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SIMULATING THE TURKISH TAX SYSTEM

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Abstract

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. Since, the proposed tax reform in this study decreases the VAT rate to 15 percent and increases the top statutory income tax rate to 40 percent. This paper constructs and present first set of a 55-period overlapping generations (OLG) model for Turkey to analyze and evaluate the impact of tax reform on macroeconomic variables and welfare. The results show that tax reform provides welfare gains to low and middle-income individuals while high-income individuals suffer.

Keywords: Overlapping Generations Model, Tax Reform, Turkey

JEL Classification: E27, H20, H30

I. Introduction

Tax systems are used for economic and social concerns such as increasing economic growth, social welfare or decreasing income inequality, tax evasion, etc. Moreover, tax systems are generally used to finance government expenditures and to reduce macroeconomic instability, especially in developing countries over the last two decades. Besides these purposes, tax policies affect the decisions of households and firms. Saving, labor supply, consumption and investment in human capital are decisions of households that are affected by tax policies. Furthermore, decisions of firms related to production, job creation, research and development are affected by 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 percent in 2000 and increased from 17 percent to 18 percent in 2005. Moreover, the 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 the Turkish government began to apply four different income tax rates, which are 15, 20, 27 and 35 percent, to its taxpayers.

Governments should do well-conducted research before deciding to change the structure of the tax system because, as we mentioned before, taxes affect the decisions of the 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 dynamic general equilibrium modeling to analyze the effects of tax systems on the decisions of economic agents. Most 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, Auerbach 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 the tax system on the 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 direct taxes due to the large size of the informal sector. Hence, the government places more emphasis on indirect taxes. Their study further suggests that the current tax rates are not optimal and that there is room for improvement. However, although more research is 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 an overlapping generations model to evaluate the effect of tax systems on the economies. An individual with a finite lifetime is based by OLG model to represent the agents in the economy. The 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 allows researchers 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 the general stance of the economy. Previous studies using the 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. The main contribution of this study 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, 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 households from 35 percent to 40 percent in order to balance the government budget constraint. The results show that low and middle-income classes benefit from the tax reform while high income households suffer from the tax reform in terms of welfare analysis.

In the following section, a literature survey on the OLG model is presented. In section 2, firstly, we summarize the studies that use the OLG model to analyze the tax system. We construct a 55-period OLG model in section 3. The model includes three representative consumers that are differentiated in terms of their income levels, namely, low, middle and

high. In section 4, the calibration and simulation results are presented. We calibrate the model for the 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 the 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 section 5, the results are summarized and the possible further directions of the research are discussed.

II. Literature Survey

The purpose of this section is to summarize the existing literature on the Overlapping Generations model for tax reforms. I will summarize OLG models constructed for various research questions, with an emphasis on tax system related discussions. Moreover, we will present the research aim to investigate the effects of tax reforms on economic activity.

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 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 study reveals that a proportional income tax is less destructive than a progressive income tax. Furthermore, using a wage tax instead of an income tax decreases welfare gains while using a consumption tax provides more gains. However, consumption tax puts large marginal tax burdens on the relatively inelastic elderly. Although the wage taxation increases 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 raise welfare. Following Auerbach et al. (1983), Auerbach and Kotlikoff (1987) construct and numerically solve a 55-period 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 savings and welfare. They state that the reason for 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 the 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 a 2 percent welfare increase in the long-run while Auerbach and Kotlikoff find about a 1 percent decrease in 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 a substantial decrease in labor supply, income and capital stock.

The studies given above use a perfect foresight OLG model. However, İmrohoroğlu (1998) incorporates lifetime uncertainty, idiosyncratic income risk and mandatory retirement. The 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, the author finds that a 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 removing the capital income taxation results in a 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 long-run effects, transition and impact of tax reforms. The authors find that both capital and labor taxation decrease production in the long-run. Furthermore, the study shows that increasing the proportional consumption tax rate decreases savings and may increase 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. Heidjra and Mierau (2010) show that both consumption and labor-income taxation provides an increase in economic growth if the redistribution plan is a biased towards the young. However, if the redistribute plan is biased towards the old, both of the taxes cause economic growth to fall. Moreover, if tax revenues are given to households as lump-sum transfers, consumption taxation provides an increase in economic growth, whereas labor income taxation causes a reduction. They also find that if the government uses tax revenues to only finance its expenditures, economic growth is affected negatively and productive resources decrease.

Yakita (2001) uses the OLG model of Blanchard (1985) to analyze the effects of wage and capital income taxes on growth and welfare. The author finds that if the fraction of human capital that reaches the new generation is not sufficiently small, the current older generations hurt from interest income tax while current younger generations benefit. Pereira and Rodrigues (2002) use 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 4 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 show 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 the 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 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.

III. The Model

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, I extend the demographic structure and adopt a 55-period model following Auerbach and Kotlikoff (1987). I assume that individuals enter the economy after age 20 and live until age 75. Hence, each model age exhibits one calendar year. Since different labor income tax rates apply to individuals at different income levels, 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, I formulate the model around three types of representative agents with different income levels.

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

Households

I extend the household sector of the Kotlikoff et al. (1983) model by incorporating three different types of households. Household sector is populated with overlapping generations of heterogeneous households 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 Altig 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.

A household's utility function is assumed to be time separable and to have constant elasticity of substitution. The instantaneous utility function for each type of household takes the following form:

$$u_t^i = [(c_{s,t+s-21}^i)^{1-\frac{1}{\rho}} + \alpha(l_{s,t+s-21}^i)^{1-\frac{1}{\rho}}]^{\frac{1}{1-\frac{1}{\rho}}} \qquad (1)$$

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

$$U_t^i = \frac{1}{(1-\frac{1}{\gamma})}\sum_{s=21}^{75}(1+\delta)^{-(s-21)}((c_{s,t+s-21}{}^{1-\frac{1}{\rho}} + \alpha l_{s,t+s-21}{}^{1-\frac{1}{\rho}})^{1/(1-\frac{1}{\rho})})^{(1-\frac{1}{\gamma})} \qquad (2)$$

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. A larger value of α would result in a household supplying less labour and preferring 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 period. Since households have a lifetime horizon, they decide the path for consumption and labor over time that maximizes their lifetime utility function subject to their budget constraint. Moreover, the government levies a 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 rent their savings determined at each time as capital to firms and receive interest income from their savings. Given this framework, the budget constraint that 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 the 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 the normalized efficiency variable for each income group i at age s and ε^i is the shifting parameter for each

type of household in terms of their income level. Therefore, the 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 leisure exceeds one, the household must retire for that period and supply zero labor. The inequality constraint for leisure of each type of household should be as follows:

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

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:

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

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

$$\max_{c_{s,t}^i, l_{s,t}^i} U_t^i = \frac{1}{(1-\frac{1}{\gamma})} \sum_{s=21}^{75} (1+\delta)^{-(t-1)} \left(\left({c_{s,t+s-21}^i}^{1-\frac{1}{\rho}} + \alpha {l_{s,t+s-21}^i}^{1-\frac{1}{\rho}} \right)^{1/(1-\frac{1}{\rho})} \right)^{(1-\frac{1}{\gamma})}$$

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

$$-(1+\tau_c) c_{s,t}^i \qquad \text{for t=1,2,3,…,55 and i=1,2,3,4}$$

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

$$a_{56,t}^i = a_{1,t}^i = 0 \qquad (5)$$

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

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

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

where:

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

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

The equation (8) shows that the effective wage for each type of household is equal to the net marginal wage per unit of leisure forgone. 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:

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

The equation (10) exhibits that the net marginal wage in period t affects l_{t+1}^i/l_t^i positively while 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.

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 a closed economy and constant debt stock, total effective physical capital during period t is:

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

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 will be as follows:

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

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

$$Y_t = AK_t^\theta L_t^{1-\theta} \quad (13)$$

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

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

$$r_t = \theta A K_t^{\theta-1} L_t^{1-\theta} - \varphi \quad (14)$$

$$w_t = (1-\theta) A K_t^{\theta} L_t^{-\theta} \quad (15)$$

where is φ the rate of capital depreciation.

Government Sector

The government in this model collects tax revenues by taxing capital income, wage income and consumption to finance its expenditure that grows. Government consumption is assumed to be unproductive and generate no utility to households. 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 will be as follows:

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

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

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

$$+ D_{t+1} - D_t \quad (17)$$

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:

$$G_t = TR_t - r_t D_t \quad (18)$$

Equation 18 shows that if there will be a change in tax revenues due to change in tax rates, the change offsets by equal change in government expenditure.

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 $(\tau_{k,t}, \tau^i_{w,t}, \tau_{c,t})$, each type of household chooses consumption sequence $\{c^i_{s,t+s-1}\}^{55}_{s=1}$, labour sequence $\{n^i_{s,t+s-1}\}^{55}_{s=1}$and asset stock sequence $\{a^i_{s,t+s-1}\}^{55}_{s=1}$ 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.

IV. Calibration and Simulation Results

In the previous section, we constructed the model to analyze the Turkish tax system. In the first part of this section, 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 the initial steady state before tax reform, final steady state and transition path of the proposed tax reform are given and analyzed.

Solution of the Model:

The solution of the model begins with a determination of the initial steady state. After the adoption of a new policy, the final steady state of the economy is solved. Finally, the economy's transition path from the initial steady state to the final steady state is computed. 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 convergence holds.

The solution for the initial steady state of the model begins with guesses of aggregate capital stock and 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 accomplished this problem by assuming 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 the initial steady state. However, the difference between solving the transition path and initial steady state is that households that lived before the policy adoption should be considered differently. Following Kotlikoff and Auerbach (1983), we should consider them as if 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.

