı üyeleri kamu çalışanlarından oluştuğu için temsili ES tüketicisi modelde dışsal olarak belirlenen ücret alırlar. SSK mensubu tüketicisi ise özel sektöre emek arz eder ve karşılığında piyasada gerçekleşen denge ücretini gelir olarak alırlar. İkinci olarak, tüm tüketicilerin bir miktar miras bıraktığı varsayılmıştır; bu davranış, bırakılan mirastan fayda alındığı varsayımı ile tüketici davranışına eklenmiştir. Veri bir zamanda 30 model yaşında olan BK, ES ve SSK tüketicileri tarafından bırakılan miras sadece aynı zamanda doğan 1 model yaşındaki BK tüketicileri tarafından alınır. Bu yapı, BK tüketicilerinin yaşamlarının başında harcamalarını finanse edebilecekleri bir miktar kaynağa sahip oldukları gözlemi ile tutarlıdır. Son olarak, ES ve SSK temsili tüketicilerinin de yaşamları boyunca bir miktar tasarruf yaptıkları varsayılmıştır.

Sentetik panel üzerinden yapılan diğer bir gözlem ise emek arzı karşılığında ücret alan ES ve SSK tüketicilerinin maaş gelirlerinin yaşla değiştiğidir. Dinamik bir modelde durağan denge durumunda bu gözlem, aynı zaman diliminde yaşamakta olan farklı yaşlardaki temsili tüketicilerin farklı ücret geliri elde ettikleri anlamına gelir. Dolayısıyla modele, veri bir t zamanında ekonomide geçerli ücretten yaşa göre farklılaşan ücret gelirlerinin eklenmesi gereklidir. Bu amaçla modele yaş etkinlik katsayıları eklenmiştir. Yaş etkinlik endeksi tüketicinin emek arzının yaş ile değiştiği fikrine dayanır. Bu endeksler hem ES hem de SSK tüketicileri için tanımlanmıştır ve tüketicinin ücret gelirinin yaş ile değişmesine imkan verecektirler.

Türkiye’de sosyal güvenlik kurumları açık vermekte ve bu açıklar devlet bütçesi çerçevesinde kapatılmaktadır. Sosyal güvenlik kurumları emekli maaş düzeylerini ve katkı payı ödemesine esas teşkil eden oranları veri olarak alırlar. Modelde sosyal güvenlik kurumu bütçeleri kurumların açıklarının değerini belirleyen denklemler olarak yer alırlar.

Devlet bütçesi bu açıkları içerecek şekilde tanımlanmıştır. Devlet, sosyal güvenlik kurumlarının açıklarını kapatmaya ek olarak; mal ve hizmet tüketimi yapar, kamu kesimi çalışanlarına maaş öder, işveren olarak Emekli Sandığı’na katkı ödemesi yapar. Modelde kamu kesiminin

iç ve dış borçlanması dışsal olarak tanımlanmıştır. Oluşan borç stoku üzerinden faiz ödemesi yapılır. Devlet bütçesini denkleştiren vergi oranı, modelin içsel değişkenlerindedir.

Modelin temel yapısı, Hanehalkı Bütçe Anketlerine ve diğer veri kaynaklarına dayanılarak yapılan gözlemler çerçevesinde, aşağıdaki şekilde özetlenebilir:

- 30 dönem yaşayan üç temsili tüketici vardır. Tüketiciler 15 dönem çalışıp 15 dönem emeklilik sürdürürler.
- Modeldeki nüfus, bir yaşındaki tüketicilerin sayılarına ve bu sayının nasıl değiştiğine dayanarak oluşturulmuştur. Örneğin, bir yaşındaki BK tüketicilerinin sayısının bir dönemden diğer döneme artma hızı, Bağ-Kur üyesi nüfusun nasıl değiştiğinin alt yapısını yaratır.
- Tüm temsili tüketiciler miras bırakmaktadırlar.
- BK tüketicisi miras alan tek tüketicidir. BK tüketicisi tasarruf kararları ve bu kararlardan doğan faiz geliri ile yaşam boyu tüketim kararlarını ve bıraktığı miras miktarını finanse eder.
- ES tüketicisi kamu kesiminden aldığı ücret geliri ve tasarruf kararlarından kaynaklanan faiz geliri ile yaşam boyu tüketim kararlarını ve miras kararını finanse eder.
- SSK tüketicisi özel sektörden aldığı ücret geliri ve tasarruf kararlarından kaynaklanan faiz geliri ile yaşam boyu tüketim kararlarını ve miras kararını finanse eder.
- Tüm tüketiciler hayatları boyunca yaptıkları tüketim ve bıraktıkları mirasın bir fonksiyonu olan yaşam boyu fayda fonksiyonunu maksimize eden tüketim, tasarruf ve miras kararlarını oluştururlar.
- Modelde üretim süreci, sermaye ve emek girdilerini kullanan ve ölçeğe göre sabit getiri özelliğine sahip bir Cobb-Douglas üretim fonksiyonu ile özetlenmiştir. Üretim fonksiyonunda emek arttıran teknoloji ve modelde teknolojik değişim mevcuttur.
- Sosyal güvenlik kurumları veri emeklilik maaşı miktarını tüm emeklilere öderler. Bu harcamalar, kurumların üyesi olan tüketicilerden ve de kamu kesimi ve özel kesim işverenlerinden alınan katkılarla finanse edilir. Gelirlerin yetersiz olması durumunda sosyal güvenlik sistemi açık verir.

