SIMULATING TURKISH TAX SYSTEM

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ABSTRACT

SIMULATING TURKISH TAX SYSTEM

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Tax systems are used for economic and social concerns such as promoting the economic growth or decreasing the income inequality and tax evasion, increasing the social welfare, etc. Researchers argue that the consumption taxes are quite high in Turkey compared to other OECD countries. Therefore, the proposed tax reform in this study is to decrease the Value Added Tax (VAT) rate and to increase the top statutory income tax rate. This thesis constructs and presents first set of a 55-period overlapping generations (OLG) model for Turkey to analyze and evaluate the impact of tax reform on the Turkish macroeconomic variables and welfare. The results show that the proposed tax reform provides welfare gains to the low and middle income individuals while high income individuals are suffered.

Keywords: Overlapping Generations Model, Tax reform in Turkey, Welfare

ÖZ

TÜRKİYE VERGİ SİSTEMİNİN SİMÜLASYONU

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Vergi sistemleri ekonomik büyümeyi desteklemek, gelir eşitsizliğini ve vergi kaçakçılığını azaltmak, toplum refahını artırmak gibi ekonomik ve toplumsal kaygılar için kullanılıyor. Araştırmacılar Türkiye'de tüketim vergisinin oldukça yüksek olduğunu iddia etmektedirler. Bu yüzden bu çalışmada önerilen vergi reformu tüketim vergi oranını düşürmüş ve en yüksek yasal gelir vergisi oranını arttırmıştır. Bu çalışma önerilen vergi reformunun makroekonomik değişkenler ve refah üzerine etkisini değerlendirmek ve analiz etmek amacıyla Türkiye için ilk 55 dönemlik bir ardışık nesiller modelini kurmuştur. Sonuçlar vergi reformunun düşük ve orta gelirli bireylerin refahının artmasını sağlarken yüksek gelirli bireylerin zarar görmesine sebep olduğunu göstermiştir.

Anahtar Kelimeler: Ardışık Nesiller Modeli, Türkiye'de Vergi Reformu, Refah

To My Father

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CHAPTER 1

INTRODUCTION

Tax systems are used for economic and social concerns such as increasing the economic growth, social welfare or decreasing the income inequality, tax evasion etc. Moreover, tax systems are generally used to finance government expenditures and reduce to macroeconomic instability especially in developing countries over the last two decades. Besides these purposes, the tax policies affect the decisions of households and firms. Saving, labor supply, consumption and investment in human capital are the decisions of households that are affected by tax policies. Furthermore, decisions of firms related to production, creating jobs, research and development are affected by the tax systems. Hence, developing countries and most of the OECD countries have made structural changes in their tax systems. Turkey has also implemented structural changes in its tax system. For instance, the Value Added Tax (VAT) rate changed from 15 percent to 17 in 2000 and increased from 17 percent to 18 in 2005. Moreover, top statutory income tax rate was decreased from 40 percent to 35 percent in 2005. Also, there were five different income tax rates in Turkey which were 15, 20, 25, 30, 35 percentages, and they were applied to different income levels before 2006 but these rates were changed in 2006 and Turkish government began to apply four different income tax rates which are 15, 20, 27 and 35 percent, to its tax payers.

Governments should do a well conducted research before deciding to change the structure of the tax system because, as we mentioned before, taxes affect the decisions of agents of an economy. Hence, many studies have been conducted to evaluate and analyze the effects of tax systems in economies. Some of the studies use

econometric models to evaluate the effects of taxes on various economic variables. Some other studies use the dynamic general equilibrium modeling to analyze the effects of tax systems on the decisions of economic agents. Most of general equilibrium modeling studies use the overlapping generations model (OLG) to evaluate the tax system. Auerbach and Kotlikoff (1983) construct a 55-period OLG model to evaluate the effect of tax reform on national savings and economic welfare. Moreover, Kotlikoff et al. (1983) use a 55-period OLG model to analyze the efficiency gains from dynamic tax reform. Kotlikoff et al. (2001) simulate the alternative tax reforms for the U.S. economy. Lledo (2005) use the model of Auerbach and Kotlikoff (1987) to analyze the impact of Brazilian tax reform.

There was no comprehensive research to analyze the effect of tax system on Turkish economy. Ardıç et al. (2010) use Almost Ideal Demand System (AIDS) methodology to evaluate the efficiency of indirect taxes. Authors argue that consumption taxes are quite high in Turkey compared to other OECD countries. According to them, the government has no ability to collect the direct taxes due to large size of informal sector. Hence, the government has more emphasis on indirect taxes. Their study further suggests that the current tax rates are not optimal and there is no room for improvement. However, although more researches are needed to analyze the effects of the tax system on the Turkish economy by using a dynamic general equilibrium model, existing studies are not satisfactory to answer this problem yet.

As we mentioned before, most of the studies in the literature that attempt to answer this problem use overlapping generations model to evaluate the effect of tax systems on the economies. In the OLG model an individual with a finite lifetime is used to represent the agents in the economy. Representative agent maximizes his/her lifetime utility subject to his/her lifetime budget constraint. In each period, new individuals are born to live with older cohorts and some of the individuals die and leave the economy. The OLG model provides researcher to observe dynamic behaviors of different consumers with age variation at each period. Hence, the life-cycle OLG is the most insightful tool to model general stance of the economy. The previous studies using OLG model are on the social security reform and IMF-debt austerity program performed in Turkey. The studies use a 30-period OLG model with

exogenous labor supply. Our aim is to construct a 55-period OLG model with heterogeneous agents and endogenous labor supply to analyze the impact of Turkish tax system on the economy. Therefore the main contribution of this thesis is to construct 55-period overlapping generations model in an attempt to analyze the Turkish Tax System for the first time. We solve for the initial steady state and the transition path and the final steady states after several policy changes by using three agents with different income levels namely low income, middle income and high income. The proposed tax reform decreases the value added tax rate from 18 percent to 15 percent and increases the labor income tax rate of high income household from 35 percent to 40 percent in order to balance the government budget constraint. The results show that the low and middle income classes benefit from the tax reform while the high income households suffer from the tax reform in terms of the welfare analysis.

In the following chapter, chapter 2, a literature survey on the OLG model is presented. In chapter 2, firstly, we summarize the studies that use the OLG model to analyze the tax system. After that, other studies that use the OLG model to answer various economic questions are summarized. Since, the model in this study is constructed for the Turkish Tax System; Chapter 3 discusses the details of the current Turkish Tax System. We construct a 55-period OLG model in chapter 4. The model includes three representative consumers that are differentiated in terms of their income levels namely, low, middle and high. In chapter 5, the calibration and simulation results are presented. We calibrate the model for 2009 financial year. After completing parameterization of the model, the initial steady state for the Turkish economy is calculated. Next, we proposed a tax reform which suggests decreasing the VAT rate from 18 percent to 15 and increasing top statutory income tax rate from 35 percent to 40 percent and analyze the final steady state with the initial steady state and the transition path caused by the tax reform. In chapter 6, the results are summarized and the possible further directions of the research are discussed.

CHAPTER 2

OVERLAPPING GENERATIONS MODEL: LITERATURE REVIEW

The purpose of this chapter is to summarize the existing literature on Overlapping Generations model for both tax reforms and other issues. I will summarize OLG models constructed for various research questions, with an emphasis on tax system related discussions. First, we will present the researches aim to investigate the effects of tax reforms on economic activity. After that, the studies using overlapping generations model for other purposes such as social security system, environment and etc. will be explored.

Auerbach and Kotlikoff (1983) construct a 55-period OLG model with exogenous labor supply in order to investigate the effect of various government policies on national savings and economic welfare. Authors conclude that the current effect of current tax and expenditure policy depends on the nature and timing of associated future tax rate changes. Following this study, Auerbach et. al. (1983) construct a 55 period OLG model including endogenous labor supply and a more sophisticated utility function in order to investigate the efficiency gains from dynamic taxation. The model is a perfect foresight model including a representative agent living for 55 periods, no bequest, no uncertainty and constant population growth. Government uses tax revenues and issues one-period debt to finance its' expenditures. The authors use three tax types, namely progressive annual income tax, labor income tax and consumption tax. A lump sum redistribution authority which has a budget constraint assuming that the summation of its transfers and lump-sum taxes equals to zero, is defined to calculate the pure efficiency gains from a tax reform. The study reveals that a proportional income tax is less destructive than a progressive income tax.

Furthermore, using wage tax instead of income tax decreases the welfare gains while using consumption tax provides more gains. However, consumption tax puts large marginal tax burdens on the relatively inelastic elderly. Although the wage taxation increases the capital accumulation, it causes some welfare losses. Hence, they conclude that policy makers should not confuse the tax systems that increase capital accumulation with those that raises welfare. Following Auerbach et al. (1983), Kotlikoff and Auerbach (1987) construct and solve numerically a 55 periods OLG model with a tax system. In Chapters 3 and 5 of Auerbach and Kotlikoff (1987), the authors describe and simulate the model using four proportional taxes, namely an income tax, a consumption tax, a labor income tax and a capital income tax in order to choice a tax base system. The results of this study are similar to the findings of Auerbach et al. (1983). Authors are not able to rank the four tax bases with respect to their effects on saving and welfare. They state that the reason of this is that savings and welfare are not sensitive to reasonable variations in parameter values.

Laitner (1990) uses the OLG model of Auerbach and Kotlikoff (1987) with no social security system and general income tax, to find the effects of changes in capital income tax rate, labor income tax rate and consumption tax rate. The results of this study are similar to the findings of Auerbach and Kotlikoff (1987). However, there are some differences in numerical results. Firstly, increasing capital income taxation causes capital accumulation to decrease about 20 percent (Auerbach and Kotlikoff's model finds more than a 35 percent change). Secondly, the findings of Laitner show 2 percent welfare increase in the long run while Auerbach and Kotlikoff find about 1 percent decrease in the long-run welfare.

Following Auerbach and Kotlikoff (1987), Lledo (2005) constructs a 55-period OLG model including three tax rates, labour income, consumer and capital income in order to analyze the impacts of replacing turnover taxes in Brazil by a consumption tax. The simulation results show that 70 percent of individuals obtain welfare gains under the proposed tax reform. Furthermore, tax reform does not cause substantial decrease in labor supply, income and capital stock.

The studies given above use a perfect foresight OLG model. However, İmrohoroğlu (1998) incorporates the lifetime uncertainty, idiosyncratic income risk and

mandatory retirement. Author constructs a 65 period OLG model with exogenous labor supply and a representative agent facing individual income risk, lifetime uncertainty and borrowing constraints in order to evaluate the effects of decreasing capital income taxation on capital accumulation and welfare. The author shows that the capital income tax rate that maximizes welfare is positive. Also, removing capital income tax entirely provides the steady-state capital stock toward the Golden Rule to be higher. Furthermore, author find that 10 percent capital income tax rate maximizes steady-state welfare in the benchmark case. Lastly, the study reveals that increasing the consumption tax rate in order to compensate the removing the capital income taxation results in 6.4% increase in welfare.

A life-cycle OLG model is conducted by Heijdra and Ligthart (2000) and Heidjra and Mierau (2010). Heijdra and Ligthart (2000) extend the overlapping generations model of Blanchard-Yaari type including endogenous labor supply and three tax instruments, namely a capital income tax, labor income tax and consumption tax in order to analyze the long-run effects, transition and the impact of tax reforms. They normalize the population to one and assume that each household faces a constant probability of death, does not receive bequest, and makes a life assurance contract with annuities companies. The government finances its expenditure consisting of lump-sum transfers to the households by using three tax instruments, a consumption tax, a capital income tax and a labor income tax. Authors find that both capital and labor taxation decrease the production in the long-run. Furthermore, the study shows that increasing proportional consumption tax rate decreases the savings and may increase the capital accumulation if the labor supply effect is dominated by the generational turnover effect. Finally, the labor tax decreases the capital stock due to endogenous labor supply. The difference between the models of Heidjra and Mierau (2010) and Heijdra and Ligthart (2000) is that Heijdra and Mierau (2010) do not include capital income tax, and assume annuity market to be imperfect and three redistribute plans, namely evenly across all individuals, a bias toward the young or the old. The tax revenues of the government is either given to households as lump-sum transfers or used to finance government expenditures. Authors show that both consumption and labor-income taxation provides an increase in economic growth if the redistributive plan has a bias toward the young. However, if the redistributive

plan has a bias towards the old, both of the taxes cause economic growth to fall. Moreover, if the tax revenues are given to households as lump-sum transfers, consumption taxation provides an increase in economic growth whereas the labor income taxation causes a reduction. They also find that if government uses tax revenues to only finance its expenditures, economic growth is affected negatively and productive resources decrease.

Yakita (2001) use OLG model the Blanchard (1985) to analyze the effects of wage and capital income taxes on growth and welfare. The model assumes that private human capital accumulation of individuals and fraction of average human capital reaches to new generations in a small open economy. The author finds that if the fraction of human capital that reaches to the new generations is not sufficiently small, the current older generations are hurt from interest income tax while current younger generations benefit. The reason of this result is that the tax policy redistributes the income from older cohorts to current younger cohorts. Also, if a large size of human capital reaches to new generations, the wage tax causes all generations to suffer due to increase in financial asset holdings and reduce the consumption.

Pereira and Rodrigues (2002) use a dynamic general equilibrium modeling to evaluate the tax reform package proposed by Cavaco Silva, the Portuguese Prime Minister. The tax reform decreases the corporate income tax and firms' social security contribution by four percentage points and reduces the top statutory income tax rate by 5 percentage points. These reductions are financed by fighting tax evasion, controlling improvident public expenditure. If these steps are not enough, the government will increase the VAT rate by up to 2 percentage points. The simulation results showed that long-run GDP gains would be between 0.72% and 2.91%.

The models of previous studies include a representative agent to analyze the effects of tax system. The first study that incorporates heterogeneous agents in OLG model is done by Kotlikoff et al. (2001). Authors use an OLG model to compare the equity, welfare, and macroeconomic effects of a proportional income tax, a proportional consumption tax, a flat tax, a flat tax with transition relief, and a progressive variant

of the flat tax called the "X tax." They extend the model of the Auerbach and Kotlikoff (1987) by adding 12 heterogeneous groups that are differentiated in terms of their earning abilities. The study implies that using a proportional consumption tax instead of the U.S. federal tax system results in 11 percent increase in production. This tax policy provides welfare gains to the middle- and upper-income classes whereas older transition generations and low-income households are losers. Furthermore, the model predicts that the flat tax results in 5 percent decrease in long-run output but provides welfare gains to all long run cohorts. The young and future cohorts of low income households are negatively affected due to a clean income tax but the others are winners. Lastly, the X tax combining consumption tax and progressive wage tax elements provides everyone to be better off in the long run and production rises by 7.5 percent. However, this tax policy causes initial older cohorts facing an implicit tax on their wealth to suffer.

The following Table 3.1 includes a brief summary of studies using OLG model to evaluate the tax systems.

Table 2-1: Summary of the Studies using OLG Model to Evaluate the Tax Systems

Year	Author	Article	Model	Result
1983	Auerbach, A.J. And Kotlikoff, L.J.	National Savings, Economic Welfare and the Structure of Taxation	a 55 period OLG model with -exogenous labor supply -labor income tax, capital income tax, consumption tax	- the immediate effect of current tax and expenditure policy depends on the nature and timing of associated future tax rates
1983	Auerbach, A.J. And Kotlikoff, L.J., and Skinner, J.	The Efficiency Gains from Dynamic Tax Reform	a 55 period OLG model with -endogenous labor supply -labor income tax, capital income tax, consumption tax	- a proportional income tax is less distortionary than the progressive income tax -using wage tax instead of income tax reduces economic efficiency while using consumption tax provide more gains -wage taxation stimulates capital accumulation but causes to welfare loss
1987	Auerbach, A.J. And Kotlikoff, L.J.	Dynamic Tax Reform	a 55 period OLG model with -endogenous labor supply -labor income tax, capital income tax, consumption tax	-consumption tax has long-run capital accumulation than the one's with either labor income or capital income tax -proportional consumption taxation is more efficient than the proportional income taxation

Table 2-1 (cont'd)

1990	Laitner, J.	Tax Changes and Phase Diagrams for an Overlapping Generations Model	a 55 period OLG model with -endogenous labor supply -labor income tax, capital income tax, consumption tax	-rising the level of consumption tax rate leads to higher capital accumulation and provides welfare gains -old generations suffer at the time of policy change -future generations benefit from the policy -increasing the level of capital income tax causes lower capital accumulation and provides long-run welfare gains -increasing the level of wage tax decreases the long-run welfare
1998	Imhoroğlu, S.	A Quantitative Analysis of Capital Income Taxation	a 65-period OLG model with -idiosyncratic income risk -life-span uncertainty -capital income tax	-capital income tax maximizes social welfare is positive and eliminating it increase the capital accumulation -increasing in consumption tax to offset the elimination of capital income taxation provides rise in steady-state welfare
2000	Heijdra, B.J. and Ligthart, J.E.	The Dynamic Macroeconomic Effects of Tax Policy in an Overlapping Generations Model	a life-cycle OLG model with -endogenous labor supply -const probability of death -life insurance contract -no bequest -labor income tax,capital income tax,consumption tax	-both capital and labor taxes cause the long-run production to decrease -increasing the level of proportional consumption tax results in lower savings and may provides social welfare gains if the generaional turnover effect dominates the labor supply effect

Table 2-1 (cont'd)

2001	Altig, D., Auerbach, A.J., Kotlikoff, L.J. Smetters, K.A. and Walliser, J.	Simulating Fundamental Tax Reform in the United States	a 55 period OLG model with -endogenous labor supply -12 heterogenous agents -bequest motive -5 differen tax reforms; a proportional income tax, a proportional consumption tax, the flat tax, the flat tax with transition relief, the X tax	-replacing U.S. Federal tax system with proportional consumption tax provides more output. Middle and upper income classes are winner but older generations and low income class are losers. -all long-run cohort are better off under the flat tax reform but this reform causes log-run output to decrease
2005	Lledo, V.D.	Tax Systems under Fiscal Adjustment: A Dynamic CGE Analysis of the Brazilian Tax Reform	a 55 period OLG model with -endogenous labor supply -labor income tax, capital income tax, consumption tax	-70 percent of individuals obtains welfare gains by switching from corporate and financial transaction taxes to a flat broad base consumption tax. -tax reform does not cause to substantial decrease in the capitala stock, labor supply and income
2010	Heijdra, B.J. and Mierau, J. O.	Growth Effects of Consumption and Labor Income Taxation in an Overlapping Generations Model	a life-cycle OLG model with -endogenous labor supply -age-dependent mortality -life insurance contract -no bequest -labor income tax, consumption tax -imperfect annuity market	both consumption and labor-income taxation provides an increase in economic growth when the government redistributes proceeds of taxation with a bias toward the young -both of the taxes cause economic growth to fall if the proceeds are redistributed with a bias towards the old. -it has a negative effect on economic growth and productive resources are reduced if government uses tax revenues to only finance its consumption.