Model Parameterization and Calibration

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

Earnings-Ability Profiles

Auerbach et al. (2008) and Altig 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

high school graduates through their lifetime depend on experience and the square of experience.

$$\epsilon_t = e^{\beta_0+\beta_1 t+\beta_2 t^2} \quad (19)$$

where t demonstrates the number of years of experience. Moreover, Fehr et al. (2008) use 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 each household is estimated:

$$\epsilon_t^i = e^i * e^{\beta_0+\beta_1 t+\beta_2 t^2} \quad (20)$$

where e^i is the shifting parameter for the agent i. The coefficients of the age-earnings ability profile have been utilized from Tansel and Bircan (2012). After controlling for years of schooling, cohort effect, and other specified variables, authors find that the values for α, β_1 and β_2 equals 4.551, 0.044 and -0.001, respectively. These results are used in calibration. Following Kudrna and Alan (2010), we assume that the three income groups have different years of schooling. Low income households generally have a primary school or lower level of education. Middle income households are assumed to have a high school education. Finally, high income households are assumed to have a university education. According to the 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 that 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.

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 CGE analysis. We utilize the statistics for the 2009 financial year to determine the 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 savings 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 the IMF database and the total investment rate

equals 14.93 percent. The interest rate equals 12.4 percent for 2009 according to statistics taken from the State Planning Organization (SPO).

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 0.346 of GDP according to the SPO database. The statistic for the rate of general government non-interest expenditures is obtained from the State Planning Organization of Turkey and is equal to 22.2 percent. The tax rates are the actual tax rates in Turkey.

The depreciation rate for Turkey is computed by Çiçek and Elgin (2011) and the authors estimate it as 6 percent. We take the 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 the Turkish economy in 2009. The following table, Table 4.1, represents the final parameterization.

Table 4.1- 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
φ	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.

Simulation Results

In this part of the section, the results for initial, final steady states and transition path will be exhibited. Given the parameterization above, the equilibrium for the initial steady state is computed based on tax policy settings in 2009. After computing the initial steady state, the final steady state and transition path for the proposed tax system experiment are computed

and macroeconomic variables belonging to the final steady state will be analyzed and compared with initial state results.

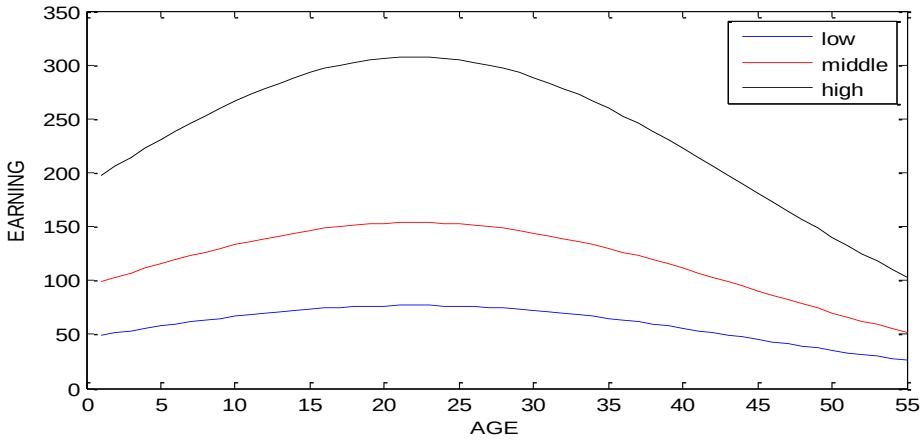
Initial Steady State

The initial tax structure of the economy with 46 percent debt stock is used to compute the initial equilibrium for the economy. The simulation results are shown in Table-3.2. The model estimation results match most of the real macroeconomic variables of Turkish economy for 2009 except consumption. The reason to not match the consumption rate might be due to the fact that that our model is constructed for a closed economy and the data for consumption does not only includes the consumption of domestic goods but also includes the consumption of import goods. The simulation result shows that the ratio of capital stock to GDP equals 2.9808. Moreover, the equilibrium interest and average wage rates equal 13.45 percent and 1.7098, respectively.

Table 4.2- 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 4.1- Age-Earnings Profiles



After analyzing the aggregate results of macroeconomic variables, the behaviours of the households will be compared with each other. Figure 4.1 exhibits the results of age-earnings profiles for each type of household and the results show that the earnings of each type of household reaches its top level when it is 40 years old, and earnings begin to decrease after this age. This drop becomes more rapid after age 50 due to low labour supply and decreases in wages.

As we expected, Figure 4.2 shows that high income households hold larger amounts 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 for this result is that high income groups have much more income than other groups to allocate to both consumption and savings. As we can see from Figure 4.2, asset stocks take their highest value for each type of household at age 65

Figure 4.2- Asset Stocks Decisions

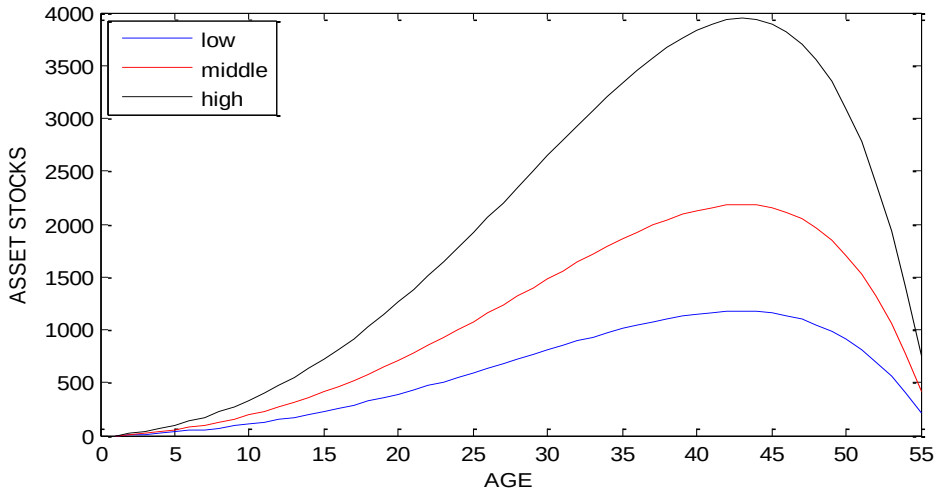
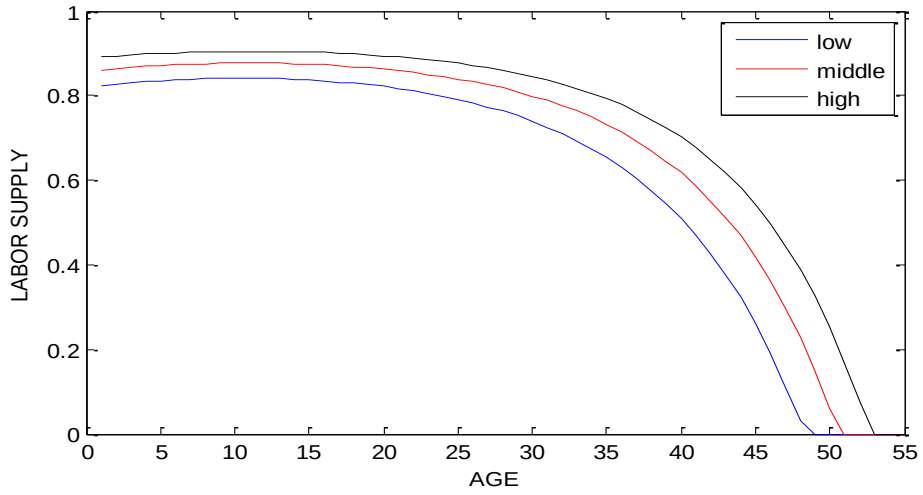
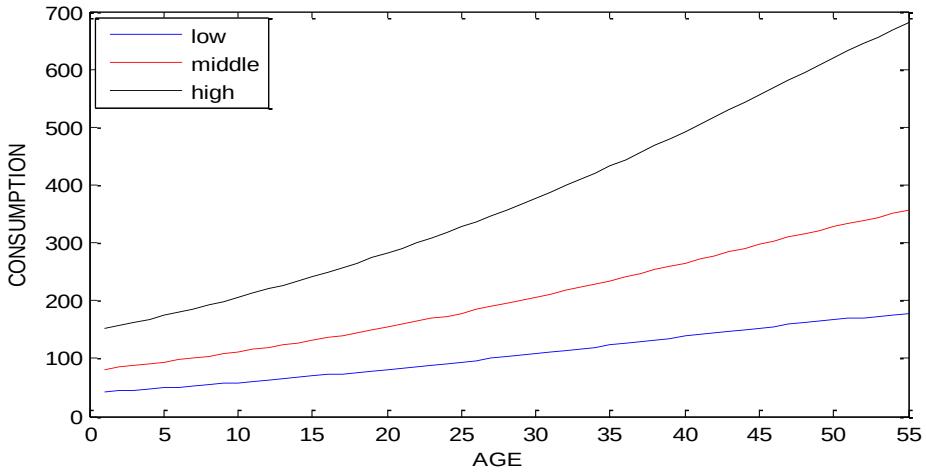


Figure 4.3- Labor Supply Decisions



Labor supplied by each household is represented by Figure 4.3. The aggregate labor supply equals 1.4675. Both middle and high income individuals supply higher levels of labor than low income individual since agents begin with no initial assets and these two groups earns a higher level of wages for each labor supply then the low income agent. Since they begin with no initial assets, agents supply higher labor during the first 20 years of their life because the earnings ability of agents increases in the early years of their life. Moreover, Figure 4.3 shows that the high income household retires 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 low income individuals because the opportunity cost of leisure is still high for them.

Figure 4.4- Consumption Decisions



Lastly, the lifetime consumption decision of each income group and the results are exhibited in Figure 4.4. As we can see the graph above, consumption begins with its lowest level at earlier age for all income groups but the consumption of the high income group is higher than the other two groups as expected. The reason for this is that the high income group earns higher amounts for each unit of labor than the others and has more resources to allocate to both consumption and saving. Consumption increases through the life-time for all groups and reaches its highest level at the last year of their life.