- Sosyal güvenlik sisteminin açıkları devlet tarafından karşılanır. Devlet üretimin bir kısmını vergi olarak alır ve yurt içi ve yurt dışı piyasalarda borçlanır. Kamu kesiminin harcamalarını iç ve dış borç stoklarına yapılan faiz ödemeleri, kamu çalışanlarına ödenen maaşlar, kamunun işveren olarak yaptığı sosyal güvenlik katkıları ve sosyal güvenlik sisteminin açıklarını kapatmak için sosyal güvenlik kurumlarına yapılan transferler oluşturur.
- Modelde ihracat dışsal olarak veri iken ithalat üretim düzeyinin, dolayısıyla gelirin, bir oranı olarak belirlenmiştir. Sermaye hesabı kalemleri olarak ise devletin aldığı dış borç ve dış borç stoku üzerinden yurt dışına yapılan faiz ödemesi vardır. Cari hesap sermaye hesabına eşit olarak tanımlandığı için modelde ödemeler bilançosu daima dengededir.

Oluşturulan modelin Türkiye ekonomisine kalibre edilmesi gereklidir. Modeldeki davranışsal denklemlerdeki parametreler hakkında Türkiye ekonomisine ilişkin verilerin ne ima ettiğini saptamak önemlidir. Model denklemlerindeki parametre değerlerinin veri bir ekonomi için hesaplanması veya tahmin edilmesi işlemine model kalibrasyonu ismi verilir. Bu uygulama, 2007 yılı Türkiye ekonomisi verileri esas alınarak yapılmıştır. 2007 yılı reform sürecinin tamamlanmasından bir önceki yıl olması nedeniyle seçilmiştir.

Kalibrasyon işlemine nüfus ile başlanmıştır. Durağan denge durumunda farklı temsili tüketicilerin bir yaş hücrelerindeki birey sayısının artış hızı birbirine ve ekonomideki nüfus artış hızına eşit olmalıdır. Bu nüfus artış hızı Türkiye toplam nüfusunun 1990-2009 yılları ortalamaya artış hızına eşit olarak seçilmiştir.

Modelin sosyal güvenlik sistemi kapsamında olan nüfusu içerdiğine dikkat edilmelidir. Nüfus artış hızı veri iken 2007 yılında sosyal güvenlik kapsamında olan nüfus, farklı yaş gruplarına dağıtılmıştır. 2007 yılında iki model yaşında olan bireyler 2006 yılında bir model yaşındadır. Dolayısıyla 2007 yılında iki model yaşında olan birey sayısı 2007 yılında bir model yaşında olan birey sayısının nüfus artış hızına bölümüne eşittir. Bu işlemin tüm yaş grupları için tekrarlanması 2007 yılı için tüm yaş gruplarında kaç bireyin olduğunun hesaplanmasını sağlar.

Kalibrasyon aşamasında modeldeki nüfus artışının TÜİK tarafından yapılan ve 2025 yılına kadar uzanan toplam nüfus değişim hızı tahminlerini tutması sağlanmıştır. Dolayısıyla her bir zaman birimi için bir model yaşı harici yaş gruplarındaki birey sayısı veri iken, bir yaşında olan nüfusu hesaplamak mümkündür. Bu şekilde ilerleyen zaman için tüm yaş gruplarındaki

birey sayıları hesaplanabilir. 2025 yılı sonrası, bir yaşında olan birey sayısının büyüme hızı birim değerinde sabitlenmiş ve uzun vadede modelde nüfusun ve emek arzının sabitlenmesi sağlanmıştır. Dolayısıyla modelde Türkiye ekonomisi için öngörülen yaşlanan nüfus olgusu üretilebilmiştir.

Yaş etkinlik endekslerinin hesaplanması için 2003 ve 2005 yıllarında yapılan Hanehalkı Bütçe Anketleri kullanılmıştır. Bu anketlerden Bağ-Kur ve Emekli Sandığı üyeleri için her bir yılda ortalama ücret gelirini ve yaş grupları için ortalama ücret gelirini içeren bir sentetik panel veri seti oluşturulmuştur. Bu veri seti, bir yaş polinomu ve doğum yılı özelliklerini ayırtmak üzere kukla değişkenler kullanılarak en küçük kareler yöntemi ile bir regresyon analizine tabi tutulmuştur. Analiz sonucunda elde edilen yaş polinomu katsayıları ile yaş etkinlik endeksleri hesaplanmıştır.