Overlapping generations model is used for many purposes besides the tax system. For example, Previdoli, Stephan and Muller-Furstenberger (1997) compares the model of finitely lived agents with the one of infinitely lived agents in order to determine best suited model for analysis of global environmental policies. The determined connections between economy and environment are similar for both models. The government taxes the carbon emissions and the model assumes the pollution to have feedback effects on production. Since there is no altruistic behavior, the model does not consider future cohorts in terms of environmental quality. The study finds that model with finitely and infinitely lived agents are complements. Wendner (2001) constructed a 55 period OLG model including exogenous labor supply, a representative agent retiring after 40 periods to analyze the impacts of environmental tax reforms and social security tax reforms together. Individual facing an intertemporal budget constraint chooses bequests, consumption sequences and asset stock decisions that maximize the lifetime utility. The government only taxes CO_2 emissions in order to finance the pension system. The main findings of increasing the tax rate on CO_2 emissions are that labor demand increases, the net labor income raises due to fall in social security tax rate. Therefore, this tax reform positively affects the saving and the consumption.

Ventura and Huggett (2000) uses an 80-period OLG model in order to find why income households have a higher saving rate than the saving rate of low level income households in US. The model assumes that individuals have life-span uncertainty and productivity of labor is uncertain. Moreover, government collects labor and capital income taxes, and social security taxes. Labor endowments are differently identified in order to have difference between consumer incomes. Therefore, under this framework, the model analyzes the saving behavior of each individual with different income levels.

Heer and Mausner (2012) construct 240-period (each period represents a quarter, corresponding to 60 years) OLG with aggregate productivity risk, elastic labor supply and monetary authority. Household maximize life-time utility subject to consumption, money demand, capital and labor supply. Firms in production sector are competitive whereas the firms in the retail sector are monopolistically

competitive and set staggered prices. Also, government put progressive income tax and financed the pensions, consumption and transfers by tax revenues. Authors construct the model in a way to replicate three channels of the effect of inflation on income distribution, namely factor prices, bracket creep and sticky pensions. Authors find that after the first period, an expansionary monetary shock decreases the unequal distribution of both the factor income and the disposable income. Furthermore, this effect will be much higher if the government redistributes the revenues from seignorage and taxes to households as lump-sum transfers.

Hamann (1992) uses a 55-period overlapping generations model with a representative agent has no altruistic behavior, inelastic labor supply and no uncertainty in order to evaluate the effects of inflationary finance. Government obtains taxes and appeal to seignorage to afford government expenditures and transfers to private households. In addition, all individuals and government can borrow or lend at the market interest rate. Author concludes that disinflation should be financed by consumption tax and the temporary disinflation policies affect very little the current inflation. Furthermore, the study finds that the announcement of policies that are consistent economically can have critical impacts even prior to their implementation.

Overlapping generations models have been widely used to analyze the social security systems. For example, Ferreira (2005) constructs a 55 period OLG model incorporating a deficit-running government and endogenous labor supply in order to evaluate the impacts of variant pension reforms in Brazil. In a model with endogenous labor, social security tax rate is solved to balance the budget of the social security system. The pay-as-you-go social security system of Brazil is tried to be fully privatized under the proposed reforms. The study shows that the substantial welfare gains can occur if the social security labor tax is eliminated.

Neusser (1993) extend the OLG model constructed by Auerbach and Kotlikoff (1987) by including bequest motive and pay-as-you-go social security system in order to analyze the effects of the permanent and transitory changes in labor supply growth in Australia. Author finds that the permanent increase in labor supply increases long run GDP growth while transitory change cause a temporary change in

the short-run. In addition, the equivalent variation measure is calculated for welfare analysis. Both permanent and transitory changes in labor supply provide an increase in the welfare of households that were born in first year. However, households who were born after the changes suffer under both permanent and transitory change.

In another research on social security, Imhoroğlu, Imhoroğlu and Joines (1999) construct a 65-period overlapping generations model with households having individual income risk, mortality risk and borrowing constraints. In addition, households get social security benefits financed by a payroll tax on the employed agents. Authors include the land in the model as a fixed factor of production in order to eliminate the dynamic inefficiency. The results show that a new born individual prefers to be born into an economy with funded social security instead of an economy with any positive replacement rate.

The previous studies conducted a 30 period OLG model for Turkish economy are about the IMF-led austerity program and the social security reform. The first study is conducted by Voyvoda and Yeldan (2005). Authors construct a 30 period OLG model with exogenous growth and labor supply and open capital markets in order to evaluate macroeconomic effects of IMF-led austerity program and sensitivity of the program targets to growth shocks. Authors conclude that the program can reduce the path of the ratio of aggregate public debt to GNP only gradually and slowly. They also state that this path presents significant degree of inertia.

Değer (2011) constructs a 30-period overlapping generations (OLG) model in order to analyze the impacts of the social security system reform performed in Turkey. The study shows that the reform increases the deficits of the social security system in the short run, and it can only reduce the deficits in the medium to long run.

The developing OLG models for various research questions became quite popular. The studies given above tried to answer different questions or investigate the effects of policy changes in various countries. Each study constructs an overlapping generations model that has different structure for the specific purpose. An OLG model that represents the structure of Turkish Tax System is constructed and presented in the fourth part in order to analyze macroeconomic effects of the tax

system in Turkey. We construct a 55-period OLG model including endogenous labor supply with three heterogeneous agents who are differentiated in terms of their income levels. The model includes three proportional tax types, labor income, consumption and capital income, at the same time.

CHAPTER 3

TURKISH TAX SYSTEM

The aim of this chapter is to present the information about the Turkish tax system. In the first part, general information of the tax structure and taxes for various groups will be explained. In the second part, some performance results related to taxation will be given in terms of tax types and tax base. These results will be used in the theoretical model as a proxy for Turkish Tax System will be determined in the second part of this chapter.

3.1. TAXATION

Turkey applies a multi-tax system. Also, the Turkish tax legislation consists of separate laws covering different types of taxes. The Turkish tax system includes three main types of taxes namely, income taxes, expenditure taxes and wealth taxes. Income taxes consist of personal income and corporate income taxes. Taxes on expenditures are divided into six types, value added, special consumption, banking and insurance transaction, stamp duty, special communication and customs taxes. Moreover, taxes on wealth comprised of inheritance and gift, property and motor vehicle taxes.

3.1.1. INCOME TAXES

3.1.1.1. Personal Income Tax

Government levies personal income tax on Turkish residents' worldwide income. However, foreign residents, employed in Turkey, are taxed only on income earned in Turkey. Turkey has unitary tax system under which income earned from different

sources is aggregated and tax due is computed on the total aggregated income. Moreover, income earned in Turkey by residents and nonresidents are classified into seven types. These seven types are commercial, agricultural and salary and wage incomes, income from capital investment, revenues from immovable properties, self-employment earnings and other income and earnings.

Individual income and earnings are subject to the progressive income tax rates which are ranged from 15% to 35% and calculated on a cumulative basis. Table 3.1 presents 2011 tax rates for each type of income within the determined income tax bracket.

Table 3-1: Income Tax Rates in terms of Tax Brackets

Taxable Annual Income		
Lower Level TL	**Upper Level TL**	**Tax rate**
0	9,400	15%
9,400	23,000	20%
23,000	53,000 (80,000 for wage income)	27%
53,000 (80,000 for wage income)	-	35%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 5)

Income and some gains of both resident and non-resident individuals are subject to withholding tax. The following Table 3.2 shows the individual income and gains that are subject to withholding tax.

Table 3-2: Individual Incomes subject to Withholding Tax

Individual income subject to WHT	Resident	Non-resident
Employment income (wage, bonus, fringe benefits etc.	15-35%	15-35%
Income from professional services	20%	20%
Progress billings on long-term constructions	3%	3%
Income from sales of rights, other intangible assets	N/A	20%
Rental income (both tangibles and intangibles)	20%	20%
Dividend income	15%	15%
Time deposit interest and repo gains	15%	15%
Interest income from Turkish Government bonds and Treasury Bills	10%	10%
Capital gains from sale of Turkish Government bonds and Treasury Bills	10%	10%
Interest income derived from Eurobonds issued by the Undersecretariat of Treasury	0%	0%
Capital gains derived from Eurobonds issued by the Undersecretariat of Treasury	Not subject to WTH	Not subject to WTH
Gains derived from intermediary institution Warrants (underlying asset is quoted at ISE)	0%	0%
Capital gains from sale of shares traded at Istanbul Stock Exchange (ISE) and held less than 1 year	0%	0%
Capital gains from sale of shares of investment trusts traed at Istanbul Stock Exchange (ISE) and held less than 1 year	10%	10%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 6)

3.1.1.2. Corporate Income Taxes

Government levies corporate income tax on the incomes of corporations, companies or other legal entities that are reside in Turkey at a rate of 20%. In addition to this all income types that are mentioned in the personal income tax section are regarded as corporate incomes if they are obtained by corporations or companies. Turkish Tax legislation considers resident corporations or companies as full-liable tax payers. On the other hand, non-residents that regarded as limited liability taxpayers are subject to taxation on their Turkish income. The Taxable income of this group consists of the following:

- Profits from commercial, agricultural and industrial enterprises in Turkey
- Income arising from leasing of movable and immovable properties and intangible rights in Turkey
- Professional fees earned in Turkey
- Other income and revenues earned in Turkey

Withholding tax (WHT) is applied to some of the resident and nonresident corporations. The important corporate income and earnings subject to the withholding tax and their WHT rates is presented in the following table 3.3.

Table 3-3: Corporate Incomes subject to WTH

Corporate income subject to WHT	Resident	Non-Resident
Income from professional services		20%
Progress billings on long-term constructions	3%	3%
Income from sales of rights, other intangible assets		20%
Rental income (both tangibles and intangibles)		20%
Royalties, Know-how. etc.		20%
Dividend income		15%
Branch remittance		15%
Time deposit interest and repo gains	15%	15%
Interest income from government bonds and treasury bills	0-10%	0-10%
Capital gains from sale of government bonds and treasury bills	0-10%	0-10%
Interest income derived from Eurobonds issued by the Undersecretariat of Treasury	0%	0%
Capital gains derived from Eurobonds issued by the Undersecretariat of Treasury	0%	0%
Gains derived from intermediary instution Warrants (underlying asset is quoted at ISE)	Not subject to WTH	Not subject to WTH
Capital gains from sale of shares acquired after 01.01.2006	0-10%	0-10%
All kinds of income provided to companies which are resident in low tax jurisdictions		30%
Interest income over receivables		0-1-5-10%
Income from petroleum exploration activities		5%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 17)

3.1.2. TAXES ON EXPENDITURES

3.1.2.1. Value Added Tax

Turkish government levies Value Added Tax (VAT) on the supply and importation of goods and services. The Turkish tax legislation generally considers provider and the importer of the goods and services or the individual who performs the services as VAT taxpayer. Following transactions taking place in Turkey are subject to VAT:

- Supply of goods and services in the context of commercial, industrial, agricultural and professional activities
- Importation of goods and services
- Goods and services imported and deliveries and services result in other activities

The standard VAT rate in Turkey is 18 percent. However, some of the goods and services groups are taxed at lower rates and table 3.4 presents the VAT rates for these groups:

Table 3-4: VAT Rates for Various Goods and Services

Goods and Services subject to VAT	Tax Rate
Deliveries of newspapers and magazines	1%
Processing and deliveries of agricultural commodities	1%
Basic foods	1%-8%
Houses (up to net 150 m2)	1%
Secondhand passerger cars	1%
Cinema, theater, opera, etc.	8%
Deliveries of books and similar publications	8%
Medical products and devices, etc.	8%
Cotton and certain textile products	8%
Shoes, cases, bags, carpets, leather dressings	8%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 32)

3.1.2.2. Special Consumption Tax

The Turkish Tax System imposes a special consumption tax on the consumption of luxury products such as automobiles, petroleum products, alcoholic and non-alcoholic beverages, cosmetics, natural gas, cigarettes, tobacco products, electronic goods and etc. This tax is applied as a percentage of the sales prices or as a fixed amount per unit.

3.1.2.3. Banking and Insurance Transaction Taxes (BITT)

These taxes are applied to the gross income of banking and insurance companies coming from all of the transactions except the transactions consistent with the Financial Leasing Code. BITT Taxpayers are Banks, bankers, insurance companies, financing companies, lenders and factoring companies are BITT taxpayers. The standard BITT rate is 5% but the tax rates for the specific transactions are stated in the following table.

Table 3-5: Tax Rates for Specific Transactions

Interbank deposit transactions	1%
Repo gains	1%
Sale of government bonds and treasury bills	1%
Foreign exchange transactions	0%
Other transactions	1-5%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 35)

3.1.2.4. Stamp Duty

Documents determined by the Stamp Tax Law are subject to Stamp Tax. Documents such as agreements, contracts, and letters of cancellation, financial statements, and letters of guarantee, receipts, and notes payable are subject to stamp tax. Persons who sign the documents are considered as taxpayer of the stamp tax. The general stamp tax rate of the agreements is 0.825%. The tax rate on rental agreements and letters of cancellation is 0.165% while the tax rate of letters of guarantee and deeds of settlement is 0.825%.

3.1.2.5. Special Communication Tax

Government applies special communication tax to telecommunication services. Operators that supply telecommunication services are the taxpayers of this tax. The following table 3.6 includes the special communication tax rates:

Table 3-6: Special Communication Tax Rates

Mobile Telecommunication Services	0.3
Services related to internet via cable, wireless and mobile	0.2
Services related with the transmission of radio and television broadcasts	0.2
Other telecommunication services	0.2

Source: Ernst&Young, Concise tax guide for Turkey (2011: 37)

3.1.2.6. Tax on Customs

Custom duty is applied to the imported goods. Taxable events are free circulation of goods, registration of customs declaration and temporary importation in case of partial exemption. Those who declare to the custom office are considered as taxpayer of this tax.

3.1.3. TAXES ON WEALTH

3.1.3.1. Inheritance and Gift Taxes

This tax is levied on beneficiaries and gift recipients. Inheritance and gift tax is levied on the worldwide assets of Turkish citizen received. Resident foreigners pay taxes if they receive any assets from Turkish citizens and assets located in Turkey from resident foreigners or nonresidents. On the other hand, nonresident foreigners are subject to this tax if the assets received by this group are in Turkey. Table 3.7 exhibits the tax rates for inheritance and gift.

Table 3-7: Inheritance and Gift Tax Rates

Base (TL)	Inheritance Tax Rates	Gift Tax Rates
0-170,000	1%	10%
170,000-540,000	3%	15%
540,000-1,340,000	5%	20%
1,340,000-2,940,000	7%	25%
2,940,000-…	10%	30%

Source: Ernst&Young, Concise tax guide for Turkey (2011: 38)

3.1.3.2. Property Tax

The property tax is levied on the buildings and lands located in Turkey. Turkish tax legislation considers owner of the building or land, the owner of usufruct. If no one of these exists, person who acts as owner of the building or the land is the taxpayer of this tax. The tax base for the building or land is determined in terms of the value recorded by the Land Registry. General tax rate for the buildings is 0.2% but if the buildings are used as residences, the tax rate falls to 0.1%. The tax rate for the lands is 0.1% while the parceled land is taxed at 0.3%.

3.1.3.3. Motor Vehicle Tax

Motor vehicles are subject to motor vehicle tax. Both individuals and corporations who have motor vehicles registered to their own names are taxpayers. The weight, age and engine capacity of vehicles are determinants of the amount of the tax imposed.

3.2. PERFORMANCE RESULTS RELATED TO TAX TYPES

In this part, some descriptive findings regarding the Turkish tax system will be discussed. In Table 3.8 below, the number of active taxpayers for each type of tax is given. We could observe that the total number of income and value added taxpayers constitute 92% of total number of active taxpayers in 2011.

Table 3-8: The Number of Active Taxpayers for Each Type of Tax

Type of Tax	The Number of Active Taxpayers in 2009	The Number of Active Taxpayers in 2010	The Number of Active Taxpayers in 2011
Income Tax	1.683.308	1.693.316	1.703.754
Corporate Income Tax	640.786	652.009	663.967
Value Added Tax	2.249.950	2.271.049	2.293.765
Total Number of Active Taxpayers	4.103.583	4.248.942	4.334.678

Source: Revenue Administration, Tax Statistics

In addition, Table 3.9 shows that tax revenues collected from VAT consist of more than 30 percent of the total tax revenues from 1996 to 2010 and this ratio is higher than both the ratio for income tax and corporate income tax. Moreover, Figure 3.1 shows that the tax revenues collected from income tax and value added tax constitute 50% to 65% of total tax revenues since 1996.