Final Steady State

After analyzing the results of the initial steady state, in this part of the section, 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 has no ability to collect direct taxes due to the large size of the informal sector. Hence, the government has more emphasis on indirect taxes. Therefore, the proposed tax reform recommends decreasing the VAT rate from 18 percent to 15 which is applied in the 2000s and increases the top statutory income tax from 35 percent to 40 percent, which is also the average income tax rate for high income household in OECD countries. The main aim of this recommendation is to observe its effect on social welfare and analyze the distributive impact of the tax reform.

Given the parameterization and the recommended tax reform given, the steady state of the economy is computed and the results are given in Table 4.3 in comparison to the initial steady state. As we can see in Table 4.3, most of the variables decrease except consumption, debt stock and the interest rate. Aggregate asset stocks decreases since the labor income tax of the high income group increases, which causes the resources that this group allocates to savings and consumption to decline.

Table 4.3-Final Steady State after Tax Reform

Variables	Initial S.S.	Final S.S.
K/Y	2.98	2.96
L (Labor Supply)	78.39	78.23
C/Y	0.61	0.62
S/Y	10.25	0.10
I/Y	14.90	0.148
G/Y	23.21	0.22
D/Y	34.60	0.35
TR/Y	27.86	26.76
Y	297.88	294.96
r	13.45	13.57
w	1.70	1.69

Figure 4.5 represents the asset stock decisions of each income group before and after tax reform. The result shows that the asset stocks held by high income households decreases whereas there is a slight increase in the asset stocks held by low and middle income groups. The decline in asset stocks of high income agents dominates the increase in asset stocks of both low and middle income agents.

Figure 4.5- Asset stock decisions before and after the tax reform

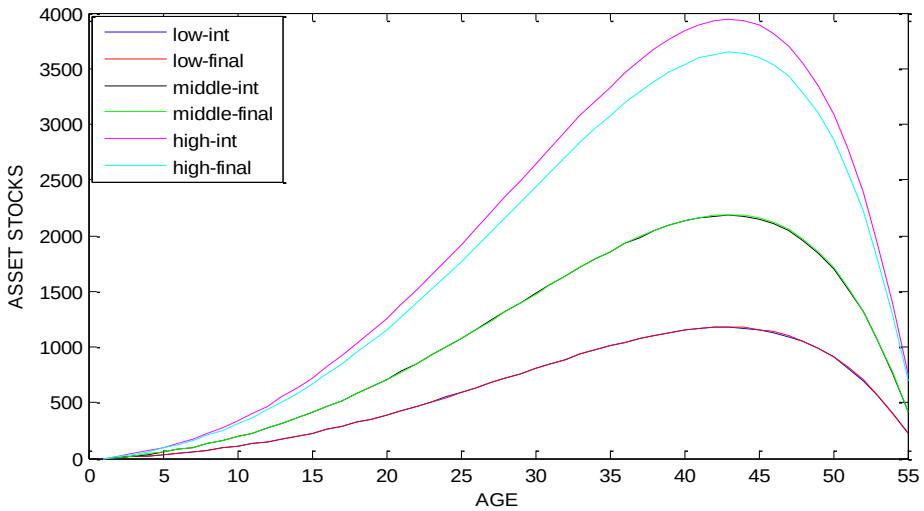
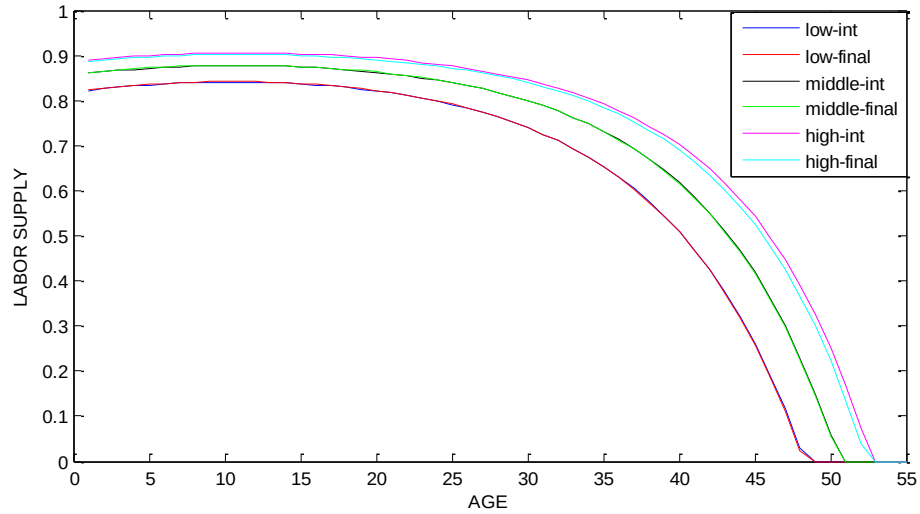


Figure 4.6- Labor supply decisions before and after the tax reform



As we can see from Figure 4.6 above, labor supplied by all agents slightly decreases after the tax reform**.** The reason for the decline in labor supply is that agents do not have to work much to afford their initial consumption level since the consumption tax rate decreases so consumption is cheaper now. In other words, the income effect which causes decreases in supplied labor dominates the substitution effect and results in the increase in the labor supply. Moreover, both high income and middle income households still retire after the low income individual retires and the age of retirement for each the type of household does not change.

Figure 4.7- Consumption decisions before and after the tax reform

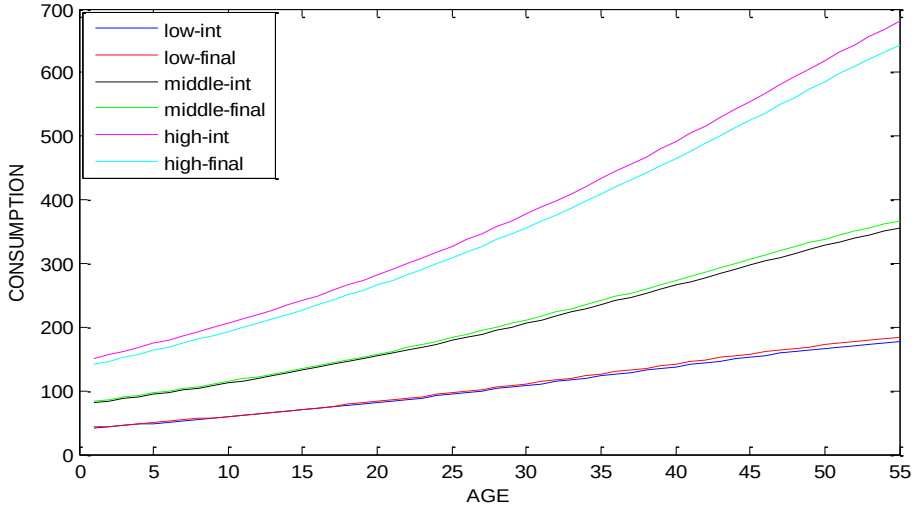


Figure 4.7 shows the lifetime consumption decisions of all groups for both the initial and final steady states. The aggregate consumption increases in the final steady state when comparing the value of the initial steady state. Moreover, it is easily seen that the consumption of low

and middle income groups increase while the consumption of the high income agent decreases. This means that the increase in consumption of low and middle groups dominates the decrease in consumption of the high income class. The reason for this is that the level of labor income tax rate changes only for the high income class while it remains constant for the other two groups. In terms of welfare analysis, low and middle income individuals are the winners while high income individuals are the losers.

Transition Path

In the former part of this section, we analyzed the final effect of the proposed tax reform on various macroeconomic variables. In this part, we investigate how the economy transits from the initial steady state to the final steady state. The effects of the proposed tax reform mentioned before 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 eventually decreased.

The macroeconomic effects of the tax reform on the real variables through the transition path are given at Table 4. As we can see, GDP falls by 0.7 percent immediately and 1.1 percent ultimately. In the short run, an increase in the capital-labor ratio causes a short-run decrease in the interest rate and a short-run increase in the wage rate. The long-run decrease in the capital-labor ratio results in the opposite effects on interest and wage rates. Moreover, the consumption rate increases in the short-run, and it decreases in the long-run.

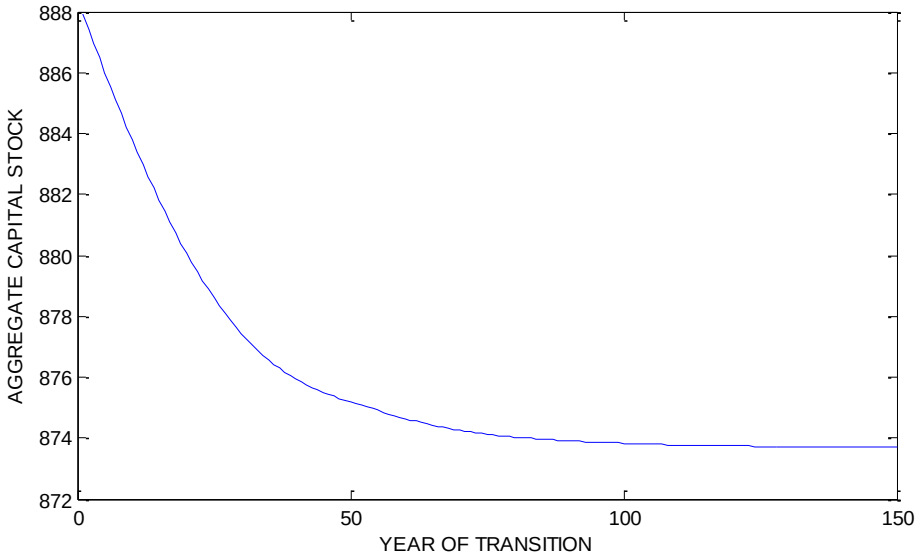
First, we will evaluate the change of capital stock from the initial equilibrium to the final equilibrium. The change of aggregate capital stock through time is presented in Figure 4.8. It is easily observed that the aggregate capital stock converges and reach a new equilibrium after 75 periods. In other words, if the Turkish government adopts tax reform in 2009, Turkey's economy would have reached the new steady state in 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 the transition path. Figures 4.23 and 4.24 in the appendix represent the decisions of low and middle income classes on asset stocks, respectively. However, Figure 4.25 in the appendix shows that the asset stocks hold by the high income class decreases through time. The fall in asset stocks of the high income group dominates the rise in asset stocks of the low and middle income groups.