Kalibrasyonun önemli bir aşaması modelin makroekonomik dengesini temsil edecek bir sosyal hesaplar matrisi oluşturulmasıdır. Bu matris, ekonomideki tüm aktörler ve hesaplar için satırda gelir, sütunda ise giderlerin kaydını içerir. Makroekonomik çerçevesi tutarlı olan bir modelde sosyal hesaplar matrisinin satır ve sütun toplamlarının, yani tüm aktörlerin ve hesapların gelir ve giderlerinin, eşit olması gereklidir. Türkiye ekonomisinin 2007 yılı için makroekonomik büyüklükleri derlenmiş ve sosyal hesaplar matrisinin ilgili hücrelerine işlenmiştir. Edinilemeyen bazı değerler ise matrisin satır ve sütun eşitliklerinin ima ettiği denklem sistemi çözülüp hesaplanmıştır. Sonuçta elde edilen matrisin satır ve sütun toplamları tutarlıdır.

Kalibrasyon aşaması, elde edilen sosyal hesaplar matrisinin hücre değerleri ile model parametre değerlerinin elde edilmesi ile tamamlanır. Bu işlemin modelin bazı içsel değişkenlerinin hesaplanmasını gerektirdiğine dikkat edilmelidir. Örneğin, Emekli Sandığı'nın emekli maaşı bağlama oranının hesaplanabilmesi için kamu kesimi çalışanlarının aldığı ücrete ve emekli olan Emekli Sandığı mensuplarının aldığı emekli maaşı değerine ihtiyaç vardır. Bu veriler ile bağlama oranı, emekli maaşının ücrete oranı olarak hesaplanır.

Temsili tüketicilerin fayda fonksiyonu parametrelerinin hesaplanması ise daha detaylı bir yaklaşım gerektirir. Temsili tüketicinin fayda maksimizasyon probleminin çözülmesi, veri bir zaman diliminde iki ardışık yaştaki tüketicinin tüketimlerini birbirine bağlayan ve Euler denklemi olarak adlandırılan 29 adet birincil koşul sağlar. Bu problemin bir diğer birincil koşulu da 30 yaşında bir tüketicinin bırakacağı miras ile 30 yaşında yapılan tüketimin bağlantılı olduğunu gösterir. Yine t zamanında tüm tüketiciler için 30 adet bütçe denklemi olacaktır.

Bütçe denklemleri tüketim, tasarruf ve bırakılan miras kararlarını bağlayacaktır. Ayrıca, mikro yapı ile makro çerçevenin tutarlılığı için, t zamanında temsili tüketicilerin yaptıkları tüketimlerin sosyal hesaplar matrisindeki toplam tüketim değeriyle, tasarruftan elde ettikleri toplam faiz gelirinin de yine sosyal hesaplar matrisindeki toplam faiz geliri ile tutarlı olmalıdır.

Zamanlararası ikame oranı veri iken, yaşam fayda fonksiyonundaki indirim katsayısı ve mirasın faydadaki payını gösteren katsayı bu denklem sisteminde içsel değişkenlerdir. Dolayısıyla sistemde 30 adet tüketim kararı, 29 adet varlık stoku kararı, bir adet bırakılan miras kararı ve iki fayda fonksiyon parametresi içsel değişkendir. Betimlenen denklem sistemi 62 denklem ve 62 değişken içerir ve veri bir zaman diliminde temsili tüketicilerin tüm kararlarının ve fayda fonksiyon parametrelerinin hesaplanması için kullanılabilir. Bu işlem, modelin denklemlerinin 2007 Türkiye ekonomisi verileri ile tutarlı parametre değerlerine sahip olmasını sağlar ve kalibrasyonun son aşamasıdır.

Türkiye ekonomisine kalibre edilmiş olan modelden sayısal çözüm alınması çalışmanın takip eden adımını oluşturmaktadır. Modelin sayısal çözümlenmesi Auerbach ve Kotlikoff (1987)'nin de kullandığı Gauss-Seidel yöntemine dayanmaktadır. Auerbach ve Kotlikoff (1987) bu yöntemin modelin bir grup değişkeni için değer varsayılmasına, modelin varsayımlar altında çözümlenmesine ve elde edilen sonuçlar ile varsayımlar yakınsayana kadar bu iki aşamanın tekrarlanmasına dayandığını ifade eder.

Buna göre, modelin sayısal çözümlenmesi, durağan denge durumunda 30 dönem, yani bir temsili tüketicinin ömrü kadar süre için sermaye stoku tahmin edilmesi ile başlar. Tahmin edilen sermaye stoku vektörü kullanılarak model denklemlerinin ima ettiği faiz oranı ve özel sektör ücret düzeyi elde edilir. Kamu kesimi tarafından ödenen ücretin modelde dışsal olması bu noktada önemlidir. Hesaplanan fiyatlar veri iken temsili tüketici davranışı çözümlenir. Temsili tüketici tasarruf kararlarından ekonominin sermaye stoku serisi tekrar üretilir. Eğer hesaplanan sermaye stoku serisi varsayılan sermaye stoku serisinin komşuluğunda ise algoritma durur. Aksi durumda hesaplanan sermaye stoku serisi varsayılan serinin yerine geçer ve algoritma tekrar çalışır. Hesaplamalar son iki iterasyondaki sermaye stoku serisi yakınsayınca kadar devam eder.