Table 3-9: Tax Revenues for Each Type of Tax between 1996 and 2011

| YEARS	Tax Revenues	Income Tax	The Rate in Tax Revenues	Corporate Income Tax	The Rate in Tax Revenues	VAT	The Rate in Tax Revenues	The Total of IT,CIT and VAT	The Rate in Tax Revenues
1996	2,244,094	676,017	30.1	189,338	8.4	743,026	33.1	1,608,381	71.7
1997	4,745,484	1,500,245	31.6	396,238	8.3	1,561,562	32.9	3,458,045	72.9
1998	9,228,596	3,481,752	37.7	748,383	8.1	2,725,083	29.5	6,955,218	75.4
1999	14,802,280	4,936,551	33.3	1,549,525	10.5	4,164,334	28.1	10,650,410	72
2000	26,503,698	6,212,977	23.4	2,356,787	8.9	8,379,554	31.6	16,949,318	64
2001	39,735,928	11,579,424	29.1	3,675,665	9.3	12,438,860	31.3	27,693,949	69.7
2002	59,631,868	13,717,660	23	5,575,495	9.3	20,400,201	34.2	39,693,356	66.6
2003	84,316,169	17,063,761	20.2	8,645,345	10.3	27,031,099	32.1	52,740,205	62.6
2004	101,038,904	19,689,593	19.5	9,619,359	9.5	34,325,208	34	63,634,160	63
2005	119,250,807	22,817,530	19.1	11,401,986	9.6	38,280,429	32.1	72,499,945	60.8
2005	131,948,778	26,849,808	20.3	13,583,291	10.3	42,263,650	32	82,696,749	62.7
2006	151,271,701	31,727,644	21	12,447,354	8.2	50,723,560	33.5	94,898,558	62.7
2007	171,098,466	38,061,543	22.2	15,718,474	9.2	55,461,123	32.4	109,241,140	63.8
2008	189,980,827	44,430,339	23.4	18,658,195	9.8	60,066,230	31.6	123,154,764	64.8
2009	196,313,308	46,018,360	23.4	20,701,805	10.5	60,169,248	30.6	126,889,413	64.6
2010	235,714,637	49,385,289	21	22,854,846	9.7	75,649,986	32.1	147,890,121	62.7
2011	284,446,206	59,884,487	21.1	29,233,615	10.3	95,549,333	33.6	184,667,435	64.9

Source: Revenue Administration, Tax Statistics
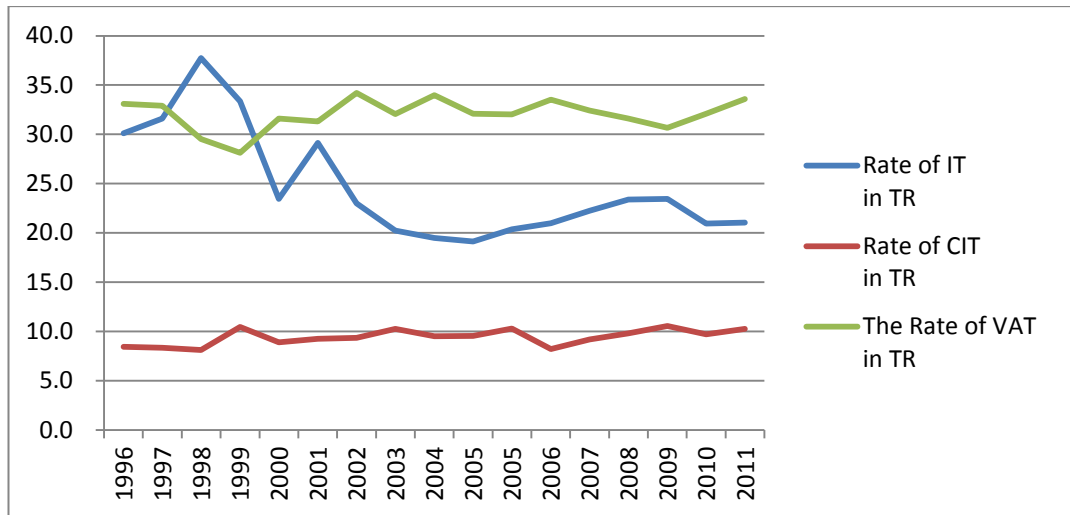
Figure 3-1: Ratio of Revenues Obtained for Each Type of Tax to Tax Revenues
Source: Revenue Administration, Tax Statistics

It is easily observed in Figure 3.2 below that the tax revenues in Turkey increased since 2000 and the big portion of this raise is coming from the rise of income tax and VAT revenues.
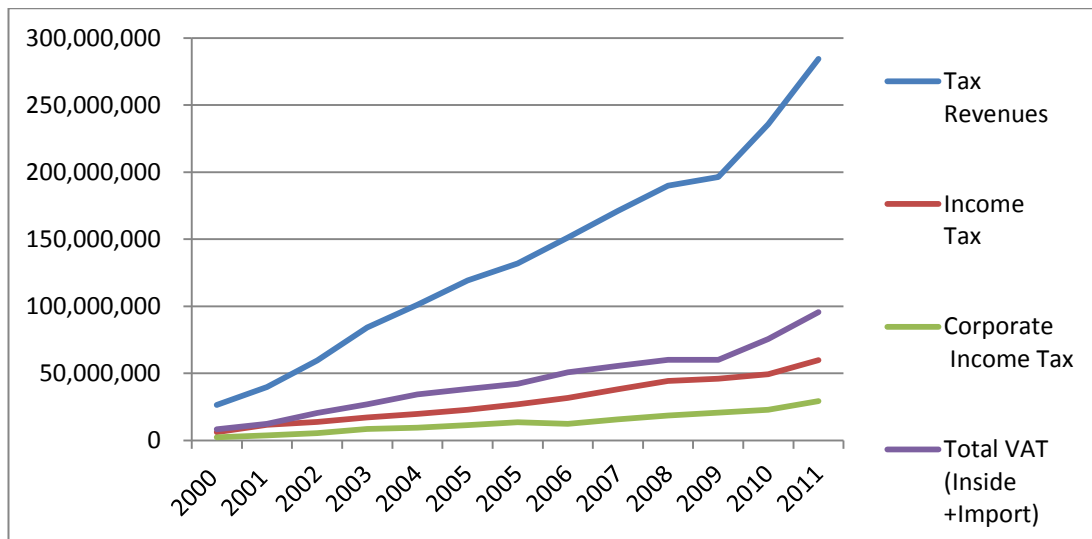

Figure 3-2: Tax Revenues relative to GDP
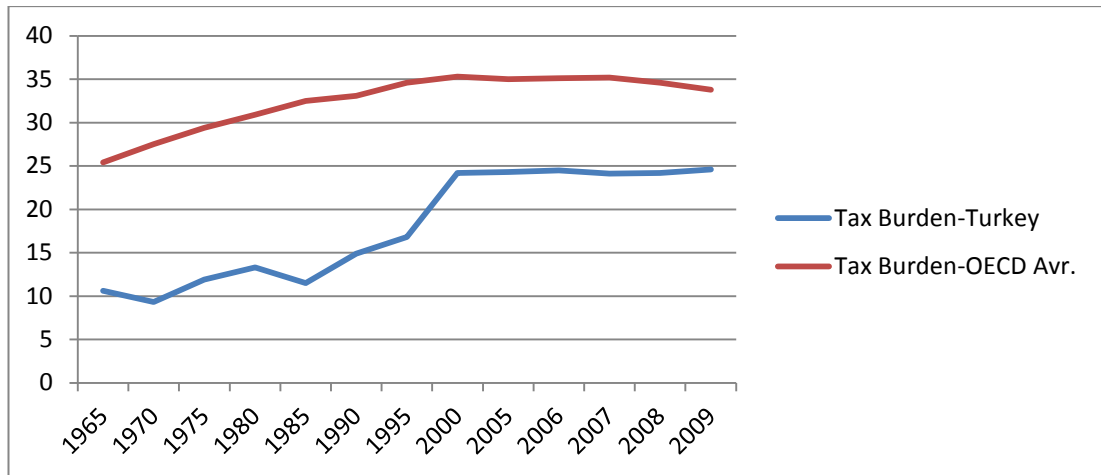**Source: Revenue Administration, Tax Statistics**

Figure 3-3: Ratio of Tax Burden of Turkey and OECD Average to GDP
Source: Revenue Administration, Tax Statistics

Figure 3.3 presents the relative tax burden of Turkish taxpayers and the average of OECD countries in terms of GDP. It is obviously seen that tax burden in Turkey is lower than the OECD-average. Furthermore, the ratios for revenues of each type of taxes for Turkey and the average of OECD are represented in Figure 3.4. The ratio of revenue of corporate income tax for Turkey is lower than the average of the OECD countries for the given years. Also, the ratio of personal income tax revenues in Turkey is lower than the ratio of the OECD-average. One of the reasons of this result might be that the size of informal sector is quite big, fluctuates between 40 and 50 percent of GDP and government has no ability to collect taxes from informal sector. On the other hand, the ratio of consumption tax revenues in Turkey is higher than the OECD-average after 2005. Some researchers claim that the VAT rate is too high in Turkey compared to that in the OECD countries. This is very apparent especially after VAT rate increased from 15 percent to 18 percent. Moreover, Figure 3.4 shows that ratio of VAT revenues to GDP in Turkey is higher than both the ratio of personal income tax revenues and corporate income tax revenues to GDP in Turkey.
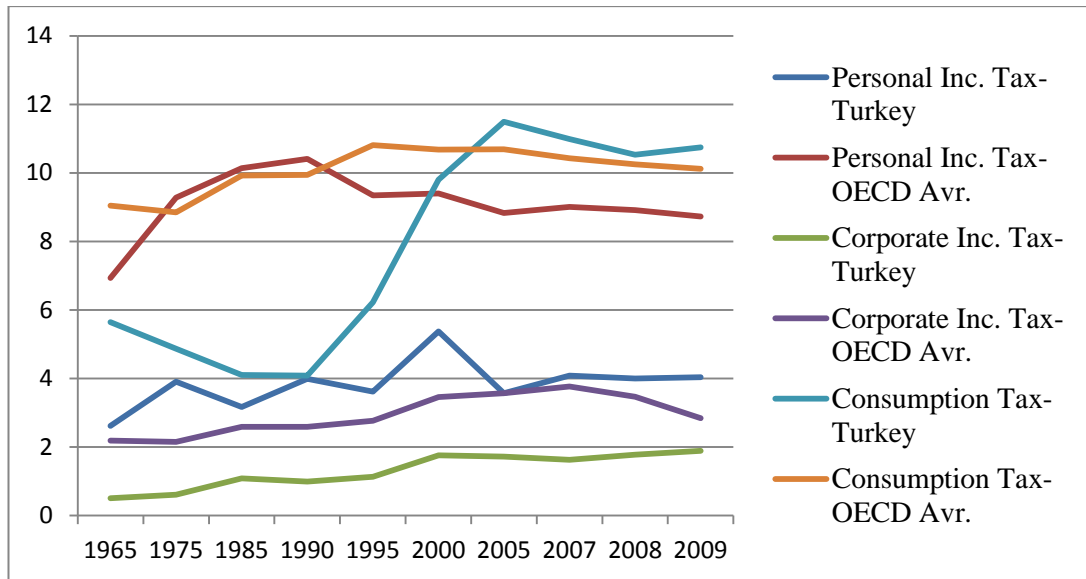
Figure 3-4: The Ratio of Revenues of Each Type of Taxes for Turkey and OECD-Average to GDP
Source: Revenue Administration, Tax Statistics

As it can be seen from the table above, the income tax, including personal income tax and capital income tax, and the value added tax are the most important tax types in Turkey. Therefore, in our theoretical model, we would use these 3 tax instruments, namely capital income tax, labor income tax and value added tax as consumption tax, as a proxy for the Turkish Tax System.

CHAPTER 4

THE OVERLAPPING GENERATIONS MODEL FOR THE TURKISH TAX SYSTEM

The aim of this chapter is to construct a model to analyze the Turkish Tax System. This chapter consists of two main parts. In the first part, I will introduce a brief summary for a basic two-period overlapping generations model (OLG). In the second part of this chapter, the extensions of the model will be outlined and the theoretical model would be constructed to analyze the impacts of the tax system in Turkey in the light of information given in chapters 2 and 3.

4.1. Basic Two-Period Overlapping Generations Model

In this part of the chapter, I will introduce a basic two-period overlapping generations model with consumption, labor income and capital income taxation. The model includes a representative agent who lives for two periods. There is a government who collects taxes to finance its expenditure.

4.1.1. Households

Each individual in the model lives for 2 periods. Consumer born at time t lives for period t and t+1. Therefore, in each period, two individuals are living in the model. So, problem of the consumer born at time t is to maximize lifetime utility by choosing how much to consume in each period and how much to save for the next period. Individuals have the following lifetime utility function:

$$U(t) = \frac{c_{1,t}^{1-\theta}}{1-\theta} + \beta \frac{c_{2,t+1}^{1-\theta}}{1-\theta} \tag{4.1}$$

where $c_{1,t}$ represents the consumption of the individual born at time when young and $c_{2,t+1}$ denotes the consumption of the individual when old. Moreover, the term β is the discount factor which shows the time preference rate between two periods. The parameter θ which measures the relative risk aversion of the individual is the inverse of intertemporal elasticity of substitution. For the simplification of this part, I will assume that the parameter θ equals to one and the utility function is as follows:

$$U(t) = lnc_{1,t} + \beta lnc_{2,t+1} \tag{4.2}$$

Individuals work only in the first period of their lives and supply inelastically one unit of labor and earn an equilibrium wage income (w_t). Individual who faces labor income taxation and consumption taxation uses net wage income to afford the young-age consumption and decide how much to save for the next period. So, the budget constraint of the young individual is the following:

$$(1 + \tau_{c,t})c_{1,t} + s_{1,t} \leq (1 - \tau_{w,t})w_t \tag{4.3}$$

where $s_{1,t}$ is the saving of the individual for the next period, w_t is wage income and $\tau_{c,t}$ and $\tau_{w,t}$ are consumption tax and labour income tax rate that has been levied on individuals by government respectively.

Old individuals rent their savings, determined at time t, as capital to firms at time t+1 and receive interest income from their savings. This income is used to finance old-age consumption. Hence, the budget constraint of old-age individual who faces capital income taxation and consumption taxation is the following:

$$(1 + \tau_{c,t+1})c_{2,t+1} \leq \left(1 + r_{t+1}(1 - \tau_{k,t+1})\right)s_{1,t} \tag{4.4}$$

where r_{t+1} and $\tau_{k,t+1}$ are the market interest rate and capital income tax rate at time t+1, respectively.

Therefore, the individual's optimization problem is the following:

$$\underset{c_{1,t}, c_{2,t+1}, s_{1,t}}{max} U(t) = lnc_{1,t} + \beta lnc_{2,t+1}$$

$$\text{subject to} \quad (1 + \tau_{c,t})c_{1,t} + s_{1,t} \leq (1 - \tau_{w,t})w_t$$

$$(1 + \tau_{c,t+1})c_{2,t+1} \leq \left(1 + r_{t+1}(1 - \tau_{k,t+1})\right)s_{1,t}$$

$$c_{1,t}, c_{2,t+1}, s_{1,t} \quad \geq 0 \tag{4.5}$$

Taking first derivatives of individual's utility function with respect to $c_{1,t}$ and $c_{2,t+1}$ yields the following Euler equation:

$$c_{2,t+1} = \frac{\beta\left(1 + r_{t+1}(1 - \tau_{k,t+1})\right)(1 + \tau_{c,t})}{(1 + \tau_{c,t+1})} c_{1,t} \tag{4.6}$$

Using budget constraints and the Euler condition, the following equations can be obtained for young-age, old-age consumptions and savings in terms of wage income:

$$c_{1,t} = \frac{1}{(1+\beta)(1+\tau_{c,t})}\left[(1 - \tau_{w,t})w_t\right] \tag{4.7}$$

$$c_{2,t+1} = \frac{\beta\left(1 + r_{t+1}(1 - \tau_{k,t+1})\right)}{(1+\beta)(1+\tau_{c,t+1})}\left[(1 - \tau_{w,t})w_t\right] \tag{4.8}$$

$$s_{1,t} = \frac{\beta}{(1+\beta)}\left[(1 - \tau_{w,t})w_t\right] \tag{4.9}$$

Consumption of young depends on time preference rate, wage income, labor income and consumption tax rates. On the other hand, consumption of old does not only depend on the parameters that affect the consumption of young, but it also depends on capital income tax rate in the second period, at date t+1. Due to a simplifying assumption, savings only depend on labor income tax rate, time preference rate and wage income. As the equations above suggest consumptions of old and young and savings increase with wage income. Moreover, if the labor income tax rate increases, saving, consumption of both the young and the old decreases. Increasing the consumption tax rate in the first period, it only causes a decrease in young-age consumption. However, increasing the capital income tax rate only causes to a decrease in old-age consumption while leaving saving and young-age consumption unchanged.

4.1.2. Production

There is a representative firm which produces under a perfect competition environment and aims to maximize its profit. The representative firm uses capital and

labor as inputs to make production which takes place through constant returns to scale Cobb-Douglas technology. Hence, the functional form of the production function is as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{4.10}$$

where A_t represents the technology, K_t stands for capital and L_t stands for labor. Technology is assumed to be constant and equals to A. Also, capital is assumed to depreciate at a constant rate δ. Given this framework, the representative firm's profit maximization problem subject to capital and labor yields the following two first order conditions:

$$r_t = \alpha A K_t^{\alpha-1} L_t^{1-\alpha} - \delta \tag{4.11}$$

$$w_t = (1-\alpha) A K_t^{\alpha} L_t^{-\alpha} \tag{4.12}$$

4.1.3. Government

Main purpose of the government in this basic model is to collect tax revenues to finance its expenditures. Government levies taxes on capital income, labor income and consumption in order to gain revenues. Moreover, we assume that government expenditures do not increase the utility of the individuals. In each period, government runs a balanced budget. Hence, the government budget constraint is the following:

$$G_t = \tau_{k,t} r_t s_{1,t} + \tau_{c,t} c_{1,t} + \tau_{c,t} c_{2,t} + \tau_{w,t} s w_t \tag{4.13}$$

4.2. Extensions and the OLG Model for Turkish Tax System

In this part, some extensions will be augmented to the basic model in order to represent the basic characteristics of the Turkish economy and Turkish Tax System. Since a two-period model is not adequate, we extend the demographic structure and adopt a 55 period model following Auerbach and Kotlikoff (1987). We assume that the individuals enter the economy after age 20 and lives till age 75. Hence, each model age exhibits one calendar year. Since different labor income tax rates applied to different income level individuals, individuals are distinguished by having different productivity profiles (suggesting different income levels) over age and

referred to as income types, low, middle and high. Hence, we formulate the model around three types of representative agents with different income levels.

In the model, we allow labor to be endogenous. Thus, individuals get utility from leisure and they make annual decision about how much to consume, how much to work in order to maximize their lifetime utility function.

Given the framework of a two-period OLG model and extensions, the model is constructed in the following part.

4.2.1. Households

I extend the household sector of Kotlikoff et al. (1983) model by incorporating three different types of households. Household sector is populated with overlapping generations of heterogeneous household distinguished by age (i.e. generations aged from 20 to 75 years) and their earning ability types, low, middle and high. 165 households live at any given time. Following Kotlikoff et. al. (2001), the population is normalized to one and the fraction of each type of households in population is determined in terms of the income level. Also, life-time uncertainty is not considered in the model. Households in the model do not leave bequests and receive no inheritances. Also, households in the model can choose how much to work and when to retire. Within this framework, households make annual decisions about how much to consume, how much to save and hours of work in order to maximize their lifetime utility.

Household's utility function is assumed to be additive, time separable and constant elasticity of substitution. Instantaneous utility function for each type household takes the following form:

$$u_t^i = [(c_t^i)^{1-\frac{1}{\rho}} + \alpha(l_t^i)^{1-\frac{1}{\rho}}]^{1/(1-\frac{1}{\rho})} \tag{1}$$

Assuming time separability, the lifetime utility function for each type of households at time t can be represented as follows:

$$U_t^i = 1/(1-\frac{1}{\gamma}) \sum_{t=1}^{55}(1+\delta)^{-(t-1)}(u_t^i)^{(1-\frac{1}{\gamma})} \tag{2}$$

where c_t^i and l_t^i are the consumption and leisure of type i household at time t. The parameter ρ shows how responsive an individual's annual labor supply is to that year's wage rate. It also represents the elasticity of substitution between c_t and l_t. The parameter α shows the intensity of household preferences for leisure. The larger value of α would result in household to supply less labour and prefer a greater amount of leisure. The term δ represents the time preference rate. On the other hand, the taste parameter γ shows the household's elasticities of substitution between consumption (or leisure) in different periods.