Table 4.4. Macroeconomic Effect-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

Figure 4.8- Transition Path of the Aggregate Capital Stock



The aggregate labor supply has a similar path to 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 ss. The change of aggregate labor supply through time is presented in Figure 4.9. 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 the year 2074. The reason for this decline is that old individuals born before the policy change that belong to low and middle income groups decrease their supplied labor, since the consumption tax rate decreases and leisure preference parameter is high so they enjoy leisure more instead of working. Although individuals belonging to the high income class supply a higher level of labor, the fall in other classes dominates the rise of this class. Also, the reason for the flatter decline in labor between the years 23 and 50 is that the high income individuals born before the policy change, whose ages are between 52 and 71, retire at age 71 instead of retiring at age 72. Moreover, Figures 4.26 and 4.27 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 the transition path. Since the consumption tax rate decreases and households gain utility from leisure, the income effect for both low and middle income households, which causes individuals to work less, dominates the substitution effect which results in individuals working more. On the other hand, Figure 4.28 in the appendix reveals that the effective labor supplied by the high income class increases through

the transition path, since the negative effect resulting from the rise of the labor income tax rate dominates the positive effect of the fall in the consumption tax rate.

Figure 4.9- Transition Path of the Aggregate Effective Labor Supply

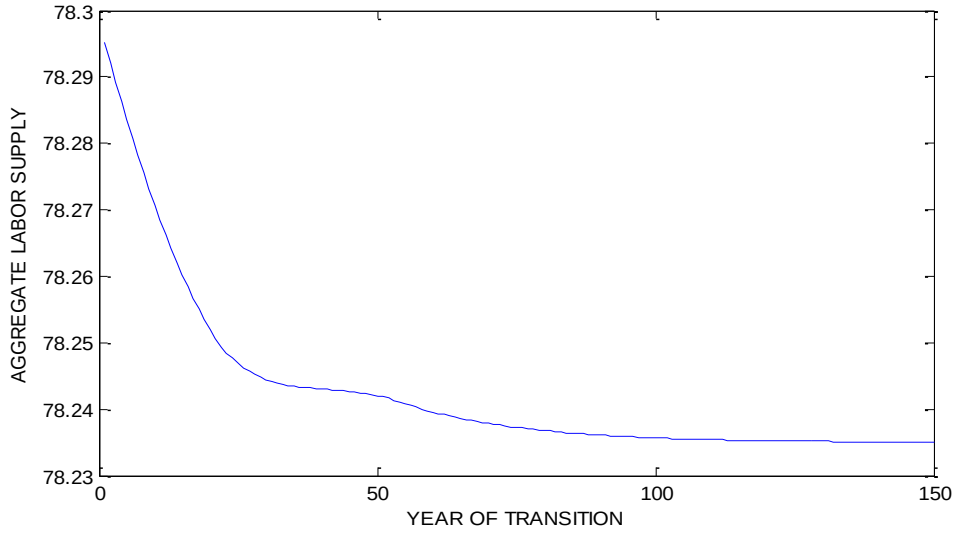
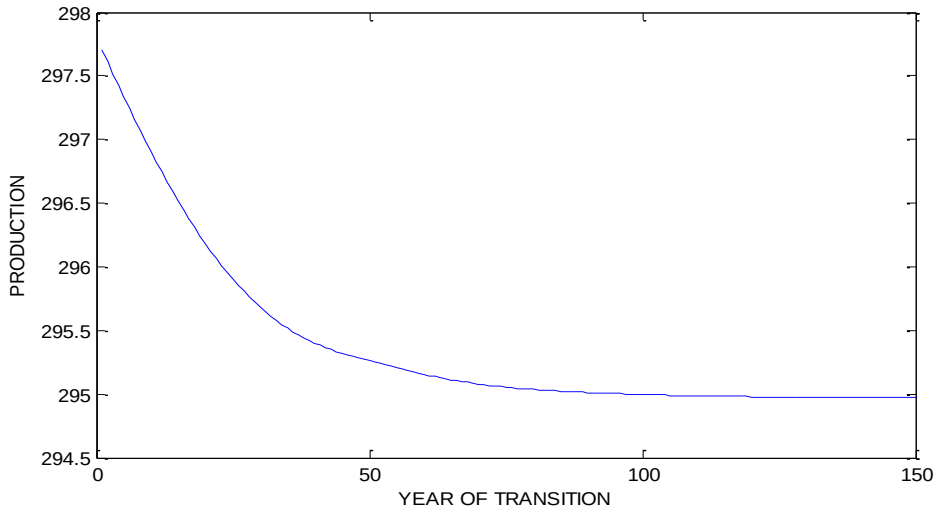
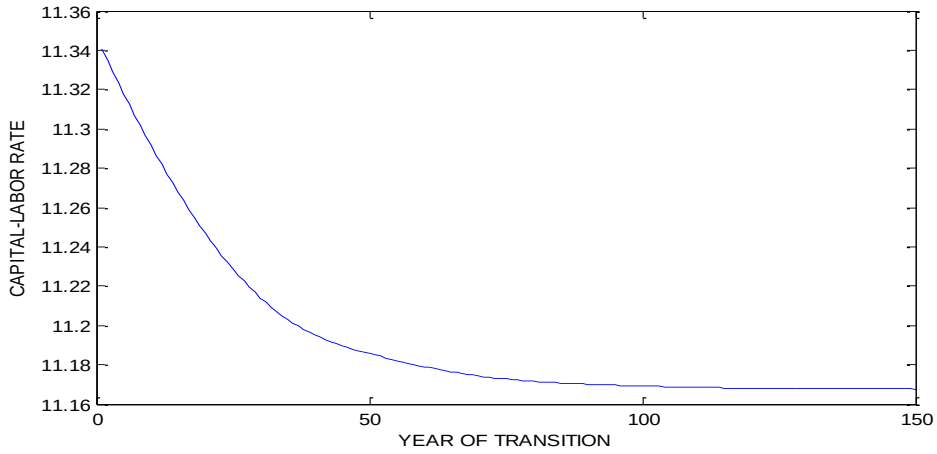


Figure 4.10- Transition Path of Production



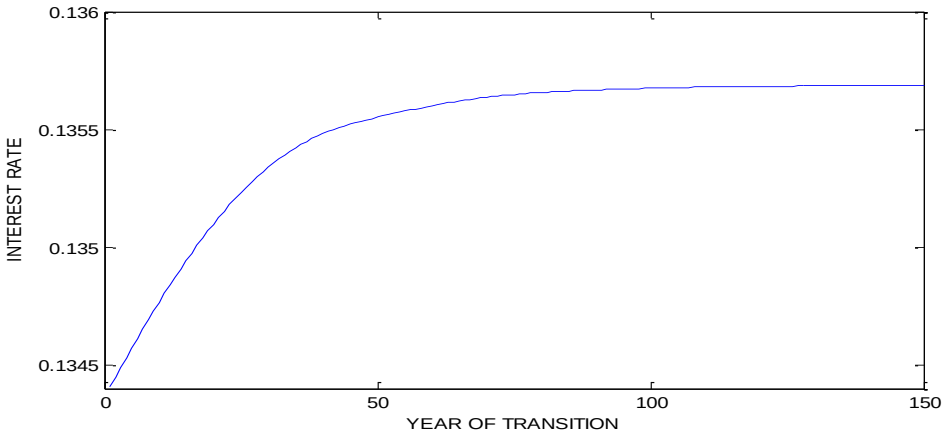
The transition path for production is presented in Figure 4.10. It is obvious that production converges to a new equilibrium over time and eventually reaches the new steady state value after 71 years, which means that it reaches the new equilibrium at 2080 for Turkey's economy after applying the tax reform. It is shown that, both the aggregate labor supply and the aggregate capital stock decreases. Because of the Cobb-Douglas production type, the decline in the aggregate capital stock combines with the decrease in aggregate labor supply, and the production of the economy falls through time.

Figure 4.11- Transition Path of the Capital-Labor Rate



The transition for the interest rate is exhibited in Figure 4.12. It begins at a lower rate in the first year of transition and increases through time to reach 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 for this rise is quite trivial. The interest rate equals the marginal product of capital minus the depreciation rate, and we observe that the rate of capital to labor, as exhibited Figure 4.11, decreases through the transition path, which results in the marginal product of capital increasing.