Kalibre edilmiş olan modelin durağan denge durumu için çözümü, tüketimin kararlarının birincil koşul denklemlerinin ima ettiği gibi sabit bir eğime sahip olduğunu gösterir. Bu duruma tek istisna BK tüketicisidir. Bu tüketici çalıştığı dönemlerde faiz geliri üzerinden sosyal

güvenlik katkısı ödediği için çalıştığı yıllara ait birincil koşul denkleminde faiz, sosyal güvenlik katkı oranı ile çarpım halinde bulunur. Bu tüketici emekli olduğunda artık katkı ödemesi yapmadığı için emeklilik yaşlarına karşılık gelen birincil koşul denklemlerinde bu oran yer almamaktadır. Dolayısıyla çalışır durumdan emekli durumuna geçişte, yani model yaşı 15'ten model yaşı 16'ya geçişte, BK tüketicisinin model yaşına göre tüketim kararlarını gösteren fonksiyonun eğimi değişir. Tüm temsili tüketiciler için tüketim fonksiyonunda dalgalanmalar yoktur, ki bu durum yaşam döngüsüne dayanan tüketim modellerinin teorik öngörülleri ile tutarlıdır.

Tasarruf kararları incelendiğinde, ücret karşılığı çalışan ES ve SSK tüketicilerinin hayatlarının ilk yarısında tasarruflarını sıfır düzeyinden arttırma eğiliminde oldukları görülmektedir. Fakat bu tüketiciler hayatlarının sonuna doğru tasarruf birikimlerinin bir kısmını eritmektedirler. Hayatına edindiği bir miras ile başlayan BK tüketicisi ise sürekli varlık stoku biriktirme eğilimindedir. En yüksek miras miktarı BK tüketicisi tarafından bırakılmaktadır.

Modelin sayısal çözümlemesi için hazırlanan kod, bir denge noktasından başlayarak model ekonomideki değişkenlerin zaman içerisindeki seyrini sayısal olarak hesaplayabilmektedir. Modelin sosyal güvenlik parametrelerindeki değişikliklere verdiği tepkilerin incelenmesi için ekonominin takip ettiği patikanın hesaplaması yapılmıştır. Bu şekilde iki patika hesaplanmıştır. İlk patikada sadece yaşlanan nüfus olgusu vardır. İkinci patikada ise yaşlanan nüfus olgusuna ek olarak bağlama oranı ve katkı oranı şokları modele verilmiştir. Çalışmada yapılan yorumlarda anlaşılabilirliği arttırmak amacıyla ilk patikaya “temel patika”, ikinci patikaya ise “deney patikası” ismi verilmiştir.

Her iki patika üzerinde de bazı dışsal değişkenler için büyüme oranları varsaymak zorunludur. Kamu kesimi tarafından ES mensubu temsili tüketicilere ödenen ücretin her dönem teknoloji kadar arttığı varsayılmıştır. Devlet iç ve dış borç stoku ile devletin mal ve hizmet tüketiminin her bir dönemde teknoloji büyüme oranı ile nüfusun artış oranının çarpımı kadar büyüdüğü varsayılmıştır. Dolayısıyla bu büyüklükler nüfus artış hızı bire düşünce sadece teknoloji kadar büyümeye başlarlar. Bu durum, model değişkenlerinin yakınsamasının gözlemlenmesini etkin emek başına hesaplanan değerler çerçevesinde kolaylaştırır.

Demografik yapı üzerine yapılan hesaplamalar sonucunda model yaşlanan nüfus olgusunu temsil edebilmektedir. Nüfus yaşlanması, sosyal güvenlik reformundan bağımsız bir olgudur. Sosyal güvenlik reformu yapılsa bile Türkiye’de nüfus yaşlanmasının gerçekleşmesi bek-

lenmektedir. Dolayısıyla temel patikada nüfus yaşlanması olgusu korunarak model çözülmüş, sosyal güvenlik reformu deneyi yaşlanan nüfus olgusu veri kabul edilerek incelenmiştir.