Households decide how much to consume (or save) and how much to work at each time. Since households have lifetime horizon, they decide the path for consumption and labor over time that maximizes lifetime utility function subject to budget constraint. Moreover, government levies proportional labor income tax for each income group, capital income tax and consumption tax. Households decide how much to work in each period and earn a wage income. Since it is a closed economy, households loan their savings determined at each time as capital to firms and receive interest income from their savings. Given this framework, the budget constraint belongs to each type of households is:

$$a_{s+1,t+1}^i = \left(1 + r_t\left(1 - \tau_{k,t}\right)\right)a_{s,t}^i + \left(1 - \tau_{w,t}^i\right)w_{s,t}e_{s,t}^i n_{s,t}^i - \left(1 + \tau_{c,t}\right)c_{s,t}^i \qquad (3)$$

where r_t is the pretax returns to savings at time t, $w_{s,t}e_{s,t}^i$ and $n_{s,t}^i$ are the hourly wage and labor supply for each type of households at time t, respectively. The term $e_{s,t}^i$ is the age-specific earnings ability variable for each income level and the term $w_{s,t}$ is the aggregate wage at time t.

The age-specific earnings ability profile is an exogenous function of experience which is taken as equal to age of household, and square of experience and it differs across three types of households. The earnings ability e_s^i is taken as $e_s^i = \varepsilon^i \overline{e_s^i}$ where $\overline{e_s^i}$ is normalized efficiency variable for each income group i at age s and ε^i is the shifting parameter for each type of household in term of the income level. Therefore, wage rate for a household of type i and age s is defined as $w_{s,t}^i = w_t e_s^i$, where w_t is the aggregate wage rate at time t.

We also need to impose the required restriction that labor supply cannot be negative. In other words, if the leisure exceeds one, the household must retire for that period and supplying zero labor. The inequality constraint for leisure of each type of household should be as follows:

$$l_t^i \leq 1 \text{ for } t=1, 2,\ldots,55 \text{ and } i=1, 2, 3 \qquad (4)$$

In addition to the budget constraint and the inequality constraint for leisure, households enter the economy without asset stock and do not leave any assets after dying (in terms of bequests for example). Hence, the following constraint should be imposed:

$$a_{56,t}^i = a_{1,t}^i = 0 \text{ for all } t \text{ and } i=1, 2, 3 \qquad (5)$$

The household type i's optimization problem according to the given framework above is the following:

$$\max_{c_{s,t}^i, l_{s,t}^i} U_t^i = 1/(1 - \frac{1}{\gamma}) \sum_{t=1}^{55}(1 + \delta)^{-(t-1)}(u_t^i)^{(1-\frac{1}{\gamma})} \qquad (2)$$

$$\text{s.t.} \quad a_{s+1,t+1}^i = \left(1 + r_t(1 - \tau_k)\right)a_{s,t}^i + \left(1 - \tau_w^i\right)w_{s,t}e_{s,t}^i n_{s,t}^i \qquad (3)$$

$$-(1 + \tau_c)c_{s,t}^i \quad \text{for } t=1,2,3,\ldots,55 \text{ and } i=1,2,3$$

$$l_t^i \leq 1 \qquad (4)$$

$$a_{56,t}^i = a_{1,t}^i \qquad (5)$$

Taking the first derivative of this maximization problem with respect to consumption and leisure yield the following two Euler equations:

$$l_t^i = (\frac{w_t^{i*}}{\alpha(1+\tau_c)})^{-\rho}c_t^i \qquad (6)$$

$$c_{t+1}^i = (\frac{1+r_t(1-\tau_k)}{1+\delta})^\gamma \left(\frac{v_{t+1}^i}{v_t^i}\right)c_t^i \qquad (7)$$

where:

$$w_t^{i*} = w_t e_t^i(1 - \tau_w^i) \qquad (8)$$

$$v_t^i = [1 + a^\rho (\frac{w_t^{i^*}}{(1+\tau_c)})^{(1-\rho)}]^{(\frac{\rho-\gamma}{1-\rho})} \qquad (9)$$

The equation (8) shows the effective wage for each type of household is equal to the net marginal wage per unit of leisure forgone. The equation (6) represents the relation between consumption and leisure at each time t. It also provides evidence how the terms a and ρ affect the labor-leisure tradeoff. Keeping ρ constant, an increase in a yields an increase in l_t^i/c_t^i. On the other hand, if a is kept constant, the percentage change in l_t^i/c_t^i with respect to a change in effective wage is equal to ρ.

Using the equations (6) and (7), one can easily obtain the transition equation for leisure of each income type household:

$$l_{t+1}^i = (\frac{1+r_t(1-\tau_k)}{1+\delta})^\gamma \left(\frac{v_{t+1}^i}{v_t^i}\right) (\frac{w_{t+1}^{i^*}}{w_t^{i^*}})^{-\rho} l_t^i \qquad (10)$$

The equation (10) exhibits that the net marginal wage in period t affects positively l_{t+1}^i/l_t^i. On the other hand it is negatively related to the net marginal wage in period t+1. Equations (7) and (10) determine the choices of consumption and leisure sequences.

4.2.2. Production Sector

The production sector consists of one firm which represents a large number of perfectly competitive firms. The aggregate production technology is in Cobb-Douglas form which displays constant returns to scale and uses capital and labor to produce output. Due to the assumption of closed economy and constant debt stock, total effective physical capital during period t is:

$$K_t = \sum_{i=1}^3 \emptyset^i \sum_{s=1}^{55} a_{t+s-1}^i/T - D_t \qquad (11)$$

where D_t represents the government debt stock at each time t and $\emptyset^i$ shows the fraction of each type of household in population and T=55.

Aggregate total effective labor during period t is as follows:

$$L_t = \sum_{i=1}^3 \emptyset^i \sum_{s=1}^{55} e_s^i ((1 - l_{s,t+1-s}^i)/T) \qquad (12)$$

Since there is a standard Cobb-Douglas aggregate production function, the output is:

$$Y_t = AK_t^\theta L_t^{1-\theta} \tag{13}$$

where Y_t is real GDP and θ is share of capital in production. Technology is assumed to be constant and it is assumed that there is depreciation of capital.

Given this framework, representative firm's profit maximization problem yields the following two equations for the rate of return of capital and wage rate respectively:

$$r_t = \theta AK_t^{\theta-1} L_t^{1-\theta} - del \tag{14}$$

$$w_t = (1-\theta)AK_t^\theta L_t^{-\theta} \tag{15}$$

where del is the rate of capital depreciation.

4.2.3. Government Sector

The government in this model collects tax revenues by taxing capital income, wage income and consumption to finance its expenditures. Government consumption is assumed to be unproductive and generate no utility to households. Although not all the government consumption needs to be unproductive in real life we assume it this way for model simplicity. Furthermore, government can issue one-period debt, which is a perfect substitute for capital in household portfolios, to help finance its' current consumption. Government tax revenue at the end of year t (TR_t) given D_t as government debt is:

$$TR_t = r_t(K_t + D_t)\tau_{k,t} + \tau_{c,t}C_t + \sum_{i=1}^{3} \tau_{w,t}^i w_t L_t^i \tag{16}$$

Given this framework, government balanced budget constraint for each period is as follows:

$$G_t + D_t r_t = K_t r_t \tau_{k,t} + D_t r_t \tau_{k,t} + C_t \tau_{c,t} + \sum_{i=1}^{3} L_t^i w_t \tau_{w,t}^i$$

$$+D_{t+1} - D_t \tag{17}$$

Moreover, we assume that the government faces a fiscal adjustment restriction under which the debt stock cannot increase i.e. $D_{t+1} = D_t$. Under this constraint, government balanced budget constraint in each period is the following:

$$G_t = TR_t - r_t D_t \tag{18}$$

Equation 18 shows that a change in tax revenues due to change in tax rates, the change needs to be offset by an equal change in government expenditure.

4.2.4. Equilibrium under perfect foresight

An equilibrium consists of sequences of consumption choices, labour choices, asset stock choices and factor of production demands such that

i) Given wage rate w_t, interest rate r_t and tax rates $(\tau_{k,t}, \tau_{w,t}^i, \tau_{c,t})$, each type of households chooses consumption sequence $\{c_{s,t+s-1}^i\}_{s=1}^{55}$, labour sequence $\{n_{s,t+s-1}^i\}_{s=1}^{55}$ and asset stock sequence $\{a_{s,t+s-1}^i\}_{s=1}^{55}$ so that lifetime utility (2) is maximized subject to budget constraints (3, 4, 5).

ii) Given factor prices w_t and r_t firm demands capital K_t and labour L_t at each year t so as to maximize profits.

iii) Government budget (18) is balanced at each year t.

iv) Asset market clears at each year t.

v) Labor market clears at each year t.

vi) The goods market clears at each year t.

CHAPTER 5

CALIBRATION AND SIMULATION RESULTS

In the previous chapter, we constructed the model to analyze the Turkish Tax System. In the first part of this chapter, the solution method of the model will be defined. Next, calibration and model parameterization will be explained. After completing the calibration and parameterization, the simulation results for initial steady state before tax reform, final steady state and transition path of the proposed tax reform are given and analyzed.

5.1. Solution of the Model:

The solution of the model begins with a determination of initial steady state. After the adoption of new policy, the final steady state of the economy is solved. Finally, economy's transition path from initial steady state to the final steady state is computed. The Matlab software applying Gauss-Seidel method is used to solve these three steps. The iteration techniques start with guesses for some of the endogenous variables and iteration gives the new solutions to update the guessed variables by the combination of the new and previous variables. This procedure is repeated until the convergence holds.

The solution for the initial steady state of the model begins with guesses of aggregate capital stock, aggregate labor supply to obtain the market clearing interest and wage rates by solving the production side of the model. Given tax rates for consumption, capital and labor incomes and combining them with wage and interest rates, the household optimization problem can be solved. By solving each household's

problem, the life cycle decisions of asset, consumption and labor supply for each household are obtained. So, we calculate the new values for aggregate capital stock and labor supply and they are used to update the initial guesses. The steady state has been solved when the initial and the final solution for the guessed variables are equal to each other.

The final or the new steady state of the economy after the adaptation of the new policy can be solved either with the method that we used to solve the initial steady state or together with transition path.

Solution of the transition path from initial steady state to final is more complicated since the conditions of the economy changes over time. Furthermore, equilibrium in transition years should be solved simultaneously since the wage and interest rates, capital stock and labor supply affect the households' decisions. We solve this problem by assuming that the economy reach the new equilibrium after 150 years following Auerbach and Kotlikoff (1987). In other words, all prices are constant after 150 years. We begin with guesses of capital stock (K) and labor supply (L) for each of the 150 transition years. The wage and interest rates for each transition year are calculated based on these initial guesses. The iteration technique is similar to the method used for initial steady state. However, the difference between solving the transition path and initial steady state is that households lived before the policy adoption should be considered differently. Following Kotlikoff and Auerbach (1983), we should consider them as they are born again and they will be treated as the members of new generations but their lifespan is less than 55 years and since they have made decisions on consumption and labor supply based on prior policy before, they hold initial assets at the time of policy change.

5.2. Model Parameterization and Calibration

In this section, we calibrated the model to match the variables of the 2009 financial year. The tax rates used for initial steady state are taken as the standard levels that the government applied in 2009.

5.2.1. Earnings-Ability Profiles

Auerbach et al. (2008) and Kotlikoff et al. (2001) use the following form for the age-specific earnings ability profile in their study which is estimated by Welch (1979). The earnings of the high school graduates through their life-time depend on experience and square of experience.

$$\epsilon_t = e^{\beta_0 + \beta_1 t + \beta_2 t^2}$$

where t demonstrates the number of the years of experience. Moreover, Fehr et al. (2008) use the shifting parameters to derive the income-class specified profiles for low, middle and high income households. Since, our model includes three different income level classes, the following age-earnings ability profiles for the each household is estimated:

$$\epsilon_t^i = e^i * e^{\beta_0 + \beta_1 t + \beta_2 t^2}$$

where e^i is the shifting parameter for the agent i. The coefficients of the age-earnings ability profile has been utilized from Bircan and Tansel (2010). After controlling for years of schooling, cohort effect, and other specified variables, authors find that the values for α, β_1, β_2 equals to 4.551, 0.044 and -0.001, respectively. These results are used in calibration. Following Kudrna and Alan (2010), we assume that three income groups have different years of schooling. The low income households have generally primary school education or lower level of education. The middle income households are assumed to have high school education. Finally, the high income households are assumed to have university education. According to the statistics of Turkish Statistical Institution the annual gross earnings of employees worked and paid for the whole year by education attainment, university graduates earn almost 4 times of primary school graduates. So, we normalize the age-earning ability profile according to middle income class and the shifting parameters for low, middle and high income classes are taken as 0.5, 1 and 2, respectively.

5.2.2. Calibration and Preference Parameters

We select the real macroeconomic variables, capital-output ratio (K/Y), consumption rate (C/Y), savings rate (S/Y), investments rate (I/Y) and interest rate which are

generally used in Computable General Equilibrium (CGE) analysis. We utilize the statistics for 2009 financial year to determine values of given macroeconomic variables. The consumption rate is taken as the portion of GDP consumed by households and this value is equal to 68.59 percent. The saving rate is taken as the ratio of gross domestic savings to gross domestic product and it is equal to 12.76 percent. Furthermore, the investment rate is taken from IMF database and total investment rate equals to 14.93 percent. The interest rate equals to 12.40 percent for 2009 year according to State Planning Organization (SPO) statistics.

The tax burden, government domestic debt stock and general government non interest expenditures are taken as fiscal aggregates. The tax revenue to GDP ratio is taken from SPO and the rate equals to 27.2 percent for Turkey in 2009. The domestic debt stock rate of the government for 2009 equals to 0.346 of GDP according to the SPO database. The rate of general government non interest expenditures is obtained from State Planning Organization of Turkey and it is equal to 22.2 percent. The tax rates are the actual tax rates in Turkey and are given in the Turkish Tax System part in chapter 3.

The depreciation rate for Turkey is computed by Çiçek and Elgin (2010) and authors estimate it approximately 5 percent. We take depreciation rate to be equal to approximately 5 percent in Turkey. The preference parameters $(\alpha, \delta, \gamma, \rho)$ are chosen to match the macroeconomic variables of Turkish economy in 2009. The following table, Table 5.1, represents the final parameterization.

Table 5.1- Benchmark Parameter Definitions and Values

Symbol	Definition	Value
ρ	Elasticity of substitution between leisure and consumption	1.5
α	Utility weight on leisure	1.5
γ	Intertemporal elasticity of substitution	0.3
δ	Rate of time preference rate	0.015
A	Technology parameter	1
θ	Capital share	0.55
ϵ_t^i	Earnings Ability Profiles $$\epsilon_t^i = e^i * e^{\beta_0 + \beta_1 t + \beta_2 t^2}$$	$e^1/e^2/e^{3^*}$ $\beta_0/\beta_1/\beta_2$ 0.5/1/2 4.551/0.044/-0.001
$\emptyset^i$	Fraction of households of income class	0.4/0.5/0.1
Del	Depreciation rate	0.05
Policy Parameters (in percent)		
τ_c	Consumption tax rate	18
τ_k	Capital income tax rate	10
τ_w^i	Labor income tax rate	20/27/35

Note: e^1, e^2, e^3 are shifting parameters for low, middle and high income individuals, respectively.

5.3. Simulation Results

In this part of the chapter, the results for initial, final steady states and transition path will be exhibited. Given the parameterization above, the equilibrium for initial steady state is computed based on the tax policy settings in 2009. After computing initial steady state, final steady state and transition path for the proposed tax system experiment are computed. Macroeconomic variables belong to final steady state is analyzed and it is compared with the initial state results.

5.3.1. Initial Steady State

The initial tax structures of the economy with 46 percent debt stock are used to compute the initial equilibrium for the economy. The simulation results are shown in Table 5.2. The model estimation results match the most of the real macroeconomic variables of the Turkish economy for 2009 except consumption. The reason behind this might be due to the fact that our model is constructed for a closed economy and the data for consumption do not only include the consumption of domestic goods but also includes the consumption of imported goods. The simulation results show that the ratio of capital stock to GDP equals to 2.98. Moreover, the equilibrium interest and average wage rates equal to 13.45 percent and 1.71, respectively.

Table 5.1: Initial Steady State (In percent of GDP)

Variables	Model	Turkey
Consumption	61.20	68.59
Investment	14.90	14.93
Savings	10.25	12.76
Interest rate	13.45	12.40
Tax Revenue	27.86	27.20
Government expenditure	23.21	22.20
Debt	34.60	34.60
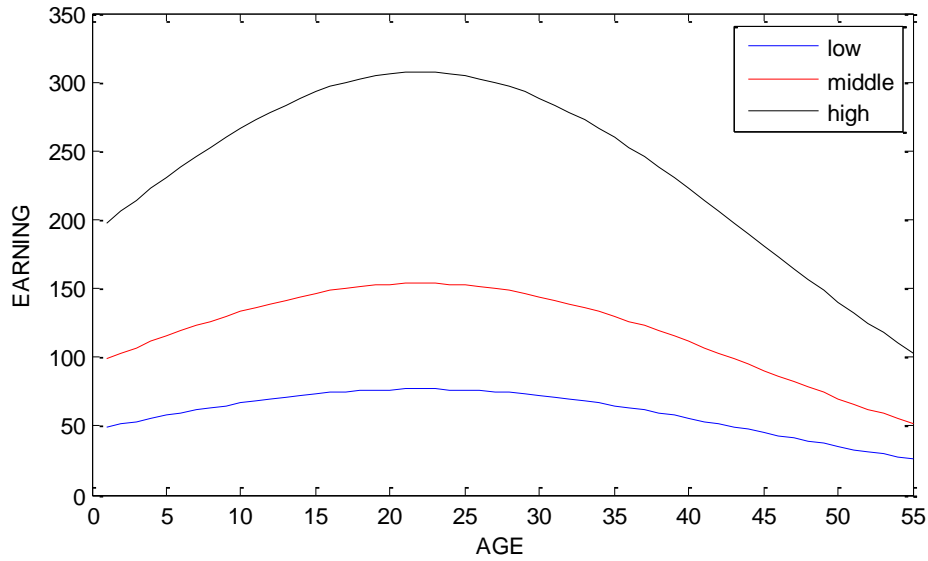
Figure 5.1: Age-Earnings Profiles

After analayzing the aggregate results of macroeconomic variables, the behaviours of the households will be compared with each other. Figure 5.1 exhibits the results of age-earnings profiles for each type of households and the results show that the earnings of each type of household get its top level when they are 40 years old and earnings begin to decrease after this age. This drop becomes more rapid after age 50 due to low labor supply and decreases in wages.