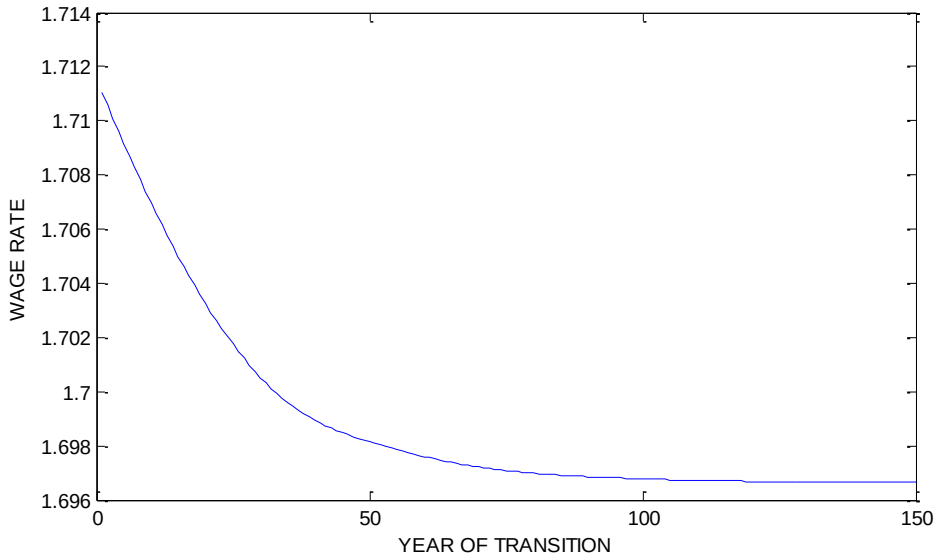
Figure 4.12- Transition Path of Interest Rate



The transition path of the wage rate is different than the path of the interest rate. Figure 4.13 represents the path of the wage rate. We clearly observe that the wage begins at a high rate and converges to new equilibrium after 75 years. This means the wage rate reaches its new equilibrium in 2074. Since the wage rate equals the marginal product of effective

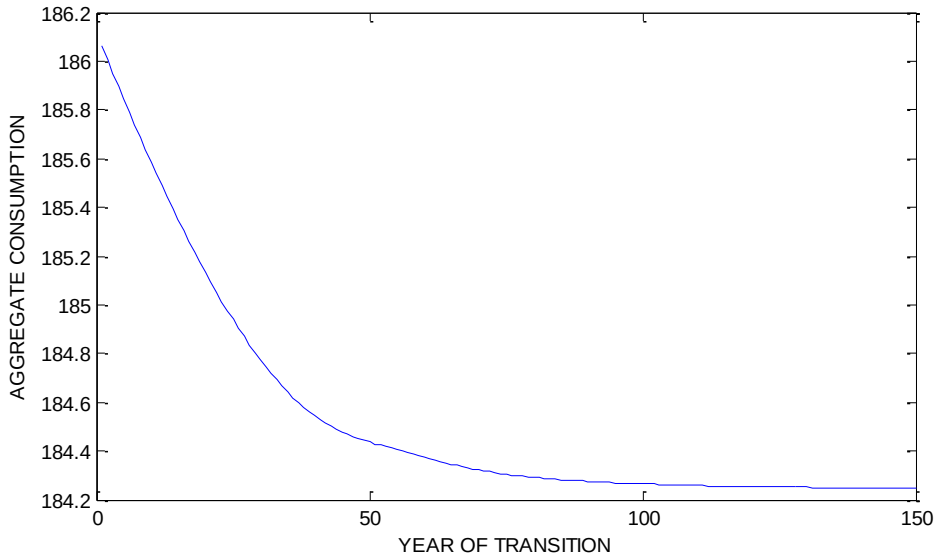
labor, and the decrease in the rate of capital to labor, as exhibited in Figure 4.11, causes the marginal product of labor to decrease, the wage rate decreases over time.

Figure 4.13- Transition Path of the Wage Rate



Aggregate consumption also follows a different path than the capital stock. The transition path of consumption is exhibited in Figure 4.14. The figure reveals that consumption rises sharply at the time of 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 for this sharp rise is that the old individuals belong to the low and middle income groups before the policy change alter their consumption decisions in the time of policy adaptation and increase their consumption after the policy adaptation. However, households belonging 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, this means that the rise in low and middle-income groups dominates the fall in the later group. Also, we present the consumption paths of low, middle and high-income households in Figures 4.29, 4.30 and 4.31 in the appendix, respectively.

Figure 4.14- Transition Path of Aggregate Consumption



The transition path of the investment is represented in Figure 4.15. We observe that investment begins with a higher level at the first year of the transition and starts to decrease gradually until reaches the new equilibrium after almost 75 years. In other words, the investment rate of 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 group so the required investment is very high in the first year compared to the following years. Furthermore, transition path of investment rate is exhibited at Figure 32 in the appendix. It is observed that the investment rate decreases through transition path. Figure 32 reveals that although the production decreases through the transition path, the fall in investment is higher than the fall in production.

Figure 4.15- Transition Path of Investment

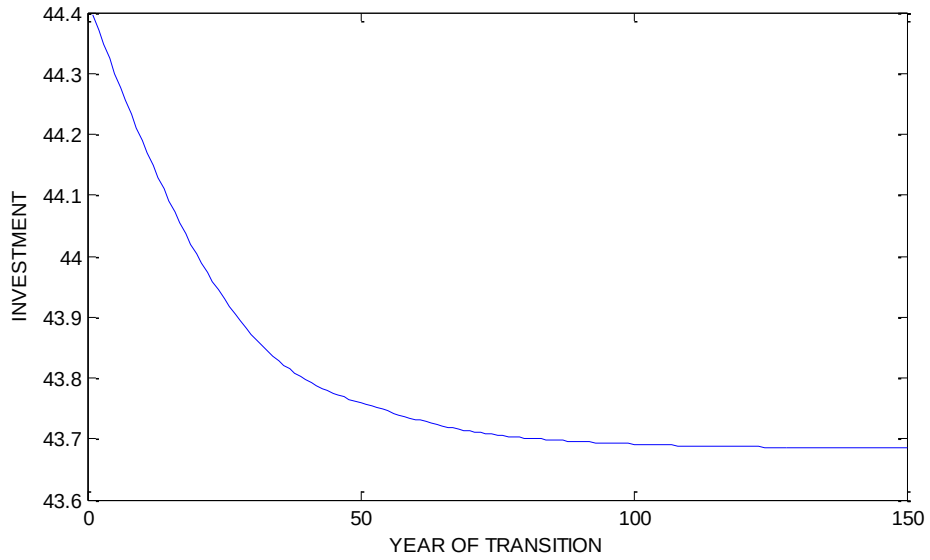


Figure 4.16- Transition Path of the Savings Rate

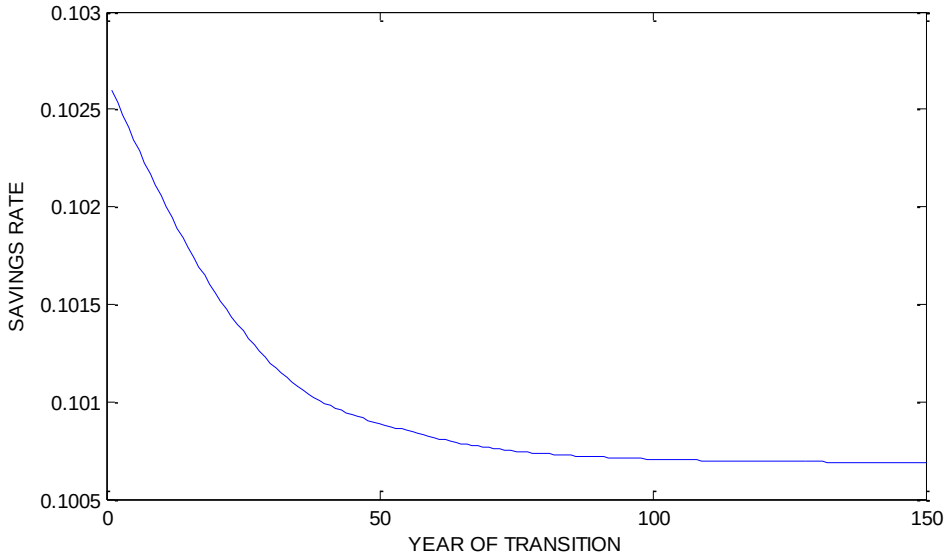


Figure 4.16 shows the transition path of the savings rate. As we can see from Figure 15 above, the savings rate decreases sharply until it reaches the new equilibrium after 75 years, so the savings of Turkey's economy attains the new equilibrium in 2074 after the new tax policy. The reason for this fall is that high income households decrease their holdings level of asset stock due to the high increase in the labor income tax.

Figure 4.17- Transition Path of the Tax Revenues Rate

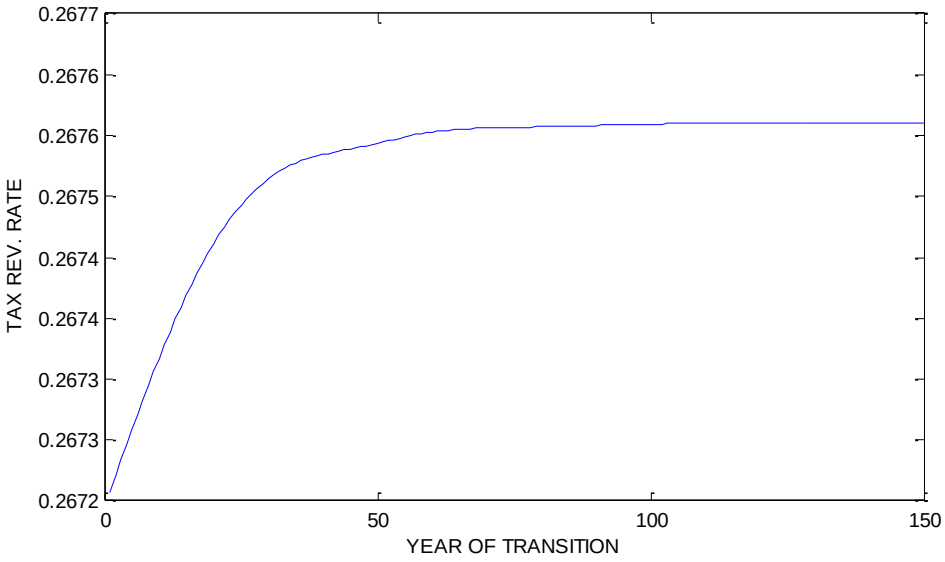
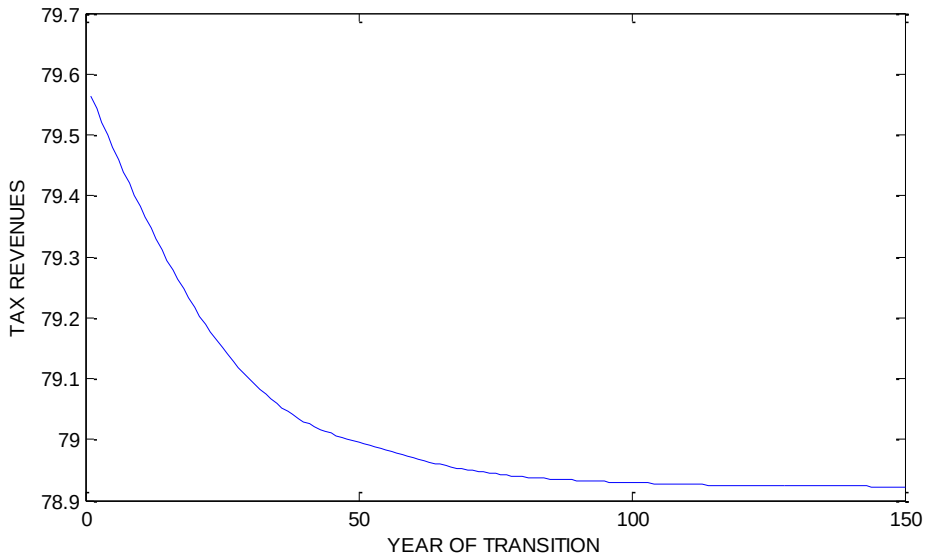