Bu tercih, yaşlanan nüfusun etkilerini incelemeyi de olanaklı kılmıştır. Yapılan inceleme, yaşlanan nüfusla birlikte beklendiği üzere ekonomide sosyal güvenlik sistemine gelir sağlayan birey sayısının, yani aktiflerin, azaldığını göstermektedir. Diğer taraftan, sistemden emekli maaşı alan emekli birey sayısı, yani pasiflerin sayısı, artmaktadır. Dolayısıyla yaşlanan nüfus olgusunun sosyal güvenlik açıklarını arttırdığı gözlemlenmiştir. Modelin kalibre edildiği 2007 yılı için milli gelirin %3.4 oranında olan sosyal güvenlik sistemi toplam açığı, sadece yaşlanan nüfus olgusunun olduğu temel patikanın ulaştığı yeni durağan denge durumunda milli gelirin %5'i civarına yaklaşmaktadır. Sosyal güvenlik sistemi açığındaki hızlı artış, ancak nüfusun büyüme oranı birime sabitlendikten sonra azalmakta ve 60 model dönemi içerisinde sabitlenmektedir.

Modelde sosyal güvenlik açıkları devlet tarafından finanse edilmektedir. Sosyal güvenlik kurumlarının açıklarındaki artış, modelin çalıştırıldığı ilk 30 dönemde diğer kamu kesimi bütçe kalemleri veri iken, devlet bütçesini denkleştiren vergi oranının artmasını gerektirir. Yapılan hesaplamalar vergi oranının %18 civarından 30 dönem içerisinde %21 civarına yükseldiğini göstermiştir. Takip eden dönemlerde devlet bütçesindeki diğer değişkenlerin büyüme oranı teknoloji büyüme oranında sabitleşir. Fakat üretimdeki artış devam ettiği için devlet bütçesindeki diğer değişkenlerin milli gelir içindeki payları düşer. Dolayısıyla vergi oranının uzun vadede %17'nin biraz altına düşmesi mümkün olur.

Çalışmanın amacına yönelik olarak modelin sosyal güvenlik parametrelerinin değiştiği durum için de çözümü yapılmıştır. Kalibrasyon aşamasında 2007 yılı emekli maaşı bağlama oranı ve aktif üyelerle işverenlere uygulanan katkı ödeme oranları hesaplanmıştır. Mevzuat değişiklikleri bu parametreleri değiştirmiştir. Kalibrasyon çerçevesinde hesaplanan oranlar, reform öncesi durumu temsil eden parametre değerleri olarak alınmıştır. Bu parametrelerin karşılık geldiği yasal tanımlar ilgili kanunlar incelenerek elde edilmiştir. İlgili parametrelerin değişiminde reformu oluşturan kanunlar temel alınmıştır. Modelin kalibrasyonunda 2007 yılı için hesaplanan değerler kanunlarda oluşan parametre değişim oranı kadar değiştirilerek bağlama ve katkı oranlarına şok verilmiştir. Örneğin reform öncesinde BK temsili tüketicisine 30 yıllık aktif üyelik karşılığında %75 olarak uygulanan bağlama oranı reformdan sonra %60'a düşmüştür.

İlgili kanun metinlerinde yapılan incelemeler göstermektedir ki reform sürecinde ES tüketicisi için bağlama oranı, aktif tüketicinin katkı ödeme oranı ve işveren durumundaki kurumun katkı ödeme oranı düşürülmüştür. Bağ-Kur üyeleri için ise hem bağlama oranı hem de katkı oranı düşmüştür. Sosyal Sigortalar Kurumu, veya yeni mevzuat çerçevesinde 5510 Sayılı Kanununun 4-a maddesi, kapsamındaki bireyler için bağlama oranı düşmüştür. Fakat çalışan ve işverenlerin katkı ödeme oranlarında değişiklik olmamıştır.

Modele emeklilik sistemi parametreleri çerçevesinde verilen şokun analizinde Bağ-Kur ve Emekli Sandığı için bütçe açığının deney patikasında ilk olarak arttığı, ancak 10 dönem sonra bu açıkların temel patikadaki düzeye düştüğü gözlemlenmiştir. Deney patikasındaki Sosyal Sigortalar Kurumu açığı ise temel patikaya oranla hemen düşmektedir. Bu durum, sosyal güvenlik kurumlarının yaptığı emekli maaşı ödemelerindeki değişikliklerden kaynaklanmaktadır.

Modele şok verildiği anda ekonomide her temsili tüketici grubu için üç alt grup ortaya çıkar. Gözlemlenen üç alt grubtan ilkinin üyeleri veri bir sosyal güvenlik kurumuna dahil temsili tüketicilerden şoktan önce emekli olanlardır. İkinci grup şoktan önce doğup, şoktan sonra emekli olan bireylerden oluşur. Son grup ise, şoktan sonra doğup şoktan sonra emekli olan bireyleri içerir.

Şoktan önce emekli olan tüm tüketiciler, şok sonrası bağlama oranlarına göre daha yüksek bağlama oranların geçerli olduğu bir yapıda emekli olmuşlardır. Dolayısıyla bu tüketicilerin almakta olduğu emekli maaşı şoktan sonra emekli olanlara oranla yüksektir. Düşen bağlama oranının sosyal güvenlik kurumlarının harcamalarını azaltıcı etkisi ancak şoktan önce emekli olan tüketicilerin nüfustaki oranı düştükçe ortaya çıkar. Fakat katkı payı ödeme oranlarındaki düşüş hemen etkisini gösterir ve kurumların gelirleri azalır. Bu nedenle BK ve ES'nin açıkları ilk 10 dönem için deney patikasında daha yüksektir. Diğer taraftan SSK kurumu için katkı oranları düşmemekte, dolayısıyla kurum gelir düşüşü yaşamamaktadır. SSK'nın açığının deney patikasında temel patikaya oranla hemen düşebilmesinin nedeni, azalmayan SSK katkı oranlarıdır.