As we expected, Figure 5.2 shows that high income households hold larger amount of asset stock than the middle and low income groups while the lowest level of asset stocks is hold by low income households. The reason of this result is that the high income groups have much more income than other groups to allocate for both consumption and savings. As we can see from Figure 5.2, asset stocks take its highest value for each type of household at age 65.
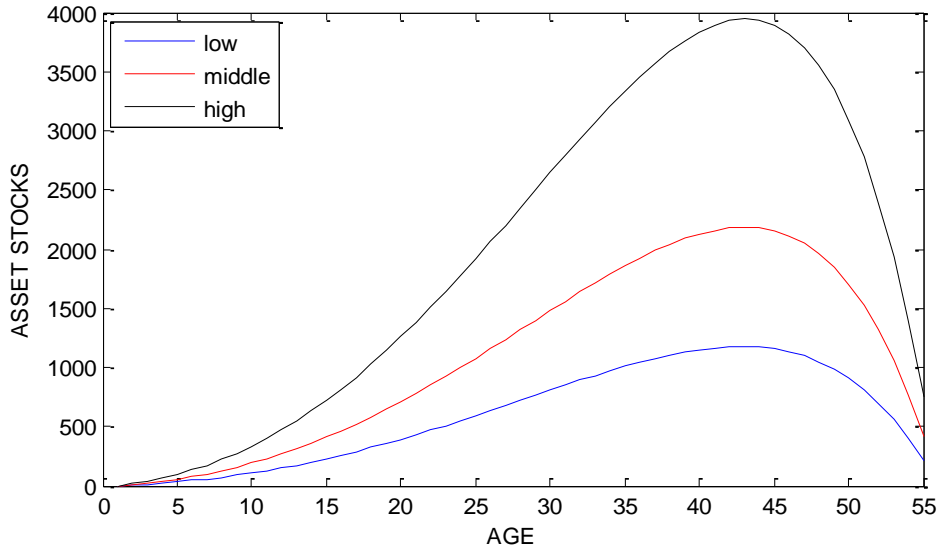
Figure 5.2: Asset Stocks Decisions
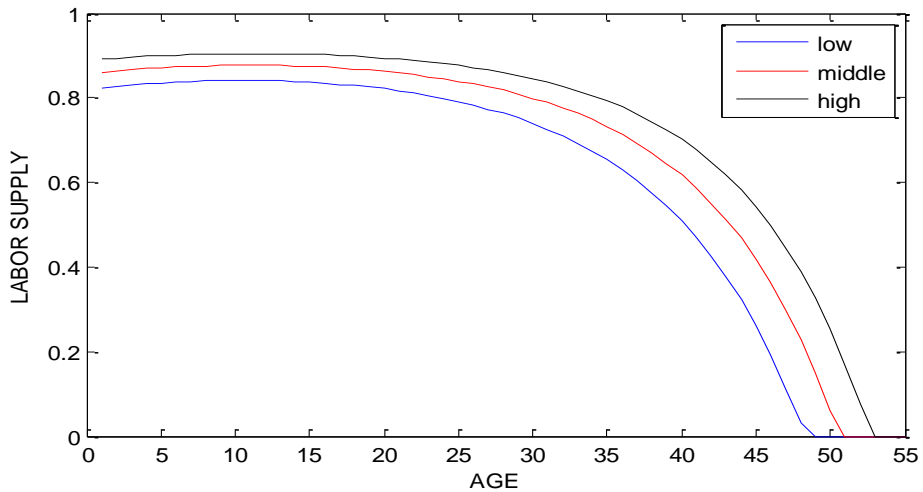
Figure 5.3: Labor Supply Decisions

Labor supplied by each household is represented in Figure 5.3. The aggregate labor supply equals to 1.4675. Both the middle and high income individuals supply higher level of labor than the low income individuals since these agents begin the economy with no initial asset and these two groups earn the highest level of wage for each labor supply then the low income agents. Since they begin with no initial asset, these agents supply higher labor during the first 20 years of their life because earnings ability of agents increases in the early years of their life. Moreover, Figure 5.2 shows that high income households retire at age 72 while the low and middle income

households retire at age 68 and 70, respectively. Both high income and middle income households retire after the low income individuals because the opportunity cost of leisure is still high for them.
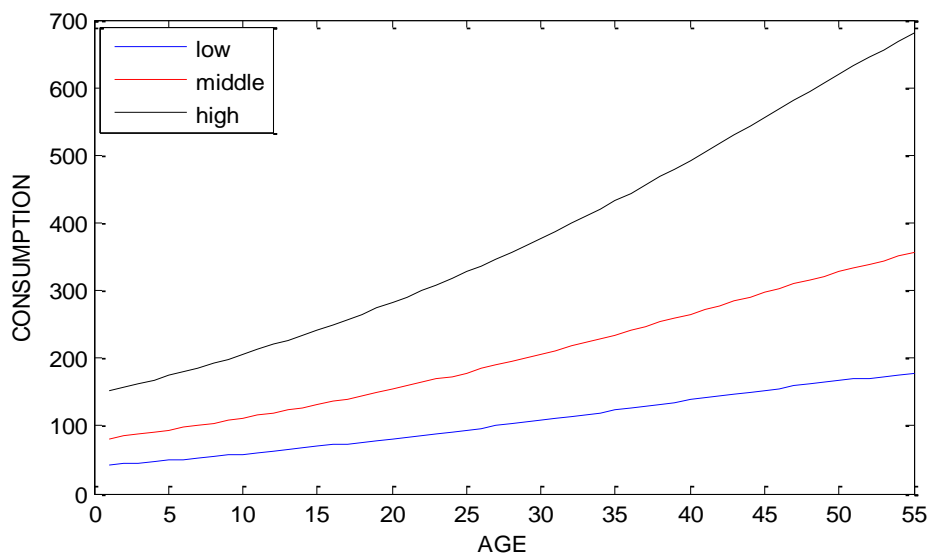
Figure 5-4: Consumption Decisions

Lastly, the life-time consumption decision of each income group and the results are exhibited in Figure 5.4. As we can see the graph above, consumption begins with its lowest level at earlier age for all income groups but the consumption of high income group is higher than the other two groups as expected. The reason for this is that the high income group earns higher amount for each unit of labor than the others and has more resources to allocate for both consumption and saving. The consumption increases through the life-time for all groups and reaches its highest level at the last year of their life.

5.3.2. Final Steady State

After analyzing the results of the initial steady state, in this part of the chapter, we propose an alternative tax system and evaluate the simulation results with the initial steady state. Consumption taxes are quite high in Turkey compared to other OECD countries. The Turkish government cannot collect the direct taxes due to large size of informal sector. Hence, the government has more emphasis on indirect taxes. Therefore, the proposed tax reform recommends to decrease the VAT rate from 18

percent to 15 which is applied in 2000's and increase the top statutory income tax from 35 percent to 40 percent. 40 percent is the average income tax rate for high income households in the OECD countries. The main aim of this recommendation is to observe the effect of it on social welfare and analyze the distributive impact of the tax reform.

Given the parameterization and the recommended tax reform, the steady state of the economy is computed and the results are given in Table 5.3 in comparison to the initial steady state. As we can see in Table 5.3, most of the variables decrease except consumption, debt stock and the interest rate. The aggregate asset stocks decreases since the labor income tax of high income group increases which leads a decline in the resources that this group allocates to savings and consumption.

Table 5.2: Final Steady State after Tax Reform

Variables	Initial S.S.	Final S.S.
K/Y	2.9808	2.962
L (Labor Supply)	78.3974	78.235
C/Y	0.612	0.6246
S/Y	10.25	0.1007
I/Y	14.9	0.1481
G/Y	23.21	0.2201
D/Y	34.6	0.3494
TR/Y	27.86	0.2676
Y	297.8811	294.9691
R	13.45	0.1357
W	1.7098	1.6966

Figure 5.5 represents the asset stock decisions of each income group before and after tax reform. The results show that the asset stocks hold by the high income group decreases whereas there is slightly increase in asset stocks hold by low and middle

income groups. The decline in asset stocks of high income agent dominates the increase in asset stocks of both low and middle income agents.
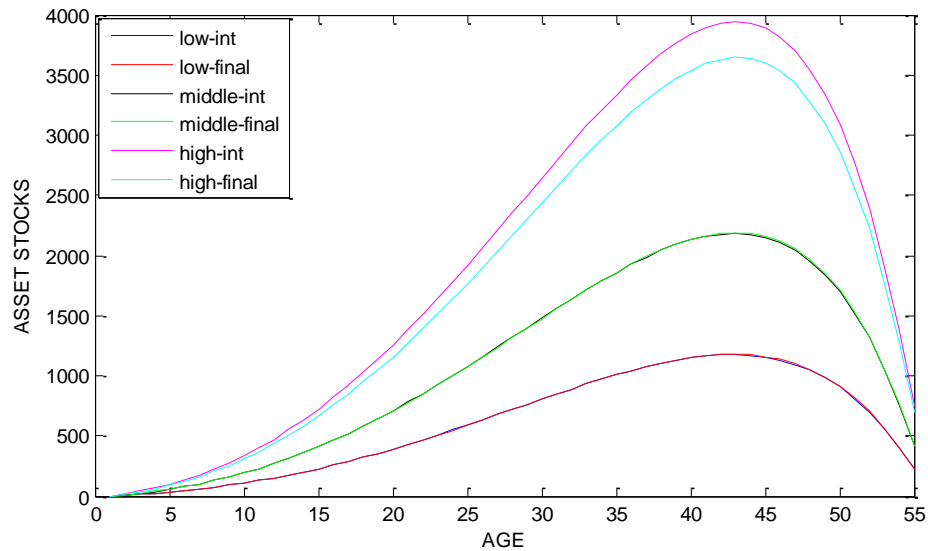
Figure 5-5: Asset stock decisions before and after the tax reform
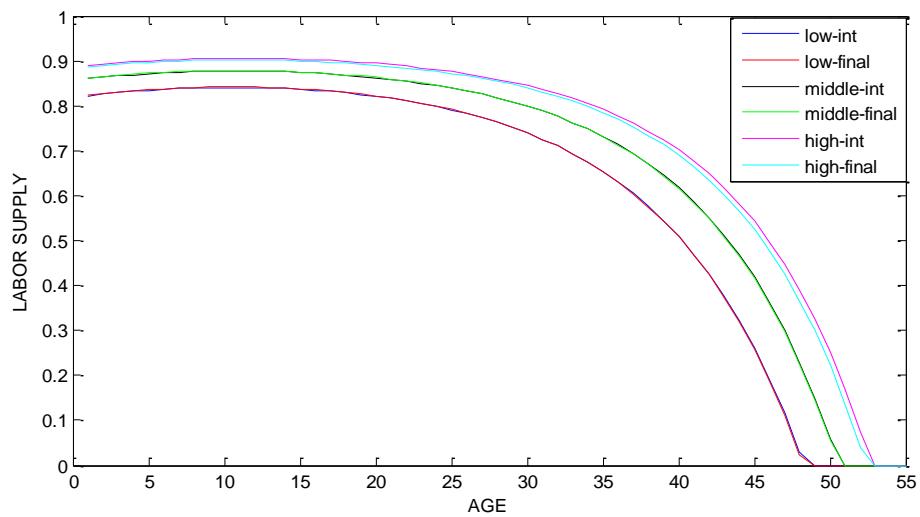
Figure 5-6: Labor supply decisions before and after the tax reform

As we can see from Figure 5.6 above, labor supplied by all agents slightly decreases after the tax reform**.** The reason of the decline in the labor supply is that agents do not have to work much to afford their initial consumption level since the consumption tax rate decreases. Therefore, consumption is cheaper now. In other

words, income effect which causes labor supply to decrease dominates the substitution effect which causes an increase in the labor supply. Moreover, both high income and middle income households still retire after the low income individuals and the age of retirement for each type of households does not change.
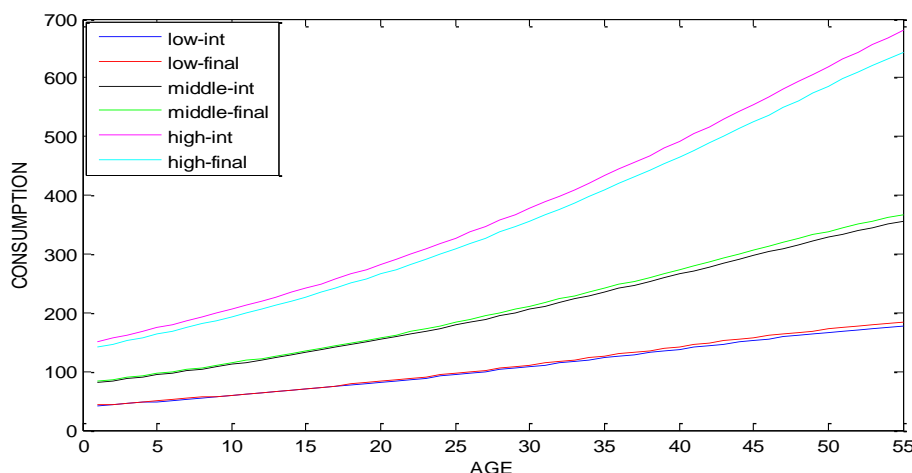
Figure 5-7: Consumption decisions before and after the tax reform

Figure 5.7 shows the life-time consumption decisions of all groups for both initial and final steady states. The aggregate consumption increases in the final steady state compare to the value of the initial steady state. Moreover, it is easily seen that consumptions of low and middle income groups increase while consumption of high income agents decreases. This means that the increase in consumptions of low and middle groups dominates the decrease in consumption of high income class. The reason of this is that the level of labor income tax rate changes only for the high income class while it remains constant for other two groups. In terms of welfare analysis, the low and middle income individuals are the winners while the high income individuals are the losers.

5.3.3. Transition Path

In the former part of this chapter, we analyzed the final effect of the proposed tax reform on various macroeconomic variables. In this part, we investigate how the economy transit from the initial steady state to the final steady state. The effects of the proposed tax reform on the macroeconomic variables through time will be analyzed. As we introduced the final changes of variables in the former part, almost

all macroeconomic variables except interest rate, consumption rate and debt stock rate decrease eventually.

The macroeconomic effects of the tax reform on the real variables through transition path are given in Table 5.4. As we can see, GDP falls by 0.05 percent immediately and 1 percent ultimately. In the short run, increase in capital-labor ratio causes a short-run decrease in the interest rate and a short-run increase in wage rate. The long-run decrease in capital-labor ratio results in the opposite effects on interest and wage rates. Moreover, consumption rate increases in the short-run but it decreases in the long-run.

First, we will evaluate the change of capital stock from initial equilibrium to the final equilibrium. The change of aggregate capital stock through time is presented in Figure 5.8. It is easily observed that the aggregate capital stock converges and reach to a new equilibrium after 75 periods. In other words, if the Turkish government adopts tax reform at 2009, Turkey's economy would have reached the new steady state at 2084. When we analyze the asset stock decisions of each type of household, the low and middle income households increase their level of asset stock through transition path. Figures 5.23 and 5.24 in appendix represent the decisions of low and middle income classes on asset stocks, respectively. However, Figure 5.25 in appendix part shows that the asset stocks hold by high income class decrease through time. The fall in asset stocks of high income group dominates the rise in asset stocks of low and middle income groups.

Table 5.4. Macroeconomic Effects-Summary of Selected Variables

Number of Years after reform	0	1	2	3	4	5	6	7	8	9	10	50	100	150
Composition of GDP [1]														
Consumption	0.6120	0.6250	0.6250	0.6250	0.6250	0.6250	0.6250	0.6251	0.6251	0.6251	0.6251	0.6246	0.6246	0.6246
Investment	0.1483	0.1491	0.1491	0.1491	0.1490	0.1490	0.1490	0.1489	0.1489	0.1489	0.1488	0.1482	0.1481	0.1481
Savings	0.1108	0.1026	0.1025	0.1025	0.1024	0.1023	0.1023	0.1022	0.1022	0.1021	0.1021	0.1009	0.1007	0.1007
Government Expenditures	0.2774	0.2207	0.2207	0.2207	0.2207	0.2207	0.2206	0.2206	0.2206	0.2206	0.2206	0.2202	0.2201	0.2201
Tax Revenues	0.3149	0.2673	0.2673	0.2673	0.2673	0.2673	0.2673	0.2673	0.2673	0.2674	0.2674	0.2675	0.2676	0.2676
Debt Stock	0.346	0.3462	0.3463	0.3464	0.3465	0.3466	0.3467	0.3468	0.3469	0.3470	0.3471	0.3491	0.3494	0.3494
Real Variables [2]														
GDP	1.000	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.991	0.990	0.990
Capital	1.000	1.000	0.999	0.999	0.998	0.998	0.997	0.997	0.996	0.996	0.995	0.986	0.984	0.984
Labor	1.000	0.999	0.999	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.998	0.998	0.998
Consumption	1.000	1.021	1.020	1.020	1.020	1.019	1.019	1.019	1.018	1.018	1.018	1.012	1.011	1.011
Savings	1.000	1.000	0.999	0.998	0.998	0.997	0.996	0.995	0.994	0.993	0.992	0.976	0.973	0.973
Wages	1.000	1.001	1.000	1.000	1.000	1.000	0.999	0.999	0.999	0.999	0.998	0.993	0.992	0.992
Interest Rates	1.000	0.999	1.000	1.000	1.000	1.000	1.001	1.001	1.001	1.002	1.002	1.008	1.009	1.009

Notes: [1]- Selected Variables as percentage of GDP

[2]- Normalized by initial steady-state values
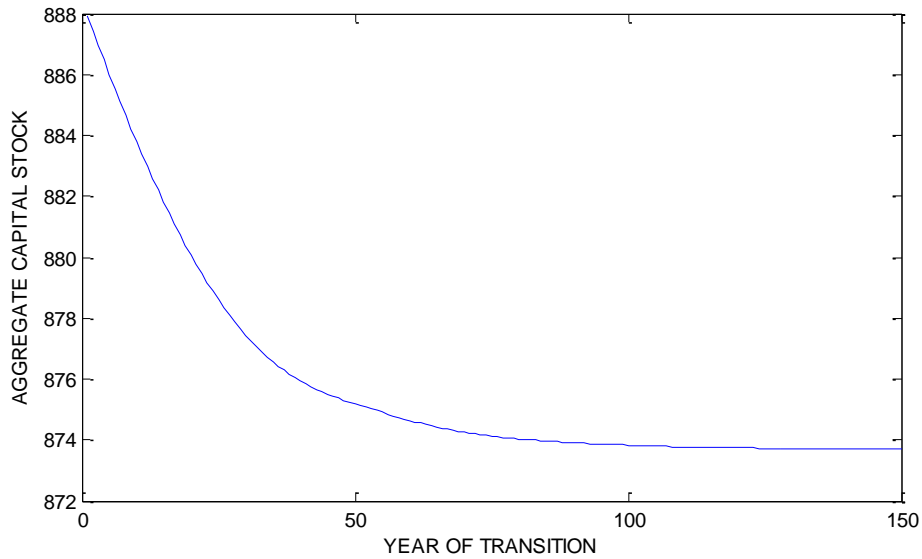
Figure 5-8: Transition Path of Aggregate Capital Stock