Figure 4.18- Transition Path of Tax Revenues



The path of the tax revenue rate is exhibited in Figure 4.17. It begins at a higher rate and it increases gradually through time. Moreover, we present the level of tax revenue in Figure 4.18. Although the tax revenues decrease, the tax revenue rate increases because of decreases in the production level of the economy. The tax revenue rate converges to new equilibrium after 75 years.

The debt stock rate, which is presented in Figure 4.19 increases, and it converges to a new equilibrium toward the 75^{th} year of the transition. Although the value of the debt stock is

constant, the debt stock rate increases because of decreases in the level of production in the economy through time.

Figure 4.19- Transition Path of Debt Stock Rate

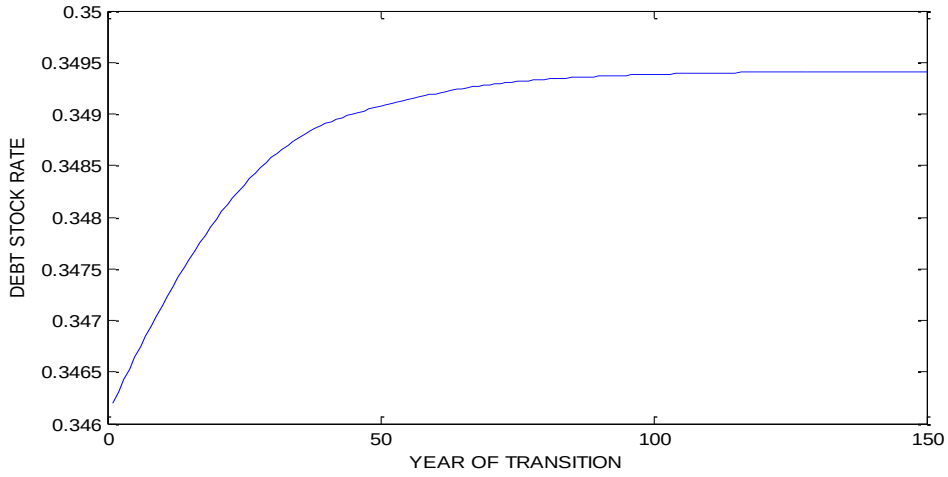


Figure 4.20- Transition Path of Government Expenditures

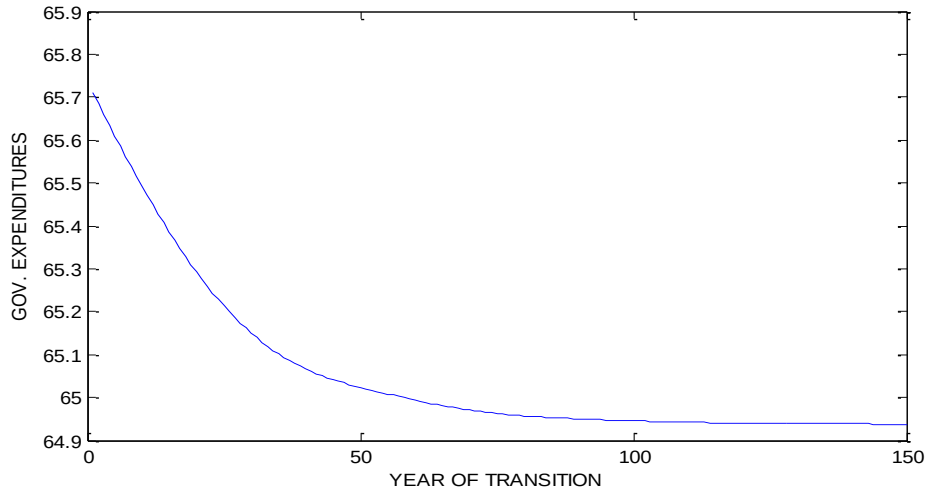
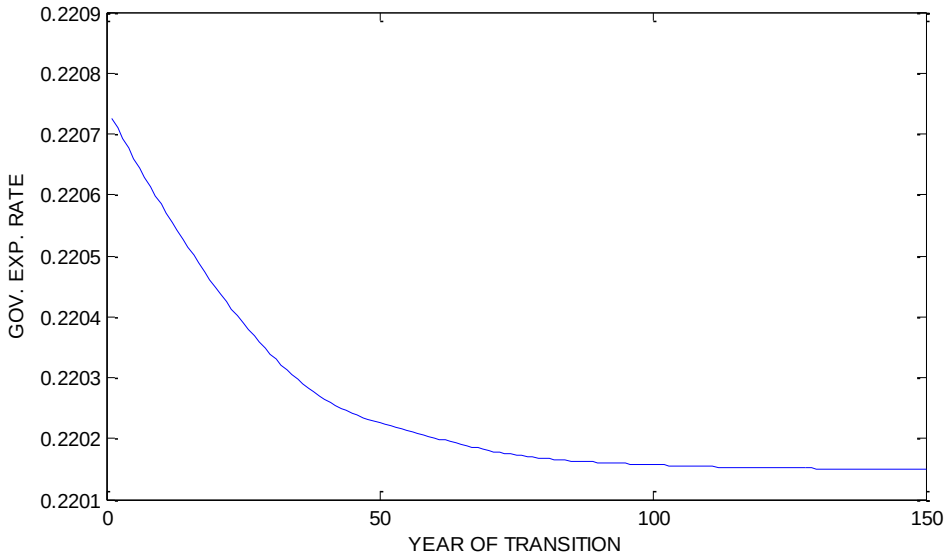


Figure 4.20 exhibits the result of the transition path for government expenditures. We observe that the tax revenues of the government fall during the transition periods and the interest rate increases for all the years of transition. We assume that the debt stock of the government is constant and we define government expenditure equal to tax revenues minus the interest payment of debt stock at each time. Hence, government expenditures decrease. Figure 4.21 shows that the government expenditures rate decreases too. Although production decreases through the transition path, the fall in government expenditure is higher than the fall in production.

Figure 4.21- Transition Path of the Government Expenditures Rate



Welfare Analysis

Welfare analysis is conducted to measure the impact of tax reform on different generations. Following Auerbach and Kotlikoff (1987), the lifetime utility of each generation belonging to each type of household (U_s^i) is calculated. These lifetime utilities are compared to the level of lifetime utility that the households would obtain if there was no change in the tax system (U_0^i). An equivalent variation measure is calculated by determining the proportion $\emptyset^i$ by which the each household's lifetime resources would be increased or decreased in the original tax system in order for the household to obtain the level of lifetime utility (U_s^i). Since our preferences given in section 3 are homothetic, a $\emptyset$% increase in 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:

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

$$=(1+\emptyset^i)^{\frac{1}{1-\frac{1}{\gamma}}}U_0^i \qquad (21)$$

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

$$\emptyset^i = \left(\frac{U_s^i}{U_0^i}\right)^{\frac{1}{1-\frac{1}{\gamma}}} - 1 \qquad (22)$$

Figure 4.22- Welfare Effects of the Tax Reform

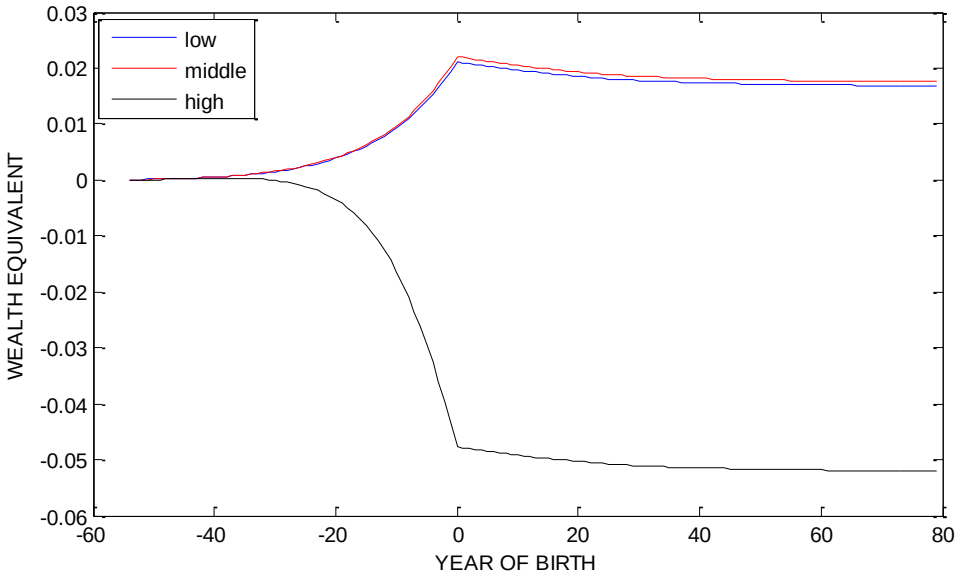


Figure 4.22 presents the effects on cohort welfare of the tax reform. The vertical axis of Figure 4.22 shows the proportion $\emptyset^i$ of lifetime resources needed under the initial tax system to attain the same level of utility achieved with the tax reform. Horizontal axis shows the year of birth, taking zero to the year of time of policy change. We find that the ratios are greater than zero for all transition periods, which means that households belonging to the low and middle-income classes are affected positively by the tax reform. Although both young and future cohorts are affected positively, young cohorts gain more utility than future cohorts. Households born before the tax reform are also affected positively but not as much as 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 loses. 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 not as much as the young and future cohorts. The reason for this negative effect is that the labor income tax rate of this class increases and puts more tax burden on them, despite the decrease in the consumption tax.