Deney patikasında sosyal güvenlik açıklarının temel patikaya göre daha düşük olma eğilimi, devlet bütçesini dengeleyen vergi oranının deney patikasında daha düşük olması anlamına gelir. Fakat hem sosyal güvenlik kurumlarının açıklarında hem de vergi oranında modelin 17. döneminde bir kırılma gözlemlenmektedir. Örneğin deney patikası üzerindeki vergi oranının

temel patikadaki değere oranı 17. döneme kadar hızla düşerken bu dönemden sonra düşüş hızı yavaşlamaktadır.

Aynı gözlem faktör fiyatları için de geçerli görünmektedir. Hem özel sektör ücretleri hem de faiz oranı için deney patikası değerinin temel patika değerine oranı 17. döneme kadar artmaktadır. Daha sonra ücret için geçerli olan patikalar arası oran artmaya devam ederken faiz için hesaplanan patikalar arası oran düşmeye başlar. Emek arzı her iki patikada da aynı değerlerde veri iken, her iki faktör fiyatının aynı yönde hareket etmesi standart bir sonuç değildir.

Faktör fiyatlarının 17 dönem için aynı yönde hareket etmesinin arkasındaki neden devletin modeldeki vergi toplama mantığından kaynaklanır. Devlet, üretimin bir kısmını vergi olarak aldığından firma kar fonksiyonunda üretim vergiden netlenmiş olarak gözüktür. Dolayısıyla, örneğin faiz oranı sermayenin marjinal verimine değil, sermayenin marjinal veriminden vergi oranı kadar eksikliğine eşittir. Dolayısıyla deney patikasında sermaye stoku temel patikaya oranla daha hızlı artsa bile vergi oranındaki düşüş sermayenin marjinal verimindeki düşüşün önüne geçer ve vergi oranının deney patikasında hızla düştüğü ilk 17 dönem için faiz oranı deney patikasında temel patikaya oranla yükselir.

Yapılan vurgular ilk 17 dönemin modelin sayısal çözümünde önemli olduğunu ve bu dönemde oluşan gelişmelerin modelin verdiği sonuçlar açısından kritikliğini vurgulamaktadır. Edinilen sayısal çözümlerde 17. dönemde gerçekleşen değişiklik temsili tüketici davranışları incelendiğinde ortaya çıkar.

Tüm temsili tüketicilerin tüketim ve tasarruf kararları, temel ve deney patikalar üzerindeki değerlerin oranı üzerinden karşılaştırılarak incelenmiştir. Saptanan ortak nokta, şoktan önce emekli olan tüketiciler, şoktan önce doğup şoktan sonra emekli olan tüketiciler ve şoktan sonra doğan tüketicilerin farklı davranışlar gösterdiği yönündedir. Şoktan önce emekli olan tüketiciler, değişen sosyal güvenlik parametrelerinden etkilenmemektedirler. Bu tüketiciler için sadece faiz oranından gelen ikincil bir etki söz konusudur. Şoktan önce doğup sonra emekli olan tüketiciler ise hayat planlarını şok öncesi sosyal güvenlik parametrelerine göre yapmışlardır. Bu bireyler yüksek bağlama oranına göre planlama yaptıkları için deney patikası üzerinde kendilerini düşük emekli maaşı ve hayatlarının başında yaptıkları planda karar verdikleri tüketim patikasını finanse edemeyebilecek düşük tasarruf kararlarıyla karşı karşıya bulurlar. Dolayısıyla bu tüketicilerin bütçe kümelerinde ciddi daralmalar olur.

Şok sonrası doğan tüketiciler ise yeni sosyal güvenlik parametrelerine göre planlama yaparlar ve davranışlarında keskin değişiklikler olmaması beklenir. Bu durum ücret karşılığı çalışan tüketiciler için doğrulanmıştır. Fakat temsili BK tüketicisi sadece tasarruf kararları ve aldığı miras ile hayatını sürdürmektedir. Dolayısıyla bu tüketicinin optimum kararları faiz değişikliklerine karşı çok hassastır. Modelde 17. dönemde eski sistemde emekli olan bireyler ölüp ekonomiyi terk ettiklerinde bu tüketicilerin yerine yeni sistem altında karar alan bireyler gelir. Farklı davranış özellikleri gösteren tüketicilerin birbirinin yerine geçmesi, ekonomideki tasarruf kararlarını ve dolayısıyla sermaye stoku birikimini etkiler. Deney patikasında 17. dönemde sermaye stoku birikiminde oluşan değişiklik faiz oranının da değişmesine sebep olur. 17. dönemde doğan temsili BK tüketicileri bu durumu bir şok olarak algırlar ve farklılaşan davranışlar gösterirler. Bu BK tüketicisi grubu 47. dönemde ölüp ekonomiyi terk ettiğinde aynı durum, daha küçük ölçekte, tekrarlanır.