The aggregate labor supply has a similar path with the aggregate capital stock. We observed in the previous part that the aggregate labor supply in the final steady state is smaller than the supply in the initial steady state. The change of aggregate labor supply through time is presented in Figure 5.9. Aggregate effective labor supply gradually decreases and reaches the new equilibrium after 75 years. That means aggregate labor supply in the Turkish economy reaches the new equilibrium in year 2074. The reason of this decline is that the old individuals born before the policy change and belong to low and middle income groups, decrease their labor supply. Since the consumption tax rate decreases and leisure preference parameter is high, they enjoy leisure more instead of working. Although the individuals in the high income class supply higher level of labor, the fall in other classes dominates the rise of this class. Also, the reason of flatter decline in labor between the years 23 and 50 is that the high income individuals born before the policy change whose ages between 52 and 71, retire at age 71 instead of retiring at age 72. Figures 5.26 and 5.27 show the effective labor supply of low and middle income households. The results show that the effective labor supplied by both low and middle income households decreases through transition path. Since the consumption tax rate decreases and households gain utility from leisure, income effect for both low and

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middle income households which causes individuals to work less dominates the substitution effect which results in individuals to work more. On the other hand, Figure 5.28 in appendix reveals that the effective labor supplied by high income class increases through the transition path since negative effect, as a result of the rise in labor income tax rate, dominates the positive effect as a result of the fall in consumption tax rate.
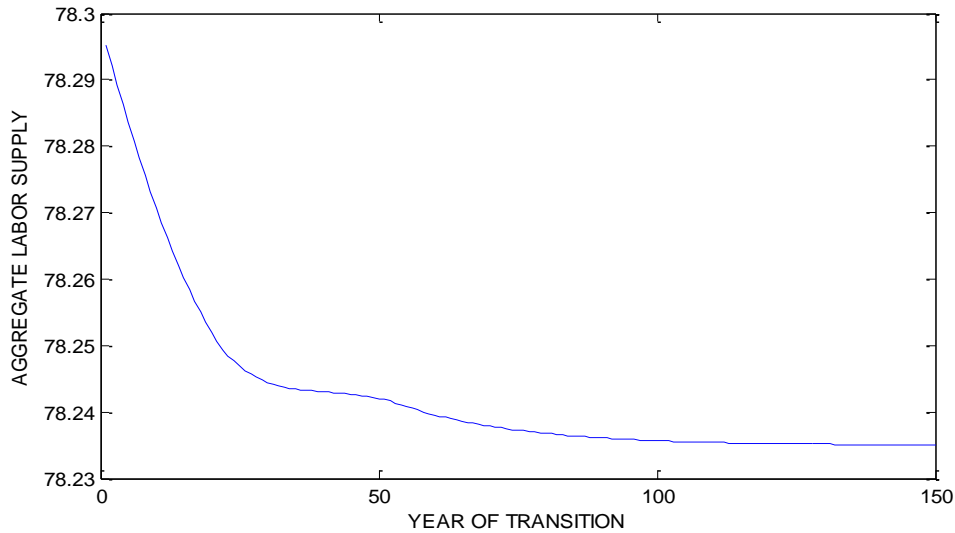
Figure 5-9: Transition Path of Aggregate Effective Labor Supply
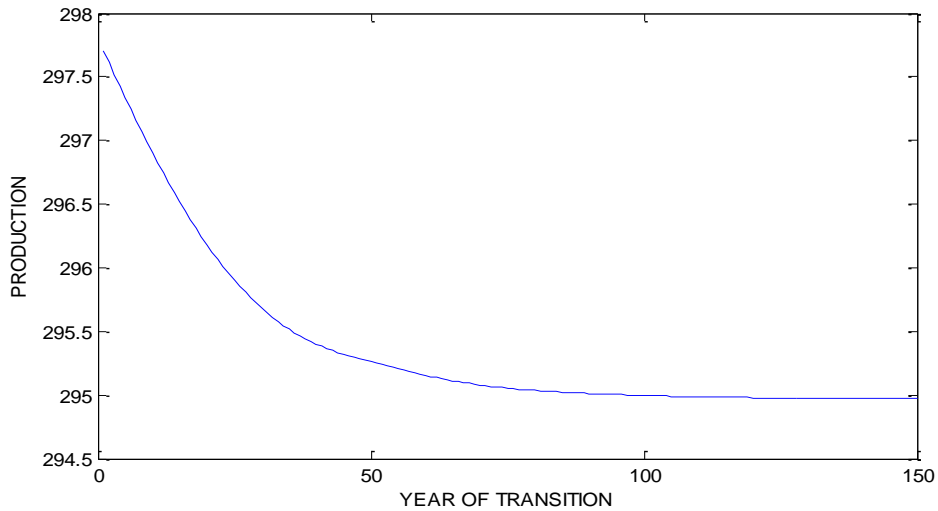
Figure 5-10: Transition Path of Production

The transition path for production is presented in Figure 5.10. It is obviously seen that the production converges to a new equilibrium through time and eventually

reaches the new steady state value after 71 years which means that the Turkish economy reaches the new equilibrium in 2080 for Turkey's economy after applying the tax reform. It is shown that while the aggregate labor supply increases, the aggregate capital stock decreases. Because of using a Cobb-Douglas production function, the decline in the aggregate capital stock dominates the increase of aggregate labor supply and the production of the economy falls through time.
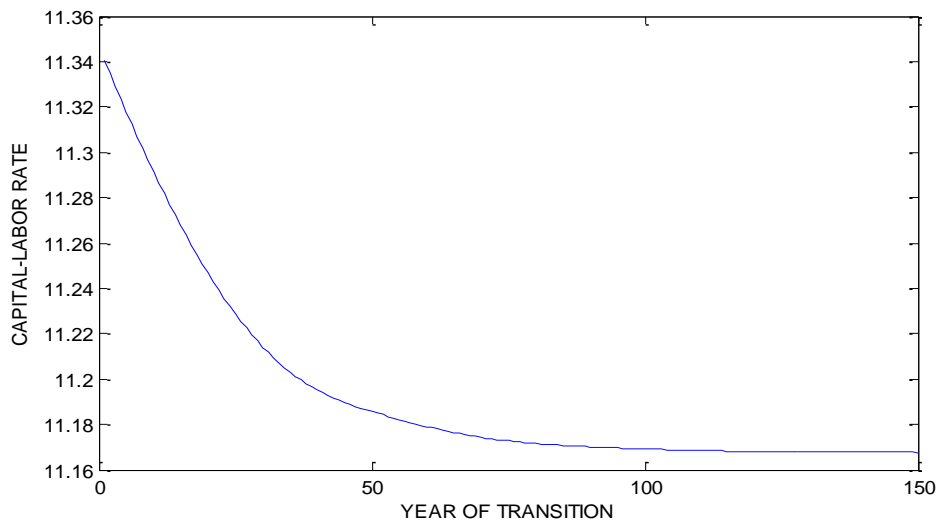
Figure 5-11: Transition Path of Capital-Labor Rate

The transition for interest rate is exhibited in Figure 5.12. It begins at a lower rate in the first year of transition and increases through time and reaches the equilibrium level after 75 years. If the tax reform was adopted in 2010, the interest rate converges to its new level in 2074. The reason of this rise is trivial. As the interest rate equals to marginal product of capital minus depreciation rate and we observe that the rate of capital to labor, exhibited in Figure 5.11, decreases through the transition path and this results in marginal product of capital to increase.
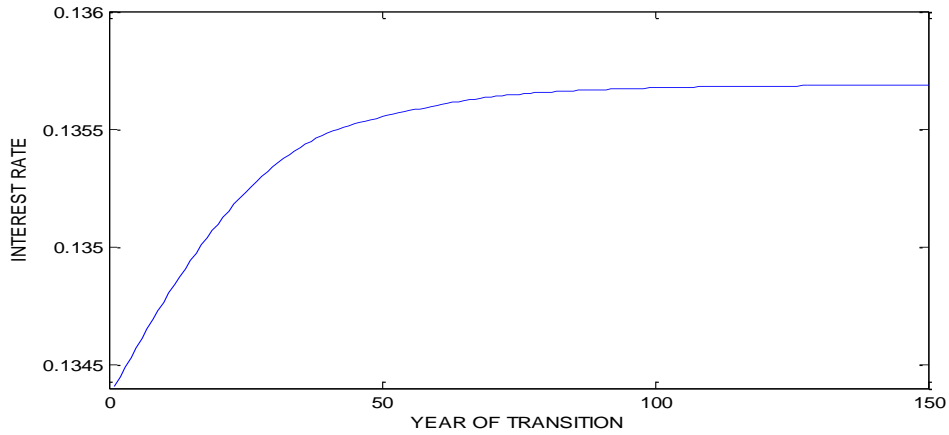
Figure 5-12: Transition Path of Interest Rate

The transition path of the wage rate is different than the path of the interest rate. Figure 5.13 represent the path of the wage rate. We clearly observe that the wage begins at a high rate and converges to the new equilibrium after 75 years. This mean the wage rate reaches its new equilibrium in 2074. Since the wage rate equals to marginal product of effective labor and decrease in the rate of capital to labor is exhibited in Figure 5.11 causes to marginal product of labor to decrease. Therefore the wage rate decreases through time.
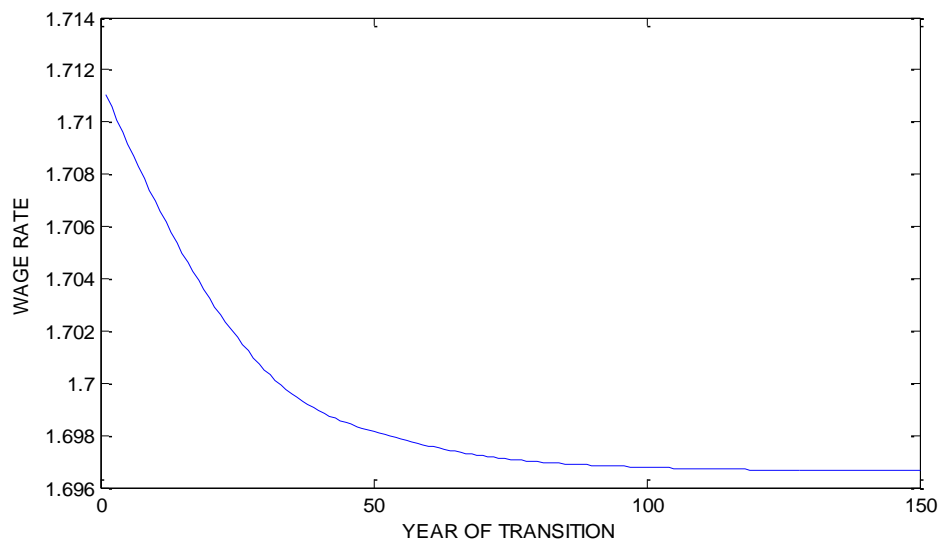
Figure 5-13: Transition Path of Wage Rate

The aggregate consumption also follows a different path than the capital stock. The transition path of consumption is exhibited in Figure 5.14. The figure reveals that

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consumption rises sharply at the time of the policy adaptation. After the first year of transition, it gradually decreases and reaches the new equilibrium after 75 years. In other words, the aggregate consumption of the Turkish economy reaches the new equilibrium in 2074. The reason of this sharp rise is that the old individuals belong to low and middle income groups before the policy change alter their consumption decisions in the time of policy adaptation and they increase their consumption after the policy adaptation. However, households belong to high income groups before the policy change decrease their consumption since the labor income tax rate increases. Since there is a sharp increase in consumption, the rise in low and middle income groups dominates the fall in later group. Also, we present the consumption paths of low, middle and high income households in Figure 5.29, 5.30 and 5.31 in the appendix, respectively.
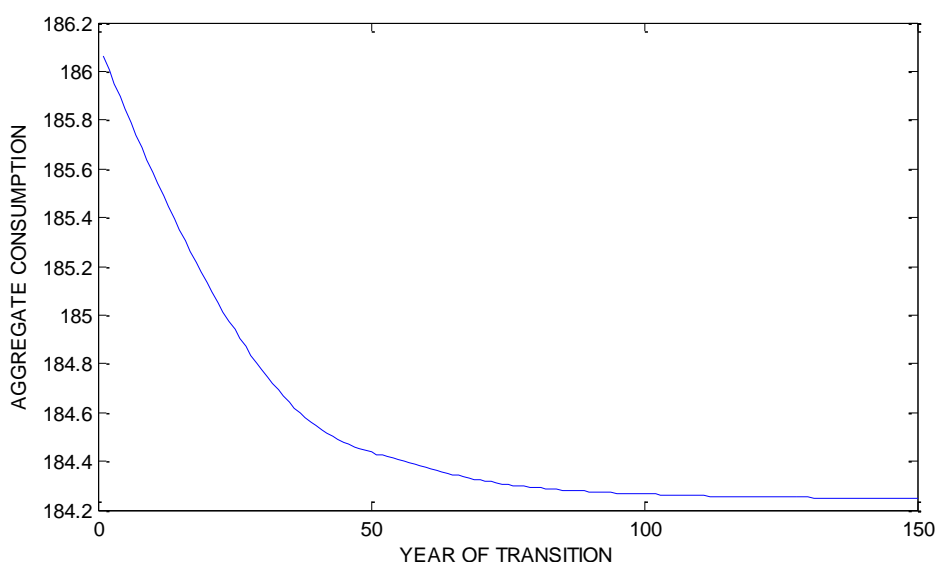
Figure 5-14: Transition Path of Aggregate Consumption

The transition path of the investment is represented in Figure 5.15. We observe that investment begins with a higher level at the first year of the transition and starts to decrease gradually until it reaches the new equilibrium after almost 75 years. In other words, the investment rate of the Turkish economy converges to the new equilibrium in 2074 after the adaption of new policy in 2009. In the earlier years of the transition, the change in capital stock is quite higher than the following years due to decrease in asset stocks held by the high income groups. Therefore the required investment is very high in the first year compared to the following years. Furthermore, transition

path of the investment rate is exhibited in Figure 5.32 in the appendix. It is observed that the investment rate decreases through the transition path. Figure 5.32 reveals that although the production decreases through the transition path, the fall in investment is higher than the fall in production.
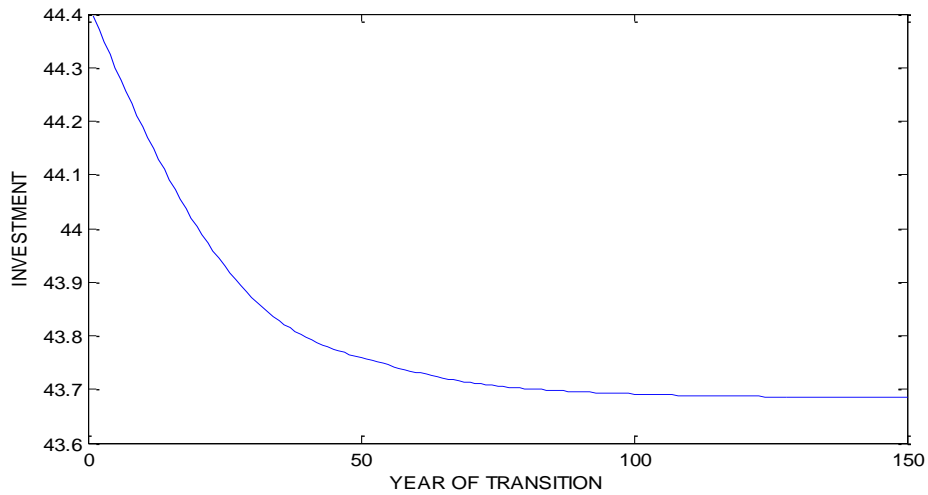

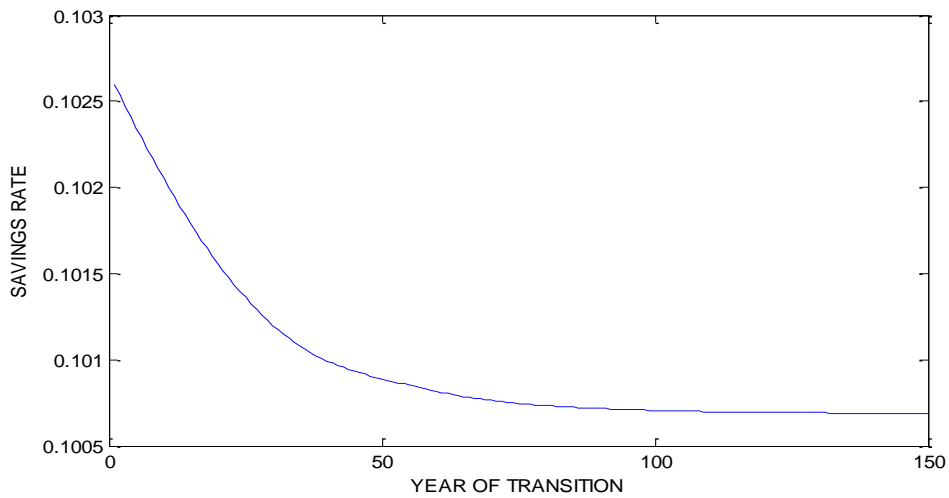**Figure 5-15: Transition Path of Investment**