V. Conclusion

The tax system is generally aimed at financing government expenditures. Moreover, the tax system is used for other social and economic purposes such as increasing economic growth and 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 has also performed tax reforms in the last decade. We analyze the Turkish tax system by using the overlapping generations model. This is the first study that formalizes tax reform in Turkey using an OLG model with 55 periods and different income groups. We propose an alternative tax system for the Turkish government. In order to increase welfare without harming production, and increase fairness, we decrease the VAT rate from 18 percent to the 15 percent rate used before 2000, and increase the top statutory labor income tax from 35 percent to 40 perecnt, which is the average tax rate of The OECD countries.

The simulation results for the final steady state and transition path of the new tax policy are calculated and evaluated. They indicate that both aggregate capital stock and effective labor supply decrease to a lower level. Hence, the production of the economy decreases to a lower level. 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 the wage has a positive relationship with the ratio of K/L. The consumption of the low and middle income classes increase while the consumption of the high income group decreases after tax reform. According to the results of welfare analysis, individuals of low and middle income classes, especially young cohorts, are affected positively and enjoy substantial utility gains after the tax reform. However, households of the high income class, especially future cohorts, hurt from the tax reform. If the concern of government is to increase the welfare of low and middle income individuals and is to decrease inequality, the proposed tax reform achieves this purpose with a slight fall in production, which is 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 study assumes that agents initially have zero initial wealth. However, in Turkey, households have a strong bequest motive, which affects 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 study 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 tax evasion and informality are concerns of the government's policies. Hence, in order to observe the effect of the tax system on tax evasion and the transition from the informal sector to the 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. The payments belonging to the social security system are financed by tax revenues. Therefore, the model can be extended by including mandatory retirement and social security systems.