Deney patikasında daha düşük bağlama oranları ile karşı karşıya olan tüketicilerin tasarruf kararlarının, deney patikasında daha yüksek olduğu gözlemlenmiştir. Artan tasarruf kararları, iç borç stokunun takip ettiği patika veri iken, deney patikasında daha yüksek varlık stoku, dolayısıyla da daha yüksek sermaye stokunun birikmesine yol açar. Emegın hem deney patikasında hem de temel patikada aynı olduğu düşünülürse, deney patikasında ekonominin üretim düzeyi daha yüksek olacaktır.

Yapılan analizin son aşaması, deney patikası üzerindeki refah değişikliklerine yoğunlaşmaktadır. Bu aşamada iki bilgiye başvurulmuştur. Başvurulan ilk bilgi, elde edilen optimum kararların fayda fonksiyonlarına yerleştirilmesi ile dolaylı fayda fonksiyonu değerlerinin elde edilmesidir. Dolaylı fayda fonksiyonu değerleri, reformdan önce doğan tüketicilerin kalan hayat süreleri için hesaplanmıştır. Fayda fonksiyonu parametre değerlerindeki farklılıklardan dolayı elde edilen dolaylı fayda değerleri sadece aynı grup tüketicilerin karşılaştırması için kullanılabilir. Örneğin bir BK temsili tüketicisi için elde edilen dolaylı fayda fonksiyonu değeri ES tüketicisi için kullanılamaz. Benzer şekilde, modelin 1. döneminde 28 yaşında olan bir tüketicisi için sadece iki dönemlik dolaylı fayda hesaplanmıştır ve bu değer 1. dönemde 29 yaşında olup bir dönem ömrü kalmış bir tüketicisi için hesaplanan dolaylı fayda değeri ile karşılaştırılmaz.

Kullanılan ikinci bilgi ise sosyal refah ölçütüdür. Bu amaçla bir sosyal refah fonksiyonu oluşturulması gereklidir. Oluşturulan fonksiyon veri bir zamanda toplumun refahını ölçebilmeli,

bunun için de veri bir zamanda yaşayan temsili tüketicilerin fayda fonksiyonlarını karşılaştırma sorununu aşarak tüketici dolaylı faydalarını ortak bir ölçütte toplayabilmelidir.

Oluşturulan sosyal refah fonksiyonu, temsili tüketicilerin anlık dolaylı faydalarının bir önceki zaman dilimine göre yüzde değişimine dayalıdır. Faydada oluşan değişikliklerin yüzde olarak ifade edilmesi, fayda fonksiyon parametre farklılıklarından kaynaklanan karşılaştırılabilirlik sorununu aşmayı sağlar. Veri bir zamanda, farklı yaştaki her temsili tüketici için elde edilen dolaylı anlık faydadaki yüzde değişimler, ilgili yaş grubunun toplam nüfus içindeki payı ile ağırlıklandırılmış ve elde edilen ağırlıklandırılmış değerler toplanarak sosyal fayda ölçütüne ulaşılmıştır.

Çalışmada ilk olarak reformdan önce doğan tüketicilerin kalan yaşamlarındaki dolaylı fayda değerleri incelenmiştir. Deney patikasındaki değerler ile temel patikadaki değerler arasında yapılan incelemede görülmüştür ki, bir temsili tüketici reform anında emekliliğe ne kadar yakın ise reformdan o kadar olumsuz etkilenmektedir. Çünkü bu tüketiciler, yüksek bağlama oranı beklentisi ile düşük bir tasarruf tercihi yapmışlardır. Reformda bağlama oranları düşüncü ömürleri boyunca elde ettikleri kaynaklar düşer ve bütçe kümeleri daralır. Bütçe kümesi daralması tüketimde, dolayısıyla da kalan yaşam süresindeki dolaylı fayda fonksiyonu değerinde düşüşe neden olur.

Emeklilikten göreceli olarak uzak olan tüketiciler ise emeklilik öncesinde tasarruf kararlarını yükselterek göreceli olarak daha az olumsuz etkilenmeyi başarabilmektedirler. Reformdan önce emekli olan tüketicilerse sosyal güvenlik parametrelerindeki değişimlerden doğrudan etkilenmedikleri için reform kaynaklı refah etkileri bu tüketicilerde göreceli olarak düşüktür. Reform öncesinde emeklilik zamanı yaklaşmış ücret karşılığı çalışanların, yani ES ve SSK temsili tüketicilerinin, en olumsuz etkilerle karşı karşıya kaldıkları gözlemlenmiştir.