Figure 5-16: Transition Path of Savings Rate

Figure 5.16 shows the transition path of the savings rate. As we can see from Figure 15 above, the savings rate decreases sharply until it reaches the new equilibrium after 75 years. In other words, the savings of Turkish economy attains the new equilibrium in 2074 after the new tax policy. The reason of this fall is that high income households decrease their holdings level of asset stocks due to the high increase in the labor income tax.
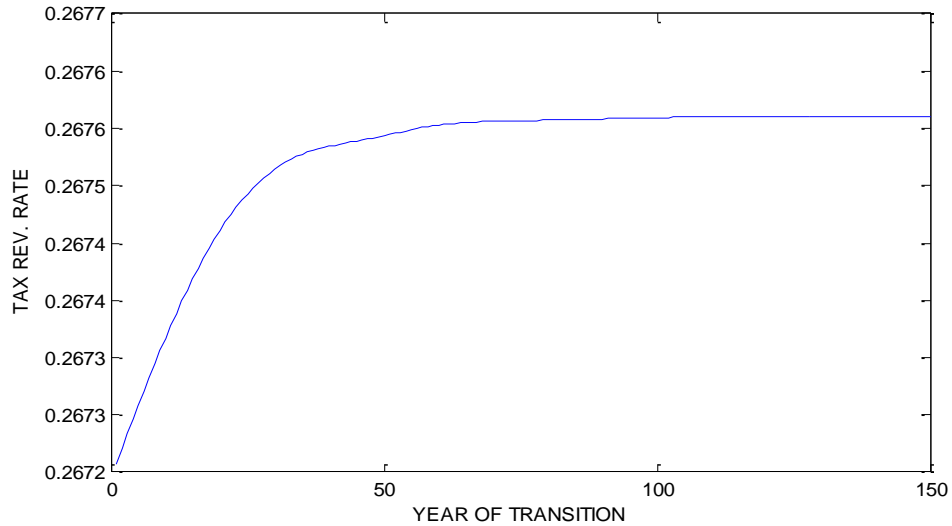
Figure 5-17: Transition Path of Tax Revenues Rate
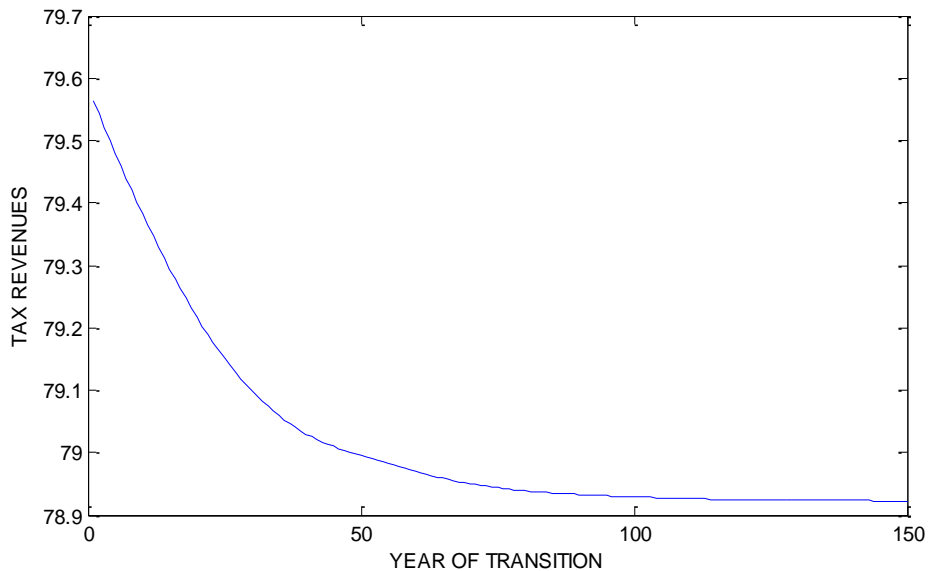
Figure 5-18: Transition Path of Tax Revenues

The path of the tax revenue rate is exhibited in Figure 5.17. It begins at a higher rate and it increases gradually through time. Moreover, we present the level of the tax revenue in Figure 5.18. Although the tax revenues decrease, the tax revenue rate increases because of the decrease in the production level of the economy. The tax revenue rate converges to a new equilibrium after 75 years.

The debt stock rate which is presented in Figure 5.19 increases and it converges to a new equilibrium toward the end of the 75th year of the transition. Although the value

of the debt stock is constant, the debt stock rate increases because of the decrease in the level of production in the economy through time.
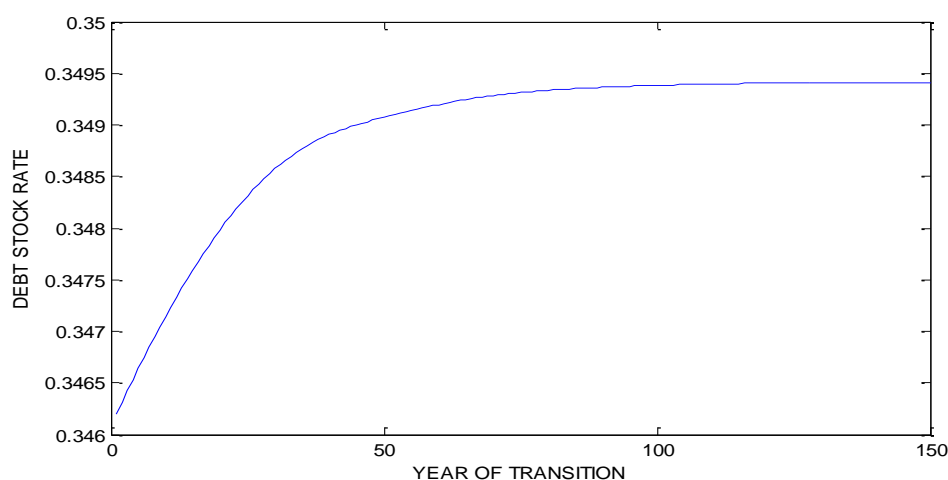
Figure 5-19: Transition Path of Debt Stock Rate
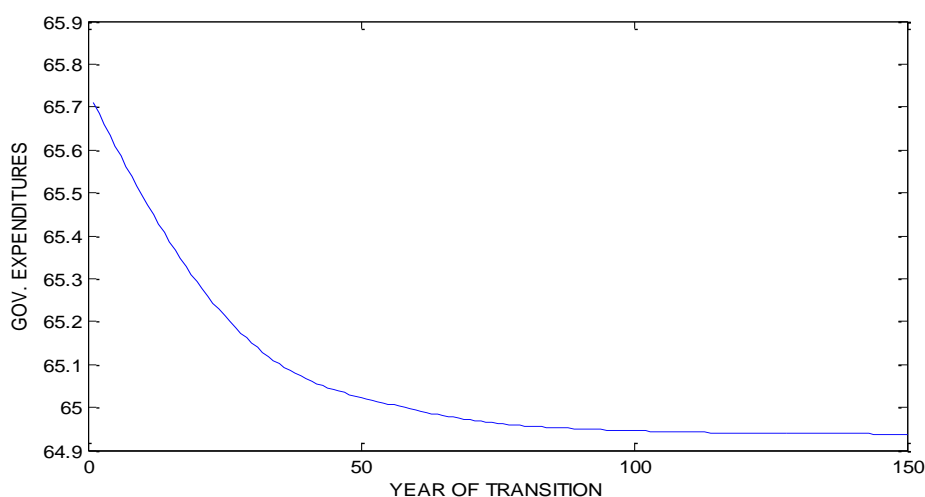
Figure 5-20: Transition Path of Government Expenditures

Figure 5.20 exhibits the result of the transition path for government expenditures. We observe that the tax revenues of the government fall during the transition periods and interest rate increases during the transition. We assume that the debt stock of the government is constant and we define government expenditures as tax revenues minus interest payment of the debt stock at each period. Hence, the government expenditures decrease. Figure 5.21 shows that government expenditures rate decrease too. Although the production decreases through the transition path, the fall in government expenditure is higher than the fall in production.
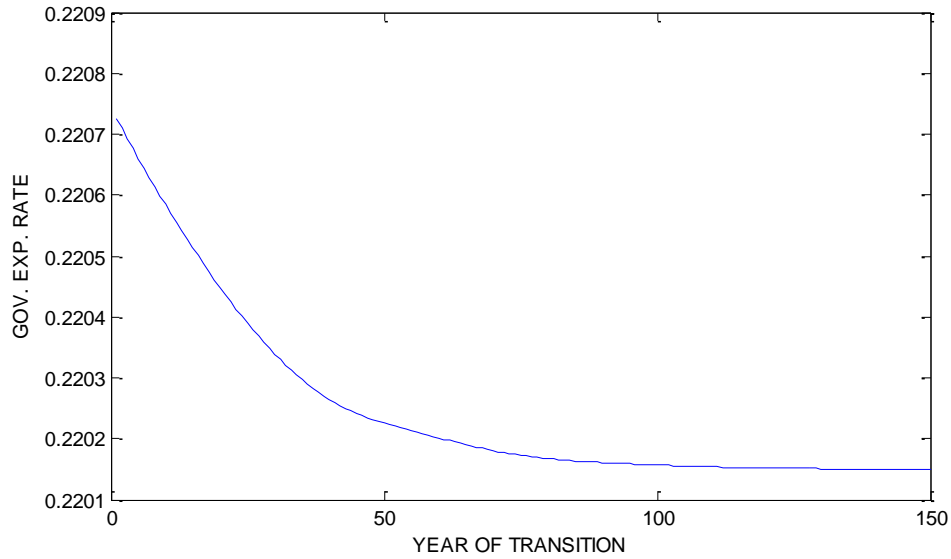
Figure 5-21: Transition Path of Government Expenditures Rate

5.4. Welfare Analysis

The welfare analysis is conducted to measure the impact of the tax policy on different generations. Following Auerbach and Kotlikoff (1987), the lifetime utility of each of these generations belonging to each type of households (U_s^i) is calculated. These lifetime utilities are compared to the level of lifetime utility that the households would obtain if there is no change in the tax system (U_0^i). An equivalent variation measure is calculated by determining the proportion $\emptyset^i$ by which each household's lifetime resources would be increased or decreased in the original tax system for households to obtain the level of lifetime utility (U_s^i) . Since our preferences given in chapter 4 are homothetic, a $\emptyset$% increase in the lifetime resources would lead to a proportional increase in consumption and leisure. If we assume that this increase takes place in the initial steady state, the new lifetime utility of each type of household will be as follows:

$$1/(1 - \frac{1}{\gamma}) \sum_{t=1}^{55} (1 + \delta^i)^{-(t-1)} ([(c_t^i(1 + \emptyset^i))^{1 - \frac{1}{\rho}} + \alpha(l_t^i(1 + \emptyset^i))^{1 - \frac{1}{\rho}}]^{1/(1 - \frac{1}{\rho})})^{(1 - \frac{1}{\gamma})}$$

$$= (1 + \emptyset^i)^{\frac{1}{1 - \frac{1}{\gamma}}} U_0^i \qquad (18)$$

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Since we know the values of U_s^i and U_s^i from our previous calculations, the equivalent variation measure can be obtained as follows:

$$\emptyset^i = (\frac{U_s^i}{U_0^i})^{\frac{1}{1-\frac{1}{\gamma}}} - 1 \tag{20}$$
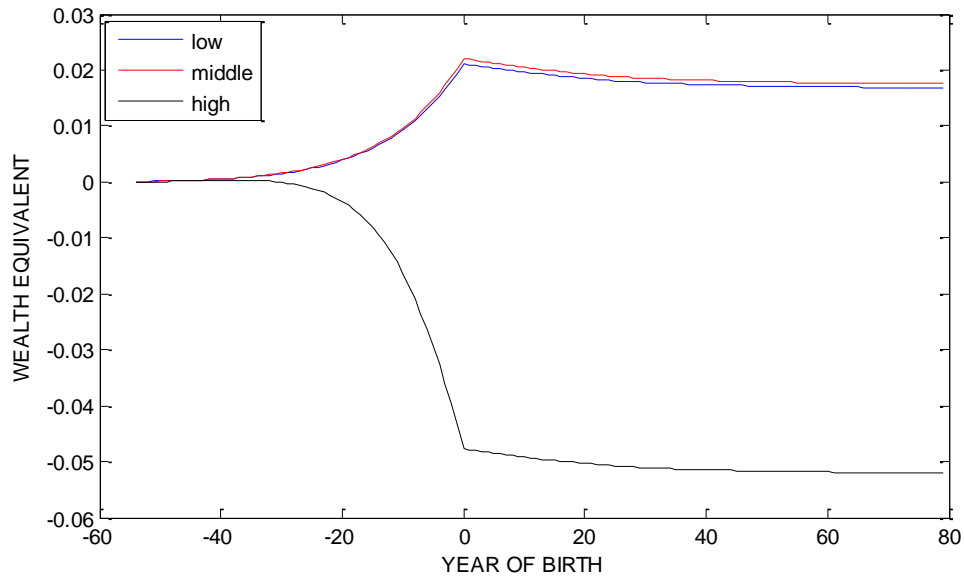

Figure 5-22: Welfare Effects of the Tax Reform

Figure 5.22 presents the welfare effects of the tax reform for different cohorts. Vertical axis of Figure 5.22 shows the proportion $\emptyset^i$ of lifetime resources needed under the initial tax system to attain the same level of utility achieved with the tax reform. Horizontal axis shows the year of birth. The time of the policy change is taken as year zero. We find that the ratios are greater than zero for all transition periods which means that households belong to low and middle income class are affected positively by the tax reform. Although both young and future cohorts are affected positively, young cohorts gain more utilities than the future cohorts. The households born before the tax reform are also affected positively but not as much as the households born after the tax reform. However, high income households are affected negatively from the tax reform. Both young and future generations experience substantial utility losses. However, the future cohorts lose more utility than the young cohorts. The high income households born before the tax reform experience substantial utility loss but it is not as much as of the young and future

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cohorts. The reason of this negative effect is that the labor income tax rate of this class is increased which puts more tax burden on them despite the decrease in consumption tax.

5.5. Summary of the Results

The simulation results indicate that both aggregate capital stock and effective labor supply decrease to lower levels. Hence, the production level in the economy decreases to a lower level too. The interest rate increases through the transition path since the ratio of capital stock to labor decreases. On the other hand, the wage rate decreases to a lower level because wage has positive relation with the ratio of K/L. The consumption of low and middle income classes increases while the consumption of the high income group decreases after the tax reform. According to the results of the welfare analysis, individuals of low and middle income classes, especially young cohorts, are affected positively and they enjoy substantial utility gains after the tax reform. However, households of high income class, especially future cohorts, were adversely affected by the tax reform.

CHAPTER 6

CONCLUSION

Tax systems are generally aimed at financing government expenditures. Moreover, tax systems are used for other social and economic purposes such as increasing economic growth, decreasing income inequality. Taxes affect the decisions of firms and households. Therefore, most of the OECD countries have changed the structures of their tax system especially in personal, corporate and consumption taxes. The Turkish government also performed tax reforms in last decade.

In this thesis, we analyze the Turkish Tax System by using overlapping generations model. This is the first study that formalizes the tax reform in Turkey using an OLG model with 55 periods and different income groups. In the second chapter, studies aimed to analyze tax systems or used OLG model for other purposes are evaluated and summarized. After completing the literature search, the Turkish Tax System is explained and some important information related to taxes is given. For instance, the ratio of tax revenues obtained from personal income and consumption taxation consist of a range from 50 to 60 percent of all tax revenues collected. In order to analyze the Turkish Tax System, we construct a 55-period OLG model by extending the Laitner (1990) dynamic model by adding three households differentiated in terms of their income levels. The labor and retirement decisions are assumed to be endogenous.

The model is calibrated for 2009 financial year of the Turkish economy. Some of the parameters used in the model for the Turkish economy are obtained from the previous studies. However, most of the parameters especially the ones that belong to

preferences are defined as ad hoc measures to match the determined macroeconomic variables of Turkish economy. The initial steady state for the tax system is calculated. The simulation results are matched for most of macroeconomic variables (with a slight difference except for the consumption rate of 2009 year). The reason of this is that the model constructed for a closed economy. However, the data are derived for consumption includes the consumption of imported goods as well.

We propose an alternative tax system for the Turkish government. In order to increase the welfare without harming production, and increase the fairness, we decrease the VAT rate to 18 percent to 15 used before 2000 and increase top statutory labor income tax from 35 percent to 40 percent which is the average tax rate of the OECD countries in order to balance the government budget.

The simulation results for final steady state and transition path of the new tax policy are calculated and evaluated. The results show that the aggregate capital stock of the economy decreased to a lower level compared to initial steady state since the large portion of the asset stocks is held by high income households and the labor income tax rate for them is increased. Moreover, aggregate labor supply decrease too. Although the labor supplied by high income households, the fall in labor supplied by low and middle income households dominates the rise in labor supply of high income class. Capital labor ratio decreases to a lower level at the final steady state and interest rate increases since it is negatively related to the capital labor ratio. On the other hand wage rate decreases to a lower level as it has a positive relationship with the capital labor ratio.

Consumption rate after the tax reform increases to a higher level. The consumptions of low and middle income classes increase whereas the consumption belongs to high income group decreases. Savings and investment rates of the economy decrease to lower levels. The dynamic behind the fall in savings and investment is that the rise in the savings of low and middle income classes is dominated by the fall in savings of high income group. Tax revenues decrease to a lower level since the large amount of tax revenues is collected from consumption taxation and the consumption tax rate is decreased to a lower level according to the new tax policy. Government expenditure decreases to a lower level because the combining effect of fall in tax revenues and

the rise in interest payment of debt stock due to increase in interest rate. Although the retirement decisions of the agents are endogenous, low, middle and high income agents still retire at the ages 68, 70 and 72, respectively after the tax reform. After the adopted new tax policy in the Turkish economy reaches the new equilibrium in almost 75 year after a transition path.

According to the results of the welfare analysis, individuals of low and middle income classes, especially young cohorts, are affected positively and enjoy the substantial utility gains after the tax reform. However, households of high income class especially future cohorts are hurt from the tax reform.

The proposed tax reform provides welfare gains to low and middle income classes while high income individuals do suffer. If the concern of government is to increase the welfare of low and middle income individuals and is to decrease the inequality, the proposed tax reform achieves this purpose with a slight fall in production by 0.9 percent. However, in terms of economic growth this policy might have detrimental effects.

A more sophisticated model that resembles the Turkish economy more is left for future studies. Firstly, the model used in this thesis assumes that agents initially have zero initial wealth. However, in Turkey, households have strong bequest motive which affect the saving decisions. In order to have a more realistic model for the Turkish economy, the model should include the bequest motive. Secondly, the tax reform model in this thesis assumes the labor supply to be endogenous but it would also be important to include the informality in terms of labor. According to the Yeldan (2001) and Boratov et al. (2000), the size of informal employment is between 40 percent and 50 percent. Decreasing the tax evasion and informality are the concerns of the government's policies. Hence, in order to observe the effect of tax system on tax evasion and transition from informal sector to formal sector, the model should incorporate the informal sector. Finally, the retirement decisions of households are assumed to be endogenous and the model used in this study does not incorporate the social security system. Therefore, the model can be extended by including the mandatory retirement and social security systems.