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APPENDIX

SUPPLEMENTARY FIGURES FOR SECTION FOUR

Figure 4.23- Asset Stocks Decisions of Low Income Household

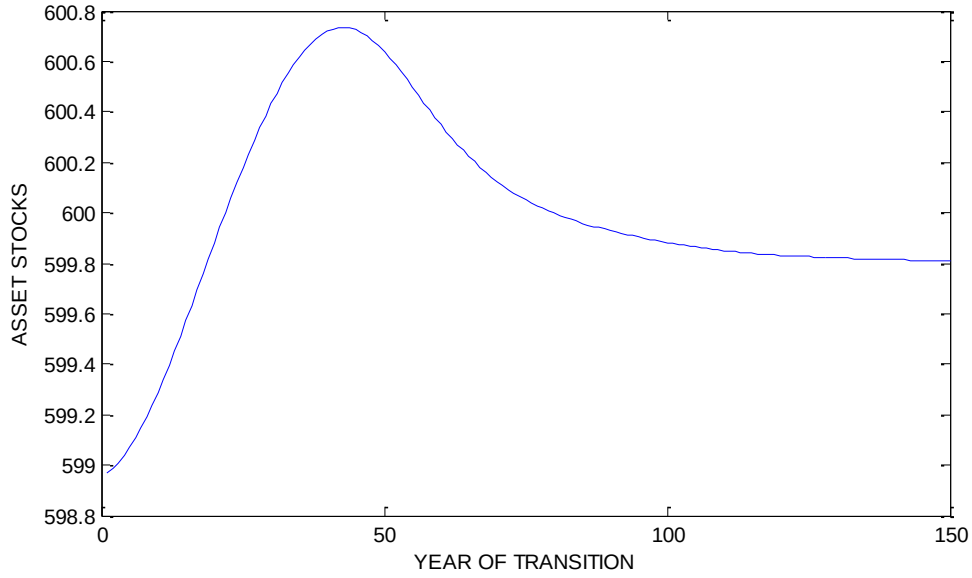

Figure 4.24- Asset Stocks Decisions of Middle Income Household

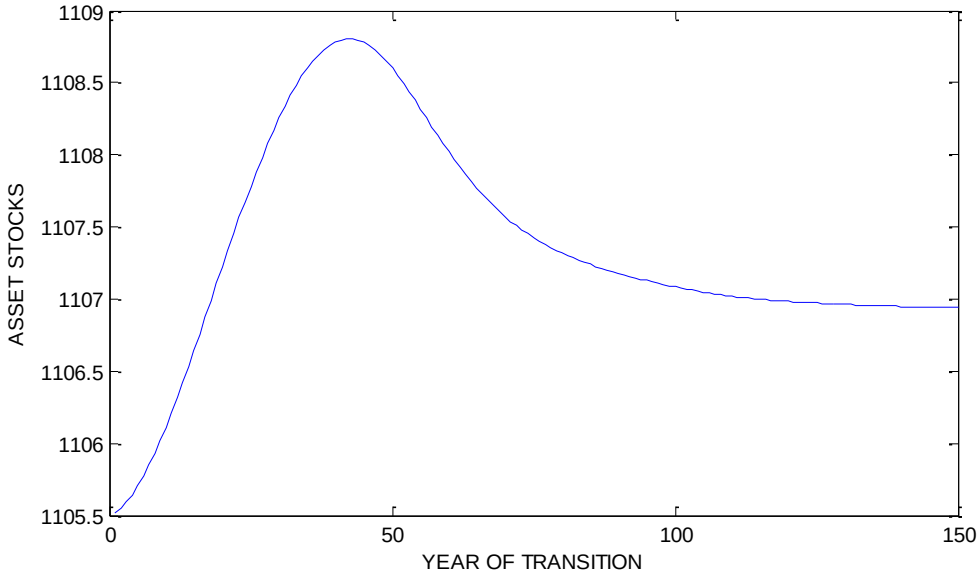

Figure 4.25- Asset Stocks Decisions of High Income Household

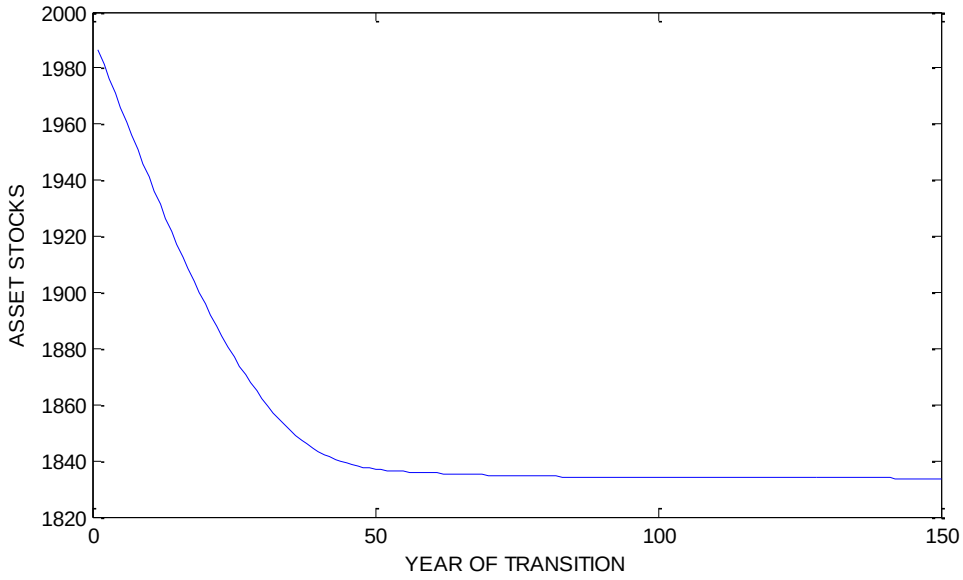

Figure 4.26- Labor Supply of Low Income Household

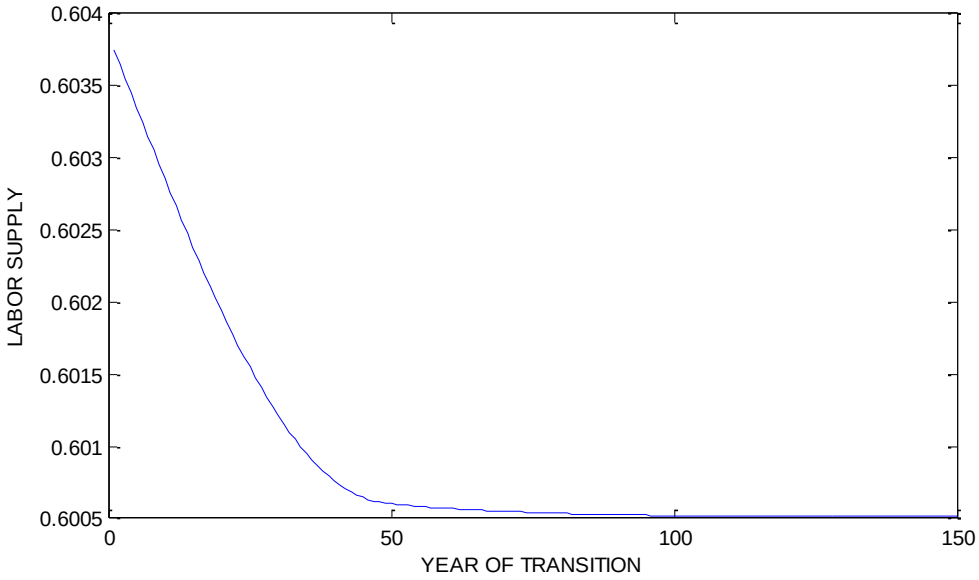

Figure 4.27- Labor Supply of Middle Income Household

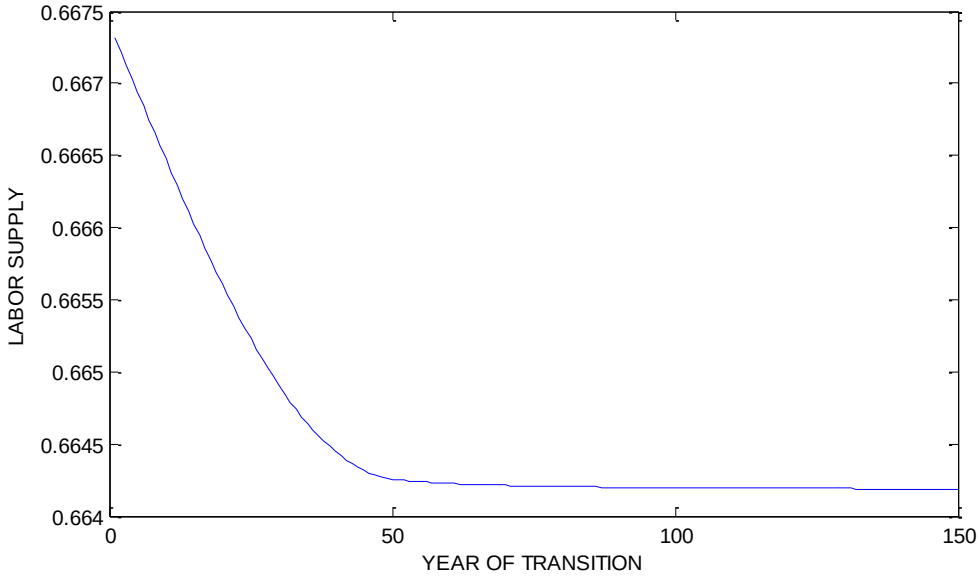

Figure 4.28- Labor Supply of High Income Household

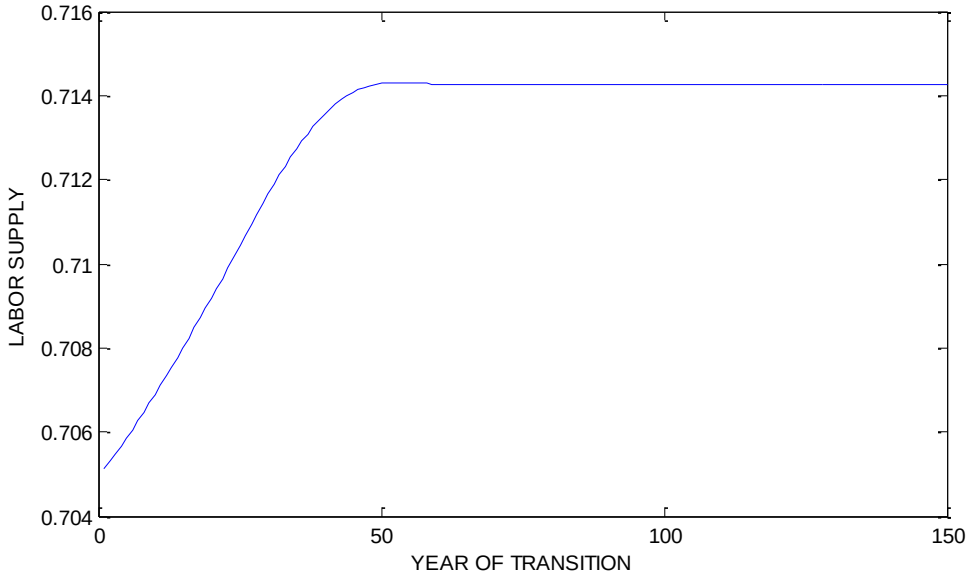

Figure 4.29- Consumption Decisions of Low Income Household

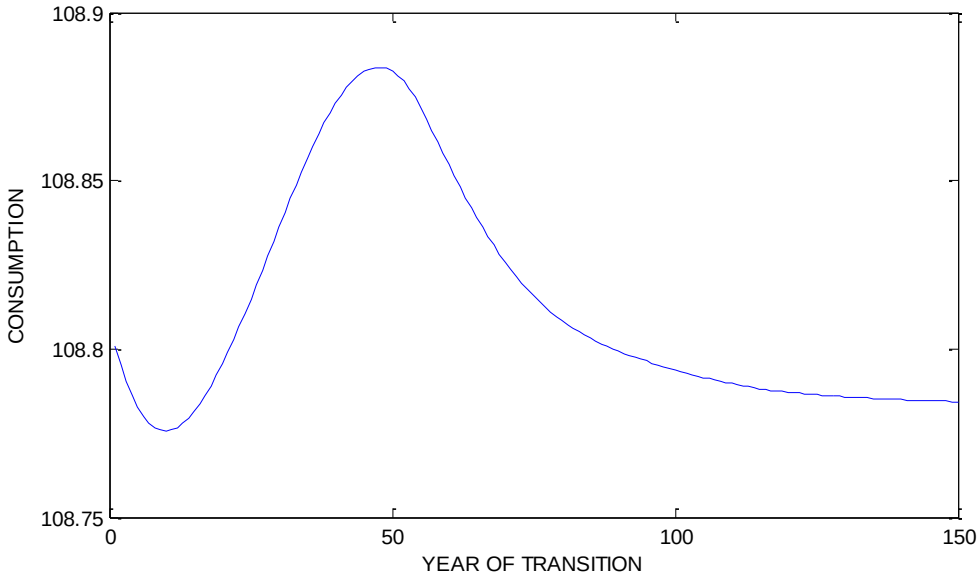

Figure 4.30- Consumption Decisions of Middle Income Household

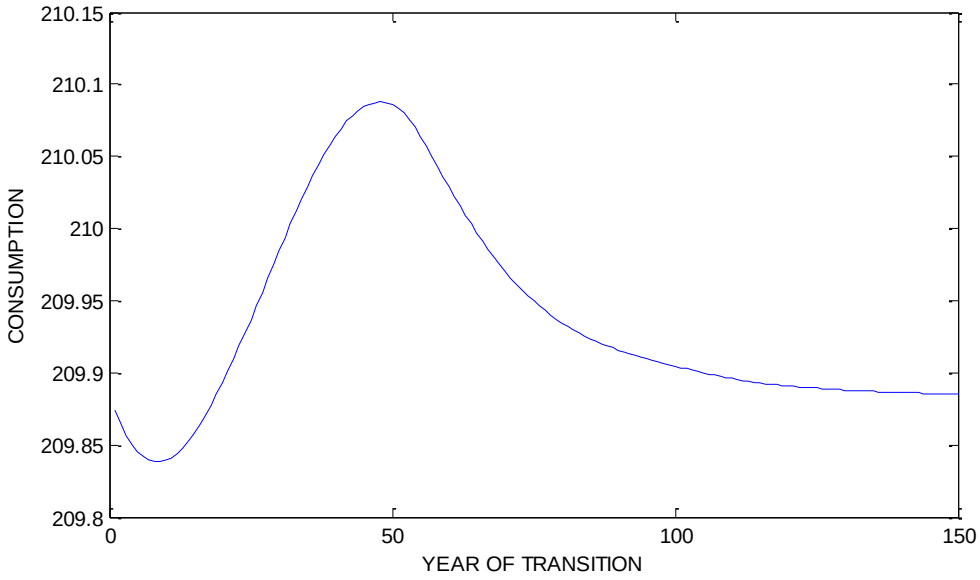

Figure 4.31- Consumption Decisions of High Income Household

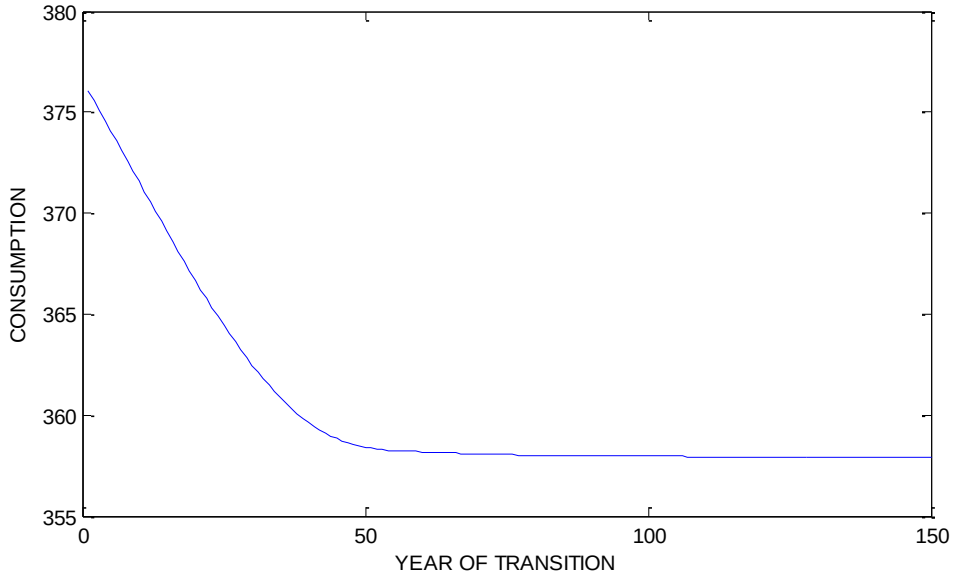

Figure 4.32- Transition Path of Investment Rate