Temel patika ve deney patikasında dolaylı fayda fonksiyonu değerleri karşılaştırıldığında, SSK temsili tüketicilerinin reformdan en olumlu etkilenen grup olduğu görülmektedir. Temsili SSK tüketicisinin dolaylı fayda fonksiyon değeri deney patikasında sürekli artmakta, yeni dengede temel patikaya oranla %1.5e yakın artış göstermektedir. Deney patikası üzerindeki bir temsili BK tüketicisi, dalgalanan tüketim kararlarından kaynaklanan dalgalı bir dolaylı fonksiyon değeri seyri izlemektedir. Temsili SSK tüketicisine oranla daha az olsa da temsili BK tüketicisi de deney patikası üzerinde daha yüksek dolaylı fayda değerlerine ulaşmaktadır. Temsili ES tüketicisi ise deney patikası üzerinde temel patikaya oranla daha düşük fayda

değerlerine ulaşmakta ve parametrik sosyal güvenlik reformundan en olumsuz etkilenen grup olarak ön plana çıkmaktadır.

Yapılan analizin son aşaması her iki patikada sosyal refah fonksiyonunun aldığı değerlerin karşılaştırılmasını içerir. İlk 10 dönem için deney patikası için hesaplanan sosyal refah değeri temel patikadaki değerden daha düşüktür. Daha sonra sosyal refah değeri deney patikasında temel patikaya oranla daha yüksek değerlere ulaşmaktadır. Burada temel saptama, reformun kısa vadede toplum için olumsuz etkilere sahip olduğudur. Bu olumsuz etkiler özellikle şoktan önce doğan ve şoktan sonra emekli olan tüketicilerin yaşadığı negatif tüketim tercihi değişimlerinden kaynaklanmaktadır.

Sonuç olarak oluşturulan model, sosyal güvenlik sisteminin açığının kısa vadede artacağını, ancak daha sonra açığın azalma yoluna gireceğini işaret etmektedir. Fakat ifade edilen kısa vade, yaklaşık 10 model dönemine karşılık gelmektedir ve takvim yılı olarak daha uzun sürebilir. Kalibrasyona temel olan 2007 yılında sosyal güvenlik sisteminin açığı milli gelirin %3.4ü civarında iken deney patikasında bu oran %2.9a inmiştir. Reform, emekli maaşlarını hesaplamakta kullanılan bağlama oranlarını düşürmekte ve tasarrufu, dolayısıyla da sermaye stoku oluşumunu ve büyümeyi teşvik edici etkiler göstermektedir. Fakat yapılan reform Emekli Sandığı mensubu kamu çalışanları ile reform anında emeklilik yaşına yaklaşmış olanlarda ciddi olumsuz refah etkileri göstermektedir. Temsili tüketicilerde gözlemlenen olumsuz refah etkiler, modelin çalıştırıldığı ilk 10 dönem içerisinde toplumsal refahın da olumsuz etkileneceğini göstermektedir. Yani reform belirlenen mali hedeflere ulaşsa da kısa vadede olumsuz refah etkileri gösterme potansiyeline sahiptir.

Yapılan çalışma, Türkiye’de sosyal güvenlik reformunun Türkiye’ye özgü aktör davranışlarını ve Türkiye sosyal güvenlik sisteminin özgün özelliklerini yansıtacak şekilde modellenmesi yönünde bir ilk adım niteliği taşımaktadır. Hem sosyal güvenlik sisteminin mevcut durumunu hem de reformun yapısını daha iyi yansıtabilmesi için modelde bazı değişikliklere gidilebilir. Yapılan sosyal güvenlik reformunun kapsamında olan emeklilik yaşı artışı ve emekli maaşı hesaplamasında aktif olarak çalışılan son 365 günde elde edilen gelir yerine yaşam boyu elde edilen ortalama gelirin kullanılması reformun etkilerinin detaylandırılmasını sağlayabilir. Emeklilik yaşı artışı sosyal güvenlik sisteminin giderlerindeki kısa vadede gözlemlenen ani artışı frenleyebilir. Hesaplama yöntemi değişikliği ise faktör fiyatlarının seyrine göre çok çeşitli sonuçlar verebilir.

Türkiye’de ciddi bir sorun olarak görülen kayıt dışı ekonominin modelde temsil edilmesi, özellikle sosyal güvenlik kapsamında olmayan kayıt dışı çalışanların kayıt altına alınabilmesi veya tersi yöndeki mekanizmaları içerecek şekilde modelin geliştirilmesi, kayıt dışı istihdam ile sosyal güvenlik arasındaki bağlantılara odaklanan tartışmalara katkı olacaktır. Daha ileri bir aşama olarak kamu kesiminin detaylandırılması reformun maliye politikaları ile desteklenebilirliğini tartışmaya açabilir. Oluşturulan modelle atılan adım, dinamik bir tartışma ve araştırma alanında Türkiye’de araç zenginliğine katkı yapmaktadır.