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APPENDIX-A

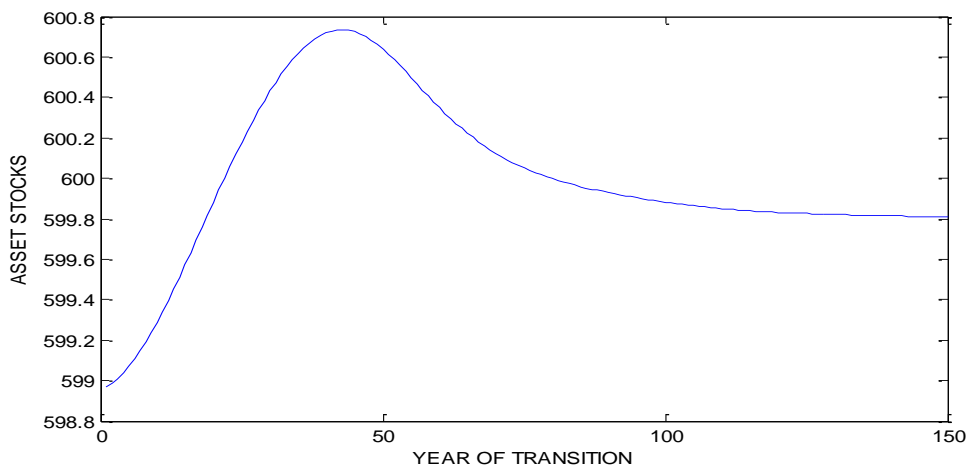# SUPPLEMENTARY FIGURES FOR CHAPTER FIVE

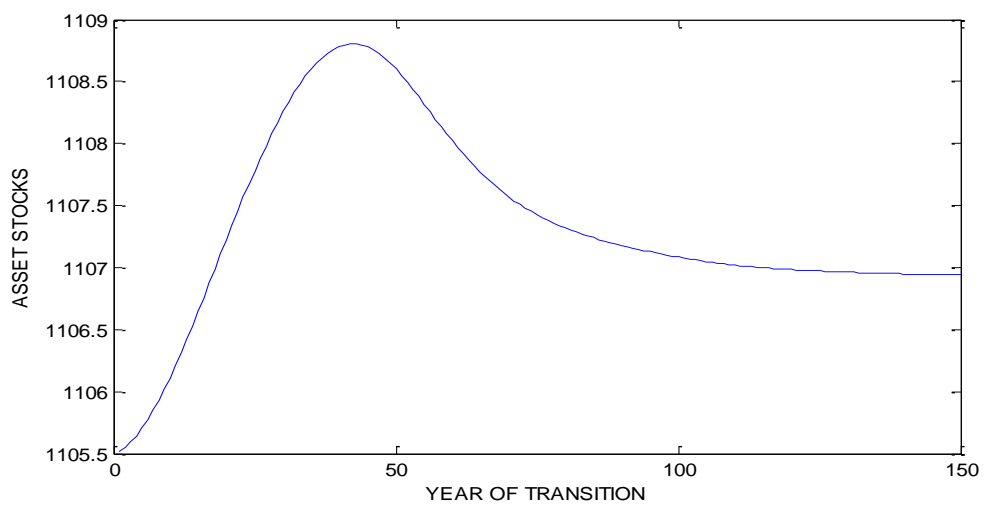**Figure 5-23: Asset Stocks Decisions of Low Income Household**

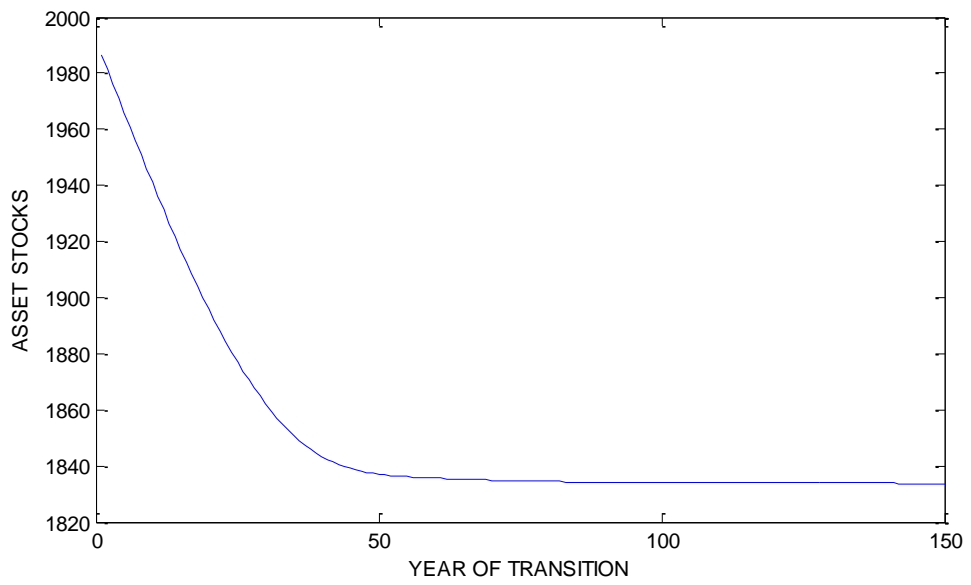**Figure 5-24-: Asset Stocks Decisions of Middle Income Household**
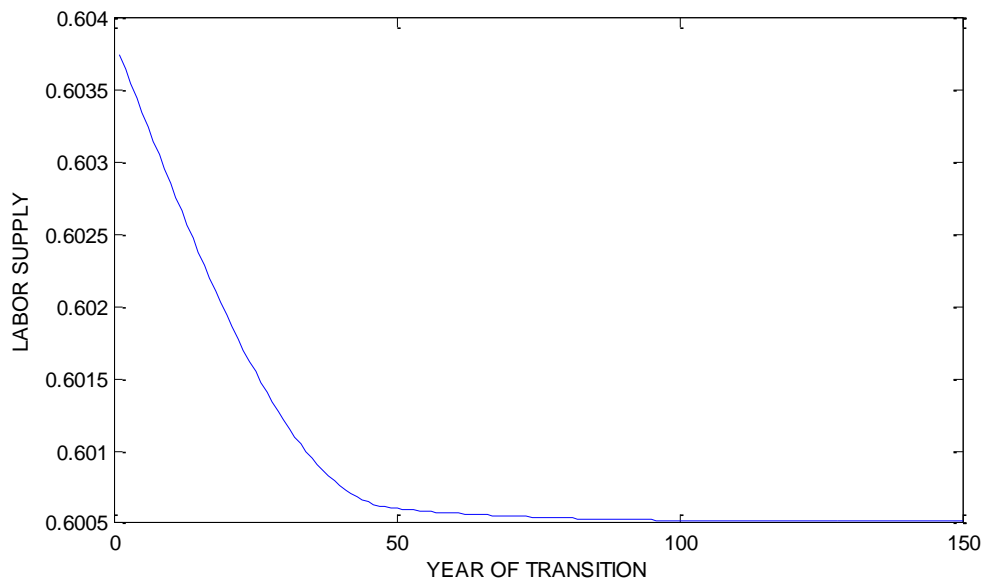
Figure 5-25: Asset Stocks Decisions of High Income Household

Figure 5-26: Labor Supply of Low Income Household

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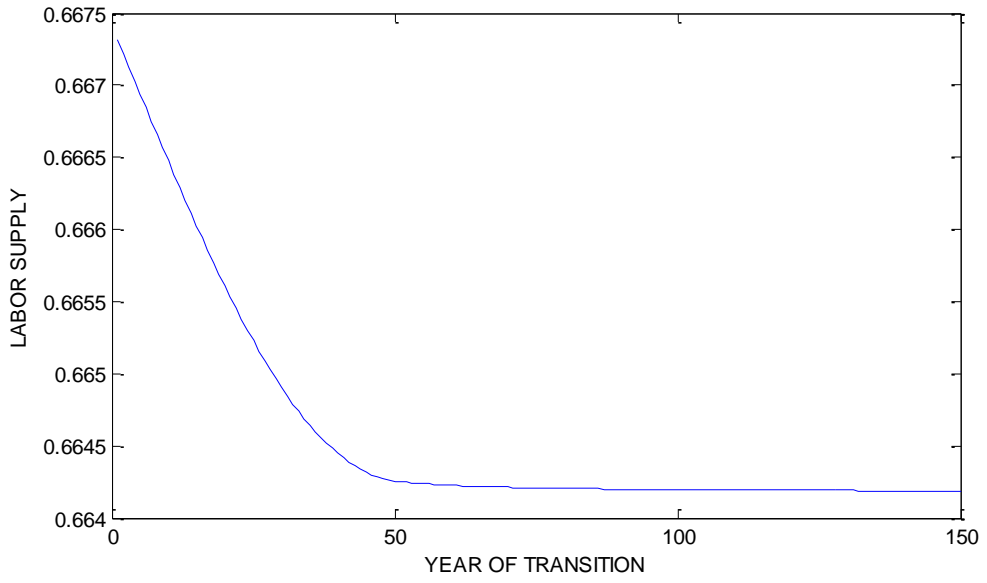
Figure 5-27: Labor Supply of Middle Income Household
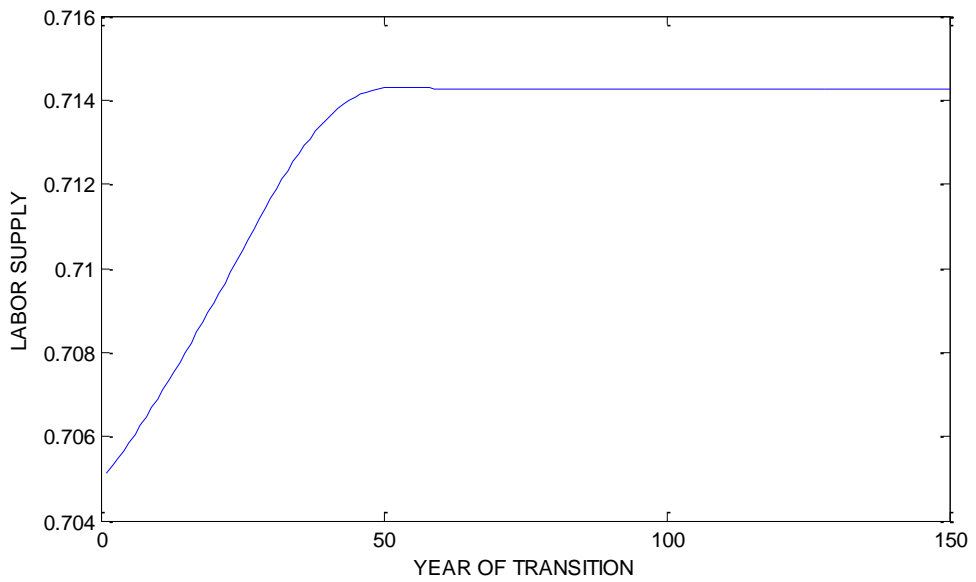
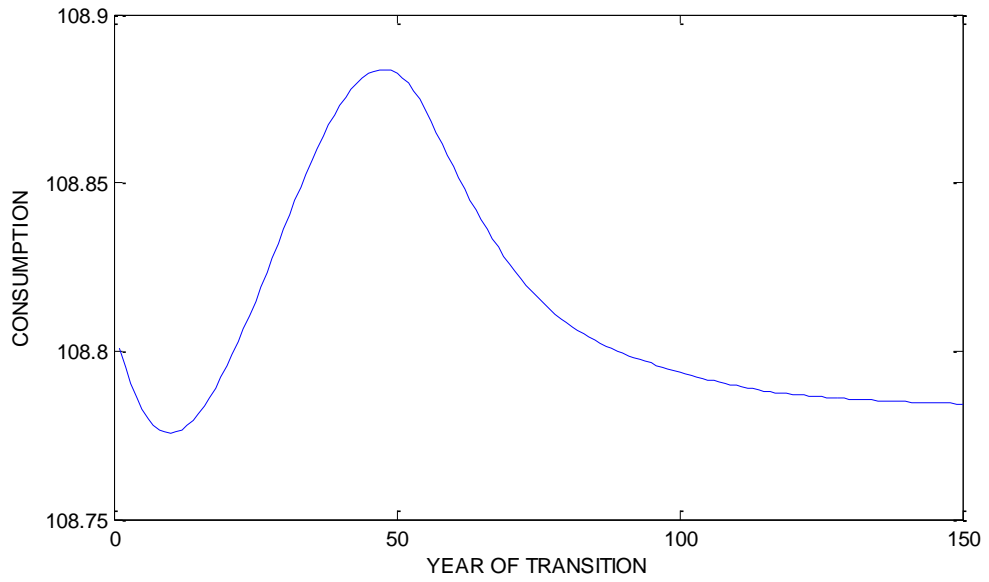**Figure 5-28: Labor Supply of High Income Household**

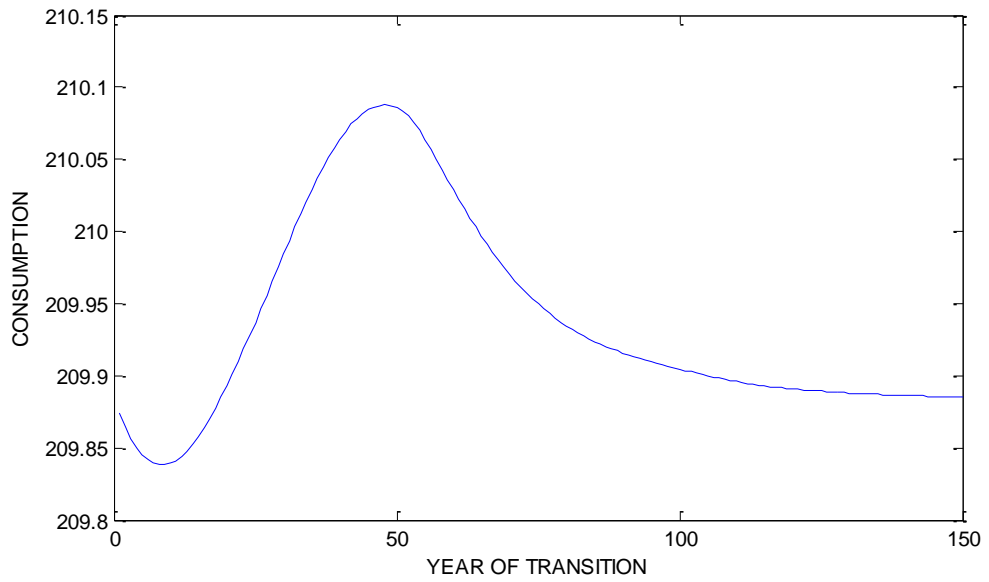**Figure 5-29: Consumption Decisions of Low Income Household**

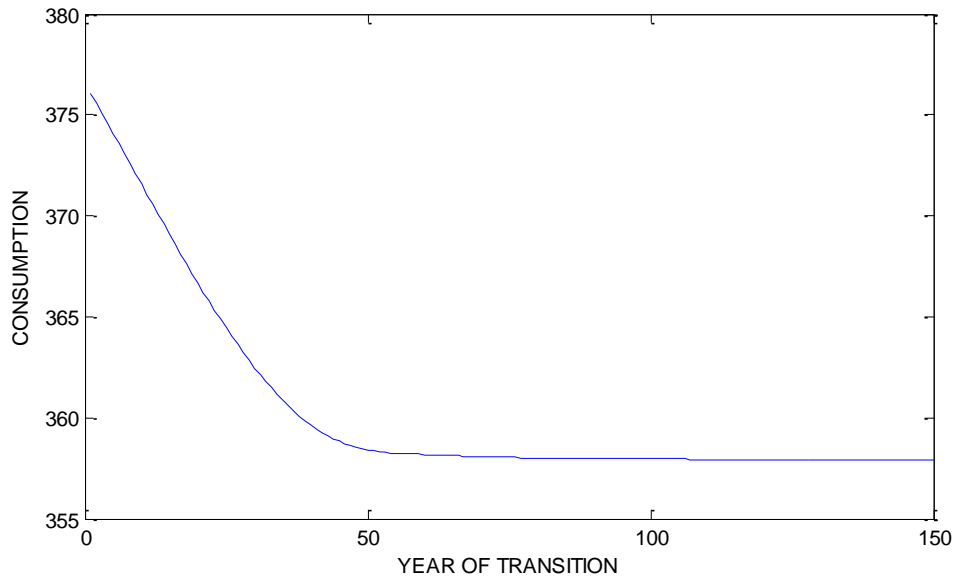**Figure 5-30: Consumption Decisions of Middle Income Household**

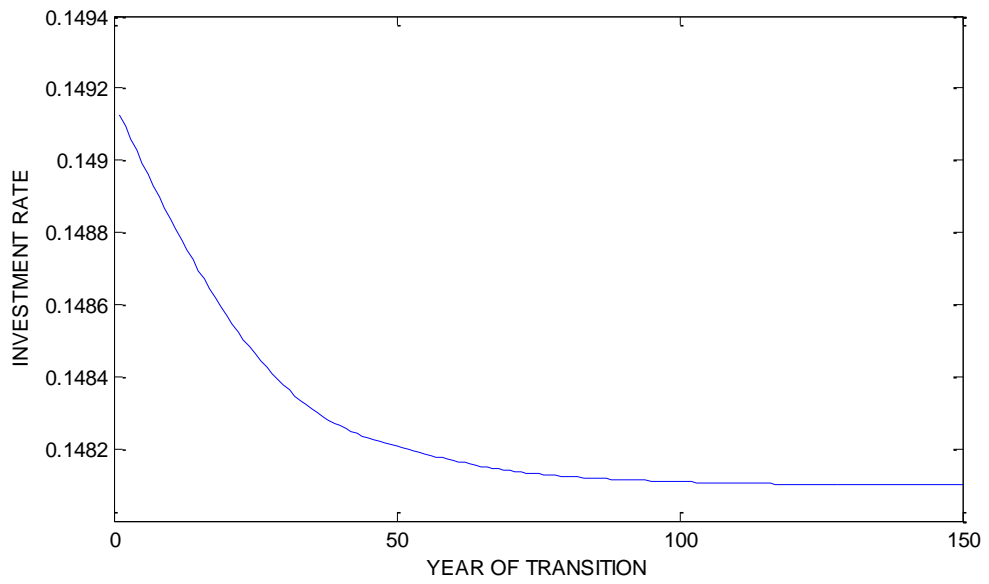**Figure 5-31: Consumption Decisions of High Income Household**

Figure 5-32: Transition Path of Investment Rate

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Soyadı : İLERİ
Adı : Adem
Bölümü : İktisat

<u>**TEZİN ADI**</u> (İngilizce) : Simulating Turkish Tax System

<u>**TEZİN TÜRÜ**</u> : Yüksek Lisans ☒   Doktora ☐

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